ESSAYS ON MONETARY POLICY WITH ISLAMIC BANKS

A thesis submitted for the Degree of Doctor of Philosophy

By

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ABSTRACT

This thesis examines three different aspects of monetary policy in a varying sample of developing countries, with some Islamic banks. The first essay estimates a variety of interest rate rules for the conduct of monetary policy for Indonesia, Israel, South Korea, Thailand and Turkey, in both high and low inflation conditions. The findings are that the reaction of monetary policy to both inflation and output gaps differs between the high and low inflation regimes and that the exchange rate channel is important only in the low inflation regime. The second essay examines the bank lending channel of monetary transmission in Malaysia, a country with a dual banking system, with both Islamic and conventional banks. The results show that Islamic credit is less responsive to interest rates shocks than is conventional credit, in both high and low growth conditions. In contrast, the relative importance of Islamic credit shocks in driving output and inflation is greater under low -inflation conditions and higher Islamic credit leads to higher growth and lower inflation in such conditions. The third essay re-examines the question of causality between credit and GDP between two sets of countries one set without Islamic banks and the other set with dual banking systems, including some Islamic banks. The results suggest long-run causality from credit growth to GDP in countries with only Islamic banks.

Dedicated to My Family

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Mohamad Husam Helmi

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DECLARATION

I hereby declare that this thesis has not previously been accepted for any degree, award, or qualification by any other university or institution of academic learning, and is not concurrently submitted for any degree other than that of the PhD, being studied at Brunel University. I also certify that this thesis has been written by me and it is entirely the result of my own investigations except where otherwise identified by references and that I have not plagiarised another's work.

PUBLICATIONS AND CONFERENCES

I have presented Chapter 3 titled “*Bank Lending Channel, Commercial vs. Islamic Banks in Malaysia*” at Young Finance Scholars' Conference (in a poster session), University of Sussex, UK, 8 May 2014, and at the Research Student Conference, 11th of March 2014 at Brunel University, UK. A paper drawn from the chapter is submitted to Journal of International Financial Markets, Institutions & Money.

I have presented material from Chapter 4 titled “*Does Credit Cause Economic Growth? Time-Series and Panel Evidence from Two Data Sets of Countries With and Without Islamic Banks*” at the 10th BMRC-DEMS Conference on Macro and Financial Economics, May 2014 at Brunel University, UK. A paper drawn from the chapter is submitted to International Journal of Finance and Economics.

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CHAPTER ONE

INTRODUCTION

The fundamental aim of studies on monetary policy is to determine the optimal rule that central banks can follow to achieve price stability. To achieve this most central banks across the global have adopted inflation targeting framework (IT) since 1990s. In this context, researchers have interpreted the recent low and stable level of inflation in many advanced countries and some emerging economies as a consequence of the adoption of the IT and following monetary policy rules such as the Taylor rule. However, Daude et al. (2016) pointed out that central banks in emerging markets, that adopted IT with a flexible exchange rate regime, frequently intervene in the foreign exchange rate market: they have an implicit comfort zone for smoothing exchange rate fluctuations, even if they do not specify an exchange rate target (see also de la Torre et al., 2013; Mohanty, 2013; Ghosh et al., 2016). Therefore, the exchange rate pass-through can be significant and should also be considered (Svensson, 2000; Goldberg and Campa 2010): it may force central banks targeting price stability to tighten their monetary policy, or lead to a competitiveness loss (Gagnon and Ihrig, 2004; Baily, 2003; Bailliu and Fujii; 2004; Ghosh et al., 2016). Further, the recent 2007 financial crisis has raised a series of severe challenges to policy-makers. For instance, the shocks to the economy and financial markets interrupted the monetary policy transmission mechanism linking the real economy and monetary policy. This has raised a doubt about the adequacy of such a rule in delivering low and stable inflation as the primary target for central banks (e.g., Taylor and Davradakis, 2006; Martin and Milas, 2004, 2013; Caglayan et al., 2016, among others).

Further, given the current debate on the causes of the global financial crisis, there is mounting evidence that excessive credit growth to finance speculative and unproductive activities by conventional banks were one of its main causes (see Bernanke, 2009 and Turner, 2009). Therefore, such banks may suspect of their main contribution in disrupted the transmission mechanism linking monetary policy to the real economy and possibly causing an increase in prices rather than contributing to economic growth (see, e.g., Chapra and Chapra, 1992; Mills and Presley, 999; Iqbal, 2001; Gulzar and Masih, 2015; Kammer et al., 2015; Caporale and Helmi, 2016).

Other contributions to this debate include the recent ongoing literature on Islamic finance in relation to the finance-growth nexus. Islamic finance institutions are not allowed to charge a predetermined interest rate, which is replaced by an ex-post profit and loss sharing rate (Chong and Liu, 2009). They can only provide credit for transactions related to a tangible, underlying asset, projects that are directly linked to real economic activities and cannot engage in any speculative activities. This helps to improve on the allocation of resources in the economy, which is likely to boost economic growth in the long-run and most likely contribute to achieve low and stable inflation (Hasan and Dridi 2010; Khan, 2010 and Kammer et al., 2015). An interesting issue not thoroughly analysed in the finance-growth nexus literature is whether the relationship between credit and economic growth is different in countries with/without Islamic banks.

Islamic banks have grown very rapidly in recent years both in size and number, with more than 700 Islamic financial institutions operating in 85 countries across the Middle East, Asia, Europe and the US with approximately $2.2 trillion Sharia-compliant assets in 2015 - expected to reach $3 trillion in 2018 (Ernst and Young, 2014, 2016). There is substantial research that investigates the monetary policy channels through conventional banks (e.g., Bernanke and Blinder, 1988; Bernanke and Gertler, 1995; Kashyap and Stein, 1995; and Çatık and Martin, 2012; among others). However, the role of Islamic finance in the monetary transmission mechanism has received less attention in the related literature (e.g., Kassim et al. 2009; Sukmana and Kassim, 2010; Cevik and Charap, 2011 and Ergeç and Arslan, 2013).

The empirical studies and the on-going debate in this area of research have remained very much work in progress in bridging this gap. Accordingly, a number of interesting questions are yet to be answered in the Islamic finance and monetary policy literature: Is the behaviour of monetary authorities in emerging economies truly described by a linear interest rate rule or can their conduct of monetary policy be instead characterized by a nonlinear Taylor rule? Does credit promote GDP or does GDP promote credit in the short run and in the long run? Does the relationship between credit and economic growth vary between countries with and without Islamic banks? This thesis aims to answer these questions thoroughly by using a wide range of data and advanced linear and nonlinear econometric techniques. Specifically, this thesis aims: (i) to explore the interest rate setting behaviours of central banks in inflation targeting (IT) emerging countries, and (ii) to examine the different aspects of the role of Islamic finance in the bank lending channel and economic growth. As such, the thesis comprises of three empirical chapters in the area of monetary policy and Islamic banks.

Chapter 2 investigates the behaviour of central banks in the conduct of monetary policy in the context of five IT- emerging countries, namely Indonesia, Israel, South Korea, Thailand, and Turkey. The empirical studies argue that central banks respond to the deviation in inflation and output gaps as well as to other variables, such as exchange rate following a linear behaviour (e.g., Clarida, Gali and Gertler, 1998; Svensson, 1999; Taylor, 1999; Ball, 2000; Shortland and Stasavage, 2004; Ghatak and Moore, 2011). These studies, however, do not consider a possible nonlinearity in the reaction of central banks to the evolution in the economy (e.g. Taylor and Davradakis, 2006; Martin and Milas, 2013; Caglayan et al., 2016). These asymmetric and nonlinear features in conducting monetary policy arise either from a nonlinear macroeconomic model (see, Robert-Nobay and Peel, 2003; Dolado et al., 2005, among others) or from an asymmetric policymaker preferences (see, e.g., Favero et al., 2000, Taylor and Davradakis, 2006; Surico, 2007; Castro, 2011; Martin and Milas, 2004, 2013; Ahmad, 2016). Yet, less attention is given to investigate both linear and nonlinear Taylor rule in emerging economies (see Hasanov and Omay, 2008; Akyürek et al., 2011; Miles and Schreyer, 2012; Akdoğan, 2015). Further, Ghosh et al. (2016) argue that the IT frameworks in emerging market economies (EMEs) should be supplemented by foreign exchange intervention and find that such countries adjust the interest rate in response to the movement in the exchange rate. For this purpose, we estimate a threshold augmented Taylor rule using GMM technique and compare the results with those of a baseline linear Taylor rule.

The findings of this chapter confirm that the monetary policy in these countries could be described by nonlinear Taylor rule, and this is either because of asymmetric policy-maker preferences or nonlinear macroeconomic structure. Further, our findings also suggest that central banks respond to the exchange rate movement in the lower regime (low inflation). These suggest that the EME central banks with IT (implicitly) take into account the movement in the exchange rate in their conduct of monetary policy. One possible explanation of the observed more weight on the exchange rate in the low regime is that there is a tendency of policymakers to pursue other objectives when the inflation rate undershoots the target (Akdoğan, 2015). Therefore, an augmented nonlinear Taylor rule appears to better capture the monetary policy behaviour in these countries.

Chapter 3 contributes to the existing Islamic finance literature in the area of the bank lending channel by focusing on the role of both Islamic and conventional credit in a dual banking system. Of particular interest, Malaysia is classified as one of the largest Islamic banking sectors in the world, accounting for around 16.7% of the Islamic finance global market in 2014 (Ernst and Young, 2014). Further, the Malaysian authority is planning to increase the market share of Islamic banks to 40% of total financing by 2020 and aiming to make the country an international hub for Islamic finance (BNM, 2012).

Given the growing role of the Islamic finance across the Middle East, Asia, Europe and the US, there is much less known empirical studies about the contribution of such banks to the bank lending channel. For instance, the transmission mechanism of monetary policy has been analysed extensively in numerous studies focusing on countries with conventional banking systems (e.g., Bernanke and Gertler, 1995; Peersman and Smets, 2001; Çatık and Martin, 2012; Ahmad and Pentecost, 2012; Aiyar et al., 2016). By contrast, there is very little evidence concerning economies with a dual (Islamic and conventional) banking system, where this mechanism might be rather different given the distinctive features of Islamic finance, such as the prohibition to charge a predetermined interest rate and the granting of credit only to productive projects (Iqbal, 2001; Chong and Liu, 2009). Further, Khan and Mirakhor (1989) found that monetary policy shocks have less effect on Islamic banks, because the profit and loss sharing (PLS) paradigm allows them to share risk with the depositors. Kassim et al. (2009) reported instead that credit is more sensitive to interest rate movements in the case of Islamic banks, which might make them more unstable. Sukmana and Kassim (2010) estimated a VAR model to analyse the role of Islamic banks in the transmission mechanism of monetary policy in the case of Malaysia, whilst Ergeç and Arslan (2013) examined the case of Turkey.

While, most of the existing empirical studies in this area, in the cause of EMEs, have employed linear econometric techniques (see, e.g., Kassim et al., 2009; Sukmana and Kassim, 2010; Ergeç and Arslan, 2013; Gulzar and Masih, 2015), we employ a two-regime threshold vector autoregression (TVAR) model that takes into account possible nonlinearities in the relationship between bank lending and monetary policy under different economic conditions.

The findings of this chapter indicate that Islamic credit is less responsive than conventional credit to interest rate shocks both in the high and low growth regimes. By contrast, the relative importance of Islamic credit shocks in driving output growth is much greater in the low growth regime, their effects being positive. These findings can be interpreted in terms of the distinctive features of Islamic banks. Given the evidence suggesting that Islamic credit boosts growth during low growth periods, policy-makers should take into account the Islamic bank lending channel in the design of monetary policy in economies with a dual banking system at such times. Policies aimed at improving the institutional structure and the efficiency of Islamic banks might also be appropriate, with a view to making the transmission of monetary policy more effective in countries such as Malaysia.

Chapter 4 revisits the relationship between real credit and real GDP in two sets of seven emerging countries, the first without Islamic banks, and the second with a dual banking system including both Islamic and conventional banks. The earlier and well-established finance-growth nexus literature show mixed evidence: some studies reach the conclusion that financial development boosts economic growth (e.g., Schumpeter, 1911; McKinnon, 1973; Shaw, 1973; King and Levine, 1993; and Beck et al., 2014), whilst others argue that causality runs in the opposite direction (e.g., Robinson, 1952; Berthelemy and Varoudakis, 1996; Ang, and McKibbin, 2007).

Only a few empirical studies of countries with Islamic banking exist. Majid and Kassim (2010) find evidence supporting the "supply-leading" view. By contrast, Furqani and Mulyany (2009) report that economic growth causes financial development only in the short run in a country with Islamic banking such as Malaysia - on the whole, their analysis is consistent with the "demand-following" view. Abduh and Omar (2012) find bidirectional causality between Islamic finance and economic growth in Indonesia. Most recently, Imam and Kpodar (2015) conclude that countries with Islamic banks experience faster economic growth than those without Islamic banks.

Consequently, this chapter examines in depth the effects of Islamic banking on the causal linkages between credit and GDP. Unlike previous studies, it checks the robustness of the results by applying both time series and panel methods. Moreover, it tests for both long- and short-run causality; the former has been analysed in the traditional literature on the finance-growth nexus, whilst the latter is relevant for the current debate on macro-prudential policies and the attempt by the BIS to identify the best early warning indicator (EWIs). Our analysis also seeks to contribute to the on-going debate on whether the profit-and-loss sharing (PLS) paradigm of Islamic banking might lead to an optimal distribution of funds (Siddiqi, 1999), and on the role of Islamic finance in promoting economic growth rather than causing an increase in the price level by linking all financial transaction to real economic activities (Chapra and Chapra, 1992; Mills and Presley, 999; Gulzar and Masih, 2015; Kammer et al., 2015).

The results of this chapter suggest significant differences between the two sets of countries with/without Islamic banks reflecting the distinctive principles of Islamic finance. Our extensive cointegration and causality analysis provides strong evidence of long-run causality running from real credit to real GDP in countries with Islamic banks only and this is confirmed by the panel causality tests. However, there are differences between the two sets of short-run results: the panel tests suggest that short-run causality runs from real credit to real GDP in countries without Islamic banks (and that there is bidirectional causality in three of them, i.e. Iran, Singapore and Tunisia), whilst the time-series ones do not detect any. As for the countries without Islamic banks, our findings do not support the idea that credit or financial development has a crucial role in stimulating economic growth (see King and Levine, 1993; and Levine and Zervos, 1998 among others). This could be because the effects of credit and financial services depend on the allocation of loans to productive investment projects (see Ang and McKibbin, 2007). A weak effect could reflect an increase in credit in conjunction with a lack of monitoring from banks (see Moran, 1992, and Gavin and Hausman, 1996). This may lead to an inappropriate choice of projects as well as providing credit to unproductive or speculative activities.

Finally, **Chapter 5** draws a conclusion and summarises the key results of this thesis. It also suggests some recommendations regarding policy implications, and identifies the main limitations of this thesis. It concludes with some recommendations for future research that are beyond the scope of this thesis.

CHAPTER TWO

MONETARY POLICY RULES IN THE EMERNING COUNTRIES: EVIDENCE FROM THE ESTIMATION OF NONLINEAR TAYLOR RULE

2.1 Introduction

The low level of inflation achieved in recent decades in the developed world is often seen as the result of the adoption of policy rules by independent central banks. Taylor (1993) showed how monetary policy in the US during the 1980s and the early 1990s could indeed be described in terms of a clearly specified rule. Later studies (e.g., Clarida, Gali and Gertler, 1998; Svensson, 1999; Taylor, 1999; Ball, 2000, Shortland and Stasavage, 2004; Ghatak and Moore, 2011) extended the original linear Taylor rule and emphasised possible nonlinearities in the reaction function of central banks (e.g. Taylor and Davradakis, 2006; Martin and Milas, 2013; Caglayan et al., 2016). These can arise either from nonlinear macroeconomic relationships (see Robert-Nobay and Peel, 2003; Dolado et al., 2005, among others) or from asymmetric preferences or objectives of policymakers (see Favero et al., 2000, Taylor and Davradakis, 2006; Surico, 2007; Cukierman and Muscatelli, 2008; Castro, 2011; Martin and Milas, 2004, 2013; Ahmad, 2016).

Several recent empirical studies have provided evidence of nonlinearities and threshold effects in the reaction of monetary authorities to inflation and output gaps (see Favero et al., 2000, Taylor and Davradakis, 2006; Surico, 2007; Cukierman and Muscatelli, 2008; Castro, 2011; Martin and Milas, 2004, 2013; Ahmad, 2016, among others). However, only a few papers have addressed this issue in the case of developing and emerging economies (see Hasanov and Omay, 2008; Akyürek et al., 2011; Miles and Schreyer, 2012; Akdoğan, 2015).

The present study aims to fill this gap in the literature by estimating a threshold nonlinear Taylor rule in five inflation targeting (IT) emerging countries (Indonesia, Israel, Korea, Thailand, and Turkey); moreover, an augmented rule including the exchange rate is considered. Further, we aim to answer the following questions: is the behaviour of monetary authorities in these emerging countries truly described by a linear interest rate rule or can their conduct of monetary policy be instead characterized by a nonlinear Taylor rule? Markov regime switching models have often been estimated to capture nonlinearities in monetary policy rules (Bae et al. 2012; Murray et al., 2015; Gonzalez-Astudillo, 2014). However, these have been criticised for not allowing a smooth transition between regimes (Castro, 2011), unlike Threshold Autoregressive (TAR) and Smooth Transition Autoregressive (STAR) models in which the regime change is driven by past values of the variables in the sample (Tong, 1990; Akdoğan, 2015).

Therefore in this paper we estimate a TAR specification which is ideally suited to capturing asymmetries in the behaviour of monetary policy authorities, unlike Markov regime switching models that treat regime changes as exogenous (since they are driven by an unobservable state variable - Atanasova, 2003; Balke, 2000; Castro, 2011). Moreover, this model allows to estimate the optimal threshold value of inflation in each country. The estimation method is GMM, which has the advantage of taking into account the possible correlation between the regressors and the error term that could give rise to endogeneity problems.

The layout of the chapter is as follows. Section 2.2 reviews the literature on the Taylor rule. Section 2.3 describes the evaluation of monetary policy in five emerging economies. Section 2.4 outlines the econometric model. Section 2.5 discusses the data. Section 2.6 presents the empirical results. Section 2.7 offers some concluding remarks.

2.2 Literature Review

Central banks conduct their monetary policy either by following a discretionary-based approach or a rule-based one. However, the choice between these approaches has been a controversial point among researchers. The trade-off between the objectives of monetary policy may create the scope for central banks to exercise a discretionary action in order to achieve, for example, short-run gains in output with the cost of higher inflation (Nikolov, 2002). Therefore, the monetary policy should be managed by following a rule to avoid any policy surprises and committing to its long-run objectives (e.g., Taylor, 1993, 1999, 2013; Mceachern, 2014). The following is a brief discussion about discretionary-based approach versus a rule-based one in the conduct of monetary policy.

2.2.1 Discretionary-Based Approach

The discretionary monetary policy is managed subjectively and judgmentally in response to economic changes without following any announced rule or plan for the future (Taylor, 1993; Mayer, 1993). The rule versus discretionary policy was addressed by Kydland and Prescott (1977) and Barro and Gordon (1983). They argue that if policy-makers desire to increase output by creating a new surprise every year, private agencies will rationally recognise that and revise their expectation. Therefore, the expected and actual inflation will be higher but not the GDP.

The exercise of such discretionary action might result in a number of disadvantages to the economy. First, the inflationary bias arises from the incentive of policy-makers to increase the output above its potential equilibrium level (Kydland and Prescott, 1977; Walsh, 2003, 2011). Therefore, this incentive action is likely to increase the inflation rate and overthrows the private sector expectations of a lower inflation rate (Gordon, 2006). Second, the time-inconsistency problem causes the central bank to lose its credibility (Orphanides and Williams, 2007). Third, the discretionary-based approach is characterised by being inconsistent, a short-sighted solution, and not easily followed by economic agents (Blanchard and Fischer, 1989; Orphanides and Williams, 2007).

Despite these disadvantages, the monetary authorities could achieve some benefits from applying discretionary actions, i.e., (1) it is flexible to respond to a shock; (2) political gains; (3) to lower the government's real debt by generating unexpected inflation; (4) it is likely with surprising inflation to increase real economic activity and decrease unemployment rate in the short-run (King, 1997; Sauer, 2010). Given the disadvantages and criticisms of the discretionary policy, researchers and economists have focused and called for following the policy rules.

2.2.2 Rule-Based Approach

The policy rule could be defined as "nothing more than a systematic decision process that uses information in a consistent and predictable way" (Meltzer, 1993, p. 223). Similarly, Taylor (2000, p. 443) described it as "a contingency plan that specifies as clearly as possible the circumstances under which a central bank should change the instruments of monetary policy". To put it differently, such a rule is defined by the choice of instrument and considered as a guide for setting the monetary policy (Taylor, 1993; Hall and Mankiw, 1994; Svensson, 1999). Therefore, it prevents policy-makers from acting at a short-run stabilisation and helps avoid the inflationary bias, which may arise from following a discretionary approach (Walsh, 2011). Further, following a rule include (1) avoiding the time-inconsistency problem, (2) increasing communication with the public, (3) gaining credibility, (4) helping policy-makers in forecasting the rational-expectations of economic agencies, and (5) reducing the uncertainty (e.g., Taylor, 1993; Svensson, 1999; Orphanides and Williams, 2007; Walsh, 2011 and Taylor, 2013b).

Next, Hall and Mankiw (1994) argue that an optimal monetary policy rule should satisfy three main characteristics. First, it should be efficient by conveying the minimum amount of fluctuations in price for a known level of fluctuations in output. Second, a good monetary policy rule should be simple, which increases the possibility of adopting it and continuing to be implemented. Third, accountability is a main characteristic of a good policy rule, which makes the monetary policy more credible if people can hold the authority accountable for achieving the announced objectives. For instance, the Monetary Policy Committee of the Bank of England is subject to accountability by a Parliamentary Committee (Taylor, 1998).

Having defined the characteristics of a good policy rule, following a rule may have side effects. These side effects arise from the adoption and close control of one variable (e.g., inflation) which might possibly cause high degree of fluctuations in other macroeconomic variables such as the unemployment and the exchange rate (Hall and Mankiw, 1994). Therefore, policy makers should consider following an optimal monetary policy rule that is able to provide superior performance as dignified by stability in prices and output, and satisfies the three characteristics discussed above.

It is worth noting that the monetary policy rule could be the Milton Friedman fixed rule for money growth, nominal income targeting (NIT) such as the McCallum rule or the Taylor rule with inflation target (see, e.g., Hall and Mankiw, 1994; Bernanke and Mishkin, 1997; Ball, 1999; Taylor 1993, 2013, among others). However, the uncertainty in money demand made targeting money growth rule less attractive for central banks, which abandoned this rule later. Therefore, the recent argument in the literature has mostly focused on a rule that targets inflation such as the Taylor rule or the nominal income targeting (see McCallum 1993, Hall and Mankiw 1994). What follows is a description of both the NIT and Taylor rule.

2.2.3 Nominal Income Targets

The nominal income targeting aims to stabilise the nominal output around a target path, that is expected to increase smoothly "at a ratio equal to the long-run average rate of growth of real output plus a desired inflation rate" (McCallum, 1998, p. 2). Central banks with the NIT would achieve lower level of variations in unemployment and real GDP, and inflation rate is expected to be very close to its anticipated value. The nominal income targets could be the level or growth of nominal income, which provides central banks with two distinctive features: (1) a long-run nominal anchor, and (2) smoothing out variations in nominal income (Clark, 1994; Frisch and Staudinger, 2003; McCallum, 2015).

McCallum (1999) beliefs that the NIT is superior to monetary targeting considering the changes in financial regulation and the unpredictable money demand with the innovation in technology. This view supports those of Meade (1978), Tobin et al. (1980), and McCallum (1988) who argued that targeting nominal income is more effective in stabilizing employment and real GDP than targeting the money supply. Further, McCallum (1993), and Hall and Mankiw (1994) suggest that the adoption of nominal income targets can result in a more stable GDP as deviations in real output appears to be lower than "pure inflation targeting". However, there is no consensus on how the components of the nominal income growth are identified regards to real GDP growth and inflation variables. McCallum (1997) responded to this point arguing that it could be tested by a wide range of models. Also, McCallum and Nelson (1999) added that the NIT with growth rate targeting does not require estimating the potential output, which is an unreliable measure, while other monetary policy rules (e.g., Taylor rule) do require that.

However, many writers have challenged the NIT on the grounds that maintaining the level of nominal income is the fiscal policy responsibility rather than the monetary policy (Bean, 1983). In addition, Hall and Mankiw (1994) and Ball (1999) found that the nominal income targets are inefficient rule in that they cause high degree of fluctuation in GDP and price level, which contradicts the view of McCallum (1993), and Hall and Mankiw (1994). Further, Rudebusch (2002) examine the uncertainty about the performance of nominal income rules, which might due to the issues of real-time data and model uncertainty. The findings suggest a poor performance of the NIT over a range of empirical models and data uncertainty. Most importantly, the response of inflation and output to a policy shock is not the same in terms of timing.

Recently, the adoption of inflation target by many developed countries has led to emerging empirical research comparing both the inflation targeting rule (e.g., Taylor rule) and the NIT. For instance, McCallum (1999) finds supportive evidence that US monetary policy can be described by a rule with NIT and concludes that the recent success of the Fed policy is a proof of using a rule aimed to stabilise nominal income growth. Similar study by Frisch and Staudinger (2003) find that both the Taylor rule and NIT have similar perforce with a demand shock, while a notable different reaction is identified with supply shock. For instance, central bank (adopting NIT) suffers from a constant trade-off between real GDP growth and price stability, while this trade-off with IT regime depends on the weight placed by the central banks on inflation and output stabilisation.

Finally, having discussed the challenges with the NIT and giving the recent adoption of inflation targeting by many central banks, the Taylor rule, discussed in the next Section, has gained much attention in the literature.

2.2.4 Taylor Rule

In line with the argument about the rule versus discretionary policy, it is worthwhile shedding some light on the inflation targeting regime. Since the 1990s, several central banks around the world have adopted an inflation targeting framework (Bernanke and Mishkin, 1997). This is thought to have several advantages, namely: (1) to lead to more independent central banks; (2) to reduce inflation, making monetary policy more credible; (3) to decrease uncertainty about the expected level of inflation; (4) to improve communication between policy-makers and the public, making monetary policy more transparent (Bernanke and Mishkin, 1997; Svensson, 2000; Gemayel, 2011). However, under this framework a lower inflation rate might be achieved at the cost of lower output and higher unemployment in comparison to other monetary regimes (Bernanke and Mishkin, 1997).

Taylor (1993, 1999) argued that the monetary policy of the Fed can broadly be described by an interest rate rule based on the deviations of output and inflation from target (see also Orphanides, 2002). The adoption of such a rule appears to have had a significant impact on economic performance in the US (Bernanke, 2004; Siegfried, 2010; Taylor, 2013a). Clarida, Gali and Gertler (1998) investigated the so-called Taylor rule in two sets of countries, i.e. the G3 (Germany, Japan and the USA) and the E3 (UK, France and Italy). They found that monetary authorities in the G3 adjusted the real interest rate in response to inflationary pressures following a forward-looking rather than a backward-looking rule, whilst in the E3 other central banks followed the German Bundesbank very closely. Gerlach and Schnabel (2000) concluded that monetary policy in the Economic and Monetary Union area (EMU) was well described by a Taylor rule, and Stuart (1996) reached the same conclusion for the UK. Côté et al. (2004) reported that none of their estimated seven simple Taylor rules for the Canadian economy was robust to model uncertainty.

Svensson (2003) argued that central banks should announce and follow a simple instrument rule (see also Judd and Rudebusch, 1998; McCallum 1999; Taylor, 2000; Rudebusch, 2002). However, a number of papers have criticised the Taylor rule arguing that following it mechanically is undesirable (e.g., Ball, 2000; Svensson, 1999, 2003; McCallum and Nelson, 1999; Carlson, 2007 and Martin and Milas, 2013, among others). For example, the Federal Reserve cut the interest rate sharply during the stock market crash in 1987 and the Asian crisis in 1997-98 (Carlson, 2007). Similarly, the Bank of England reduced the interest rate from 5% in 2008 to 0.5% in March 2009 - the biggest cut since its creation in 1694 (Astley et al., 2009). Policy makers might need to adjust the rule when new information arrives (Taylor, 2000; Woodford, 2001). For instance, Martin and Milas (2013) pointed out that the Bank of England abandoned its monetary rule during the recent financial crisis with the aim of achieving financial stability. Taylor (2013b) suggested that deviations from the Taylor rule might be due to international spillovers.

Some other issues raised in the literature are the accurate estimation of potential output (MacCallum, 1999) and data uncertainty with real time as opposed to ex-post data (Orphanides and Van Norden, 2002 and Hatipoglu and Alper, 2008). Under-forecasting or over-forecasting the output gap might lead to inappropriate policy actions (Orphanides, 2002, 2003). The Hodrick-Prescott filter (HP) is the most commonly used method because of its flexibility (Cerra and Saxena, 2000), but it has various disadvantages. The first is that the most recent observations suffer from a lack of accuracy (Shortland and Stasavage, 2004). The second is the possibility of misspecification of the underlying economic structure since the suggested values of the filter are specific to US data (Sarikaya et al., 2005). The third is the fact that it does not take into account the high volatility of trend output in the case of the emerging economies (Hatipoglu and Alper, 2008). Another criticism of the baseline Taylor rule is that it does not allow the central bank to smooth interest rate movements (Goodfriend, 1991), whilst a smoothing parameter in the reaction function might be important to achieve credibility as well as to avoid any capital market disruption (McCallum, 1999; Levin et al., 1999 and Clarida et al., 2000, among others).

More importantly, the baseline Taylor rule might be inappropriate for open economies subject to external shocks (Svensson, 2000, 2003); in this case it might be necessary instead to include other variables such as the exchange rate (see, Ball, 2000; Svensson, 2000, 2003; Obstfeld and Rogoff, 2000; Leitemo and Söderström, 2005; Ostry et al., 2012; Galimberti, and Moura, 2013, Ghosh et al., 2016, among others). Taylor (2001), Edwards (2007) and Mishkin (2007) conclude that this is in fact not required in the case of the developed economies; however, it might be in emerging countries.

Ball (1999) had shown that following a monetary policy rule including the exchange rate instead of the original Taylor rule results in lower variance of the consumer price index. Debelle (1999) also argued that the unpredictability of output and inflation is reduced in this way. Ball (1999) concluded that such an augmented rule was followed in Canada from 1975 to 2003, whilst Lubik and Schorfheide (2007) found that it was in the UK as well as Canada, but not in Australia and New Zealand.

Taylor (2000) argued that a flexible exchange rate combined with a policy rule based on inflation targeting is the only sound monetary policy for developing and emerging economies. A floating exchange regime was instrumental to achieving low and stable inflation in such countries according to Masson et al., 1997. However, this conventional wisdom is increasingly being questioned (Ghosh et al., 2016). The exchange rate pass-through can be significant and should also be considered (Svensson, 2000; Goldberg and Campa 2010): it may force central banks targeting price stability to tighten their monetary policy, or lead to a competitiveness loss (Gagnon and Ihrig, 2004; Baily, 2003; Bailliu and Fujii; 2004; Ghosh et al., 2016).

Daude et al. (2016) pointed out that central banks in emerging markets with a flexible exchange rate regime frequently intervene in the foreign exchange rate market: they have an implicit comfort zone for smoothing exchange rate fluctuations, even if they do not specify an exchange rate target (see also Ghosh et al., 2016; de la Torre et al., 2013; Mohanty, 2013). Gali and Monacelli (2005), Adolfson et al. (2008), and Caglayan et al., (2016) also found that the behaviour of central banks is affected by exchange rate movements using dynamic stochastic general equilibrium (DSGE) models. Garcia et al. (2011) concluded that including the exchange rate in the linear Taylor rule does not provide any significant gain for developed countries, but it does in the case of emerging economies. Shortland and Stasavage (2004) showed that the West African Economic and Monetary Union (BCEAO) considered the foreign exchange position in addition to the inflation rate and the output gap in setting their monetary policy rules. Filosa (2001) also reported that central banks reacted strongly to exchange rate movements in Indonesia, Korea, Malaysia, Thailand, Brazil, Chile and Mexico.

Mohanty and Klau, (2005) and Aizenman et al. (2011) provided further evidence that central banks in emerging economies with IT (implicitly) take into account exchange rate movements in the conduct of monetary policy. Some authors (e.g., Calvo and Reinhart, 2002; Galimberti and Moura, 2013; Catalán-Herrera, 2016) argue that the adoption of IT in the EMEs does not stop such countries from intervening in the exchange rate market - for instance, in the case of Israel (Brenner and Sokoler, 2009). Yilmazkuday (2008) found that the central bank of Hungary only reacts to exchange rate movements, while those of Poland and the Czech Republic seem to respond to deviations of output and inflation from target in setting their interest rate.

Finally, Shrestha and Semmler (2015) estimated a simple linear Taylor rule using an autoregressive distributed lag (ARDL) model in five East Asian countries (Malaysia, Korea, Thailand, Indonesia and Philippines), and concluded that the baseline Taylor rule is not sufficient to describe monetary policy in emerging countries and should be amended to take into account financial instability. Ghosh et al. (2016) also provide evidence of foreign exchange rate intervention which is consistent with achieving price stability under inflation targeting in the emerging countries.

The literature on Taylor rules for emerging economies leads to some important conclusion of the considerable role of the exchange rate in setting the interest rate in such countries, so Taylor rule should be amended including this variable.

2.2.5 Nonlinear Taylor rule

In the previous Section, the empirical studies about the Taylor rule suggest that the behaviour of the central bank can be described by a linear monetary policy rule. A further important issue is whether the reaction function of central banks might be characterised by nonlinearities reflecting either the structure of the economy (Robert-Nobay and Peel, 2003; Dolado et al., 2005, among others) or their own asymmetric preferences (see, Favero et al., 2000, Taylor and Davradakis, 2006; Surico, 2007; Cukierman and Muscatelli, 2008; Castro, 2011; Martin and Milas, 2004, 2013). For instance, the policy response might be different depending on the phase of the cycle, with output stabilisation being given more importance during recessions and inflation being instead the main concern during expansions (Cukierman and Gerlach, 2003; Ahmad, 2016). Dolado, Maria-Dolores and Naveira (2000) found that the central banks of Spain, France and Germany are less responsive to inflation when it is below as opposed to above target. Taylor and Davradakis (2006) suggested that the Bank of England sets interest rates following a nonlinear Taylor rule, despite its symmetric inflation target. Martin and Milas, (2013) also found empirical support for a nonlinear Taylor rule in the UK during the recent financial crisis.

Much less evidence on nonlinear Taylor rules is available for the developing and emerging countries. Moura and de Carvalho (2010) examined the conduct of monetary policy in seven Latin American countries. Their findings suggest asymmetry responses to inflation, output and exchange rate in Brazil, Chile and Mexico. Two studies analyse nonlinearities in the Taylor rule in Turkey. Hasanov and Omay (2008) investigated possible asymmetries over the business cycles using monthly data spanning the period 1990:01–2000:10. They estimated a threshold Taylor rule using GMM where the output gap is the transition variable, and found that the Central Bank of the Republic of Turkey (CBT) reacts more strongly to output movements during recessions than expansions. Moreover, it responds to foreign reserves, real exchange rates and short-term capital inflows both in expansion and recession periods, and to money growth, budget deficits, and net foreign assets only in expansion periods. Akyürek et al. (2011) examined inflation targeting in Turkey by estimating both linear and nonlinear Taylor rules (using a rolling method for the latter) over the period 1999:07–2008:07; they found that a Taylor rule including the foreign interest rate and the exchange rate captures accurately the monetary policy of the CBT.

Miles and Schreyer (2012) examined the reaction functions of the central banks of four Asian countries, namely, Thailand, Malaysia, Korea and Indonesia using quantile regression analysis. They found evidence of nonlinearities but some cross-country differences. For instance, monetary authorities in Indonesia do not respond to the output gap in the lower quantiles (0.2 and 0.4), while the central bank of Korea responds to it in both the lower and higher quantiles. Further, only the central banks of Malaysia and Indonesia react to exchange rate fluctuations. Finally, Akdoğan (2015) found evidence of asymmetric behaviour of monetary policy in nineteen inflation-targeting countries including Thailand, Turkey and Israel using an Asymmetric Exponential Smooth Transition Autoregressive (AESTAR) model. Moreover, the estimated nonlinear Taylor rule predicts well out of sample.

2.3 Evolution of Monetary Policy in Emerging Economies

In this Section, we describe the evaluation of the monetary policy in the five countries in our sample with IT regime, namely Indonesia, Israel, South Korea, Thailand, and Turkey. As the focus of this chapter is on the conduct of monetary policy using Taylor rule, we focus mainly in the description of the monetary policy in these countries on what the Central Banks' used as their main policy instrument, what were their objectives over the different time periods, and what are the institutional differences between the countries (e.g., in terms of political structures or adopted exchange rate policies) which might be relevant as to how policy reaction functions are modelled in these countries.

2.3.1 The Monetary Policy Framework in Turkey

This Section presents an outline of the Turkish economy and the conduct of the monetary policy in such an economy. Over the 1980s and 1990s, the Turkish economy was characterised by the high level of inflation and was subject to a series of economic crises. The average annual inflation rate was 20% in the early 1980s, 35-40% by the end of 1980s, 60-65% in the early 1990s, and around 80% prior to the government disinflationary programme in 1998 (Hasanov and Omay, 2008).

The 1980s are marked as the years of liberating the Turkish economy. For example, since then the economy has become more open to international trade. The commercial banks have also allowed opening foreign currency accounts for the Turkish nationals as the barriers on foreign exchange transactions were removed. However, during the 1990s, the Turkish economy was subject to external shocks because of such liberalization policies, as well as macroeconomic instability. For example, the yearly average inflation reached up to 80% in 1998, with the government borrowing being 15% of GNP. The disinflation programme focused on a tight monetary policy and was not concerned with controlling government borrowing (Hasanov and Omay, 2008).

The Central Bank of Turkey (CBT) announced its first monetary programme in 1990 in order to control the extended credits to the public sector, net assets, and total liabilities over a short and medium term period. The monetary policy was successful in achieving its first monetary programme in 1990 with stabilising the financial markets. The policy-makers considered 1990 as the year of recovery in the economy. However, The CBT was forced to stop its monetary programme in 1991 due to the first Gulf war crisis, which brought an economic and political instability to the region including Turkey. In that year the GDP increased only 0.3%. After the war in 1992, the CBT announced its new monetary plan but the plan was abandoned in order to prevent the greater fluctuations in the exchange rate. As the central bank was not successful in stabilising the Turkish Lira (TL), Turkey asked the IMF for help and started a stabilisation programme in April 1994. The stabilisation programme resulted in an 7.8% average growth rate in the post-crisis 1995-1997 (Kara, 2012; Alper et al., 2013). However, in December 1999, Turkey suffered an earthquake, which caused huge damage to the industrial area, and as a result the GDP decreased by 6.1% and the economy entered into a recession. In 2000s, Turkey again asked the IMF for help to avoid the high level of inflation. In 1999, the central bank began to use an exchange rate policy based on a forward-looking inflation target as a part of the IMF disinflation plan. During this period, the CBT failed in decreasing the inflation expectation of the economic agencies and it faced delays in obtaining the expected revenue from the privatization programme. Therefore, the government had to continue borrowing more money at a high interest rate. The average interest rate decreased to 38% in 2000, where it has reached 109% in 1999. The inflation rate did not decrease as was planned and was still above the rate of depreciation in the TL.

In February 2001, the Turkish economy experienced a strong currency crisis, which leads to implementing a new monetary policy framework based on three main reforms. First, the fixed exchange rate regime was abandoned and replaced by a flexible one. Second, the inflation target was introduced and fully adopted in 2006, reducing the inflation rate from around 70% in 2001 to 8.81% in 2015 (Alp and Elekdag, 2011; Sengonul and Thorbecke, 2005). Further, the yearly average growth rate was 5% up to the recent 2008 financial crisis, which has affected severely the economy. Third, in May 2001, the monetary authority introduced a new law, in which the price stability became its main objective and the central bank was granted instrument independence with the short-term interest rate being the operational instrument (Kara, 2012).

In the post- 2008 crisis period, the CBT revised the inflation targeting framework and introduced financial stability as a new supplementary objective. It uses other instruments alongside the short-term interest rate such as the interest rate corridor between the overnight borrowing and lending rates. The current inflation target for 2016 is 5% (Kara, 2012; Alper et al., 2013).

2.3.2 The Monetary Policy Framework in Israel

This Section describes the development in the Israeli economy and outlines the main evolution of the monetary policy over the last two decades. Since 1985, the monetary policy in Israel has experienced significant changes in its primary targets, instruments, exchange regime, and financial structure.

The Economic Stabilization Plan (ESP) was introduced with price stability as the main focus for the monetary policy. In order to achieve price stability, the bank of Israel (BOI) followed different strategies that can be classified into three phases (De Fiore, 1998). In the first phase (1986-1991), the BOI adopted a fixed exchange rate for the Shekels against the US dollar at 1.5 as its nominal anchor, with the interest rate being used to stabilise the exchange rate. This nominal anchor (exchange rate) was pegged to a basket of five currencies, namely German mark, US dollar, UK pound, French franc, and Japanese yen in August 1986. Although the BOI was successful in reducing the inflation rate from three-digit (i.e., 440% in 1984) to double-digit with average of 18% between 1986 and 1991, the fixed exchange rate regime was eventually abandoned, with the credibility of stabilising the exchange rate being difficult to maintain, given the growing liberalization of the financial markets, the high cost of market intervention and the loss of international competitiveness. There was a notable fear to the policy-makers that the disinflation plan could be endangered and they had to move towards a new phase with more flexibility in the exchange rate (De Fiore, 1998; Elkayam, 2001).

In the second phase (1992-1996), a new monetary policy was introduced by moving towards inflation targeting regime and the exchange rate was allowed to vary between upward-crawling bands (3% to 7%). During this phase, the BOI had a different focus, specifically the short-term interest rate was set to achieve inflation target rather than stabilising the exchange rate. Throughout this period, the inflation rate was reduced to a yearly average of 10%. However, it was difficult for the monetary authority to attain these goals since this new exchange rate regime became a constraint on price stability objective. In addition, the level of interest rate was not able to keep the nominal exchange rate within the range. Further, other exogenous factors have influenced the real economy. For instance, the political situation between Palestinians and the Israelis has improved with the peace agreement in 1993. This has clearly contributed to an increase in the percentage of growth fixed non-residential investment to income. Further, the expansionary fiscal policy was followed during 1994-1996 with a budget deficit of 4.4% of GDP in 1995. This lead to an increase in the demand which caused inflationary pressures, thus the BOI followed a contractionary monetary policy (De Fiore, 1998).

In the third phase (starting in 1997), the exchange rate band system was replaced with a floating exchange rate regime and this year is considered as the official inflation targeting regime for Israel. The inflation rate was dropped to 7% in 1997 and further to 2.5% in 1999 (Bufman et al., 1995; Elkayam, 2001). However, this drop in the inflation rate during this period was due to the fluctuations in the international financial markets in 1998, the contractionary monetary policy and the slowdown of the Israeli economy. In achieving its goals, the BOI uses the short-term interest rate and the inflation target is determined in consultation with the government, which is set to be 1% to 3% for the current year of 2016. Further, the central bank is independent in setting and managing its monetary instruments and free from any political pressure from the government (Maman and Rosenhek, 2011).

To sum up, the monetary policy was successful in moving from a very high inflation environment to a low inflation era. Some researchers argue that the adoption of inflation target with a floating exchange regime and the interest rate rule followed are the reasons of such success in bringing inflation down (Masson et al., 1997; Taylor, 2000). This claim is yet to be examined in this chapter using the linear and nonlinear Taylor rule.

2.3.3 The Monetary Policy Framework in Thailand

This Section describes the development in the monetary policy and the economy in Thailand, with a special attention to the inflation targeting period. This development can be classified into three periods according to the Bank of Thailand (BoT).

In the first period (before the Asian crisis June-1997), the BoT adopted a fixed exchange target by either fixing its currency to the US dollar (until 1984) or to a basket of currencies in which the dollar was the main component (until June 1997). The main objectives for the monetary policy were to avoid imbalances in the balance of payment and to maintain low inflation with the fixed exchange regime (Lauridsen, 1998; BoT, 2016).

The financial sectors were subject to a series of financial reforms during 1989-93, which planned to increase foreign capital inflows and local savings. Specifically, the Bangkok International Banking Facility (BIBF) was introduced in 1992 to attract international funds. As a result, external debt doubled from 40$ billion in 1992 to 80$ billion in March 1997. Further, the high interest rate and the fixed value of Baht increased the level of foreign investment with an average investment ratio of 44% during 1990-96. The fixed exchange rate led people assume that there is no currency risk, which also encouraged locals to borrow more either form local banks or from outside. However, during 1996 it was observed that the economic growth was the lowest in decade with a negative export growth and the BoT kept high interest rate continuing its tight monetary policy. Eventually, a speculative attack hit the baht leading to a currency crisis. Although some researchers (see Krugman, 1999) blame the excessive and unproductive investment for causing the Asian crisis, the fixed exchange rate regime in the case of Thailand was an important factor (Lauridsen, 1998).

In the second period (July 1997-May 2000), the monetary policy in Thailand has experienced significant changes in its financial structure, exchange rate regime, policy instruments, and primary targets following the Asian crisis in 1997. In specific, in July 1997, the BoT abandoned the fixed exchange rate regime and moved towards a managed floating one. The monetary targeting became the main objective for the monetary policy using financial programming approach in order to achieve price stability and sustainable economic growth. During this period, Thailand received substantial financial help for the IMF, World Bank and Japanese government with a total of US$17.2 billion (Nakornthab, 2009; BoT, 2016). Monetary policy was tightened temporary to stop the collapse of the baht. As the value of the baht became stable, the BoT cut the interest rate and reached its lowest levels over a decade in September 1999. Therefore, by late 1998 the economic growth turned positive and became 4%; 4% and 5.5% in 1999 and 2000, respectively (Sharma, 2003).

In the third period (since May 2000), the IMF plan was successful in Thailand and resulted in broad reassessment of both the domestic economy and the external environment. However, the monetary targeting became less effective with unstable link between GDP growth and money supply in the aftermath of crisis. Therefore, the monetary authority has adopted the inflation targeting regime with the inflation forecast as the intermediate policy target. Further, the central bank appointed the first Monetary Policy Board (MPB) in April 2000, which has the power to decide on the monetary policy and revise the inflation target (Nakornthab, 2009). The BoT use an operational policy rate to influence the short-term money market rates. This policy rate is the 1-day repurchase rate which replaced the 14-day repurchase rate in 2007. During the first four years of the inflation targeting framework, the monetary policy was accommodative in order to support the economic recovery after the Asian financial crisis. Later, this policy turned to be tightened due to cost-push (oil prices) inflationary pressure until December 2006, and it is back to accommodative monetary policy afterwards to support gradual recovery of the Thai economy.

An impotent characteristic of inflation targeting regime is the independence of the central banks, which is formalised clearly in the new Bank of Thailand Act (2008) as it was operating under de facto independence previously. Further, the new Act makes firing the Bank's governor more difficult aiming to strengths the operational independence of BoT. The inflation target is set annually by both the MPC and the Ministry of Finance and a semi-annual inflation report must be submitted to the cabinet (Nakornthab, 2009; BoT, 2016).

2.3.4 The Monetary Policy Framework in South Korea

South Korea is classified as one of the most industrialised country in Asia. Similar to other East Asian countries, it was also hit by the Asian crisis. For example, the GDP growth was above 6% and the current account deficit was only 4% of GDP with $US 30 billion foreign reserves in 1996 (Ito, 2007); however, such reserves declined to $US 20 billion by the end of 1997 as a result of the interventions in the foreign exchange market to maintain the peg of its currency (won) against the US dollar and also to prevent possible defaults by commercial banks. Although the value of its currency had only depreciated slightly at the start of the crisis, it then depreciated from 1: 172 to the dollar on 4th December to 1: 962 by 23 December. Further, the rate of unemployment reached 7.6% in July 1998, as opposed to 2.6% in 1997. The economic growth declined sharply because the investment rate decreased from 36% of GDP before the crisis to 25% of GDP in 1998. Therefore, the government received international help of $US 57 billion from the IMF, the World Bank and Japan to tackle the unprecedented crisis (Ito, 2007).

A wider range of economic reforms was started including financial reforms, Labour reforms, trade liberalization and capital account liberalization following the IMF programme. The monetary policy was also issued by the Bank of Korea (BoK) Act in 1998, with price stability being the main objective for the monetary policy and financial stability as a secondary objective. The BoK adopted inflation target, which is set in consultation with the government. Further, the Monetary Policy Committee (MPC) is responsible for the decision making and the central bank has the instrument independence by setting the interest rate, which is the Base Rate since 2008 (Lee and Rhee, 2007). The recent IT has been set at 2% in collaboration between the central bank and the government for the period of three years from 2016 to 2018 (BoK, 2016).

2.3.5 The Monetary Policy Framework in Indonesia

The evolution of the monetary policy in Indonesia is addressed in this Section, with a special focus on the inflation targeting regime. Prior to the adoption of IT, the implication of monetary policy was based on following a pegged exchange rate regime with the money supply being the operational target.

Like other East Asian countries, Indonesia was hit significantly by the Asian crisis in 1997 and experienced the largest currency depreciation among the East Asian countries. The value of its currency (rupiah) depreciated sharply to one-sixth of its pre-crisis value by mid-January 1998 causing a significant damage to the economy; for instance, GDP decreased by 13% in 1998 with high unemployment rate, the Jakarta stock market collapsed, and massive failures prevailed in companies (Ito, 2007). In addition, the inflation rate was around 82% by mid-1997 and the Bank Indonesia (BI) had to increase the interest rate to around 70%. An important issue in the case of Indonesia is that a social and political crisis started in 1998, as a result of the economic crisis. However, these forced the BI to abandon the crawling band exchange rate regime and adopt the floating one (Mariano and Villanueva, 2006). Further, a series of institutional reforms was introduced, which redirected the BI towards price and exchange rate stability. Therefore, the monetary policy issued the Act No. 23 in 1999, which granted more independence for the BI in implementing its monetary policy. According to this Act, the BI has both instrument (base money) and goal independence (inflation target) and the stability of the local currency became the primary objective for the monetary policy, defined as low and stable prices through adopting inflation target with free floating exchange rate regime (Hirawan and Cesaratto, 2008). Thus, the inflation target of 3-5% was adopted in 2000 and the base money was considered as the monetary policy instrument.

Four years later, the monetary authority issued a new Act No. 3 in 2004, which also aimed to achieve and maintain the stability of the rupiah and to minimise any associated excessive fluctuations (BI, 2016). The Consumer Price Index (CPI) is used to measure inflation, which is viewed by the BI as a requirement for a sustainable economic growth. According to this new Act, the government is responsible for setting the inflation target for three years period, while the central bank has instrument independence and can freely decide on setting its operational target to achieve the inflation target (Mariano and Villanueva, 2006). Since 2005, the interest rate has become the primary instrument of monetary policy to influence economic activity and it is determined on a monthly basis by the Board of Governors of Bank Indonesia. Further, the announced inflation target for 2016 is a target corridor of 4±1% (BI, 2016).

2.4 Methodology

2.4.1 The Linear Taylor Rule

Taylor (1993) suggested the following monetary policy rule for the US Fed:

$$r_t = p_t + .5y_t + .5(p_t - 2) + 2, \tag{2.1}$$

where r_t is the Federal funds rate, p_t is the rate of inflation over the previous four quarters and y_t is the percentage deviation of real GDP from target. This implies that the policy interest rate goes up if inflation increases above the 2% target or if real GDP rises above trend GDP. Taylor (1998) modified this rule by adding two extra variables, namely the central bank's target inflation rate (π^*) and estimate of the equilibrium real rate of interest (${r_t}^f$) as shown below:

$$r_t = \pi_t + gy_t + h(\pi_t - \pi^*) + {r_t}^f \tag{2.2}$$

This simple formulation has been criticised for not taking into account the effects of the exchange rate on monetary policy, which have been considered by later studies, e.g. Ball (1999), Svensson (2000), Taylor (1999) and Ghosh et al. (2016). The EMEs have reasons to consider the fluctuation in the exchange rate in its conduct of monetary policy (Ghosh et al., 2016). Svensson (2000) explains the direct and indirect impact of exchange rate on the economy and on setting the interest rate and the fluctuations in the exchange rate could have a great effect of pass through of the exchange rate into the local price through the import channel (Goldberg and Campa 2010). On the depreciation side, it may force central banks, targeting price stability, to tighten their monetary policy, while it might lead to loss of international competition with the appreciation side (Gagnon and Ihrig, 2004; Baily, 2002; Bailliu and Fujii; 2004; Ghosh et al., 2016). The augmented Taylor rule can be written as:

$$i_t = f\pi_t + gy_t + h_0 e_t + h_1 e_{t-1}, \quad (2.3)$$

where i_t is the short-term nominal interest rate, π_t is the inflation rate, y_t is the output gap and e_t the real exchange rate. No intercept in this equation implies that the targeted inflation rate is zero and interest rates and exchange rates are measured relative to their long-run values (Taylor, 2001). In the present study, we first estimate the following linear Taylor rule using GMM as in Clarida, Gali and Gertler (1998, 2000):

$$r_t = \alpha_0 + \alpha_1 r_{t-1} + \alpha_2 \sum_{k=1}^{3}(E_{t-1}\pi_{t+k} - \pi^t) + \alpha_3 \sum_{k=1}^{3}(E_{t-1}y_{t+k}) + \alpha_4 \sum_{k=1}^{3}(E_{t-1}rer_{t+k}) + \varepsilon_t \,. \quad (2.4)$$

where $r_t$is the short-term interest rate, π_{t+k} is the CPI inflation, π^t is the inflation target and y_{t+k} is the output gap calculated as the difference between the log of output from its potential, and rer_{t+k} is real effective exchange rate. It is assumed that policy makers respond to forecasts of inflation, the output gap and the exchange rate over the coming quarter, therefore a 3-month lead average is used for these variables in the estimation (Svensson, 1997; Martin and Milas, 2013; Ahmad, 2016).

2.4.2 The Nonlinear Taylor Rule

Given the mounting evidence of possible nonlinearities in the reaction function of central banks, we also estimate a threshold model specified as follows (see following Taylor and Davradakis, 2006; Martin and Milas, 2013; Caglayan et al., 2016):

$$r_t = I[\pi_{t-1} \geq \pi^*]\left[\beta_0^H + \beta_1^H r_{t-1} + \beta_2^H \sum_{k=1}^{3}(E_{t-1}\pi_{t+k} - \pi^t) + \beta_3^H \sum_{k=1}^{3}(E_{t-1}y_{t+k}) + \beta_4^H \sum_{k=1}^{3}(E_{t-1}rer_{t+k})\right]$$
$$+I[\pi_{t-k} < \pi^*]\left[\beta_0^L + \beta_1^L r_{t-1} + \beta_2^L \sum_{k=1}^{3}(E_{t-1}\pi_{t+k} - \pi^t) + \beta_3^L \sum_{k=1}^{3}(E_{t-1}y_{t+k}) + \beta_4^L \sum_{k=1}^{3}(E_{t-1}rer_{t+k})\right] + \varepsilon_t. \quad (2.5)$$

The threshold variable is the inflation rate, since central banks might respond more aggressively when inflation overshoots than when it undershoots its target (Akdoğan, 2015); specifically, we use the first lag of inflation π_{t-1}. π^* is the optimal threshold value of inflation defining the high/low inflation regime of the model, and is estimated endogenously along with the other parameters (Martin and Milas, 2013). $I[.]$ is the dummy indicator function that equals 1 when $\pi_{t-k} \geq \pi^*$, and 0 otherwise. Therefore, the monetary policy responses are driven by the optimal threshold value of inflation π_{t-k}.

In the above regression, the optimal threshold value of inflation, π^*,is estimated along with the other parameters by minimising an appropriate criterion function using a one-dimension grid search including the possible breakpoints of inflation. Following Taylor and Davradakis (2006), we use the generalised method of moments (GMM) estimator given the possible correlation between the repressors and the error term. The criterion function that GMM minimises is given by

$$J = \hat{\epsilon}' Z W^{-1} Z' \hat{\epsilon}'. \tag{2.6}$$

where $\hat{\epsilon}'$ is the estimated disturbance vector and Z is a vector of l instrumental variables satisfying the orthogonality condition $E(Z'\epsilon) = 0$. This condition will generally not hold exactly in sample for estimated values of ϵ, but the GMM estimator minimises a weighted average of the squared values of the l sample moments $Z'\hat{\epsilon}$. In a linear context a two-step procedure can be followed to construct the weight matrix W based on the centred estimates of the moment conditions (see e.g. Hansen, 2003, 2016). For a threshold model a one-dimensional grid search is conducted over the interval including the possible breakpoint of π_{t+k} [0.10, 0.90]:

$$\hat{\pi}^* = arg \quad min_{\pi_1 \in \Pi^*} \quad J. \tag{2.7}$$

where J is the function minimised by GMM, as explained in Eq. (2.6) (Taylor and Davradakis, 2006)

2.5 Data Description

We estimate both the linear and threshold Taylor rule using GMM in five emerging markets, namely Indonesia, Israel, South Korea, Thailand, and Turkey, all of which have adopted inflation targeting and a floating exchange rate regime, and have similar development levels. A detailed description of the variables used is given in Table A2.1 in the Appendix A2. Figs. 2.1 to 2.4 contain plots of the variables. There are noticeable deviations of inflation from target, with low volatility in Turkey; the real effective interest rate is highly volatile in all countries, but considerably less in South Korea and Israel during the recent financial crisis.

It is assumed that policymakers respond to forecasts of inflation, output gap and exchange rate over the coming quarter, therefore 3-month lead average of the inflation, output gap and real exchange rate are used in the estimation (Svensson, 1997; Martin and Milas, 2013; Ahmad, 2016). Output is proxied by the industrial production index (IPI) except in the case of Indonesia, where this series is not available and the manufacturing index is used instead. The output gap, y_{t+k}, is calculated as the proportional deviation of the log IPI from its Hodrick and Prescott (1997) trend[1] (see Fig. 2.4). The consumer price index (CPI) is used to calculate the inflation rate, π_{t+k}, and the inflation gap is constructed as the difference between the inflation rate, π_{t+k}, and the inflation rate target, π^t, (see Fig. 2.2). Further, the real effective exchange rate, rer_{t+k}, is the 3-month leading average of the natural log of the "real broad effective exchange rate". These data were retrieved from the IMF's International Financial Statistics (IFS) while the inflation target, π^t, is obtained from the websites of the central banks of the countries under investigation. All series are seasonally adjusted. The frequency is monthly and the sample period corresponds to the actual adoption of inflation targeting by the five countries examined: January 2001-November 2014 for Indonesia; June 1997-Feb 2015 for Israel; January 1998-March 2015 for Korea; May 2000-September 2015 for Thailand; and January 2006-2015 September for Turkey.

Table A2.1 in the Appendix A2 provides a detailed description of the variables used in the estimation. Figs. 2.1 to 2.4, by contrast, display the evolution of the variables over the sample period. Graphical inspections suggest that the inflation gap exerts some

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[1] We have chosen the HP filter because of its flexibility in tracking trend output and it allows for minimizing the sum of square of the actual output and the potential output (Konuki, 2010) and follow Ravn and Uhlig (2002) in setting the adjustment parameter equal to 14400.

levels of deviation between the inflation rate and its target but low volatility in Turkey (see Fig. 2.2). The real effective exchange rate also exhibits high volatility in all countries with a sharp decline in Korea and Israel during the recent 2007 financial crisis (see Fig 2.3).

Table 2.1. Summary of Descriptive Statistics.

Country	Variable	Obs	Mean	Standard Deviation	Skewness	Kurtosis	JB
Indonesia	r	164	9.093	3.305	1.262	0.524	42.012***
	PI	164	1.865	3.371	0.937	0.415	24.491***
	rer_{t+k}	164	4.476	0.108	-1.200	1.953	62.226***
	y_{t+k}	164	-0.075	3.873	-2.255	8.507	596.491***
Israel	r	215	5.401	4.025	0.732	-0.634	22.732***
	PI	215	-0.325	2.071	-0.001	-0.569	3.053**
	rer_{t+k}	215	4.599	0.087	-0.022	-0.97	8.561**
	y_{t+k}	215	-0.060	2.872	0.217	0.183	2.014
South Korea	r	204	4.318	3.294	4.469	22.576	4719.929***
	PI	204	-0.359	1.411	-1.445	6.451	403.605***
	rer_{t+k}	204	4.668	0.103	0.363	-0.012	4.435**
	y_{t+k}	204	-0.115	4.022	-1.958	8.378	678.047***
Thailand	r	182	2.319	1.036	0.804	0.021	18.159***
	PI	182	0.697	2.002	-0.079	1.291	11.545***
	rer_{t+k}	182	4.537	0.082	-0.146	-1.411	15.629***
	y_{t+k}	182	-0.167	5.499	-2.304	9.423	762.331***
Turkey	r	162	15.322	13.144	1.572	1.883	82.681***
	PI	162	2.733	4.123	1.716	10.382	756.833***
	rer_{t+k}	162	4.478	0.091	-0.786	0.742	19.532***
	y_{t+k}	162	-0.147	4.793	-0.984	3.280	96.349***

Notes: r, PI, rer_{t+k}, and y_{t+k} denote the short-term policy rate, inflation gap, real effective exchange rate, and output gap, respectively. JB is the Jarque-Bera test for normality. *** and ** indicate statistical significance at the 1% and 5% levels, respectively.

A wide range of descriptive statistics is reported in Table 2.1. The mean is positive for the policy rate and the real effective exchange rate, and negative for the output gap in all cases; it is negative for the inflation gap in Israel and South Korea, and positive in the other countries. The policy rate is most volatile in Turkey and Israel while the output gap exhibits the highest volatility in Thailand. The real effective exchange rate is the least volatile variable in all countries in our sample. The policy rate exhibits positive skewness while the real effective exchange rate and output gap are characterised by negative skewness in all countries with the exception of Israel. Excess kurtosis characterises the output gap in all countries, and all variables in South Korea except the real effective exchange rate. The Jarque-Bera (JB) test statistics imply a rejection at the 5% level of the null hypothesis of normality for all variables except for the output gap in Israel and the real effective exchange rate in Israel and South Korea.

2.6 Results and Discussion

2.6.1 Unit Root Test

As a first step, a battery of standard and nonlinear unit root tests was carried out to examine the stochastic properties of the series. The ADF (Dickey and Fuller, 1981) PP (Phillips-Perron, 1988), and KPSS (Kwiatkowski, Phillips, Schmidt and Shin, 1992) test results (see Table 2.2) imply that all variables are stationary in levels, except for the policy rate, which is not stationary in Indonesia, Israel and Thailand. The order of integration of interest rates is generally a contentious issue. Nelson and Plosser (1982) characterised them as a nonstationary variable. Clarida et al. (2000), although they could not reject the unit root null, pointed out that the nominal interest rate should be a stationary variable according to many theoretical models. Martin and Milas (2004, 2013) and Castro (2011) found that the order of integration of both interest rates and inflation is ambiguous, but decided to treat them as stationary, as we do in the current paper as well.

Visual inspections of the series (see Figs. 2.1 to 2.4) suggest structural breaks might be present; for example, the recent financial crisis of 2007-8 appears to have had a significant impact on the policy rate (see Fig. 2.1). As shown by Perron (1989), structural break reduce the power of standard unit root tests. Therefore, we also performed two unit root tests allowing for up to m unknown breaks, namely the Lumsdaine and Papell (1997) (thereafter LP) and Lee and Strazicich (2003) (thereafter LS) ones. At least one of these two tests (see Table 2.3) rejects the null hypothesis of a unit root at either the 5% or 10% level. Therefore all variables can be treated as I(0) and are entered into the threshold Taylor rule model in levels. The break dates mainly correspond to the 2007-8 recent global financial crisis and the 2001 dot-com bubble crisis in the US (see Table 2.3).

Table 2.2. Linear Unit Root Tests.

Country	Variable	ADF Test		PP Test		KPSS Test	
		Intercept	Trend & Intercept	Intercept	Trend& Intercept	Intercept	Trend& Intercept
Indonesia	r	-2.052	-2.051	-1.743	-1.491	2.052***	0.274***
	PI	-3.363**	-3.363*	-2.718*	-2.746	0.273	0.092
	rer_{t+k}	-3.951***	-4.138***	-3.215**	-2.567	1.819***	0.320***
	y_{t+k}	-11.656***	-11.622***	-11.814***	-11.815**	0.028	0.027
Israel	r	-1.865-	-3.324*	-1.950	-2.861	3.802***	0.547***
	PI	-3.589***	-3.607**	-3.036**	-3.093	0.354*	0.121*
	rer_{t+k}	-2.008	-1.591	-1.774	-1.515	1.422***	0.837***
	y_{t+k}	-4.919***	-4.907***	-6.418***	-6.418***	0.042	0.042
South Korea	r	-9.486***	-6.810***	-11.265***	-10.778***	1.493***	0.255***
	PI	-3.183**	-3.165*	-2.702*	-2.692	0.379*	0.380***
	rer_{t+k}	-2.258	-2.281	-2.684*	-2.653	0.469*	0.478***
	y_{t+k}	-4.433***	-4.428***	-4.830***	-4.834***	0.040	0.039
Thailand	r	-2.088	-2.072	-1.721	-1.656	0.311	0.281***
	PI	-3.009**	-2.985	-2.521	-2.537	0.258	0.249***
	rer_{t+k}	-1.247	-2.564	-0.946	-2.933	3.304***	0.200**
	y_{t+k}	-5.313***	-5.297**	-5.392***	-5.390***	0.031	0.030
Turkey	r	-4.834***	-3.595**	-5.245***	-3.413*	2.428***	0.511***
	PI	-4.386***	-4.571***	-6.956***	-6.956***	0.082	0.082
	rer_{t+k}	-2.857*	-2.301	-2.200	-2.094	1.086***	0.560***
	y_{t+k}	-4.110***	-4.096***	-8.848***	-8.847***	0.061*	0.060

Note: ***, **, * indicates significance at the 1%, 5% and 10% level respectively. Bandwiths in the PP unit root tests are determined by the Newey-West statistic using the Barlett-Kernel. The lag length for the ADF test is chosen based on the AIC criterion. The KPSS test is estimated with the Bartlett-kernel and the bandwidth is selected based on the Newey and West (1994). r, PI, rer_{t+k}, and y_{t+k} denote the short-term policy rate, inflation gap, real effective exchange rate, and output gap, respectively. The null hypothesis of the ADF and PP tests is that series is nonstationary while the null hypothesis is stationary against the alternative of a unit root for the KPSS test.

Figure 2.1. Policy Rate.

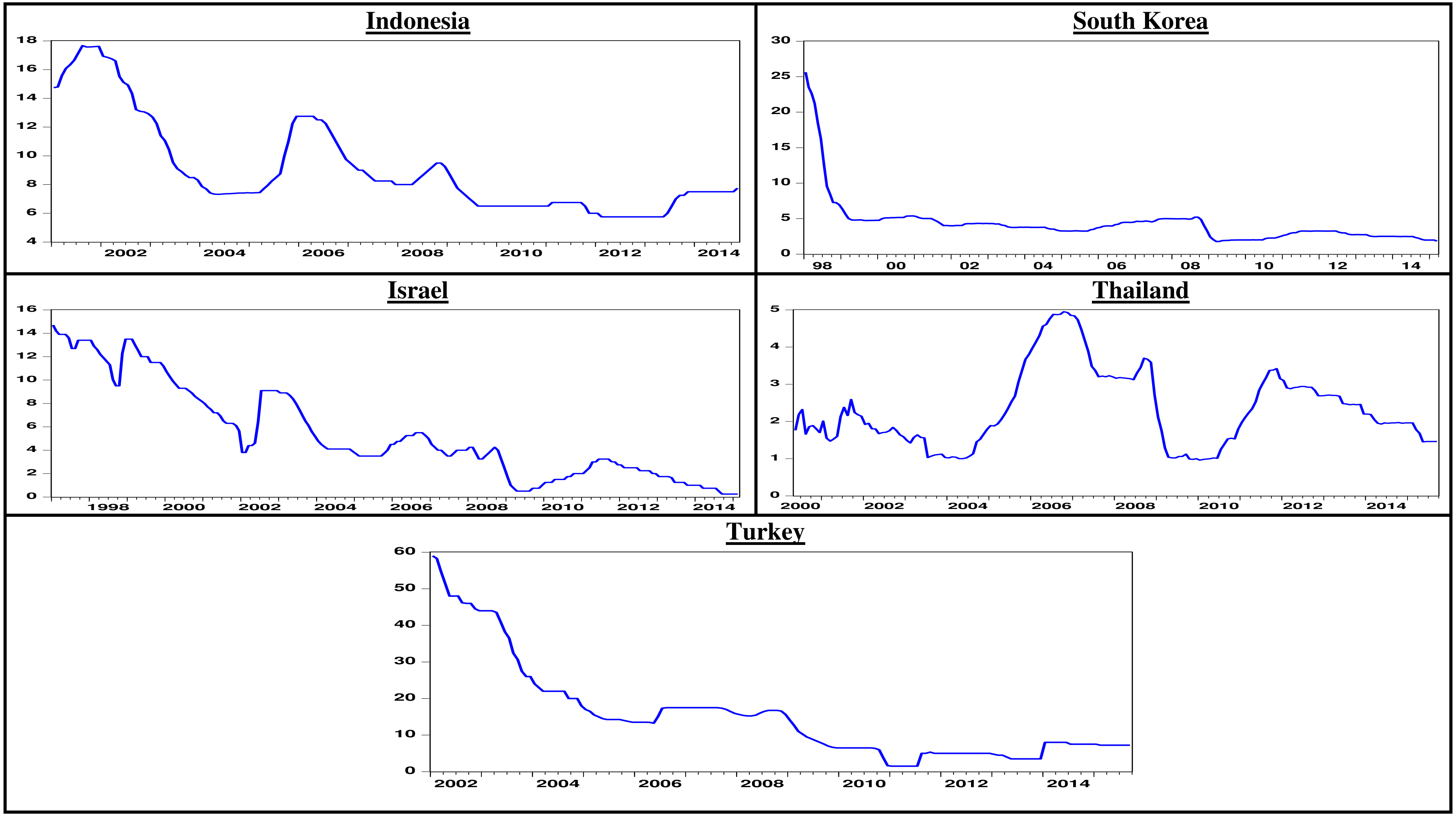


Figure 2.2. Inflation Gap.

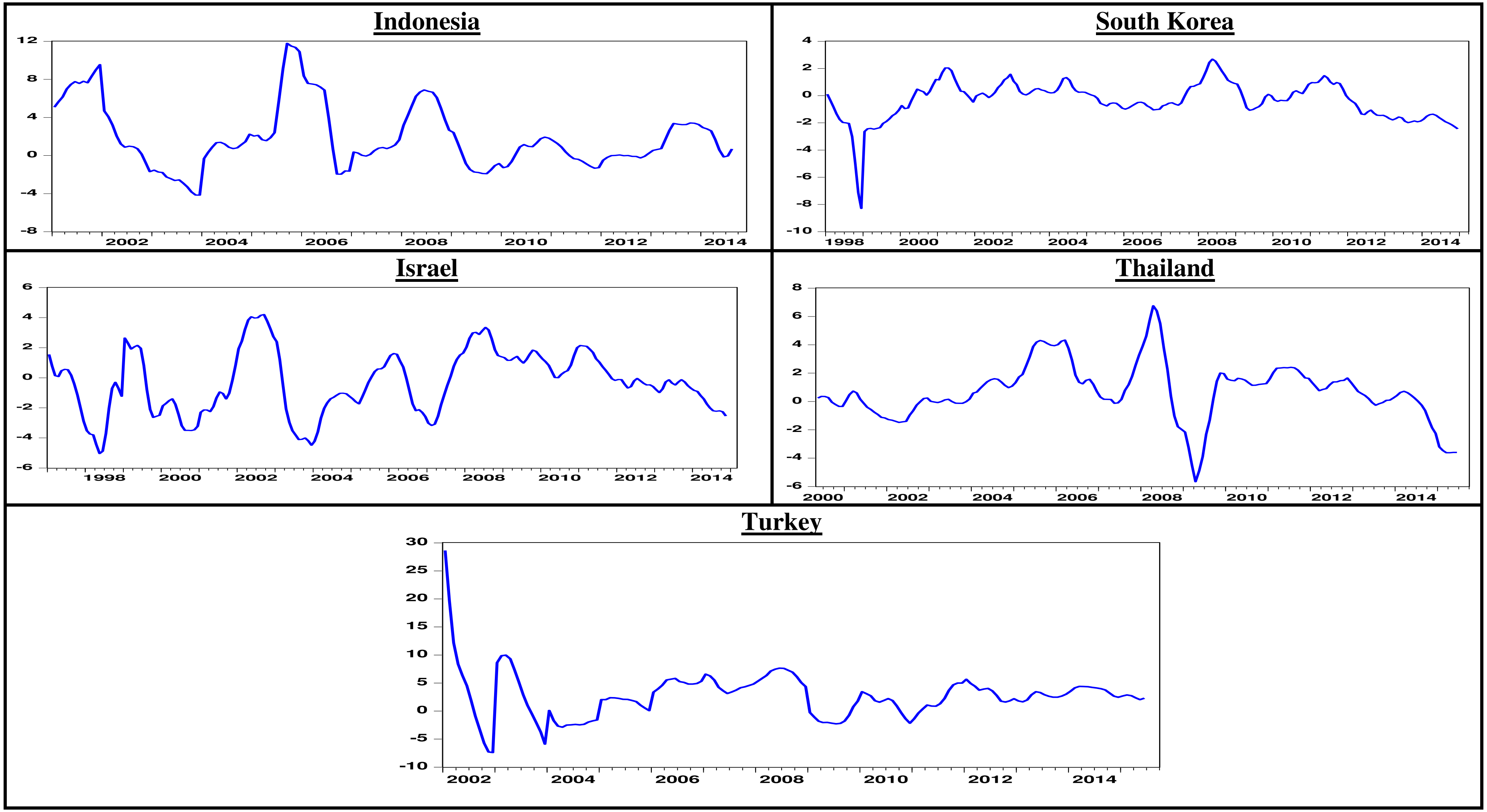


Figure 2.3. Real Effective Exchange Rate.

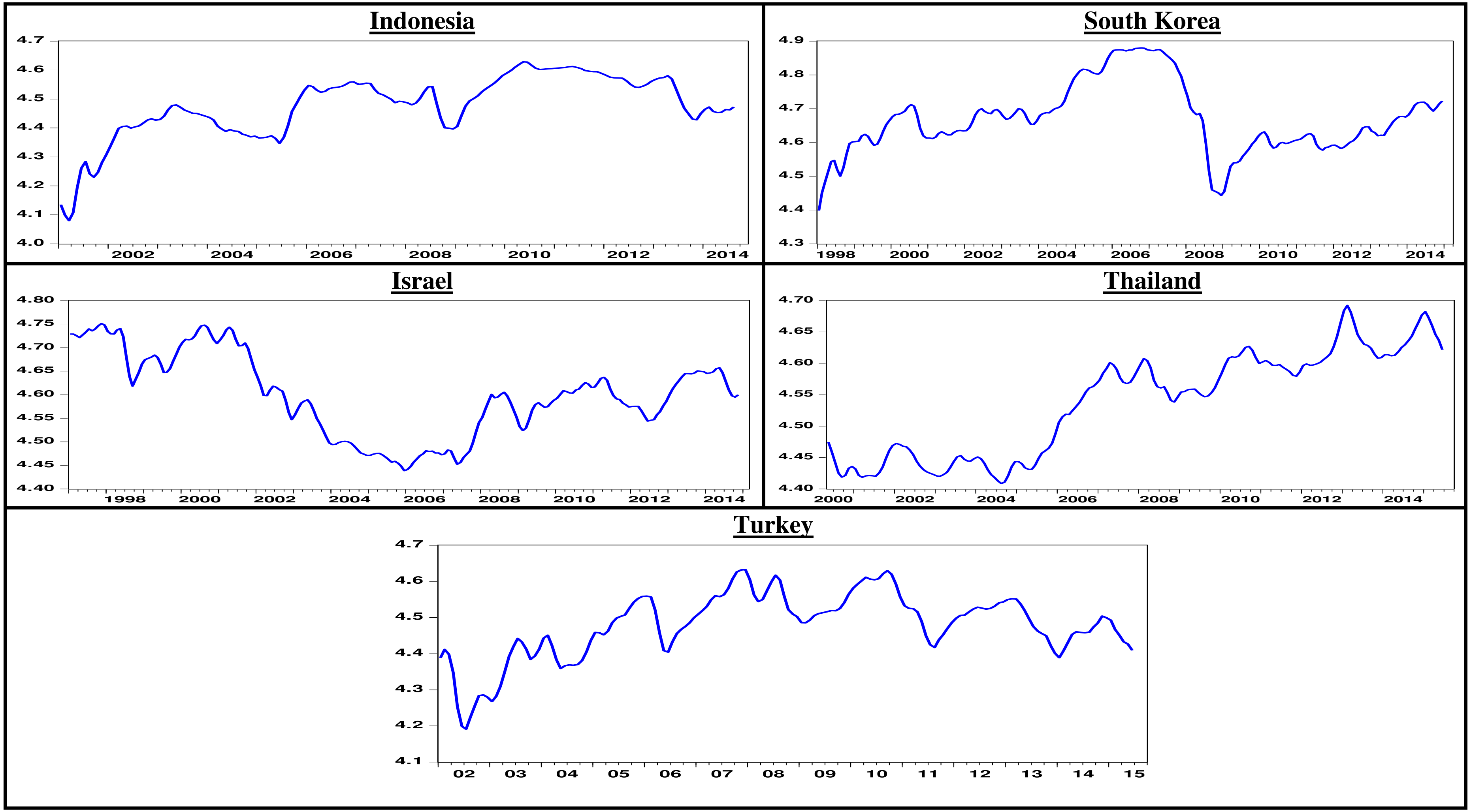


Figure 2.4. Output Gap.

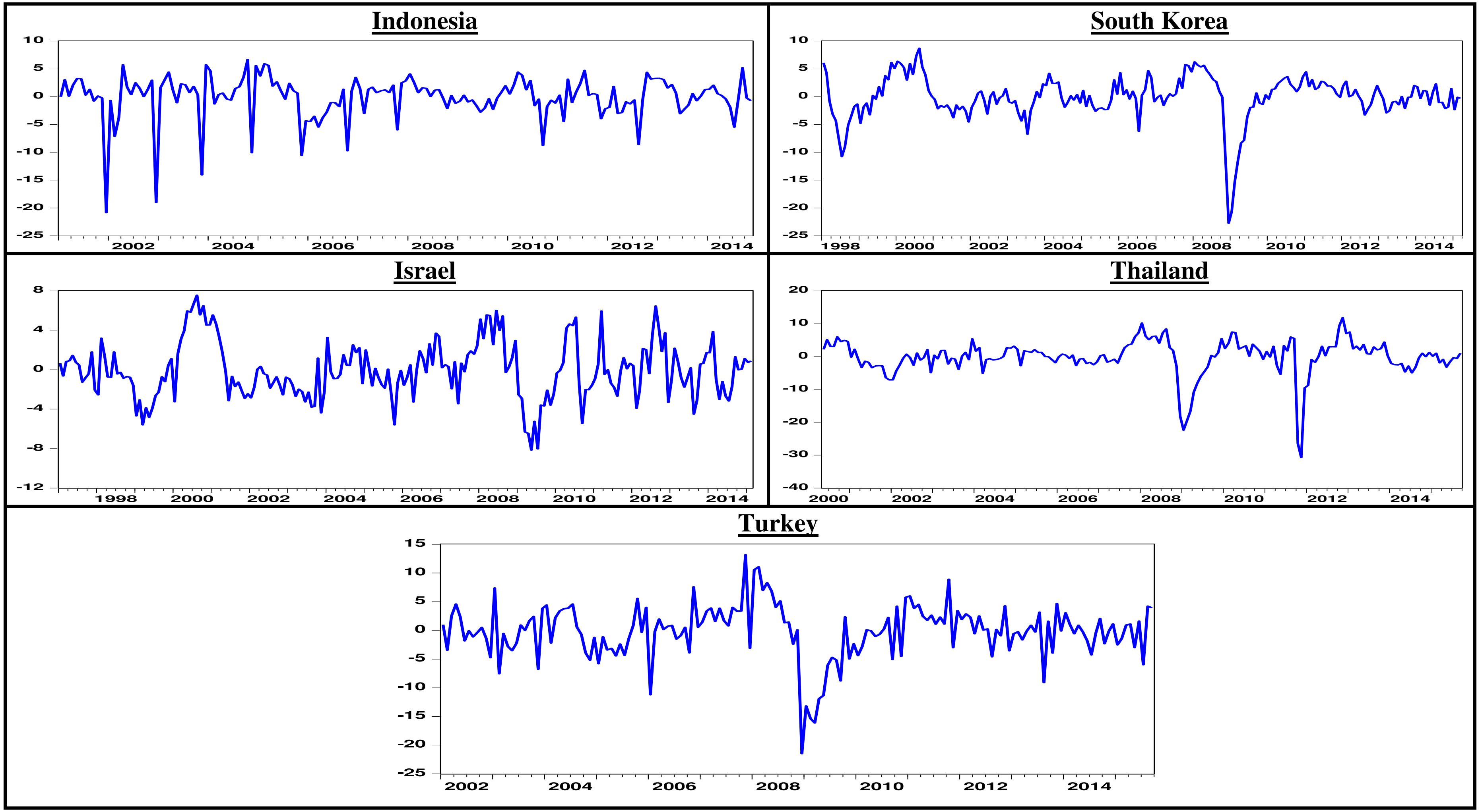


Table 2.3. Nonlinear Unit-Root Tests.

		Lee-Strazicich (LS) Test								Lumsdaine Papell (LP) Test								
		Model A (Crash Model)			Model C (Trend Shift Model)					Breaks in Intercept			Breaks in Trend			Breaks in Intercept and Trend		
		LM-Stat	Breakpoints		LM-Stat	λ_1	λ_2	Breakpoints		t-stat	Breakpoints		t-stat	Breakpoints		t-stat	Breakpoints	
			D_{1t}	D_{2t}				DT_{1t}	DT_{2t}		D_{1t}	D_{2t}		DT_{1t}	DT_{2t}		DT_{1t}	DT_{2t}
Indonesia	r	-3.554 **	2003:04 (-1.77)	2005:05 (0.318)	-4.612 **	0.34	0.61	2005:05 (4.734)	2008:10 (-4.477)	-3.706	2003:01 (-3.040)	2005:03 (2.293)	-4.467	2004:01 (4.045)	2005:11 (-3.062)	-5.404	2003:11 (-0.9085) (-4.720)	2006:06 (-4.720) (-4.242)
	PI	-3.907 ***	2004:01 (-1.884)	2005:06 (4.523)	-5.079 ***	0.33	0.62	2005:03 (3.610)	2009:10 (-1.611)	-4.102	2005:03 (2.198)	2012:10 (1.804)	-4.450	2003:01 (2.863)	2005:08 (-2.677)	-5.475	2003:01 (-0.913) (4.014)	2006:06 (-3.881) (-3.624)
	rer_{t+k}	-2.451	2004:03 (1.602)	2007:01 (1.595)	-4.231 **	0.21	0.71	2003:08 (-4.978)	2009:12 (0.548)	-7.877 ***	2005:06 (7.207)	2009:04 (6.192)	-5.422	2009:01 (1.691)	2010:12 (-2.878)	-7.071 ***	2005:06 (6.547) (-0.183)	2009:04 (5.955) (1.112)
	y_{t+k}	-4.151 ***	2005:02 (1.387)	2007:12 (1.612)	-7.747 ***	0.29	0.42	2004:10 (6.757)	2006:05 (-5.502)	-12.27 ***	2005:10 (-2.949)	2010:06 (-2.318)	-11.680 ***	2004:08 (-1.272)	2006:06 (1.229)	-12.706 ***	2005:10 (-4.017) (-1.861)	2008:02 (-1.861) (-3.316)
Israel	r	-3.276 **	2002:07 (-4.100)	2011:03 (1.235)	-4.869 ***	0.30	0.44	2002:03 (4.054)	2004:07 (-3.442)	-5.092	1999:11 (-2.780)	2010:07 (2.220)	-4.582	2001:07 (2.305)	2009:03 (1.237)	-6.338	2002:05 (4.938) (-2.512)	2005:02 (2.796) (4.743)
	PI	-3.836 ***	1999:10 (0.799)	2001:10 (1.216)	-6.201 ***	0.27	0.61	2001:08 (3.403)	2007:05 (1.767)	-4.834	2001:09 (2.853)	2007:03 (3.023)	-4.173	2006:07 (1.285)	2009:01 (-1.865)	-5.150	2003:01 (-2.755) (-0.027)	2007:03 (1.924) (-2.228)
	rer_{t+k}	-2.371	2001:06 (0.835)	2007:02 (-2.876)	-5.100 ***	0.26	0.63	2001:06 (-4.902)	2007:08 (7.021)	-4.591	2001:09 (-3.919)	2007:09 (2.499)	-4.782	2001:02 (-3.532)	2004:10 (4.401)	-4.565	2001:09 (-3.663) (-3.129)	2007:04 (4.019) (2.747)
	y_{t+k}	-6.207 ***	2001:04 (-0.523)	2008:01 (0.583)	-7.445 ***	0.17	0.30	1999:12 (4.642)	2002:02 (-5.012)	-6.037 *	2001:03 (-3.131)	2008:12 (-3.121)	-5.109	2000:07 (-1.414)	2003:01 (1.392)	-6.214	2000:01 (3.4098) (-1.305)	2003:09 (2.705) (3.512)
South Korea	r	-1.125	2000:10 (-0.976)	2002:05 (-1.402)	-3.881	0.23	0.68	2001:10 (8.557)	2008:12 (0.671)	-7.345 ***	2001:06 (-1.575)	2008:09 (-2.796)	-6.810 **	2007:09 (-1.206)	2010:01 (0.995)	-7.421 ***	2008:09 (-3.123) (1.959)	2011:08 (-0.395) (-2.181)
	PI	-2.948 *	2001:01 (2.322)	2011:11 (-1.482)	-5.052 ***	0.17	0.87	2000:09 (3.367)	2011:12 (-2.058)	-4.714	2000:07 (2.260)	2011:10 (-2.504)	-5.654	2000:09 (-4.050)	-2.4217 (2011:05)	-6.213	2001:06 (-1.592) (-4.719)	2007:07 (3.178) (-1.611)
	rer_{t+k}	-2.100	2007:12 (-0.016)	2009:10 (-1.426)	-5.582 ***	0.65	0.77	2008:05 (-6.215)	2010:04 (4.489)	-6.021 *	2004:07 (2.721)	2008:05 (-5.432)	-4.604	2006:12 (-4.166)	2009:04 (4.191)	-6.976 **	2005:09 (4.796) (-4.847)	2008:05 (-5.178) (4.798)
	y_{t+k}	-5.139 ***	2000:08 (- 1.3899)	2009:08 (1.073)	-5.740 ***	0.65	0.76	2008:07 (-2.075)	2010:04 (3.546)	-5.204	2000:10 (-1.982)	2008:08 (-2.643)	-4.896	2000:06 (-2.164)	2002:10 (1.496)	-6.523 *	2008:10 (-4.660) (4.380)	2011:02 (-2.238) (-4.348)

		Lee-Strazicich (LS) Test								Lumsdaine Papell (LS) Test								
		Model A (Crash Model)			Model C (Trend Shift Model)					Breaks in Intercept			Breaks in Trend			Breaks in Intercept and Trend		
		LM-Stat	Breakpoints		LM-Stat	λ_1	λ_2	Breakpoints		t-stat	Breakpoints		t-stat	Breakpoints		t-stat	Breakpoints	
			D_{1t}	D_{2t}				DT_{1t}	DT_{2t}		D_{1t}	D_{2t}		DT_{1t}	DT_{2t}		DT_{1t}	DT_{2t}
Thailand	r	-3.293 **	2007:04 (-0.047)	2011:11 (-2.1981)	-4.524 **	0.41	0.73	2005:06 (2.549)	2009:06 (-0.347)	-4.465	2005:03 (2.889)	2008:09 (-3.398)	-3.3551	2006:11 (-2.819)	2009:02 (2.216)	-5.104	2005:08 (3.752) (-4.572)	2010:11 (4.372) (2.204)
	PI	-2.527	2002:10 (-0.347)	2009:10 (-1.807)	-6.887 ***	0.30	0.64	2005:09 (-0.748)	2010:08 (5.177)	-5.598 *	2008:04 (-4.744)	2012:11 (-4.274)	-4.9740	2005:07 (-3.100)	2013:05 (-2.008)	-6.707 *	2008:04 (-5.746) (0.413)	2012:08 (-0.393) (-4.240)
	rer_{t+k}	-3.225 **	2004:10 (0.375)	2013:03 (-0.379)	-5.948 ***	0.19	0.36	2004:02 (2.117)	2006:06 (2.958)	-4.738	2005:11 (4.049)	2009:11 (1.760)	-4.9108	2005:01 (3.908)	2007:02 (-4.263)	-5.857	2004:11 (-1.826) (5.039)	2008:02 (-4.531) (-4.996)
	y_{t+k}	-6.134 ***	2003:08 (0.572)	2011:02 (1.824)	-7.542 ***	0.72	0.88	2011:09 (7.061)	2013:10 (-6.013)	-5.780	2008:08 (-1.935)	2012:01 (1.221)	-5.3278	2007:02 (-0.733)	2009:03 (0.763)	-6.597	2008:10 (-3.742) (3.370)	2010:11 (-2.268) (-3.285)
Turkey	r	-1.073	2006:07 (-1.383)	2011:07 (4.954)	-3.656	0.24	0.69	2005:01 (6.892)	2010:10 (-0.121)	-4.349	2011:07 (1.653)	2013:11 (1.784)	-3.8316	2004:01 (2.072)	2011:01 (2.263)	-4.814	2004:08 (-1.111) (3.494)	2008:12 (-4.328) (-0.332)
	PI	-0.869	2009:12 (3.576)	2013:03 (1.665)	-6.270 ***	0.18	0.56	2004:03 (8.110)	2008:12 (-3.085)	-7.972 ***	2005:12 (4.388)	2008:12 (-5.034)	-6.4101 *	2008:04 (-4.207)	2010:04 (3.643)	-7.806 ***	2005:12 (3.982) (1.823)	2008:12 (-4.977) (-0.399)
	rer_{t+k}	-4.110 ***	2008:02 (2.105)	2010:10 (-0.687)	-6.618 ***	0.47	0.64	2007:11 (-1.161)	2009:12 (4.203)	-5.407	2004:08 (3.939)	2006:08 (3.704)	-5.7263	2007:10 (-3.752)	2010:08 (-2.247)	-6.478	2008:07 (-3.399) (-1.841)	2011:02 (-2.113) (-3.240)
	y_{t+k}	-4.231 ***	2008:01 (2.642)	2009:12 (-2.093)	-5.878	0.31	0.52	2005:12 (4.977)	2008:08 (-5.279)	-5.445	2008:07 (-3.327)	2010:05 (1.941)	-4.4580	2007:06 (-1.633)	2009:04 (1.796)	-7.840 ***	2008:11 (-6.401) (5.082)	2010:09 (-0.151) (-5.452)

Notes: r_t, π_{t+k}, rer_{t+k}, and y_{t+k} denote the short-term policy rate, inflation gap, real effective exchange rate, and output gap, respectively. The general to specific procedure is followed to find the optimum lag length, allowing for a maximum of 12 lags. The t-statistics are represented in parentheses (.). The critical values are obtained from Lee and Strazicich (2003). Model A allows for breaks in the intercept, whereas Model C allows for breaks in both the intercept and the trend. D_{1t} and D_{2t} refer to the first and second break dates, while DT_{1t} and DT_{2t} indicate the first and second break dates when allowing for the trend. λ_1 and λ_2 are the locations of the first and second breakpoints, respectively ($\lambda = D_t/T$ for Model A and $\lambda = DT_t/T$ for Model C, where T is the sample size). LM-Stat is the Lagrange Multiplier unit root test, reported by Schmidt and Phillips (1992). ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively

2.6.2 Linear Taylor Rule Results

The linear estimation results are reported in Table 2.4. We use the GMM estimator with an optimal weighting matrix, which takes into account possible serial correlation (Hansen, 1982). Following Clarida, Gali and Gertler (1998) and Taylor and Davdarakis (2006), a constant and the sixth, the ninth and the twelfth lags of each variable in the regression models, i.e. the interest rate, inflation gap, output gap and real effective exchange rate, are the chosen instruments. If their number and that of the orthogonality conditions exceed the number of estimated parameters, the regression is over-identified. To investigate the validity of our instruments, we carry out Sargan tests, the null hypothesis being that the over-identifying restrictions are valid.

In the case of Indonesia, the GMM findings of the Taylor rule using monthly data over the period January 2001-November 2014 are displayed in column (1) in Table 2.4. The coefficient on the lagged interest rate ($\alpha_1 = 0.952$) is highly significant and close to one. This implies that the Indonesian monetary authorities adjust the interest rate with the smoothing parameter. There is evidence that they respond to deviations of inflation from target. The estimate of α_2 is significant and positive ($\alpha_2 = 0.058$). Further, they react to the output gap ($\alpha_3 = 0.026$) but not to the exchange rate. The Sargan test does not reject the null hypothesis, which confirms the exogeneity of the instruments.

For Israel the estimated period is from June 1997-Feb 2015 and the findings are reported in column (2) in Table 2.4. There is strong evidence that the central bank responds to inflation ($\alpha_2 = 0.036$) with a high level of interest rate smoothing ($\alpha_1 = 0.981$). The nominal interest rate is increased by 0.036 in response to an increase in inflation rate above target. In addition, the estimated coefficient on the output gap ($\alpha_3 = 0.012$) is significant at the 10% level whilst that on the exchange rate ($\alpha_3 = 0.258$) is insignificant.

Despite the fact that the Sargan test confirms the validity of the instruments, we do not find any evidence of a linear Taylor rule in South Korea using monthly data over the period January 1998-March 2015. The estimated coefficients on the inflation gap ($\alpha_2 = -0.004$) and on the output gap ($\alpha_2 = -0.002$) are negative, small, and insignificant. Similarly, there is no evidence of any response to exchange rate movements. However, the coefficient on the lagged interest rate is highly significant ($\alpha_1 = 1.003$).

Next, we estimate the linear Taylor rule for Thailand using monthly data over the period May 2000-September 2015. The Sargan test, reported in column 4 of Table 2.4, confirms again the validity of the instruments, demonstrating the exogeneity of the instruments. One interesting result is that the coefficient on the lagged interest rate is highly significant and close to unity ($\alpha_1 = 0.985$). Moreover, the effect of the inflation gap ($\alpha_2 = 0.026$) is also significant, implying that the Thai central bank adjusts the nominal interest rate when inflation deviates from its target. We also find significant evidence of the monetary authority response to output gap as the coefficient on the output gap is significant as well but negative ($\alpha_3 = -0.015$).

In Turkey the coefficient on the inflation gap is significant and the highest of all five countries ($\alpha_2 = 0.082$), whilst the coefficient on the output gap, $\alpha_3 = 0.001$, is insignificant (see column 5 of Table 2.4). Therefore, the findings suggest that the policymakers in Turkey place weight on controlling inflation rather than the deviation in the output gap. In contrast to the other countries examined, the Central Bank of the Republic of Turkey also appears to react to the exchange rate ($\alpha_4 = 0.483$). This shows the important role of the exchange rate movement in setting the interest rate in Turkey compared to the other countries in the sample. Further, the null hypothesis of the validity of the over-identifying restrictions cannot be rejected, all parameters have the expected sign, and there is a high degree of interest rate smoothing ($\alpha_1 = 0.977$).

Overall, our findings support the existence of a Taylor rule in Indonesia, Israel, Thailand and Turkey, but not in South Korea, where the coefficients on both the output and inflation gap are found to be statistically insignificant. Further, the coefficient on the exchange rate is insignificant in all countries, except Turkey. Next we examine whether there is any evidence of nonlinearities.

Table 2.4. Estimation of Linear Taylor Rule.

$$r_t = \alpha_0 + \alpha_1 r_{t-1} + \alpha_2 \sum_{k=1}^{3}(E_{t-1}\pi_{t+k} - \pi^t) + \alpha_3 \sum_{k=1}^{3}(E_{t-1}y_{t+k}) + \alpha_4 \sum_{k=1}^{3}(E_{t-1}rer_{t+k}) + \varepsilon_t.$$

	Indonesia (1)	Israel (2)	South Korea (3)	Thailand (4)	Turkey (5)
α_0	-0.914	0.131	0.148	0.344	-2.289***
	(0.792)	(0.729)	(0.240)	(0.354)	(0.922)
α_1	0.952***	0.981***	1.003***	0.985***	0.977***
	(0.006)	(0.004)	(0.004)	(0.006)	(0.002)
α_2	0.058***	0.036***	-0.004	0.026***	0.082***
	(0.004)	(0.006)	(0.004)	(0.004)	(0.006)
α_3	0.026***	0.012*	-0.002	-0.015***	0.001
	(0.006)	(0.007)	(0.002)	(0.002)	(0.003)
α_4	0.258	-0.022	-0.032	-0.070	0.483***
	(0.171)	(0.160)	(0.052)	(0.078)	(0.203)
Sargan Test	50.351	53.184	52.386	56.569	41.589
Prob	[0.236]	[0.161]	[0.181]	[0.096]	[0.575]

Note: Standard errors of the parameters are presented in parentheses. The probability of the Sargan test statistics are given in brackets. ***, ** and * indicate significance of the parameters at the 1%, 5%, and 10% levels respectively. The set of instrument includes a constant and the sixth, the ninth and the twelfth lags of each variable in the regression models. The horizons of the real effective exchange rate, output and inflation gap are, respectively, the 3-month lead average of the real exchange rate, inflation, and output gap (Svensson, 1997; Martin and Milas, 2013; Ahmad, 2016).

2.6.3 Threshold Taylor Rule Results

As emphasised in the recent literature, there are various reasons why the reaction function of monetary authorities might not be linear: for instance, if the weights on positive and negative output and inflation gaps respectively are not the same, the behaviour of the central bank might be better described a nonlinear Taylor rule. (see, e.g., Robert-Nobay and Peel, 2003; Dolado et al., 2005; Taylor and Davradakis, 2006; Surico, 2007; Castro, 2011; Martin and Milas, 2004; 2013; Caglayan et al., 2016, among others). As already mentioned, we use GMM to estimate the threshold model given by Eq. (2.5) because this method takes into account the possible correlation between the regressors, it is ideally suited to modelling the possibly asymmetric behaviour of central banks since it treats regime switches as endogenous, and it allows to estimate the optimal threshold value of inflation for each country – this is chosen as the threshold indicator since monetary policy typically places more weight on inflation (Castro, 2011; Martin and Milas, 2013). The optimum threshold values obtained from the grid search based on the minimisation of the condition given by Eq. (2.7) are reported in Table 2.5. Turkey has the highest value, ($\pi^* = 8\%$), followed by Indonesia ($\pi^* = 6\%$). Israel and South Korea have the same (lower) value ($\pi^* = 3\%$), while Thailand has the lowest one ($\pi^* = 1\%$). The likelihood ratio tests based on the null hypothesis H_0: $\beta_1^L = \beta_1^H,\ \beta_2^L = \beta_2^H,\ \beta_3^L = \beta_3^H,\ \beta_4^L = \beta_4^H$ confirm the existence of threshold effects in all countries. More specifically, Regime 1 is the high inflation regime where the inflation rate exceeds its optimum threshold value $\pi_{t-1} \geq \pi^*$, whilst regime 2 is the low inflation regime, where $\pi_{t-k} < \pi^*$ (see Fig. 2.5 for the regime classifications). Table A2.2 in the Appendix A2 gives details of the identified regimes for each country.

The estimation results for the nonlinear Taylor rule are also reported in Table 2.5. We use a constant and the sixth, ninth and twelfth lags of each variable (the interest rate, the inflation gap, the output gap and the real effective exchange rate) as the instruments (Clarida et al., 1998; Taylor and Davdarakis, 2006). However, an important issue in applying GMM estimator is the validity of the instruments. As such, we test the validity of our instruments using the Sargan (1958) test. A rejection of the null hypothesis of orthogonal to errors may suggest that the instruments do not confirm the orthogonality restriction, thus the findings are not reliable. The result of Sargan's (1958) test, reported in Table 2.5, confirms their validity in all cases.

In the case of Indonesia the interest rate smoothing coefficient is close to unity in both regimes (see column (1) of Table 2.5). Monetary authorities react to the inflation gap ($\beta_2^H = 0.050$) and output gap ($\beta_3^H = 0.053$) when the inflation rate exceeds its target level, but not in the low inflation regime. This is in line with the evidence presented by Miles and Schreyer (2012), who find a response to the output gap in the higher quantiles (0.6 and 0.8), but not in the lower ones (0.2 and 0.4). Further, the estimated coefficient on the real effective exchange rate ($\beta_4^L = 2.063$) implies that the central bank reacts to its fluctuations only in the low inflation regime. These findings are in line with the argument by Mariano and Villanueva (2006), who explain that the central bank of

Indonesia is closely monitoring the movement in the exchange rate. They add that tighter monetary policy is employed if the depreciation in the exchange rate is caused by changing in portfolios, while expansionary policy is implemented if this depreciation is a result of a trade shock.

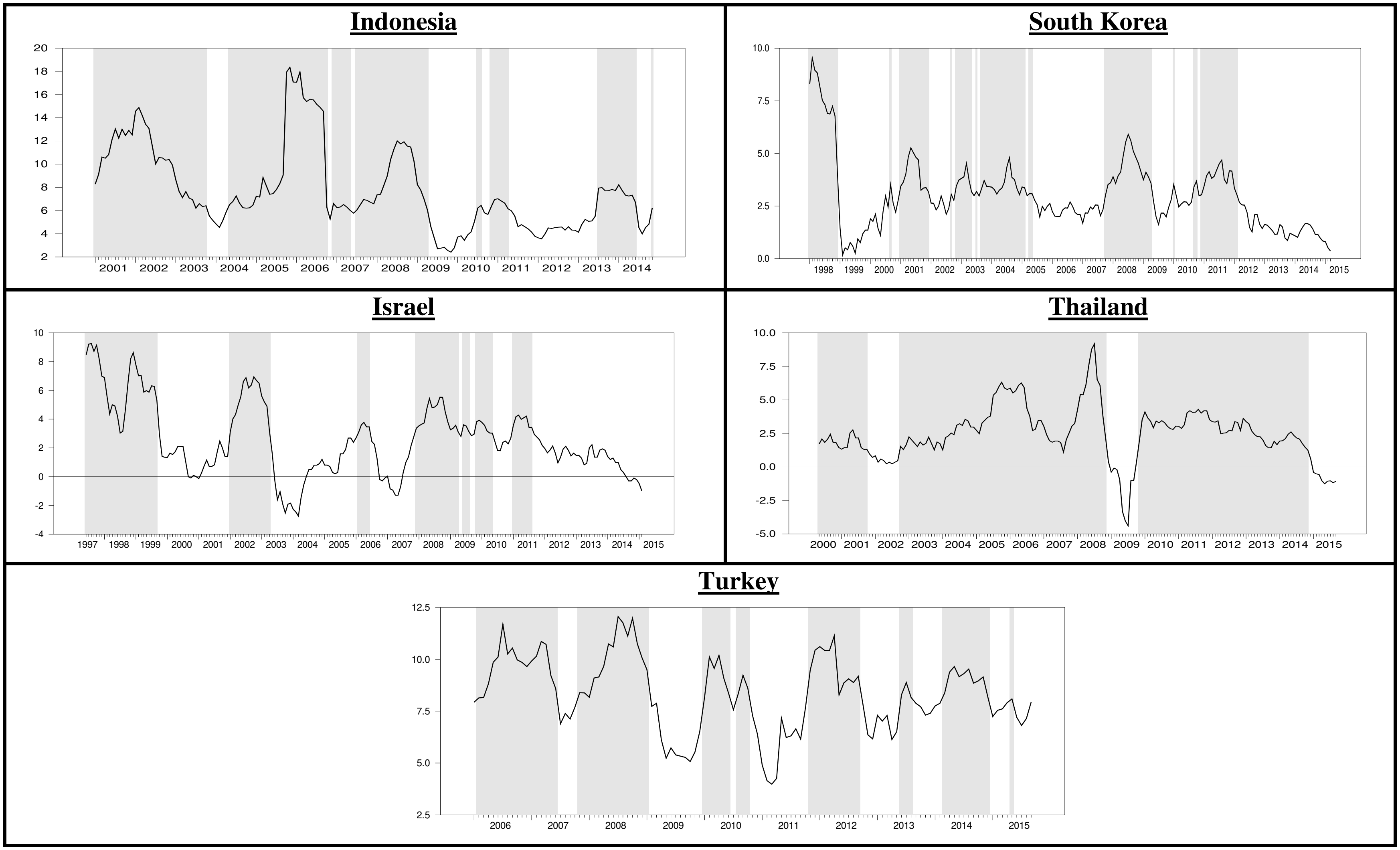
In Israel, the coefficients on the lagged interest rate, inflation and output gap are positive and highly significant in the high inflation regime; by contrast, in the low inflation one the coefficient on the exchange rate ($\beta_4^L = -0.756$) is significant and negative, while that on the output gap becomes insignificant (see column (2) of Table 2.5). Therefore, the behaviour of the monetary authority in Israel can be described better by nonlinear Taylor rule. This behaviour could be explained by either the asymmetry in the bank of Israel's preferences regarding the weight assigned to deviations of output gap and inflation from the target or nonlinearity in the macroeconomic structure of the economy (Dolado et al., 2005; Taylor and Davradakis, 2006).

In South Korea, the findings of the threshold Taylor rule for South Korea, reported in column (3) of Table 2.5, indicate a clear evidence of different responses by the central bank across the two regimes. The monetary authorities appear to follow an augmented nonlinear Taylor rule only in the low inflation regime, where the coefficients on the lagged interest rate, the inflation gap, the output gap and the real effective exchange rate are all statistically significant with the expected positive sign (see column (3) of Table 2.5). By contrast, they only respond to deviations of inflation from target in the high inflation regime, the interest rate smoothing coefficient being ($\beta_1^H = 0.984$).

In particular, the findings of Thailand, presented in column (4) of Table 2.5, suggest that the lowest interest rate smoothing coefficient of all countries considered in the low inflation regime ($\beta_1^L = 0.575$), which is generally found to be close to unity. The estimated response to the real effective exchange rate is significant and stronger than in other countries such as Israel and South Korea in the low inflation regime ($\beta_4^L = 1.467$). The reason is that the pass through into local prices through the import channel depreciation in the exchange rate may force central banks to tighten their monetary policy, and the appreciation might lead to loss of international competition (Goldberg and Campa 2010; Ghosh et al., 2016). Further, the central bank only responds to the output gap (with a negative coefficient) in the high inflation regime, and the response to the inflation gap is found to be significant in both low and high regimes in Thailand. A nonlinear rule is likely to have been the key to achieving price stability as well as sustainable economic growth since the adopting of inflation targeting in 2000 in this country. Similarly, Miles and Schreyer (2012) find that the central bank in Thailand responds aggressively to the deviation of inflation from the target using quantile regression analysis with four different quantiles.

Finally, the reaction of monetary policy in the countries in our sample to both inflation and output gaps differs between the high and low inflation regimes. As such, this could be attributed to the asymmetry in the monetary policy's preferences regarding the weight assigned to deviations of output gap and inflation from the target. Further, the difference responses in both the high and low inflation regimes might be due to nonlinearity in the macroeconomic structure of the economy (Dolado et al., 2005; Taylor and Davradakis, 2006). These cross country differences can be explained by the different characteristics of such countries in terms of their economic performance, the degree of financial liberalisation, and vulnerability to external shocks and the extent to what they are influenced by their major trading partners' business and financial conditions.

Figure 2.5. Regime Classifications.



Note: the upper regime, the shaded areas, represents the high inflation regime where inflation rate exceeds its optimum threshold value $\pi_{t-1} \geq \pi^{*}$. These optimum threshold values are respectively, $\pi_{t-1} \geq 6\%$, $\pi_{t-1} \geq 3\%$, $\pi_{t-1} \geq 3\%$, $\pi_{t-1} \geq 1\%$, and $\pi_{t-1} \geq 8\%$ for Indonesia, South Korea, Israel, Thailand, and Turkey which are obtained from the grid search based on the minimization condition in Eq. (2.7).

Table 2.5. Estimation of Nonlinear Threshold Taylor Rule.

$$r_t = I[\pi_{t-1} \geq \pi^*]\left[\beta_0^H + \beta_1^H r_{t-1} + \beta_2^H \sum_{k=1}^{3}(E_{t-1}\pi_{t+k} - \pi^t) + \beta_3^H \sum_{k=1}^{3}(E_{t-1}y_{t+k}) + \beta_4^H \sum_{k=1}^{3}(E_{t-1}rer_{t+k})\right] + I[\pi_{t-1} < \pi^*]\left[\beta_0^L + \beta_1^L r_{t-1} + \beta_2^L \sum_{k=1}^{3}(E_{t-1}\pi_{t+k} - \pi^t) + \beta_3^L \sum_{k=1}^{3}(E_{t-1}y_{t+k}) + \beta_4^L \sum_{k=1}^{3}(E_{t-1}rer_{t+k})\right] + \varepsilon_t,$$

	Indonesia (1)	Israel (2)	South Korea (3)	Thailand (4)	Turkey (5)
π^*	0.06	0.03	0.03	0.01	0.08
Panel A: Regime 1-High Inflation					
β_0^H	0.872	-8.574	-1.761	1.027	2.031
	(1.637)	(7.028)	(1.283)	(0.786)	(1.377)
β_1^H	0.979***	0.998***	0.984***	0.982***	0.992***
	(0.005)	(0.012)	(0.017)	(0.008)	(0.005)
β_2^H	0.050***	0.056***	0.070***	0.0604***	-0.006
	(0.006)	(0.017)	(0.028)	(0.011)	(0.021)
β_3^H	0.053***	0.041***	0.006	-0.021***	-0.002
	(0.011)	(0.014)	(0.005)	(0.002)	(0.003)
β_4^H	-0.186	1.837	0.377	-0.232	-0.431
	(0.367)	(1.537)	(0.278)	(0.173)	(0.295)
Panel B: Regime 2-Low Inflation					
β_0^L	-8.759***	3.596***	-0.886***	-5.554	4.414
	(4.084)	(2.068)	(0.402)	(3.539)	(3.041)
β_1^L	0.891***	0.981***	0.927***	0.575***	0.994***
	(0.053)	(0.009)	(0.010)	(0.204)	(0.005)
β_2^L	-0.021	0.120***	0.041***	0.138***	0.057***
	(0.023)	(0.027)	(0.008)	(0.073)	(0.011)
β_3^L	-0.014	0.009	0.016***	0.015	0.046***
	(0.016)	(0.011)	(0.004)	(0.014)	(0.008)
β_4^L	2.063***	-0.756***	0.248***	1.467***	-1.012
	(0.851)	(0.451)	(0.248)	(0.842)	(0.677)
Sargan Test	37.743	33.202	42.889	33.379	31.681
Prob	[0.527]	[0.731]	[0.181]	[0.723]	[0.791]
LR linearity test	61.741	204.333	270.238	54.865	26.920
Chi(6)	0.000	0.000	0.000	0.000	0.000

Note: Standard errors of the parameters are presented in parentheses. The probability of the Sargan and LR linearity tests are given in brackets. ***, ** and * shows significance of the parameters at 1%, 5%, and 10% respectively. π^* represents to the optimal threshold value for inflation. Regime 1 (High inflation regime) is where inflation rate exceeds its optimum threshold value $\pi_{t-1} \geq \pi^*$while, regime 2 (Low inflation regime) is where inflation rate is below its optimum threshold value $\pi_{t-1} \leq \pi^*$. The set of instrument includes a constant and the sixth, the ninth and the twelfth lags of each variable in the regression models. The horizons of the real effective exchange rate, output and inflation gap are, respectively, the 3-month lead average of the real exchange rate, inflation, and output gap (Svensson, 1997; Martin and Milas, 2013; Ahmad, 2016).

Finally, in the case of Turkey, the threshold regression findings generally suggest that the validity of the Taylor rule depends on the inflation regimes prevailing in the economies. For instance, only the coefficient on the lagged interest rate is significant in the high inflation regime, whilst those on the output and inflation gaps are also statistically significant and positive in the low inflation regime. The parameter of the exchange rate is found to be insignificant, hence the results indicate asymmetry in the reaction of the central bank to inflation, output gaps and the exchange rate among both the low and high regime.

The inclusion of the real effective exchange rate in our interest rate Taylor rule shows remarkable outcomes: the linear regression does capture the impact of the movement in this variable on setting the interest rate in all countries in our sample, except for Turkey. However, the threshold Taylor models, displayed in Table 2.5, indicate that the policymakers react to the exchange rate in four countries only in the low inflation regime, except for Turkey. This means that the monetary policy in these emerging countries can be described by augmented nonlinear Taylor rule including the exchange rate.

To sum up, our findings from the nonlinear regressions provide evidence that the behaviour of the policymakers in EMEs can be characterised by a threshold Taylor rule. One possible explanation of the observed more weight on the exchange rate in the low regime is that there is a tendency of policymakers to pursue other objectives when the inflation rate undershoots the target (Akdoğan, 2015).

2.7 Conclusion

This chapter has examined the interest rate setting behaviour of monetary authorities in five emerging countries (Indonesia, Israel, South Korea, Thailand, and Turkey) that have adopted inflation targeting. In addition to the basic linear Taylor rule, an augmented one including the exchange rate has also been considered. As such, the fluctuations in the exchange rate could have a great effect of pass through of the exchange rate into the local price through the import channel (Goldberg and Campa 2010). On the depreciation side, it may force central banks, targeting price stability, to tighten their monetary policy, while it might lead to loss of international competition with the appreciation side (Gagnon and Ihrig, 2004; Baily, 2003; Bailliu and Fujii; 2004; Ghosh et al., 2016). Several recent empirical studies have provided evidence of nonlinearities and threshold effects in the reaction of monetary authorities to inflation and output gaps (see Favero et al., 2000, Taylor and Davradakis, 2006; Surico, 2007; Cukierman and Muscatelli, 2008; Castro, 2011;

Martin and Milas, 2004, 2013; Ahmad, 2016, among others). Further, a nonlinear specification has been estimated using GMM to allow for possible asymmetries.

The empirical findings can be summarised as follows. First, monetary authorities in these economies respond not only to deviations of inflation and output from target but also to movements in the real exchange rate (but only when inflation is below target, except for Turkey). Second, a nonlinear Taylor rule best describes their behaviour in Indonesia and Thailand, but not in South Korea, whilst the evidence is mixed in the case of Turkey and Israel. In particular, monetary authorities in all countries in our sample respond to deviations of inflation from target in the upper (high inflation) regime, except for Turkey; in Indonesia they do not react to inflation falling below target in the lower regime; in South Korea and Turkey they respond to deviations of GDP from its long-run level in the lower regime when inflation is below target. Future research could expand the model by including a financial index to examine the effects of the recent 2007-8 financial crisis on the conduct of monetary policy in the emerging economies.

Appendix A2

Table A2.1. Definitions of the Variables and Sources.

		Interest rate	Inflation rate	Inflation expectations	Exchange rate	Production
Indonesia (2001:01-2014:11)	**Definition**	Discount rate (end of period)	CPI	Inflation target	Real effective exchange rate (2010=100)	Production in total manufacturing index (2010=100)
	Conversion	Level	The 3-month leading average of the inflation rate (calculated as percentage changes from the CPI)	Level	The 3-month leading average of the log real effective exchange rate	3-month lead average of the output gap.
	Data Source	IMF	FRED	Bank Indonesia	FRED	FRED
Israel (1997:06-2015:02)	**Definition**	Discount rate (end of period)	CPI	Inflation target	Real effective exchange rate (2010=100)	Industrial production index
	Conversion	Level	The 3-month leading average of the inflation rate (calculated as percentage changes from the CPI)	Level	The 3-month leading average of the log real effective exchange rate	3-month lead average of the output gap.
	Data Source	IMF	FRED	Bank of Israel	FRED	IMF
South Korea (1998:01-2015:03)	**Definition**	Discount rate (end of period)	CPI	Inflation target	Real effective exchange rate (2010=100)	Industrial production index
	Conversion	Level	The 3-month leading average of the inflation rate (calculated as percentage changes from the CPI)	Level	The 3-month leading average of the log real effective exchange rate	3-month lead average of the output gap.
	Data Source	IMF	FRED	Bank of Korea	FRED	IMF
Thailand (2000:05-2015:09)	**Definition**	Discount rate (end of period)	CPI	Inflation target	Real effective exchange rate (2010=100)	Industrial production index
	Conversion	Level	The 3-month leading average of the inflation rate (calculated as percentage changes from the CPI)	Level	The 3-month leading average of the log real effective exchange rate	3-month lead average of the output gap.
	Data Source	IMF	IMF	Bank of Thailand	FRED	IMF
Turkey (2006:01-2015:09)	**Definition**	Discount rate (end of period)	CPI	Inflation target	Real effective exchange rate (2010=100)	Industrial production index
	Conversion	Level	The 3-month leading average of the inflation rate (calculated as percentage changes from the CPI)	Level	The 3-month leading average of the log real effective exchange rate	3-month lead average of the output gap.
	Data Source	IMF	IMF	CBRT	FRED	IMF

Note: FRED is the Federal Reserve Economic Data and CBRT is the Central Bank of the Republic of Turkey.

Table A2.2. Regime Classifications.

	Regime 1: High inflation	Regime 2: Low inflation
	2001:01-2003:08	2003:09-2004:02
	2004:03-2007:03	2007:04
Indonesia	2007:05-2009:01	2009:02-2010:05
(2001:01-2014:11)	2010:06	2010:07-2010:08
	2010:09-2011:02	2011:03-2013:03
	2013:04-2014:04	2014:05-2014:08
	1997:01-1999:08	1999:09-2001:11
	2001:12-2003:02	2003:03-2005:11
Israel	2005:12-2006:04	2006:05-2007:09
(1997:06-2015:02)	2007:10-2009:06	2009:7
	2009:08-2010:02	2010:03-2010:10
	2010:11-2011:07	2011:08-2014:11
	1998:01-1998:10	1998:11-2000:10
	2000:11-2001:10	2001:11-2002:07
South Korea	2002:08-2005:02	2005:03-2007:08
(1998:01-2015:03)	2007:09-2009:02	2009:03-2009:10
	2009:11	2009:12-2010:06
	2010:07-2011:12	2012:01-2014:12
Thailand	2000:05-2001:08	2001:09-2002:07
(2000:05-2015:09)	2002-08-2008:09	2008:10-2009:08
	2009:09-2014:09	2014:10-2015:06
	2006:01-2007:04	2007:05-2007:08
	2007:09-2008:12	2009:01-2009:10
Turkey	2009:11-2010:08	2010:09-2011:08
(2006:01-2015:09)	2011:09-2012:07	2012:08-2013:04
	2013:05-2013:06	2013:07-2013:11
	2013:12-2014:10	2014:11-2015:06

Note: Regime 1 is the high inflation regime where the inflation rate exceeds its optimum threshold value $\pi_{t-1} \geq \pi^*$, whilst regime 2 is the low inflation regime, where $\pi_{t-k} < \pi^*$.

CHAPTER THREE

BANK LENDING CHANNEL, ISLAMIC VS CONVENTIONAL CREDIT, EMPIRICAL EVIDENCE FROM MALAYSIA

3.1 Introduction

The transmission mechanism of monetary policy has been analysed extensively in numerous studies focusing on countries with conventional banking systems (e.g., Brunner and Meltzer, 1988; Bernanke and Gertler, 1995; Peersman and Smets, 2001; Kassim et al., 2009, Çatık and Martin, 2012; Ahmad and Pentecost, 2012; Fungácová et al., 2014; Aiyar et al., 2016). By contrast, there is very little evidence concerning economies with a dual (Islamic and conventional) banking system, where this mechanism might be rather different given the distinctive features of Islamic finance, such as the prohibition to charge a predetermined interest rate and the granting of credit only to productive projects (Iqbal, 2001; Chong and Liu, 2009): financing speculative activities is restricted since these are thought to cause an increase in the price level without contributing to the real economy, social justice and economic efficiency, which Islamic finance should promote according to Sharia law[2] (Gulzar and Masih, 2015; Kammer et al., 2015; Caporale and Helmi, 2016). For instance, Khan and Mirakhor (1989) concluded that monetary policy shocks have less effect on Islamic banks because the profit and loss sharing (PLS) paradigm allows them to share risk with the depositors. Kassim et al. (2009) reported instead that credit is more sensitive to interest rate movements in the case of Islamic banks, which might make them more unstable. Sukmana and Kassim (2010) estimated a VAR model to analyse the role of Islamic banks in the transmission

[2] Sharia law is based on the Quran, the hadith and Islamic jurisprudence developed by many Muslim scholars.

mechanism of monetary policy in the case of Malaysia, whilst Ergeç and Arslan (2013) examined the case of Turkey.

Islamic banks have grown very rapidly in recent years both in size and in number, with more than 700 Islamic financial institutions operating in 85 countries across the Middle East, Asia, Europe and the US with approximately \$2.2 trillion Sharia-compliant assets in 2015 (expected to reach \$3 trillion in 2018)[3]. Of particular interest is the case of Malaysia, which has a dual (Islamic and conventional) banking system and one of the largest Islamic banking sectors in the world, accounting for around 16.7% of the Islamic finance global market in 2014 (Ernst and Young, 2014). It has had well-established Islamic financial institutions for over 30 years, with the share of Islamic finance growing from 0.073% in 1994 to 26.207% in 2015Q2 at a compounded annual growth rate of 38.3% compared to 7.9% for conventional banks. Islamic banks are expected to grow at a yearly rate of 18% for the next five years (see Table A3.1 in the Appendix A3), with the Malaysian authorities planning to increase their market share to 40% of total financing by 2020 and aiming to make the country an international hub for Islamic finance (BNM, 2012).

This chapter analyses the transmission mechanism of monetary policy in Malaysia using a nonlinear framework, in contrast to most of existing empirical studies, that have employed instead linear econometric techniques (see, e.g., Kassim et al., 2009; Sukmana and Kassim, 2010; Ergeç and Arslan, 2013; Gulzar and Masih, 2015). The adopted econometric framework is a two-regime threshold VAR (TVAR) model, with the output gap being used as the threshold variable, since monetary policy is designed differently during economic expansion (growth) and contraction (recession) phases. This model has several interesting features that make it particularly suitable for analysing the impact of monetary policy on bank lending behaviour. First, it allows for potential nonlinearities in the responses to monetary policy shocks, which is crucial since the impact of the latter may depend upon the macroeconomic conditions. Second, since the threshold variable is treated as an endogenous variable, regime switches resulting from structural shocks can also be captured (Atanasova, 2003; Balke, 2000): the impulse response functions in a TVAR model depend on the size and sign of shocks as well as the state of the economy.

This chapter contributes to the existing literature on Islamic finance as follows. As previous studies used only VAR approach, this chapter takes a step further by

[3] For more details, see Chong and Liu (2009), Abedifar et al. (2013), and Ernst and Young (2016).

employing the Threshold VAR model (TVAR) which allows for parameter switching across the different phases of the business cycle (specifically in Malaysia). Second, we test the role of both Islamic and conventional credit in bank lending channel in dual banking system in Malaysia. In particular, the principles of Islamic finance are significantly different from those of traditional finance in terms of charging predetermined interest rate as well as the allocation of credit in the economy. Therefore, this study is one of the few empirical studies that contribute to the on-going debate about Islamic finance. As such, in dual banking systems, policy recommendations and implications would be very important to policymakers. Our results show that the bank lending channel is indeed state-dependent in Malaysia. More specifically, Islamic credit is found to be less responsive than conventional credit to interest rate shocks in both high and low growth regimes. By contrast, the relative importance of Islamic credit shocks in driving output growth is much greater in the low growth regime, their effects being positive.

This chapter proceeds as follows: Section 3.2 presents a briefly review of monetary policy transmission channels, Islamic finance and more specifically Islamic banks vs. conventional banks in the bank lending channel. Section 3.3 discusses the data, while Section 3.4 outlines the methodology used in our empirical estimation. The empirical results and the corresponding discussions are captured in Section 3.5. Finally, Section 3.6 offers some concluding remarks and policy proposals.

3.2 Literature Review

3.2.1 Monetary Policy Transmission Channels

It is essential for policymakers to examine how the effects of monetary policy shocks are transmitted into the real economy. These shocks have been examined traditionally through the movements in real interest rates. For instance, a contractionary policy leads to an increase in real interest rates, which causes a decline in the level of investment spending, and thereby dampens the growth in total demand and GDP. Monetary policymakers also affect the value of equities (e.g. stocks and real estate) through an increase in interest rate movements resulting in a decline in both consumption and investment expenditures. Further, with an open economy, where currency is considered as an asset, the exchange rate is used as a monetary policy channel to influence net exports, which have huge effects on the local prices and economic growth (Igan et al., 2013).

While the traditional monetary policy channels are the main focus of most macroeconomic models, the results of the empirical studies supporting these channels are still mixed (see Bernanke and Gertler, 1995). As such, some studies (Mishkin, 1995 and Igan et al., 2013) argued that the effects on the real economy is not only related to assets price, interest rate and cost of capital but also can be explained based on frictions in financial intermediation. Therefore, credit should be considered as an important channel for policy transmission. Following, we describe the monetary policy transmission channels. In addition we discuss the essential role of bank lending channel in Malaysia, which funds most of its economic activities through loans from both Islamic and conventional banks.

3.2.1.1 The Interest Rate Channel

This channel represents the traditional Keynesian theory, which assumes that a reduction in the money supply pushes real cost of borrowing up. This increase is likely to have effect on firms and households. Specifically, firms respond to the increase by cutting their spending, including cost of inputs and wage bill, which can lead to a reduction in aggregate demand in the economy (Mishkin, 1995). Further, the effects on the household are in two folds. On the one hand, the cutting down of wage bill by firm may lead to a reduction in household income level. On the other hand, the increase in the cost of borrowing also reduces household expenditure on durable goods and services. Because cost of capital is long-lived, the households and businesses' investment decisions consider the long vision in responses to changes in interest rates. With the fact that the policy rate is a short-term rate, the interest rate channel involves the relationship between the long and short-term interest rates through expectation theory of the term structure (Boivin et al., 2010). Therefore, this channel rather focuses on the real long-term interest rate, which has the main impact on investment decisions, than the nominal or real short-term interest rate.

This channel has been extensively examined by Taylor (1995), Smets and Wouters (2003), Angeloni et al. (2003), who find a strong evidence supporting the important role of interest rate channel in influencing GDP and inflation. Conversely, other studies (see Bernanke and Gertler, 1995, Iacoviello and Minetti, 2008; Boivin et al., 2010, Ibarra, 2016, among others) claims that empirical studies failed to identify the effect of interest rate through the cost of capital which shows controversial effects on the long-run investment and the short-run responsiveness is relatively small. For instant, the long-run elasticities of households spending on housing range from -0.2 to -1.0 in the USA (see Reifschneider et al., 1999; McCarthy and Richard, 2002). In addition, Mishkin (1995) highlights that the interest rates channel may not be able to explain all the fluctuations in output, especially in a small open economy. Therefore, some researcher (see, Krainer, 2014; Hollander and Liu, 2016 among others) question the primacy of the interest rate channel and focus on other channels such as assets price channels (exchange rate and equity price channels) and credit channel, explained in the rest of this section.

3.2.1.2 The Exchange Rate Channel[4]

Given the increasing trend of integration of economies with floating exchange rates, the channel of the latter has received more attention among various stakeholders, including governments, policymakers, and researchers. For instance, when the monetary authorities reduce interest rates, the return on domestic deposits becomes less attractive as compared to foreign deposits and assets (Boivin et al., 2010). This leads to depreciation in the value of the domestic currency making the prices of domestic goods and services much cheaper as compared to those produced in other countries. The decrease in the prices is likely to spur growth in net exports, aggregate demand and economic development (Mishkin, 1995). Some empirical studies (e.g. Bryant et al., 1993 and Smets, 1995; Obstfeld and Rogoff, 1995) confirm the importance of exchange rate channel in open and small economies with floating exchange rate regimes.

However, monetary economists argue whether in the current medium-term positioning of monetary policy or under a fixed exchange rate regime in some countries, the exchange rate channel is still significant for monetary policy. For instant, some empirical studies found little evidence of the role of the exchange rate channel in the monetary transmission mechanism in Hong Kong, GCC countries and Denmark (see, Espinoza and Prasad, 2012; Cevik and Teksoz 2013).

[4] For more information, see Mishkin (1995, 1996, and 2001).

3.2.1.3 Equity Price Channels

The classical Keynesian theory was criticized by monetarists for considering only two relative rates: Interest and exchange rates. Therefore, Meltzer (1995) argue that policymakers should consider the broad effects of assets prices and real wealth in the monetary transmission mechanism. As such, these effects can be examined within the paradigm of Tobin's (1969) theory and wealth effect on consumption (De Bonis and Silvestrini, 2012; Luo and Young, 2016).

First, Tobin's q theory defines q as the ratio of the market value of a company to its replacement cost of capital. If q is high, the replacement cost of capital is low relative to the stock market value of the company, and the cost of expanding the business will be comparatively cheaper than the market value of the firm. The expansion plan can be achieved by issuing new shares with high price that is likely to increase the firm's investment spending, aggregate demand and output level. In other words, a decrease in interest rates normally cause share prices to increase. As consequence, capital markets are likely to experience more investments in shares, which are likely to cause a growth in economic output (Tobin, 1969).

Second, the monetary decisions normally influence the wealth effect on consumption that partly derives equity prices. In their seminal article, Ando and Modigliani (1963) argued that consumer spending depends on the long-term resources of consumers such as financial wealth (e.g. stocks and housing). For instance, a contractionary monetary policy, usually decreases the price of stocks, could reduce the following: households' financial wealth, consumption, aggregate demand, employment and GDP. The wealth effect concept has been examined in detail by various papers, including Catte et al. (2004), Boivin et al. (2010), and Domanski et al. (2016).

However, Mishkin (2001, p.16) argues targeting assets prices by using appropriate monetary tools might lead to less accurate economic outcomes. This is due to likely weak linkage between prices and monetary policy. For example, the author stated that, "most fluctuations in stock prices occur for reasons unrelated to monetary policy, either reflecting real fundamentals or animal spirits". Hence, Mishkin (2001) proposed that other transition channels of monetary policy should be considered.

3.2.1.4 The Credit Channel

The gap in the above traditional channels (see section 3.2.1.1 – 3.2.1.3) initiated a strand of literature that examines whether frictions and imperfect information in credit market could help identifying the influence of monetary policy on the real economy (Bernanke and Gertler, 1995). For instance, the money view theory is criticized on the basis that the standard IS-LM model does consider the credit market (e.g. banks credit) in its analysis of the monetary transmission mechanism (Brunner and Meltzer, 1988). As a result, the credit channel explains how the changes in interest rates are transmitted directly to the real economy through changes in the so called external finance premium, which compares between costs of internal and external fund (securities). Bernanke and Gertler (1995) argue that the external finance premium could explain the effects of monetary policy better than the movement in interest rates. Further, this channel indicates heterogeneity among borrowers, showing that a group of investors are subject to changes in credit conditions more than others (Walsh, 2003). The credit channel is classified into balance sheet and bank lending channels, as described in the following subsection.

3.2.1.4.1 The Balance Sheet Channel

This channel, called broad credit[5], examines the effect of monetary policy shocks on loan demand through the financial position of borrowers, which have an impact on the external finance premium and on the general terms of credit. If agency costs cause an arbitrage opportunity between external and internal fund, net worth, net cash flow and collateral value, spending by firms would be impacted in ways that is not considered by interest rate channel (Bernanke and Gertler, 1995). According to Bernanke, Gertler, and Gilchrist (1999), three empirical conclusions can be drawn based on the balance sheet channel: (1) internal funds is much cheaper than external funds for borrowers; (2) an increase in net worth of borrowers decreases the cost of external funds; (3) a fall in net worth constraints firms access to funds, thus, causing a decline in investment spending, aggregate demand and output.

For instance, a strong financial position means that borrowers are in a better standing to offer more collateral and secure more fund from banks. Therefore, the investment decisions by borrowers are linked to any changes in the value of their

5 For more detailed discussion about balance sheet channel, see Bernanke and Gertler (1995) and Igan et al. (2013) among others.

balance sheets items. Intuitively, a positive interest rate shock has both direct and indirect effects on borrowers' financial position (Bernanke and Blinder, 1988). The direct effects weaken the net cash flow of the borrowers and damage their collateral value, while the indirect effects are characterised by a decline in the revenue of firms with either a varying or fixed short run cost (Oliner and Rudebusch, 1996). Both the direct and the indirect effects reduce the creditworthiness of firms and limit their ability to borrow from banks, thereby, causing a reduction in output (Bernanke and Gertler, 1995).

However, there is heterogeneity, raised from agency cost, among small and large firms in response to a monetary shock. Small firms are more subject to agency problem than those large ones, so "the linkage between internal sources of funds and investment spending should be particularly strong for small firms after a monetary contraction" (Walsh, 2003 p. 318). Identifying such differences between borrowers requires disaggregate data, which is not the focus of this chapter, on the characteristics of borrowers.

3.2.1.4.2 The Bank Lending Channel

The bank lending channel (also called narrow credit) investigates how the effects of changes in monetary policy rates are transmitted to the economy through supply of credit facilities by banks. For instance, medium and small-sized firms funds their activities mainly through banks, while large corporations have access to bank credit, as well as nonbanking sources of credit through the financial markets (see Gertler and Gilchrist, 1994; Kashyap and Stein, 1995; Igan et al., 2013, Apergis and Christou, 2015 among others).

If the supply of banks credit to the private sectors is weakened, the external finance premium would increase, thereby causing a decline in output. For instant, contractionary monetary policy, draining bank reserves and deposits, will decrease the supply of loanable funds. This decreases households and firms spending, thereby leading to a reduction in real economic activities (Mishkin, 2001).

Further, medium and small-sized companies are more affected by monetary policy actions than large companies with easy access to other financial securities, such as bonds and equities. For instance, when there is an increase in interest rates, large companies are more likely to raise capital from the financial markets; while the medium and small-sized companies would still have to heavily depend on bank loans to finance their operational activities (see Walsh, 2003 and Boivin et al., 2010). Although this channel is very important across all economies, it is expected to play a much significant role in transmitting the monetary policy shocks to the real economy of developing countries and emerging markets (Mishkin, 2004). These economies are either bank-based or have less developed financial markets, which are less liquid as compared to those of the developed countries.

The discussion above highlights the role of the conventional banks in the transmission mechanism of the monetary policy, especially in the developing and emerging economies. Recently, the growing role of Islamic finance in some countries, as discussed earlier, has drawn the attention of researchers and economists to investigate the participation of Islamic banks in the economy.

Table 3.1. Market Share and Number of Islamic Banks in Selected Countries.

	Market Share of Islamic Bank		% changes	No of Banks	Total assets
Country	2007	2012			
Indonesia	0.62%	4.6%	3.98%	10	97-5608
Turkey	2.96%	5.6%	2.64%	5	1189-13062
Iran	100%	100%	0.00%	16	3939-67454
Singapore	0.21%	0.06%	-0.15%	1	366
Jordan	6.20%	13%	6.8%	3	494-4622
Tunisia	1.51%	2.2%	0.69%	3	760
Malaysia	7.26%	21.35%	14.09%	18	187-38110

Sources: BankScope, Central Banks of different countries, and Ernst and Young (2014). The total assets, in millions, are in ranges.

Table 3.1 presents the share and the number of Islamic banks in selected countries over a period of six years. It is evident that the shares of Islamic banks are different across the sample, where this share varies from 100% in Iran to less than 1% in Singapore. However, there is a notable increase in the market share of Islamic banks in Malaysia from 7.26% in 2007 to 21.35% in 2012 and it doubled in Jordan from 6.20% in 2007 to 13% in 2012. In addition, the number of Islamic banks, operating in western countries, is also increasing, for instance, there are 22 and 10 Islamic banks in the UK and the USA, respectively (see Table A3.2 in the appendix A3).

Considering the consistent growth in Islamic finance in many Islamic and non-Islamic countries, it is important to investigate how a monetary policy is transmitted through the banking channel in the setting of a dual banking system

(Islamic and conventional banking) as in Malaysia, which is the main focus of this chapter.

Theoretically, although Islamic banks play the same role as the conventional ones as financial intermediates, Islamic banks are different in terms of charging interest rates. For, example, Islamic banks are not allowed to charge pre-determined interest rate on loans or offer a fixed rate on deposits. That is, they operate according to the Sharia principles. In the following section, we discuss the difference between the Islamic and conventional banks, as well as the reaction of the Islamic banks to the monetary policy shock in a dual banking system.

In the context of Malaysia, although the empirical studies examining the bank lending channel in Malaysia are limited, a number of authors confirm the significant role of this channel in Malaysia. This includes that of Tang (2002), Ibrahim (2005), Kassim and Majid (2009), Zulkhibri (2013). Further, like other emerging markets, Malaysia has generally emerging financial market and dominated by banks credit, which represents 70% of the total finance in Malaysia (Mukherjee and Bhattacharya, 2011; BNM, 2015). Malaysia has a dual banking system (Islamic and conventional banks) where Islamic banks credit accounts for 26.01% of total banks financing in 2015Q2 with compounded annual growth rate of 38.3% compared to 7.9% for conventional banks (see Table A3.1 in the appendix A3). Further, the PLS paradigm might increase the access to finance for medium and small -sized enterprises[6], which are classified as the main borrowers of Islamic banks in Malaysia and elsewhere (Iqbal and Mirakhor, 2013). Moreover, Islamic banks provide credit to households and private sectors not normally dealing with banks for religious reasons, which results in higher financial inclusion (see Baele et al., 2014, Imam and Kpodar, 2015; Mili et al., 2015). For these reasons, the bank lending channel, examining both Islamic and conventional banks, is expected to have relatively significant role in the transmission compare to other monetary policy channels in Malaysia.

3.2.2 Islamic Finance

Although Islamic banks share some features with conventional financial intermediaries, they differ from the latter in that they operate on the basis of the

[6] For more detailed discussion, see Iqbal and Mirakhor, (2013) who argue that market imperfections and informational asymmetries hamper the access to finance by SMEs but Islamic finance, structured on the principles of risk sharing, might increase their access to fund.

Sharia principles outlined in the Quran, the hadith[7] and Islamic jurisprudence, with the ex-post PLS rate replacing the predetermined rate of commercial banks (Iqbal, 2001; Chong and Liu, 2009). The prohibition of the conventional ex-ante interest rate is seen as instrumental to improving both social justice and economic efficiency (El-Gamal, 2006; Berg and Kim, 2014). That is, Islamic banking is a case of ethical finance and hence it has economic implications for systemic stability and the distribution of credit risk, since the productivity of the project, rather than the creditworthiness of borrowers (as in the case of conventional banks) is the main factor determining the allocation of credit (see Zaheer et al., 2013, Di Mauro et al., 2013).

Another important feature of Islamic banks is that they are not allowed to engage in any speculative transactions such as derivatives, toxic assets and gambling, which are not compliant with Sharia principles (Beck et al., 2013). It is reckoned that financing such activities is responsible for many financial crises and normally causes an increase in the price level rather than contributing to real activities in the economy (Di Mauro et al., 2013). Speculative investments make conventional banks "risk transferring" while Islamic banks are "risk sharing" (see Hasan and Dridi, 2010). By contrast, Islamic banks only provide credit to finance productive investment rather than speculative activities (Gulzar and Masih, 2015; Kammer et al., 2015). Each financial transaction is underpinned by an existing or potential real asset, whilst conventional banks can provide credit without such constraints (see Siddiqi, 1999, 2006 and Askari, 2012). In addition, Islamic banks cannot generate profit based on pure financing so they must engage, for instance, in investment or sale transactions and share both the return and the risk of the contract (Baele et al., 2014).

3.2.3 Islamic Finance Contracts

Islamic financial contracts are designed according to the PLS principle. For instance, Musharaka (partnership) is based on the idea of equity participation. [8] Under this contract, each participant pays for a percentage of the capital in the company. The profits or losses generated from the business are then shared between the owners on the basis of an agreed profits and losses share called the PLS ratio

[7] Hadith represents the actions and sayings of the prophet Mohammad, which are one of the main sources of Islamic guidance in many aspects of Muslim life including economic activities.
[8] For a detailed discussion, see Kettell (2010) and Baele et al. (2014).

(Ariff, 1988). In the case of Mudharabah (profit-sharing), one party (Islamic bank) supplies all the required finances, while the other party (customer/entrepreneur) contributes the labour and management skills. Therefore, the bank is considered as a shareholder and any profit from the business is shared between the entrepreneur and the bank according to a pre-determined criterion (rather than as a percentage of the investment). The Islamic bank takes any losses, while the entrepreneur loses his/her reward on provision of labour (Haron et al., 1994 and Kettell, 2010). A third type of contract is known as Murabahah (cost plus): it is essentially the sale of a particular product, with the two parties agreeing on the price, the cost and the profit margin of the item. More specifically, Islamic banks purchase the product on the behalf of the customer and resell it to him/her at a marked-up price (Ariff, 1988; Haron et al., 1994; Shaban, et al., 2016). Finally, Ijarah (leasing) involves the transfer of usufruct at an agreed rent (rather than the ownership of the asset) to customers (Baele et al., 2014). The client approaches the bank to rent, for example, machinery, vehicles, or any other equipment and makes a promise to lease that equipment. The Islamic bank buys the machinery or any other equipment and leases it to its customers for an agreed rent. If the customer requires the bank to buy the equipment as well, the rent and a periodic instalment will be paid as a part of the purchase (Zaher and Hassan, 2001).

3.2.4 Islamic vs. Conventional Banks in the Bank Lending Channel

There are large empirical studies of monetary transmission for countries with conventional banks (e.g. Brunner and Meltzer, 1988; Bernanke and Gertler, 1995; Peersman and Smets, 2001; Kassim and Majid, 2009, Çatık and Martin, 2012; Ahmad and Pentecost, 2012; Fungácová et al., 2014; Aiyar et al., 2016), while only a few studies have examined monetary policy transmission mechanism in countries with both conventional and Islamic banks, and considered Islamic financial instruments, financial stability, liquidity and risk management in such economies (see, e.g., Kassim et al., 2009; Sukmana and Kassim, 2010; Cevik and Charap, 2011; Ergeç and Arslan, 2013; Gulzar and Masih, 2015).

Cihák and Hesse (2010) used cross-country data to assess whether Islamic banks play a positive role in the financial stability of the banking system. They compared small-size Islamic and conventional banks and found that, on average, the former are more stable than the latter. However, this is not the case for larger banks:

as the size of Islamic banks increases, their financial stability decreases since credit risk management becomes more difficult in the presence of limited and risky investment opportunities.

Çevik and Charap (2011) examined the causal relationship between the conventional deposit rates and Islamic PLS rates in Malaysia and Turkey. They found that these two variables exhibit cointegration, with the former Granger-causing the latter but not vice versa. Chong and Liu (2009) also reported that the PLS rates mimic the movement of conventional ones in Malaysia. Kassim and Manap (2008) carried out causality tests using the Toda-Yamamoto method to analyse the information content of the Islamic interbank money market rate (IIMMR) and the conventional interbank money market rate (CIMMR) in Malaysia; they concluded that the information in the former can explain movements in total bank loans and the real exchange rate and suggested that this rate should be adopted as a monetary policy instrument by the Malaysian authorities.

Sukmana and Kassim (2010) used a VAR framework and found significant evidence that Islamic banks in Malaysia contribute to the transmission of monetary policy shocks to the real economy through the banking channel. More recently, Ergeç and Arslan (2013) showed in the context of a vector error correction model (VECM) that movements in the overnight interest rate have asymmetric effects on Islamic and conventional banks in Turkey: for instance, a positive interest rate shock leads to an increase (decrease) in the level of deposits in conventional (Islamic) banks.

Kassim et al. (2009) estimated a vector autoregression (VAR) model and found that loans and deposits are more responsive to interest rate changes in the case of Islamic as opposed to commercial banks in Malaysia, which makes the former less stable financially (see also Rosly, 1999). By contrast, Khan and Mirakhor (1989) argued that Islamic banks are less affected by monetary shocks (and therefore are more stable) than conventional banks, the reason being that profit and loss sharing allows Islamic banks to transfer part of the risk to the depositors (Hassan, 2006; Said, 2012, Ghassan et al., 2013; Shaban, et al., 2016).

The impact of credit facilities on economic activity has been previously investigated with the TVAR model by numerous studies. For instance, Atasanova (2003) estimated a TVAR model for the UK and finds the evidence of asymmetry in the effects of monetary policy in the credit constrained and unconstrained regimes.

The results further suggest that the impact of credits on output differs across monetary contractions and expansions. He concluded that interest rate channel is only valid for the post-inflation targeting period. Çatık and Martin (2012) extended the work of Çatık and Karaçuka (2012) by using a TVAR model to analyse different monetary transmission mechanisms; however, they did not consider the possible role of Islamic finance. They found that the response to macroeconomic shocks has become different in Turkey compared to other market economies following the introduction of inflation targeting.

None of the studies mentioned above examines the monetary transmission mechanism in countries with a dual banking system (including both Islamic and conventional banks) allowing for possible nonlinearities. Further, the special characteristics of Islamic finance and its increasing market share in Malaysia and elsewhere have motivated us to examine its impact on the real economy through the monetary transmission mechanism. Given these features, Islamic finance and the unique dual banking systems in Malaysia, one would expect a different response to a monetary policy shock by both Islamic and conventional banks. To the best of our knowledge, no study has examined the transmission of the monetary policy through Islamic and conventional banks using the TVAR model, which allows for parameter switching across the different phases of the business cycle (upper and lower regimes). The present chapter aims to fill this gap in the literature.

3.3 Data Description

To investigate the bank lending channel of monetary policy in the dual banking system of Malaysia, we collected monthly data for Islamic credit and conventional credit from the National Bank of Malaysia. In addition, data on the money supply (M2), the consumer price index (CPI), the industrial production index (IPI), and the overnight policy rate (I) were retrieved from the IMF's International Financial Statistics (IFS). The resulting sample includes 258 monthly observations over the period 1994:01-2015:06.

A wide range of descriptive statistics is reported in Table 3.2. The means of monthly total, conventional, and Islamic credit changes are all positive. The highest is that of Islamic credit changes, which highlights its sharp growth relative to conventional credit over the sample period. All other means are also positive, except that of policy rate changes, which is negative and small. Islamic credit changes are more volatile than both total and conventional credit changes, and both interest rate changes and industrial production growth are more volatile than inflation and money growth. Most variables exhibit skewness (positive in all cases, with the exception of policy rate changes) and excess kurtosis. The Jarque-Bera (JB) test statistics imply a rejection at the 5% level of the null hypothesis of normality.

Table 3.2. Summary of Descriptive Statistics for the Endogenous Variables.

Statistics	$\Delta ltcre_t$	$\Delta lccre_t$	$\Delta licre_t$	Δint_t	$\Delta lcpi_t$	$\Delta lipi_t$	$\Delta lm2_t$
Maximum	0.059	0.058	0.692	4.260	0.038	0.096	0.055
Minimum	-0.019	-0.020	-0.024	-5.180	-0.011	-0.076	-0.019
Mean	0.008	0.006	0.034	-0.001	0.002	0.004	0.009
St.Deviation	0.008	0.009	0.069	0.590	0.003	0.026	0.010
Skewness	0.964	0.994	5.584	-1.581	3.205	0.203	0.556
Ex. kurtosis	7.322	7.145	42.658	40.598	32.75	3.722	4.503
JB	238.95^{***}	225.567^{***}	18107.1^{***}	15185.5^{***}	9923.7^{***}	7.357^{**}	37.30^{***}
Observations	256	256	256	256	256	256	256

Notes: $\Delta ltcre_t$, $\Delta lccre_t$, $\Delta licre_t$, Δint_t, $\Delta lcpi_t$, $\Delta lipi_t$, and $\Delta lm2_t$ denote respectively total credit changes, conventional credit changes, Islamic credit changes, policy rate changes, price level changes (inflation), industrial production growth, and money supply growth. JB is the Jarque-Bera test for normality. ***, and ** indicate statistical significance at the 1% and 5% levels, respectively.

3.4 Methodology

The VAR approach is the most frequently used in the literature investigating the monetary transmission mechanism. Its advantage is that it does not require imposing possibly arbitrary exclusion restrictions, an issue even more relevant in the case of emerging countries whose economic structure is less well known (Mishra and Montiel, 2012). Further, it estimates the dynamic response of the system to a shock without debatable identification restrictions (Sims, 1980). Following Bernanke and Blinder (1992), linear VAR models are often estimated.

However, since monetary policy is designed differently during economic expansion (growth) and contraction (recession) phases, a nonlinear specification is more appropriate. Therefore, we investigate the bank lending channel in Malaysia by estimating a TVAR model, which is an extension of the linear VAR model in which the economy has two regimes and switches between them depending on the optimum value of the threshold variable. A two-regime TVAR model is specified as follows (Atanasova, 2003; Balke, 2000):

$$Y_t = I[c_{t-d} \geq \gamma]\left(A_0^1 + \sum_{i=1}^{p} B_t^1 Y_{t-i} + \sum_{i=1}^{q} C_t^1 X_{t-i}\right) + I[c_{t-d} < \gamma]\left(A_0^2 + \sum_{i=1}^{p} B_t^2 Y_{t-i} + \sum_{i=1}^{q} C_t^2 X_{t-i}\right) + \varepsilon_t. \tag{3.1}$$

where Y_t and X_t stand for the vectors of endogenous and exogenous variables respectively, A_0 is the vector of intercept terms, B_t and C_t are parameter matrices, p and q are the lag orders of the endogenous and exogenous variables, and ε_t is the vector of innovations with a variance covariance matrix of $E(\varepsilon_t\varepsilon_t') = \sum$. Given that we use three alternative measures for credit (in logs), namely total credit $(ltcre_t)$, Islamic credit $(licre_t)$, and commercial or conventional credit $(lccre_t)$, three different vectors of endogenous variables are used as follows:

Model 1: $Y_{1,t}' = [\Delta lm2_t, \Delta int_t, \Delta ltcre_t, \Delta lcpi_t, \Delta lipi_t]$, (3.2)

Model 2: $Y_{2,t}' = [\Delta lm2_t, \Delta int_t, \Delta lccre_t, \Delta lcpi_t, \Delta lipi_t]$, (3.3)

Model 3: $Y_{3,t}' = [\Delta lm2_t, \Delta int_t, \Delta licre_t, \Delta lcpi_t, \Delta lipi_t]$, (3.4)

where Δ is the first difference operator, int_t stands for the interbank rate, $lm2_t$ denotes the log of money supply M2, $lcpi_t$ is the log of the consumer price index. Since GDP data are not available on a monthly basis, the log of the industrial production index, denoted by $lipi_t$, is used as a proxy for economic activity.

In order to capture the possible effects of global developments on the conduct of monetary policy, the following exogenous variables are included when each of the above vectors of the endogenous variables are estimated (Peersman and Smets, 2001):

$X_t' = [\Delta lcompri_t, \Delta ffr_t, \Delta lipius_t, \Delta lner_t]$, (3.5) where $lcompri_t$ is the log of the world commodity price index [included to take into account the "price puzzle" as in Gorden and Leeper (1994)], ffr_t is the US federal funds rate, $lipius_t$ is the log of the US industrial production index, and, $lner_t$ is the log of the domestic nominal exchange rate vis-à-vis the US dollar.

Further, c is the threshold variable and γ is the optimum value of the threshold; $I[.]$ is the dummy indicator function that equals 1 when $c_{t-d} \geq \gamma$, and 0 otherwise. c_{t-d} is the threshold variable lagged by d periods. The threshold variable is often defined as the moving average of one of the endogenous variables in Y_t (see for example Balke, 2000; Calza and Sousa, 2006). In our case, it is the twenty-four month moving average of the IPI growth rate, $magr_{t-d}$ (see Fig. 3.1).[9]

Eq. (3.1) indicates that the economy is in regime 1 when the threshold variable exceeds or is equal to the optimal threshold value $\geq \gamma$, otherwise it is in regime 2. If there is no significant difference between the estimated parameters $A_0^1 = A_0^2$, $B_i^1 = B_i^2$, $C_i^1 = C_i^2$, the threshold model reduces to a linear VAR one.

The regime switching parameters $(A_i^1, A_i^2, B_i^1, B_i^2, C_i^1, and\ C_i^2)$, the threshold value (γ) and the delay parameter (d) can all be estimated endogenously within this framework. First, the optimum number of lags of the endogenous and exogenous variables is determined on the basis of model selection criteria. Then, the existence of a threshold effect in a multivariate framework is tested using the $C(d)$ statistic introduced by Tsay (1998), which is a multivariate extension of Tsay's (1989) nonlinearity test. The procedure is the following: the variables are ordered according to increasing values of the threshold variable, $magr_t$, then the VAR model is estimated recursively starting from the first m_0 observations; finally, the test statistic is calculated by regressing the residuals on the explanatory variables, and testing for the joint significance of the latter. If the model is linear, the residuals should be uncorrelated with the explanatory variables; under the null of linearity $H_0 = A_0^1 = A_0^2$, $B_i^1 = B_i^2$, $C_i^1 = C_i^2$ the test statistic follows a chi-squared distribution with $k(pk + qv + 1)$ degrees of freedom, k and v being the number of variables in the vectors of endogenous and exogenous variables respectively, and p and q the corresponding lag orders.

[9] The Hodrick-Prescott filter of industrial production index is also used as an alternative threshold variable. C(d) test results yield very similar regime classifications. These results are reported in the appendix A3 (see Table A3.2 and Fig. A3.1).

After the determination of the delay parameter, the $C(d)$ statistic is computed over the trimmed interval of the threshold parameter, $(c_1\ and\ c_2)$ = [0.15, 0.85], to maximise the probability of identifying the two regimes. Then, this interval is partitioned into grids, and the model is estimated for each grid. The grid, including the minimum selection criteria value, is selected as the optimal threshold value of the transition variable, γ. The impulse response functions and forecast error decompositions obtained from this model are nonlinear since the parameters are allowed to evolve over regimes.

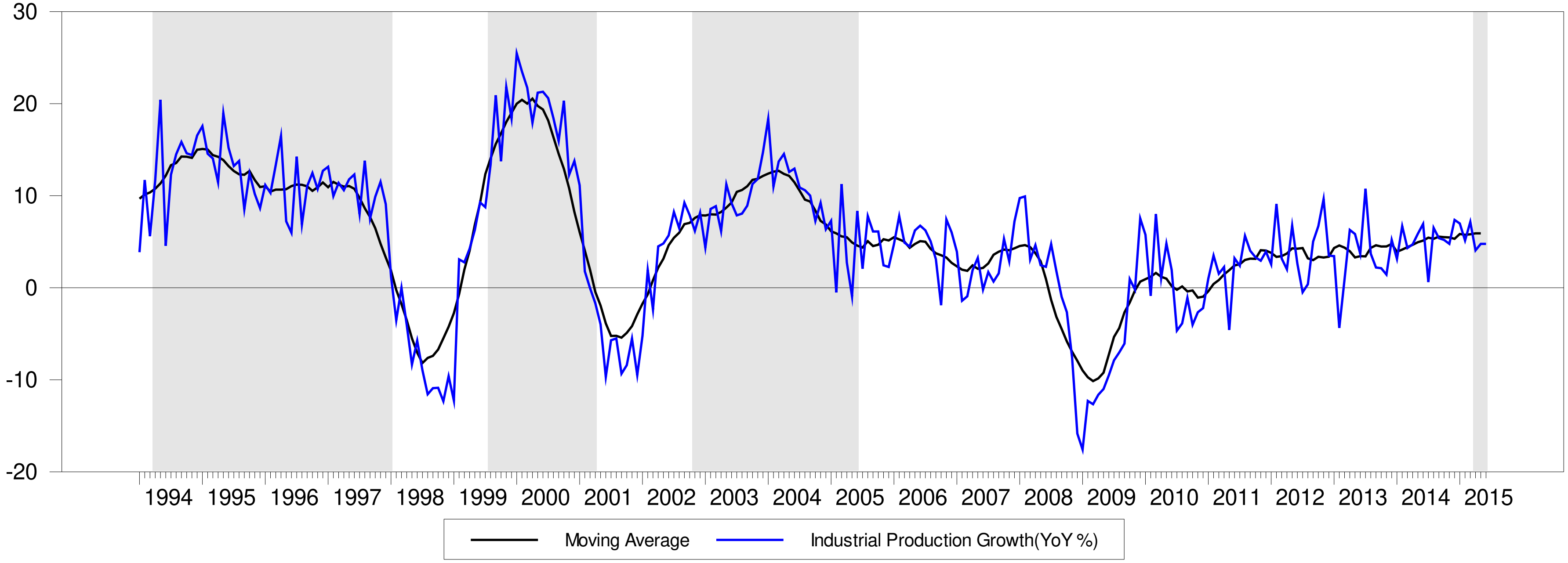
3.5 Empirical Results

3.5.1 Unit Root Test

In order to examine the time series properties of the variables under consideration, a battery of unit root tests were carried out using Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1981) and Phillips-Perron (PP) tests (Phillips-Perron, 1988). These conventional tests favor the first difference stationarity of the all variables (see Table 3.3).

However, it can be observed from Figs. (3.2-3.6) that structural breaks in the variables are likely to be present, for example, the endogenous variables are affected by the Asian crisis in 1997-98 (see Figs. 3.2-3.4) and the exogenous variables (the US variables) may suggest a structure break which should have affected by the recent financial crisis in 2007 (see Fig. 4.5). Therefore, we also performed the Lee and Strazicich (2003) unit root test allowing for two structural breaks to take into account the possible impact of the global and local crises on the degree of integration of the series. We choose this test as it is able to evaluate the stationarity of the time series up to m unknown structural breaks, which is the case of our sample. The results of the Lee and Strazicich (2003) test, reported in Table 3.4, confirm those of the ADF and PP tests and suggest that all variables can be treated as I(1), and therefore they are entered into the VAR/TVAR models in first differences. The break dates mainly correspond to the 1997-98 Asian financial crisis and the 2007-8 recent global financial crisis; in the case of the exogenous variables there appears to be an additional break coinciding with the 2001 dot-com bubble crisis in the US (see Table 3.4).

Figure 3.1. Regime Classifications.



Note: Upper regime where $\gamma \geq 5.561$, is represented by the shaded areas obtained from the TVAR, specification of model 1 including total credits.

Table 3.3. Unit Root Tests.

	ADF				PP			
Variable	Level		1st. Difference		Level		1st. Difference	
	Constant	Constant & Trend	Constant	Constant & Trend	Constant	Constant & Trend	Constant	Constant & Trend
int_t	-2.515	-3.098	-3.890***	-3.881**	-2.180	-2.875	-25.695***	-25.645***
lcl_t	-1.632	-3.202*	-3.867***	-4.140***	-2.344	-2.798	-7.762***	-7.722***
$lcpi_t$	-1.120	-3.007	-7.879***	-7.918***	-0.987	-2.861	-11.459***	-11.446***
ler_t	-2.301	-2.239	-12.332***	-12.309***	-1.754	-1.711	-12.332***	-12.309***
lil_t	-2.256	-3.607	-5.010***	-4.775***	-3.106**	-3.061**	-7.146***	-9.543***
lip_t	-2.428	-2.377	0.158***	-7.569***	-2.528	-2.341	-7.357***	-7.531***
$lm2_t$	-1.504	-1.700	-6.352***	-6.499***	-2.050	-1.403	-13.864***	-14.056***
ltl_t	-2.441	-2.961	-6.264***	-6.452***	-2.004	-2.643	-8.461***	-8.700***
ffr_t	-1.391	-2.868	-4.392***	-4.364***	-1.2192	-2.830	-7.275***	-7.289***
$lcompri_t$	-1.065	-2.113	-3.872***	-3.868**	-1.282	-1.767	-10.052***	-10.033***
$lipus_t$	-2.150	-2.707	-3.871***	-3.934**	-2.522	-2.250	-12.682***	-12.867***

Note: ***, **, * indicates significance at the 1%, 5% and 10% level respectively. Bandwiths in the PP unit root tests are determined by the Newey-West statistic using the Barlett-Kernel.

Table 3.4. Lee and Strazicich Unit Root Test with two Structural Breaks.

Variable	Model A (Crash Model)			Model C (Trend Shift Model)				
	Statistics	Breaks		Statistics	Breaks			
		D_{1t}	D_{2t}		D_{1t}	D_{2t}	DT_{1t}	DT_{2t}
int_t	-3.204	1998:01	2011:04	-5.846*	1997:06	2000:07	1997:06	2000:07
		(5.793)	(0.351)		(9.101)	(0.385)	(-5.971)	(5.699)
Δint_t	-11.748***	1998:4	2005:10	-10.927***	1996:10	1999:07	1996:10	1999:07
		(-0.537)	(0.251)		(1.064)	(0.033)	(-1.079)	(4.254)
$lccre_t$	-3.170	1998:12	2008:04	-2.780	1997:07	2003:03	1997:07	2003:03
		(1.047)	(0.201)		(2.921)	(-0.198)	(10.121)	(4.463)
$\Delta lccre_t$	-2.697	1999:11	2008:10	-6.155**	1997:04	2007:07	1997:04	2007:07
		(-1.872)	(-2.403)		(2.912)	(-2.313)	(-5.462)	(5.732)
$lcpi_t$	-1.865	2006:03	2008:10	-4.087	1999:11	2006:02	1999:11	2006:02
		(-1.736)	(-2.298)		(3.009)	(4.362)	(-4.586)	(3.202)
$\Delta lcpi_t$	-5.612***	1999:05	2009:02	-9.206***	2008:05	2010:05	2008:05	2010:05
		(-0.750)	(-0.607)		(13.381)	(-1.424)	(-9.327)	(9.364)
$lner_t$	-1.886	1998:08	2007:09	-5.222	1998:03	2010:06	1998:03	2010:06
		(-4.336)	(-1.201)		(-3.369)	(0.488)	(3.808)	(-3.736)
$\Delta lner_t$	-4.404**	1997:09	1998:01	-5.441*	1997:08	1998:10	1997:08	1998:10
		(-4.596)	(-7.314)		(-0.454)	(-3.041)	(-5.122)	(5.483)
$licre_t$	0.275	1997:04	1999:04	-2.918	1997:11	2002:05	1997:11	2002:05
		(4.538)	(1.627)		(1.230)	(0.390)	(-6.646)	(0.533)
$\Delta licre_t$	-5.510***	1998:02	2003:08	-7.787***	1997:04	1999:12	1997:04	1999:12
		(-1.850)	(-0.761)		(8.146)	(-1.216)	(-6.648)	(6.491)
lip_t	-1.454	2006:09	2008:09	-4.127	1998:03	2008:08	1998:03	2008:08
		(-0.209)	(-0.351)		(-1.593)	(-5.123)	(-2.413)	(-5.242)
Δlip_t	-5.375***	2002:06	2010:02	-6.502***	1997:12	2000:11	1997:12	2000:11
		(1.113)	(1.748)		(10.152)	(1.677)	(5.780)	(-6.384)
$lm2_t$	-2.684	1998:03	2003:11	-4.060	2000:12	2006:04	2000:12	2006:04
		(-1.377)	(-2.484)		(-0.117)	(-0.899)	(-3.819)	(2.845)
$\Delta lm2_t$	-5.166***	2002:12	2010:04	-8.004***	1997:11	2005:06	1997:11	2005:06
		(0.649)	(0.356)		(4.908)	(-5.428)	(-7.389)	(7.781)
$ltcre_t$	-3.200	1999:04	2008:06	-2.914	1998:10	2011:07	1998:10	2011:07
		(2.734)	(-0.668)		(0.975)	(0.351)	(-7.742)	(3.472)
$\Delta ltcre_t$	-6.542***	1998:01	2007:12	-12.843***	1997:11	2000:03	1997:11	2000:03
		(-3.201)	(-3.063)		(-0.358)	(0.388)	(-7.924)	(4.163)
ffr_t	-2.817	2001:04	2008:01	4.256	2002:06	2007:12	2002:06	2007:12
		(-2.494)	(-6.035)		(-0.005)	(0.206)	(-2.138)	(-5.352)
Δffr_t	-5.421***	1999:05	2007:04	-8.810***	2005:08	2008:09	2005:08	2008:09
		(-1.189)	(-0.800)		(-6.726)	(8.330)	(8.106)	(-8.267)
$lcompri_t$	-1.828	2010:04	2012:08	-4.268	2001:12	2010:04	2001:12	2010:04
		(-3.586)	(1.566)		(0.391)	(-4.137)	(1.188)	(-0.660)
$\Delta lcompri_t$	-4.621***	2002:08	2013:05	-6.855***	2006:04	2009:06	2006:04	2009:06
		(1.3770)	(-0.484)		(2.807)	(-2.213)	(-4.357)	(6.469)
$lipus_t$	-1.446	2005:08	2008:08	-4.428	1998:06	2008:08	1998:06	2008:08
		(-3.728)	(-7.293)		(-1.203)	(-6.661)	(-0.310)	(-3.206)
$\Delta lipus_t$	-5.509***	1999:05	2007:02	-8.568***	2005:08	2008:09	2005:08	2008:09
		(1.348)	(-0.681)		(-6.384)	(7.986)	(7.844)	(-8.017)

Notes: Δ is the first difference operator. $ltcre_t$, $lccre_t$, $licre_t$, int_t, $lcpi_t$, $lipi_t$, $lm2_t$, $lcompri_t$, ffr_t, $lipus_t$, and $lner_t$ denote respectively the log of total credit, the log of conventional credit, the log of Islamic credit, policy rate, the log of price level, the log of industrial production, the log of money supply, the log of the world commodity price index, the US federal funds rate, the log of the US industrial production index, and the log of the nominal exchange rate vis-à-vis the US dollar. The general to specific procedure is followed to find the optimum lag length, allowing for a maximum of 12 lags. The t-statistics are represented in parentheses (.). The critical values are obtained from Lee and Strazicich (2003). Model A allows for breaks in the intercept, whereas Model C allows for breaks in both the intercept and the trend. D_{1t} and D_{2t} refer to the first and second break dates, while DT_{1t} and DT_{2t} indicate the first and second break dates when allowing for the trend. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Figure 3.2. Conventional, Islamic, and Total Credit.

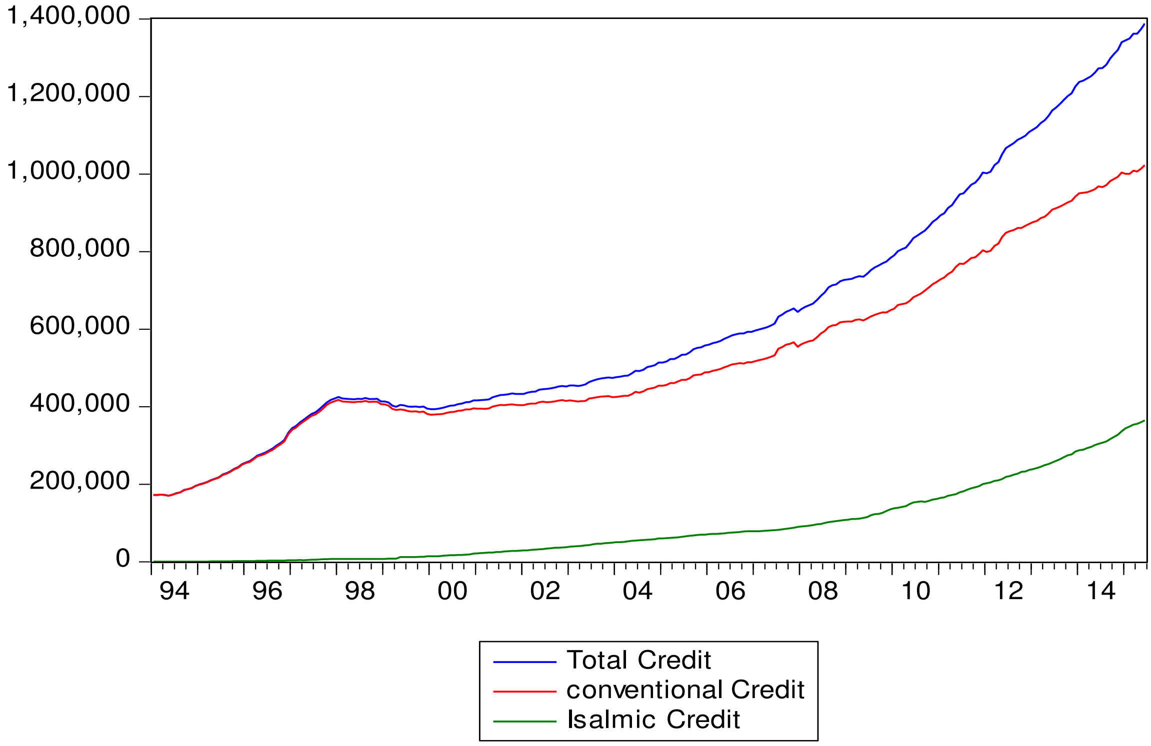


Figure 3.3. Consumer Price Index (CPI) and Industrial Production Index (IP).

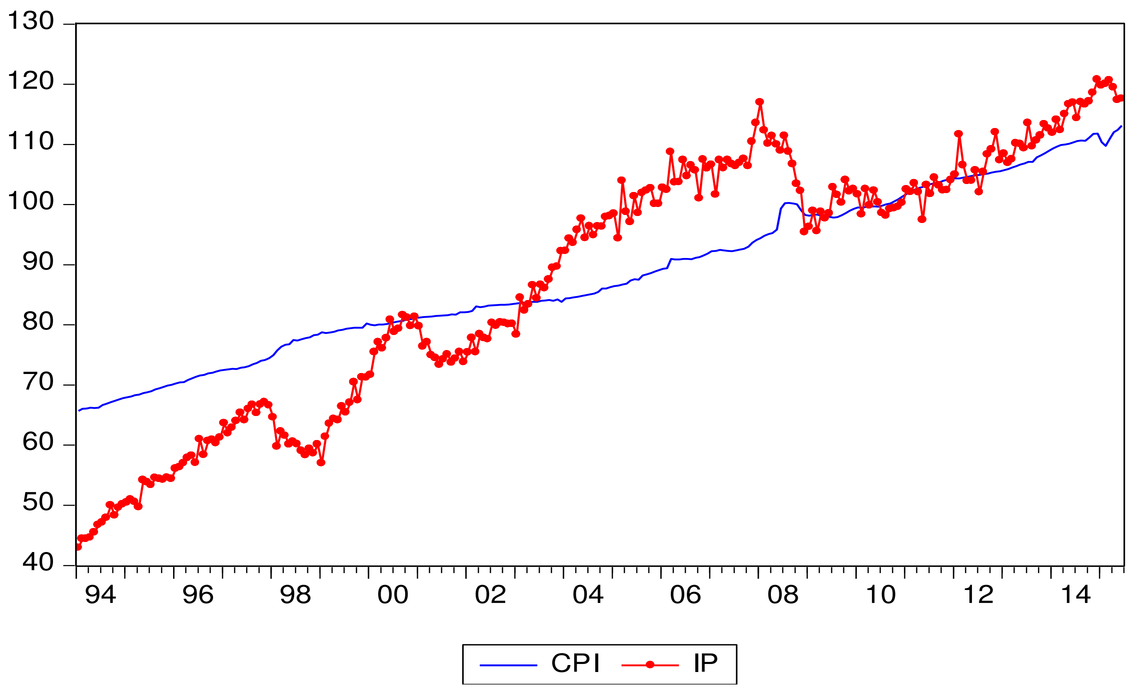


Figure 3.4. Money Supply M2.

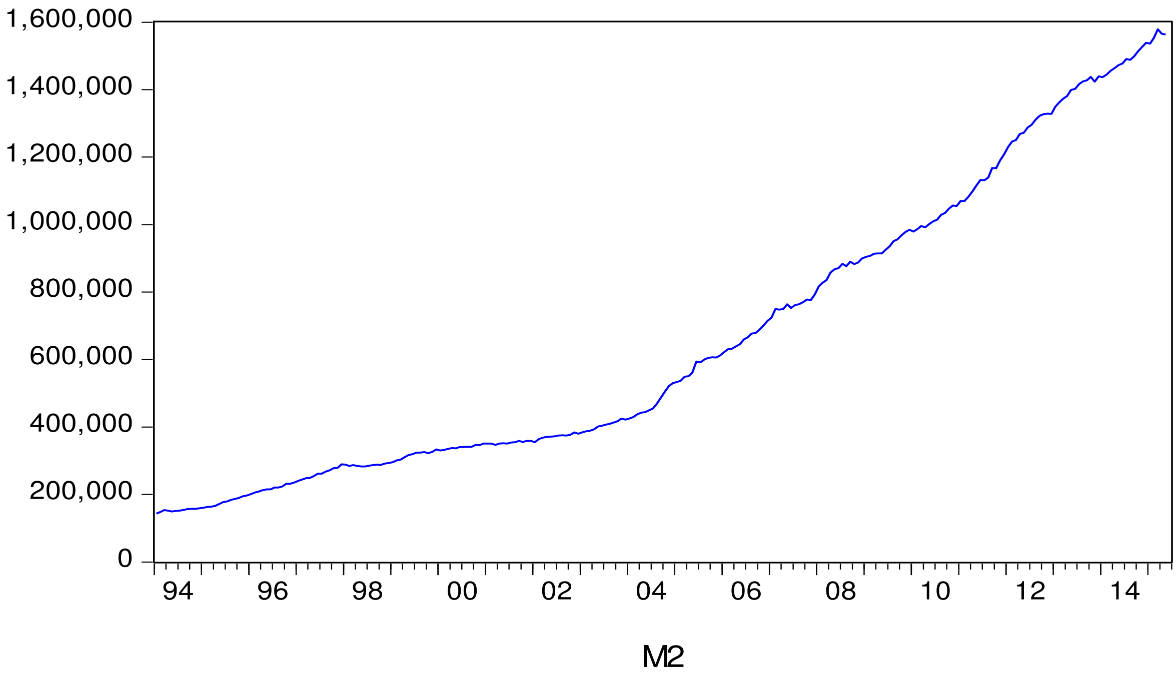


Figure 3.5. Industrial Production Index USA.

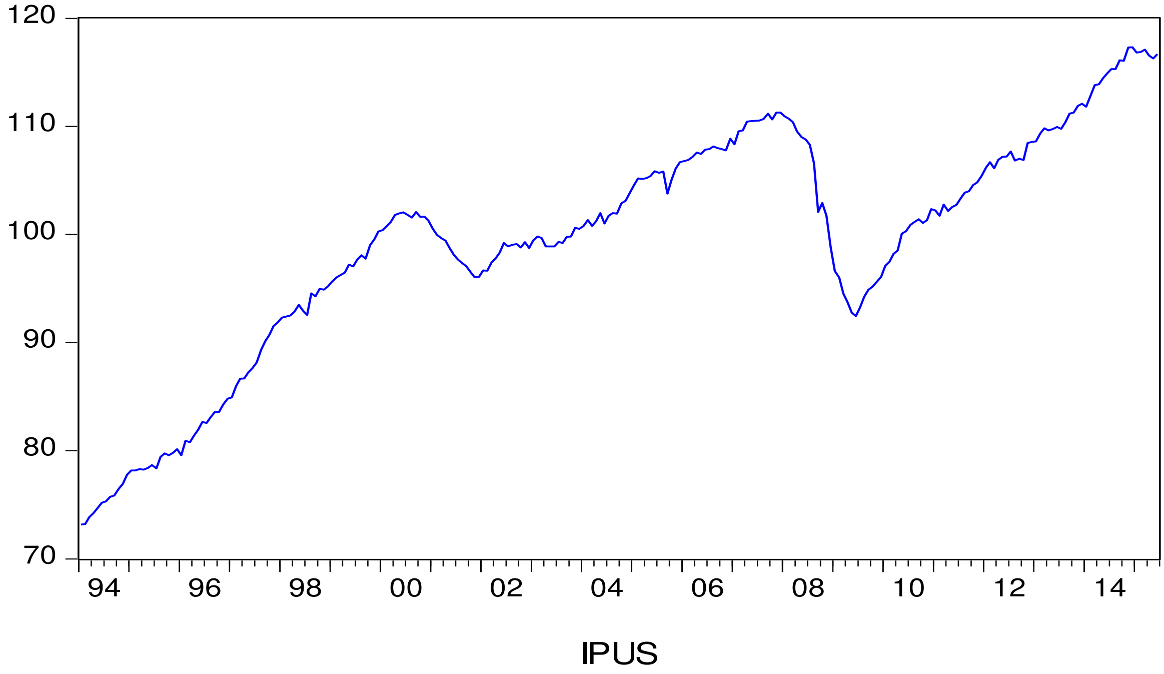


Fig. 3.6 displays the monetary policy (I) and the PLS rate over the period 1994Q1-2015:2. The graphical analysis shows that the two rates are moving together over time. Hence, the following trends emerge. First, the PLS rate was higher than the conventional interest rate prior to the Asian crisis in 1997 and after the crisis, 1999-2002, but consistently became lower until 2008. Second, one can observed that the PLS rate is more volatile than the conventional counterparty. Gan and Yu (2009) argue that the PLS rate can be used as a policy rate; therefore, we examine the possibility of using the PLS as a monetary policy indicator by conducting Granger-causality test. Both rates are stationary on the first difference or simply I(1), so we apply Granger-causality on the differenced data and the results are reported in Tables 3.5. The findings show a bidirectional causality between the two rates, thus, there seems to be no need to estimate two separate VAR/TVAR models with different interest rate measures. Therefore, only the overnight rate is included in our model as the policy rate for the above reasons.

Figure 3.6. The Policy Rate (I) & 3-Month Islamic Deposit Rate (PLS).

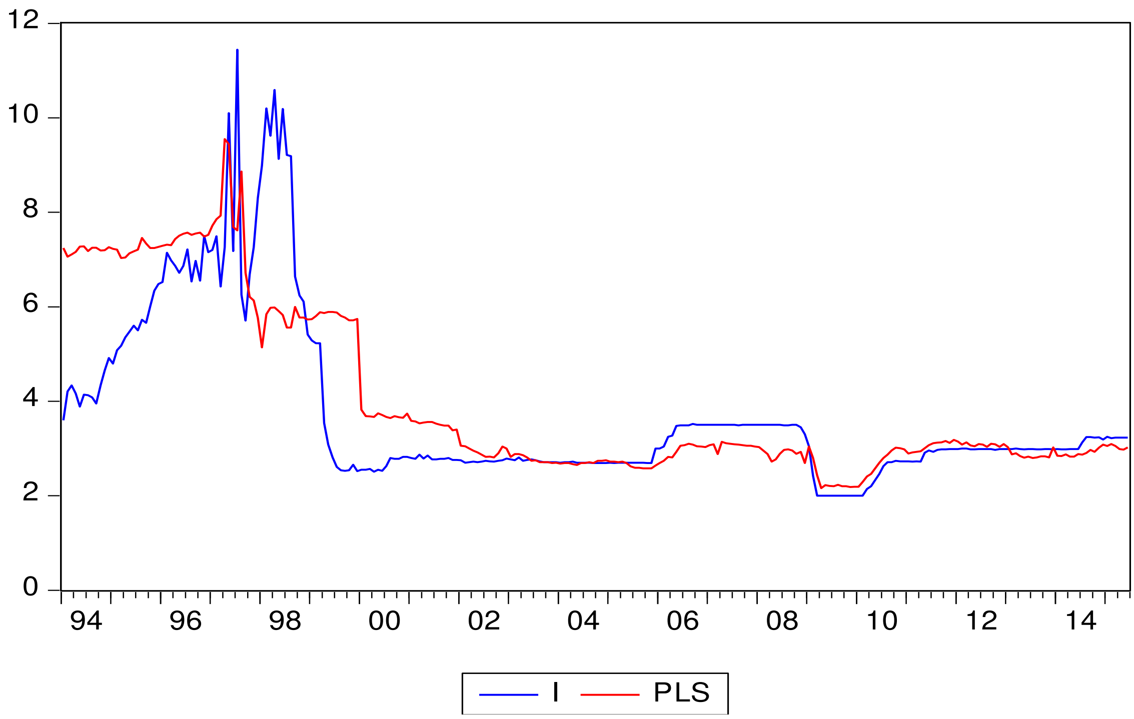


Table 3.5. Granger-Causality Test between Overnight Rate (I) and the PLS.

		Panel A: $\Delta PLS \nrightarrow \Delta I$ (H_0: $all\ \varphi_{1i} = 0$)		Panel B: $\Delta I \nrightarrow \Delta PLS$ (H_0: $all\ \beta_{2i} = 0$)	
Country	*K*	F-statistic[a]	p-values	F-statistic[b]	p-values
Malaysia	4	12.213	0.000***	11.368	0.000***

Notes: */**/*** represent statistical significance at the 10%, 5% and 1% level, respectively. *K* is number of lags. In both Panels A and B, F-statistic[a] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1i} = 0$, and F-statistic[b] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \beta_{2i} = 0$. Panel A and Panel B are estimated using equations (1) and (2) respectively.

$$\Delta i_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i}\, \Delta i_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\, \Delta \text{PLS}_{\,t-i} + \epsilon_{1t} \quad (1)$$

$$\Delta \text{PLS}_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i} \Delta PLS_{t-i} + \sum_{i=1}^{k} \beta_{2i}\, \Delta \text{i}_{\,t-i} + \epsilon_{2t} \quad (2)$$

3.5.2 TVAR:

A pre-requisite to the estimation of the TVAR models is the computation of *C(d)* statistics to uncover the presence of a threshold effect in a multivariate framework. The results from the recursive estimation based on the starting points of m_0=25 and m_0=50 and the delay parameters of $d = 1, 2, 3, 4$ and 5 are presented in Table 3.6. Except the fourth and fifth lags of model 3, the null hypothesis of linearity is rejected at the 5% significance level. This implies that there are two different regimes corresponding to different phases of the business cycle. The optimum delay parameter of the threshold variable, $magr_{t-d}$, is estimated to be equal to 3 for all three TVAR specifications on the basis of the χ^2 test statistic. Then, the interval containing the possible optimal threshold value of the $magr_{t-d}$ [-0.709 12.025] is partitioned into 500 grids, and the optimal threshold value for each TVAR model is obtained in the grid satisfying the minimum Akaike Information Criterion (AIC). The estimated threshold values of 5.561%, 5.558% and 5.556% for models 1, 2, and 3, respectively, lead to very similar regime classifications. It is also noteworthy that the endogenously estimated optimal threshold values are slightly above the average growth rate of industrial production (5.294%) over the investigation period. On that basis, regimes 1 and 2 can be defined as the upper and lower growth regimes respectively, since they contain observations above or below the optimal threshold.

Having identified the regimes, generalized impulse response functions are estimated (see Figs. 3.7 to 3.9) and forecast error variance decomposition analysis (see Tables 3.7 and 3.8) is conducted for the three TVAR models. The results from a simple linear VAR model are also presented for comparison purposes. The responses, computed from the TVAR (model 1) and the corresponding VAR model (see Figs. 3.7 and 3.8), illustrate the effects of positive interest rate changes and negative money supply changes (a monetary tightening) on output growth and inflation. They both lead to a decline in output growth as expected, their impact being greater when the economy is in the low growth regime. Negative money shocks result in lower inflation, especially in the low growth regime, whilst an increase in interest rates brings about higher inflation in the linear VAR model and the low (but not the high) growth regime in the TVAR model.[10] This suggests that monetary authorities can achieve lower inflation by decreasing interest rates only when the economy is operating above its potential growth rate.

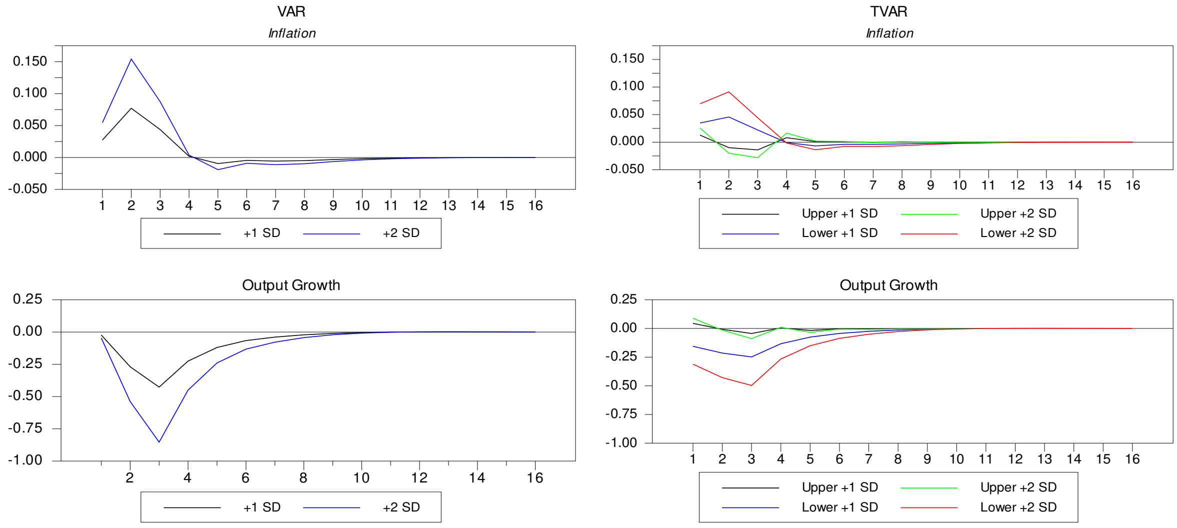
[10] The results of the effects of positive interest rate and negative money supply shocks on output growth and inflation obtained from models 2 and 3 were qualitatively the same (see Figs. A3.2 to A3.4 in the appendix A3).

Table 3.6. Multivariate Threshold Nonlinearity Test.

Total Credits				Commercial Credits				Islamic Credits			
d	m	C(d) statistics	P-value	D	m	C(d) statistics	P-value	d	m	C(d) statistics	P-value
1	25	186.490	0.000	1	25	188.160	0.000	1	25	164.240	0.000
1	50	174.990	0.000	1	50	176.150	0.000	1	50	157.070	0.000
2	25	172.430	0.000	2	25	174.790	0.000	2	25	154.080	0.000
2	50	188.660	0.000	2	50	190.040	0.000	2	50	168.210	0.000
3	25	173.450	0.000	3	25	177.260	0.000	3	25	174.110	0.000
3	50	188.780	0.000	3	50	194.410	0.000	3	50	184.250	0.000
4	25	121.780	0.033	4	25	125.550	0.020	4	25	106.660	0.195
4	50	120.120	0.042	4	50	123.730	0.025	4	50	105.140	0.224
5	25	136.840	0.003	5	25	142.250	0.001	5	25	117.300	0.060
5	50	131.730	0.008	5	50	137.170	0.003	5	50	113.370	0.096
γ	5.561	AIC	2440.74	γ	5.558	AIC	2427.456	γ	5.556	AIC	3312.63

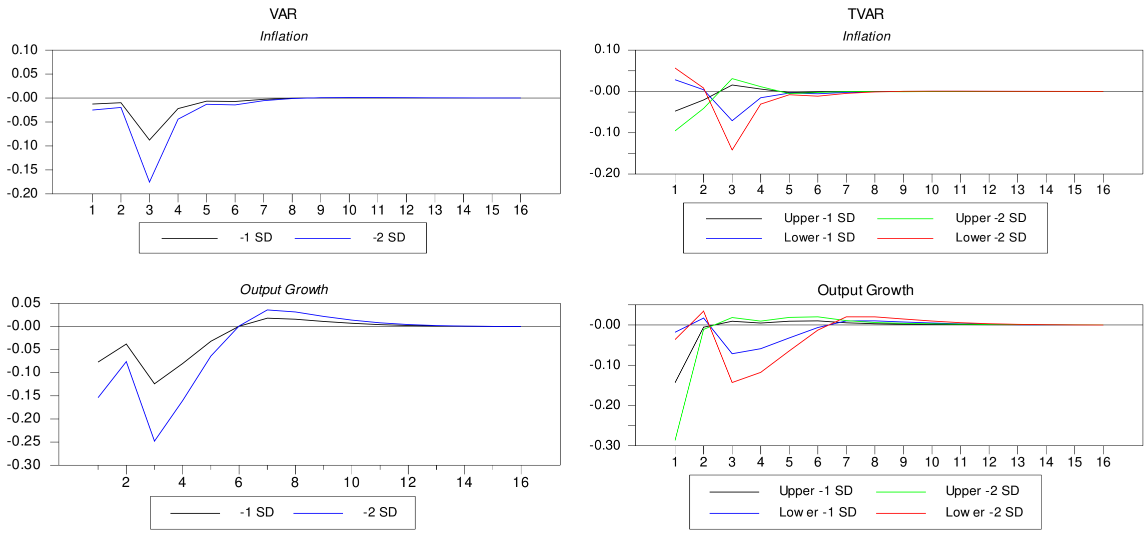
Notes: The AIC refers to the minimum value of Akaike Information Criterion, C(d) statistics is based on the arranged regression model introduced by Tsay (1998), d is the delay parameter, m refers to the number of initial observations, and γ represents the optimum values of the threshold variable, *magr* (the twenty-four month moving average of the IPI growth rate).

Figure 3.7. Responses to Interest Rate Changes Shocks.



Note: The figures are obtained from model 1.

Figure 3.8. Responses to Negative Money Supply Changes Shocks



Note: The figures are obtained from model 1.

Figs. 3.9 and 3.10 display the effects of a tightening in total, conventional and Islamic credit respectively on output growth and inflation based on the estimated linear and TVAR models.[11] A tightening credit changes chocks generally lead to a decrease in both output growth and inflation. More specifically, the impact of these shocks on inflation seems to be relatively larger in the low growth regime than in the high growth regime (see Fig 3.10). Total and conventional credit shocks have the same qualitative effects on output growth (see Fig 3.9). In addition, the impact of Islamic credit shocks on both output growth and inflation seem to be lower than the conventional credit in both regimes, this impact of Islamic credit shocks being more sizeable in the low growth regime. Possible explanations for these findings are the lower share of Islamic banking in the financial system of Malaysia, and also the principles of Islamic finance not allowing Islamic banks to engage in speculative activities (Hasan and Dridi, 2010; Khan, 2010; and Kammer et al., 2015). These results are consistent with those of Amar et al. (2015), who found that in Saudi Arabia Islamic banking credit has a positive effect on non-oil private output but not much of an impact on the price level.

Fig. 3.11 shows the responses of total, conventional and Islamic credit changes to interest rate changes, obtained respectively from models 1, 2 and 3. A positive interest rate shock generally leads to a decline in conventional and Islamic credit, especially when the economy operates in the low growth regime. In addition, Islamic credit appears to be less responsive than conventional credit to interest rate shocks in both regimes; this is consistent with the findings of Khan and Mirakhor (1989), who concluded that monetary policy shocks have less effect on Islamic banks because the PLS paradigm allows Islamic banks to share a percentage of risk with the depositors; by contrast, Kassim et al. (2009) found that in Malaysia Islamic loans and deposits are more responsive to interest rate changes than commercial ones. Further evidence is provided by Fig. 3.12, which shows that negative money supply shocks lead to a smaller decline in Islamic credit in both regimes.

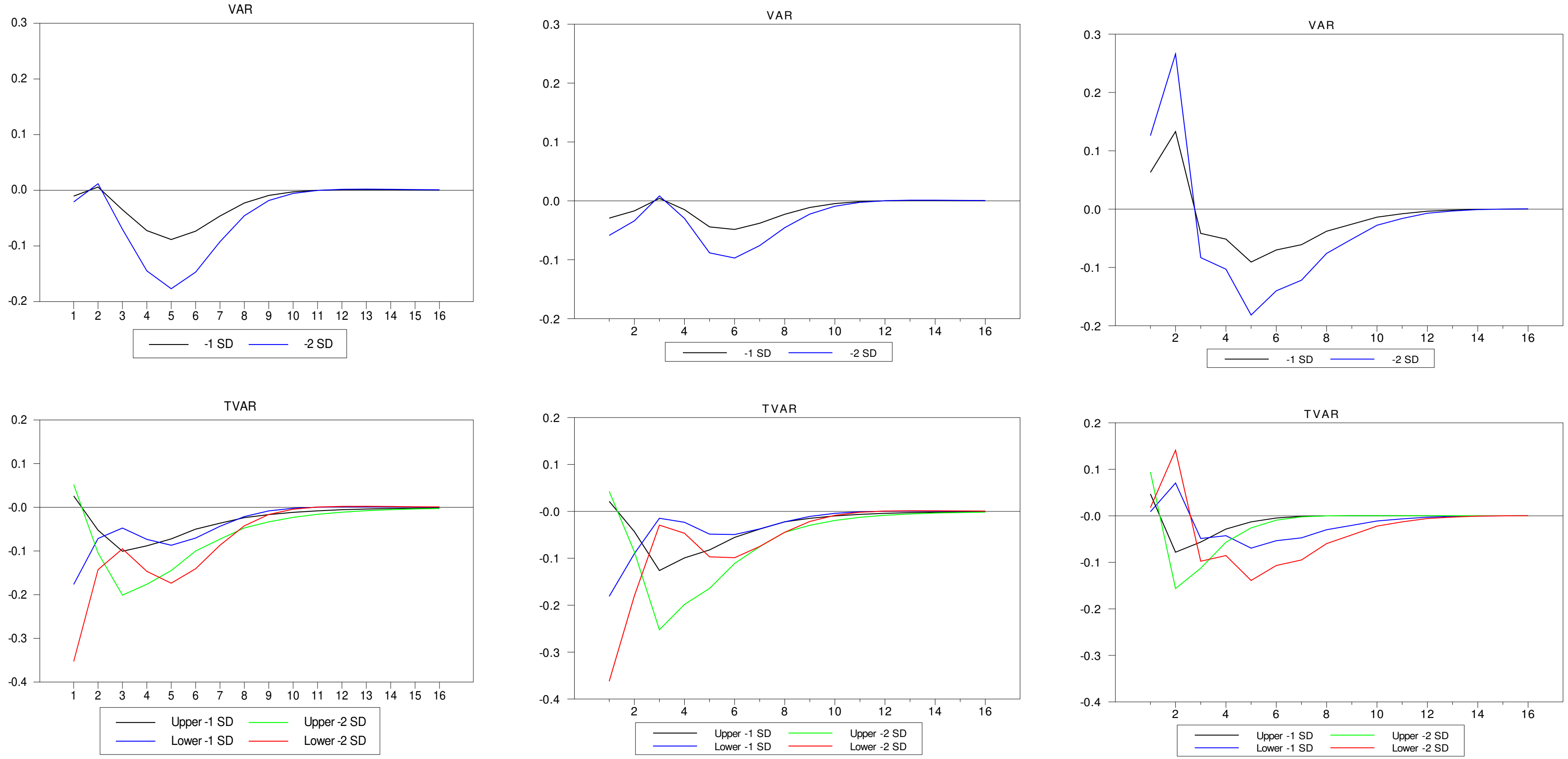
[11] The effects of tightening in the total, conventional and Islamic credit changes on output growth and inflation are obtained from models 1, 2 and 3, respectively.

Figure 3.9. Responses of Output Growth to Credit Changes Shocks.

Responses of Output Growth to Total Credit Changes Shocks.

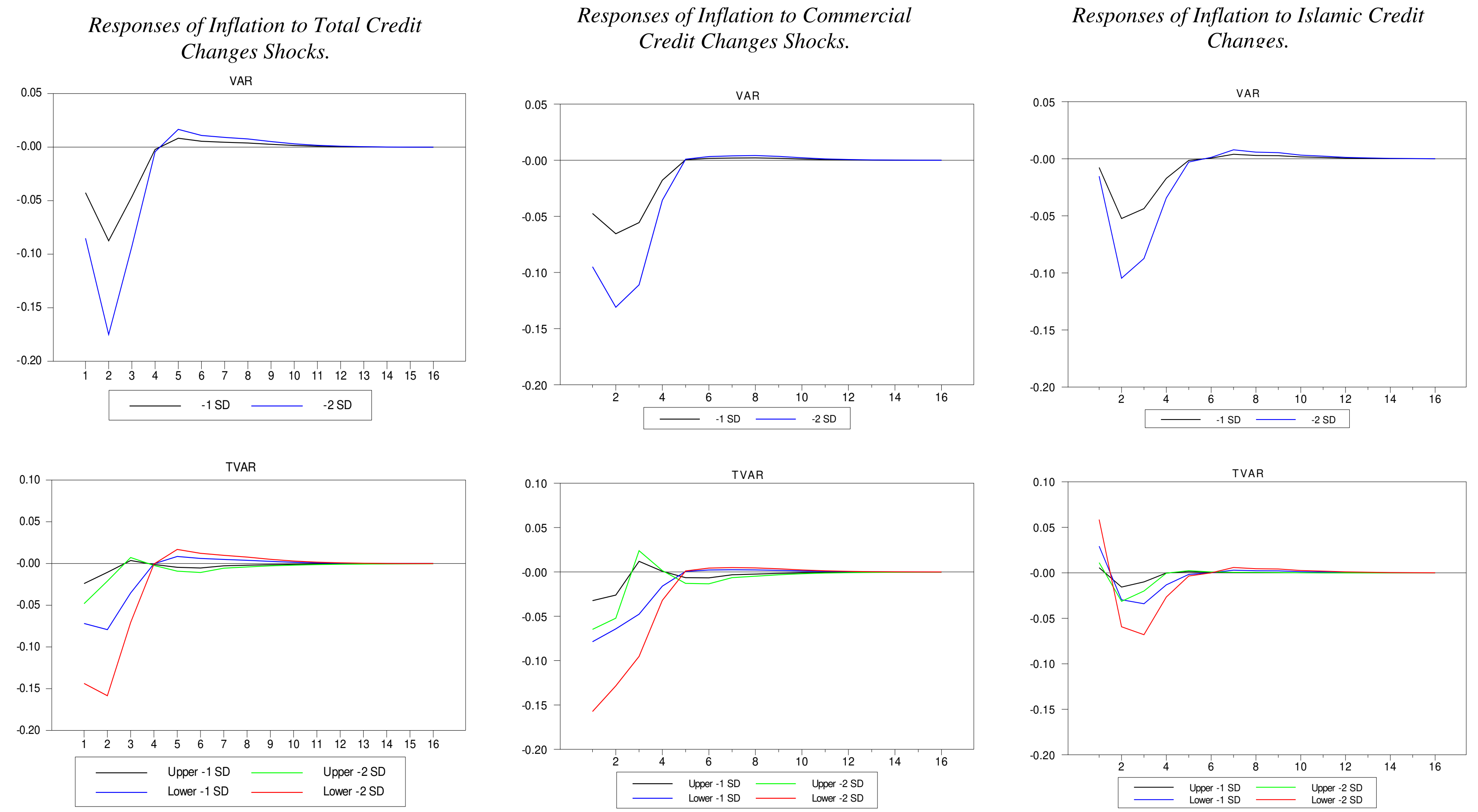
Responses of Output Growth to Commercial Credit Changes Shocks.

Responses of Output Growth to Islamic Credit Changes Shocks.



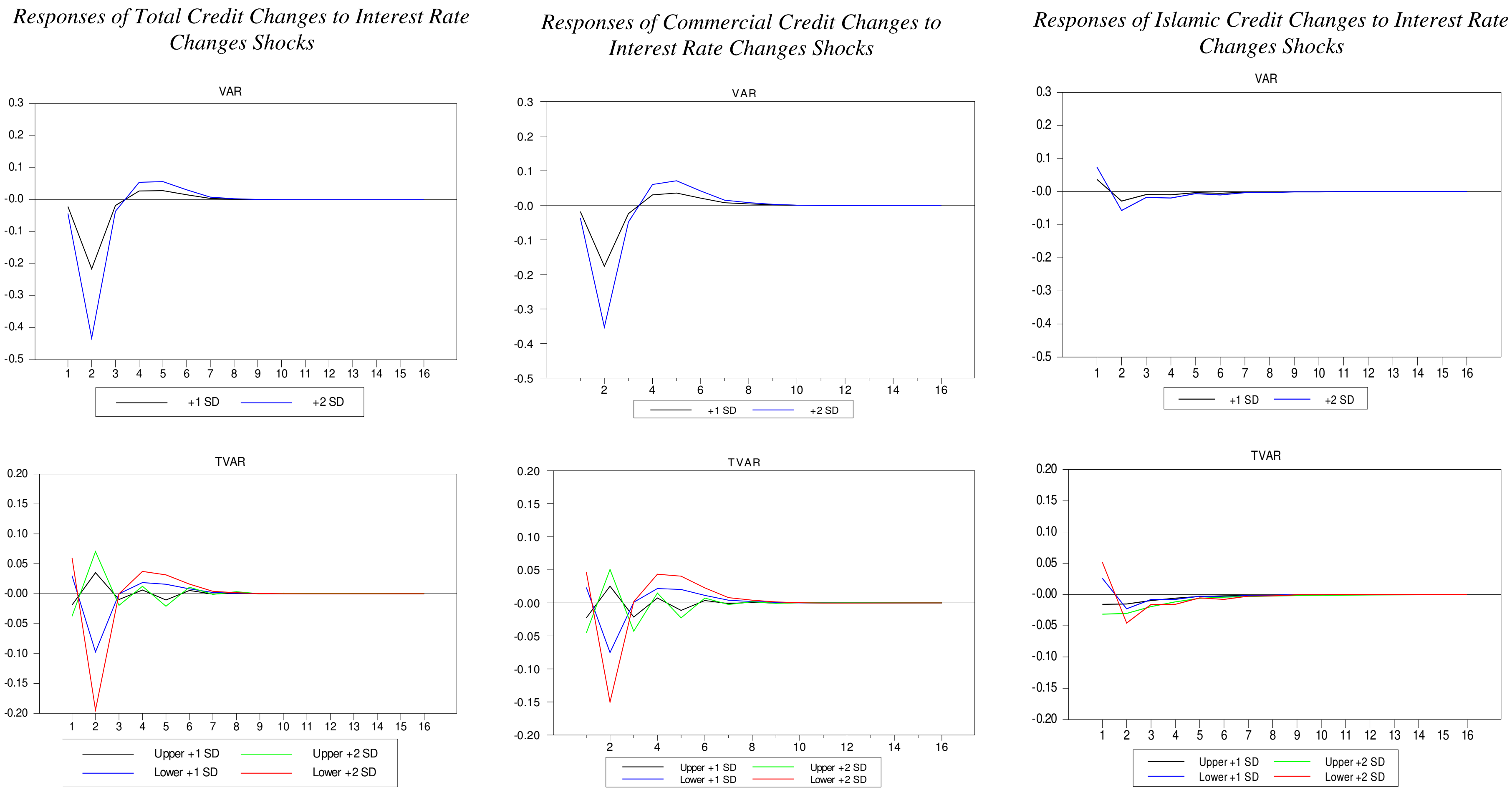
Note: The figures displayed in the left, middle and right panels are obtained from models 1, 2 and 3, respectively.

Figure 3.10. Responses of Inflation to Credit Changes Shocks.



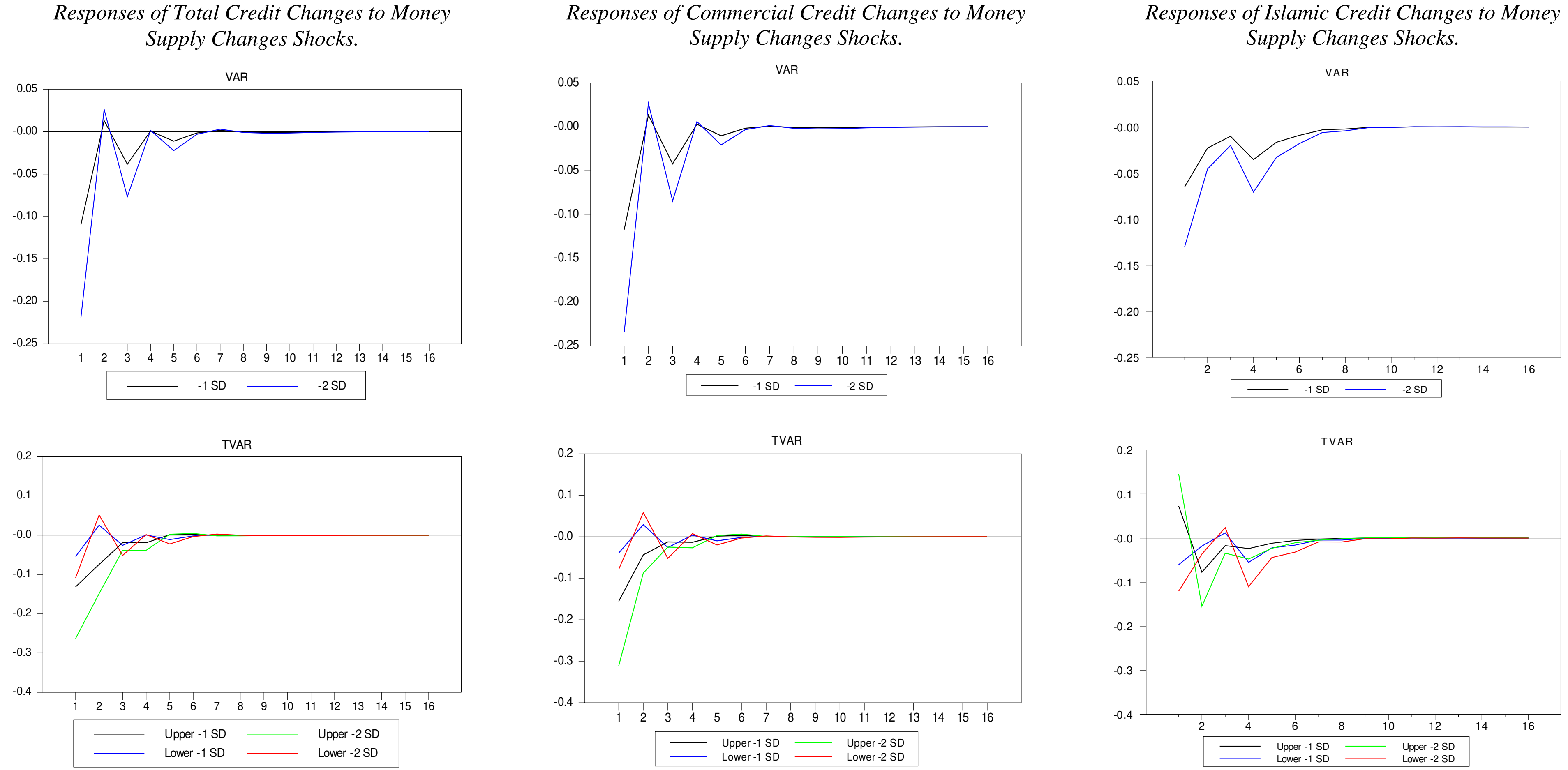
Note: The figures displayed in the left, middle and right panels are obtained from models 1, 2 and 3, respectively.

Figure 3.11. Responses of Credit Changes to Interest Rate Changes Shocks.



Note: The figures displayed in the left, middle and right panels are obtained from models 1, 2 and 3, respectively.

Figure 3.12. Responses of Credit Changes to Money Supply Changes Shocks



Note: The figures displayed in the left, middle and right panels are obtained from models 1, 2 and 3, respectively.

3.5.2.1 Variance Decompositions

The forecast error variance decomposition analysis from the linear and TVAR models (see Tables 3.7 and 3.8) corroborates the findings of the linear and threshold impulse responses by highlighting clear differences between the low and high growth regimes. Both the linear and threshold variance decomposition results imply that most of the forecast error variance of output growth and inflation is explained by their own shocks. The linear model might underestimate the contribution of credit changes, which appears to be much higher in the nonlinear model in both regimes. Conventional credit changes explain more of the variations in inflation, especially in the low growth regime, than Islamic credit changes that seem to play a relatively minor role (slightly greater in the high growth regime). For instance, in the low growth regime, over a 15-month horizon, conventional credit changes account for 8.4 percent of the total variation in inflation as opposed to 1.792 percent in the case of Islamic credit changes. This finding might reflect the distinctive features of Islamic credit, which only funds transactions related to a tangible underlying asset rather than speculative activities, thereby boosting growth rather than causing higher inflation (Kammer et al. 2015; Khan, 2010; Caporale and Helmi, 2016).

As for output growth, it appears that in the high growth regime most of its variation is driven by conventional and Islamic credit changes: the contribution of the former (7.949 percent) is higher than that of the latter (3.598 percent) over a 15-month forecast horizon. However, in the low growth regime their relative importance is reversed: Islamic and conventional credit changes account for 12.209 and 4.631 of the variance respectively over the same forecast horizon. The sizeable contribution of Islamic credit changes to output growth in the low growth regime could be attributed to the Islamic banks' business model and business ethics, which enhance economic growth (Adeola, 2007). Specifically, the PLS paradigm and asset-based Islamic banking make these institutions less vulnerable and more stable during financial crises; for instance, their assets and credit were double those of conventional banks during the recent financial crisis of 2007-08 in Saudi Arabia, Kuwait, UAE, Qatar, Bahrain, Jordan, Turkey and Malaysia (see Hasan and Dridi, 2010).

Table 3.7. Variance Decomposition of Inflation.

Model 1

Step	S.E.	$\Delta lm2_t$	Δint_t	$\Delta ltcre_t$	$\Delta lcpi_t$	$\Delta lipi_t$
Linear VAR						
1	0.342	0.134	0.639	1.553	97.675	0.000
3	0.357	0.865	0.909	2.466	95.724	0.036
6	0.358	0.984	0.924	2.554	95.309	0.230
9	0.358	0.985	0.926	2.554	95.305	0.231
12	0.358	0.985	0.926	2.554	95.305	0.231
15	0.358	0.985	0.926	2.554	95.305	0.231
Upper Regime						
1	0.277	3.219	0.299	0.876	95.606	0.000
3	0.285	3.812	0.678	1.064	93.452	0.994
6	0.286	3.840	0.757	1.173	92.709	1.521
9	0.287	3.838	0.757	1.196	92.669	1.541
12	0.287	3.838	0.757	1.198	92.666	1.542
15	0.287	3.838	0.757	1.198	92.665	1.542
Lower Regime						
1	0.364	0.643	0.667	4.268	94.422	0.000
3	0.393	2.797	1.821	8.107	86.308	0.967
6	0.394	2.911	1.896	8.239	85.879	1.075
9	0.394	2.914	1.906	8.250	85.853	1.077
12	0.394	2.914	1.907	8.251	85.852	1.077
15	0.394	2.914	1.907	8.251	85.852	1.077

Model 2

Step	S.E.	$\Delta lm2_t$	Δint_t	$\Delta lccre_t$	$\Delta lcpi_t$	$\Delta lipi_t$
Linear VAR						
1	0.341	0.116	0.638	1.936	97.310	0.000
3	0.357	0.845	0.928	3.362	94.837	0.029
6	0.358	0.970	0.941	3.425	94.462	0.203
9	0.358	0.971	0.943	3.425	94.458	0.204
12	0.358	0.971	0.943	3.425	94.458	0.204
15	0.358	0.971	0.943	3.425	94.458	0.204
Upper Regime						
1	0.276	2.824	0.321	1.324	95.531	0.000
3	0.285	3.441	0.681	2.228	92.642	1.007
6	0.286	3.468	0.745	2.330	91.960	1.498
9	0.286	3.466	0.744	2.354	91.917	1.517
12	0.286	3.466	0.744	2.356	91.914	1.519
15	0.286	3.466	0.744	2.356	91.914	1.519
Lower Regime						
1	0.363	0.715	0.732	4.741	93.811	0.000
3	0.392	2.781	2.018	8.263	85.992	0.945
6	0.394	2.908	2.078	8.395	85.598	1.022
9	0.394	2.910	2.090	8.400	85.577	1.023
12	0.394	2.910	2.091	8.400	85.576	1.023
15	0.394	2.910	2.091	8.400	85.576	1.023

Model 3

Step	S.E.	$\Delta lm2_t$	Δint_t	$\Delta licre_t$	$\Delta lcpi_t$	$\Delta lipi_t$
Linear VAR						
1	0.346	0.179	0.885	0.006	98.930	0.000
3	0.362	1.647	1.234	0.967	96.002	0.149
6	0.363	1.790	1.251	0.964	95.554	0.442
9	0.363	1.790	1.255	0.964	95.545	0.446
12	0.363	1.790	1.255	0.964	95.545	0.446
15	0.363	1.790	1.255	0.964	95.545	0.446
Upper Regime						
1	0.220	7.640	0.024	1.781	90.556	0.000
3	0.224	7.604	0.400	2.731	89.201	0.065
6	0.225	7.591	0.546	2.751	88.851	0.260
9	0.225	7.590	0.552	2.753	88.837	0.269
12	0.225	7.590	0.552	2.753	88.836	0.270
15	0.225	7.590	0.552	2.753	88.836	0.270
Lower Regime						
1	0.413	1.589	1.041	0.919	96.451	0.000
3	0.446	3.746	2.713	1.534	91.003	1.003
6	0.449	3.860	2.857	1.666	89.992	1.625
9	0.449	3.855	2.898	1.770	89.843	1.634
12	0.449	3.854	2.900	1.792	89.816	1.639
15	0.449	3.853	2.901	1.792	89.814	1.639

Notes: Models 1, 2 and 3 are respectively based on the vectors $Y'_{1,t} = [\Delta lm2_t, \Delta int_t, \Delta ltcre_t, \Delta lcpi_t, \Delta lipi_t]$, $Y'_{2,t} = [\Delta lm2_t, \Delta int_t, \Delta lccre_t, \Delta lcpi_t, \Delta lipi_t]$ and $Y'_{3,t} = [\Delta lm2_t, \Delta int_t, \Delta licre_t, \Delta lcpi_t, \Delta lipi_t]$, respectively.

Table 3.8 Variance decomposition of output

Model 1						
Linear VAR						
Step	S.E.	$\Delta lm2_t$	Δint_t	$\Delta ltcre_t$	$\Delta lcpi_t$	$\Delta lipi_t$
1	0.750	1.053	0.092	0.020	0.062	98.773
3	0.960	0.782	3.357	0.326	0.232	95.302
6	0.973	0.787	3.671	1.024	0.621	93.897
9	0.973	0.791	3.670	1.071	0.643	93.824
12	0.973	0.792	3.670	1.072	0.643	93.823
15	0.973	0.792	3.670	1.072	0.643	93.823
Upper Regime						
Step	S.E.	$\Delta lm2_t$	Δint_t	$\Delta ltcre_t$	$\Delta lcpi_t$	$\Delta lipi_t$
1	0.583	6.911	0.890	0.356	0.011	91.832
3	0.719	4.650	0.865	3.873	1.603	89.009
6	0.750	4.299	0.853	7.265	1.851	85.732
9	0.753	4.269	0.848	7.582	1.902	85.399
12	0.753	4.267	0.847	7.603	1.906	85.377
15	0.753	4.267	0.847	7.605	1.906	85.375
Lower Regime						
Step	S.E.	$\Delta lm2_t$	Δint_t	$\Delta ltcre_t$	$\Delta lcpi_t$	$\Delta lipi_t$
1	0.776	0.050	3.869	5.056	2.971	88.053
3	0.982	0.379	14.057	4.026	8.231	73.308
6	1.006	0.624	16.300	4.653	8.373	70.050
9	1.008	0.637	16.282	4.854	8.474	69.753
12	1.008	0.640	16.281	4.855	8.476	69.748
15	1.008	0.640	16.281	4.855	8.476	69.748

Mode 2						
Linear VAR						
Step	S.E.	$\Delta lm2_t$	Δint_t	$\Delta lccre_t$	$\Delta lcpi_t$	$\Delta lipi_t$
1	0.750	0.980	0.128	0.153	0.076	98.662
3	0.962	0.741	3.653	0.242	0.280	95.084
6	0.974	0.751	4.029	0.641	0.658	93.921
9	0.974	0.754	4.029	0.677	0.675	93.865
12	0.974	0.754	4.029	0.677	0.675	93.865
15	0.974	0.754	4.029	0.677	0.675	93.865
Upper Regime						
Step	S.E.	$\Delta lm2_t$	Δint_t	$\Delta lccre_t$	$\Delta lcpi_t$	$\Delta lipi_t$
1	0.584	6.853	1.144	0.178	0.004	91.821
3	0.719	4.678	0.952	3.907	1.409	89.054
6	0.751	4.328	0.935	7.549	1.637	85.551
9	0.754	4.295	0.928	7.921	1.679	85.177
12	0.754	4.293	0.927	7.947	1.682	85.151
15	0.754	4.293	0.927	7.949	1.683	85.149
Lower Regime						
Step	S.E.	$\Delta lm2_t$	Δint_t	$\Delta lccre_t$	$\Delta lcpi_t$	$\Delta lipi_t$
1	0.776	0.077	3.998	5.531	3.058	87.336
3	0.982	0.425	14.733	4.262	7.674	72.906
6	1.007	0.677	17.477	4.459	7.857	69.530
9	1.009	0.689	17.470	4.629	7.965	69.247
12	1.009	0.692	17.469	4.631	7.967	69.242
15	1.009	0.692	17.469	4.631	7.967	69.242

Mode 3						
Linear VAR						
Step	S.E.	$\Delta lm2_t$	Δint_t	$\Delta licre_t$	$\Delta lcpi_t$	$\Delta lipi_t$
1	0.791	0.794	0.227	1.687	0.013	97.278
3	1.007	0.766	4.372	1.708	0.464	92.690
6	1.026	0.746	4.966	1.681	1.221	91.386
9	1.027	0.753	4.983	1.686	1.255	91.323
12	1.027	0.753	4.983	1.686	1.255	91.323
15	1.027	0.753	4.983	1.686	1.255	91.323
Upper Regime						
Step	S.E.	$\Delta lm2_t$	Δint_t	$\Delta licre_t$	$\Delta lcpi_t$	$\Delta lipi_t$
1	0.596	2.683	0.268	0.144	0.594	96.311
3	0.740	3.299	1.204	2.258	2.713	90.525
6	0.774	3.271	1.380	3.483	3.465	88.401
9	0.777	3.280	1.402	3.592	3.536	88.190
12	0.777	3.281	1.403	3.598	3.540	88.178
15	0.777	3.281	1.403	3.598	3.541	88.177
Lower Regime						
Step	S.E.	$\Delta lm2_t$	Δint_t	$\Delta licre_t$	$\Delta lcpi_t$	$\Delta lipi_t$
1	0.791	0.055	4.080	1.012	1.875	92.978
3	0.998	0.354	10.458	5.003	7.432	76.752
6	1.048	0.692	10.407	11.260	7.543	70.097
9	1.056	0.690	10.390	12.204	7.551	69.165
12	1.057	0.691	10.438	12.202	7.554	69.116
15	1.057	0.691	10.437	12.209	7.556	69.107

Notes: Models 1, 2 and 3 are respectively based on the vectors $Y'_{1,t} = [\Delta lm2_t, \Delta int_t, \Delta ltcre_t, \Delta lcpi_t\ \Delta lipi_t]$, $Y'_{2,t} = [\Delta lm2_t, \Delta int_t, \Delta lccre_t, \Delta lcpi_t\ \Delta lipi_t]$ and $Y'_{3,t} = [\Delta lm2_t, \Delta int_t, \Delta licre_t, \Delta lcpi_t\ \Delta lipi_t]$, respectively.

3.6 CONCLUSION

This chapter has examined the bank lending channel of monetary transmission in Malaysia, a country with a dual banking system including both Islamic and conventional banks, over the period 1994:01-2015:06. It contributes to the existing literature by using a two-regime TVAR model, where long term trend of growth is utilized as the threshold, allowing for nonlinearities and showing that this channel in Malaysia is state-dependent. In particular, the results indicate that Islamic credit changes are less responsive than conventional credit ones to interest rate shocks in both the high and low growth regimes. By contrast, the relative importance of Islamic credit changes in driving output growth is much greater in the low growth regime, their effects being positive. Conversely, the contribution of commercial credit shocks has declined significantly as the economy switches to the lower regime.

These findings are broadly consistent with the existing evidence on the state-dependence of the transmission channels of monetary policy in developed economies. Moreover, they can be interpreted in terms of the distinctive features of Islamic banks, which operate according to the principles of Islamic finance, and therefore charge the ex-post PLS rate instead of conventional interest rates, and only finance projects directly linked to real economic activities (El-Gamal, 2006; Berg and Kim, 2014). Given the evidence suggesting that Islamic credit boosts growth during low growth periods, policy-makers should take into account the Islamic bank lending channel in the design of monetary policy in economies with a dual (Islamic and conventional) banking system at such times. Policies aimed at improving the institutional structure and the efficiency of Islamic banks might also be appropriate, with a view to making the transmission of monetary policy more effective in countries such as Malaysia. In addition, the role of commercial banks as financial intermediators for the allocation of resources should be revised and utilised through providing higher ratio to productive investment

Future research should also consider the bank lending channel using disaggregated data (see, Kashyap and Stein, 2000), and examine the other monetary channels. Further, one could examine the robustness of the results by using different types of interest rates.

APPENDIX A3

Table A3.1. Islamic Finance and Market Share (in Billions of Malaysian Ringgit).

	1994	1998	2002	2006	2010	2014	2015*
Total Credit	2147617	5039	5333846	6947982	10030611	15332897	8179310.11
Islamic Credit	1564	87805	399125	897672	1807254	3690233	2127214.80
Share of Islamic Credit	0.073%	1.742%	7.482%	12.920%	18.017%	24.067%	26.011%

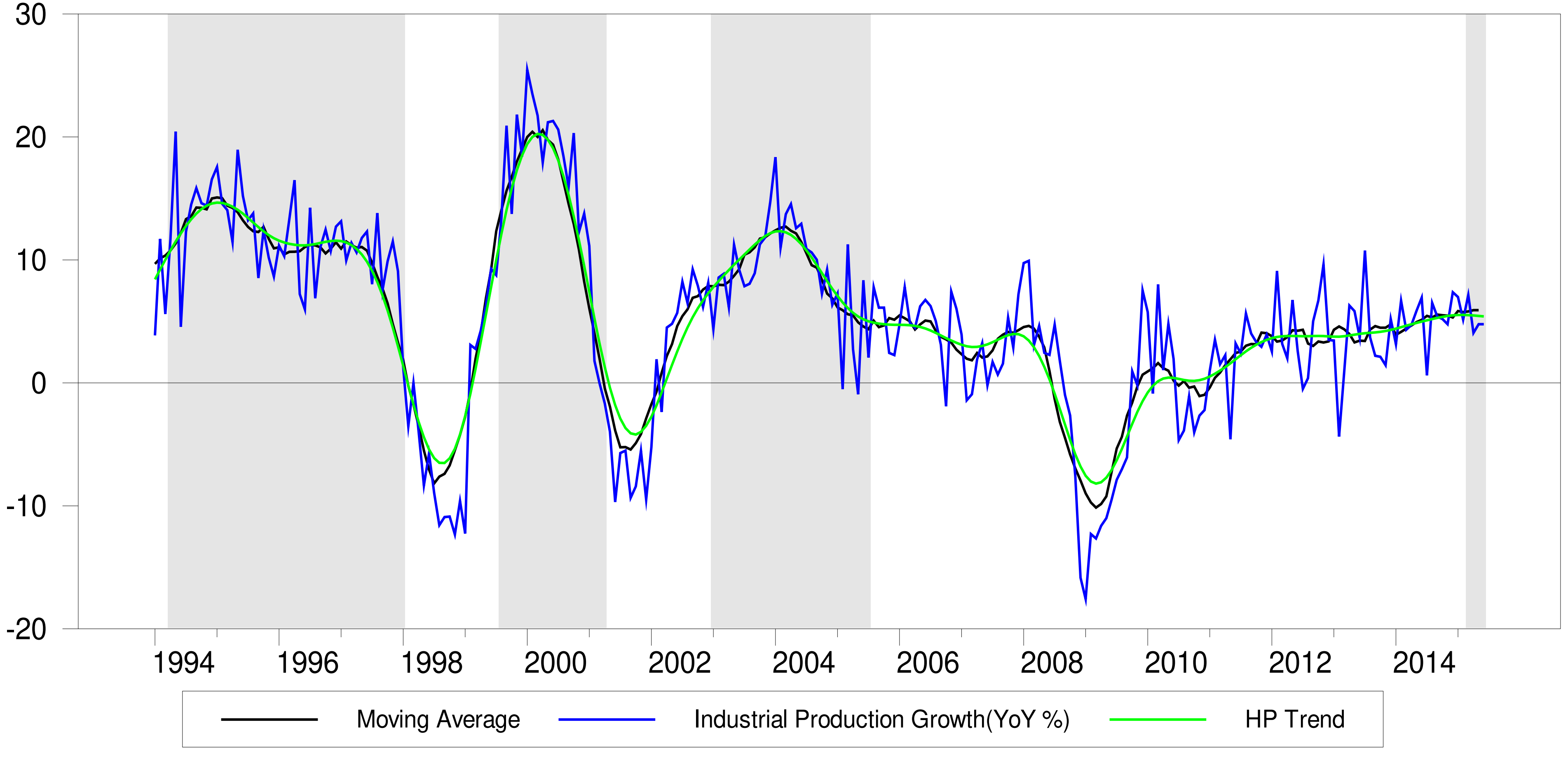
Sources: The Central Bank of Malaysia and authors calculation.
* 2015 figures are calculated based on the sum of the first two quarters of the year.

Table A3.2. Multivariate Threshold Nonlinearity Tests Based on HP Filter.

		Model 1	
d	m_0	*C(d)* statistics	P-value
1	25	159.830	0.000
1	50	157.610	0.000
2	25	154.730	0.000
2	50	165.320	0.000
3	25	155.470	0.000
3	50	176.980	0.000
4	25	169.320	0.000
4	50	168.220	0.000
5	25	157.220	0.000
5	50	164.890	0.000
γ	5.527	AIC	-6097.750

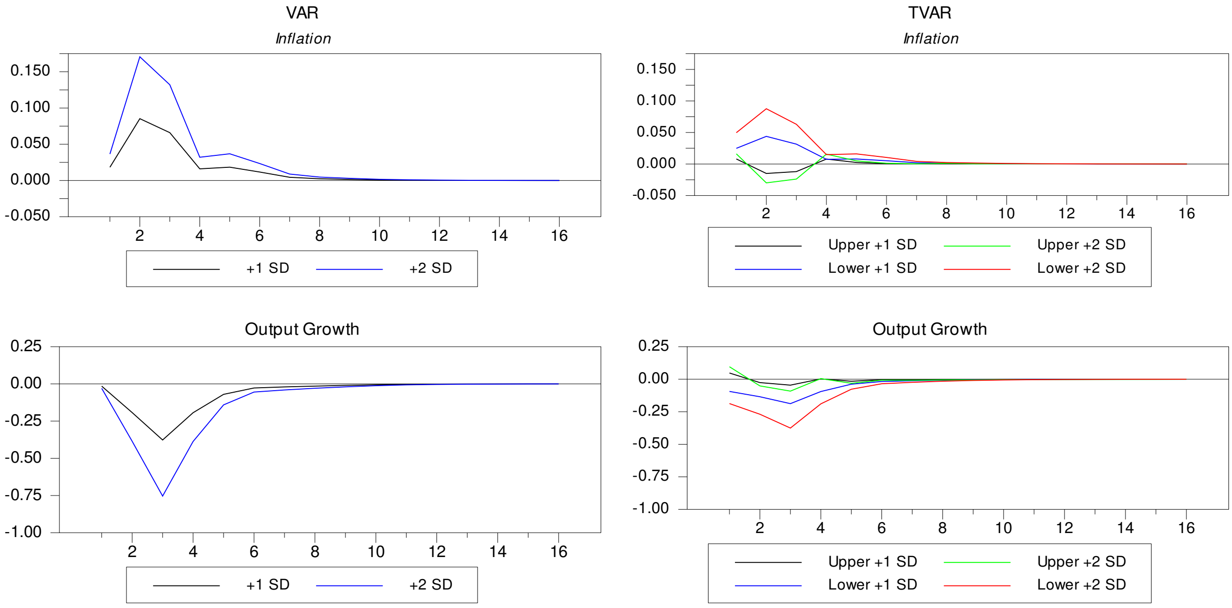
Notes: The AIC refers to the minimum value of Akaike Information Criterion, *C(d)* statistics is based on the arranged regression model introduced by Tsay (1998), d is the delay parameter, m_0 refers to the number of initial observations, and γ represents the optimum values of the threshold variable.

Figure A3.1. Regime Classifications using HP Filter.



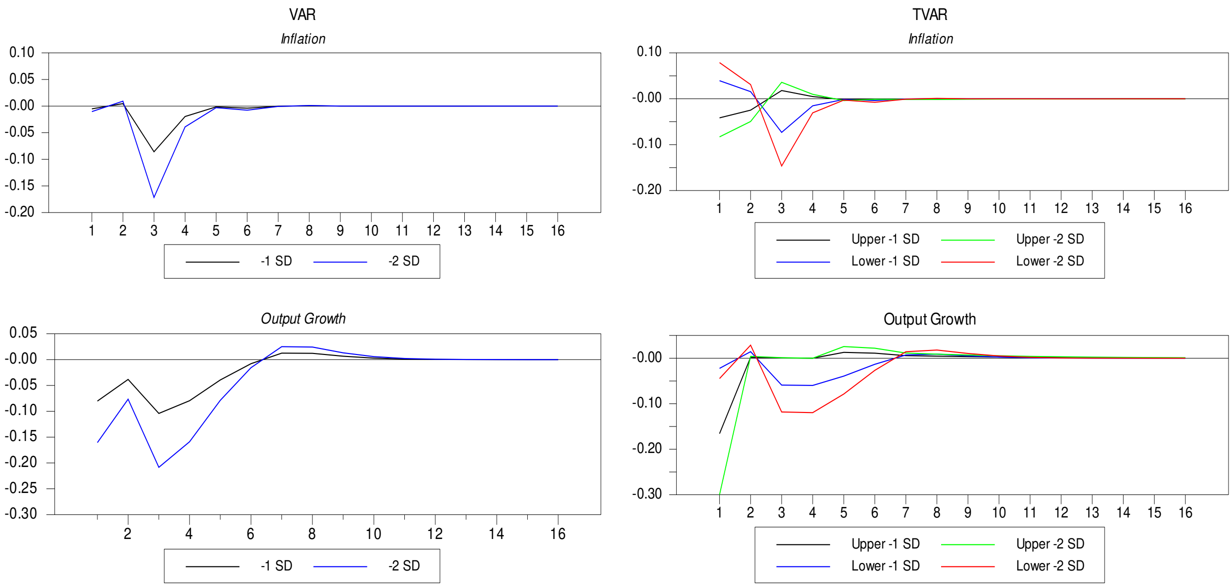
Note: Upper regime where $\gamma \geq 5.527$, is represented by the shaded areas obtained from the TVAR model including total credits as an endogenous variable).

Figure A3.2. Responses to Interest Rate Changes Shocks.



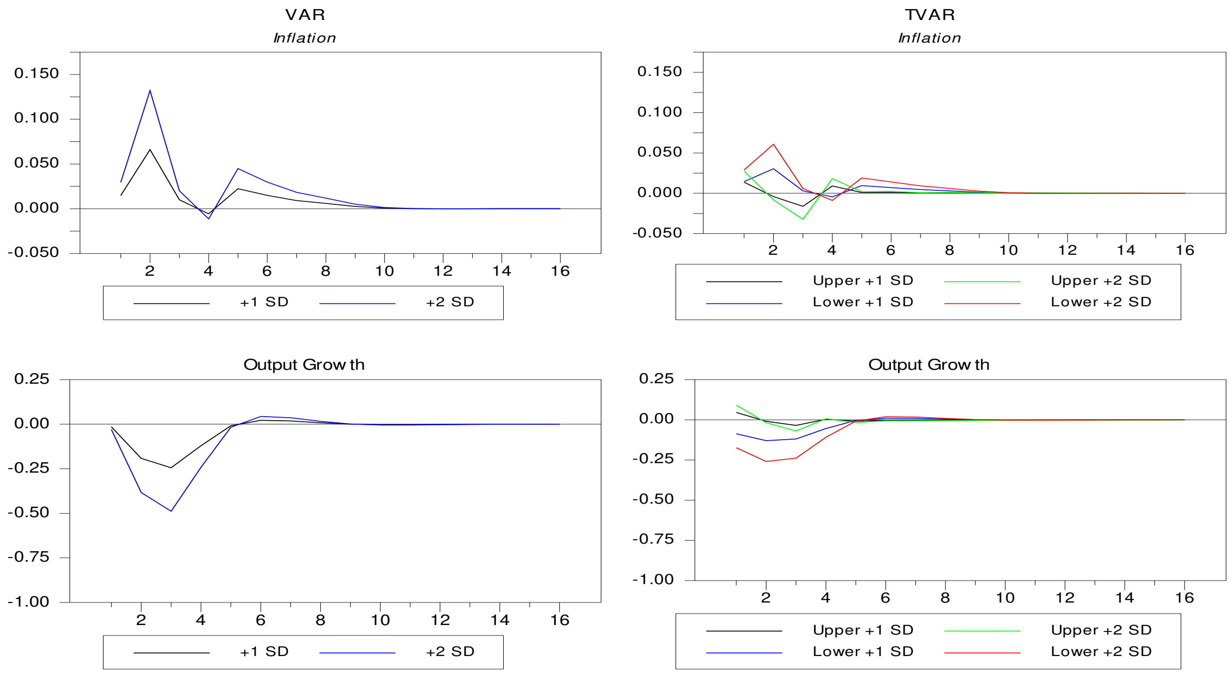
Note: The figures are obtained from model 2.

Figure A3.3 Responses to Negative Money Supply Changes Shocks.



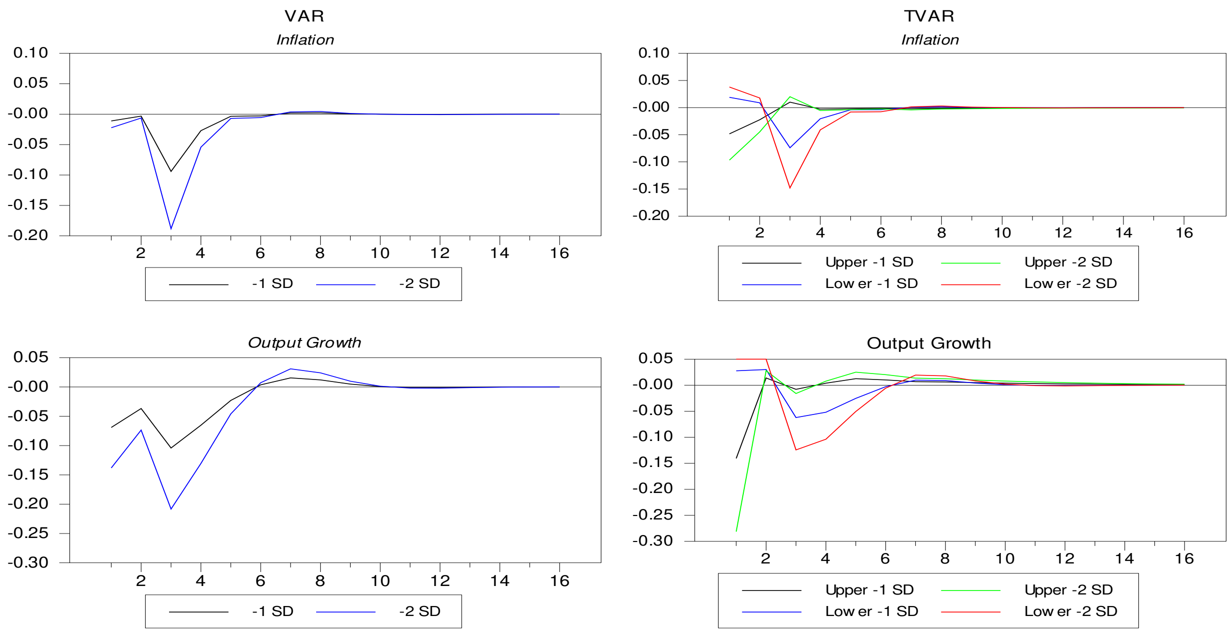
Note: The figures are obtained from model 2.

Figure A3.4 Responses to Interest Rate Changes Shocks.



Note: The figures are obtained from model 3.

Figure A3.5. Responses to Negative Money Supply Changes Shocks.



Note: The figures are obtained from model 3.

CHAPTER FOUR

ISLAMIC BANKING, CREDIT AND ECONOMIC GROWTH: SOME EMPIRICAL EVIDENCE

4.1 Introduction

The finance-growth nexus has been extensively investigated in the literature, with mixed evidence: some studies reach the conclusion that financial development boosts economic growth, which is known as the supply-leading view (e.g., Schumpeter, 1911; McKinnon, 1973; Shaw, 1973; King and Levine, 1993; and Beck et al., 2014), whilst others argue that causality runs in the opposite direction (e.g., Robinson, 1952; Berthelemy and Varoudakis, 1996; Ang, and McKibbin, 2007); Rousseau and Wachtel (2011) have reported that the linkage has become weaker over time. Moreover, there is no consensus on how to measure financial development and how to handle the endogeneity problem. Most recently, the Bank for International Settlements (BIS) hereafter has focused on the role of credit, and whether it might be used as an early warning indicator (EWI), since excessive lending is thought to be one of the main factors that have caused the 2007-8 global financial crises. The credit-to-GDP ratio was in fact adopted by the Basel III committee (2010) as a guide to build up countercyclical capital buffers during booms in order to use them during crises (see Barrell at al., 2010; Drehmann, 2013).

An interesting issue not thoroughly analysed in the finance-growth literature is whether the relationship between credit and economic growth is different in countries with Islamic banks. Such institutions are not allowed to charge a predetermined interest rate, which is replaced by the ex-post profit and loss sharing rate (Chong and Liu, 2009). Further, they can only provide credit for transactions related to a tangible, underlying asset and cannot engage in any speculative activities (Hasan and Dridi, 2010; Khan, 2010 ; Kammer et al., 2015 among others). Only a few empirical studies of countries with Islamic banking exist. Majid and Kassim (2010) find evidence supporting the "supply-leading" view. By contrast, Furqani and Mulyany (2009) report that economic growth causes financial development only in the short run in a country with Islamic banking such as Malaysia - on the whole, their analysis is consistent with the "demand-following" view. Abduh and Omar (2012) find bidirectional causality between Islamic finance and economic growth in Indonesia. Most recently, Imam and Kpodar (2015) conclude that countries with Islamic banks experience faster economic growth than those without Islamic banks.

The chapter aims to examine in depth the effects of Islamic banking on the causal linkages between credit and GDP by comparing two sets of seven emerging countries, the first without Islamic banks, and the second with a dual banking system including both Islamic and conventional banks[1]. We attempt to answer the following questions: Does credit promote GDP or does GDP promote credit in the short run and in the long run? Does the causality relationship vary between countries with and without Islamic banks? If it does, then a different set of regulations should be applied to the two groups.

Unlike previous studies, this chapter contributes to the current literature in a different respect. First, we check the robustness of the results by applying both time series and panel methods. The time series technique has some issues related to the size of the sample, and the power of the unit root test, therefore, different conclusions could be drawn regard the direction of causality across countries based on the time-series data. However, the panel technique addresses these issues.

Second, the chapter examines the causal relationship between real credit and real GDP of countries with dual banking system (both Islamic and conventional banking), and countries with only conventional banking system. To the best of our knowledge, this is the first study that investigates the causality relationship between the two economic indicators of countries with the two different banking systems.

Third, while previous studies focus on either long-run or short-run causality, we move a step further by testing for both causal relationships. Literature on the long-run causality mainly deals with the finance-growth nexus, while those of the short-run relationship are centred on macro-prudential policies, which are recently used by BIS to identify the appropriate early warning systems.

[1]The First data set includes seven Latin American countries, namely Argentina, Brazil, Chile, Costa Rica, Ecuador, Guatemala, Peru, while the second data set includes Malaysia, Indonesia, Turkey, Iran, Jordan, Singapore and Tunisia (see Table 4.1).

Fourth, using the outcome of the causality tests, the chapter also seeks to contribute to the on-going debates: whether the profit-and-loss sharing (PLS) paradigm of Islamic banking might lead to an optimal distribution of funds (Siddiqi, 1999); the role of Islamic finance, which emphasises on real economic activities rather than speculative transactions, in promoting economic growth instead of causing an increase in the price level (Chapra and Chapra, 1992; Mills and Presley, 999; Gulzar and Masih, 2015; Kammer et al., 2015).

In brief, our findings highlight significant differences between the two sets of countries. Specifically, the time series analysis provides evidence of long-run causality running from credit to GDP in countries with Islamic banks only. This is confirmed by the panel causality tests, although in this case short-run causality in countries without Islamic banks is also found. The remainder of this chapter is structured as follows: Section 4.2 reviews the related literature review; Section 4.3 discusses the data description; Section 4.4 explains the methodology; Section 4.5 analyses the empirical results for cointegration and causality in the time-series and panel approaches; finally, Section 4.6 offers some concluding remarks.

4.2 Literature Review

4.2.1 The Finance-Growth Nexus Literature

There is extensive literature studying the relationship between financial development and economic growth. The argument of whether financial development leads to economic growth or whether financial development is a result of economic growth was addressed earlier by Patrick (1966). In his study, Patrick divided this relationship into supply-leading and demand-following hypotheses. The supply-leading theory considers that well-structured and developed financial institutions increase the supply of credit, which causes GDP growth. In contrast, the demand-following theory states that growth in GDP creates demand for financial services by economic agents, which spurs expansion and development in the financial sector.

The demand-following hypothesis is consistent with Robinson (1952) who argues that it is growth that derives the demand for credit thereby enhancing financial deepening within an economy. However, King and Levine (1993) constructed several financial development indicators by using mainly banking sector variables. The authors investigated the relationship between these indicators and economic growth in 80 countries over the period from 1960 to 1989. The results revealed that financial development indicators are positively correlated with economic growth and have a significant predicative power for economic growth over the period of the study.

In a related study, Atje and Jovanovic (1993) argued that the financial indicators of King and Levine (1993) may be less informative since it does not adjust for the role of stock markets in economic growth process. In this regard, Atje and Jovanovic (1993) calculated the financial development indicators by using the bank-based variables, as well as accounting for the impact of stock markets on economic growth. Their empirical analysis showed that the role of stock markets is positive and significantly causes economic growth. The authors constructed their indicators by using mainly banking sector variable. Whereas Atje and Jovanovic (1993) calculate the financial development indicators considering the role of stock markets in causing economic growth. It is interesting to note that stock markets have a positive relationship with economic growth (Atje and Jovanovic, 1993).

The development in the empirical literature criticizes the cross-section study for its weaknesses as summarized by Ang (2008). First, the assumption of the empirical studies, which is based on a finance-leading view, raises the problem of endogeneity. Thus, the inappropriate or lack of control for endogeneity in the single equation, which is used by this approach, makes the estimation of the cross-section analysis biased and inconsistent. Second, it assumes a static relationship between financial development and economic growth, thereby causing doubt about the short-run and long-run causality**.** This view is supported by Ericsson et al. (2001) who write that the cross-section studies ignore the level relationship, so the causality is a short-run relationship rather than a long-run relationship. Third, averaging the data does not help in explaining and capturing the individual feature of the financial institutions and financial history for each country.

In addition to the above concerns, a seminar work by Demetriades and Hussein (1996) argue that the cross-section method does not identify the different forms of causality across countries in the sample. They added that the findings from this method "cannot be seen as substitutes for the standard causality tests using time-series data" (p391). As such, they adopted a time-series approach in investigating the finance-growth nexus, namely, the time-series approach. The authors estimate the causality relationship between financial development and real GDP per capita using time-series data in 16 developing and developed countries. They use two indicators for financial development, namely, ratio of bank deposit liabilities to nominal GDP and ratio of bank claims on the private sectors to nominal GDP. Although their findings do not support the theory that credit is the main cause of economic development, they find a bi-directional causality between financial indicators and economic growth.

Arestis and Demetriades (1997) found a heterogeneous causality relationship across countries, which are explained by the degree of development in the financial system and financial institutions in each country. As a consequence, the authors support the finding of Demetriades and Hussein's (1996). In a related study, Ang and McKibbin (2007) investigate the causal relationship between financial development and economic growth in Malaysia using time-series from 1960 to 2001. They constructed a new indicator for financial development based on principal component analysis. Their main finding is that the reform in the financial institutions helps in expanding the financial systems but it does not promote the economic growth. The causality results show that economic growth causes higher financial development, which supports the demand-following theory.

Ang (2008), however, argues that the short time horizons in the macroeconomic data sets used in Demetriades and Hussein (1996), and Arestis and Demetriades (1997) may not appropriately capture the causality dynamics as compared to using a longer period data set. Although, given the importance of the individual country results for policy-makers, Ang (2008) raised the issue of the direction of causality based on country specifics and such findings cannot be generalized.

To overcome the drawbacks of the cross-section and time-series techniques, the panel approach is used to account for the cross-section and time dimensions. Calderón and Liu (2003) investigate the causality relationship between financial development and economic growth in panel data for 109 countries using the Geweke decomposition test. The outcome shows that financial development promotes economic growth, while a bi-directional causality is confirmed as the sample is divided into developing and developed countries. More specifically, financial development Granger causes economic growth in developing countries more than developed economies. Similarly, Christopoulos and Tsionas (2004) employed time-series and panel causality tests to examine the direction of causality between financial development and economic growth and their findings support the supply-leading view: financial development Granger causes economic growth.

Moreover, Cappiello et al. (2010) used an OLS panel procedure to explore the existence of a significant relationship between GDP and loan growth within the Euro area over the period 1999Q1-2008Q1. Specifically, the authors examined the following thesis: (1) the relationship between GDP growth and total loan growth; (2) the nexus between GDP growth and changes in credit standards. The results confirm a positive and significant relationship between GDP and loans growth, while a negative impact of changes in credit standards on economic growth. Recent studies pay much attention to the relationship between the size of financial intermediation and economic growth, as well as accounting for volatility of credit to private sector growth. For instance, Beck et al. (2013) analysed the data set of 77 countries between 1980 and 2007. They found a positive long-run relationship between the size of the financial sectors and economic growth, but this relationship appears to be insignificant over a short-run period of 5 - years. While a higher level of credit to private sector is associated with lower volatility, it becomes negative and significant in the short-run using a 5-year window.

Conversely, the relationship between financial development indicators and economic growth has changed over-time. This view is supported by Rousseau and Wachtel (2011) who declare that the relationship between financial development and growth appears to become weaker. In the same vein, Beck et al. (2013) in their re-estimation of this relationship focusing on the period between 1995 and 2007 support the argument that finance-growth relationship has changed and became a weaker relationship overtime.

A small number of studies have attempted to investigate the relationship between Islamic finance and GDP (see Furqani and Mulyany, 2009; Majid and Kassim, 2010; Abduh and Omar, 2012; Imam and Kpodar, 2015, among others). A recent study by Imam and Kpodar (2015) used a sample of countries with and without Islamic banks and show that these countries experience faster economic growth than those without Islamic banks. Detailed examination of the short-run and long-run relationship between Islamic finance and economic growth in Indonesia by Abduh and Omar (2012) show that bi-directional causality between Islamic finance and economic growth. While Majid and Kassim (2010) support the "supply-leading" view; Furqani and Mulyany (2009) support the "demand-following" view in Malaysia using causality tests. Using fixed investments as an indicator for economic growth, Furqani and Mulyany (2009) find that economic growth promotes financial development in Islamic banking only in the short run. Furthermore, Gheeraert (2014) finds that the development of Islamic banks has a significant impact on the overall banking sector development in countries with dual banking system. Additionally, they confirm that Islamic banks have a complementary role beside their conventional ones.

According to the traditional literature on the finance-growth nexus, there is no consensus on either the direction of causality between economic growth and financial development or the best measures of financial development. This discussion has been clearly focussed on issues around the long run relationship between financial development and the growth of GDP, but causality has several dimensions in addition to the long run structure. Most recently, the BIS has focused on the role of credit, and whether it might be used as an early warning indicator (EWI), since excessive lending is thought to be one of the main factors that have caused the global financial crisis of 2007-8. The new data set by BIS shows that credit has significantly outgrown GDP during the period from 1954 to 2014. In the 1950s, the percentage of total credit to GDP was around 50% in the developed countries while prior to the recent financial crisis in 2007 some countries experienced high increases in the level of credit accounting for around 200% of GDP (Dembiermont et al., 2013). The growing literature on credit highlights the importance of using total credit rather than only using credit by banks as indicators for an early warning system. According to Drehmann and Tsatsaronis (2014, p55) the credit-to-GDP gap or so called credit gap is the "difference between the credit-to-GDP ratio and its long-term trend". The credit-to-GDP ratio was in fact adopted by the Basel III committee (2010) as a guide to build up countercyclical capital buffers during booms in order to use them during crises (e.g., Borio and Lowe, 2002; Borio and Drehmann, 2009; Drehmann et al., 2011; Dembiermont et al., 2013; Drehmann, 2013; Behn et al., 2013; Buncic and Melecky, 2013; Drehmann and Juselius, 2014; Farrell, 2014; and Drehmann and Tsatsaronis, 2014).

4.2.2 Overview of Islamic Banking

The principles of Islamic finance are based on the Quran, hadith[2] and Islamic jurisprudence (Sharia). The first is the prohibition of interest payment (Riba), defined by some Islamic scholars as usury, and by others as any pre-determined interest rate (Chong and Liu, 2009). In the Holy Quran, ten statements/verses condemned the practice of Riba or charging pre-determined interest rate. For example, the

[2] Hadith stands for the actions and quotations of the Prophet Mohammad, which are one of the main sources of Islamic guidance in many aspects of Muslim life including economic activities.

Surah/chapter al-Baqarah says: "O you who believe! Fear God and give up whatever remains of Riba (usury), if you are believers" (Quran 2:278). Another verse in the Surah al-Baqarah distinguishes between Riba and trading: “Allah has allowed trading and forbidden Riba (usury)” (Quran 2:275). Accordingly, many financial contracts are constructed on the basis of the difference between trading and Riba as well as Islamic jurisprudence (Sharia), for instance Musharaka (partnership), Mudharabah (profit-sharing), Murabahah (cost plus) and Ijarah (leasing) contracts[3]. Thus, Islamic financial institutions are not allowed to make money through pure financing, and financial contracts must be linked directly to real economic activities (Gulzar and Masih, 2015; Kammer et al., 2015). Each financial transaction is underpinned by an existing or potential real asset, in contrast to the case of conventional banks that can provide credit without such constraints (see Siddiqi, 2006 and Askari, 2012).

The second principle is based on the profit and loss sharing paradigm (PLS) between the two parties of any financial contract, which is seen as a crucial feature that distinguishes Islamic from conventional banks. Furthermore, the conventional ex-ante interest rate, which is a risk-shifting rate, is replaced by the ex-post profit and loss sharing rate (PLS), which is instead a risk-sharing rate (Chong and Liu, 2009). This is thought to encourage Islamic banks to invest in small and medium enterprises (SMEs) and long-term ventures, and thus to stimulate economic growth (Chapra, 1992; Mills and Presley, 999; Iqbal and Mirakhor, 2013). Furthermore, the prohibition of the conventional ex-ante interest rate is viewed as a foundation for improvements in both social justice and economic efficiency (El-Gamal, 2006 and Berg and Kim, 2014).

The third principle does not allow Islamic banks to engage in any speculative transactions, option and futures contracts, hedging, toxic assets, gambling and funding of any activities which are considered harmful to the community such as producing alcohol (Hasan, Dridi 2010; Khan, 2010 and Kammer et al., 2015). It is thought that financing such activities would cause an increase in prices rather than contributing to GDP. The fourth principle requires asset-backing: transactions should be related to a tangible, underlying asset. In addition, the main criterion for the allocation of credit by Islamic banks is the productivity of the project, instead of the creditworthiness of the customer as in the case of conventional banks. Therefore, credit is channelled to productive investment rather than speculative activities, which are not allowed according to the principles of Islamic finance (Di Mauro et al., 2013). Bernanke (2009)

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[3] For more details see Appendix A4.

and Turner (2009) argue that excessive and unproductive credit growth, investment in speculative transactions and interest-based debt financing were in fact some of the main causes of the 2007-8 financial crisis. In contrast, in the Islamic banking system, these activities are either not allowed or partly mitigated – for instance, as highlighted by Mohieldin (2012), asset-backed debt guarantees a direct relationship between loans and the real economy. In this way, greater market discipline and financial stability are achieved (Di Mauro et al., 2013). Given the distinctive features of Islamic banking, one would expect to find differences in the role of credit between countries with and without Islamic banks. More specifically, Islamic finance is underpinned by an existing or potential real asset, so we would expect that credit to cause GDP in the long run in countries with Islamic banks. This is the issue analysed in the present study. In the following sections, we will discuss the data set and the methodology.

4.3 Data Description

We investigate the causal relationship between real credit to the private sector and real GDP in fourteen emerging countries using sufficiently long time series data. These countries have a similar level of development and without recent long periods of colonial history affecting their institutions. The data set is divided into two subsamples (see Table 4.1), namely : (1) Latin American countries with no Islamic banks, including Argentina, Brazil, Chile, Costa Rica, Ecuador, Guatemala, and Peru; (2) countries with Islamic and conventional banks, which comprise Malaysia, Indonesia, Turkey, Iran, Jordan, Singapore and Tunisia.[4] Oil exporting countries with Islamic banks are excluded from the sample since their economic growth might be mainly driven by oil revenues rather than financial development or credit. However, Iran has been included because of its diversified economy which does not depend solely on oil revenues.

The data is drawn from the International Monetary Fund (IMF) database, which is seasonally adjusted to eliminate the potential effects of seasonality on our estimates. Specifically, we use real credit to the private sector (Cr), and real gross domestic product (GDP). We consider credit as gross credit injected into all private sectors of the

[4] The countries in the second subsample are chosen based on the Bankscope country classification of Islamic and conventional banks.

economy, i.e. excluding credit to the government (IMF, 2014)[5]. The government exclusion is because credit to the private sector increases in boom periods and decreases during credit crunches or crises, whereas credit to the public sector moves in the opposite direction (see Drehmann et al., 2011).

Table 4.2 presents the descriptive statistics of real GDP and real credit to the private sector of the two subsamples. For each variable, basic descriptive statistics and Jarque-Bera test (JB) of normality are presented. As regards the countries with Islamic banks, Jordan and Indonesia have the lowest and highest economic output and credit volumes to the private sector, respectively (see Table 4.2 Panel B). Furthermore, the lowest and highest economic output and credit to the private sector among countries without Islamic banks are observed in Costa Rica and Brazil, in that order (see Panel A of Table 4.2). In addition, the standard deviates for all the countries show that the GDP and credit to the private sector values tend to deviate more from their expected values. However, the deviations are more pronounced in the countries with Islamic banks.

Table 4.1 Sample of Countries

Data Set 1 Countries without Islamic Banks	Period	Data Set 2 Countries with Islamic Banks*	Period
Argentina	1993Q1-2013Q1	Indonesia	2001Q4-2013Q1
Brazil	2001Q4-2013Q1	Turkey	2001Q4-2012Q4
Chile	1997Q4-2013Q1	Iran	1994Q1-2007Q4
Costa Rica	2001Q4-2012Q4	Singapore	2003Q1-2013Q1
Ecuador	2001Q4-2012Q2	Jordan	1992Q1-2012Q4
Guatemala	2001Q4-2012Q4	Tunisia	2000Q1-2012Q4
Peru	1996Q1-2012Q4	Malaysia	2001Q4-2012Q4

Note: * Classified with Islamic banks according to Bankscope database.

The JB test failed to reject that credit is normally distributed in Brazil, Chile, Costa Rica, Ecuador, Guatemala, Indonesia, Singapore and Malaysia in both panels. However, this test reveals that credit is not normally distributed in Argentina, Peru, Iran and Jordan at the 1% level. Similarly, the JB test rejects the normality of GDP in four countries-Argentina, Peru, Iran and Jordan.

In terms of excess kurtosis and skewness, credit to the private sector exhibits excess kurtosis and is positively skewed in three countries, including Argentina, Peru and Iran. GDP also exhibits excess kurtosis and skewness in two countries: Argentina

[5] "Claims on private sector include gross credit from the financial system to individuals, enterprises, nonfinancial public entities not included under net domestic credit, and financial institutions not included elsewhere" (IMF-IFS line 32d).

and Iran. In both countries with and without Islamic banks, GDP and credit to private sector are positively skewed except for Singapore, which shows a negatively skewed GDP (see Table 4.2).

Table 4.2 Summary of descriptive statistics for credit and GDP

Panel A: Countries without Islamic Banks								
	Variable	Argentina	Brazil	Chile	CostaRica	Ecuador	Guatemala	Peru
Mean	Credit	99870.15	704847.3	18740.63	5508.063	10928.92	63548.12	61504.52
	GDP	683826.7	1257260	48099.18	3389.046	12900.84	65892.21	70018.58
St. Dev	Credit	85834.51	253648.7	22983.08	3123.105	4946.739	21882.91	31564.11
	GDP	595919.3	820646.9	7891.308	1407.419	4316.059	19632.00	29940.39
Min	Credit	37680.37	336492.6	19387.08	1467.960	4965.563	31259.41	21759.39
	GDP	223991.2	382406.9	9150.734	1417.687	6384.677	38467.71	32629.44
Max	Credit	408004.0	1220474	97289.74	11000.14	21859.28	121762.2	142796.1
	GDP	2461950	3093791	33867.75	5768.434	20984.91	101324.8	135014.2
Skewness	Credit	2.027	0.324	0.500	0.189	0.594	0.404	1.186
	GDP	1.466	0.806	0.398	0.158	0.249	0.245	0.693
Ex. kurtosis	Credit	6.347	1.878	2.025	1.535	2.298	3.00	3.244
	GDP	4.027	2.411	1.829	1.685	1.901	1.754	2.212
JB	Credit	93.346***	3.216	5.042	4.292	3.418	1.226	16.133***
	GDP	32.585***	5.652*	5.184	3.428	2.608	3.358	7.209**
Obs	Credit	81	46	62	45	43	45	68
	GDP	81	46	62	45	43	45	68

Panel B: Countries with Islamic Banks								
Statistics	Variable	Indonesia	Turkey	Iran	Singapore	Jordan	Tunisia	Malaysia
Mean	Credit	1095585	274679.2	171511.7	256633.6	6923.090	26284.25	686856.2
	GDP	1118588	208677.6	175352.4	65438.53	2352.280	11538.97	161416.8
St. Dev	Credit	680260.3	217948.5	236101.7	77686.10	4428.236	9612.233	191713.5
	GDP	564432.2	83842.08	204990.3	15293.24	1433.630	3144.230	45998.68
Min	Credit	294763.6	33557.72	4636.539	168642.4	2004.358	13123.26	448221.6
	GDP	427350.1	68784.23	5269.603	39371.97	881.945	7162.824	88475.43
Max	Credit	2656303	772647.7	988511.3	432203.2	16138.58	48086.03	1106141
	GDP	2170798	360824.3	824121.5	87169.01	5687.685	17020.73	237320.7
Skewness	Credit	0.410	0.821	1.778	0.753	0.742	0.775	0.586
	GDP	0.730	0.185	1.413	-0.142	0.992	0.247	0.024
Ex. kurtosis	Credit	2.486	2.558	5.382	2.396	2.031	2.568	2.222
	GDP	1.804	2.060	4.102	1.795	2.576	1.656	1.766
JB	Credit	4.601	5.430*	59.58***	4.497	10.998***	5.289*	3.716
	GDP	4.028	1.913	29.93***	2.619	14.415***	4.186	2.856
Obs	Credit	46	45	78	41	84	49	45
	GDP	46	45	78	41	84	49	45

Notes: ***, **, and * indicate significance at the 1 %, 5%, and 10% levels, respectively. JB is the Jarque-Bera test for normality.

4.4 Methodology

4.4.1 Theoretical Discussion on the Causality Inference in a Bivariate Model.

It should be noted that bivariate causality inference might be invalid if a relevant variable has been omitted (see Caporale and Pittis, 1997). In our case, in the absence of capital restrictions, ideally one could include foreign direct investment (FDI) and estimate a trivariate system. However, for most countries the FDI variable is only available in an annual frequency supported by the World Bank, IMF, United Nations Conference on Trade and Development (UNCTAD) and OECD databases. Using interpolation methods to obtain quarterly data from the annual ones have well-known limitations, for instance, the logarithms of four quarterly estimates do not add up to that of the yearly estimate (e.g., Chow and Lin, 1971, Fernandez, 1981, Palm and Nijman, 1984 and Guerrero, 1990). Therefore, employing interpolated data to investigate the direction of causality between the two variables may produce less accurate results, and hence we exclude FDI from our analysis. Although, in some respects, the exclusion may have an effect on the causality inference, but this is less severe as compared to that of using interpolated data.

4.4.2 Time Series Approach

The testing process involves three stages. The first step is to determine the order of integration for the used variables by using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests before secondly performing two tests of cointegration, namely, the Engle and Granger (1987) two-step procedure and the Johansen (1988) tests. Our third step is causality estimation, which is preceded based on the findings from the cointegration tests. If there is no evidence of cointegration, the causality test is applied on first-differenced VARs representation, as below in Eqs.(4.1) and (4.2). However, if the two variables are $I(1)$ and cointegrated, causality tests are carried out using the vector error correction model (VECM) representation, as below in Eqs. (4.3) and (4.4).

4.4.2.1 Granger causality analysis

Granger Causality tests are very popular in the economics and finance literature to test the causality between any two variables. They are robust and can be extended to use in multivariate time series. If the cointegration does not exist, Granger causality test can be written as follows (Engle and Granger, 1987)

$$\Delta RGDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i}\, \Delta RGDP_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\, \Delta \mathrm{RCR}_{\,t-i} + \epsilon_{1t}, \tag{4.1}$$

$$\Delta \mathrm{RCR}_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i} \Delta RCR_{t-i} + \sum_{i=1}^{k} \beta_{2i}\, \Delta \mathrm{RGDP}_{\,t-i} + \epsilon_{2t}, \tag{4.2}$$

where $RGDP_t$ is the log of real gross domestic product while RCR_t stands for the log of real credit to private sector; Δ is the first difference operator; $\alpha_1\ and\ \alpha_2$ are constant drifts; β_{ji} and φ_{ji} are polynomials of order k-1 and $\epsilon_{1t}\ and\ \epsilon_{2t}$ are the residuals. Failure to reject the null hypothesis of $H_0: \sum_{i=1}^{k} \varphi_{1i} = 0$ implies that real credit to the private sector does not Granger-cause real GDP. Similarly, failure to reject the null hypothesis of $H_0: \sum_{i=1}^{k} \beta_{2i} = 0$ implies that real GDP does not Granger-cause real credit to the private sector. Eqs. (4.1 and 4.2) are estimated when $RGDP_t\ and\ \mathrm{RCR}_t$ are $I(1)$ and are not cointegrated using differenced data, and in levels if the series are I(0).

Following Engle and Granger (1987), if the order of integration of the series is I(1) and they are cointegrated, an error correction term (ECT) is introduced into the model. Therefore, a VECM is specified as follows:

$$\Delta RGDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i}\, \Delta RGDP_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\, \Delta RCR_{\,t-i} + \delta_1 ECT_{t-1} + \epsilon_{1t}, \tag{4.3}$$

$$\Delta RCR_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i}\, \Delta RCR_{t-i} + \sum_{i=1}^{k} \beta_{2i}\, \Delta RGDP_{t-i} + \delta_2 ECT_{t-1} + \epsilon_{2t}, \tag{4.4}$$

where α_1 *and* α_2 are constant drifts, ECT_{t-1} is the error correction term, which represents the deviations from the long-run cointegration relationship, and δ_1 *and* δ_2 denote the speeds of adjustment towards the long-run equilibrium, which are expected to be negative (Granger et al., 2000).

Therefore there are two sources of causality between $RGDP_t$ and RCR_t, either through the error correction term (ECT_{t-1}) or through the lagged dynamic terms $\Delta RCR_{\ t-i}$ in Eq. (4.4). Consequently, one can test for three types of causality between real GDP and real credit to the private sector. First, one can test whether $\Delta RCR_{\ t}$ Granger-causes $\Delta RGDP_t$ in the short run by carrying out a Wald test of the null hypothesis H_0: $\sum_{i=1}^{k} \varphi_{1i} = 0$. Second, one can test for long-run causality by performing a weak-exogeneity test on the coefficient of the lagged error correction term ECT_{t-1}. Failure to reject the null hypothesis H_0: δ_1=0 implies that real credit to the private sector does not Granger-cause real GDP in the long run. Third, strong exogeneity can be tested by testing the joint significance of the coefficients on the lagged dynamic terms and the lagged error correction term (Engle et al., 1983 and Charemza and Deadman, 1997). The null hypothesis in this case is H_0: $\sum_{i=1}^{k} \varphi_{1i} = \delta_1 = 0$. However, this test does not allow distinguishing between long- and short-run causality (Ang and McKibbin, 2007).

To sum up, when the variables are stationary, the causality test is performed on their levels. However, when the variables are non-stationary a cointegration relationship between them is examined. On the one hand, if the variables are not cointegrated then the causality test is performed on their first differences as in Eqs. (4.1) and (4.2). On the other hand, if they are cointegrated, the VECM causality tests technique is applied by using the error correction term in Eqs. (4.3) and (4.4) (see Engle-Granger, 1987 and Johansen, 1988). In this respect, three types of causality tests are employed: (1) short-run test using the lagged dynamic terms; (2) weak-exogeneity test, which considers the first lagged error correction term; (3) strong-exogeneity test, which tests both the lagged dynamic terms and the first lagged error correction term (see Table 4.3 for a tabular summary).

In the cointegration analysis, if the Engle-Granger (1987) and Johansen (1988, 1995) tests produce contradictory results, more weight is attached to the former given the poor finite sample properties of the latter (see Banerjee et al., 1986; Demetriades and Hussein, 1996) and the fact that, being a two-stage residual-based test, any error occurring in the first stage is passed directly onto the second stage (Asteriou and Hall, 2015). In the case of causality inference, we follow Demetriades and Hussein (1996): if the findings from the VECM and VAR specifications differ, we place more weight on the former.

Table 4.3. Timeline of The Time-Series Technique

1. Unit root tests	2. Cointegration tests	3. Causality tests	
1.1Stationary →	No need to test for → cointegration	3.1 Run Granger-causality test on level of data	
1.2Non-stationary	2.1Non-cointegrated →	3.2 Run Granger-causality test using first differenced data	
	2.2 Cointegrated →	3.3 Run ECM based causality when data are cointegration→	Three types of causality: A. **Short-run test** using the lagged dynamic terms B. **weak-exogeneity test** using first lagged error correction term. C. **strong-exogeneity test** tests both the lagged dynamic terms and the first lagged error correction term.

Note: the panel approach follows the same estimation process.

Time-series techniques have been criticised because small sample distortions can affect the power of standard unit root and cointegration tests (see Christopoulos and Tsionas, 2004). These issues can be addressed using panel approaches (Ang, 2008) to carry out cointegration tests with higher power (Persyn and Westerlund, 2008). With this in mind, we apply various panel methods as well to check the robustness of our findings (see below).

4.4.3 Panel Approach

4.4.3.1 Panel Unit Root Tests

We employ the Maddala and Wu (1999) and Im et al. (2003) panel unit root tests. The MW test is a test for heterogeneous panel, while the IPS test is a test for dynamic heterogeneous panel, which uses the average of each individual statistical value of the ADF unit root test.

4.4.3.1.1 Im, Pesaran, and Shin (IPS) Test

The panel unit root test by Im et al. (2003) is specified as follows for each cross section[6]:

$$\Delta y_{i,t} = \alpha_i + \beta_i y_{i,t-1} + \sum_{j=1}^{k} \varphi_{ij} \Delta y_{i,t-j} + \epsilon_{i,t} \,. \tag{4.5}$$

In Eq. (4.5), $y_{i,t}$ represents each variable ($RGDP_t$ and RCR_t) in our model in the current chapter and α_i denotes as the individual fixed effect, i =1, 2, 3…, N cross-section units or series and over periods of t = 1, 2, 3…, T.

The null hypothesis is presented as:

$$H_0 : \beta_i = 0, \qquad \text{for } i = 1,\ 2,\ 3\ \ldots,\ N,$$

while the alternative hypothesis is written as:

$$H_A : \beta_i < 0, \qquad \text{for at least one } i$$

The IPS statistic is constructed using average individual ADF statistics as follows:

$$t_{IPS} = \frac{\sqrt{N}\left(\bar{t} - E[t_i |\ \beta_i = 0]\right)}{\sqrt{var\ [t_i | \beta_i = 0]}} \rightarrow N(0,1). \tag{4.6}$$

In Eq. (4.6), $\bar{t} = N^{-1} \sum_{i=1}^{N} t_i$. The values of both $E[t_i |\ \beta_i = 0]$ and $var\ [t_i | \beta_i = 0]$ are calculated using Monte Carlo procedure

[6] For more discussion about the IPS unit root test, see Christopoulos and Tsionas (2004)

4.4.3.1.2 MW Statistic (Fisher-ADF and Fisher-PP Tests)

The MW statistic is implemented as a Fisher-type test of combining the p-values from each cross-sectional unit root test, which is defined as follows (see Maddala and Wu, 1999 and Breitung, 2000):

$$P_{MW} = -2\sum_{i=1}^{N} \ln p_i \tag{4.7}$$

where p_i denotes the p-value from a single unit root test for each cross-section i. The test follows a x^2 distribution with $2N$ degree of freedom as $T_i \rightarrow \infty$ for all N (Baltagi and Kao, 2000).

According to Maddala and Wu (1999), the MW approach is superior to the IPS test. The latter is sensitive to the specification of deterministic trends compare to the former. For instance, the IPS test suffers from loss of power when individual trends are included (Breitung, 2000). On the other hand, MW approach is calculated based on different lag lengths for each individual unit root regression.

4.4.3.2 Panel cointegration Tests

In this section, we apply a number of panel cointegration tests. First, we use two residual-based tests, namely Kao (1999) and Pedroni (2004) tests. Second, we perform the Westerlund (2007) test, which is an error correction test.

4.4.3.2.1 Kao Test

Following Engle-Granger (1987), Kao (1999) developed a residual-based panel cointegration test where an ADF test is performed on estimated residuals, which are estimated as follows:

$$\hat{e}_{i,t} = \rho\hat{e}_{i,t-1} + \sum_{j=1}^{n} \vartheta_j \, \Delta\hat{e}_{i,t-j} + v_{it}\,. \tag{4.8}$$

The ADF test statistic, with the null hypothesis of no cointegration, is computed as:

$$ADF = \frac{t_{ADF} + \frac{\sqrt{6N\hat{\sigma}_v}}{2\hat{\sigma}_{0\,v}}}{\sqrt{\frac{\hat{\sigma}_{0\,v}^2}{2\hat{\sigma}_v^2} + \frac{3\hat{\sigma}_v^2}{10\hat{\sigma}_{0v}^2}}},$$

(4.9)

where t_{ADF} represent the ADF-statistic of the formula in Eq (4.8). Based on the sequential limit theory, the ADF test statistics follows the normal distribution (Asteriou and Hall, 2015).

4.4.3.2.2 Pedroni Tests

Pedroni (2004) suggests various methods for testing the long-run relationship, which can be classified into two groups of seven different cointegration statistics. The first group (panel statistics) includes four tests based on pooling the residuals of the estimated model within-dimension of the panel and it consists of. The second group (group statistics) consists of three tests based on pooling the residuals of the equation between-dimension. The long-run coefficients are estimated using the dynamic ordinary least squares (DOLS).

The null hypothesis of no cointegration can be presented as:

$H_0 : p_i = 1,$

while the two alternative hypothesises can be written as:[7]

$H_A : (p_i = p) < 1,$ for all *i* (panel statistics or within-dimension)

$H_A : p_i < 1,$ for all i (group statistics or between-dimension)

The standardized statistic is calculated as:

$$\frac{\aleph_{N,T} - \mu\sqrt{N}}{\sqrt{v}} \rightarrow N(0,1),$$

(4.11)

[7] For a detailed discussion on Pedroni test, see Pedroni (2004) and Asteriou and Hall (2015).

where $v\ and\ \mu$ are Monte Carlo generated adjustment terms and $\aleph_{N,T}$ is the panel cointegration statistic.

4.4.3.2.3 Westerlund approach

Westerlund (2007) proposed a non-residual-based panel cointegration test with a null hypothesis of no cointegration. The author showed that, for small samples, the new test has higher power and produces accurate results than those of the residual-based cointegration tests. Hence, we employ the Westerlund cointegration approach as follows. The panel cointegration regression can be written as:

$$\Delta y_{it} = \delta'_i d_t + \alpha_i y_{it-1} + \lambda'_i x_{it-1} + \sum_{j=1}^{\rho_i} \alpha_{ij}\, \Delta y_{it-j} + \sum_{j=0}^{\rho_i} \gamma_{ij}\, \Delta x_{it-j} + e_{it}, \tag{4.12}$$

where $d_t = (1, t)'$ is the deterministic components, $\alpha_i$is the error correction parameter, ρ_i is the lag order which is allowed to vary in each individual, which is chosen by Akaike Information criterion (AIC). The test computes two pairs statistics, namely the group mean statistics, and the pooled test statistics. Based on the former, the alternative hypothesis assumes that the panel is cointegrated as a whole; while the latter considers the alternative hypothesis: at least one of the individual cross-sectional units is cointegrated (Persyn and Westerlund, 2008).

Specifically, the test proposes two main statistics: the group mean and panel statistics, which are calculated based on the least squares estimate of α_i in Eq (4.12**).** The estimation of the group mean statistics requires three steps as follows: The first step is to run Eq **(**4.12) for each individual *i*, which gives

$$\Delta y_{it} = \hat{\delta}'_i d_t + \hat{\alpha}_i y_{it-1} + \hat{\lambda}'_i x_{it-1} + \sum_{j=1}^{\rho_i} \hat{\alpha}_{ij}\, \Delta y_{it-j} + \sum_{j=0}^{\rho_i} \hat{\gamma}_{ij}\, \Delta x_{it-j} + \hat{e}_{it}. \tag{4.13}$$

The second step requires estimating the equation below.

$$\alpha_i(1) = 1 - \sum_{j=1}^{\rho_i} \alpha_{ij}, \tag{4.14}$$

The last step is to calculate the G_τ and G_α group mean test statistics as:

$$G_\tau = \frac{1}{N}\sum_{i=1}^{N}\frac{\hat{\alpha}_i}{SE(\hat{\alpha}_i)} \text{ and } G_\alpha = \frac{1}{N}\sum_{i=1}^{N}\frac{T\hat{\alpha}_i}{\hat{\alpha}_i(1)}, \tag{4.15}$$

Where $SE(\hat{\alpha}_i)$ is the standard error of $\hat{\alpha}_i$. Now, the panel approach allows both the dimension and parameters of Eq (4.12) to vary across the cross-sectional components. Similarly, the panel statistics are applied in three steps. The first step is to estimate Eq. (4.12) which yields the following projection errors as:

$$\Delta\tilde{y}_{it} = \Delta y_{it} - \hat{\delta}'_i d_t - \hat{\lambda}'_i x_{it-1} - \sum_{j=1}^{\rho_i}\hat{\alpha}_{ij}\,\Delta y_{it-j} - \sum_{j=0}^{\rho_i}\hat{\gamma}_{ij}\,\Delta x_{it-j}, \tag{4.16}$$

and

$$\tilde{y}_{it-1} = y_{it-1} - \tilde{\delta}'_i d_t - \tilde{\lambda}'_i x_{it-1} - \sum_{j=1}^{\rho_i}\tilde{\alpha}_{ij}\,\Delta y_{it-j} - \sum_{j=0}^{\rho_i}\tilde{\gamma}_{ij}\,\Delta x_{it-j}. \tag{4.17}$$

The second step requires estimating the error correction parameter α and its standard error by using $\Delta\tilde{y}_{it}$ and $\tilde{y}_{it-1}$. The final step is to calculate the ρ_τ and ρ_α panel mean test statistics as:

$$\rho_\tau = \frac{\hat{\alpha}}{SE(\hat{\alpha})} \text{ and } \rho_\alpha = T\hat{\alpha} \tag{4.18}$$

4.4.3.3 Panel Causality Test

In this section, we apply a panel causality test. If the two variables are not cointegrated, the following model is estimated: [8]

[8] See Asteriou and Hall (2015).

$$\Delta RGDP_{it} = \alpha_{1i} + \sum_{K=1}^{m} \beta_{1,i,k}\ \Delta RGDP_{i,t-k} + \sum_{k=1}^{m} \varphi_{1,i,k}\ \Delta R\mathrm{CR}_{\ i,t-k} + \epsilon_{1it},$$

(4.19)

$$\Delta RCR_{it} = \alpha_{2i} + \sum_{k=1}^{m} \varphi_{2,i,k}\ \Delta RCR_{i,t-k} + \sum_{k=1}^{m} \beta_{2,i,k}\ \Delta RGDP_{\ i,t-k} + \epsilon_{2it},$$

(4.20)

where *i* is the country (*i* = 1 ,2 , 3……N), *t* refers to time period (t = 1 ,2 , 3…T), and m is the lag lengths. The causality relationship can be tested using the standard Wald test in Eqs. (4.19 and 4.20) Failure to reject the null hypothesis of $H_0 \sum_{k=1}^{m} \varphi_{1,i,k} = 0$ implies that the real credit to private sector does not Granger cause the real GDP. Likewise, failure to reject the null hypothesis of $H_0\colon \sum_{k=1}^{m} \beta_{2,i,k} = 0$ suggests that real GDP does not Granger-cause the real credit to private sector. Eqs. (4.19) and (4.20) are estimated when $RGDP_t$ *and* RCR_t are *I*(1) and are not cointegrated using differenced data, while causality tests are estimated using level data, if the data are *I*(0),

If $RGDP_{it}$ and RCR_{it} are cointegrated, an error correction term is introduced to our equation to test for causality as follows:

$$\Delta RGDP_{it} = \alpha_{1i} + \sum_{K=1}^{m} \beta_{1,i,k}\ \Delta RGDP_{i,t-k} + \sum_{k=1}^{m} \varphi_{1,i,k}\ \Delta R\mathrm{CR}_{\ i,t-k} + \delta_{1i} ECT_{i,t-1} + \epsilon_{1it}$$

(4.21)

$$\Delta RCR_{it} = \alpha_{2i} + \sum_{k=1}^{m} \varphi_{2,i,k}\ \Delta RCR_{i,t-k} + \sum_{k=1}^{m} \beta_{2,i,k}\ \Delta RGDP_{\ i,t-k} + \delta_{2i} ECT_{i,t-1} + \epsilon_{2it}$$

(4.22)

Similar to the time series approach, we can test for three types of causality between real DP and the real credit to private sectors. First, with respect to short-run causality, the null hypothesis of H_0: $\varphi_{1,i,k} = 0$ for all *i* and *k* in Eq. (4.21) or H_0: $\sum_{k=1}^{m} \beta_{2,i,k} = 0$ in Eq. (4.22). Failure to reject the null hypothesis of $H_0\colon \sum_{k=1}^{m} \varphi_{1,i,k} = 0$ implies that the real credit to private sector does not Granger cause the real GDP in the short-run. Second, the long-run causality can be tested by setting the null hypothesis of H_0: $\delta_{1i} = 0$ for all *i* in Eq. (4.21) or H_0: $\delta_{2i} = 0$ for all *i* in Eq. (4.22). Finally, we examine the strong-exogeneity test of both lagged dynamic terms and the first lagged error correction term. Accordingly, non-rejection of the null hypothesis of H_0: $\sum_{k=1}^{m} \varphi_{1,i,k} = \delta_{1i} = 0$ in Eq. (4.21), implies that RCR_{t} does not cause $RGDP_t$.

4.5 Empirical Analysis

In this section, we present the empirical analysis as follows: we perform a unit root test on all the variables; we examine potential cointegration relationships between the covariates; and conduct a bivariate causality inference.

4.5.1 Unit Root Tests

As a first step, we carry out a battery of unit root tests to examine the stochastic properties of the individual series using Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1981) and Phillips-Perron (PP) tests (Phillips-Perron, 1988). These tests suggest that real credit to the private sector and real GDP are non-stationary I(1) in levels in the countries with and without Islamic banks.

We also applied panel unit root tests, namely the MW (Maddala and Wu. 1999) and Im, Pesaran and Shin (IPS) tests (Im et al., 2003). We choose these tests as they allow for heterogeneity in the autoregressive coefficient and can deal with an unbalanced panel, which is the case of our sample. In addition, the first generation panel method, such as Levin and Lin (1993), has low power and serial correlation problems (Bangake and Eggoh, 2011)[9]. Interestingly, the results of the panel unit root tests indicate that both real credit to the private sector and real GDP can be characterised as I(1). Having established that the variables for both time series and panel approaches are I(1), the empirical analysis in the following section involves estimating cointegration tests to determine the long-run relationship between credit to private sectors and real GDP.

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[9] For more discussion about panel unit root tests, see Harris and Sollis (2003), Banerjee (1999), Christopoulos and Tsionas (2004), and Breitung and Pesaran (2008) among others.

Table 4.4 Results of the ADF and PP Unit Root Tests.

Variable	RCr				RGDP			
	ADF Test		PP Test		ADF Test		PP Test	
	Levels	1 Diff	Levels	1 Diff	Levels	1 Diff	Levels	1 Diff
Panel A: Countries without Islamic banks								
Argentina	-1.54 (0.51)	-1.96 (0.61)	-0.31 (0.91)	-2.99** (0.03)	-0.85 (0.95)	-4.65*** (0.00)	-0.50 (0.98)	-7.56*** (0.00)
Brazil	1.10 (0.99)	-6.01*** (0.02)	0.96 (0.99)	-6.12*** (0.00)	0.29 (0.97)	-4.01*** (0.00)	-0.14 (0.95)	3.45** (0.01)
Chile	-2.34 (0.40)	-10.62*** (0.00)	-2.18 (0.49)	-10.41*** (0.00)	-2.84 (0.18)	-4.71*** (0.00)	-2.32 (0.41)	-4.71*** (0.00)
Costa Rica	-0.99 (0.74)	-1.92 (0.31)	-0.91 (0.77)	-5.31** (0.00)	-0.61 (0.85)	-6.59*** (0.00)	-0.61 (0.85)	-6.59*** (0.00)
Ecuador	-1.97 (0.15)	-2.34* (0.07)	-3.15 (0.11)	-5.20*** (0.00)	-1.13 (0.69)	-3.93*** (0.00)	-1.09 (0.71)	-3.77*** (0.00)
Guatemala	-1.71 (0.73)	-6.31*** (0.00)	-1.70 (0.73)	-6.31*** (0.00)	-2.51 (0.32)	-7.37*** (0.00)	-2.50 (0.32)	-7.36*** (0.00)
Peru	-0.91 (0.78)	-2.78* (0.06)	-0.67 (0.84)	-11.33*** (0.00)	-1.69 (0.43)	-3.58*** (0.00)	-2.19 (0.21)	-20.63*** (0.00)
Panel B: Countries with Islamic banks								
Indonesia	-0.35 (0.90)	-4.14*** (0.00)	-2.53 (0.31)	-6.91*** (0.00)	-0.62 (0.85)	-1.76 (0.39)	-3.16 (0.11)	-8.68*** (0.00)
Turkey	-0.16 (0.93)	-5.99*** (0.00)	-0.13 (0.94)	-6.41*** (0.00)	-1.07 (0.71)	-4.98*** (0.00)	-1.82 (0.36)	-5.43*** (0.00)
Iran	-2.32 (0.41)	-5.55*** (0.00)	-0.43 (0.98)	-5.58*** (0.00)	-1.77 (0.71)	-8.92*** (0.00)	-1.75 (0.72)	-8.93*** (0.00)
Singapore	-1.76 (0.70)	-1.84 (0.19)	-1.15 (0.90)	-4.92*** (0.00)	-1.86 (0.65)	-4.55*** (0.00)	-1.16 (0.90)	-4.64*** (0.00)
Jordan	-1.53 (0.51)	-2.12 (0.52)	-1.02 (0.73)	-8.32*** (0.00)	-1.57 (0.79)	-10.6*** (0.00)	-1.45 (0.83)	-10.68*** (0.00)
Tunisia	-1.35 (0.86)	-5.21*** (0.00)	-2.33 (0.41)	-6.03** (0.00)	-1.58 (0.48)	-6.71*** (0.00)	-1.64 (0.45)	-6.71*** (0.00)
Malaysia	-1.28 (0.87)	-6.14*** (0.00)	-0.80 (0.95)	-9.13*** (0.00)	-1.13 (0.69)	-5.08*** (0.00)	-1.61 (0.47)	-3.18** (0.02)

Notes: The 10%, 5% and 1% critical values for the ADF and PP tests are respectively -2.573, -2.874 and -3.459. */**/*** indicate significance at the 10%, the 5% and the 1%, respectively. The numbers in parenthesis are the statistical significance *p*-values. The lag length for the ADF test is chosen based on the AIC criterion. The bandwidths in the PP unit root test are determined by the Newey-West statistic using the Barlett-Kernel. RCr is the real credit to private sectors and RGDP is the real GDP.

Table 4.5. Results of the Panel Unit Root Tests.

Variables	RCr			RGDP		
	MW Tests		IPS Test	MW Tests		IPS Test
	Fisher-ADF	Fisher-PP		Fisher-ADF	Fisher-PP	
Panel A: Countries without Islamic banks						
Levels	16.65 (0.27)	11.33 (0.65)	2.03 (0.97)	12.82 (0.54)	13.11 (0.51)	-0.02 (0.48)
1 Diff	53.34*** (0.00)	275.80*** (0.00)	-3.69*** (0.00)	29.98*** (0.00)	188.88*** (0.00)	-1.52* (0.06)
Panel B: Countries with Islamic banks						
Levels	12.68 (0.55)	13.87 (0.46)	-0.49 (0.31)	11.12 (0.68)	9.82 (0.77)	0.07 (0.52)
1 Diff	32.45*** (0.00)	269.5*** (0.00)	-2.96*** (0.00)	15.89 (0.32)	210.9*** (0.00)	-5.25*** (0.00)
Panel C: All countries						
Levels	19.80 (0.87)	25.29 (0.61)	0.76 (0.77)	16.81 (0.95)	13.11 (0.99)	2.53 (0.99)
1 Diff	74.15*** (0.00)	524.06*** (0.00)	-4.20*** (0.00)	35.49** (0.15)	393.53*** (0.00)	-2.20** (0.01)

Notes: */**/*** represent statistical significance at the 10%, the 5% and the 1% level, respectively. MW tests (Fisher-ADF and Fisher-PP) and IPS represent the pane unit root tests of Maddala and Wu (1999) and Im, Pesaran and Shin (Im et al., 2003) respectively. In all the tests, the null hypothesis is that of non-stationarity. Probabilities for Fisher-tests were calculated by using an asymptotic $\chi 2$ distribution and IPS test assumes asymptotic normality. The critical values for MW test are 31.41 and 37.57 at the 5% and the 1% critical values. MW (Fisher-ADF and Fisher-PP) statistics are based on individual ADF statistics and their associated P-value pooled test statistic. IPS: $W_{tbar}$is reported. Figures in parenthesis represent asymptotic P-values of individual test. RCr is the real credit to private sectors and RGDP is the real GDP.

4.5.2 Cointegration Test

In this section, we test for the existence of a long-run relationship between real credit to the private sector and real GDP. For this purpose we use both time series (Engle and Granger, 1987 and Johansen, 1988) and panel cointegration (Pedroni, 2004, Kao, 1999 and Westerlund, 2007) methods. The empirical analysis of the time series cointegration approach is discussed in the following section.

4.5.2.1 Time Series Cointegration Approach

The theory of cointegration between two variables was introduced by Granger (1981). This theory was developed later in the literature by many economists, such as Phillips (1987), Engle and Yoo (1987), Engle and Granger (1987) and Johansen (1995) among others. Following the literature, (see, Davidson and MacKinnon, 1993), we summarise the concept of cointegration in time series data as follows. If a pair of time series x_t and y_t has unit roots and the linear combination of the two series are non-stationary, then x_t and y_t are not cointegrated. However, if that linear combination between both x_t and y_t is found to be I(0), then the two variables are cointegrated and have a long-run relationship[10].

Table 4.6. Results of Engle-Granger Cointegration Test Based on Residuals

Country	Variables in cointegration vector (RGDP and RCr)		
	Engle-Granger tau-statistic	p-values^	N
Panel A: Countries without Islamic Banks.			
Argentina	-0.916 (4)	0.916	76
Brazil	-2.843 (1)	0.172	44
Chile	-2.954 (0)	0.136	61
Costa Rica	-3.045 (3)	0.121	44
Ecuador	-4.757 (1)***	0.002	41
Guatemala	-2.608 (9)	0.256	35
Peru	-1.577 (2)	0.733	65
Panel B: Countries with Islamic Banks.			
Indonesia	-1.727 (8)	0.667	46
Turkey	-2.309 (4)	0.381	44
Iran	-3.757 (0)**	0.024	55
Singapore	-2.210 (1)	0.429	39
Jordan	-1.763 (11)	0.649	83
Tunisia	-1.841 (10)	0.613	38
Malaysia	-1.843 (0)	0.612	44

Notes: */**/*** represent statistical significance at the 10%, the 5% and the 1% level, respectively. Null hypothesis *Ho:* series are not cointegrated. The critical values of MacKinnon (1996) for ADF test statistic are -3.04, -3.33 and -3.89 at the 10%, 5% and 1% respectively. ^ MacKinnon (1996) p-values. The optimal lag length, representing in parentheses, is selected by the Akaike Info Criterion (AIC). N is the number of obs. RCr is the real credit to private sectors and RGDP is the real GDP.

4.5.2.1.1 Engle-Granger Two-Step Tests

The Engle-Granger cointegration test results are reported in Table 4.6. The null hypothesis of no cointegration is rejected only for Ecuador in the case of the countries without Islamic banks (see Table 4.6. Panel A), and only for Iran at the 5% significance level in the other group. On the other hand, the findings fail to identify any long-run relationship among the two variables in the remaining countries in our sample. Overall, the Engle-Granger tests fail to identify any long-run relationship between the two variables in most countries in our sample except for (Ecuador and Iran). These results

[10] For more detailed discussion, refer to Burke and Hunter (2005); Asteriou and Hall (2015), among others

are consistent with those of Demetriades and Hussein (1996), who also failed to detect cointegration between real GDP per capita and various financial indicators in 11 out of the 16 countries in their sample. However, it is well known that the Engle-Granger cointegration test has low power in the case of a relatively short sample such as ours (see Kremers et al., 1992 and Demetriades and Hussein, 1996).

4.5.2.1.2 Johansen Cointegration Tests

The Johansen cointegration test is considered to be a superior test over the Engle-Granger technique and depends on the maximum likelihood of vector autoregression (VAR). Therefore we also apply the multivariate tests of Johansen (1988; 1995). Because these are very sensitive to the lag length (see Banerjee et al., 1993, Cheung and Lai, 1993, and Chang and Caudill, 2005), we use the Schwarz Information Criterion (SC) to determine the optimal lag length, but include extra lags when required to remove serial correlation (as in Hunter and Menla Ali, 2014, where the Akaike Information Criterion (AIC) is used instead). To avoid the issue of the optimal lag length, Demetriades and Hussein (1996) estimate Johansen cointegration test using different lag lengths 2, 3 and 4 lags. However, they do not test for the presence of the serial correlation and other diagnostic tests at the chosen lags in their sample, which we test for in this chapter and all the diagnostic tests show appealing results, which confirm the validity of the estimated models. Furthermore, to achieve normality, the following dummies were included: Chile 2008Q1, Argentina 2002Q2, and Tunisia 2011Q1, Jordan 2006Q1 and Singapore 2008Q4. We follow Dimitraki and Menla Ali (2015) and control for outliers defined as such when the residual is greater than $|3.5\sigma|$[11].

The results from the diagnostic tests for the residuals are displayed in Table 4.7. Evidently, the LM tests provide no evidence of any remaining serial correlation (see both Panels A and B in Table 4.7). Further, the null hypothesis of both homoscedasticity and normality cannot be rejected in any cases. Thus, we conclude that the VAR models are data congruent and carry out the Johansen cointegration tests using the optimal lag length reported in Table 4.7.

On the basis of the trace and eigenvalues statistics (see Table 4.8. Panel A), the findings show that Johansen cointegration techniques are fairly more promising than those obtained from the Engle-Granger method in that they capture more cases of long-run relationship. For instant, the null of no cointegration cannot be rejected at the 5%

[11] For more detailed discussion about including a dummy variable in testing for cointegration, see Juselius and MacDonald (2004).

level only in the case Guatemala among the countries without Islamic banks; therefore it appears that there is a stable long-run relationship between credit and GDP almost in every case. As for countries with Islamic banks, both the trace and eigenvalue statistics reject the null hypothesis of no cointegration at the 5% level for all but of one of them, namely Turkey, for which the results are contradictory (see Panel B) – in this case we give more weight to the trace statistic that suggests cointegration, because this test is known to provide more robust results than the maximal eigenvalues one (see Luintel and Khan, 1999). Furthermore, Lanne et al. (2002, p1) claim that trace statistics "have more heavily distorted sizes whereas their power performance is superior to that of the maximum eigenvalue competitors".

Table 4.7. VAR Lags Order and Diagnostic Tests.

Panel A: Countries without Islamic Banks.							
Country	Argentina [*k*=5]	Brazil [*k*=5]	Chile [*k*=3]	Costa Rica [*k*=3]	Ecuador [*k*=7]	Guatemala [*k*=4]	Peru [*k*=3]
LM test	4.012 (0.404)	2.817 (0.588)	3.634 (0.457)	5.772 (0.216)	2.716 (0.606)	3.656 (0.454)	2.194 (0.700)
JB test	3.475 (0.481)	2.492 (0.646)	6.103 (0.191)	6.683 (0.153)	0.501 (0.973)	4.188 (0.381)	3.615 (0.461)
Hetro test	68.762 (0.288)	52.424 (0.745)	40.195 (0.417)	39.298 (0.324)	78.701 (0.642)	55.797 (0.299)	36.136 (0.462)
Panel B: Countries with Islamic Banks.							
Country	Indonesia [*k*=5]	Turkey [*k*=5]	Iran [*k*=6]	Singapore [*k*=3]	Jordan [*k*=4]	Tunisia [*k*=5]	Malaysia [*k*=5]
LM test	4.060 (0.398)	3.744 (0.441)	4.881 (0.299)	5.605 (0.230)	5.475 (0.241)	2.259 (0.688)	4.103 (0.392)
JB test	6.066 (0.194)	2.385 (0.665)	4.410 (0.353)	1.847 (0.763)	1.235 (0.872)	3.403 (0.492)	0.135 (0.997)
Hetro test	83.776 (0.486)	70.221 (0.172)	57.549 (0.892)	33.152 (0.733)	162.643 (0.052)	97.741 (0.202)	62.764 (0.484)

Notes: *k* denotes number of lags based on the Schwarz information criterion (SC) and subject to removal of serial correlation. The null of LM test is no serial correlation. Breusch & Pagan (1979) test for heteroscedasticity with the null hypothesis *Ho*: Constant variance. The LM test and tests Breusch & Pagan are based on F-statistics. JB test is a chi-squared test for normality with *Ho*: residual are multivariate normal. *P-values* are in parentheses.

To summarise, the Johansen tests provide much stronger evidence of the existence of a long-run relationship between credit and GDP. The Johansen test confirms 13 long-run relationships out of the 14 countries in the sample, while the sign of cointegration is found only in two countries-Iran and Ecuador- with Engle-Granger approach. The only exception is Guatemala -this might reflect the presence of nonlinearities, the need for a broader definition of credit[12], or the fact that credit did not have a significant role in financing economic activities during the period under investigation: its average growth rate was small or negative in Guatemala, as opposed to 12.4% in Latin America, during the period 2004-2011 (Hansen and Sulla, 2013).

Table 4.8. Results of the Johansen Cointegration Tests.

	Null Hypothesis: r=0; Alternative Null: r=1 Variables : RGDP and RCr						
	Maximum Eigenvalue Test			Trace Test			
	Max-Eigen statistic (λ_{max})	95% Critical Value	*p*-value^	Trace statistic (λ_{trace})	95% Critical Value	*p*-value^	*K*
Panel A. Countries without Islamic Banks.							
Argentina	19.519	14.264	0.007***	20.044	15.494	0.009***	5
Brazil	10.897	15.892	0.259	20.324	20.261	0.049**	5
Chile	15.796	14.264	0.028**	15.929	15.494	0.043**	3
Costa Rica	17.175	14.264	0.016**	18.884	15.494	0.015**	3
Ecuador	26.813	14.264	0.000**	27.670	15.494	0.000***	7
Guatemala	2.802	14.264	0.959	3.780	15.494	0.920	4
Peru	25.503	19.387	0.005***	33.213	25.872	0.005***	3
Panel B. Countries with Islamic Banks.							
Indonesia	26.972	14.264	0.000***	28.521	15.494	0.000***	5
Turkey	12.271	14.264	0.101	16.376	15.494	0.036**	5
Iran	29.077	15.892	0.000***	36.175	20.261	0.000***	6
Singapore	14.066	14.264	0.054*	16.852	15.494	0.031**	3
Jordan	17.803	15.892	0.024**	26.603	20.261	0.006***	4
Tunisia	33.687	15.892	0.000***	41.805	20.261	0.000***	5
Malaysia	39.738	14.264	0.000***	48.656	15.494	0.000***	5

Notes: */**/*** represent statistical significance at the 10% and 5% and 1% level, respectively. The table reports the Max-Eigen statistics and Johansen trace statistics (Johansen, 1995). *r* is the number of cointegration vectors. ^ is the respective *p*-values. *K* is the number of lag lengths based on Schwarz Information Criterion (SC), subject to the removal of serial correlation (see Table 4.7). RCR is the real credit to private sectors and RGDP is the real GDP

[12] For example, according to the Basel III recommendations, the ideal definition of credit would "include all credit extended to households and other non-financial private entities in an economy independent of its form and the identity of the supplier of funds" ((BCBS, 2010 p 10). In addition, the BIS database defines the total credit series as "all sources of credit, independent of the country of origin or type of lender" Drehmann, (2013 p 42). However, BIS definition of total credit is beyond the scope of this chapter and it is available only for 40 advanced and emerging market economies (see Dembiermont et al., 2013).

4.5.2.2 Panel cointegration approach

Panel cointegration approaches have recently received much attention; especially in the empirical literature, to control for the drawbacks in the time-series techniques. The panel cointegration techniques, however, depend on two dimensions, a time series dimension (T) and the cross-sectional dimension (N). This approach has several desirable statistical features, for instant; the increased power of panel approach in estimating cointegration is the most cited rationale for its recent popularity in cointegration literature (see Westerlund, 2007, and Persyn and Westerlund, 2008). Accordingly, we carry out panel cointegration tests, specifically two residual-based tests (Pedroni, 2004 and Kao, 1999) tests and an error correction-based panel cointegration test (Westerlund, 2007).

4.5.2.2.1 Panel cointegration residual-based test

Pedroni (2004) suggested two groups of statistics. The first group, including four of them, involves pooling the within-dimension residuals, while the second, including three, is based on pooling the between-dimension residuals. There are several possible estimators one could use, such as OLS, Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS). In their comprehensive study, Kao and Chiang (2000) found that both the FMOLS and OLS estimators suffer from small sample bias, and concluded that the DOLS method outperforms them. This is the estimator chosen here.

The results of Pedroni (2004) and Kao (1999) tests are reported in Table 4.9 and 4.10 respectively. Both of them fail to reject the null hypothesis of no cointegration in the countries without Islamic banks. By contrast, both the panel ADF-Statistics and Group ADF-Statistics (without trend) indicate a long-run relationship at the 5% and 10% level respectively between credit and GDP in the countries with Islamic banks. When a time trend is included, four of the seven Pedroni statistics reject the null hypothesis of no cointegration between real credit to the private sector and real GDP (see Table 4.9 Panel B), whilst the Kao test does not suggest any long-run relationship for countries with Islamic banks (see Table 4.10).

Table 4.9. Results of the Pedroni Test based on Residuals of Panel Cointegration.

	No time dummy		Time dummy	
Test statistics	Statistic	*p*-value	Statistic	*p*-value
Panel A. Countries without Islamic Banks.				
Within dimension				
Panel v	-1.333	0.909	0.595	0.275
Panel rho	1.572	0.942	1.414	0.921
Panel PP	1.371	0.914	0.734	0.770
Panel ADF	1.559	0.941	0.517	0.697
Between dimension				
Group v	0.234	0.592	0.782	0.783
Group PP	-0.876	0.190	-0.179	0.428
Group ADF	-1.144	0.126	-0.790	0.214
Panel B. Countries with Islamic Banks.				
Within dimension				
Panel v	0.646	0.259	2.088	0.018**
Panel rho	-0.462	0.322	-0.198	0.421
Panel PP	-0.567	0.285	-0.668	0.252
Panel ADF	-1.902	0.028**	-2.431	0.007***
Between dimension				
Group v	0.073	0.529	-0.398	0.344
Group PP	-0.425	0.335	-1.350	0.088*
Group ADF	-1.388	0.082*	-4.368	0.000***
Panel C. All countries				
Within dimension				
Panel v	-1.030	0.848	1.764	0.038**
Panel rho	1.733	0.958	1.251	0.894
Panel PP	1.418	0.922	0.458	0.676
Panel ADF	1.427	0.923	-0.712	0.238
Between dimension				
Group v	0.217	0.586	0.271	0.606
Group PP	-0.921	0.178	-1.081	0.139
Group ADF	-1.791	0.036**	-3.647	0.000***

Notes: */**/*** indicate that the null hypothesis of no cointegration is rejected at the 10%, 5% and 1% level, respectively. All tests are left-sided except the variance ratio which is right-sided (see Ozturk and Acaravic, 2010). Statistics are asymptotically distributed as normal. The null hypothesis is no cointegration, while the alternative hypothesis (1) within dimension is common AR coefficients and (2) it is individual AR coefficients between dimensions.

Table 4.10. Results of the Kao Test Based on Residuals of Panel Cointegration.

ADF-Statistics	Panel A. Countries without Islamic Banks	Panel B. Countries with Islamic Banks.	Panel C. All countries
t-stat	-0.645	-0.194	-0.803
p-value	(0.259)	(0.422)	(0.211)

Notes: */**/*** represent statistical significance at 10%, 5% and 1% level respectively. The lag length for the ADF test is chosen based on the AIC criterion and Newey-West automatic bandwidth selection and Bartlett kernel.

4.5.2.2.2 Westerlund Panel Cointegration test

Westerlund (2007) criticises the panel residual-based tests performed above (pointing out in particular that the common factor restriction might be invalid), and proposes four more advanced panel-cointegration tests with higher power. The first two, G_τ and G_α, are based on group-mean test statistics, which test the alternative hypothesis that the panel as a whole is cointegrated, whereas the other two, p_τ and p_α, are pooled test statistics, which are designed to test the alternative that at least one of the individual cross-sectional units is cointegrated (Persyn and Westerlund, 2008). The results for these tests are reported in Table 4.11. It can be seen that both group-mean statistics G_τ and G_α reject the null hypothesis of no cointegration in all three panels (comprising countries with and without Islamic banks and all countries in turn), suggesting the existence of a long-run relationship between real credit to the private sector and real GDP in each case. However, the other two panel statistics p_τ and p_α, which are based on pooling the information from the error correction term, fail to reject the null hypothesis of no cointegration between the two variables.

Table 4.11. Results of the Westerlund (2007) Panel Cointegration Test.

	Panel A. Countries without Islamic Banks			Panel B. Countries with Islamic Banks			Panel C. All countries		
Test	Value	Z-value	p-value	Value	Z-value	p-value	Value	Z-value	p-value
G_τ	-4.748	-7.880	0.000***	-4.563	-7.272	0.000***	-4.656	-10.714	0.000***
G_α	-21.55	-3.840	0.000***	-22.10	-4.058	0.000***	-23.59	-6.580	0.000***
p_τ	-5.128	0.538	0.705	-4.322	1.477	0.930	-6.820	1.264	0.897
p_α	-7.218	0.769	0.779	-7.115	0.815	0.792	-8.285	0.419	0.662

Notes: */**/*** represent statistical significance at the 10%, 5% and 1% level respectively. The Lags length and the leads are selected according to the Akaike Information Criterion (AIC). *P-values* are one sided test based on the normal distribution. τ and α refer to different test statistics. p_τ and p_α are pooled test statistics; G_τ and G_α are group mean test statistics. For further information about both pooled and group mean test statistics refer to Persyn and Westerlund (2008).

4.5.3 Causality tests

Having established that the two variables are cointegrated, the empirical analysis in this section involves an examination of causality relationship. Therefore, we apply both time series and panel approaches to test for three types of causality (where the null hypothesis is that of no causality): short-run causality, using lags of the explanatory variables; long-run causality (weak exogeneity), using the error correction term; strong exogeneity, using both lags and the error correction term. As already mentioned, we estimate a VECM or a VAR in first differences depending on whether or not cointegration holds between real credit to the private sector and real GDP.

4.5.3.1 Time Series Causality Approach

4.5.3.1.1 Causality Test Based on Engle-Granger Cointegrating Vectors

It is evident from Table 4.12 that there is a long-run equilibrium relationship only in the case of Iran and Ecuador. For these two countries the ECM-based causality tests suggest bidirectional long-run causality in Iran and unidirectional causality from real credit to the private sector to real GDP in Ecuador, at the 10% and 5% level of significance respectively. The F-statistic fails to reject the null of no short-run Granger causality from credit to GDP in Ecuador but not in Iran at the 10% significance level (see Table 4.12, Panel B).The diagnostic tests (LM test, JB test, heteroscedasticity test, ARCH test) suggest no serial correlation, deviations from normality, heteroscedasticity, or ARCH effects in either case (see Table 4.13).

Table 4.12. ECM Test with Engle-Granger Cointegrating Vectors.

Panel A: Ho: $\Delta RCr \nrightarrow \Delta GDP$								
		SR Granger non-causality test (H_0: $all\ \varphi_{1i} = 0$)		LR Weak-exogeneity test (H_0: δ_1=0)			SR+LR Strong-exogeneity test (H_0:$all\ \varphi_{1i} = \delta_1 = 0$)	
	K	F-statistic	p-values	ECT_{t-1}	t-statistic	p-values	F-statistic[a]	p-values
Iran	6	2.243	0.057*	-0.387	-1.996	0.052*	2.773	0.018**
Ecuador	6	1.140	0.372	-0.467	-2.552	0.018**	1.807	0.1362
Panel B: Ho: $\Delta GDP \nrightarrow \Delta RCr$								
		SR Granger non-causality test (H_0: $all\ \varphi_{2i} = 0$)		LR Weak-exogeneity test (H_0: δ_2=0)			SR+LR Strong-exogeneity test (H_0: $all\ \varphi_{2i} = \delta_1 = 0$)	
	K	F-statistic	p-values	ECT_{t-1}	t-statistic	p-values	F-statistic[a]	p-values
Iran	6	2.080	0.077*	-0.197	-2.923	0.005***	2.260	0.049**
Ecuador	6	2.560	0.049**	-0.063	-0.813	0.424	2.797	0.031**

Notes: */**/*** represent statistical significance at the 10%, 5% and 1% level, respectively. K is number of lags in ECM. F-statistic is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1i} = 0$, F-statistic[a] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1i} = \delta_1 = 0$, and t-statistic is of the Wald statistics test for the significance of the null hypothesis H_0: δ_1=0. Part A and Part B are estimated using equations (4.3) and (4.4) respectively.

$$\Delta RGDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i}\, \Delta RGDP_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\, \Delta RCR_{\,t-i} + \delta_1 ECT_{t-1} + \epsilon_{1t} \quad (4.3)$$

$$\Delta RCR_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i}\, \Delta RCR_{t-i} + \sum_{i=1}^{k} \beta_{2i}\, \Delta RGDP_{t-i} + \delta_2 ECT_{t-1} + \epsilon_{2t} \quad (4.4)$$

Table 4.13. Residual Diagnostic Tests for ECM Test with Engle-Granger Vectors

	LM test		JB Test		Hetro Test		ARCH Test	
	RCr↛ GDP	GDP↛ RCr	RCr↛ GDP	GDP↛ RCr	RCr↛ GDP	GDP↛ RCr	RCr↛ GDP	GDP↛ RCr
Ecuador	2.812	0.242	3.234	0.235	12.776	19.143	0.098	0.077
	(0.245)	(0.886)	(0.198)	(0.888)	(0.465)	(0.118)	(0.753)	(0.781)
Iran	3.844	2.411	4.291	1.752	11.264	6.838	2.081	0.401
	(0.146)	(0.299)	(0.116)	(0.416)	(0.588)	(0.941)	(0.149)	(0.526)

Note: The null of LM test is no serial correlation. Breusch & Pagan (1979) test for heteroscedasticity with the null hypothesis *Ho*: Constant variance. The null of ARCH test is *Ho*: no ARCH effect. These tests are based on F-statistics. JB test is a chi-squared test for normality with *Ho*: residual are multivariate normal. *P-values* are in parentheses.

4.5.3.1.2 Causality Test Based on Johansen Cointegrating Vectors

Next we test for causality within a VECM framework for the countries where cointegration holds according to the Johansen tests. As explained above, there are two possible sources of causality, namely the lagged dynamic terms of the independent variable and the error correction term. Furthermore, a strong-exogeneity test can be conducted by testing their joint significance. The results are reported in Tables 4.14 and 4.15 (t-statistic and F-statistics) respectively.

The results, as displayed in Table 4.14. Panel A, show that real credit to the private sector causes real GDP in the short run in Argentina and Ecuador at the 1% level, and at the 10% level in Brazil. Bidirectional short-run Granger causality is found in Ecuador. As for the long-run weak-exogeneity tests, the null hypothesis of non-causality from real credit to the private sector to real GDP is rejected in Chile and Ecuador at the 1% level, and in Costa Rica at the 10% level. The error correction term has a negative sign in all countries except Argentina and Brazil, which indicates that the causality relationship in the long-run is not valid as the error term is not converging towards equilibrium in the long run. On the other hand, long-run causality from real GDP to real credit to the private sector is found in Argentina and Brazil at the 10% and 1% level respectively Finally, the strong exogeneity tests suggest bidirectional causality in all countries except Peru and Costa Rica (see Table 4.14. Panel A).

Table 4.14. ECM Test with Johansen Cointegrating Vectors for Countries without Islamic Banks.

		Panel A: Ho: ΔRCr ↛ ΔGDP						
		SR Granger non-causality test (H_0: $all\ \varphi_{1i} = 0$)		LR Weak-exogeneity test (H_0: δ_1=0)			SR+LR Strong-exogeneity test (H_0:$all\ \varphi_{1i} = \delta_1 = 0$)	
Country	*K*	F-stat[a]	*p*-values	ECT_{t-1}	t-stat[c]	*p*-values	F-stat[b]	*p*-values
Argentina	5	9.920	0.000***	0.056	4.406	0.000***	13.082	0.000***
Brazil	5	2.086	0.095*	0.116	3.031	0.005**	4.702	0.001***
Chile	3	0.422	0.737	-0.260	-2.720	0.009***	3.587	0.012**
Costa Rica	3	1.091	0.366	-0.187	-1.910	0.064*	1.408	0.252
Ecuador	7	5.449	0.001***	-0.629	-3.830	0.001***	7.991	0.000***
Peru	3	0.276	0.842	-0.021	-0.272	0.785	0.290	0.883
		Panel B: Ho: ΔGDP↛ ΔRCr						
		SR Granger non-causality test (H_0: $all\ \varphi_{2i} = 0$)		LR Weak-exogeneity test (H_0: δ_2=0)			SR+LR Strong-exogeneity test(H_0:$all\ \varphi_{2i} = \delta_1 = 0$)	
Country	*K*	F-stat	*p*-values	ECT_{t-1}	t-stat	*p*-values	F-stat	*p*-values
Argentina	5	1.133	0.352	-0.023	-2.298	0.024***	2.561	0.027**
Brazil	5	3.802	0.009***	-0.038	-4.545	0.000***	19.952	0.000***
Chile	3	1.363	0.264	-0.122	-2.108	0.040**	7.006	0.000***
Costa Rica	3	1.826	0.161	-0.120	-2.923	0.006***	6.021	0.000***
Ecuador	7	2.928	0.029**	-0.127	1.372	0.185	2.906	0.026**
Peru	3	1.039	0.381	-0.088	-5.407	0.000***	12.110	0.000***

Notes*:* */**/*** represent statistical significance at the 10%, 5% and 1% level, respectively. *K* is number of lags in ECM. In Panel A, F-stat[a] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1i} = 0$, F-stat[b] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1i} = \delta_1 = 0$, and t-stat[c] is of the Wald statistics test for the significance of the null hypothesis H_0: δ_1=0. Panel A and Panel B are estimated using equations (4.3) and (4.4) respectively.

$$\Delta RGDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i}\ \Delta RGDP_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\ \Delta RCR_{\ t-i} + \delta_1 ECT_{t-1} + \epsilon_{1t} \quad (4.3)$$

$$\Delta RCR_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i}\ \Delta RCR_{t-i} + \sum_{i=1}^{k} \beta_{2i}\ \Delta RGDP_{t-i} + \delta_2 ECT_{t-1} + \epsilon_{2t} \quad (4.4)$$

As regards countries with Islamic banks, Table 4.15 show the short-run, long-run and strong-exogeneity results of the causality test between real credit to private sector and real GDP. There is evidence of short-run bidirectional causality in three out of the seven countries with Islamic banks (Iran, Singapore and Tunisia), and short-run unidirectional causality from real credit to the private sector to real GDP in Malaysia (see Table 4.15 Panel A). The weak exogeneity tests indicate that both variables are weakly exogenous at the 1% level in all countries with Islamic banks (at the 10% level in Indonesia only). Long-run causality from real GDP is found only in Jordan at the 5% level. The strong exogeneity tests imply bidirectional causality except for Indonesia and Turkey (see Table 4.15). It is noteworthy that in the long run real GDP causes real credit to the private sector in the countries without Islamic banks, while causality runs in the opposite direction in the countries with Islamic banks. In brief, our results provide strong evidence of long-run causality running from real credit to real GDP and weak evidence of bidirectional short-run causality in countries with Islamic banks. In contrast, for the countries without Islamic banks there is strong evidence of long-run causality running from real GDP to real credit. With regard to the residual diagnostic tests, Table 4.16 shows that there are no signs of serial correlation in the residuals, no evidence of heteroscedasticity or ARCH effects and the normality hypothesis is accepted in most countries in our sample.

Table 4.15. ECM Test with Johansen Cointegrating Vectors For Countries with Islamic Banks.

				Panel A :Ho:* ΔR*Cr* ↛ Δ*GDP				
		SR Granger non-causality test (H_0: $all\ \varphi_{1i} = 0$)		LR Weak-exogeneity test (H_0: δ_1=0)			SR+LR Strong-exogeneity test(H_0:$all\ \varphi_{1i} = \delta_1 = 0$)	
Country	*K*	F-stat[a]	*p*-values	ECT(-1)	t-stat	*p*-values	F-stat[b]	*p*-values
Indonesia	5	1.753	0.148	-0.072	-1.952	0.063*	1.578	0.188
Turkey	5	0.966	0.455	-0.461	-2.847	0.008***	1.970	0.105
Iran	6	2.620	0.029**	-0.460	-2.876	0.006***	3.237	0.000***
Singapore	3	3.433	0.030**	-0.039	-4.350	0.000***	7.459	0.000***
Jordan	4	0.331	0.856	-0.087	-3.392	0.001***	3.756	0.004***
Malaysia	4	6.955	0.000***	-0.054	-4.906	0.000***	6.074	0.000***
Tunisia	8	10.525	0.000***	-0.024	-8.585	0.000***	17.717	0.004***
				Panel B: Ho:* Δ*GDP*↛ Δ*RCr				
		SR Granger non-causality test (H_0: $all\ \varphi_{2i} = 0$)		LR Weak-exogeneity test (H_0: δ_2=0)			SR+LR Strong-exogeneity test(H_0:$all\ \varphi_{2i} = \delta_1 = 0$)	
Country	*K*	F-stat	*p*-values	ECT(-1)	t-stat	*p*-values	F-stat[a]	*p*-values[a]
Indonesia	5	0.899	0.5241	-0.078	-1.600	0.123	0.794	0.613
Turkey	5	1.124	0.370	-0.056	-1.327	0.195	1.259	0.307
Iran	6	3.496	0.004***	-0.152	-1.912	0.062*	4.305	0.000***
Singapore	3	2.948	0.049**	-0.004	1.674	0.104	2.256	0.000***
Jordan	4	1.301	0. 278	-0.055	-2.457	0.016**	2.045	0.083*
Malaysia	4	1.526	0.219	-0.083	1.800	0.081*	5.352	0.001***
Tunisia	8	4.158	0.004***	-0.008	-1.794	0.085*	7.219	0.000***

Notes*:* */**/*** represent statistical significance at 10%, 5% and 1% level, respectively. *K* is number of lags in ECM. In Panel A, F-stat[a] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1i} = 0$, F-statistic[b] is of the Wald statistics test for the significance of the null hypothesi H_0: $all\ \varphi_{1i} = \delta_1 = 0$, and t-stat[c] is of the Wald statistics test for the significance of the null hypothesis H_0: δ_1=0. Part A and Part B are estimated using equations (4.3) and (4.4) respectively.

$\Delta RGDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i}\, \Delta RGDP_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\, \Delta RCR_{\,t-i} + \delta_1 ECT_{t-1} + \epsilon_{1t}$ (4.3).

$\Delta RCR_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i}\, \Delta RCR_{t-i} + \sum_{i=1}^{k} \beta_{2i}\, \Delta RGDP_{t-i} + \delta_2 ECT_{t-1} + \epsilon_{2t}$ (4.4).

These findings can be explained in terms of the principles of Islamic finance. As previously mentioned, Islamic banks spur economic growth by providing credit for productive investment and financial contracts such as Mudharabah and Musharaka must be linked directly to real economic activities (Gulzar and Masih, 2015; Kammer et al., 2015), their financial transactions being linked to real assets (Siddiqi, 2006 and Askari, 2012). Moreover, they provide credit to households and firms not normally dealing with the financial system for religious reasons, which results in higher financial inclusion and possibly higher economic growth (Imam and Kpodar, 2015). In addition, Islamic banks are not allowed to engage in any speculative transactions such as option and future contracts or funding any activities which are considered harmful to the community such as producing alcohol (see Khan, 2010 and Kammer et al., 2015). It is thought that financing such activities would put upward pressure on prices rather than contributing to total GDP growth. Another important explanation is that the risk-sharing principle encourages Islamic banks to finance project on a long-term basis with higher risk-return profiles and this promotes economic growth, which is confirmed by our findings in Table 4.15 (Mills and Presley, 1999 and Chonga, Liu, 2009). Although Choudhury (1999) found no evidence that Islamic banking stimulates output growth in a sample of countries including Turkey, his results might simply reflect the lack of Shariah law-complaint financial products (see Johnson, 2013). This inconsistency between Choudhury's empirical study and ours may also possibly due to different methodologies, different sample or different time periods used in the two studies[13].

As for the countries without Islamic banks, our findings do not support the idea that credit or financial development has a crucial role in stimulating economic growth (see King and Levine, 1993; and Levine and Zervos, 1998 among others). This could be because the effects of credit and financial services depend on the allocation of loans to productive investment projects (see Ang and McKibbin, 2007). A weak effect could reflect an increase in credit in conjunction with a lack of monitoring from banks (see Moran, 1992, and Gavin and Hausman, 1996). This may lead to an inappropriate choice of projects as well as providing credit to unproductive or speculative activities. As argued by Cecchetti and Kharroubi (2012), finance can be a drag on economic growth once the ratio of credit to the private sector to GDP exceeds 90% - in fact Law and Singh (2014) found this ratio to be 88% for most countries without Islamic bank included in our sample[14].

In summary, our results provide strong evidence of long-run causality running from real credit to real GDP in countries with Islamic banks against weak evidence of short-run causality in both directions. In contrast, they provide strong evidence of a long-run causality running from real GDP to real credit for those countries without Islamic banks.

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[13] The Choudhury (1999) sample period covered 1988-1996 and countries included Turkey, UAE, Sudan and Egypt.

[14] The average credit/GDP ratios are 161.63%, 16.15%, 250.64%, 150.99%, 95.27%, 87.02 and 81.85 in Brazil, Argentina, Chile, Costa Rica, Guatemala, Peru, and Ecuador respectively.

Table 4.16. Residual Diagnostic Tests for ECM Test with Johansen Cointegrating Vectors.

	LM Test		JB Test		Hetro Test		ARCH Test	
	ΔRCr↛ ΔGDP	ΔGDP↛ ΔRCr	ΔRCr↛ ΔGDP	ΔGDP↛ ΔRCr	ΔRCr ↛ ΔGDP	ΔGDP↛ ΔRCr	ΔRCr↛ ΔGDP	ΔGDP↛ ΔRCr
Panel A: Countries without Islamic Banks.								
Argentina	0.427 (0.807)	3.014 (0.221)	0.139 (0.932)	2.413 (0.299)	27.283 (0.011)**	14.891 (0.314)	0.405 (0.524)	0.164 (0.685)
Brazil	0.784 (0.675)	2.764 (0.251)	0.873 (0.646)	3.563 (0.168)	8.563 (0.739)	17.996 (0.115)	1.093 (0.295)	0.056 (0.812)
Chile	3.063 (0.216)	1.834 (0.399)	0.367 (0.832)	3.065 (0.215)	14.846 (0.095)*	12.171 (0.203)	2.726 (0.098)	4.751 (0.029)
Costa Rica	1.632 (0.442)	1.471 (0.479)	2.902 (0.234)	0.774 (0.678)	12.458 (0.131)	11.738 (0.163)	15.931 (0.101)	2.353 (0.125)
Ecuador	2.317 (0.598)	1.597 (0.206)	0.177 (0.915)	1.027 (0.524)	17.325 (0.364)	17.163 (0.375)	1.229 (0.267)	0.011 (0.914)
Peru	1.016 (0.601)	0.121 (0.940)	1.772 (0.412)	0.485 (0.784)	2.153 (0.975)	2.358 (0.968)	0.361 (0.547)	0.845 (0.357)
Panel B: Countries with Islamic Banks.								
Indonesia	3.569 (0.167)	7.510 (0.185)	0.514 (0.773)	6.414 (0.040)**	7.659 (0.958)	9.889 (0.872)	2.003 (0.157)	0.209 (0.646)
Turkey	2.913 (0.232)	2.921 (0.232)	2.851 (0.240)	2.153 (0.340)	11.168 (0.514)	10.984 (0.530)	0.074 (0.785)	0.255 (0.613)
Iran	2.511 (0.284)	0.433 (0.651)	1.509 (0.470)	6.869 (0.032)**	13.043 (0.523)	17.762 (0.217)	1.733 (0.187)	1.423 (0.232)
Singapore	2.123 (0.345)	0.005 (0.994)	0.499 (0.779)	4.031 (0.133)	7.191 (0.617)	2.112 (0.989)	0.021 (0.884)	0.009 (0.922)
Jordan	0.802 (0.848)	9.202 (0.101)	0.657 (0.719)	1.291 (0.524)	19.640 (0.050)*	23.32 (0.015)**	1.080 (0.301)	0.001 (0.965)
Malaysia	0.277 (0.870)	2.040 (0.360)	0.086 (0.957)	4.357 (0.113)	10.309 (0.413)	13.425 (0.201)	0.099 (0.752)	8.063 (0.152)
Tunisia	0.112 (0.945)	1.739 (0.419)	8.860 (0.114)	0.057 (0971)	14.540 (0.628)	23.389 (0.137)	0.568 (0.455)	0.610 (0.434)

Notes: */** represent statistical significance at 10% and 5% level, respectively. The null of LM test is no serial correlation. Breusch & Pagan (1979) test for heteroscedasticity with the null hypothesis *Ho*: Constant variance. The null of ARCH test is *Ho*: no ARCH effect. These tests are based on F-statistics. JB test is a chi-squared test for normality with *Ho*: residual are multivariate normal. *P-values* are in parentheses.

4.5.3.1.3 Granger-Causality Test Based on First Difference

The results for the cases when there is no cointegration and a VAR in first differences is estimated can be summarised as follows (see Table 4.17 Panel A). Among the countries without Islamic banks bidirectional causality is found in Argentina, Brazil and Ecuador, and unidirectional causality from real GDP to real credit in Chile and Peru, whilst there is no evidence of causality in either direction in Costa Rica. These results are similar to those obtained from the ECM tests within the Johansen framework (see Table 4.14). With regard to the diagnostic tests, Table 4.18 shows no autocorrelation in the residuals in all countries, while the JB test rejects the null hypothesis of normality in two countries, namely Chile and Guatemala at the 10% and 5% level of significance respectively. In addition, it appears that the Granger-causality model has a sign of heteroscedasticity in Chile and Costa Rica.

Table 4.17. Causality Test between Real GDP and Real Credit Based on the First Difference.

Panel A. Countries without Islamic Banks.					
		Part A: $\Delta RCr \nrightarrow \Delta GDP$ (H_0: $all\ \varphi_{1i} = 0$)		*Part B:* $\Delta GDP \nrightarrow \Delta RCr$ (H_0: $all\ \beta_{2i} = 0$)	
Country	*K*	F-statistic[a]	*p*-values	F-statistic[b]	*p*-values
Argentina	5	7.461	0.000***	4.161	0.002***
Brazil	5	2.094	0.094*	2.258	0.075*
Chile	3	1.145	0.339	7.226	0.000***
Costa Rica	3	0.445	0.721	1.715	0.182
Peru	3	0.384	0.764	3.996	0.011**
Guatemala	5	15.369	0.000***	0.637	0.673
Ecuador	7	2.554	0.049**	2.389	0.059*
Panel B. Countries with Islamic Banks.					
		Part A: $\Delta RCr \nrightarrow \Delta GDP$ (H_0: $all\ \varphi_{1i} = 0$)		*Part B:* $\Delta GDP \nrightarrow \Delta RCr$ (H_0: $all\ \beta_{2i} = 0$)	
Country	*K*	F-statistic[a]	*p*-values	F-statistic[b]	*p*-values
Indonesia	5	1.755	0.153	0.583	0.712
Turkey	5	0.592	0.705	1.378	0.262
Iran	6	2.418	0.042**	1.971	0.090*
Singapore	3	5.406	0.004***	1.751	0.177
Jordan	4	0.800	0.529	0.976	0.426
Tunisia	7	5.803	0.000***	4.497	0.002***
Malaysia	4	0.902	0.474	3.448	0.019**

Notes: */**/*** represent statistical significance at the 10%, 5% and 1% level, respectively. *K* is number of lags. In both Panels A and B, F-statistic[a] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1i} = 0$, and F-statistic[b] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \beta_{2i} = 0$. Part A and Part B are estimated using equations (4.1) and (4.2) respectively.

$$\Delta RGDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i}\, \Delta RGDP_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\, \Delta \mathrm{RCR}_{t-i} + \epsilon_{1t} \qquad (4.1)$$

$$\Delta \mathrm{RCR}_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i} \Delta RCR_{t-i} + \sum_{i=1}^{k} \beta_{2i}\, \Delta \mathrm{RGDP}_{t-i} + \epsilon_{2t} \qquad (4.2)$$

Table 4.18. Residual Diagnostic Tests for First Difference Causality Test.

	LM test		JB test		Hetro test		ARCH	
Panel A: Countries without Islamic Banks.								
	$\Delta RCr \nrightarrow \Delta GDP$	$\Delta GDP \nrightarrow \Delta RCr$	$\Delta RCr \nrightarrow \Delta GDP$	$\Delta GDP \nrightarrow \Delta RCr$	$\Delta RCr \nrightarrow \Delta GDP$	$\Delta GDP \nrightarrow \Delta RCr$	$\Delta RCr \nrightarrow \Delta GDP$	$\Delta GDP \nrightarrow \Delta RCr$
Argentina	3.094	2.838	3.057	0.011	21.603	15.767	0.080	0.069
	(0.212)	(0.241)	(0.216)	(0.994)	(0.016)**	(0.202)	(0.776)	(0.791)
Brazil	1.567	3.232	0.645	3.081	4.678	17.335	0.955	0.066
	(0.456)	(0.198)	(0.723)	(0.214)	(0.911)	(0.067)*	(0.328)	(0.796)
Chile	5.150	0.941	2.310	4.690	15.147	3.743	5.634	7.110
	(0.161)	(0.624)	(0.315)	(0.095)*	(0.019)**	(0.808)	(0.131)	(0.130)
Costa Rica	2.062	2.490	1.619	3.662	10.150	13.144	2.417	2.404
	(0.356)	(0.287)	(0.444)	(0.160)	(0.118)	(0.041)**	(0.063)	(0.053)*
Ecuador	13.954	0.347	4.024	0.478	11.219	20.996	0.311	0.250
	(0.124)	(0.840)	(0.133)	(0.787)	(0.736)	(0.101)	(0.576)	(0.616)
Peru	0.984	1.552	1.689	2.718	1.839	6.060	0.350	0.302
	(0.611)	(0.122)	(0.429)	(0.256)	(0.933)	(0.416)	(0.553)	(0.582)
Guatemala	1.174	2.196	0.741	7.258	3.400	7.725	0.405	1.016
	(0.556)	(0.333)	(0.690)	(0.026)**	(0.970)	(0.806)	(0.524)	(0.977)
Panel B: Countries with Islamic Banks.								
Indonesia	15.272	3.524	0.153	1.067	4.032	9.956	0.648	0.174
	(0.226)	(0.171)	(0.926)	(0.586)	(0.945)	(0.619)	(0.420)	(0.675)
Turkey	2.241	1.777	0.573	5.918	9.759	9.213	0.148	0.255
	(0.326)	(0.411)	(0.750)	(0.051)*	(0.461)	(0.512)	(0.699)	(0.612)
Iran	4.184	4.840	7.707	8.290	12.791	11.203	4.055	1.355
	(0.123)	(0.102)	(0.021)**	(0.015)**	(0.384)	(0.511)	(0.131)	(0.244)
Singapore	1.219	1.605	4.690	0.264	2.036	5.137	0.036	0.166
	(0.543)	(0.448)	(0.095)*	(0.876)	(0.916)	(0.643)	(0.849)	(0.683)
Jordan	0.764	9.458	2.329	1.855	11.324	19.155	0.039	0.1800
	(0.682)	(0.149)	(0.312)	(0.395)	(0.184)	(0.023)**	(0.842)	(0.671)
Malaysia	2.948	7.785	8.995	2.361	13.079	8.774	0.0267	0.972
	(0.229)	(0.168)	(0.011)**	(0.307)	(0.109)	(0.458)	(0.870)	(0.324)
Tunisia	2.733	1.221	0.635	1.532	11.246	9.221	0.644	3.250
	(0.255)	(0.543)	(0.727)	(0.464)	(0.734)	(0.865)	(0.422)	(0.995)

Note: */**/*** represent statistical significance at the 10%, 5% and 1% level, respectively. The null of LM test is no serial correlation. Breusch & Pagan (1979) test for heteroscedasticity with the null hypothesis *Ho*: Constant variance. The null of ARCH test is *Ho*: no ARCH effect. These tests are based on F-statistics. JB test is a chi-squared test for normality with *Ho*: residual are multivariate normal. *P-values* are in parentheses.

As for countries with Islamic banks, causality runs from real credit to real GDP in Singapore, and in the opposite direction in Malaysia; there is bidirectional causality in Iran and Tunisia, and no causality in either directions in Indonesia, Turkey and

Jordan. These results are consistent with those from the ECM tests in Table 4.15 in which the F-statistics fail to reject the null hypothesis of non-causation in the short-run between real credit and real GDP in either direction. There is no sign of misspecification according to the diagnostic tests, while normality is quite widespread across countries with Islamic banks (see Table 4.18 Panel B).

4.5.3.2 Panel Causality Approach

Having established that real credit to private sector and real GDP are cointegrated in a panel context, the empirical analysis in this section involves an examination of causality relationship using the ECM based causality test. The null hypothesis of non-causation is tested against the alternative of causation. We examine three types of causality in the short-run, the long-run and the strong-exogeneity in three panels, namely countries without Islamic banks, countries with Islamic banks and all countries.

The panel causality test results are shown in Table 4.19. As already mentioned, the lag length is selected according to the Schwarz Bayesian Criterion subject to the removal of the serial correlation in the error term. In the countries with Islamic banks, long-run causality from real credit to real GDP is found at the 5% level while the F-statistic fails to reject the null hypothesis of no causality in the short run (see Table 4.19 Panel A2). By contrast, short-run causality from real credit to GDP is found for countries without Islamic banks (see Table 4.19 Panel A1). There is strong evidence of long-run causality from real GDP to real credit in both sets of countries, but no evidence of short-run causality (see Table 4.19 Panel B). However, bidirectional causality in the long run is found in the countries with Islamic banks.

On the whole, the long-run results obtained from the two approaches are rather similar: both suggest that real GDP causes real credit in the countries without Islamic banks except for Ecuador, whereas there is causality in the opposite direction in the countries with Islamic banks. Bidirectional long-run causality is found in two countries without Islamic banks (Chile and Ecuador, at the 1% level) and one with Islamic banks (Jordan, at the 5% level). However, there are differences between the two sets of short-run results: the panel tests suggest that short-run causality runs from real credit to real GDP in countries without Islamic banks (and that there is bidirectional causality in three of them, i.e. Iran, Singapore and Tunisia), whilst the time-series ones do not detect any.

Based on the results from the panel causality, we could conclude that the direction of causality is different among the two main panels. Specifically, real credit causes real GDP in the long-run in the panel for countries with Islamic banks while short-run causality seems to be present in the panel of the countries without Islamic banks. Compared to the time-series results, the individual countries reveal different causal relationship across the two samples.

Table 4.19. Results Of The Panel Causality Test.

	SR Granger non-causality test (H_0: $all\ \varphi_{1,i,k} = 0$)		LR Weak-exogeneity test (H_0: δ_1=0)		SR+LR Strong-exogeneity test(H_0:$all\ \varphi_{1,i,k} = \delta_{1,i} = 0$)	
Panel A :*Ho:* ΔR*Cr* ↛ Δ*GDP*						
K	F-stat	*p*-values	t-stat	*p*-values	F-stat[a]	*p*-values
Panel A1. Without Islamic banks						
5	5.315	0.000***	-0.495	0.620	5.240	0.000***
Panel A2. With Islamic banks						
5	0.875	0.453	-2.471	0.014**	2.119	0.078*
Panel A2. All Countries						
6	3.83	0.009***	-0.367	0.713	3.433	0.004***

	SR Granger non-causality test (H_0: $all\ \beta_{2,i,k} = 0$)		LR Weak-exogeneity test (H_0: $\delta_{2,i}$=0)		SR+LR Strong-exogeneity test(H_0:$all\ \beta_{2,i,k} = \delta_{2,i} = 0$)	
Panel B: *Ho:* Δ*GDP*↛ Δ*RCr*						
K	F-stat	*p*-values	t-stat	*p*-values	F-stat[a]	*p*-values[a]
Panel B1. Without Islamic banks						
5	1.247	0.290	-3.446	0.000***	3.153	0.008***
Panel B2. With Islamic banks						
5	0.845	0.469	-2.109	0.035**	1.581	0.179
Panel B3. All Countries						
6	1.015	0.398	-2.311	0.021**	1.840	0.102

Notes: */**/*** represent statistical significance at the 10%, 5% and 1% level, respectively. *K* is number of lags in ECM. Total panel observations are 355, 338, and 677 for countries without Islamic banks, with Islamic banks and all countries respectively. F-stat is of the Wald statistics test for the significance of the null hypothesis $H_0: all\ \varphi_{1,i,k} = 0$, F-stat[a] is of the Wald statistics test for the significance of the null hypothesis $H_0: all\ \varphi_{1,i,k} = \delta_{1i} = 0$, and t-stat is of the Wald statistics test for the significance of the null hypothesis H_0: δ_{1i}=0. Panel A and Panel B are estimated using equations (4.20) and (4.21) respectively

$$\Delta RGDP_{it} = \alpha_{1i} + \sum_{K=1}^{m} \beta_{1,i,k}\ \Delta RGDP_{i,t-k} + \sum_{k=1}^{m} \varphi_{1,i,k}\ \Delta \text{RCR}_{\ i,t-k} + \delta_{1i} ECT_{i,t-1} + \epsilon_{1it} \quad (4.20)$$

$$\Delta RCR_{it} = \alpha_{2i} + \sum_{k=1}^{m} \varphi_{2,i,k}\ \Delta RCR_{i,t-k} + \sum_{k=1}^{m} \beta_{2,i,k}\ \Delta RGDP_{\ i,t-k} + \delta_{2i} ECT_{i,t-1} + \epsilon_{2it} \quad (4.21)$$

We tested for autocorrelation in the residual by using Ljung-Box test with the null hypothesis that autocorrelations is zero up to lag k. Table 4.20 displays the diagnostic test results for the three panel causality models. The findings suggest again that all models pass the diagnostic tests against autocorrelations, and suggest data congruence.

Table 4.20. Residual Diagnostic Test Ljung-Box Q-statistics for Autocorrelation.

		ΔRCr ↛ ΔGDP		ΔGDP↛ ΔRCr	
	K	Q-stat	*p*-values	Q-stat	*p*-values
Panel A. Countries Without Islamic Banks	5	0.494	0.992	3.036	0.694
Panel B. Countries With Islamic Banks	5	2.051	0.842	2.806	0.730
Panel C. All Countries	6	0.781	0.978	3.161	0.788

Note: Null hypothesis is no autocorrelation for Ljung-Box Q-statistics. *K* is number of lags.

4.6 CONCLUSION

The chapter examines the effects of Islamic and conventional banking on economic growth by exploring the relationship between "real credit to the private sector" and real GDP of selected emerging countries with and without Islamic banks. While previous studies used either time-series analysis or panel approach, we apply both techniques in order to investigate the changes in the effects of the two banking systems at country and group levels. First, we perform the ADF and PP unit root tests for time series approach, while for the panel technique we use the Maddala and Wu (1999) and Im et al. (2003) tests. Second, we examine the long-run relationship between the variables using the-Engle-Granger (1987) and Johansen (1988) cointegration tests in a time-series setting; and Pedroni (2004), Kao (1999) and Westerlund (2007) tests for panel approach. Third, we test for three types of causality, namely the short-run causality, the long-run causality (weak-exogeneity), and the strong-exogeneity test.

Our extensive cointegration and causality analysis reveals strong evidence of long-run causality running from real credit to real GDP, and a weak evidence of short-run causality in both directions in the countries with Islamic banks. In contrast, long-run causality appears to run in the opposite direction, from real GDP to real credit, in the countries without Islamic banks. These differences between the two sets of countries can be reasonably attributed to the distinctive features of Islamic banks. These banks, which are not allowed to engage in speculative transactions, provide loans to projects that are directly linked to real economic activities. This helps to improve on the allocation of resources in the economy, which is likely to boost economic growth in the long-run. However, economies dominated by commercial banks may not necessarily benefit from the allocation of resources as compared to those of economies with Islamic banks, and hence Moran (1992) and Gavin and Hausman (1996) found a weak effect of credit on total GDP growth.

Therefore one could argue that policy makers aiming to stimulate growth should appropriately regulate commercial banks to increase the proportion of credit to productive investment and impose limits on engaging in speculative transactions; this is clearly an important issue, given the current debate on the causes of the global financial crisis, and the mounting evidence that excessive credit growth to finance speculative, unproductive activities was one of its main causes (see Bernanke, 2009 and Turner, 2009). In addition, they should favour a bigger market share for Islamic banks in the countries where they are present.

Future research should also consider possible nonlinearities in the relationship between credit and growth, and examine the robustness of the results by using other measures of credit such as total credit, the credit-to-GDP gap, credit to non-financial sector, principal components analysis (PCA) and broader definition for credit, which could capture various dimensions of total credit (see Drehmann et al. 2011, and Drehmann and Tsatsaronis, 2014).

Although we believe that this chapter covers several aspects of causality from time-series and panel perspectives, nevertheless, it also has some limitations. The data on credit and other candidate indicators (e.g. FDI) are one of the main limitations of this chapter. In fact, in order to obtain a complete picture and richer specifications of the causality between credit and GDP of countries with and without Islamic banks, several features must be taken into account. These features should reflect a broader definition for credit, institutional quality, and aggregate or disaggregate data for proportion of loans (productive and speculative loans) provided by both banking systems. Therefore, the empirical estimation in this study narrowed the choice of credit variables to the most widely-used indicator (credit to private sector).[15]

[15] For example, the new data set by the BIS (Total credit to the non-financial sector) is only available for 40 advanced and emerging economies.

Appendix A4

Table A4.1 Islamic Financial models

Islamic Financial models	Explanation
Musharaka (partnership)	It is built on the idea of equity participation. Under Musharaka contract, each participant pays a percentage of the capital in the company. The profits or losses generated from the business will be shared between the owners based on an agreed profits and losses share called PLS (Ariff, 1988).
Mudharabah (profit-sharing)	Mudharabah is a contract between two parties: one party supplies the capital of the company, while the other party will be considered as an entrepreneur. Therefore, the Islamic bank becomes a shareholder on the bases that any profit or loss occurring from the business is shared between the two parties on a per-determined profit sharing percentage (Haron et al., 1994).
Murabahah (cost plus)	It is a financial contract for buying and selling a particular product. A Murabahah contract should specify the price, the cost of the item and the profit margin at the time of signing the contract. The role of the bank in a Murabahah financial instrument is to finance purchasing the good by buying it on the behalf of the customer. The bank will resell it to the customer after adding a mark-up to the cost price (Ariff, 1988; Haron et al., 1994).
Ijarah (leasing)	The Ijarah refers to an agreement between the lessor and the client to rent for example machinery, vehicles, a shop or any other equipment. An Islamic bank using an Ijarah financial instrument will buy the machinery or any other equipment and lease it to its customers for an agreed rent. If the customer requires the bank to buy the equipment as well, the rent and a monthly instalment as a part of the purchase will be incurred. (Zaher and Hassan, 2001).

CHAPTER FIVE

CONCLUDING REMARKS

This thesis contributes to the literature and the empirical studies on monetary policy and Islamic banks. The distinctive features of Islamic finance and the increasing share of the Islamic banking across the Middle East, Asia, Europe and the US have motivated us to pursuing research in this area.

While the recent financial crisis has raised a series of severe challenges to policy-makers regarding the adequacy of Taylor rule and the actual role of credit in the economy through the transmission mechanism, some researchers suggest that central banks should revise their policy rule (Taylor rule) by including, for example, an index of financial stress or should adopt nominal income targets (see, e.g., Taylor and Davradakis, 2006; Martina and Milas, 2004, 2013; Balakrishnan et al., 2009; McCallum, 2015; Caglayan et al., 2016, among others). However, the Islamic finance literature has interpreted this and offered different perspective regarding the role of credit in the economy. Islamic banks are not allowed to engage in any speculative transactions, which are not compliant with Sharia principles (Beck et al., 2013). It is reckoned that financing such activities is responsible for many financial crises and normally causes an increase in the price level rather than contributing to real activities in the economy (Di Mauro et al., 2013). Further, each financial transaction is underpinned by existing or potential real assets, whilst conventional banks can provide credit without such constraints (see Siddiqi, 1999, 2006; Askari, 2012; Baele et al., 2014).

With this backdrop, this thesis investigates the different aspects of the monetary policy rule and Islamic credit using advanced econometric methods. These techniques include a threshold nonlinear Taylor rule using the GMM technique, a two-regime threshold vector autoregression (TVAR) model, and panel data models. The main findings of this research are that Islamic credit is less responsive than conventional credit to interest rate shocks in both the high and low growth regimes. Further, it highlights significant differences of credit between the two sets of countries with/without Islamic banks reflecting the distinctive features of Islamic banks. Our results are in line with a number of empirical studies, such as Mills and Presley (1999), Ergeç and Arslan (2013), Imam and Kpodar (2015), and Kammer et al. (2015). The key findings and contributions of this thesis are summarised below.

First, Chapter 2 contributes to the literature on monetary policy rule by investigating the possible nonlinearities in the conduct of monetary policy in five emerging countries that adopted inflation target, namely Indonesia, Israel, South Korea, Thailand, and Turkey. For this purpose, a threshold Taylor rule using the GMM technique is employed and we compare the results with a baseline linear Taylor rule. Further, the exchange rate is included in our TVAR based on the argument that the EMEs have an implicit comfort zone for smoothing the variations in the exchange rate, even though these countries do not announce a specific exchange targeting (see, e.g., Goldberg and Campa 2010; Ghosh et al., 2016). This approach enables us to assess whether the behaviour of policy-makers in the EMEs can be described by either a linear or nonlinear Taylor rule.

We find evidence of asymmetry in conducting the monetary policy in the EMEs and it suggests that monetary policy in these five countries in our sample can be addressed by a nonlinear Taylor rule. The results confirm that the policymakers in Indonesia, Israel, South Korea and Thailand with the exception of Turkey respond to the movement in the exchange rate when the economy is in recession, but not in booming phase in all countries in our sample. These results are in line with those of de la Torre et al. (2013); BIS (2013) and Daude et al. (2016). Future research could estimate nonlinear Taylor rule including financial index to examine the effect of the recent financial crisis on the conduct of monetary policy in the EMEs. This would help to show to what extent the findings of this chapter can be generalized to other emerging economies and developing countries that adopted inflation target.

Second, given the significant growth in Islamic finance and the government agenda in Malaysia aiming to increase its market share to 40% by 2020 (BNM, 2012), Chapter 3 examines the bank lending channel of monetary transmission in Malaysia, a country with a dual banking system including both Islamic and conventional banks over the period 1994:01-2015:06. The main contribution of this chapter is in using the TVAR model which allows for parameter switching across the different phases of the business cycle (upper and lower regimes) and takes into account possible nonlinearities in the relationship between bank lending and monetary policy under different economic conditions. The findings of this chapter confirm that Islamic credit changes are less responsive than conventional credit ones to interest rate shocks in both the high and low growth regimes. On the other hand, we find strong positive evidence that credit provided by Islamic banks contributes to economic growth more when the economy switches to low growth regime.

The results of this chapter are in line with the existing literature on the state-dependence of the transmission channels of monetary policy in developed economies. Moreover, Islamic banks operate according to the principles of Islamic finance, and therefore charge the ex-post PLS rate instead of conventional interest rates, and only finance projects directly linked to real economic activities (El-Gamal, 2006; Berg and Kim, 2014). Therefore, these distinctive features of Islamic banks clearly explain our findings. From a policy perspective in economies with a dual (Islamic and conventional) banking system, it is useful for policy-makers to take into account the Islamic bank lending channel in the design of monetary policy. Further, policies aimed at improving the institutional structure and the efficiency of Islamic banks might also be appropriate, with a view to make the transmission of monetary policy more effective in countries such as Malaysia.

Third, Chapter 4 contributes to the on-going debate on finance-growth nexus and Islamic finance literature as one of the first empirical studies that examines the effects of Islamic banking on the causal linkages between real credit and real GDP by comparing two sets of seven emerging countries, the first without Islamic banks, and the second with a dual banking system (Islamic and conventional banks). This relationship is tested for both long- and short-run causality by applying both time series and panel methods unlike previous studies. Specifically, three types of panel unit root tests are used; Fisher-ADF and Fisher-PP tests (Maddala and Wu, 1999) and Im, Pesaran and Shin test, (Im et al., 2003). Three different panel cointegration tests -Pedroni (2004), Kao (1999) and Westerlund (2007) - are employed to examine the long-run relationship between real credit and real GDP.

The main findings of this chapter are threefold. First, the time series analysis provides strong evidence of long-run causality running from real credit to real GDP in countries with Islamic banks only. Second, we find weak evidence of short-run causality in both directions in the countries with Islamic banks. Third, long-run causality appears to run in the opposite direction, i.e., from real GDP to real credit, in the countries without Islamic banks. These are confirmed by the panel causality tests, although in this case short-run causality in countries without Islamic banks is also found. Our findings reveal a notable difference in the role of credit in each set of countries and can plausibly be attributed to the principles of Islamic finance. These banks only allow to provide loans to projects that are directly linked to real economic activities and are not allowed to engage in speculative transactions, options and futures contracts, hedging, toxic assets, and gambling, in this way improving the allocation of resources in the economy and boosting long-run economic growth. In contrast, conventional banks can provide credit without such constraints (see Siddiqi, 2006 and Askari, 2012).

The findings of this chapter are of potential importance to policy-makers aiming to stimulate growth. They should impose limits on engaging in speculative transactions and seek to increase the percentage of credit to productive investment rather than expanding the size of the financial sector. This is clearly an important issue, given the current debate on the causes of the global financial crisis, and the mounting evidence that excessive credit growth to finance speculative, unproductive activities was one of its main causes (see Bernanke, 2009 and Turner, 2009). In addition, they should favour a bigger market share for Islamic banks in the countries where they are present. Future research in this filed might consider possible nonlinearities in the relationship between credit and growth.

Although we believe that this thesis covers several aspects of Islamic finance and monetary policy, and causal relationships drawn from time-series and panel perspectives, however, it also has some limitations. For instance, the data on credit and other candidate indicators (e.g., FDI) are one of the main limitations our studies. In fact, in order to obtain a complete picture and richer specifications of the relationship between credit and economic growth of countries with and without Islamic banks, several features must be taken into account. These features should reflect a broader definition for credit, institutional quality, and aggregate or disaggregate data for proportion of loans (productive and speculative loans) provided by both banking systems. Therefore, the empirical estimation in this study narrowed the choice of credit variables to the most widely-used indicator (credit to private sector in Chapter 4) and Islamic and conventional loans.

Future research should consider possible nonlinearities in the relationship between credit and growth, and examine the robustness of the results by using other measures of credit such as total credit, the credit-to-GDP gap, credit to non-financial sector, principal components analysis (PCA) and broader definition for credit, which could capture various dimensions of total credit (see Drehmann et al. 2011, and

Drehmann and Tsatsaronis, 2014). Further, someone could consider the bank lending channel using disaggregated data (see Kashyap and Stein, 2000), and examine the other monetary channels. Further, one could examine the robustness of the results by using different type of interest rates.

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