Charles University in Prague

Faculty of Social Sciences
Institute of Economic Studies

BACHELOR THESIS

Inflation Target Setting in Emerging Markets

Author: **Előd Orosz**

Supervisor: **doc. Roman Horváth, Ph.D.**

Academic Year: **2012/2013**

Declaration of Authorship

I hereby declare that I compiled this thesis on my own under the leadership of my supervisor, using only the listed sources and literature. This thesis was not used to obtain another academic degree.

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Prague, May 17, 2013

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Acknowledgments

I am especially grateful to my thesis adviser, doc. Roman Horváth Ph.D., whose willingness to share his experience and provide valuable insights aimed my effort in the right way.

A part of this thesis was written while the autor was at the University of Sarajevo.

Abstract

This thesis focuses on emerging market economies which are using inflation targeting as a monetary policy framework. We present an analyses of development of inflation target in emerging market economies and detect its determinants by econometric methods. We use Random Effects Interval Regression, Ordinary Least Squares, Random Effects Generalized Least Squares and Fixed Effects estimator. The thesis contains two main parts. First part surveys theoretical background of inflation targeting and focuses predominantly on emerging markets. Second part contains an empirical study on inflation targeting. We find out that inflation target in emerging countries is affected by more factors than central banks report. Moreover, we find out that price level has an inverse effect on inflation target if we examine just emerging countries, than if we examine whole group of inflation targeting countries.

JEL Classification	E31, E52, E58
Keywords	inflation targeting, monetary policy, emerging markets

Author's e-mail	elodorosz@gmail.com
Supervisor's e-mail	roman.horvath@gmail.com

Bibliographic record

Orosz, E., (2013). *Inflation Target Setting in Emerging Markets.* Bachelor thesis, Charles University in Prague, Faculty of Social Sciences, Institute of Economic Studies, pages 55. Supervisor: doc. Roman Horváth, Ph.D.

Character count: 67,624

Abstrakt

Tato práce se zaměřuje na rozvíjející se země, které jako základ své měnové politiky používají inflační cílování. Zabývá se analýzou vývoje inflačního cílování v rozvíjejících se tržních ekonomikách a zjišťuje jeho determinanty v těchto zemích pomocí ekonometrických metod. Hlavními použitými metodami jsou intervalové odhady náhodných efektů (Random Effects Interval Regression), běžná metoda nejmenších čtverců (Ordinary Least Squares), náhodné efekty zobecněné metody nejmenších čtverců (Random Effects Generalized Least Squares) a odhad pevných efektů (Fixed Effects). Práce obsahuje dvě hlavní části. První část nejprve představuje obecný teoretický zálad pro cílování inflace a následně se zaměřuje zejména na rozvíjející se trhy. Druhá část je empirická a podává výsledky naší studie. Zjistili jsme, že v některých rozvíjejících se zemích je inflační cílování silně ovlivněno vládou a také jsme došli k poznatku, že výčet ovlivňujících faktorů uváděný centrálními bankami je mnohdy neúplný. Navíc jsme došli k odlišným závěrům při zkoumání vlivu cenové hladiny na inflační cílování v rámci rozvíjejících se ekonomik v porovnání s celou skupinou zemí, které inflační cílování používají.

Klasifikace JEL	E31, E52, E58
Klíčová slova	cílování inflace, monetární politika, rozvíjející se trhy

E-mail autora	elodorosz@gmail.com
E-mail vedoucího práce	roman.horvath@gmail.com

Bibliografická evidence

Orosz, E., (2013). *Stanovení inflačních cílů v rozvíjejících se ekonomikách.* Bakalářská práce, Univerzita Karlova v Praze, Fakulta sociálních věd, Institut ekonomických studií,55 stran. Vedoucí práce: doc. Roman Horváth, Ph.D.

Počet znaků: 67,624

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Acronyms

BP LM Breusch-Pagan Lagrange Multiplier

CB Central Bank

CBI Central Bank Independence

CPI Consumer Price Index

FE Fixed Effects

GDP Gross Domestic Product

GLS Generalized Least Squares

IT Inflation Targeting

MPC Monetary Policy Committee

OECD Organization of Economic Cooperation and Develpment

OLS Ordinary Least Squares

PPP Purchasing Power Parity

RE Random Effects

USA United States of America

Bachelor Thesis Proposal

Author	Előd Orosz
Supervisor	doc. Roman Horváth, Ph.D.
Proposed topic	Inflation Target Setting in Emerging Markets

Preliminary thesis content Inflation targeting is one of the monetary policy frameworks used by the central bank to maintain the price stability in the economy. In last twenty years it became one of the most popular monetary policy regimes. Level of IT differs from country to country. We will focus our research to the emerging market economies. By analyses of data from official sources (IMF, OECD, central banks, national statistical offices) we will search the determinants of the level of IT and the reason of different inflation targets in different countries.

Outline

1. Introduction
2. Theoretical concepts and approaches
3. Analysis of data
4. Comparison
5. Conclusion

Předběžná náplň práce Inflační cílování je jeden z konstrukce měnové politiky používaných centrální bankou na udržování cenové stabilitě v ekonomice. V posledních dvaceti letech se stal jedním z nejpopulárnějších měnově-politických režimů. Úroveň inflační cílování se liší od země k zemi. Náš výzkum se zaměříme na rozvíjejících zemí s tržní ekonomikou. Pomocí analýzy dat z oficiálních zdroju (IMF, OECD, centrální banky, národní statistické úřady), budeme hledat determinanty úroveň inflační cílování a důvod různých inflačních cílů v různých zemích.

Předběžná náplň práce

1. Úvod
2. Teoretické koncepty a přístupy
3. Analýza dat
4. Srovnání výsledků
5. Závěr

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Author Supervisor

Chapter 1

Introduction

Since 1989, when Reserve Bank of New Zealand as first adopted inflation targeting as a monetary policy regime, Inflation Targeting (IT) gained unexpected popularity among central banks. Numerous industrial countries and increasing number of developing countries adopted it as a monetary policy regime (Freedman & Ötker 2009). Nowadays 27 Central Bank (CB)s are using it around the world from less developed countries like Ghana or Columbia to the most developed countries like Great Britain or Sweden. To the middle of the last decade an internationally recognized point of view was formed among the central bankers, that CB can maximize the welfare of society by reaching and continuous sustaining of price stability. Inflation targeting is treated as the most appropriate tool to fix inflation expectations.

The objective of this thesis is to find the determinants of inflation targets in emerging markets and highlight the differences between emerging and developed countries inflation targets. In addition, our aim is to find a theoretical correspondence between our empirical findings and existing economical theories.

First part of Chapter 2 reviews inflation targeting since of its beginnings. Analyses the effect of monetary policy to the real economy and the relationship between politics and real economy. A separate subsection deals with cost of inflation. Practical questions that are related to the IT are discussed in the second part of the chapter. Further it emphasizes the close relationship between optimal inflation theory and IT and presents some stylized facts. Third part is focused on emerging markets. It highlights the main differences between emerging and developed countries in monetary term and tries to find explanation for higher inflation target of emerging countries in general.

Our empirical findings are presented in Chapter 3. We built a backward looking model to detect the effect of explanatory variables on inflation targets. Most of explanatory variables are chosen based on previous academic works dealing with inflation targeting e.g. (Roger 2009) or (Walsh 2007), however we defined a new variable as well.

Current scientific literature provides various methods for modelling inflation target setting. We used Random Effects Interval Panel regression as the most suitable estimator in our case, since dependent variable is not just a single point. Moreover we used alternative estimators like ordinary least squares, random effects generalized least squares and fixed effects estimator to provide robustness checks.

Last part of this thesis seeks to highlight differences between emerging and developed inflation targeting countries in their target setting. However, detailed study of developed countries target setting is beyond the scope of this thesis, comparison of explanatory variables significance and coefficients should provide useful base for future extension of our work.

Chapter 2

Theoretical Background of Inflation Targeting

2.1 Review on Inflation Targeting

Inflation is always a monetary phenomenon, which means that its reasons we have to look among the reasons of growth in money supply. Changing price level might have both positive and negative effect depending on the direction and the degree of change. The role of monetary policy is to secure circumstances for predomination of positive effects and eliminate the potential negative effects. If we want to determine the components of optimal monetary policy, first of all, we have to look over what central bank can do for the maximization of the welfare of society.

2.1.1 Monetary Policy and Real Economy

Monetary policy we can be understood as a set of all activities of CB by which it has an impact to the real economy and its fosters to reach the targets of economy. Long-term objectives of the CB can be stabilization of the economic growth, stable interest rate, low unemployment, stability of financial sector or price stability. CB can reach these long-term objectives via medium-term objectives, which can be obtained via short-term targets (Cahlík *et al.* 2010).

In the 1960's the most widespread view among economists was, that a long term switch between unemployment and inflation exists. Nowadays, it is empirically proven that the only monetary policy tool by which economic growth can be boosted in long-term is the stable price level. The discrediting of activist monetary policy approach was a result of complex findings:

- Effects of monetary policy actions are often long and occur with unpredictable delay, therefore they are frequently counter-productive and cause the destabilization of the economy. For example, if the CB during a recession mitigates the monetary conditions to boost economy, it is possible that the effect will be perceivable just few quarters later, when the economy will be in recovery.

- The expectations-augmented Philips curve is vertical or has a slightly positive slope, which means that in long-term it is impossible to influence unemployment rate by change of inflation rate, i.e. do not exist exchange between them.

- Discretionary monetary policy due to the problem of time consistency effects higher inflation, because economical actors expect the CB to boost the economy by surprise inflation and this assumption is embedded to the inflation expectations. The consequence is higher inflation also in the case when CB does not mitigate monetary conditions.

Therefore if CB wants to realize real-economic goals, in long-term makes more harm to the economy, than profit. Monetary policy can contribute to the creation of optimal conditions for sustainable growth by achieving and maintaining of price stability.

2.1.2 Cost of Inflation

If we want to search for the cost of inflation, first of all we have to distinguish anticipated and unanticipated inflation. In case of unanticipated inflation costs are higher as price of different commodities changing with different velocity, which cause a temporary change in relative prices. In case of anticipated inflation economic actors have the possibility to prepare for changing prices, therefore loss and redistribution of wealth will be less significant (Cahlík *et al.* 2010). Inflation has numerous static and dynamic costs. The most important static costs are:

- Menu cost: related to the cost of price changes. Changing prices is costly, therefore companies change prices less frequently than it is reasonable, nominal rigidities tend to be higher.

- Shoe leather cost: holding money is starting to be more costly, hence

economic actors for the increased price want to hold smaller amount. It causes the increase of transactions.

- Distortion effect on the tax system. Income tax is usually defined in nominal term, which means that in constant real wage the tax burden dead weight loss is increasing, resp. short-term investments are starting to be more attractive because of changes in amortization methods.

- Decreasing the information carrying role of prices. It is difficult to decide whether the price of given product was risen because of inflation, or it was a result of relative changes in prices.

- Increase the required risk premium on the investors side, especially that rating agencies also take into account inflation while preparing creditor rating.

As inflation increases uncertainty, it decreases the volume of growth since in less predictable environment fewer investments are realized - dynamic cost.

After summarizing all the information, we can see that low inflation is better for economy than high. However due to some positive effects of inflation, zero inflation is not the best choice either. The positive effects of inflation are discussed in section 2.2.

2.1.3 New Keynesian Model

The ambition of monetary policy to set up price stability can be also derived from New Keynesian model. This model has microeconomic basics and defines the relationship between politics and real economy in detail. As such a thing, it is more feasible for comparison of different monetary policy approaches as well. Monetary policy can influence output in short-term, because of nominal rigidities. Changes in interest rate can influence aggregate demand. In this analytical framework the only real goal of monetary policy should be the elimination of welfare effect distortions caused by nominal rigidities. This aim can be reached by stabilization of inflation rate. From standard form of the model, not containing real rigidities, also follows that price stability with appropriate inflation can push output gap to zero, i.e. proper lowering of inflation rate automatically eliminates output gap. This "divine coincidence" remains even if economy is suffering from a supply shock. Exchange between the two goals, price stability and output gap minimizing, arises in case of supply shock.

Optimal monetary policy divides the effect of shock between two variables. Moreover it is possible to derive from the model the importance of expectations: monetary policy can reach advantages in welfare if it is able, through credibility, to change expectations of economic actors into an appropriate way.

2.1.4 Inflation Targeting System

Inflation targeting is in accordance with the implications of New Keynesian model. In this approach CB determines a numerical inflation target for a certain time horizon, and explicitly declares that the primary goal is to reach this inflation target. An important characteristic of the system is not only the emphasized information of public about the CB's plans and targets but also the increased transparency and accountability of the monetary authority (Roger 2009).

In practice CBs often use flexible inflation targeting, which decreases the risk of missing inflation target and takes into account real economical aspects. In this approach IT is not a mechanical decision making mechanism, but a framework: such a constrained discretion, which tend to find golden mean between strict and rigid rule-following compliance and the complete indiscipline and discretionary, ad hoc decision making (Bernanke 2003). CBs usually influence expectations by publishing objective functions, it allows them more flexibility, than publishing a certain decision rule or reaction function. Moreover, with institutional guarantees they increases their own credibility and commitment in favour of target.

Since monetary policy actions effect in longer time horizon, in inflation targeting monetary systems decisions are rather following a forward looking policy. IT plays the role of the intermediate target and it tries to determine the factors affecting the evolution of inflation. As monetary policy makers respond to the deviation from the target, the system is often called inflation forecast targeting (Svensson 1997).

IT system fulfils the requirements stated by New Keynesian framework because:

- Main priority is to reach price stability.
- It takes into account real-economy aspects, but does not want to explicitly respond to circumstantially observed variables.

- Based on medium-term target criterion, it uses the opportunity of expectation management.

IT system is also proper to enhance stability of financial system, since by achieving price stability, it decreases the price level volatility. It lowers the probability of high fluctuation of price level, which otherwise could cause financial crisis (Woodford 2012). Users of inflation targeting system are agree, that price and financial stability are mutually dependent and neither of them could exist without the other (Bernanke 2003).

2.2 Practical Questions Related to the Operation of Inflation Targeting

2.2.1 Preconditions

Successful implementation of IT has important preconditions, which have to be fulfilled by the monetary authority for proper inflation control (see Jonas & Mishkin 2004) and (Svensson 2010)

- Balanced and disciplined fiscal policy, strong fiscal position.
- Strong, well-developed financial intermediaries.
- Modelling and data availability.
- Accurate knowledge of monetary transmission mechanism of the given economy.
- Instrument for accurate and reliable inflation forecast.
- Transparent and accountable monetary policy.
- Central bank independence, mandate for price stability-oriented monetary policy.
- No other nominal targets.

Balanced and disciplined fiscal policy is crucial for proper inflation control. Unpredictable fiscal policy can cause monetarization of government debt which is attached to growth of money supply and consequently to growth of inflation. Additionally unpredictability can motivate a high dependence of IT on fiscal

policy, which can bring changes of inflation target motivated by short-term fiscal goals of the government.

Strong and well developed financial intermediaries are indispensable to run IT suitably as well. Otherwise, using CB's monetary tools to influence inflation under certain circumstances can cause the collapse of financial system.

Knowledge of monetary transmission mechanism of given economy is important for choosing the appropriate monetary tool, extent of chosen monetary tool is also determined based on this knowledge.

Inflation targeting requires accurate and reliable inflation forecast to model the economy. There are several questions related to the model. First one is to decide which interest rate assumption is better for forecast, constant or non-constant. Other one is whether inputs of forecast changing in time have to be based on model, on the market or on own estimation? Also a serious question is, how much CB's have to disclose their own policy interest rate expectation. We can find different arguments in the literature, for more details see for example Billi & Kahn (2008) and Goodhart (2001).

For central banks implementing IT, appropriate communication is essential, as communication is an elemental part of IT framework. Most prevailing forms of accountability are regular parliamentary hearings, press conferences, inflation reports and open letters usually written by the Governor of the CB to the government in the case, when inflation target has been missed (Hammond 2012).

Price stability as the main goal of CB is specified in utmost definitions. It is usually grounded in law about central banks, where some secondary targets like economic welfare of society are often defined. Less independent CBs may be more sensitive for government influence and therefore tend to have higher inflation target, since governments often put pressure on less independent CBs to cover extra spending by "printing" money. We can distinguish goal and policy independence. In first case CB has own competency to set monetary policy objectives, while in the second case, CB manages the monetary policy to reach the inflation target. Generally we can say, that for IT countries instrument independence is a fundamental requirement.

Existence of other nominal objectives than inflation target can cause a conflict of interests. Holding two nominal objectives at the same time can lead to the situation, where one objective has to be subordinated to the other without an existing scenario to solve the problem. Such situations decrease the transparency of monetary policy and also encumber to hit inflation target. Most

common example for this situation is the simultaneous existence of inflation target and exchange rate target. Exactly that happened in Hungary during 2001, when Hungarian CB implemented IT but did not abandon exchange rate band. Two years later, when Hungarian Forint hit the upper bound of the target, CB had to make a significant 2% cut of interest rate and heavy intervention in foreign exchange market by increasing Hungary's foreign exchange reserves by 50 %.

The above mentioned requirements for controlled inflation following from fiscal and financial imbalance do not occur just in emerging markets, but their importance is higher than in case of advanced economies. Nevertheless, practice had shown that in absence of these preconditions ti is still possible to implement IT. Empirical experience indicate, that a number of emerging market economies use inflation targeting as a successful monetary framework without fully fulfilling the above mentioned preconditions. Freedman & Ötker (2009) wrote as well that "There is no single most effective path toward adoption of IT" and they highlighted that it can be misleading to think that the best way for prosperous adoption of IT is to fulfil all preconditions before it could be launched.

Before the implementation of IT framework decision makers have to answer several questions, i.e. What is the suitable inflation target for the price stability of the given country? What is the optimal reaction time of central bank for divergence from the target? Necessity and optimal speed of disinflation? In case of small, open market economies, exchange rate is also an important issue. In subsequent subsections we examine these questions in detail.

2.2.2 Optimal Inflation Rate

Due to the earlier mentioned costs of inflation, the zero inflation should be optimal. However, there are factors, which suggest small but positive inflation rate. One of the reasons is measurement error, which reflects to the fact that changes in price level are measured by price indices, especially by Consumer Price Index (CPI), are upward biased. It is hard to find a concrete country specified data about measure of bias, but based on Lebow & Rudd (2003) the bias of CPI in United States of America (USA) was 0.9%, which is not negligible. It is reasonable to assume that bias of CPI in IT countries lies on a similar level, since CPI does not take into account the effect of substitution caused by change of price. Another reason why policy makers may want to aim for a low,

positive rate of inflation is avoidance of liquidity trap. In long-run, if inflation is decreasing, interest rates are usually decreasing as well. The problem is the zero lower bound of nominal interest rates. It means that nominal interest rate can not be lower than zero, even if monetary policy requires it. Another important motive to aim for positive inflation is debt-deflation. Deflation is a more serious issue than inflation is, since deflation decreases the nominal asset value, but usually does not increase the nominal debt. This phenomenon can convert to a vicious circle, which can cause more serious financial stress. The best known recent empirical example for adverse effect of deflation is the stagflation of Japanese economy since the 1990's which is still not over. The Japanese example shows how difficult can it be to get rid of deflation and stimulate the economy. Japanese central bank announced in April 2013 that they want to jump-start economy with 1400 billion dollars of quantitative easing within the next two years. Another reason why economic actors and central bankers may choose to aim positive inflation rate is the downward wage rigidity. In practice it means, that firms are usually unable to make nominal wage cuts because of the unwillingness of workers to accept it. As Tobin (1972) said, in this case inflation can "grease the wheels" of the labour market by decreasing real wages even when nominal wages remain unchanged.

It is more difficult to find any concrete information about the optimal inflation of emerging market economies, but in general it has to be higher than in case of developed countries, as developing countries are growing faster. Also based on the Balassa-Samuelson effect we can say, that in emerging countries optimal inflation rate should be higher than in developed ones.

Based on the above mentioned reasons, holding inflation in a small but positive interval can cause the dominance of benefits above the costs of inflation, while in higher territory the dominance of cost of inflation is inevitable.

2.2.3 Point or Range Target?

Central banks can determine inflation target either a point target or as an interval. The most prevalent is to determine target as a point, with some tolerance band. Advantage of the point target with band that it gives accurate information for the market about CB's objectives. In the long run, the determination of narrow target interval or tolerance bound can be harmful for CB. Since monetary policy tools are not 100%-ly perfect, the determination of a too narrow target increases the probability of missing the target, which may lead

to the loss of credibility. On the other hand, too wide target interval is unable to restrain expectations, so it is useless for CB's purposes. For similar reasons it is very important to choose the appropriate measurement of inflation. If CB chooses a narrowly defined measurement of inflation, it will be much easier to hit the target, but will be much more difficult to explain for the public, what the concrete measure means. For practical reasons it is better to choose widely defined inflation measurement like consumer price index. It is true that CPI is also influenced by factors which are out of the control of CB, but public can understand it much easier than some complex index.

2.2.4 Decision Making Under Inflation Targeting

As pilots in flight, such an important role the decision making bodies have in inflation targeting. It is common practice in IT countries that the decision making bodies meet on a regular basis. The primary goal of their meetings is to choose the most appropriate tools to reach the inflation target and to set its measure. In practice it means first of all to set the level of base interest rate.

Although the consistency and the duties of decision making body depends on the country, there is no essential differences among them. The policy making committee has a various number of members in each IT emerging country. The smallest is in Mexico with five members and highest in Poland with ten members. Also the frequency of meetings differs within the countries, it varies from 6 to 12 per year.

Just in three out of the twenty emerging IT countries is government directly represented in policy making, in four other countries government is presented in committee without voting right. The most common decision making process is voting, however, in four cases decision is made on consensus. Governor has a casting vote in nine committees.

Above mentioned policy making committees primarily decide about base interest rate, but not in every case about the inflation target. In four countries target is set by government after consultation with CB, in other three countries it is set by CB alone, five other CBs set the target jointly with government and just in seven countries the target is set by Monetary Policy Committee (MPC) or Board of Governors. Turkey is the only country, where MPC sets the target jointly with the CB. While decision making in majority of countries seems to be independent from the government, the same is not true for choosing the target. At least in nine countries out of twenty, government has a direct

influence on target. More details are presented in Table A.2 in Appendix A. The government influence spectacularly appears in the inflation target of countries. If we compare the mean value of inflation target of countries, where government has direct influence on target, with the rest, we find a significant difference. First group has a mean inflation of 4.19% while the second group has just 3.23 %. It means that in the economies, where the Government does not have direct influence on the establishment of the target, the target is by 0.96 p.p. lower. After that it is reasonable to assume that government influence has a significant effect on inflation target.

2.2.5 Tools of Inflation Targeting

The basic tool of inflation targeting is the base interest rate, by which CB determines the minimum cost of short term loans. In addition to existing tools, which are used occasionally when it is necessary. One of them is nominal anchor, which is the single variable or device which the CB uses to fix expectations of nominal price level or expectations of future actions that CB wants to do for fulfilling the inflation target (Krugman 2008). Expectations have an important role in IT framework, therefore successful CB has to be credible and follow the target steadfastly. Not least sufficient communication of the target is required towards the private agents. CB should prioritize the communicated target before the secondary targets, otherwise it could cause the loss of credibility. Moreover it always has to choose the sufficient tools to reach the communicated target. To sustain the credibility, CBs regularly present forecasts. It contains in case of all IT countries inflation forecast and in most cases also Gross Domestic Product (GDP) forecast. It is also not rare that CBs publish labour market forecasts (Hammond 2012).

2.2.6 The Optimal Scenario of Disinflation

If we want to find the optimal scenario of IT, we have to find a trade-off between two contradictory variables. If the disinflation period is too short and the fall in inflation is too sudden, decrease of inflation will cause fall in output, i.e. loss of potential output. On the contrary, if the disinflation period is too long, economy has to suffer higher cost of inflation for longer period, however decrease of inflation will not cause as significant fall in output as in previous case. It is impossible to determine the optimal speed of disinflation, as it varies from country to country. However, we can state that too fast disinflation implies

unduly high expenses in terms of output loss. While a side effect of the too slow disinflation can be a rigidity of inflation expectations which makes future disinflation more expensive (Cogley *et al.* 2011).

2.2.7 Exchange Rate in the System of Inflation targeting

In several developing IT countries exchange rate has more important role, than in developed countries. As most of the developing IT countries is a small open economy, exchange rate is one of the most important monetary indicators. McKinnon (2004) draws our attention to the fact, that we can find significant differences between monetary policies of countries with international currencies and countries on the periphery of large currency blocks. Countries in the first group focus on domestic targets first of all, while countries in the second group tend to follow external targets to decrease exchange rate volatility. It can happen as well, that in case of these small countries, exchange rate is the transmission channel for economic turmoil from business partners. Here we should mention the extraordinary importance of exchange rate for IT targeting countries indebted in foreign currency, e.g. Hungary. Central bank can choose from two approaches. One of them is activ approach which means, that CB wants to hold the exchange rate on a concrete desirable level, while passive approach means that CB will influence exchange rate just in measure, which is required for hitting the IT.

2.3 Focus on Emerging Markets

2.3.1 Differences Between Emerging and Advanced Economies

Jonas & Mishkin (2004) mentioned five significant differences between emerging market economies and advanced economies:

- Weak position of fiscal institutions.
- Unsatisfactory operation of financial institutions, lack of desirable government regulation and supervision.
- Lack of credibility in monetary authorities.
- Substitution of local currency by dollar or euro in case of malfunction of home monetary system.

- High sensitivity for capital inflow stops.

Of course advanced economies are not totally resistant against the above mentioned problems, however magnitude is substantially less. Low credibility of financial, fiscal and monetary authorities cause higher sensitivity of developing countries to sudden devaluation of own currency, which means a permanent risk of substitution of the own currency by a more stable foreign one, e.g. dollar or euro. This currency substitution risk motivated CBs to allow commercial banks to hold part of their savings in foreign currency. In presence of foreign currency reserves unexpected currency switch does not necessarily imply bank run, as banks are able to denominate the deposit in foreign currency. On the other hand, consequence of these foreign currency reserves that commercial loans are denominated in foreign exchange, mainly with the aim of decreasing commercial banks exchange rate risk. In the end, considerable part of countries loans are denominated in foreign currency, which can have a serious impact in case of balance-of-payment crisis. Mishkin & Schmidt-Hebbel (2001) mark this phenomena, as one of the main reasons of different consequence of balance-of-payment crisis in emerging and advanced economies. The explicit example, how dangerous are excessive loans denominated in foreign currency is again Hungary. At the beginning of 2010 nearly 70% of loans for housing were denominated in foreign currency, mainly in Swiss franc (Vulkovich 2011). As a result of financial crisis exchange rate of Hungarian forint against franc changed significantly, which caused collapse of large portion of these kind of loans. Of course not all IT emerging markets suffers from this problem.

2.3.2 Explanation of Higher Inflation Target in Developing Countries

Higher inflation target in developing countries is the result of higher optimal inflation in these countries. One of possible explanations for higher inflation rate is the Balassa-Samuelson effect, which says that the labour force in developing countries is less productive, than in developed countries in the sectors producing for export, but productivity differences are negligible in sectors which produce just for domestic market. The model assumes that the prices of products, which are not exported, are broadly same, but in this case in developing countries in sectors with export production the lower productivity implies lower wages than abroad, therefore lower production costs for domestic products. Low production cost causes lower price of domestic products. Higher

productivity of domestic sectors in developed countries implies the higher price of domestic products, therefore these countries tend to have higher price level. On the other hand, as emerging markets are converging to the developed ones, productivity of labour force is growing, although the velocity of growth is different in different sectors of the economy. The growth is faster in the sectors producing for export, which causes higher nominal growth of wages. Nevertheless, growth of wage has a positive impact also in sectors, where the productivity does not grow so fast. This effect causes unsubstantiated growth of wages in these sectors, which is leading to inflation at the end (Samuelson & Nordhaus 2009).

Chapter 3

Empirical Study on Inflation Targeting

3.1 The Data

Our basic sample contains a panel data of 30 inflation targeting countries, 27 of them are still using inflation targeting as a monetary policy framework, three of them (Finland, Slovakia and Spain) abandoned inflation targeting when they joined the Eurozone. However, we are focusing on the emerging market economies, the data from developed IT countries are used for comparison of the results in the end of this chapter.

Our dataset encompass yearly data from 1987 to 2012. For analysing IT it is superfluous to use more frequent than yearly data since no country which uses IT is setting target for shorter period than one year. As we know, IT was firstly introduced by Royal Bank of New Zealand at the end of 1989. Nevertheless our model contains lags and past inflation volatility, that is the reason why we have the data since 1987.

As we mentioned earlier, we can notice a significant decrease in inflation during the examined period not just in the case of IT countries, but also in the group of countries which used alternative monetary policy approaches. This trend is also noticeable in our data set. Many of IT countries started IT with disinflation period, which means that in the first few years the IT was progressively decreased to the level near to the optimal inflation rate. The length of disinflation period changes from country to country. By Mishkin & Schmidt-Hebbel (2007) these countries are called "converging targeters", while the countries with stable IT are called "stationary targeters". Based on Polillo & Guillén

(2005) we will call stationary inflation targeters countries with stable target for more than three years. Small increase of the IT is not interpreted as convergence, rather as a fine-tuning of IT, eg. Bank of Korea in 2000 or Bank of Indonesia in 2010.

We focus our research on the emerging market economies, so first of all we have to define the list of IT emerging markets. In the OECD Glossary of Statistical terms we can find the following definition:

> "There is no established convention for the designation of "developed" and "developing" countries or areas in the United Nations system. In common practice, Japan in Asia, Canada and the United States in northern America, Australia and New Zealand in Oceania and Europe are considered "developed" regions or areas. In international trade statistics, the Southern African Customs Union is also treated as developed region and Israel as a developed country; countries emerging from the former Yugoslavia are treated as developing countries; and countries of Eastern Europe and the former USSR countries in Europe are not included under either developed or developing regions"

Since the definition is not unambiguous, we will use two different classification of countries in our dataset. First one is based on the wide and second one is on the narrow definition of emerging markets. Based on classification of OECD:

Developed countries: Australia, Canada, Finland, Iceland, New Zealand, Norway, Spain, Sweden, Switzerland, United Kingdom

Emerging and developing countries: Armenia, Brazil, Chile, Colombia, Czech Republic, Ghana, Guatemala, Hungary, Indonesia, Israel, Korea, Mexico, Peru, Philippines, Poland, Romania, Serbia, Slovakia, South Africa, Thailand, Turkey

Based on classification of IMF:

Developed countries: Australia, Canada, Czech Republic, Finland, Iceland, Israel, Korea, New Zealand, Norway, Slovakia, Spain, Sweden, Switzerland, United Kingdom

Emerging and developing countries: Armenia, Brazil, Chile, Colombia, Ghana, Guatemala, Hungary, Indonesia, Mexico, Peru, Philippines, Poland, Romania, Serbia, South Africa, Thailand, Turkey

We are using both classifications to find more robust results.

The fundamental difference between developed and emerging markets is that developed countries introduced IT in a relatively calm period while most of the emerging countries adopted IT in a more turbulent period in monetary terms. The South American countries suffered from hyperinflation just a few years before the introduction of IT, former communist countries were in the process of economic transition and most of the remaining countries inflation rate was also far away from the optimal inflation rate just before the adoption of IT.

3.1.1 Basic Macroeconomic Indicators

For measuring the inflation we used the year-on-year change in CPI obtained from the Organization of Economic Cooperation and Develpment (OECD) Statistics. We also applied GDP deflator as a robustness check gained from the Federal Reserve Bank of St. Louis.

For measuring the price level we used PPP obtained from Penn World Table. We expect that countries with lower price level will set up higher IT to promote the convergence of its own price level to the price level of developed countries.

Inflation volatility is also included in our model. Retrospective inflation variance is included in our dataset of the past 3, 5 and 10 years. Based on previous discussion about optimal inflation, we expect that inflation volatility has a high influence on the level of IT.

We use GDP per capita expressed in constant national currency for indication of the economic performance of each country. Data are derived by dividing constant price GDP by total population. Since we are focusing to the short and medium term changes, we also included annual GDP growth in our data.

Another important indicator, which must not be missing in our dataset is Debt/GDP ratio. We are using general government gross debt as a percentage of GDP. Gross debt contains all liabilities that require payment or payments of interest and/or principal by the debtor to the creditor at a date or dates in the future.

3.1.2 Institutional Features

We used some soft institutional features over the basic macroeconomic indicators which may influence central bank's decision about IT. We require quantitative measure of several important institutional characteristics of central banks.

As it is discussed in the previous chapter, central bank independence has undoubted effect on IT settings. As we can see in other papers dealing with IT e.g. (Siklos 2008), finding an appropriate gauge for central bank independence is a complex task. In the investigated literature we met with two each other independent central bank credibility index. The first one was developed by Cukierman (1992) and includes measurements of institutional independence as well as measurement of the relative importance of price stability in the CB regulation in practice.

The other independence index was published by Cecchetti & Krause (2002), originally constructed by Fry *et al.* (2000). They created a weighted index for independence based on survey among central bankers. The research affects the following issues:

- How important is price stability as an objective of central bank.
- How important is the role of central bank in choosing the IT and the policy instrument.
- To what extent does the government rely on central bank financing.
- How long is the service period of the governor of central bank.

At the same time, the survey based index was an object of some critique. The result of survey based on the research of this sensitive question would be probably upward biased, as central bankers would give the impression of higher independency.

Because of the above mentioned critique and the more frequent citation of Cukierman's index in other literature, we decided to use Cukierman's Central Bank Independence (CBI) extended by Guillen and Polillo in our analysis. Our decision was reinforced also by some previous comparison of CBI indices. Horváth & Matějů (2011) studied Cukierman's and Fry's CBI indices, but the correlation which they found was below 6%.

Apart from the related independence, credibility of central banks is also an indispensable factor in IT setting. Assuming a relationship between central bank credibility and IT width might be reasonable. Unfortunately time series

data do not exist in accessible data sources, so we have to be satisfied with cross sectional central bank independence index.

As we described above, despite the fact that many of the IT central banks declare themselves to be independent, in most cases central banks are not perfectly independent from the government. Moreover in some countries, like in the United Kingdom, government set the inflation target, i.e. CB does not have goal independence. Hence we decided to put to our dataset the orientation of government party. We defined variable in the following way: -1 for left-wing governments, 1 for right-wing government and 0 in every other case.

Inflation target is the explained variable of our regressions. Summarization of IT country by country and its development is in Appendix A. The decent decrease of IT in the majority of countries is notable. Furthermore we have to mention, that none of the studied countries has higher IT than in the year of introduction of IT.

3.2 The Model

Our goal is to estimate the determinants of IT. We can see from the summary statistics in Appendix A, that in most of the cases IT is not defined just as a single point, rather as a point with some tolerance band or just as an interval. Due to this reason we need some special tools. This special tool in our case is Random Effects (RE) Interval Panel regression. Apparently for comparing the obtained results and for increasing the reliability of our analysis, we also estimate simple pooled Ordinary Least Squares (OLS), Random Effects Generalized Least Squares (GLS) and Fixed Effects (FE) estimator.

The basic model is:

$$[\pi_{i,t}^{T(L)}, \pi_{i,t}^{T(U)}] = \beta X_{i,t-1} + \epsilon_{i,t-1}$$

Where $\pi_{i,t}^{T(L)}$ and $\pi_{i,t}^{T(U)}$is the lower and upper bound of inflation target in country i at time t. $X_{i,t-1}$ is a vector of explanatory variables in country i at time *t-1*. We are using one year lagged explanatory variables because inflation target is always determined at least for one year ahead. β denote the vector of estimated parameters and $\epsilon_{i,t}$ stands for residuals.

3.2.1 Interval Regression

Our basic model is based on the wide definition of emerging countries. Our best model is presented in the first row. The significance tests are for other variables in the following rows.

As we expected, CPI inflation has the strongest impact on IT. It makes sense, that if inflation is higher, policymakers tend to set higher IT. The reason, why every IT emerging country except for South Africa began IT with disinflation period, is the trade-off between the cost of inflation cut and profits coming from it.

Table 3.1: IT Settings: Regression Results

	(1)	(2)	(3)	(4)	(5)
CPI Inflation	0.461***	0.461***	0.459***	0.441***	0.395***
	(18.16)	(18.16)	(17.58)	(17.06)	(13.76)
Inflation Volatility	−7.75***	−7.75***	−7.75**	−7.08***	74801***
	(-5.92)	(-5.93)	(-5.88)	(-5.51)	(4.89)
GDP Growth	0.069**	0.068**	0.084***	0.071**	0.024
	(2.07)	(2.04)	(2.44)	(2.19)	(0.71)
World Inflation	0.100*	0.100***	0.096***	0.109***	0.293***
	(4.76)	(4.68)	(4.46)	(5.26)	(3.19)
Price Level (PPP)	0.007*	0.007***	0.006	0.011***	0.014***
	(1.67)	(1.64)	(2.58)	(2.58)	(3.03)
Credibility		0.020			
		(0.07)			
Independence			0.099		
			(0.12)		
Gov. orientation				-0.48	
				(-0.40)	
Debt/GDP Ration					-0.007
					(-1.53)
Intercept	0.612*	0.602*	0.693	0.359	−0.044
	(1.83)	(1.64)	(0.93)	(1.08)	(-0.08)
N	154	154	142	150	133
AIC	292.0	294.0	280.4	275.1	221.6
BIC	313.3	318.3	304.0	299.16	244.7

Note: *Statistically significant at the 10% level;**Statistically significant at the 5% level; ***Statistically significant at the 1% level; t-statistics are in parentheses; all explanatory variables are lagged by one period; Inflation Volatility multiplied by 10^7.
Source: author's computations.

Inflation volatility gave us a surprising result. Based on our estimation, inflation volatility has a negative effect on IT, i.e. countries with higher volatility will set lower IT. It is in strong contradiction with our expectations, so we revisited our dataset to find the reason. We quantilized inflation volatility against quantiles of normal distribution and obtained the following plot (Figure 3.1). We can see that there are two outliers. That is Peru, at the beginning of

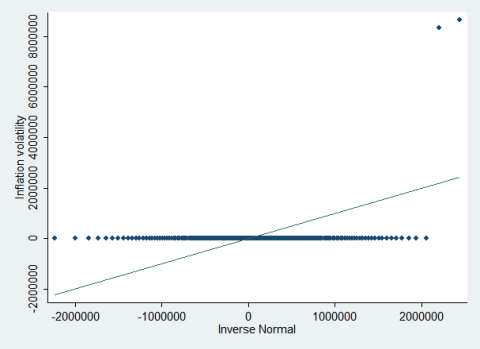

Figure 3.1: Q-Q plot of Inflation Volatility

IT. The reason of extremely high past inflation volatility was, that Peru had suffered from hyperinflation just three years before the implementation of IT policy. We used inflation volatility of the last five years, therefore hyperinflation affected just the first two years in our dataset. Due to the fact that if we continued in the inference with these observations, it would bring significant problems in our analysis and misspecification of the model, therefore we decided to drop out these observations and repeat the estimation.

Table. 3.2 presents our new results. If we compare it with the previous one, we can see that there is no change in order of magnitude of other variables coefficient, but the sign of the coefficient of inflation volatility has changed. This result seems to be more realistic and also in accordance with the theory about optimal inflation surveyed by Billi & Kahn (2008). Past inflation volatility is crucial for IT setting. All policy makers agree, that deflation is a more serious problem than inflation, hence if the inflation is more volatile, they rather maintain higher inflation to eliminate the risk of deflation. The most exact example to illustrate the harmful effect of deflation is Japan's economy in the early 90's. Falling prices created a vicious circle, which pushed Japan's economy to regression for the rest of the decade. Of course, the cost of high

Table 3.2: IT Settings: Regression Results

	(1)	(2)	(3)	(4)	(5)
CPI Inflation	0.434***	0.434***	0.434***	0.426***	0.395***
	(16.45)	(16.46)	(15.95)	(15.29)	(13.76)
Inflation Volatility	0.0056***	0.0056***	0.0054***	0.0049***	0.007***
	(4.81)	(4.82)	(4.58)	(3.09)	(4.89)
GDP Growth	0.059**	0.058*	0.057*	0.071**	0.024
	(1.92)	(1.88)	(2.27)	(1.84)	(0.71)
World Inflation	0.100***	0.101***	0.098***	0.106***	0.293***
	(5.12)	(5.08)	(4.85)	(5.26)	(3.19)
Price Level (PPP)	0.010***	0.010***	0.009*	0.0012***	0.014***
	(2.58)	(2.57)	(1.90)	(2.83)	(3.03)
Credibility		0.060			
		(0.23)			
Independence			-.073		
			(-0.10)		
Gov. orientation				-0.096	
				(-0.82)	
Debt/GDP Ration					-0.007
					(-1.53)
Intercept	0.427	0.397	0.618	0.379	−0.044
	(1.38)	(1.17)	(0.90)	(1.19)	(-0.08)
N	151	151	139	147	133
AIC	263.0	264.96	253.7	258.2	221.6
BIC	284.1	289.1	277.2	282.1	244.7

Note: *Statistically significant at the 10% level;**Statistically significant at the 5% level; ***Statistically significant at the 1% level; t-statistics are in parentheses; all explanatory variables are lagged by one period.
Source: author's computations.

inflation is also important. Related to this, we can see a strong relationship between high inflation and high volatility. Generally we can say, that more volatile inflation implies higher inflation targets.

The model shows that GDP growth has a positive effect on IT. One of the explanations for this empirical relationship can be Okun's law and the Philips curve. Okun's law describes the relationship between real GDP growth and changes in unemployment. Okun's rule of thumb says that 2% increase of real GDP is linked to 1% decrease in unemployment rate. The Philips curve describes the relationship between unemployment and wage, respectively consumer price inflation and says that lower unemployment is rate followed by higher inflation (see Cahlík *et al.* 2010). In our case it means higher inflation expectations on

the side of policy makers, which results in higher IT.

Higher world inflation is estimated to cause higher IT. The interpretation of this relationship can be the fact that all inflation targeting emerging countries are more or less open economies, hence part of the inflation is imported from business partners. Moreover, especially in case of emerging markets, convergence towards developed countries might have a significant influence on IT.

Purchasing power parity price level seems to have also a positive effect on IT. According to this result countries with higher price level should have higher inflation target which is in discrepancy with our theoretical expectations. PPP price level is statistically significant, therefore we discuss the problem in more detail in subsection 3.2.5.

Credibility of CB, Independence of CB, Government party orientation and Debt/GDP ratio are insignificant, in the 2nd,3rd,4th and 5th columns are the significance tests for these variables. For measuring the relative goodness of fit we use Akaike and Bayesian information criterion. In case of Debt/GDP ratio AIC and BIC is lower than in previous cases, which is the consequence of smaller amount of observations.

Unfortunately R^2 is not available in case of Interval panel regression estimator. To measure how well are predicted future outcomes in our model we use Pooled OLS, simple Random Effects GLS estimator and Fixed Effects. The difference in our approach in the case of above mentioned estimators is that now the dependent variable is the central inflation target point or in case of countries, where IT is defined as an interval, the average of upper and lower bound of IT.

3.2.2 Alternative Estimators

We are using alternative estimation methods to determine, how well our original model fits (Wooldridge 2009). Our original result obtained from Interval Panel regression model is represented in the first column of Table 3.3, pooled OLS is in the second, the third column contains Random Effects estimator and FE is in the last one.

Based on the results obtained, the Interval regression seems to be consistent and robust in comparison to alternative models. CPI Inflation, Inflation Volatility, World Inflation and PPP price level are significant in case of alternative models and all of them has the same sign as in case of Interval Regression. The

Table 3.3: IT Settings: Regression Results

	(1) Interval RE	(2) Pooled OLS	(3) Random Effects	(4) Fixed Effects
CPI Inflation	0.434***	0.425***	0.392***	0.3544***
	(16.45)	(15.86)	(13.38)	(10.80)
Inflation Volatility	0.0056***	0.0052***	0.0052***	0.0052***
	(4.81)	(4.15)	(4.21)	(4.06)
GDP Growth	0.059**	0.045	0.036	0.033
	(1.92)	(1.42)	(1.13)	(1.04)
World Inflation	0.100***	0.111***	0.130***	0.148***
	(5.12)	(5.24)	(5.57)	(5.84)
Price Level (PPP)	0.010***	0.014***	0.015***	0.0027
	(2.58)	(3.27)	(2.55)	(0.25)
Intercept	0.427	0.239	0.279	1.161*
	(1.38)	(0.77)	(0.64)	(1.58)
N	151	151	151	151
R^2		0.804	0.802	0.785
AIC	263.0	478.2		448.6
BIC	284.1	496.3		466.7

Note: *Statistically significant at the 10% level;**Statistically significant at the 5% level; ***Statistically significant at the 1% level; t-statistics are in parentheses; all explanatory variables are lagged by one period.
Source: author's computations.

only difference is in the case of GDP growth. It is insignificant in all alternative models and significant in the Interval regression.

The important contribution of alternative estimators is, that now we are able to estimate the R^2 of our original model. Based on the alternative models we can state that the R^2 of our original model should be around 80 %.

If we want to use Random Effects estimator, we have to be sure, that the country-specific part of the error is uncorrelated with independent variables. Let us see again our original model

$$[\pi_{i,t}^{T(L)}, \pi_{i,t}^{T(U)}] = \beta X_{i,t-1} + \epsilon_{i,t-1}$$

assuming that

$$\epsilon_{i,t} = a_i + e_{i,t}$$

and both a_i and $e_{i,t}$ are independent, identically distributed with zero mean and constant variance. In addition, a_i has to be uncorrelated with the specific

effect. The fulfillment of these conditions we tested by Breusch-Pagan Lagrange Multiplier (BP LM) test for Random Effects in the middle point of the inflation target. The null hypothesis is that variances across entities are zero, i.e. there is no significant difference across units. After running the test we get the p-value is equal to 0.16, hence we failed to reject the null hypothesis and it implies that Random Effects are not appropriate. Based on this result, there is no evidence of significant differences across countries. Consequently, we can use simple OLS regression. Additionally, we ran the BP LM test on our original dataset, i.e. included the previously dropped values. In this case the p-value is 0.11, which is just slightly above the minimum required level for rejection of the null hypothesis. Hence we fail to reject the null hypothesis, its evidence is not as strong.

We also ran the Hausman test to differentiate between the FE and RE. The null hypothesis states that both FE and RE are consistent and RE are efficient, while under the alternative hypothesis just FE are consistent and none of them are efficient. The p-value is equal to 0.1003, which means that we fail to reject the null hypothesis and RE is proper.

Moreover, we test the significance of FE by F-test, testing the joint significance of individual FE, i.e the joint significance of all a_i. The p-value equals 0.0044, therefore we reject the null hypothesis. This means that a_i has a jointly significant effect on inflation target and fosters to use FE.

Based on these three tests, we have a poor support to use RE GLS. However, we should notice that all of these test are related to RE in the middle point. On the contrary, inflation target in every IT country except for Israel and Norway is defined as an interval. If we take into account this cardinal information, we have to say that Interval RE GLS, which is based on the same estimator as middle point RE GLS, is the most appropriate technique to estimate our model.

3.2.3 Winsorising to Treat with Outliers

Solving the phenomenon of outliers simply by throwing them away from the model is inappropriate in some cases. Hence, we are using an other alternative approach for the elimination of the effect of outliers, which is called Winsorizing. Applying the transformation in our case for past inflation volatility means, that we set all item values which are below the 5^{th} percentile to the 5^{th} percentile value, and all item values which are above the 95^{th} percentile to the 95^{th} percentile value. The estimator now has to be more robust to outliers.

After Winsorizing we repeat the previous regressions, whose results are presented in the table 3.4.

Table 3.4: IT Settings: Regression Results Based on Winsorized data

	(1) Interval RE	(2) Pooled OLS	(3) Random Effects	(4) Fixed Effects
CPI Inflation	0.346***	0.336***	0.301***	0.262***
	(13.28)	(12.50)	(10.96)	(9.13)
Inflation Volatility	0.0041***	0.0039***	0.0043***	0.0043***
	(3.07)	(2.72)	(3.02)	(3.04)
GDP Growth	0.040	0.034	0.025	0.025
	(1.11)	(0.93)	(0.71)	(0.69)
World Inflation	0.091***	0.097***	0.124***	0.152***
	(4.02)	(4.01)	(4.80)	(5.57)
Price Level (PPP)	0.011**	0.016***	0.017***	−0.0035
	(2.33)	(3.26)	(2.62)	(-0.29)
Intercept	0.963	0.699	0.737	2.063*
	(2.73)	(1.96)	(1.55)	(2.60)
N	154	154	154	154
R^2		0.779	0.776	0.739
AIC	314.9	536.43		493.31
BIC	336.2	554.65		511.53

Note: *Statistically significant at the 10% level;**Statistically significant at the 5% level; ***Statistically significant at the 1% level; t-statistics are in parentheses; all explanatory variables are lagged by one period.
Source: author's computations.

Now we are using again Breusch-Pagan Lagrange Multiplier test for RE in the middle point of inflation target. The null hypothesis repeatedly is that variance among entities is zero, i.e. there no significant difference among units. The p-value of the test is 0.004, therefore we reject the null hypothesis. Consequently RE should be appropriate.

We test the significance of FE as well by F-test for joint significance of individual Fixed Effects. P-value equals to 0.00, which implies the rejection of the null hypothesis and fosters the usage of FE.

Further, we run Hausman test to decide between RE and FE. The null hypothesis says that both RE and FE are consistent, but just RE are efficient, while under the alternative hypothesis none of them is efficient, but FE is consistent. The p-value is 0.00, i.e. we reject the null hypothesis, which implies that FE estimator is consistent.

Based on the previous test, after eliminating the extreme values in past inflation volatility, FE seems to be more feasible to estimate the model.

3.2.4 Lagged Data

In the previous subsections we used one year lagged data, based on the fact that monetary authority at the time of setting the inflation target, doesn't have access for future data. Inflation targeting countries at the time of publishing inflation target also publish target horizon which can vary from country to country. From 27 countries currently using IT, 5 CBs determine the target exactly for 2 years, 13 say that the target horizon is determined on medium term. In other cases the target horizon varies between 1 year, three years and "at all times" (Hammond 2012). Based on this information, we use dataset, where explanatory variables are lagged with two years. Our estimations are presented in Table 3.5.

Table 3.5: IT Settings: Regression Results Based on Two Years Lagged Data

	(1) Interval RE	(2) Pooled OLS	(3) RE	(4) FE
CPI Inflation	0.297***	0.292***	0.252***	0.198***
	(12.87)	(13.18)	(11.39)	(8.82)
Inflation Volatility	−7.38***	−7.79***	−6.62***	−4.68***
	(-5.16)	(-5.31)	(-4.64)	(-3.39)
GDP Growth	0.115***	0.113***	0.096***	0.077**
	(3.22)	(3.27)	(2.92)	(2.51)
World Inflation	0.107***	0.113***	0.150***	0.190***
	(4.41)	(4.64)	(6.03)	(7.72)
Price Level (PPP)	0.012**	0.017***	0.020***	−0.0002***
	(2.44)	(3.68)	(3.30)	(-0.01)
Intercept	0.694*	0.368	0.389	1.725**
	(1.83)	(1.02)	(0.87)	(2.26)
N	164	164	164	164
R^2		0.723	0.716	0.660
AIC	356.7	585.2		519.3
BIC	378.4	603.8		537.9

Note: *Statistically significant at the 10% level;**Statistically significant at the 5% level; ***Statistically significant at the 1% level; t-statistics are in parentheses; all explanatory variables are lagged by two period; Inflation Volatility multiplied by 10^7.
Source: author's computations.

The first thing that we have to see is that all variables are strongly significant. Unfortunately, we cannot compare the obtained results directly as the number of observations is different. However, we can notice that inflation volatility changed its sign and became less influential, coefficient of inflation in case of lagged date slightly decreased, while coefficient of GDP growth is twice bigger. The conclusion is, that the inflation target is influenced more by GDP growth the year before last than GDP growth in the last year. Other coefficients of variables do not change significantly. The R^2 decreased slightly, however Akaike and Bayes information criteria are increased, which means that the relative quality of the model is worse than in previous case with one year lagged data.

The BP LM tests p-value equals to 0.0027, which implies the rejection of the null hypothesis and suggest the using of FE. The p-value of the F-test for joint significance of fixed effects is 0.00, i.e. we reject the null hypothesis that a_i are jointly zero.

Hausman test's p-value is 0.00 as well, which also implies the rejection of null hypothesis and suggest to use FE.

The tests in this case suggest to use FE, however, due to the above mentioned special nature of the explained variable we prefer to use RE Interval Regression.

3.2.5 Impact of Price Level on Inflation Target

As we found out in subsection 3.2.1, PPP price level in the wide group of emerging countries has a positive effect on inflation target. It is in contradiction with our expectations. After we run the regression on the whole group of IT countries, i.e. on the dataset which contains data from all emerging and developed countries using IT, we can see that the coefficient of Price Level is negative. The results are presented in table 3.6. We can notice the same sign, if we examine just the group of developed countries, presented in table 3.8.

To find the reason of changing sign for price level, we calculate the correlation between central target point and price level. In case of emerging markets it is 0.131, in case of developed countries -0.108. If we examine the whole group of IT economies, the correlation is -0.249. The relationship between price level and inflation target is showed in Figure 3.2.

If we have a look at the summary statistics of price level in emerging and developed countries separately, we can see that among the emerging countries the mean price level it is 63.4 with standard deviation of 23.5, while among

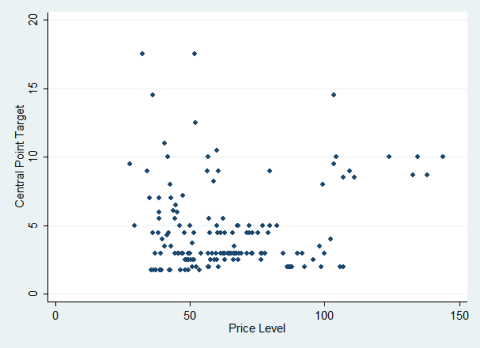

Figure 3.2: Scatterplot of Central Point Inflation Target and Price Level

the developed countries it is 103.3 with standard deviation of 26.4. Based on these results we can state that generally higher price level results lower inflation target. If we examine just emerging countries, where on average price level is lower than in developed countries and differences among price level of countries are not as significant, price level is positively related to inflation target.

3.2.6 Effect of Government Influence on Inflation Target

According to the findings from subsection 2.2.4, we found out that the mean inflation target of countries where government has direct influence on establishment of the target is 0.96 p.p. higher than the mean target of countries where government influence is not present. Based on this difference we assume, that government influence has a significant effect on IT. Therefore we generate a dummy variable for government influence on inflation target. It may have two values: '1' if in the country government has a direct impact on inflation target setting and '0' otherwise.

Before running the regressions, we checked the correlation between explanatory variables. As we realized that the correlation between price level and government influence is quite high (0.55), we decided to replace price level by government influence in our model. After that we tested our assumption on the wide group of emerging markets, where extreme values of inflation volatility in case of Peru are dropped out from the dataset.

Because variable for government influence on inflation target vary across units but does not vary across time, we estimate just RE interval regression, simple pooled OLS and RE GLS. Our estimates are presented in Table. 3.7. The result we obtained are reasonable. It seems that we have found another

Table 3.6: IT Settings: Regression Results Based on the Whole Group of IT Countries

	(1) Interval RE	(2) Pooled OLS	(3) RE	(4) FE
CPI Inflation	0.481***	0.483***	0.443***	0.412***
	(25.88)	(26.25)	(22.68)	(19.30)
Inflation Volatility	−6.5***	−7.36***	−6.31***	−5.39***
	(-5.47)	(-6.13)	(-5.46)	(-4.57)
GDP Growth	0.110***	0.104***	0.082***	0.070***
	(4.58)	(4.22)	(3.58)	(3.03)
World Inflation	0.027***	0.027***	0.035***	0.044***
	(2.69)	(5.24)	(3.42)	(4.10)
Price Level (PPP)	−0.004**	−0.003	−0.001	−0.0006
	(-2.03)	(-1.39)	(-0.41)	(-0.12)
Intercept	1.25	1.137***	1.179***	1.204**
	(5.09)	(4.63)	(3.50)	(2.52)
N	287	287	287	287
R^2		0.776	0.774	0.769
AIC	562.1	904.1		805.6
BIC	587.7	926.0		827.5

Note: *Statistically significant at the 10% level;**Statistically significant at the 5% level; ***Statistically significant at the 1% level. t-Statistics are in parentheses, All explanatory variables are lagged by one period, Inflation Volatility multiplied by 10^7.
Source: author's computations.

missing piece of our puzzle. All variables are strongly significant, Akaike and Bayes information criteria not too high and R^2 is above 0.80. We do not want to overstate its importance, but it is always better to have higher R^2 than lower. Thereafter we run the BP LM test for RE on middle point target. We have received p-value 0.19, which is satisfactory if we take into account that inflation target in reality except one country is not a single point, but and interval.

3.2.7 Comparison with Developed Market Economies

In the previous sections we have estimated models to access the determinants of inflation target in emerging countries. While discussing the inflation target settings of developed countries goes beyond the scope of this thesis, sufficient to examine how the explanatory variables used in previous section influence the inflation target of developed countries. Our first dataset contained panel data

Table 3.7: IT Settings: Including Government Influence

	(1) Interval RE	(2) Pooled OLS	(3) RE
CPI Inflation	0.441***	0.440***	0.430***
	(17.19)	(17.09)	(16.23)
Inflation Volatility	0.005***	0.004***	0.005***
	(4.51)	(3.71)	(3.79)
GDP Growth	0.065**	0.060**	0.057**
	(2.27)	(2.01)	(1.91)
World Inflation	0.099***	0.105***	0.110***
	(5.21)	(5.12)	(5.15)
Gov. Influence	0.603***	0.738***	0.795***
	(3.47)	(4.07)	(3.79)
Intercept	0.774***	0.705***	0.736***
	(4.29)	(3.79)	(3.72)
N	163	163	163
R^2		0.806	0.806
AIC	271.4	508.6	
BIC	293.1	527.1	

Note: *Statistically significant at the 10% level;**Statistically significant at the 5% level; ***Statistically significant at the 1% level. t-Statistics are in parentheses. All explanatory variables are lagged by one period.
Source: author's computations.

from 12 countries. The countries were chosen based on the wide definition of emerging economies, which we specified earlier. Here we wanted to examine, how relevant are our previous empirical findings in the developed market economies. The dataset contains data from 10 developed countries. Except Spain all of them using still IT as a monetary policy framework. Spain abandoned IT just before it joined the Eurozone.

It is reasonable to expect, that at least some of the earlier significant explanatory variables will be insignificant and the impact of variables will be different. The models are presented in table 3.8.

Direct comparison of the result is impossible, us the number of observations is different, however we can monitor significant differences. From obtained results are obvious that still CPI inflation has the biggest impact to inflation target, but its impact is much smaller. All other variables are insignificant.

However the results do not involve much information about the inflation target settings of developed countries, for our current purposes it seems to be enough. We conclude, that factors which are important in developing countries

Table 3.8: IT Settings: Regression Results Based on Developed IT Countries

	(1) Interval RE	(2) Pooled OLS	(3) RE	(4) FE
CPI Inflation	0.093***	0.123***	0.029	0.024
	(4.52)	(5.07)	(1.62)	(1.32)
Inflation Volatility	−0.021	0.002	0.006	0.007
	(-5.16)	(0.14)	(0.57)	(0.60)
GDP Growth	0.021	0.019	−.009	−0.011
	(1.25)	(1.09)	(-0.90)	(-1.02)
World Inflation	−0.004	0.004	0.002	0.002
	(-0.56)	(0.59)	(0.51)	(0.47)
Price Level (PPP)	−.0005	−0.002	0.002	0.002
	(-0.38)	(-0.94)	(1.15)	(1.32)
Intercept	2.101***	1.870***	1.853***	1.772***
	(10.52)	(8.94)	(07.85)	(9.47)
N	133	133	133	133
R^2		0.205	0.067	0.039
AIC	76.2	178.9		13.2
BIC	96.4	196.3		33.5

Note: *Statistically significant at the 10% level;**Statistically significant at the 5% level; ***Statistically significant at the 1% level. t-Statistics are in parentheses. All explanatory variables are lagged by one period.
Source: author's computations .

inflation target setting, such as inflation volatility, GDP growth, world inflation or PPP price level, are irrelevant in developed countries. Therefore if somebody wants to examine IT as a monetary framework, he has to investigate developing and developed countries separately.

Chapter 4

Conclusion

The practice of monetary policy has changed in the last 25 years in a great extent. Spectacular part of this process is the result of appearance of new monetary policy regime called inflation targeting.

We started with examining monetary policy and real economy. Our conclusion is that in long run it is preferable for economy if CB focuses on creating and sustaining the optimal conditions for growth by stable price level instead of the activist monetary policy. We distinguished anticipated and unanticipated inflation and various costs of inflation. Then we moved to the New Keynesian model and showed how inflation targeting is in correspondence with the New Keynesian theory. Further, we have continued with the practical part of operating IT. Fulfilment of at least some of the theoretical preconditions is inevitable for successful implementation of IT. We examined the target as well. It is not a simple question in most of the countries. Most often defined as a point with some tolerance band, or simply as an interval. This allows some fluctuation of inflation without loss of credibility of CB and makes IT less rigid.

We have devoted a significant part of this thesis to the detection of determinants of inflation targets in emerging markets. Our take-off position was based on the fact that even if CBs pay extraordinary attention to the transparency and communication, in most of the cases they do not explain any determinant of their inflation target. Just few CBs disclose details about target settings, which are usually very limited. The most frequently mentioned factors are the following: past inflation, inflation abroad, measurement error of inflation. Moreover, deflation risk has an important role in target settings. Common view among the central bankers is that deflation causes most malignance, therefore emerging countries with more volatile inflation set higher inflation target to eliminate

the risk of deflation. The most important contribution of the thesis lies, firstly, in specification of the significance and measuring the above mentioned inflation target's determinants in emerging countries and, secondly, finding other determinants which have a significant impact on the target as well.

Our suggestion for further study are to extend the dataset to emerging countries using alternative monetary framework. By using results from our estimation it should be possible to compute hypothetical inflation target for non-targeters. Through this hypothetical target and CB loss function it could be possible to make an accurate comparison of monetary systems and make more robust judgement about the performance of IT.

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Appendix A

Inflation Target Development

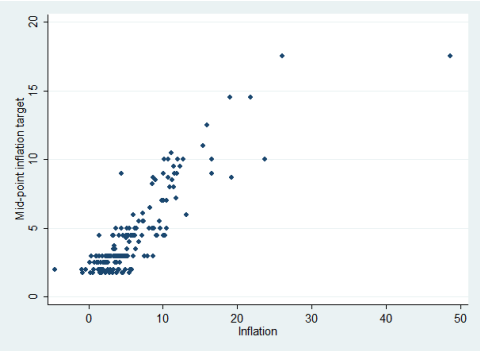

Figure A.1: Mid-point inflation target and inflation

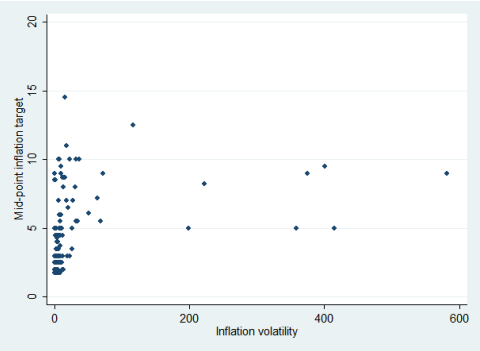

Figure A.2: Mid-point inflation target and volatility

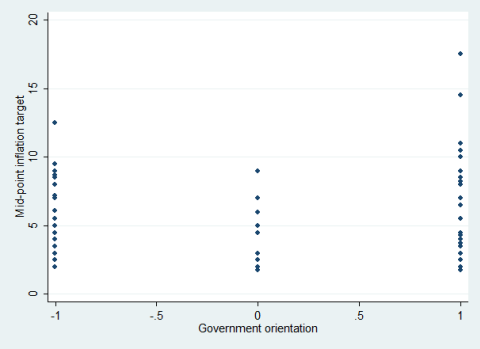

Figure A.3: Mid-point inflation target and government orientation

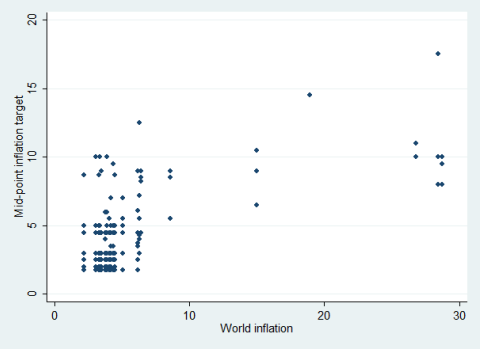

Figure A.4: Mid-point inflation target and world inflation

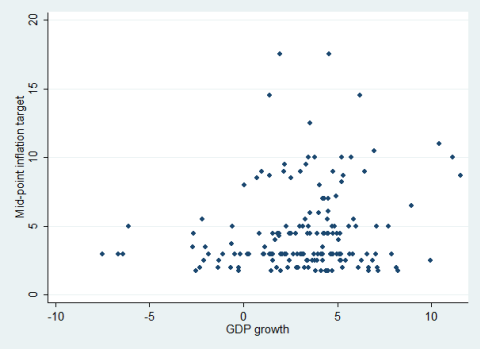

Figure A.5: Mid-point inflation target and GDP growth

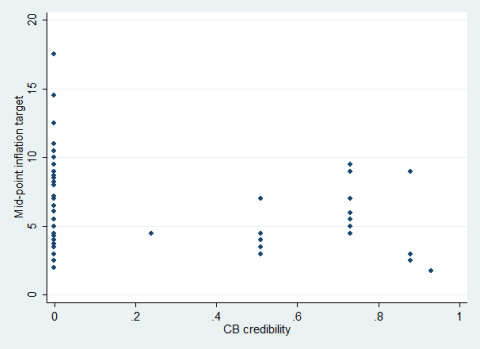

Figure A.6: Mid-point inflation target and CB credibility

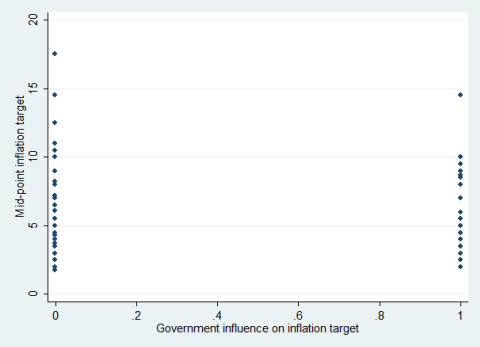

Figure A.7: Mid-point inflation target and direct government influance on target

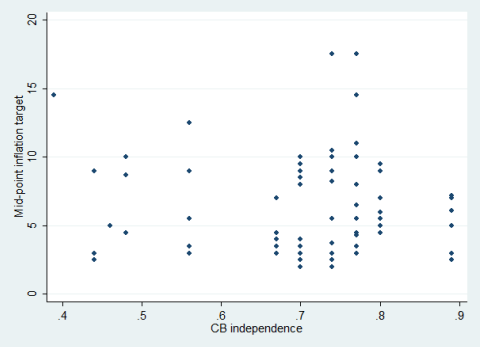

Figure A.8: Mid-point inflation target and CB independence

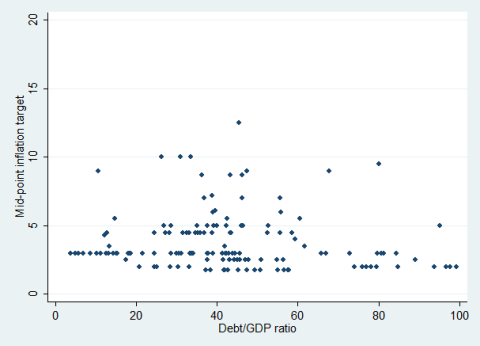

Figure A.9: Mid-point inflation target and debt/GDP ratio

Table A.1: Inflation Target Development

Country	IT adoption	IT at adoption	Stable IT period	Current IT
Armenia	2006	4%+/- 1.5pp.	2006	4%+/- 1.5pp.
Australia	1993	2%-3%	1993	2%-3%
Brazil	1999	8%+/- 2pp	2006	4.5%+/- 2pp
Canada	1991	4%+/- 1pp	1995	1%-3%
Chile	1991	15%-20%	2001	3%+/- 1pp
Colombia	1999	15%	2010	2%-4%
Czech Republic	1998	6%+/- 0.5pp	2009	2%+/- 1pp
Finland	1993	2%	1993	
Ghana	1999	10%+/- 2pp	2010	8.7%+/- 2pp
Guatemala	2006	5%+/- 1pp		4.5%+/- 1pp
Hungary	2001	7%+/- 1pp	2007	3%+/- 1pp
Iceland	2001	2.5%	2001	2.5%
Indonesia	2005	5%+/- 1pp		4.5%+/- 1pp
Israel	1992	14%-15%	2002	1%-3%
Mexico	1999	12%-13%	2003	3%+/- 1pp
New Zeland	1989	3%-5%	2003	1%-3%
Norway	2001	2.5%	2001	2.5%
Peru	2002	15%-20%	2007	2%+/- 1pp
Philippines	2002	5.5%+/- 0.5pp/	2009	4%+/- 1pp
Poland	1998	6.6%-7.8%	2004	2.5%+/- 1pp
Romania	2005	7.5%+/- 1pp		3%+/- 1pp
Serbia	2009	10%+/- 2pp		4%+/- 1.5pp
Slovakia	2005	2.5%		
South Africa	2000	3%-6%	2000	3%-6%
Spain	1999	3.5%-4%		
South Korea	1998	9%+/- 1pp/	2001	3%+/- 1pp
Sweden	1995	2%+/- 1pp	1995	2%+/- 1pp
Thailand	2000	0%-3.5%	2006	3%+/- 1.5pp
Turkey	2006	5%+/- 2pp/	2006	5%+/- 2pp
United Kingdom	1992	1%-3%	2004	2%+/- 1pp
All countries		6.71%		2.96%

Source: author's collection.

Table A.2: IT Settings: Who Set The Target?

Armenia	CB jointly with the Government
Brazil	National Monetary Council Consist: Governor, Two Ministers
Chile	CB
Colombia	Board of Directors Consist: Governor, Minister ,Five other members
Czech Republic	CB
Ghana	Government and CB
Guatemala	Monetary Board Consist: Governor, Three Ministers, Other members
Hungary	CB
Indonesia	Government After consultation with CB
Israel	Government In consultation with Governor
Mexico	Board of Governors
Peru	Board of Directors
Philippines	Government In consultation with CB
Poland	Monetary Policy Council Consist: Governor and external members
Romania	Jointly CB and Government
Serbia	CB in cooperation with Government
South Africa	Government after consultation with CB
Korea	CB after consultation with Government
Thailand	Monetary Policy Committee Consist: Governor and external members
Turkey	Monetary Policy Committee with Goverment

Source: Hammond (2012) and webpages of CB.

Appendix B

Empirical Data

Empirical data, stata source codes and alternative specifications available upon request.