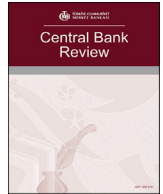


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Heterogeneity across emerging market central bank reaction functions

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ABSTRACT

The purpose of this study is to analyze monetary policy reaction functions of inflation targeting emerging market economies. Heterogeneity across central bank behavior is modelled using dynamic common correlated effects estimator in a panel data framework of 15 countries. The empirical method allows us to obtain country specific coefficients and shows differences across central bank reaction functions. Model results imply that central banks behave according to an extended Taylor rule and respond to deviation of inflation from the target, output gap, real exchange rate and external financial conditions. The study finds that emerging market central banks consider not only price stability, but also financial stability in setting of interest rates.

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1. Introduction

Since the first adoption of inflation targeting by New Zealand in 1990, an increasing number of advanced and emerging market economies have started to use inflation targeting as their monetary policy framework. Inflation targeting has become more and more popular in the last decade and more than 40 central banks around the world have formally adopted inflation targeting by the end of 2016. The number of inflation targeting countries is expected to increase every year as additional emerging market economies join the club.

Central bank behavior and its reaction function is an active field of study. There are several studies that analyze how central banks behave and respond to changes in economic variables. This study investigates the responses of inflation targeting emerging market country central banks to the changes in inflation, output gap, exchange rate, commodity prices and international liquidity conditions using an extended Taylor rule equation. Since there are important differences between the economic structures of the countries and inflation targeting frameworks, reaction functions of central banks are expected to differ across countries. The major aim of the study is to model the heterogeneity across countries and find out how different the behaviours of inflation targeting central banks are. This study uses the Dynamic Common Correlated Effects (DCCE) estimator of [Chudik and Pesaran \(2015\)](#) that allows for cross-sectional dependence, static and dynamic specifications,

endogenous regressors, fixed effects and heterogeneous slopes.

This empirical research has four motivations and contributions. First, many studies in the existing literature focus on inflation targeting in advanced countries and analyze the behavior of developed country central banks. There is relatively less research about inflation targeting developing country central banks. Reaction functions and behaviours of developing country central banks differ from their advanced country counterparts and increasing number of emerging market economies adopt inflation targeting. These are some factors that necessitate further empirical research on the reaction functions of inflation targeting developing country central banks.

Second, most of the studies in the literature rely upon individual country time series analysis. Existing empirical panel data studies use estimators that assume cross section independence and slope homogeneity in data. We employ dynamic common correlated effects (DCCE) estimator developed recently by [Chudik and Pesaran \(2015\)](#) that allows cross section dependence and slope heterogeneity. Since most of the real world data contain cross section dependence and slope heterogeneity, using this method contributes to the literature by obtaining more robust and unbiased results compared to the existing studies.

Third, with the empirical methodology employed, we both use the advantages of panel data analysis and obtain country-specific coefficients. The study contributes to the literature by modelling the heterogeneity across emerging country central bank reaction functions. The empirical methodology provides country specific coefficients of the variables and enables us to compare the behaviours of different central banks.

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Fourth, this study tests the significance of several different variables in an extended Taylor rule framework. In addition to inflation, output and exchange rate that are frequently used in the literature, we also test whether central banks respond to the changes in external financial conditions and commodity prices. The study enriches the literature by including these variables to the model that are very rarely used.

The results of the study show that most inflation targeting central banks in emerging market economies focus their primary attention on maintaining price stability and respond to the deviation of inflation from the target. In addition; current state of the economic cycle, shocks to real exchange rate and external financial conditions are also found to affect interest rate setting behavior. On the other hand, central banks do not respond to the changes in energy and food prices.

The rest of the article is organised as follows: In section 2 we provide the related literature. Section 3 explains empirical methodology and data set. Section 4 reports the model results and section 5 concludes.

2. Literature review

There is a large and growing literature on inflation targeting and it mainly focuses on advanced countries. Most of the existing studies fall into two areas. One strand of the literature analyzes the effects of inflation targeting on macroeconomic variables such as inflation, inflation volatility, interest rates and economic growth. Johnson (2002), Rose (2007), Gonçalves and Salles (2008), Brito and Bystedt (2010) and Ayres et al. (2014) are among the studies in this field and most of these research provide mixed results. Studies related to emerging market economies provide relatively more favourable evidence on the macroeconomic effects of inflation targeting.

Other line of research focuses on the behavior and reaction functions of central banks. This literature emerged after the pioneer paper by Taylor (1993). The reaction functions of central banks have been analyzed for developed economies by several studies such as Taylor (1993), Clarida et al. (1998, 2000), Dennis (2003), Lubik and Schorfheide (2007), Cukierman and Muscatelli (2008), Qin and Enders (2008) and Neuenkirch and Tillmann (2014). These studies analyze how advanced country central banks respond to the changes in variables such as inflation, output and exchange rate. Both time series and panel data methods are employed and several different empirical methods are used.

However, empirical studies on monetary policy rules and central bank reaction functions of emerging market economies are relatively few. They mostly use Taylor rule equations to investigate the behavior of central banks. What they find out in common is that emerging market central banks give an important weight on price stability in their monetary policy implementation and respond to deviation of inflation from the target. Minella et al. (2003) shows that Central Bank of Brazil has reacted strongly to inflation expectations consistent with the inflation-targeting framework. Bleich et al. (2012) find that the introduction of inflation targeting changes central bank reaction function towards inflation stabilization.

Although price stability is the leading objective of the central banks, it is not the only one. Emerging market central banks also take into account the state of the economic cycle and respond to the changes in output gap. Studies indicate that monetary policy reaction functions vary across countries. Corbo et al. (2001) find out that four out of eight countries respond to inflation gap while two of them respond to output gap. By employing VAR methodology, Schmidt-Hebbel et al. (2002) show that central banks in Brazil and Chile react to inflation gap and output gap, respectively. De Mello

and Moccero (2011) estimate a structural model and VAR model for a number of Latin American countries. Results show that the central banks of Brazil and Chile react strongly to expected inflation during inflation targeting. According to the author, monetary policies of Colombia and Mexico have become less counter-cyclical.

In addition to inflation and output, changes in exchange rate are also an important variable to consider in monetary policy for emerging market economies. Mohanty and Klau (2004) imply that price stability is the main focus of central banks and they respond to inflation, output gap and exchange rates. The authors assert that response to exchange rate shocks is even stronger compared to inflation and output gap in some countries. Moura and Carvalho (2010) show that central banks react to inflation in Brazil, Mexico, Chile and Peru. Exchange rate matters for only Mexico and output gap for Chile, Colombia and Venezuela. By using a fixed effect least squares estimation, Aizenman et al. (2011) find out that inflation and real exchange rates are significant determinants of policy interest rates while output gap is not.

Besides domestic economic variables, external economic and financial conditions are also important for emerging economy central banks. Guney (2016) studies interest rate setting behavior of the Central Bank of the Republic of Turkey by using the GMM estimator. Empirical findings show that the central bank responds to U.S. ten year bond yield in addition to inflation gap, inflation and growth uncertainties. Similarly, Caputo and Herrera (2017) find that central banks respond to federal funds rate, inflation and output gap.

Although, the number of studies related to the reaction functions of emerging market economies continue to increase, the literature is far from complete. A particular gap in the existing literature is that most researchers have focused on either individual country or regional experiences. However, very little attention has been paid to the heterogeneity of interest rate setting behavior across countries. None of the existing studies take into account cross section dependence and slope heterogeneity which arise serious econometric problems unless responded to. Empirical evidence is also scant about the significance of commodity prices. This study intends to fill these gaps and contribute to the literature.

3. Empirical methodology and data

Early empirical studies on panel data ignored cross section dependence of errors and assumed homogenous slopes. Fixed and random effect estimators that perform instrumental variable technique and the generalized methods of moments (GMM) were frequently used. These models allow only the intercepts to vary across units and leave a high degree of homogeneity that is not very realistic. A crucial contribution has been the development of first generation panel time series estimators that allow for heterogeneity in the slope coefficients such as Mean Group (Pesaran and Smith, 1995) and Pooled Mean Group (Pesaran et al., 1999). These estimators allow for heterogeneity; however they are inconsistent in case cross section dependence exists. Another contribution to panel time series literature has been the introduction of estimators that are robust to both heterogeneity and cross section dependence. These include Common Correlated Effects (Pesaran, 2006) and Augmented Mean Group (Eberhardt and Bond, 2009) estimators.

Chudik and Pesaran (2015) extend the static Common Correlated Effects (CCE) approach into a dynamic model by including lags of dependent variable and weakly exogenous regressors. Neal (2015) contributes further by replacing OLS with GMM/2SLS and also use lags of the variables to form the instrument set to overcome the problem of endogeneity. Monte Carlo simulations show that this extension makes CCE approach robust to endogenous

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