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# Returns Predictability in Emerging Housing Markets

Bora Özkan[1], M. Kabir Hassan[2] and Ali Hepşen[3]

This essay searches for a link between house prices, broad money, private credit and the macro-economy among 19 emerging markets. We also explain which variables predict the emerging markets house price index returns. The analysis consists of data for 19 emerging markets spanning the period 1966-2012. To investigate the relationship among our variables as well as the direction of the relationship, we used Fixed-Effects Panel Data Approach, Vector Auto-Regression, Granger Causality, and Variance Decomposition analysis. Using the fixed effects panel data approach, this paper analyzes the variation in 19 emerging markets house price index returns. Our results show that money market rate, growth in GDP and CPI as well as log of private credit (D) and money supply (M3) have significant predictive power on growth in house price indices a quarter ahead. There is a strong negative correlation between the growth in house price indices and the lagged money market rates and private credit. There is a strong positive correlation between the growth in house price indices and the lagged growth in GDP, CPI and log of M3. When we look at different regions, we show that in Eastern Europe only GDP has a predictive power whereas in Asia MMR, D as well as M3 has statistically significant predictive power. Granger causality tests for each country reveals strong evidence of multi-directional link between house prices, GDP, CPI, interest rates, money, and credit. House prices significantly affect the future broad money, private credit and macro variables. When we look at the variance decomposition, in almost every country we investigated, forecast errors to GDP, CPI and money market rate play an important role in explaining innovations to the house price index returns.

## 1. Introduction

Just like any other security, real estate investment also has its risks including falling property values, lack of liquidity, limited

[1] Temple University, Fox School of Business, Department of Finance. Philadelphia, USA. E-mail: bora.ozkan@temple.edu
[2] University of New Orleans, College of Business Administration, Department of Economics and Finance. New Orleans, USA. E-mail: mhassan@uno.edu
[3] Istanbul University, School of Business, Department of Finance. Istanbul, Turkey. E-mail: alihepsen@yahoo.com

diversification and sensitivity to certain economic and financial factors. The question we are looking for is if there is evidence of a significant link among house price indices, money, credit and the macro economy. Goodhart (2007) argue that modern-style macro models are inherently non-monetary. He claims "Since there are by construction no banks, no borrowing constraints and no risks of default, the risk free short-term interest rate serves to model the monetary side of the economy. As a consequence, money or credit aggregates and asset prices play no role in standard versions of these models."

Interest rates have direct effects on house prices. House prices appear to be associated with business-cycle movements in a number of real variables, such as consumption and investment. Researchers have not fully agreed on as to whether accommodative policy has contributed to the volatility of house or other asset prices. It can be argued that because house prices, macroeconomic and monetary variables move in response to other outside shocks hitting the economy, the direction of the relationship or the extent of causality among these variables can be difficult to point out.

The main objectives of the central banks are not necessarily in line with the goals for asset prices, particularly house prices; however house price changes can have important implications for economic activity and inflation. This effect has become especially more important since 2008 crisis. The consequences of excess changes in house prices also should be watched carefully by central banks and other government agencies that regulate financial institutions for the purpose of financial stability. Even though in the past, major declines in real house prices have often been associated with economic downturns, 2008 crises showed us that the opposite is also true; economic downturn can be caused by a decline in real house prices, especially when collateral values also decline significantly.

There is not a consensus among central banks as to how to react to excess changes in house prices. Some researchers argue that we should trust the markets therefore central banks should continue focusing on their goal of low inflation and output stability. However, there are also several researchers who claim central banks should act to prevent bubbles in house prices to avoid financial as well as macroeconomic turbulences. The question is then how should central banks respond to

movements in asset prices? There is also not a consensus on this question. Some researches advise that the price index targeted by a central bank should also include the future prices of goods and services as well as assets. Some researchers, on the other hand, argue that as long as the asset prices affect the forecast of future goods and services price inflation, they can be subject to the monetary policy. They claim central banks should respond to changes in asset prices by calculating the effect of the change in asset prices on expected inflation, and then adjusting the interest rates. Several researchers also point out that the changes in asset prices have implications for the stability of the financial sector; therefore there is an indirect relationship with monetary policy as well. If there is a bubble in asset prices, a correction might be inevitable. When the correction occurs it can be very costly to financial institutions therefore can impair the financial stability. It is clear that understanding the sources of asset price movements becomes a key element in determining the necessary monetary policy response. Hence, movements of house prices and the how these movements effect the financial sector and the macro-economy should closely be monitored by monetary authorities and financial regulators.

Using the fixed effects panel data approach, we analyze the variation in 19 emerging markets house index returns. The results show that money market rate as well as growth in GDP, Consumer Price Index, private credit and money supply have significant predictive power on growth in house price indices a quarter ahead. Using Vector Autoregression Model (VAR) methodology, the findings are expected to contribute to the evaluation of the emerging markets house price index behavior taking into consideration of several financial and economic factors.

Granger Causality tests reveal strong evidence of multi-directional causality between house prices, GDP, CPI, interest rates, money, and credit. In almost every country we investigated, forecast errors to GDP, CPI and money market rate play an important role in explaining innovations to the house price index returns.

The rest of the study is outlined as follows. Section II conducts a literature review. Section III explains the data as well as the variables used. Section IV outlines the framework of the methodology used in this study. Section V presents the conclusion of the study.

## 2. Literature Review

The academic studies primarily focus on the link between the housing sector and its economy. Using a vector autoregressive (VAR) model Baffoe-Bonnie (1998) tries explaining the relationship between house prices and macroeconomic key aggregates in US sub-regions. He finds that variables influence very differently across these sub-regions. Kasparova and White (2001) examine the housing markets in selected European countries using VECM. They show that effect of house prices on GDP is significantly greater than the effect of GDP on house prices. Tsatsaronis and Zhu (2004) investigate the impact of GDP, inflation and the interest rates over house prices. They show that the main reason behind the changes in house prices is the inflation hedge characteristics of residential real estate. They also show that the importance of interest rates became more obvious in the last decade of their study.

In a Federal Reserve Bank International Finance Discussion Paper (2005), Aherane et al. found that in 18 major industrial countries real house prices are pro-cyclical and they move together with real GDP, consumption, investment, CPI inflation, budget and current account balances, and output gaps. They show that house price booms are preceded by a period of easing monetary policy. After a period of rising inflation, monetary authorities begin to tighten policies before house prices peak.

Goodhart and Hoffman (2008) show that there is evidence of a significant multidirectional link between house prices, broad money, private credit and the macro economy among 17 industrialized countries. Their main results reveal that there is evidence of a significant multidirectional link between house prices, monetary variables and the macro-economy. Their results also suggest that the link between housing prices and monetary variables is stronger over more recent years and that the effects of shocks to money and credit are stronger when housing prices are booming. In a more recent study, Beltratti and Morana (2010) suggested countries that macroeconomic variables, such as interest rates and monetary aggregates, affect housing prices in G7 countries.

Asset-price volatility is believed to have been critically affected by the macro-economy (Gilchrist and Leahy, 2002). Several researches show that the housing market has a significant connection with the

performance of the overall economy and with monetary policy (Darrat and Glascock, 1989; Ball, 1994; Baffoe-Bonnie, 1998; Lastrapes, 2002; Jin and Zeng, 2004, Goodhart and Hofmann, 2008). Darrat and Glascock (1989) examined the causal relationship between money supply and real estate return and found that money supply plays an important role in changes in real estate return. Breedon and Joyce (1992) added gross financial wealth into their housing price model. They claim that money supply has a lagged effect on current real estate returns, implying a possible rejection of market efficiency. More recent studies have discussed how the relationship between money supply and asset investment leads to strong housing price fluctuation. Lastrapes (2002) used VAR model to estimate the dynamic response of housing prices to money supply shocks and interpreted these responses based on the asset view of housing demand. Jin and Zeng (2004) found that monetary policy and nominal interest rates play a significant role in the determination of housing prices, as do money shocks by generating remarkably volatile residential investment.

Kim (2005) looked at differential effects of monetary policy on housing sub-markets, specifically new home construction and existing home sales. Findings show that the existing home sale market is relatively more affected by expansionary monetary policies than is the new home construction market in the short run.

McCue and Kling (1994) examine the relationship between US equity REIT series returns and a set of macroeconomic variables. The findings indicate that nearly 60% of the variation in real estate prices is explained by the macro economy; thereby it is the nominal short-term interest rate variable that explains the majority of the real estate price movement. In a more recent study by Ewing and Payne (2005), it is found that shocks to monetary policy, economic growth, and inflation have negative impact on expected REIT returns, while on the other hand shocks to the default risk premium have positive impact on future expected returns.
Mei and Lee (1994) found the presence of a real estate factor, in addition to both a stock factor and a bond factor in asset pricing. They suggest that mutual fund managers should consider including real estate assets in their portfolios.

McMillen (2007) points out the development and increasing usage of Islamic finance for real estate funds. Ahmed (2010) looks at the global

financial crisis from an Islamic finance perspective and gives examples of real estate financing alternatives in Islamic finance. As the financial crises became global as states by Ali (2012), it started to effect Islamic banks and financial institutions as well due to their asset concentration in real estate sector.

Rahman and Shahimi (2010) show that the significant role of financing structure when controlled for macro variables does not hold for small-open developing economies like Malaysia.

Gyourko and Keim (1992) found evidence that REIT returns in the US stock market predict returns to un-securitized returns to commercial properties. They concluded that the prior year's REIT return is significant in predicting the current year's un-securitized real estate return. Myer and Webb (1993) also analyzed the lead-lag relationship using Granger causality. Their findings show that equity REITs Granger cause un-securitized real estate returns. Quan and Titman (1999) prove that real estate is positively affected by inflation as well as GDP.

Ray and Vani (2003) prove that interest rates, industrial production, money supply, inflation and exchange rates have significant affect over equity prices. Hoesli et al. (2008) present the inflation characteristics of real estate investment in the United Kingdom as well as the United States. They show a positive relationship between commercial real estate returns and expected inflation in both countries.

Schatz and Sebastian (2009) find a positive linkage between the property markets and consumer prices as well as the government bonds, while the property markets are negatively affected by the respective unemployment rates for Germany and the UK. Schatz (2009) examines the issue of whether real estate stock indices are primarily driven by the progress of property markets or by developments on general stock markets for the US and the UK. He shows that the real estate equity markets are predominantly driven by the underlying properties.

## 3. Data and Variables

Emerging markets house price index data for 19 Emerging Markets (see Appendix A) provided by Reidin.com; Bulgaria, Czech Republic, Estonia, Hong Kong Sar, Hungary, Israel, Indonesia, Lithuania, Latvia,

Mexico, Malaysia, Poland, Romania, Russia, Slovenia, Slovak Republic, South Africa, South Korea, Thailand, and Turkey. The sample period ranges from 1966Q1 to 2012Q2 which makes an unbalanced panel data set with a total of 906 quarters. On average there are 47 quarters per country; South Africa has the longest sample period with 186 quarters, whereas Thailand has the shortest with 18 quarters. The details of each country period are provided in the Appendix A.

The below table (Table 1) shows the summary statistics which are computed as the averages of each country i's time-series statistics. $RE_{i,t}$. is the quarterly growth of the house price indices of 19 emerging countries provided by REIDIN.com; $GDP_{i,t}$, is the quarterly growth of GDP; $MMR_{i,t}$, is the level of quarterly Money Market Rate; $CPI_{i,t}$, is the growth of Consumer Price Index; $D_{i,t}$ is the log of private credit and $M3_{i,t}$ is the log of money supply. Panel A is the summary statistics of all 19 countries. Panel B is the summary statistics of 11 Eastern European emerging countries; Turkey, Bulgaria, Russia, Czech Republic, Slovak Republic, Estonia, Latvia, Hungry, Lithuania, Slovenia, and Poland. Panel C is the summary statistics of 5 Asian emerging countries; Hong Kong, Indonesia, South Korea, Malaysia, and Thailand.

Other variables are obtained from IFS and OECD. Missing variables are found from each country's central bank or other official resources. The variables that we used are; the growth of house price indices, the growth of real GDP, the growth of consumer price index, the level of the short-term nominal interest rate, the log of nominal broad money and the log of nominal private credit.

**Table 1:** Summary Statistics

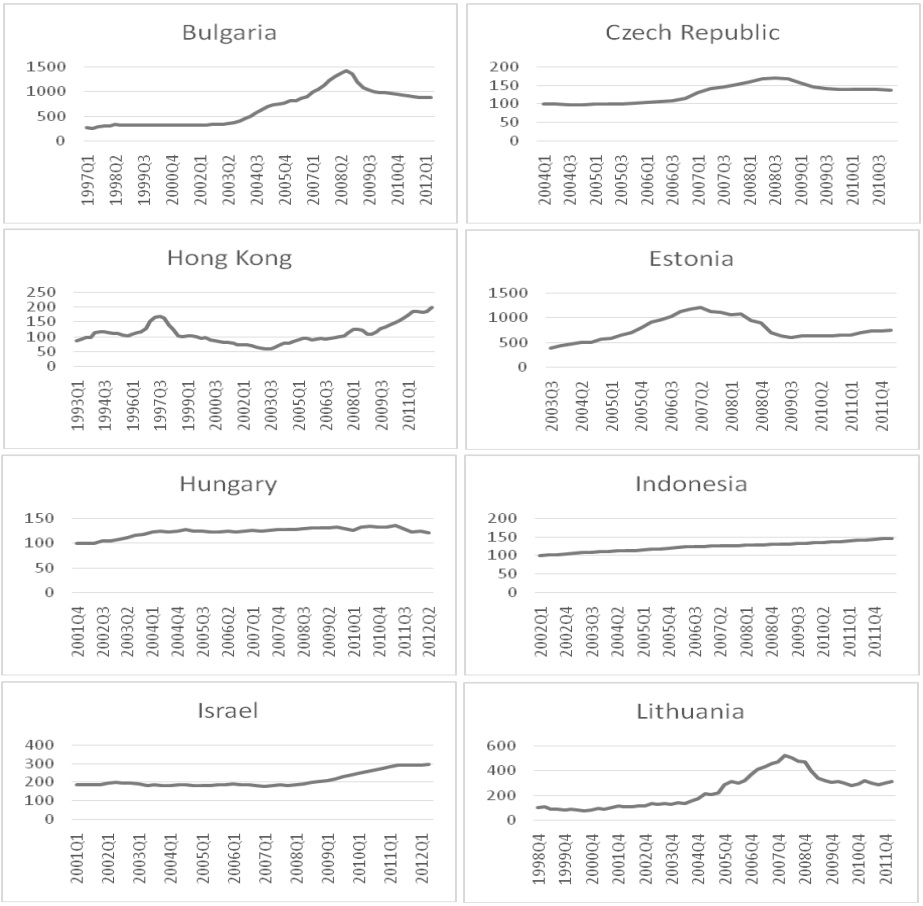
| **Panel A – All Countries** | | | | | | |
|---|---|---|---|---|---|---|
| **Variable** | **RE** | **GDP** | **MMR** | **CPI** | **D** | **M3** |
| Mean | 0.017 | 0.012 | 6.208 | 0.014 | 11.012 | 5.841 |
| Standard deviation | 0.048 | 0.078 | 7.981 | 0.019 | 2.301 | 3.977 |
| Minimum | -0.233 | -0.326 | 0.060 | -0.034 | 6.686 | -0.704 |
| Maximum | 0.389 | 0.303 | 196.153 | 0.383 | 14.554 | 17.031 |
| Observations N | 906 | 901 | 904 | 906 | 713 | 800 |
| Observations n | 19 | 19 | 19 | 19 | 18 | 17 |
| Observations T-bar | 47.684 | 47.421 | 47.579 | 47.684 | 39.611 | 47.059 |
| **Variable** | **RE** | **GDP** | **MMR** | **CPI** | **D** | **M3** |
| **Panel B – Eastern Europe** | | | | | | |
| Mean | 0.019 | 0.013 | 4.838 | 0.014 | 9.910 | 6.840 |
| Standard deviation | 0.063 | 0.103 | 10.891 | 0.024 | 1.925 | 2.410 |
| Minimum | -0.233 | -0.326 | 0.100 | -0.024 | 6.686 | 3.285 |
| Maximum | 0.389 | 0.303 | 196.153 | 0.382 | 13.716 | 10.993 |
| Observations N | 380 | 379 | 373 | 380 | 254 | 330 |
| Observations n | 11 | 11 | 11 | 11 | 10 | 11 |
| Observations T-bar | 34.556 | 34.455 | 33.909 | 34.545 | 26.400 | 30.00 |
| **Panel C – Asia** | | | | | | |
| **Variable** | **RE** | **GDP** | **MMR** | **CPI** | **D** | **M3** |
| Mean | 0.011 | 0.015 | 5.718 | 0.010 | 11.090 | 7.698 |
| Standard deviation | 0.038 | 0.071 | 4.332 | 0.013 | 2.561 | 5.685 |
| Minimum | -0.169 | -0.228 | 0.060 | -0.034 | 7.136 | 1.450 |
| Maximum | 0.191 | 0.173 | 23.927 | 0.103 | 14.083 | 17.013 |
| Observations N | 268 | 265 | 270 | 268 | 234 | 209 |
| Observations n | 5 | 5 | 5 | 5 | 5 | 3 |
| Observations T-bar | 53.600 | 53.000 | 54.000 | 53.600 | 46.800 | 69.667 |

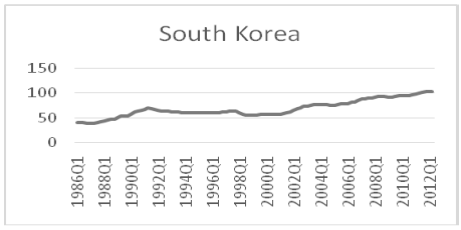
Table 1 shows the summary statistics of the country level data which are computed as the averages of each country's time-series statistics. Mean, standard deviation, minimum and maximum values and observation details are reported for the data set. Panel A is the summary statistics of all 19 countries. Panel B is the summary statistics of 11 Eastern European emerging countries; Turkey, Bulgaria, Russia, Czech Republic, Slovak Republic, Estonia, Latvia, Hungry, Lithuania, Slovenia, and Poland. Panel C is the summary statistics of 5 Asian emerging countries; Hong Kong, Indonesia, South Korea, Malaysia, and Thailand. Table 1 show that the mean growth of the 19 emerging markets house price indices is 0.017, while the growth rate is lower in Asian emerging countries; it is actually higher in Eastern European emerging countries.

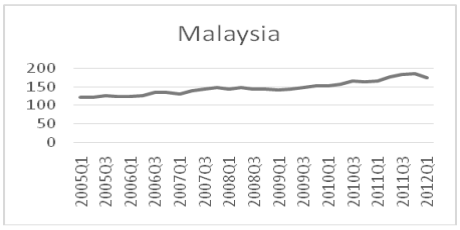
The below figures (Figure 1) show the quarterly house price indices of 19 emerging markets. It is expect to see a positive trend in house price due to growing populations. Land is an important factor in housing obviously and is in fixed supply, therefore housing becomes relatively scarce, and the relative price rises. While some countries show a continuous growth in their study periods, others show busts and booms.

**Figure 1:** House Price Indices in Emerging Countries

These graphs display quarterly house price indices in 19 Emerging Countries




South Korea
150
100
50
0
1986Q1
1988Q1
1990Q1
1992Q1
1994Q1
1996Q1
1998Q1
2000Q1
2002Q1
2004Q1
2006Q1
2008Q1
2010Q1
2012Q1


Malaysia
200
150
100
50
0
2005Q1
2005Q3
2006Q1
2006Q3
2007Q1
2007Q3
2008Q1
2008Q3
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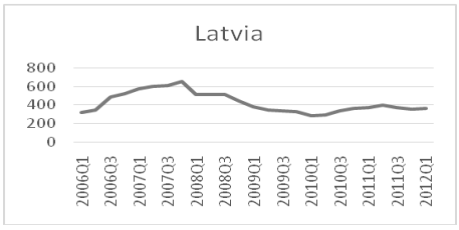
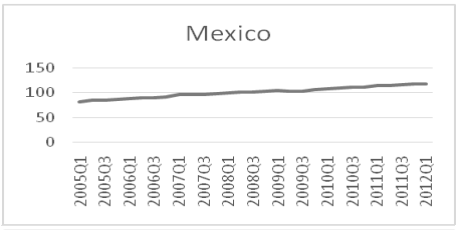
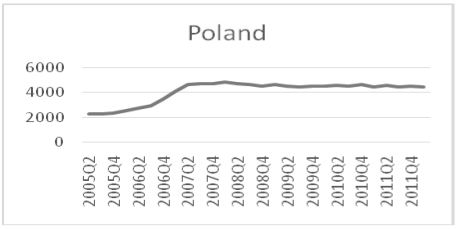
2009Q3
2010Q1
2010Q3
2011Q1
2011Q3
2012Q1


Latvia
800
600
400
200
0
2006Q1
2006Q3
2007Q1
2007Q3
2008Q1
2008Q3
2009Q1
2009Q3
2010Q1
2010Q3
2011Q1
2011Q3
2012Q1


Mexico
150
100
50
0
2005Q1
2005Q3
2006Q1
2006Q3
2007Q1
2007Q3
2008Q1
2008Q3
2009Q1
2009Q3
2010Q1
2010Q3
2011Q1
2011Q3
2012Q1


Poland
6000
4000
2000
0
2005Q2
2005Q4
2006Q2
2006Q4
2007Q2
2007Q4
2008Q2
2008Q4
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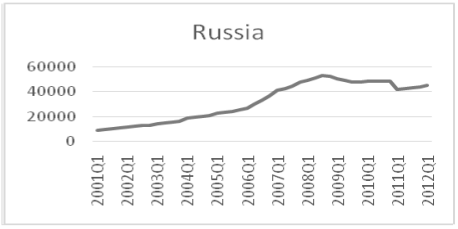
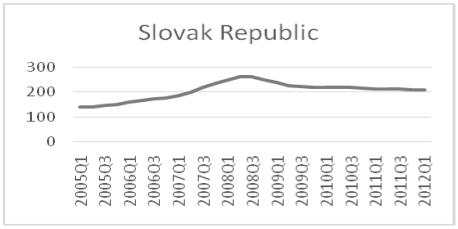
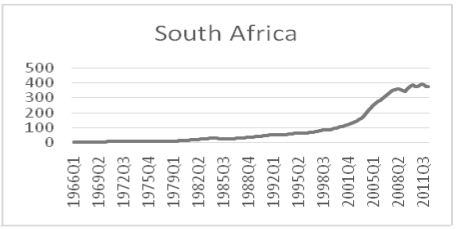
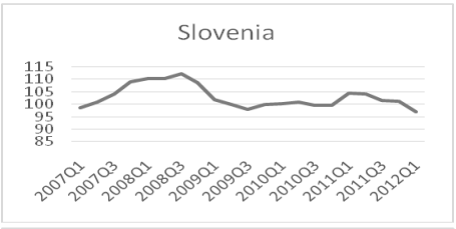
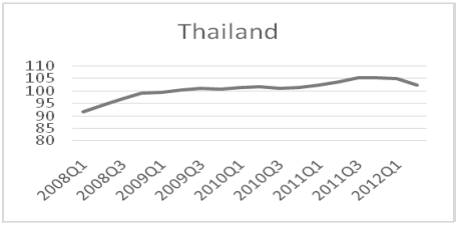
2009Q4
2010Q2
2010Q4
2011Q2
2011Q4

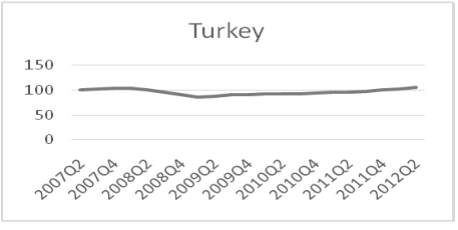

Russia
60000
40000
20000
0
2001Q1
2002Q1
2003Q1
2004Q1
2005Q1
2006Q1
2007Q1
2008Q1
2009Q1
2010Q1
2011Q1
2012Q1


Slovak Republic
300
200
100
0
2005Q1
2005Q3
2006Q1
2006Q3
2007Q1
2007Q3
2008Q1
2008Q3
2009Q1
2009Q3
2010Q1
2010Q3
2011Q1
2011Q3
2012Q1


South Africa
500
400
300
200
100
0
1966Q1
1969Q2
1972Q3
1975Q4
1979Q1
1982Q2
1985Q3
1988Q4
1992Q1
1995Q2
1998Q3
2001Q4
2005Q1
2008Q2
2011Q3


Slovenia
115
110
105
100
95
90
85
2007Q1
2007Q3
2008Q1
2008Q3
2009Q1
2009Q3
2010Q1
2010Q3
2011Q1
2011Q3
2012Q1

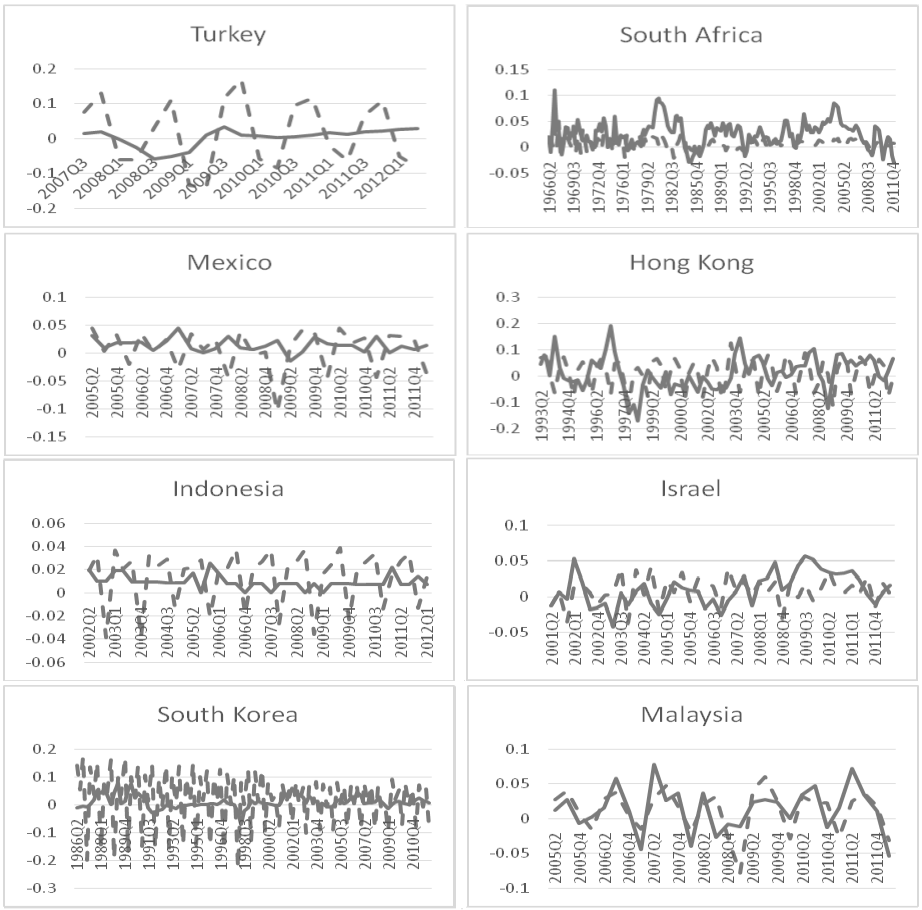

Thailand
110
105
100
95
90
85
80
2008Q1
2008Q3
2009Q1
2009Q3
2010Q1
2010Q3
2011Q1
2011Q3
2012Q1

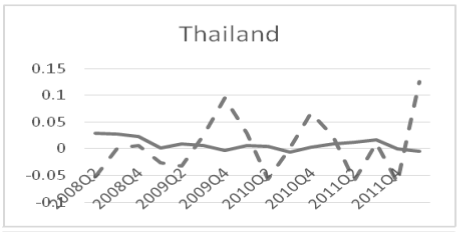

Turkey
150
100
50
0
2007Q2
2007Q4
2008Q2
2008Q4
2009Q2
2009Q4
2010Q2
2010Q4
2011Q2
2011Q4
2012Q2

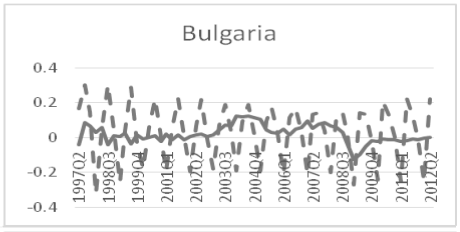
The below figures (Figure 2) show the quarterly percent change in house price indices (solid line) and the quarterly percent change in real GDP (dotted line) in 19 emerging markets.

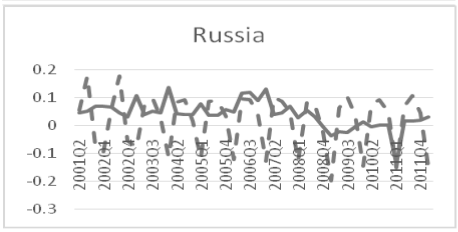
**Figure 2.** House Price and GDP Growth in Emerging Countries

These graphs display quarterly percent change in house price indices (solid line) and real GDP (dotted line)




Thailand
0.15
0.1
0.05
0
-0.05
2008Q2
2008Q4
2009Q2
2009Q4
2010Q2
2010Q4
2011Q2
2011Q4


Bulgaria
0.4
0.2
0
-0.2
-0.4
1997Q2
1998Q3
1999Q4
2001Q1
2002Q2
2003Q3
2004Q4
2006Q1
2007Q2
2008Q3
2009Q4
2011Q1
2012Q2


Russia
0.2
0.1
0
-0.1
-0.2
-0.3
2001Q2
2002Q1
2002Q4
2003Q3
2004Q2
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2005Q4
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2008Q4
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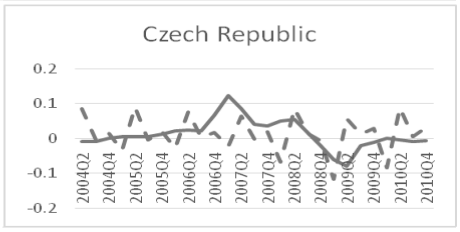
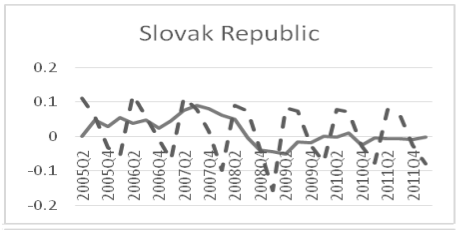
2010Q2
2011Q1
2011Q4


Czech Republic
0.2
0.1
0
-0.1
-0.2
2004Q2
2004Q4
2005Q2
2005Q4
2006Q2
2006Q4
2007Q2
2007Q4
2008Q2
2008Q4
2009Q2
2009Q4
2010Q2
2010Q4


Slovak Republic
0.2
0.1
0
-0.1
-0.2
2005Q2
2005Q4
2006Q2
2006Q4
2007Q2
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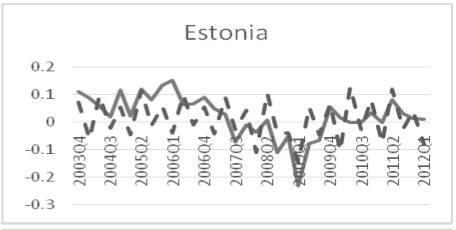
2011Q2
2011Q4


Estonia
0.2
0.1
0
-0.1
-0.2
-0.3
2003Q4
2004Q3
2005Q2
2006Q1
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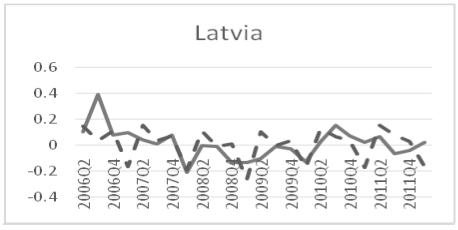
2007Q3
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q4


Latvia
0.6
0.4
0.2
0
-0.2
-0.4
2006Q2
2006Q4
2007Q2
2007Q4
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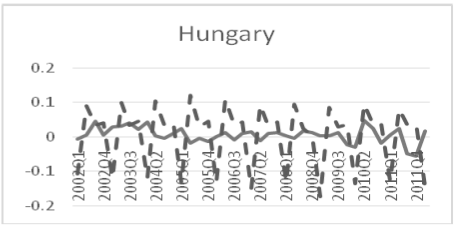
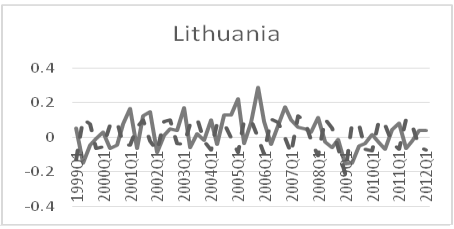
2008Q4
2009Q2
2009Q4
2010Q2
2010Q4
2011Q2
2011Q4


Hungary
0.2
0.1
0
-0.1
-0.2
2002Q1
2002Q4
2003Q3
2004Q2
2005Q1
2005Q4
2006Q3
2007Q2
2008Q1
2008Q4
2009Q3
2010Q2
2011Q1
2011Q4


Lithuania
0.4
0.2
0
-0.2
-0.4
1999Q3
2000Q1
2001Q1
2002Q1
2003Q1
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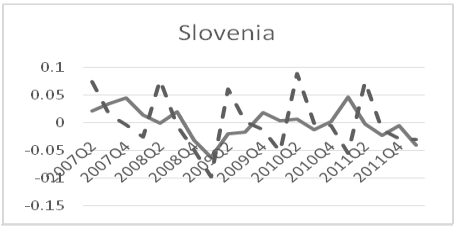
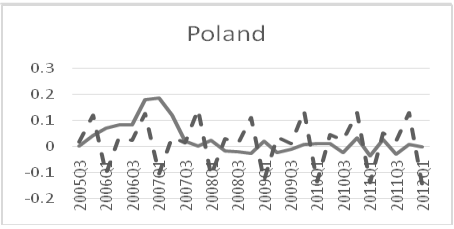
2005Q1
2006Q1
2007Q1
2008Q1
2009Q1
2010Q1
2011Q1
2012Q1

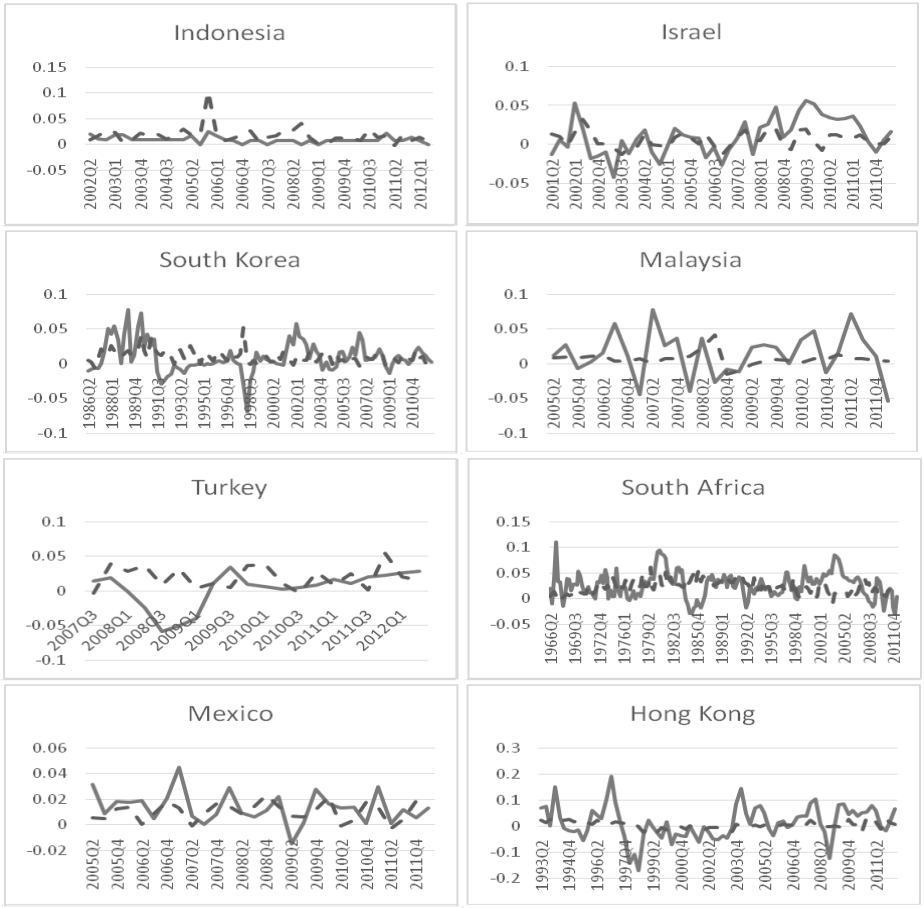

Slovenia
0.1
0.05
0
-0.05
-0.1
-0.15
2007Q2
2007Q4
2008Q2
2008Q4
2009Q2
2009Q4
2010Q2
2010Q4
2011Q2
2011Q4

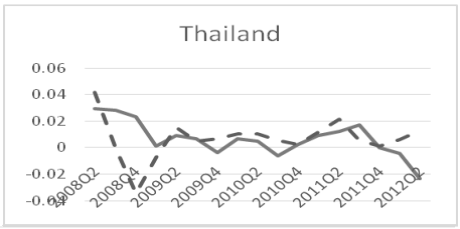

Poland
0.3
0.2
0.1
0
-0.1
-0.2
2005Q3
2006Q1
2006Q3
2007Q1
2007Q3
2008Q1
2008Q3
2009Q1
2009Q3
2010Q1
2010Q3
2011Q1
2011Q3
2012Q1

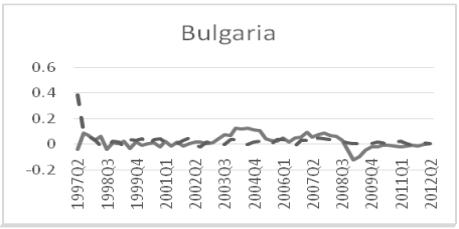
On the other hand, figure 3 shows the quarterly percent change in house price indices (solid line) and the quarterly percent change in CPI (dotted line) in our sample countries.

**Figure 3.** House Price and CPI Growth in Emerging Countries

These graphs display quarterly percent change in house price indices (solid line) and CPI (dotted line)

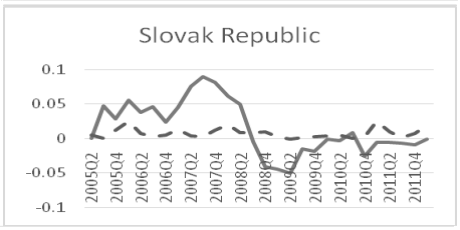


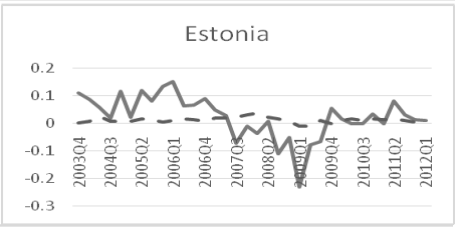

Thailand
0.06
0.04
0.02
0
-0.02
-0.04
2008Q2
2008Q4
2009Q2
2009Q4
2010Q2
2010Q4
2011Q2
2011Q4
2012Q2

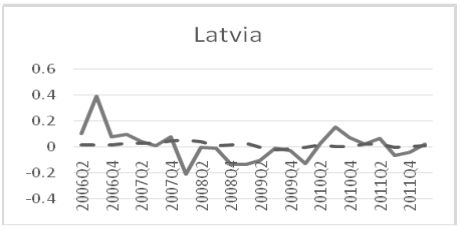

Bulgaria
0.6
0.4
0.2
0
-0.2
1997Q2
1998Q3
1999Q4
2001Q1
2002Q2
2003Q3
2004Q4
2006Q1
2007Q2
2008Q3
2009Q4
2011Q1
2012Q2


Russia
0.2
0.1
0
-0.1
-0.2
2001Q2
2002Q1
2002Q4
2003Q3
2004Q2
2005Q1
2005Q4
2006Q3
2007Q2
2008Q1
2008Q4
2009Q3
2010Q2
2011Q1
2011Q4


Czech Republic
0.15
0.1
0.05
0
-0.05
-0.1
2004Q2
2004Q4
2005Q2
2005Q4
2006Q2
2006Q4
2007Q2
2007Q4
2008Q2
2008Q4
2009Q2
2009Q4
2010Q2
2010Q4


Slovak Republic
0.1
0.05
0
-0.05
-0.1
2005Q2
2005Q4
2006Q2
2006Q4
2007Q2
2007Q4
2008Q2
2008Q4
2009Q2
2009Q4
2010Q2
2010Q4
2011Q2
2011Q4


Estonia
0.2
0.1
0
-0.1
-0.2
-0.3
2003Q4
2004Q3
2005Q2
2006Q1
2006Q4
2007Q3
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q1


Latvia
0.6
0.4
0.2
0
-0.2
-0.4
2006Q2
2006Q4
2007Q2
2007Q4
2008Q2
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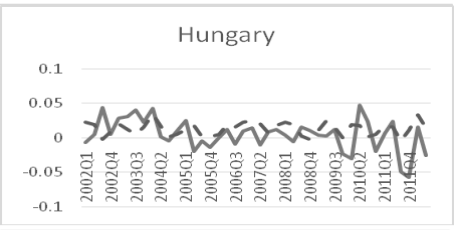
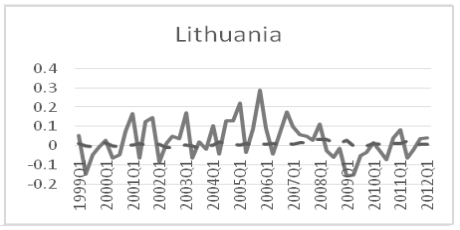
2009Q2
2009Q4
2010Q2
2010Q4
2011Q2
2011Q4


Hungary
0.1
0.05
0
-0.05
-0.1
2002Q1
2002Q4
2003Q3
2004Q2
2005Q1
2005Q4
2006Q3
2007Q2
2008Q1
2008Q4
2009Q3
2010Q2
2011Q1
2011Q4


Lithuania
0.4
0.3
0.2
0.1
0
-0.1
-0.2
1999Q1
2000Q1
2001Q1
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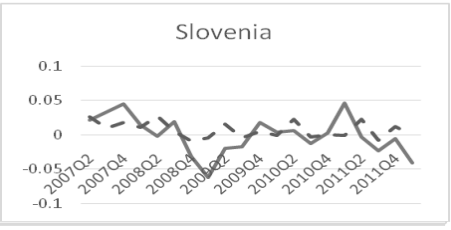
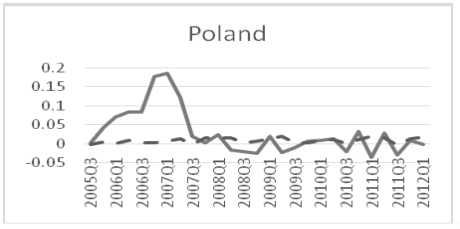
2004Q1
2005Q1
2006Q1
2007Q1
2008Q1
2009Q1
2010Q1
2011Q1
2012Q1


Slovenia
0.1
0.05
0
-0.05
-0.1
2007Q2
2007Q4
2008Q2
2008Q4
2009Q2
2009Q4
2010Q2
2010Q4
2011Q2
2011Q4


Poland
0.2
0.15
0.1
0.05
0
-0.05
2005Q3
2006Q1
2006Q3
2007Q1
2007Q3
2008Q1
2008Q3
2009Q1
2009Q3
2010Q1
2010Q3
2011Q1
2011Q3
2012Q1

The figures reveal that, while there might be a correlation between growth in house indices and GDP as well as CPI, the relationship is not perfect at all. Growth in house prices in some countries move in the same direction with growth in GDP, However, several countries also show a deviation in the direction of this relationship. The similar pattern is also found in the relationship between the growth in house price indices and the growth in CPI in these countries. This also means that there will not be a major multicollinearity problem including these variables in our empirical model.

## 4. The Theoretical Framework

### 4.1. Predictability of House Price Index Returns

#### 4.1.1. Parameter Estimates

The fixed-effects panel data regression shows the relationship between the House Price Index returns and the independent variables; gross domestic product (GDP), money market rate (MMR), consumer price index (CPI), private credit (D) and money supply (M3).

$$r_{j,t} = \alpha_j + \beta Z_{j,t} + \varepsilon_{j,t} \quad (1)$$

r is index return for country j at time t and independent variables for country j are defined by Z at time t.

The below table (Table 2) shows the parameter estimates and standard errors for house price index returns from the fixed effects regression results with clustered standard errors. In the regression, dependent variable is the quarterly growth on the house price indices of 19 emerging countries provided by REIDIN.com; $RE_{i,t}$. Independent variables are growth of $GDP_{i,t}$, level of Money Market Rate $MMR_{i,t}$, growth of Consumer Price Index $CPI_{i,t}$, log of private credit $D_{i,t}$ and log of money supply$M3_{i,t}$. Standard errors are reported in parenthesis. *, **, *** indicate significance at the 10%, 5% and 1% level, respectively.

**Table 2.** Fixed Effects Panel Regressions

| Constant | GDP | MMR | CPI | D | M3 | $R^2$ |
|---|---|---|---|---|---|---|
| 0.294*** | 0.035 | -0.002*** | 0.270*** | -0.055*** | 0.059*** | 0.16 |
| (0.079) | (0.053) | (0.001) | (0.100) | (0.016) | (0.016) | |

Table 2 shows the parameter estimates and standard errors for house price index regression results. Results show that all of the coefficients, except for GDP, are statistically significant at 1% level. Money market rate, growth in CPI, private credit and M3 are all positively correlated with the growth in house price index returns. Coefficient signs also seem to be in line with the current literature on house in developed countries. Quan and Titman (1999) and Hoesli et al. (2008) found positive relationship between house returns and anticipated inflation in the US and the UK. McCue and King (1994) claim that nominal short term interest rate explains majority of the variation in house series.

### 4.1.2. Forecasting House Price Index Returns

To test whether house prices, credit, money and economic activity can predict one-quarter-ahead market returns in emerging countries, fixed-effects panel data regression is used.

$$r_{j,t+1} = \alpha_j + \delta X_{j,t} + \xi_{j,t+1} \quad (2)$$

r is index return for country j at time t+1 and independent variables for country j are defined by X at time t. The lagged dependent variable is also added as a control variable. As stated by Ferson et al. (2003), persistent dependent variables may result in a spurious regression. In panel data, the variance-covariance matrix of the error terms is simply the combination of variance-covariance matrices of each country which, aside from the autocorrelation of the error terms within each country, causes a contemporaneous cross-sectional correlation. This can inflate the t-statistics by a significant amount. To correct this, we compute standard errors in the existence of heteroskedasticity and contemporaneous cross-correlations as suggested by Rogers (1983, 1993). By estimating intercepts, α, separately for each country j, we lower to the country-level data and make sure that each country's error term is orthogonal to the explanatory variables for that country.

Therefore, in a panel data using fixed effects regression, the results reject the time-series relation between the dependent and independent variables. In equation (2), the slope coefficient, δ, together with its clustered standard errors, shows whether there is a statistically significant relation between the house price index returns and broad money, private credit and macro economy.

The below table (Table 3) shows the parameter estimates and standard errors for house price index returns from the fixed effects regression results with clustered standard errors. In the regression, dependent variable is the lead quarterly growth of the house price indices of 19 emerging countries provided by REIDIN.com; $RE_{i,t+1}$. Independent lagged variables are growth of the house price index; $RE_{i,t}$, growth of $GDP_{i,t}$, level of Money Market Rate $MMR_{i,t}$, growth of Consumer Price Index $CPI_{i,t}$, log of private credit $D_{i,t}$ and log of money supply $M3_{i,t}$. Clustered standard errors are reported in parenthesis. $^{*}$, $^{**}$, $^{***}$ indicate significance level at the 10%, 5% and 1%, respectively.

**Table 3.** Forecasting House Price Index-Fixed Effects Panel Regressions

| | **Constant** | | **GDP** | **MMR** | **CPI** | **D** | **M3** | $R^2$ |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| 1 | 0.016*** | | 0.053 | | | | | |
| | (0.003) | | (0.038) | | | | | |
| 2 | 0.021*** | | | - | | | | |
| | (0.003) | | | (0.001) | | | | |
| 3 | 0.015*** | | | | | | | |
| | (0.003) | | | | (0.066) | | | |
| 4 | 0.042* | | | | | -0.002 | | |
| | (0.024) | | | | | (0.002) | | |
| 5 | 0.029*** | | | | | | -0.002* | |
| | (0.006) | | | | | | (0.001) | |
| 6 | | | | - | 0.216* | - | | |
| | (0.058) | (0.062) | (0.024) | (0.001) | (0.130) | (0.011) | (0.022) | |

Table 3 shows the univariate regression of the one quarter ahead house price index returns on growth of GDP, level of MMR, growth of CPI,

log of D and log of M3. Second row shows that the money market rate is negatively correlated with the future growth in house price index returns at 5% significance level with a t-statistics of -2.56 when it is regressed alone. Growth in money supply, M3, as seen in row five, is also negatively correlated with the future growth in house price index returns at 10% level with a t-statistics of -1.74 when it is regressed alone. Both variables have statistically significant predictive power. On the other hand, third row reveals that growth in CPI is positively correlated with the future growth in house price index returns at 1% level with a t-statistics of 2.67. CPI has a strong predictive power. When we regress all of the variables together, we see that all of our variables significantly predicts the growth in house price index returns. Interestingly in this setting, GDP and private credit have forecasting power so they are statistically significant as opposed to when they were regressed by themselves. The coefficient of GDP is 0.061 with a t-statistics of 2.54, whereas the coefficient of D is -0.037 with a t-statistics of -3.32. This means that when there is a positive growth in private credit, the house price indices tend to be negatively affected from this the following quarter. We explain this by the lack of organized mortgage markets in emerging markets as well as the structure of financial institutions. When private credit to businesses increase, available money to the housing markets might be declining therefore affecting the growth in prices negatively. Our results show that there is a strong negative correlation between the growth in house price indices and the lagged money market rates and private credit. There is a strong positive correlation between the growth in house price indices and the lagged growth in GDP, CPI and log of M3.

We also examine if the predictive power of these variables is different for different regions. When we do regression one quarter ahead house price index returns on our money, credit and macro variables in Eastern European emerging markets and Asian emerging markets in our sample, we actually get different results. Table 4 reveals that in Eastern Europe, only GDP has predictive power a quarter ahead at 5% significance level. The other variables are not statistically significant even at 10% level. However in Asian emerging countries, money market rate, private credit and money supply have significantly predictive power at 1% level.

The below table (Table 4) shows the parameter estimates and standard errors for house price index returns from the fixed effects regression

results with clustered standard errors. In the regression, dependent variable is the lead quarterly growth of the house price indices provided by REIDIN.com; $RE_{i,t+1}$. Independent lagged variables are growth of the house price index; $RE_{i,t}$, growth of $GDP_{i,t}$, level of Money Market Rate $MMR_{i,t}$, growth of Consumer Price Index $CPI_{i,t}$, log of private credit $D_{i,t}$ and log of money supply $M3_{i,t}$. Panel A is the fixed effects regression results of 11 Eastern European emerging countries; Turkey, Bulgaria, Russia, Czech Republic, Slovak Republic, Estonia, Latvia, Hungry, Lithuania, Slovenia, and Poland. Panel B is the fixed effects regression results of 5 Asian emerging countries; Hong Kong, Indonesia, South Korea, Malaysia, and Thailand. Clustered standard errors are reported in parenthesis. $^{*,\ **,\ ***}$ indicate significance level at the 10%, 5% and 1%, respectively.

**Table 4.** Forecasting House Price Index for Different Regions

| **Panel A - Fixed Effects Panel Regression for Eastern Europe** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Constant** | **RE** | **GDP** | **MMR** | **CPI** | **D** | **M3** | $R^2$ |
| 0.140* | 0.458** | 0.083* | -0.001 | 0.261 | -0.037 | 0.037 | 0.3 |
| (0.075) | (0.079) | (0.039) | (0.002) | (0.266 | (0.034) | (0.045) | |
| **Panel B - Fixed Effects Panel Regression for Asia** | | | | | | | |
| **Constant** | **RE** | **GDP** | **MMR** | **CPI** | **D** | **M3** | $R^2$ |
| | 0.484** | 0.006 | - | 0.094 | - | 0.050** | 0.4 |
| (0.063) | (0.084) | (0.024) | (0.001) | (0.182 | (0.016) | (0.016) | |

### 4.2. Relationship among House Prices, Credit, Money and Economic Activity

The analysis is quarterly data for 19 emerging markets spanning the period 1966-2012. To investigate the relationship among our variables as well as the direction of the relationship, we used Vector Auto-regression, Granger Causality, and Variance Decomposition analysis. The estimation of a Vector Auto-regression, VAR model, introduces by Sims (1980), requires two steps. First, a vector of variables dated at time t is regressed on several lags of itself. The residuals from these regressions are interpreted as innovations which show the new information about the variables that became available during period t. In the second step of estimation, these innovations are regressed on

themselves, using one of several statistical procedures. The second-stage regressions are often given a structural or behavioral interpretation. Therefore, the residuals from the second-stage regressions are often viewed as structural shocks.

$$Y_t = AY_{t-1} + \ldots + A'Y_{t-k} + e_t \quad (3)$$

where k is the number of lags that is considered in the system $Y_t$, $Y_{t-1},\ldots,Y_{t-k}$ equals to the 1 x p vector of variables and A,…,A' equal to the p x p matrices of coefficients to be estimated. Also $e_t$ is an 1 x p vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables.

### 4.2.1. Unit Root Test

For the co-integration methodology, at least two of the series should be non-stationary process that contains a single unit root. If Yt ~ I(1), then Zt = Yt – Yt-1 is stationary I(0). We used Augmented Dickey-Fuller test on all of the variables for each country separately. We took first differences of all the variables that are non-stationary to make them stationary. We also used Akaike and Schwarz criterions to determine the lag lengths for each country. Estimating the six dimensional VAR at the individual country level can suffer from too few degrees of freedom especially if there is missing data which is very common for macro variables. We had to drop some of the variables in some countries to get around this problem, especially the variables that have significant missing quarterly data.

### 4.2.2. Granger Causality Test

In a regression analysis, we look at the dependence of one variable on other variables, but it does not necessarily show the causation. In other words, the existence of a relationship between variables does not prove causality or the direction of the influence.

Granger (1969) developed a test approach to prove that a time series X contribute to the prediction of another series, Y. In this section the relationship among house price index returns, GDP, inflation, money

market rate, private credit and money supply are investigated using Granger Causality tests.

Table 5 displays the results from the Granger causality tests for each country, which reveals strong evidence of multi-directional causality between house prices, GDP, CPI, interest rates, money, and credit. In Hong Kong, Lithuania, Mexico and Poland, for example, the relationship between house prices and GDP is in both directions; GDP has a significant effect on the future house prices and house prices also have significant effect on the future GDP. This multi-directional relationship also exists between CPI and house prices in Hong Kong and Lithuania. There is also a multidirectional link between MMR and house prices in Czech Republic, South Africa and South Korea. Finally in Czech Republic the direction of relationship between private credit and house prices is bi-directional.

The below table (Table 5) shows the direction of granger causality tests conducted in each country. ΔREI is the growth of the house price index; ΔGDP is the growth of GDP; MMR is the level of Money Market Rate; ΔCPI is the growth of Consumer Price Index, ΔD is the log of private credit, and ΔM3 is the log of money supply. P values are in parenthesis.

**Table 5.** Granger Causality Test

| **ΔGDP → ΔREI** | **ΔREI → ΔGDP** | **ΔGDP ↔ ΔREI** |
|---|---|---|
| Hong Kong (0.09) | Bulgaria(0.01) | Hong Kong |
| Lithuania (0.01) | Estonia (0.04) | Lithuania |
| Mexico (0.02) | Hong Kong (0.01) | Mexico |
| Poland (0.08) | Lithuania (0.01) | Poland |
| | Mexico (0.07) | |
| | Poland (0.01) | |
| | Russia (0.01) | |
| | Slovak Republic (0.01) | |
| | South Africa (0.01) | |
| | Turkey (0.01) | |
| **ΔCPI → ΔREI** | **ΔREI → ΔCPI** | **ΔCPI ↔ ΔREI** |
| Hong Kong (0.09) | Hong Kong (0.01) | Hong Kong |
| Hungary (0.04) | Indonesia (0.03) | Lithuania |
| Latvia (0.04) | Lithuania (0.01) | |
| Lithuania (0.09) | Slovak Republic (0.01) | |
| Mexico (0.02) | South Korea (0.01) | |
| | Thailand (0.05) | |
| **MMR → ΔREI** | **ΔREI → MMR** | **MMR ↔ ΔREI** |
| Czech Republic (0.09) | Bulgaria (0.01) | Czech Republic |
| Estonia (0.09) | Czech Republic (0.09) | South Africa |
| Israel (0.01) | Hungary (0.04) | South Korea |
| South Africa (0.02) | South Africa (0.01) | |
| South Korea (0.02) | South Korea (0.02) | |
| | Turkey (0.04) | |
| **ΔM3 → ΔREI** | **ΔREI → ΔM3** | **ΔM3 ↔ ΔREI** |
| Hong Kong (0.01) | Czech Republic (0.01) | |
| | Malaysia (0.01) | |
| **ΔD → ΔREI** | **ΔREI → ΔD** | **ΔD ↔ ΔREI** |
| Czech Republic (0.01) | Bulgaria (0.01) | Czech Republic |
| Indonesia (0.07) | Czech Republic (0.03) | |
| | Hong Kong (0.04) | |
| | Lithuania (0.02) | |
| | Russia (0.04) | |

It is also interesting to see that in almost every country, house prices significantly affect the future broad money, private credit and macro variables. This has an important implication for the policy makers in these countries as well as the potential investors to those countries. Central banks do not necessarily implement policies to influence the future house prices, however, our results show that their policies can actually influence future house prices as well as the house prices strongly influence future broad money and private credit growth levels.

### 4.2.3. Variance Decomposition

In order to decompose the variance of each element of $Y_t$ in equation 3 into components due to each of the elements of the error term and to do so for various horizons, we conduct variance decomposition analysis. In this analysis we are trying to see how much of the variance of each element of $Y_t$ is due to the first error term and how much due to the second error term and so on.

Our findings show an interesting picture for 19 emerging markets. Table 6 presents that the forecast errors of house price index returns are mainly attributable to their own innovations in Bulgaria, Czech Republic, Slovak Republic, Slovenia, and South Africa in the following quarter. However, in Israel, only 33% is attributable to its own innovation whereas 38% of the forecast error variance is explained by the innovations in CPI. In Estonia, Indonesia, Israel, Poland and Thailand less than 60% of the forecast errors are explained by their own innovations. Interestingly in Poland, innovations in CPI explain more than 46% of the forecast error variance to house price index returns. When we look at the second quarter horizon in table 6, also in Hong Kong, Lithuania, Malaysia, Mexico, Russia and Turkey less than 60% of the forecast errors are explained by their own innovations. In almost every country we investigated, forecast errors to GDP, CPI, and money market rate play an important role in explaining innovations to the house price index returns.

The below table (Table 6) shows the variance decomposition of house index growth in each country. REI is the growth of the house price index; GDP is the growth of GDP; MMR is the level of Money Market Rate; CPI is the growth of Consumer Price Index, D is the log of private credit, and M3 is the log of money supply.

**Table 6.** Variance Decompositions

| Period | S.E. | REI | GDP | MMR | CPI | D | M3 |
|---|---|---|---|---|---|---|---|
| Bulgaria | | | | | | | |
| 1 | 0.024157 | 100 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0.031711 | 81.0747 | 5.530402 | 6.061027 | 2.8238 | 4.50706 | 0.003009 |
| 3 | 0.050675 | 77.97421 | 2.21586 | 16.83344 | 1.196401 | 1.778603 | 0.001487 |
| Czech Republic | | | | | | | |
| 1 | 0.022201 | 100 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0.047523 | 93.13504 | 5.120865 | 0.066697 | 0.051782 | 1.552998 | 0.072618 |
| 3 | 0.069225 | 78.24086 | 16.86071 | 0.053422 | 0.535702 | 4.23035 | 0.078966 |
| Estonia | | | | | | | |
| 1 | 0.063735 | 58.78516 | 12.78755 | 28.14462 | 0.282668 | 0 | 0 |
| 2 | 0.072426 | 45.53605 | 13.55422 | 34.58357 | 2.245882 | 0.031937 | 4.048342 |
| 3 | 0.078737 | 39.14124 | 14.80916 | 33.80846 | 8.379692 | 0.366971 | 3.49448 |
| Hong Kong | | | | | | | |
| 1 | 0.030106 | 74.99744 | 0.032971 | 11.88576 | 13.08383 | 0 | 0 |
| 2 | 0.047896 | 55.13629 | 0.039506 | 19.81967 | 16.62758 | 4.372861 | 4.004098 |
| 3 | 0.058281 | 43.70027 | 4.087707 | 23.19794 | 13.441 | 8.984462 | 6.588625 |
| Hungary | | | | | | | |
| 1 | 0.017843 | 68.89523 | 2.423627 | 9.406063 | 19.27508 | 0 | 0 |
| 2 | 0.018313 | 68.53662 | 2.482223 | 9.586204 | 18.3672 | 0.944833 | 0.082918 |
| 3 | 0.018922 | 67.36271 | 3.044674 | 10.54692 | 17.83996 | 0.890909 | 0.31482 |
| Indonesia | | | | | | | |
| 1 | 0.006904 | 39.00586 | 2.743775 | 7.785134 | 50.46524 | 0 | 0 |
| 2 | 0.008069 | 30.1889 | 4.633825 | 5.815601 | 53.88642 | 5.466183 | 0.009081 |
| 3 | 0.009158 | 23.55779 | 5.625276 | 14.42514 | 42.0328 | 14.18964 | 0.169355 |
| Israel | | | | | | | |
| 1 | 0.014088 | 33.45416 | 9.106639 | 19.20721 | 38.23199 | 0 | 0 |
| 2 | 0.016441 | 31.44371 | 11.93171 | 23.14612 | 31.18132 | 1.155003 | 1.142133 |
| 3 | 0.018134 | 28.46376 | 14.22682 | 25.15489 | 27.11396 | 4.055117 | 0.985443 |
| Latvia | | | | | | | |
| 1 | 0.102881 | 84.92258 | 12.07714 | 0.173257 | 2.827026 | 0 | 0 |
| 2 | 0.105802 | 80.32982 | 11.71405 | 0.257026 | 7.699099 | 0 | 0 |
| 3 | 0.106228 | 79.75319 | 11.73884 | 0.404214 | 8.103748 | 0 | 0 |
| Lithuania | | | | | | | |
| 1 | 0.077673 | 71.85774 | 11.79486 | 0.394036 | 15.95337 | 0 | 0 |
| 2 | 0.085396 | 59.73515 | 14.2033 | 0.704092 | 21.855 | 3.502454 | 0 |
| 3 | 0.098347 | 51.58357 | 19.48563 | 7.959546 | 18.30758 | 2.663678 | 0 |
| Malaysia | | | | | | | |
| 1 | 0.035419 | 62.15115 | 24.48083 | 4.723128 | 8.644898 | 0 | 0 |
| 2 | 0.044953 | 47.3974 | 37.29059 | 3.076149 | 12.11371 | 0 | 0.122148 |
| 3 | 0.045099 | 47.09465 | 37.06453 | 3.121785 | 12.10755 | 0 | 0.61148 |
| Mexico | | | | | | | |
| 1 | 0.009546 | 70.06695 | 0.004049 | 28.69054 | 1.238463 | 0 | 0 |
| 2 | 0.01064 | 56.39961 | 7.084196 | 24.06984 | 10.19012 | 0 | 2.25623 |
| 3 | 0.011372 | 51.64943 | 8.238863 | 24.71749 | 13.01386 | 0 | 2.380353 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Poland | | | | | | | |
| 1 | 0.040745 | 21.6541 | 4.496019 | 27.24993 | 46.59995 | 0 | 0 |
| 2 | 0.048746 | 24.75313 | 9.648047 | 28.18578 | 37.32417 | 0 | 0.088874 |
| 3 | 0.060885 | 28.26724 | 8.110692 | 28.71206 | 32.15057 | 0 | 2.759436 |
| Russia | | | | | | | |
| 1 | 0.037977 | 70.56521 | 18.56186 | 0.485193 | 10.38773 | 0 | 0 |
| 2 | 0.043642 | 53.50575 | 16.19698 | 0.778594 | 25.58018 | 0.951301 | 2.987207 |
| 3 | 0.047568 | 51.42839 | 14.07409 | 0.907194 | 21.53531 | 0.871043 | 11.18397 |
| Slovak Republic | | | | | | | |
| 1 | 0.018012 | 100 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0.025347 | 99.76028 | 0.061759 | 0 | 0.177958 | 0 | 0 |
| 3 | 0.034925 | 98.68466 | 0.204 | 0 | 1.111337 | 0 | 0 |
| Slovenia | | | | | | | |
| 1 | 0.032443 | 100 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0.036588 | 96.74549 | 1.225553 | 0 | 0.116883 | 0 | 1.912072 |
| 3 | 0.037587 | 94.26179 | 3.09955 | 0 | 0.141117 | 0 | 2.497541 |
| South Africa | | | | | | | |
| 1 | 0.012137 | 99.64917 | 0.17224 | 0.101014 | 0.077571 | 0 | 0 |
| 2 | 0.017433 | 93.58635 | 0.125583 | 3.793401 | 0.13879 | 1.380478 | 0.975399 |
| 3 | 0.020111 | 86.71716 | 0.576669 | 7.915657 | 0.37984 | 2.996521 | 1.414152 |
| South Korea | | | | | | | |
| 1 | 0.013546 | 85.33999 | 10.33327 | 0.045611 | 4.281133 | 0 | 0 |
| 2 | 0.017821 | 65.14771 | 22.9192 | 7.732547 | 3.763197 | 0.126361 | 0.310983 |
| 3 | 0.022263 | 47.89443 | 24.49571 | 17.4917 | 4.504618 | 5.40568 | 0.207866 |
| Thailand | | | | | | | |
| 1 | 0.009175 | 14.88978 | 0.444163 | 19.9962 | 64.66986 | 0 | 0 |
| 2 | 0.011393 | 11.03682 | 32.17626 | 14.41466 | 42.37226 | 0 | 0 |
| 3 | 0.011833 | 11.06525 | 30.71152 | 13.85177 | 44.37147 | 0 | 0 |
| Turkey | | | | | | | |
| 1 | 0.013866 | 84.12949 | 0.001894 | 6.342265 | 9.526354 | 0 | 0 |
| 2 | 0.0273 | 54.16049 | 1.609169 | 4.251012 | 39.63942 | 0 | 0.339912 |
| 3 | 0.034881 | 41.07273 | 1.133549 | 5.608226 | 51.90887 | 0 | 0.276629 |

## 5. Concluding Comments

Housing market is undoubtedly one of the most important components of a national economy. This is also true for emerging countries. However, there is not enough empirical evidence regarding their interaction with money, private credit and macro economy. Central banks are not necessarily primarily interested in movement of asset prices, particularly house prices; however house price changes can have important implications for economic activity and inflation. The consequences of substantial changes in house prices should also be watched carefully by central banks and other government agencies that

regulate financial institutions for the purpose of financial stability. 2008 crises showed that the house prices have important effects on the overall economy. Emerging markets have been relatively less affected by this crises compared to the developed markets.

Using the fixed effects panel data approach, this paper analyzes the variation in 19 emerging markets house index returns. Our results show that money market rate, growth in GDP and CPI as well as log of private credit (D) and money supply (M3) have significant predictive power on growth in house price indices a quarter ahead. There is a strong negative correlation between the growth in house price indices and the lagged money market rates and private credit. There is a strong positive correlation between the growth in house price indices and the lagged growth in GDP, CPI and log of M3. When we look at different regions, we show that in Eastern Europe only GDP has a predictive power whereas in Asia MMR, D as well as M3 has statistically significant predictive power.

Granger causality tests for each country reveals strong evidence of multi-directional link between house prices, GDP, CPI, interest rates, money, and credit. House prices significantly affect the future broad money, private credit and macro variables. When we look at the variance decomposition, in almost every country we investigated, forecast errors to GDP, CPI and money market rate play an important role in explaining innovations to the house price index returns.

Findings of this study may have important implications over the macro and monetary policies of the emerging markets. There has been a dramatic increase in REIT funds in the last decade. Emerging markets REIT funds also have become important tool in investments. Since the underlying asset of REITs are the house prices, finding variables that have important implications in a lead-lag relationship can also have important implication on these funds. Empirical findings of this paper do not necessarily support this analysis therefore a future research on the variables we investigated and REITs can present important implications for investors on more liquid assets like REITs.

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## Appendix A.

| **Monthly Data** | **Starting Date** | **Ending Date** |
|---|---|---|
| HONG KONG SAR | Jan-93 | May-12 |
| ISRAEL | Jan-01 | Apr-12 |
| KOREA | Jan-86 | Jun-12 |
| THAILAND | Mar-08 | May-12 |
| SOUTH AFRICA | Jan-66 | Jun-12 |
| TURKEY | Jun-07 | Jun-12 |
| **Quarterly Data** | **Starting Date** | **Ending Date** |
| BULGARIA | 1997Q1 | 2012Q2 |
| CZECH REPUBLIC | 2004Q1 | 2010Q4 |
| ESTONIA | 2003Q3 | 2012Q1 |
| HUNGARY | 2001Q4 | 2012Q2 |
| INDONESIA | 2002Q1 | 2012Q2 |
| LITHUANIA | 1998Q4 | 2012Q1 |
| LATVIA | 2006Q1 | 2012Q1 |
| MEXICO | 2005Q1 | 2012Q1 |
| MALAYSIA | 2005Q1 | 2012Q1 |
| POLAND (5 MISSING OBSERVATIONS) | 2002Q4 | 2012Q1 |
| ROMANIA | 2009Q1 | 2012Q1 |
| RUSSIA | 2001Q1 | 2012Q1 |
| SLOVENIA | 2007Q1 | 2012Q1 |
| SLOVAK REPUBLIC | 2005Q1 | 2012Q1 |