Inflation Targeting: 
A Comparative Empirical Analysis

Pınar KAYNAK

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Abstract

The purpose of this paper is to make a comparison between how countries with inflation targeting (IT) fared compared to their non-IT peers in general and during the financial crisis in particular. First to detect the existing correlation between IT and economic performance outcomes Ordinary Least Squares (OLS) regression is used. Second, to filter out business cycle fluctuations, Generalized Method of Moments (GMM) dynamic panel data estimator is used. The results presented here are not necessarily at odds with the prescriptions of the standard IT literature. Despite the evidence demonstrates that IT countries have a better economic performance in general and in the global financial crisis in particular, it does not establish a causality relationship.

Keywords: Inflation Targeting, Generalized Method of Moments, Causality.

JEL Classification: C51, E52, E58.

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Özet

Enflasyon Hedeflemesi: Karşılaştırmalı Ampirik Analiz

Bu çalışmanın amacı, enflasyon hedeflemesi uygulayan ülkeler ile enflasyon hedeflemesi uygulamayan ülkelerin makroekonomik performanslarının genel bir değerlendirmeimesini yapmaktır. Enflasyon hedeflemesi ile ekonomik performans göstergeleri arasındaki mevcut ilišíkii tespit etmek için Sıradan En Küçük Kareler (EKK)
1. Introduction

The current financial crisis has driven the economists' focus on the optimal monetary policy once again. As also indicated by de Carvalho Filho (2010), one of the main questions facing researchers and policymakers in the post-crisis is whether the monetary policy regimes of the Great Moderation years should survive or be scrapped.

The high and volatile rate of inflation in most countries over the earlier periods was accompanied by high variability in output and unemployment by low growth in productivity and potential output. This has raised some problems in the economy. Although, not all problems in the functioning of the economy can be ascribed to high and volatile rate of inflation, there is a consensus that an inflationary environment is detrimental for the functioning of the economy. For instance, the more uncertain is the future rate of inflation the higher is the risk premium and consequently the higher will be the real cost of borrowing. This will in turn affect the aggregate investment in the economy. Therefore as Freedman and Laxton (2009) indicates, it is not surprising that days lost to strike are typically larger at times of high in inflation than at times of low and more predictable inflation, when negotiations can focus on real wages since both sides are more or less agreed on the future rate of inflation.

The “optimum” rate of inflation - that all economists have agreed on- has not been provided yet. On the one hand, some economists such as Feldstein (1997) argue for a long-run inflation goal of zero. On the other hand, other economists such as Akerlof et al. (1996) argue that
setting inflation such a low level produces inefficiency and will result in an increase in the natural level of unemployment. Nevertheless, the common ground for the supporters of both perspectives is that low inflation clearly falls into single-digit units in general and typically defined as very low single digits for the industrialized countries.

We can see that all inflation targeters in industrialized countries (and hybrid targeters like Germany or the European Central Bank) have chosen inflation targets above zero: the midpoint of long-run inflation target ranges is 1% for the European Central Bank, 1.5% for New Zealand, 1.75% for Germany just before EMU, 2% for Canada, Sweden and Finland (and Spain before it joined EMU), and 2.5% for Australia and the United Kingdom. This choice of inflation targets above zero reflects monetary policymakers concerns that too low inflation, or particularly low inflation, can have substantial negative effects on real economic activity. There are particularly valid reasons for fearing deflation, including the possibility that it might promote financial instability and precipitate a severe economic contraction (Bernanke and Mishkin, 1997). Indeed, deflation has been associated with deep recessions or even depressions, as in the 1930s. Targeting inflation rates of above zero makes periods of deflation less likely.

It is also plausible that during periods of global booms and excess liquidity, inflation targeting (IT) central banks are more prone to tight monetary policy leaning against the wind, in pursuit of their inflation target. Indeed, IT countries were found to have higher nominal interest rates during the expansion phase prior to the current crisis and as de Carvalho Filho (2010) indicates, their procyclical nominal interest rate may have hindered the onset of lending booms or made the high-yield foreign assets of dubious quality less attractive thereby protecting the financial system. Moreover, when a financial crisis hits, countries such as IT countries, that start from a position of higher nominal interest rates have more room for rate cuts therefore less need for costly extraordinary measures.

Nevertheless, IT seems to withstand the test of time. The duration of IT regime is already as long as other monetary regimes or even longer than its alternatives such as exchange rate targeting or nonautonomous monetary regime and as Rose and Mihov (2007) highlight, unlike all other monetary frameworks no country is forced to abandon regime of IT in the crisis.
Comparing macroeconomic performances under alternative monetary policies is not an easy task. The most critical issue in making comparisons is the selection of relevant comparators. The best analysis would be comparing performance in countries, which adopted IT with how they would have performed had they not adopted IT, in an ideal world. Unfortunately this is not applicable. Hence, the challenge is to find another group of countries that can be used as relevant comparators.

The purpose of this research is to evaluate IT countries’ economic performance outcomes once they adopt IT, and to see whether they fared better in general and during the global financial crisis in particular. To be able to make such an analysis, first, the existence of a correlation between IT and the economic outcomes is examined. Once the existence of such a correlation is verified, the direction of causality is investigated. The logic behind making an additional causality analysis can be simply summarized with the following phrase: “Correlation does not imply causation.” In this research's context, causality refers to “causality of IT on economic performance outcomes”.

Another issue worth mentioning is endogeneity. Broadly speaking, a loop of causality between the independent and dependent variables of a model leads to endogeneity. The endogeneity problem is particularly relevant in the context of time series analysis of causal processes. It is common for some factors within a causal system to be dependent for their value in period t on the values of other factors in the causal system in period t-1. To address the inflation targeting endogeneity, techniques within GMM methodology is used. All the tests contribute to making the analysis more reliable in the sense that the empirical results are indeed robust and capture the causality of inflation targeting to economic performance outcomes. These economic performance outcomes of interest are: (i) growth; (ii) industrial production; (iii) inflation; (iv) unemployment rate; (v) nominal interest rate, discount rate; and (vi) real effective exchange rate. The data set roughly covers the period between 2006 and 2011. A systematic panel data analysis using a set of 73 countries is conducted.

The data set coverage concerning time dimension depends on the availability of data are presented in detail in the tables for each variable.
The remainder of the research is in six sections. Section 2 gives summary of the literature. Section 3 presents an overall evaluation of existing monetary regimes. Section 4 focuses on IT by evaluating its advantages and disadvantages compared to alternative monetary regimes. Section 5 presents the performance of IT and non-IT countries during the global financial crisis. Section 6 develops the regression analysis and its results with the corresponding data being detailed in the Data Appendix. Finally, Section 7 represents the conclusion.

2. Summary of the Literature

Despite the existence of a correlation between inflation targeting and the economy in general, the existing theoretical and empirical literature offer little guidance about causality. For instance, de Carvalho Filho (2010) focuses on the correlation between IT and the severity of the global financial crisis. However, as also himself indicates his aim is not to detect causality. Therefore, his work is not sufficient enough to draw a sound conclusion implying that IT countries performed better during the crisis. As also it will be discussed in the following sections, a more detailed work is needed to be able to draw any conclusion. Moreover, despite the amount of research about IT, there is no consensus concerning its effects on the economic performance.

One the one hand, some economists suggest that to some extent there is correlation between inflation targeting and the economic performance indicators. For instance, Roger (2009) provides an overview of inflation targeting framework and macroeconomic performance under inflation targeting. The evidence in the study shows that, although inflation target ranges are missed frequently in most countries, the inflation and growth performance under IT compares very favorably with performance under alternative frameworks. Svensson (2009) reviews the early experience with IT but with rather limited number of observations. Later studies such as Bernanke et al. (1999), Corbo et al. (2002), Clifton et al. (2001), Arestis et al. (2002), Gaytn and Johnson (2002), Neumann and von Hagen (2002), Roger and Stone (2005) afford longer periods with more data. Overall, the evidence supports the argument that IT matters. Bernanke and Mishkin (1997) find that IT has proved an effective strategy in the fight against inflation, especially in maintaining the benefits of registering low inflation levels. Neumann and von Hagen (2002) apply an event-study analysis whereby they compare the performance of IT and
non-IT central banks under similar exogenous shocks. They examine the increases in oil prices in the years 1978 and 1998 and find that actual and expected inflation responses to shocks improved more in IT countries. Bernanke (2011) finds that IT is more advantageous, and supports his view for IT by saying that “central banks that gave switch to inflation targeting have generally been pleased with the results they have obtained. The strongest evidence on that score is that, thus far at least, none of the several dozen adopters of inflation targeting has abandoned this approach.” Furthermore, although they do not provide any supporting evidence Bernanke and Gertler (1999) and Alesina and Perotti (1995) argue that Fed and European Central Bank could improve its monetary policy with the adoption of IT, respectively.

On the other hand, some economists, although they are not completely against IT, argue that the performance of IT depends on the level of development of the targeting countries. The defendants of this view claim that IT improves the performance of countries which already start the competition from the back seat, such as emerging and developing economies. For instance, Debelle (1997) compares average inflation levels for seven IT countries with G7 countries excluding non-inflation targeters and finds a steep decline in inflation in the case of the former group, concluding that IT is useful for countries facing lack of anti-inflation credibility. Also, Vega and Winkelried (2005) find that inflation targeting is able to reduce inflation in advanced and emerging economies and that this effect is larger for emerging economies. Along the same lines, Goncalves and Salles (2008) find that emerging economies adopting the inflation targeting regime experience more significant reductions in average inflation and output volatility than the non-targeting economies.

However, almost an equal number of studies claim not to find clear evidence supporting the benefits of inflation targeting. Hu (2003) discusses the effects of IT by comparing the performances of inflation targeters to non-targeters by analyzing the trade-off between inflation and output; and finds limited support for the proposition that the adoption of inflation targeting improves the trade-off between inflation and output variability. Ball and Sheridan (2004) provide another study, asking whether inflation targeting improves economic performance, as measured by the behavior of inflation, output, and interest rates. They find that after the early 90s, performance improved along many dimensions for both the targeting countries and the non-targeters, and conclude that they are unable to find any evidence that IT improves economic performance as measured by the behavior of inflation, output and interest
rates. A related study by Bodkin and Neder (2003), examines IT in the case of Canada for the period 1980-1989 and 1990-1999 (the IT period). Their results clearly indicate that inflation over the IT period did fall, but at a significant cost of unemployment and output; hence suggest that the deleterious real effects (higher unemployment and lower growth) during the decade under study suggests that some small amount of inflation (say in the range of 3 to 5 percent) may well be beneficial for a modern economy. In the same vain, the evidence collected by Breedon and Pthursson (2004) for the Longest History IT Countries (LHITCs) that includes New Zealand, Canada, UK, Sweden and Australia, draw similar conclusions, producing only a marginally significant or non-significant effect of IT adoption on inflation level. Additionally, Honda (2000) finds no evidence that IT adoption had an effect on either inflation or any other variable in Canada, New Zealand and the UK. Last but not least, Cecchetti and Ehrmann (2002) claim that IT may not have superiority over what any sensible strategy could have achieved.

The resulting empirical difference in the inflation targeting literature may be partly because of the small number of inflation targeting countries and the short history of this new monetary framework. At this point, empirical investigations of inflation targeting can provide a reasonable evaluation of what has been done and a sensible suggestion about what might happen under an inflation targeting framework.

To sum up, all these studies highlight a major deficiency in the literature: There is no sufficient study about IT and its impacts on economic outcomes concerning causality.

As a result, this research goes beyond previous works in two respects. First, its emphasis on causality distinguishes it from former works in the IT literature. Second, the dataset is comprehensive, covering 73 countries over a 8-year period from 2003 to 2011. It comprises OECD, Eastern Europe, Latin America, Asia, and Africa, of which 27 countries are inflation targeters. The wide coverage of the dataset permits a better assessment of the performance of inflation targeters compared to that of non-targeters.
3. What is Inflation Targeting?

3.1. Defining a Monetary Regime

A monetary policy regime “encompasses the constraints or limits imposed by custom, institutions and nature on the ability of the monetary authorities to influence the evolution of macroeconomic aggregates” (Bordo and Schwartz, 1999). Below, the definitions of various monetary regimes are given by the choice and clarity of the nominal anchor.

A nominal anchor is a nominal variable which serves as a target for monetary policy (Bhundia and Stone (2004)). Central banks use nominal anchors to pin down expectations of private agents about what the central bank might do to achieve a certain path. First, it can help promote price stability because it helps tie down inflation expectations directly through its constraint on the value of domestic money. Second, it can provide a discipline on policymaking that avoids so-called time-inconsistency problem described by Kydland and Prescott (1994), Barro and Gordon (1984). Even the source of time-inconsistency is not within central banks, a nominal anchor may be needed to limit political pressures to pursue overly expansionary, time-inconsistent monetary policies.

Clarity is the degree of transparency and accountability for the commitment to the anchor (Bhundia and Stone, 2004). Transparency and accountability are becoming more and more important for an increasing number of countries especially for those who adopt inflation targeting. Recently, central banks have become more independent in decision-making and in addition to nominal anchor, accountability also helps isolate central banks from political pressures (Bhundia and Stone, 2004). Although no central bank has made a commitment to output stability or other objective, they implicitly make commitment by adopting a specific monetary regime. Consequently, there is no doubt that output and financial stability have critical role on the choice of monetary regime.

3.2. Nonautonomous Regime

Nonautonomous regime countries do not issue an independent currency. These are the countries with exchange arrangements classified by the IMF as no separate legal tender (NSLT), a currency board arrangement (CBA), or a currency union arrangement with the
currency linked to that of another country (NCU). Nonautonomy is clear and adhered-to commitment to a nominal anchor which is directly or indirectly the currency of a large country. Central banks practicing nonautonomy report the most commitment and the least discretion of all the monetary regimes (Bhundia and Stone, 2004).

3.3. Weak Anchor Countries

Weak anchor countries are defined as countries which have no operative nominal anchor. Central banks in weak anchor countries report a low degree of commitment to a nominal anchor and a high level of discretion. The number of weak anchor countries has dropped off to 0 from 13, by 2002 with the world wide decline in inflation (Bhundia and Stone, 2004).

3.4. Exchange Rate Targeting

Exchange rate targeting employs the value of the exchange rate with respect to another country as the nominal anchor- usually that of a low-inflation large trading partner country (Bhundia and Stone, 2004). Countries are classified as exchange rate “peggers” if their exchange rate arrangement is categorized by the IMF as one of the following: (i) conventional pegged arrangement, (ii) pegged exchange rate within horizontal band, or (iii) crawling peg.

3.4. Monetary Targeting

Monetary targeting countries assign a monetary aggregate as the nominal anchor. Countries which publicly announce a monetary target and a floating exchange rate arrangement are classified as monetary targeting countries. As Mishkin (1998) indicates, monetary targeting depends on two big “ifs”. The biggest “if” is that there must be a strong and reliable relationship between the goal variable and the targeted aggregate (inflation and nominal income). If there is velocity instability, so that the relationship between monetary aggregate and the goal variable is weak, the monetary aggregate targeting will not work. The second “if” is that the targeted monetary aggregate must be well controlled by the central bank. If not, the monetary aggregate may not provide as clear signals about the intentions of the policymakers and thereby make it harder to hold them accountable. Although narrow monetary aggregates are easily controlled by the central bank, it is far from clear that this is the case for broader
monetary aggregates like M2 or M3. Monetary targeting were used by five countries in 1990 and by 2002 it disappeared completely, probably because of increasing instability in money demand.

4. Inflation Targeting

As indicated in the previous section the role of a monetary policy framework is to provide a nominal anchor to the economy, that is, a nominal variable that monetary policy makers can use to tie down the price level. It is well known that a strong nominal anchor can help ensure that the central bank will focus on long-run policies and resist the temptation or the political pressures to pursue short-run expansionary policies that are inconsistent with the goal of long-run price stability. Therefore, as with any other monetary policy strategy, the goal of the inflation targeting regime is to provide the economy with a nominal anchor (Martinez-Garcia, 2008).

Over the past decades, orthodox stabilization plans attempted to anchor the supply of money (monetary targeting)- examples of orthodox stabilization plans in the late 1970s and early 1980s include the United States, Germany, Japan, and Switzerland- and heterodox stabilization programs tried to anchor the exchange rate. As we know, these strategies were not successful. A monetary target has trouble serving as a nominal anchor, because typically the relationship between money and inflation is unstable. With an exchange rate targeting regime, depreciation of the currency is a highly probable event because it involves devaluation. Although, in most developed countries devaluation has little direct effects on income of households, firms and banks- because their debts are denominated in home currencies- this is does not hold in emerging market countries with their very different institutional structure. In such countries, a foreign exchange crisis can trigger a full-scale financial crisis, in which financial markets are no longer able to move funds from less productive investment opportunities to those with more productive investment opportunities, thereby causing a severe economic contraction.

Consequently, an exchange rate target results in the loss of independent monetary policy. With open capital markets, an exchange rate target causes domestic interest rates to be closely linked to those of the anchor country. It means that shocks to anchor country are directly transferred to the targeting country. Besides, targeter countries are open to speculative attacks on their
currencies. It is certainly feasible for the governments of these countries to keep their exchange rates fixed relative to another currency, but speculators will begin to question whether these countries’ commitment to exchange rate peg is going to weaken. To summarize, a target for the exchange rate is able to function as a nominal anchor but, under perfect capital mobility, it has two important disadvantages: the pegging country cannot pursue its own monetary policy and use it to respond to shocks that are independent of those hitting the anchor country and under certain conditions a target for the exchange rate leaves countries open to speculative attacks. Some examples of exchange-rate-based stabilization programs include Argentina in 1978, 1985, and 1991; Brazil in 1986; Mexico in 1987; and Uruguay in 1990.

Unlike exchange rate targeting under inflation targeting, the purpose is to anchor inflation expectations by committing to an inflation rate. That is, inflation targeting does not anchor the price level, but the expected (and, eventually, the current) rate of price increases (Martinez-Garcia, 2008). Cohen et al. (2003) point out that IT regimes developed as a way of moving away from exchange rate targets. Increased flexibility in nominal exchange rates should, therefore, be considered as a benefit, since it would smooth out real shocks, acting as a type of shock absorber for the rest of the economy.

Taking all these factors into account, IT has several additional advantages. In contrast to exchange rate targeting, it does not have the potential danger of excessive lending. By promoting a more stable value of currency, exchange rate targeting might motivate excessive lending manifested by a lending boom; because domestic financial intermediaries such as banks play a key role in intermediating these capital flows. Although, these capital inflows might transfer into productive channels (such as investment channels) and stimulate growth, there is no guarantee for that. Indeed, it is found that emerging market countries in the Asian-Pacific region with large net private capital inflows experienced large increases on their banking sectors. If the bank supervisory process is weak, as it often is in emerging market economies, the likelihood that a capital inflow will produce a lending boom is much greater. With inadequate bank supervision, the likelihood outcome of a lending boom is substantial loan losses and a deterioration of bank balance sheets. To emphasize once again, the fact that an exchange rate target in these countries leaves them more prone to financial fragility and financial crisis, with potentially catastrophic costs to their economies, suggests that exchange rate targeting is not a strategy to be recommended for especially emerging market countries.
Moreover, IT enables the monetary policy to focus on domestic considerations and to respond

to shocks in the domestic economy. It reduces political pressures on the central bank to pursue
inflationary monetary policy and thereby to reduce the likelihood of time- inconsistent policy
making. In contrast to monetary targeting, IT has the advantage that a stable relationship
between money and inflation is not critical to its success: the strategy does not depend on such
a relationship, but instead uses all available information to determine the best settings for the
instruments of monetary policy. It also has the key advantage that it is easily understood by the
public and is thus highly transparent.

As Freedman and Laxton (2009) indicate, the key point for IT to succeed is saying what you
do, and doing what you say and the evidence seems to suggest that the only way for an IT
central bank to earn credibility is the hard way: simply, they have to earn it. But once it is
earned, through its transparency an IT regime increases the central bank accountability, which
constrains discretion so that the time-inconsistency problem is fixed.

Despite the rhetoric about pursuing price stability, in practice all the IT countries have chosen
to target the inflation rate rather than the level of prices per se. In the early years of IT, there
were considerable debates over the appropriate level and measure of inflation target, whether
to use point or range targets, the appropriate length of target horizons, and so on. Over time,
target specifications appear to have converged on a fairly standardized-perhaps too
standardized- set up. All the inflation targeters have chosen midpoints for their inflation target
to be substantially above zero, and above reasonable estimates of possible upward
measurement bias in the inflation rates calculated from consumer price indices. The decision
by inflation targeters to choose inflation targets well above zero reflects the concerns of
monetary policymakers that particularly low inflation can have substantial negative effects on
real economic activity- such as deflation.

As is well known, IT was first introduced in New Zealand in 1990. Murray (2006) points out
that, when inflation targeting was implemented in New Zealand, it was viewed as a special
case, because New Zealand was a small open economy that had just announced a number of
audacious reforms. The Policy Targets Agreement was a creative and reasonable extension of
this first wave of reforms. It was designed to lend more discipline and accountability to the
conduct of monetary policy. The Governor would be given explicit policy goals, and his performance would be judged accordingly (Martinez-Garcia, 2008).

Moreover, non-advanced countries have had varied experience in terms of targeting. A number of them over the recent past have been targeting the money supply or the exchange rate, especially the latter. Money supply targeting has been shown to be a rather unreliable means of controlling inflation in view of instabilities in the demand for money. Changes in the exchange rate can be important in the case of emerging countries since such changes can have major effects on inflation. They can also produce acute vulnerability to currency crises since capital inflows can easily turn to capital outflows. A critical factor in this process is that since these countries have much of their debt denominated in foreign currency, depreciation of the domestic currency increases the debt burden of domestic firms. Typically the assets of these countries are denominated in domestic currency, so that depreciation of the domestic currency results in serious decline in net worth of the country in question. The adverse effect on investment and economic activity are considerable. This may suggest that central banks of the countries that fall within this category should target their exchange rates. This, of course, would go against one important pillar of IT, namely that of absence of other nominal anchor (Mishkin and Schmidt-Hebbel, 2001). There is also the further difficulty that the impact of changes in the exchange rate on inflation depends on the nature of the exchange rate change, i.e. a pure portfolio shock increases inflation, while the effect of a real shock would depend on its nature— whether it is a demand or supply shock (Mishkin and Schmidt-Hebbel, 2001).

Nevertheless, IT also puts great stress making transparent policy that is clear, simple, understandable and on regular communication with the public. Therefore, emerging market and developing countries adopting IT may face a number of challenges that differ in character or in degree from those faced in more advanced industrial economies. The global financial crisis has highlighted the importance of financial vulnerability and high dollarization for emerging market inflation targeters. Two further problems, which are particularly relevant to Latin America, are worth exploring. These relate to the government-controlled prices and to the high incidence of pass-through from exchange rate fluctuations to domestic prices. The first requires a high degree of co-ordination between monetary and fiscal authorities on the timing and the magnitude of changes in controlled prices. The second requires a great deal of vigilance by the monetary authorities in terms of exchange rate fluctuations; this aspect,
though, is viewed as temporary, since as inflation is tamed it is thought that the degree of pass-through is weakened (Mishkin and Savastano, 2001). Furthermore, some economists argue that on the experience of IT emerging countries is that whatever success they may have had ought to be set against the background of the ‘pre-conditions’ that need to be met before IT adoption.

IMF (2005) summarizes these pre-conditions as follows: technical capability of the central bank in implementing IT; an efficient institutional set up to motivate and support the commitment to low inflation, including institutional independence; a healthy financial system; an economic structure characterized with fully deregulated prices; and absence of fiscal dominance.

Concerning the pre-conditions by the IMF (2005) the five important challenges for non-industrial countries can be summarized as follows (Calvo and Mishkin, 2003):

1. weak public sector financial management
2. weak financial sector institutions and markets
3. low monetary policy credibility
4. extensive dollarization of financial liabilities
5. vulnerability to sharp changes in capital flows and international investment sentiment
6. in addition to all these, these countries face considerably greater uncertainty about the structure of their economies, the monetary transmission mechanism, and the cyclical position of the economy

On current evidence, these pre-conditions admittedly do not prevail in most, if not all cases (IMF, 2005; Jonas and Mishkin, 2004). Under such circumstances, the IT framework may be highly unsuitable for these countries. Consequently, some economists argue that other factors than IT must not be ruled out for the lower rates of inflation achieved by these countries. For instance, Porter and Yao (2005) argue that although the experience with the emerging IT countries is by far too short for an assessment of this hypothesis to be undertaken persuasively, still the limited available evidence adduced from emerging countries, which have pursued inflation targeting implies that “even in a country with solid institutions, a lack of fiscal dominance and low external debt, it can take a long time before the central bank has earned sufficient credibility to anchor expectations for low inflation”.

In contrast to this opinion, the opposite argument can also be true. Adoption of the IT strategy by these countries may lead to an improvement of the institutional ‘preconditions’. The Mexican experience is very interesting in that sense; because it represents a non-advanced economy that has been able to adopt IT and reduce inflation under a flexible exchange rate regime. For instance, as Francia and García (2005) point out, the challenge faced by policymakers at Banco de México was to establish monetary policy as the nominal anchor of the economy at a time when there was widespread uncertainty about the bank's commitment and its ability to achieve both financial and price stability. The strategy consisted mainly of three elements: (i) improve the transparency of the implementation of monetary policy; (ii) maintain a clear restrictive bias in order to induce a sustainable reduction in inflation; and (iii) respond appropriately to inflationary shocks. Several main points are of note in the process that led to the adoption of an inflation targeting regime in Mexico. In this process, inflation has decreased from close to 52 percent in 1995 to levels close to 3 percent over recent years, under a flexible exchange rate regime. Furthermore, Mexico's experience suggests that, under a situation of no fiscal dominance, an inflation-targeting framework in a non-advanced economy can be useful for imposing discipline on monetary policy and therefore ensuring that it provides a nominal anchor to the economy.

Hence, it can be concluded that non-advanced economies that have adopted the inflation-targeting framework also have benefited from enhanced functioning of the nominal system of the economy (i.e., less indexation and lower inflation persistence) and reached an improvement of the institutional framework for monetary policy: independence, transparency, and accountability. From another point of view it can also be interpreted that, in general, emerging economies have less solid institutions than advanced economies and therefore, the adoption of inflation targeting has resulted in further benefits for emerging economies by improving the monetary policy framework and, consequently, institutions.

Concerning independence, the central bank can avoid short-run interference from governments or parliaments and reduce inflation bias, allowing for a longer horizon in monetary policy and also making clear the responsibility for fulfilling its mandate. With respect to accountability, in a democracy, the independence provided to the central bank could require individual accountability (Blinder, 1998). Also, accountability would strengthen policy-makers incentives to fulfill the central banks mandate, thus making the monetary policy committee more
efficient. As for transparency, it is well known that accountability requires it. The benefits of transparency are obvious: it improves the efficiency of monetary policy, allows for a more effective management of expectations, and promotes the discussion and evaluation of monetary policy. The evidence suggests that these aspects are exercised in practice. Without exception, inflation-targeting central banks have offered a public explanation whenever inflation has deviated from its target, even when such an explanation is not mandatory. In general, the explanation includes a description as to why inflation has deviated from its target and the measures to be taken to return it to target. The explanation is provided through public letters, inflation reports, and/or press releases.

Because an explicit numerical target for inflation increases the accountability of the central bank, it has also the potential to reduce the likelihood that the central bank will fall into the time-inconsistency trap. Moreover, since the source of time-inconsistency is often found in (covert or open) political pressures on the central bank to undertake overly expansionary monetary policy, inflation targeting has the advantage of focusing the political debate on what a central bank can do in the long-run - i.e., control inflation- rather than what it cannot do - raise output growth, lower unemployment, increase external competitiveness- through monetary policy.

For inflation targeting to deliver these outcomes, there must exist a strong institutional commitment to make price stability the primary goal of the central bank. Inflation targeting regimes also put great stress on the need to make monetary policy transparent and to maintain regular channels of communication with the public; in fact, these features have been central to the strategy’s success in industrialized countries. As illustrated in Mishkin and Posen (1998), and in Bernanke, et. al. (1999), inflation-targeting central banks have frequent communications with the government, and their officials take every opportunity to make public speeches on their monetary policy strategy. Inflation targeting central banks have taken public outreach a step further: they publish Inflation Report-type documents (originated by the Bank of England in February 1993) to clearly present their views about the past and future performance of inflation and monetary policy.

Although, IT regime appears to be successful in moderating and controlling inflation, the likely effects of IT on the real side of the economy are more ambiguous. A common concern raised about IT is that it will lead to low and unstable growth in output and employment. A
conservative conclusion is that, once low inflation is achieved inflation targeting is not harmful to the real economy. However, given strong economic growth after disinflation was achieved in many countries that have IT- New Zealand being one outstanding example- a case can be made that IT promotes real economic growth in addition to controlling inflation.

To summarize, critics of inflation targeting note seven major disadvantages of this monetary policy strategy. Four of those disadvantages - that inflation targeting is too rigid, that it allows too much discretion, that it has the potential to increase output instability, and that it will lower economic growth- have been discussed in Mishkin (1998) and in Bernanke, et al. (1999), and are in reality not serious objections to a properly designed inflation targeting strategy which is best characterized as a constrained discretion. The fifth disadvantage, that inflation targeting can only produce weak central bank accountability because inflation is hard to control and because there are long lags from the monetary policy instruments to the inflation outcome, is an especially serious one for emerging market countries.

A sixth shortcoming of inflation targeting is that it may not be sufficient to ensure fiscal discipline or prevent fiscal dominance and that governments can still pursue irresponsible fiscal policy with an inflation targeting regime in place. In the long run, large fiscal deficits will cause an inflation targeting regime to break down: the fiscal deficits will eventually have to be monetized or the public debt eroded by a large devaluation, and high inflation will follow. Absence of outright fiscal dominance is therefore a key prerequisite for inflation targeting, and the setting up of institutions that help keep fiscal policy in check are crucial to the success of the strategy (Masson et al., 1997; Mishkin and Savastano, 2001). Similarly, a sound financial system is another prerequisite for successful inflation targeting because when financial systems blow up, there is typically a surge in inflation in emerging market countries. However, as pointed out in Mishkin and Savastano (2001), a sound financial system and the absence of fiscal dominance are also crucial to the sustainability and success of any other monetary policy strategy, including a currency board or full dollarization. Indeed, inflation targeting may help constrain fiscal policy to the extent that the government is actively involved in setting the inflation target (including through the coordination of future adjustments to government-controlled prices).

Finally, a high degree of (partial) dollarization may create a potentially serious problem for inflation targeting. In fact, in many emerging market countries the balance sheets of firms,
households and banks are substantially dollarized, on both sides, and the bulk of long-term
debt is denominated in dollars (Calvo and Vegh, 1999). Because inflation targeting necessarily
requires nominal exchange rate flexibility, exchange rate fluctuations are unavoidable.
However, large and abrupt depreciations may increase the burden of dollar-denominated debt,
produce a massive deterioration of balance sheets, and increase the risks of a financial crisis
along the lines discussed in Mishkin (1996). This suggests that emerging market countries
cannot afford to ignore the exchange rate when conducting monetary policy under inflation
targeting, but the role they ascribe to it should be clearly subordinated to the inflation objective
(Mishkin and Savastano, 2001). Inflation targeting has been a success in the countries that
have adopted it. The evidence shows that inflation targeting countries have been able to reduce
their long-run inflation below the levels that they would have attained in the absence of
inflation targeting, but not below the levels that have been attained by some industrial
countries that have adopted other monetary regimes (Bernanke, et. al., 1999; Corbo et al.,
2000). Central bank independence has also been mutually reinforced with inflation targeting,
while monetary policy has been more clearly focused on inflation under inflation targeting and
is likely to have been toughened by inflation targeting (Cecchetti and Ehrmann, 2002;
Bernanke, et.al, 1999; Corbo et al., 2000). Despite inflation targeting has successes, it is no
panacea: it requires that basic institutional infrastructure with regard to fiscal policy and the
soundness of financial institutions be addressed and improved in order to attain and preserve
low and stable inflation.

5. IT Performance During the Financial Crisis Breakdown

The purpose of this section is to make an overview evaluation of the performance of IT by
comparing IT and non-IT countries during 2006 and 2011 which includes a huge breakdown:
the global financial crisis. As indicated in Section 1, the sample starts in 2006, which is the
latest date in which the last country, i.e. Turkey adopted IT; and 2011 is the end date since
there was no available data for 2012. Third quarter of 2008 is accepted as pre-crisis period.
The behavior of six variables described as the main indicators of economic activity in Section
1 are examined.

The analysis starts with looking at how interest rates behaved in IT and non-IT countries
before and after the crisis to compare the performance of the two. As also de Carvalho Filho
(2010) indicates, the experience in the Great Depression and in Japan during the nineties
highlights the ineffectiveness of monetary policy when nominal interest rates approach the
zero bound and the standard tools of monetary policy are unable to lower the real interest rate.
It is then crucial that a monetary regime allows for sharp reductions in nominal interest rates
that result in sharp reductions in real interest rates when that is called for by a global sudden
stop.

Concentrating first on nominal interest rates (n=48, of which 24 IT countries; data through
2006: Q1), from the beginning of 2008 to second quarter of 2008, on average there were
nominal rate increases for both groups of countries, but slightly more so for IT countries
(Figure 1(a)). The tightening momentum in IT countries can be grasped by noticing that in
September 2008, the month of Lehmans failure, 6 out of 24 IT countries tightened their policy
rates (Brazil, Chile, Indonesia, Israel, Peru and Sweden). However, as the crisis deepened, IT
countries cut their policy rates by 2 percentage points more and the difference in mean policy
rates across the two groups was significant and persistent.

The real effective exchange rate (REER, n=42, of which 21 IT countries; data through 2006:
Q1) of IT countries depreciated sharply in relation to other countries with the onset of the
global crisis (Figure 1(b)). With the second quarter of 2009 as a base period, the real effective
exchange rate depreciation for the average IT country was more than 15 percentage points by
the first quarter of 2009 and while their exchange rates bounced back since the second quarter
of 2009, they were on average about 5 percent weaker in August 2009 than they were at the
outset of the crisis. This finding of sharp real depreciation for IT countries after the crisis
unfolded, followed by some appreciation towards pre-crisis levels was valid for the full sample
countries but it was also robust to including only the subset of non-advanced markets.
On the inflation front (n=68, of which 26 IT countries; data through 2006: Q1), price levels dropped across the board in the last quarter of 2008; and both IT and non-IT countries had negative inflation in the last quarter of 2009. While the path of inflation for IT and non-IT countries did not differ significantly since the crisis started, IT countries seemed to be better at avoiding persistent deflationary processes in the subsequent quarters (Figure 2(a)).

The effect of the crisis on unemployment rates (n=60, of which 27 IT countries; data through 2006: Q1) was initially very similar across countries with different monetary policy frameworks. Both the IT and non-IT countries entered 2008 with a declining path for unemployment rates. With the onset of the crisis, unemployment rates spiked up everywhere but they did by more for the IT countries up to the first quarter of 2009. From then on, unemployment rates stabilized for IT countries, and not so for non-IT ones, but the difference was not significant. However using 12 month changes in the unemployment rate, the unemployment rate of non-IT countries started increasing at a faster pace since the first quarter of 2009, and by second quarter of 2009, a significant difference had emerged favoring non-IT countries, meaning that non-IT countries’ unemployment rate was then increasing annually by about 0.5 percentage point less than their IT peers (Figure 2(b)).
The results on industrial production (n=42, of which 20 IT countries, with data through 2006: Q1) are very striking: IT countries seemed to be ahead in their road to recovery of industrial production to pre-crisis levels. While in the last quarter of 2008, both IT and non-IT countries had industrial production on average 9 percent lower than at the outset of the crisis; by the most recent observation, there was an economically significant difference: the loss in industrial output was running about 9 percent at the end of August 2008 levels for non-IT countries, while the same figure for IT countries was about 5.5 percent (Figure 3(a)).
Last but not the least, the results on the evolution of real GDP (n=49, of which 21 IT countries, data from 2006: Q1) tell an interesting story. To skip dealing with seasonal effects, growth rates relative to the same quarter of the previous year were used. It appeared that IT countries did relatively better when the world economy was doing worse. The differential in growth rates for the IT over non-IT countries was positive in the aftermath of the financial turmoil and growth slowdown occurred after the onset of the current crisis (Figure 3(b)). On the other hand, there was a small difference in mean growth rates favoring non-IT countries in the booming period leading up to the crisis. While one cannot possibly argue that those differences are causal, as they may be caused by differences in the characteristics of the IT/non-IT countries or by the adoption of policies other than IT, the evidence shows that IT countries seemed to be more resilient than other countries during global slumps or slowdowns. In order to draw a sound conclusion a more detailed analysis is needed. The following section intends to provide such analysis using econometric methods.

6. Empirical Analysis

This section provides empirical evidence consistent with the theoretical mechanism outlined in the previous sections. In conjunction with this purpose, the existence of benefits of inflation targeting on the economic performance outcomes is investigated.

6.1. Data and Methodology

The literature provides a variety of lists on IT countries and their dates of adoption, depending on the researchers’ different perspectives and interpretations of the inflation targeting framework. The list of IT countries -which identifies 27 inflation targeting countries- and the dates their adoption are based on Rose and Spiegel (2011). Following New Zealand, six industrial countries became inflation targeters in the early 1990s. Finland and Spain gave up inflation targeting after they joined the European Monetary Union in January 1999 (Hu, 2003). Most non-advanced economies have a shorter history of full implementation of inflation targeting compared to advanced countries. All IT countries are included in the sample. To provide a reliable comparison group, all countries that are at least as large as the smallest and
as rich as the poorest IT country were included as long as there was available data. The list of
countries can be found in the Appendix along with their classifications.

The failure of Lehmann Brothers is described as the trigger of the global financial crisis
happened in mid-September 2008. Quarterly frequency is used. The sample starts in 2003: Q1
and ends in 2011: Q4. IT is assigned to all countries which have adopted IT at some point in
time before the crisis.

This section consists of two parts. The first part contains Ordinary Least Squares (OLS)
estimation, which focuses on the correlation between IT and the economic performance
outcomes. The second part goes into more detail by using Generalized Method of Moments
(GMM) estimation for analyzing causality.

6.2. Ordinary Least Squares (OLS) Estimation

As indicated earlier the aim was to detect correlation between IT and economic performance
outcomes using OLS regression. An overall analysis is made using the whole sample in the
beginning which is followed by an application of the same regression to country subgroups,
 i.e. advanced and non-advanced countries eliminating the economic development differences.
The panel of country and time-period observations is unbalanced.

There are six separate regressions using different dependent variables using IT as the
explanatory variable. The dependent variables are: (i) growth rate of GDP; (ii) real GDP ; (iii)
industrial production; (iv) unemployment rate; (v) interest rate ; and (vi) real effective
exchange rate.

The simple regression using OLS to be estimated is the following:

\[ y_{it} = \lambda_i + \lambda_t + \Phi_{it}IT_i + \varepsilon_{it} \]  \hspace{1cm} (1)

where \( y_{it} \) is the dependent variable of interest, and IT is the dummy variable which is equal to
1 if a country is IT and 0 otherwise. \( \lambda_i \) is a country-specific effect, \( \lambda_t \) is a time effect, and \( \varepsilon_{it} \) is
the idiosyncratic shock. The parameter of interest is \( \Phi_{it} \), which measures the difference in
variable \( y_{it} \) between inflation targeting and other countries. The time-effect for inflation
targeting and other countries can be defined as:

\[ \eta_{it}^{T} = \lambda_t + \phi_t \]  

(2)

\[ \eta_{it}^{O} = \lambda_t \]  

(3)

**Table 1 Definitions and Source of Variables Used in Regression Analysis**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition and Construction</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP growth</td>
<td>Log difference of GDP.</td>
<td>Author’s construction using the World Bank (2012).</td>
</tr>
<tr>
<td>Initial GDP</td>
<td>Initial value of GDP. GDP is in 1960, current USS.</td>
<td>World Bank (2012).</td>
</tr>
<tr>
<td>Industrial production</td>
<td>Industrial production index is used. An industrial production index is an index covering production in mining, manufacturing and public utilities (electricity, gas and water), but excluding construction.</td>
<td>IFS (2012).</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>The ratio of total unemployment to GDP.</td>
<td>IFS (2012).</td>
</tr>
<tr>
<td>Inflation rate</td>
<td>Percent change in consumer prices over the corresponding period of previous year.</td>
<td>IFS (2012).</td>
</tr>
<tr>
<td>Education</td>
<td>Ratio of total secondary enrollment, regardless of age, to the population of the age group that officially corresponds to that level of education.</td>
<td>Global Development Network (2002) and World Bank (2002).</td>
</tr>
<tr>
<td>Lack of price stability</td>
<td>Log(100 + inflation rate).</td>
<td>Author’s calculations using data from IFS.</td>
</tr>
</tbody>
</table>

**6.2.1. Results**

The results are presented for the full sample; but also for subsamples of advanced and non-advanced countries. The classification of advanced and non-advanced countries is based on the definition of IMF. For each regression a strongly balanced panel from the first quarter of 2003
to the last quarter of 2011 is used. Since data availability differs across countries, so does country coverage in the regressions. The details on data availability and sample coverage are in the corresponding tables.

Table 2 presents the results for the full sample. The outcomes show that IT countries attain higher rates of real GDP, industrial production, and real effective exchange rate, whereas they have lower rates of growth, interest and unemployment rates. The coefficient of IT is significant in all of the regressions.

Table 2 Correlation Between IT and Economic Indicators: Whole Sample - OLS Estimation

<table>
<thead>
<tr>
<th></th>
<th>Growth</th>
<th>Real GDP</th>
<th>Ind. prod.</th>
<th>Interest rate</th>
<th>Unemployment rate</th>
<th>Exchange rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>-2.244***</td>
<td>0.221***</td>
<td>0.178***</td>
<td>-10.905***</td>
<td>-2.831***</td>
<td>0.263**</td>
</tr>
<tr>
<td>Standard error</td>
<td>1.082</td>
<td>0.026</td>
<td>0.022</td>
<td>0.684</td>
<td>0.462</td>
<td>0.40</td>
</tr>
<tr>
<td>p-value</td>
<td>0.038</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>No. of countries/ Observations</td>
<td>36/1170</td>
<td>36/1257</td>
<td>24/818</td>
<td>36/1257</td>
<td>36/1257</td>
<td>36/1257</td>
</tr>
<tr>
<td>SPECIFICATION TEST</td>
<td>Prob&gt;F</td>
<td>0.000</td>
<td>0.000</td>
<td>0.0416</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*** means significant at 1%; ** means significant at 5%; * means significant at 10%.

Notes: Fixed-effects estimation is used. IT is a dummy variable which equals to 1 if a country is inflation targeting and to 0, otherwise. All of the columns with six different dependent variables indicate six separate regressions. Source: Author’s own calculations.

Table 3 shows the results for the subsample of advanced countries. There seems to be positive correlation between IT and growth. However, the coefficient is not statistically significant. The remaining results suggest the same relationship between IT and economic performance indicators.

In Table 4 the results for the subsample of non-advanced countries are given. The results almost suggest the same relation with the whole sample: IT countries have a lower rate of growth, interest rate, unemployment rate; and a higher industrial production and real effective exchange rate. Unlike whole sample, IT countries have lower level of real GDP.
To sum up, the results show that there is a marginally significant difference in all of the economic performance indicators favoring IT countries, but the effect is concentrated among the advanced IT countries. As regards industrial production, the effect in favor of IT countries is economically significant (of the order of 16 percentage points) and marginally significant for
the full sample, advanced countries and the non-advanced countries subsample. Finally, the model does not identify any statistically significant difference for the interest rates.

6.3. Endogeneity Issues

At this point, the main qualification to the results would seem to be the standard question of endogeneity. To examine whether this is a serious issue in this context, GMM methodology is used. The dynamic panel procedure using the GMM system estimator controls for the potential endogeneity of all the explanatory variables and accounts explicitly for the biases induced by including the initial level of real GDP in the growth regressors. It is true that the estimation procedure is valid only under the assumption of weak exogeneity of the explanatory variables. That is, they are assumed to be uncorrelated with future realizations of the error term. One can test this assumption using a Sargan test of overidentification which evaluates the entire set of moment conditions in order to assess the overall validity of the instruments. However, while using Sargan test caution is needed. Because the number of moment conditions can be very large even for moderate values of T (T= time dimension), the test may be very undersized and possess extremely poor power properties. Selectively reducing the number of instruments used for each first differenced equation is a straightforward and often effective solution to this inference problem. In addition, reducing the number of instruments used can sometimes offer substantial gains in terms of power when the test based on the full instrument set is correctly sized. In applied work, it is advisable always to calculate a Sargan statistic using a highly restricted instrument set, although there are circumstances where even this may fail to result in a test with the desired properties (Bowsher, 2002).

To start with, Table 5 presents regressions with a large number of instrument variables. However, due to the reasons indicated in the above paragraph Sargan statistics are very low. Then, as a robustness check, regressions in Table 5 are re-estimated using less number of instrument variables. In this case, Sargan statistic for the full sample improves. Then the same regression distinguishing the full sample to advanced and non-advanced countries subsamples are applied. The Sargan statistic remains high for the subsample of non-advanced countries where it is low for the subsample of advanced countries. This difference comes from the difference in the number of instrument variables. Due to data availability, advanced countries subsample contains higher number of observations. As indicated in the paragraph above, this
results in a reduction in the power of the Sargan test, and hence a lower Sargan statistic is obtained in comparison to non-advanced countries subsample. Regressions [2.1], [2.2] and [2.3] in Table 6 present the results of these estimations in detail.

6.4. Generalized Method of Moments (GMM) Estimation

To understand the impact of IT on long-run growth a panel data set by transforming time-series data into five-year averages is constructed - as is now standard in the literature. This filters out business cycle fluctuations, so that the focus can be on long-run growth effects. Generalized Method of Moments (GMM) dynamic panel data estimator developed by Aghion et al. (2004) is used. However, unlike their model, the model used here does not capture a country-time effect - since 2008 financial crisis had a global effect no time-varying country specific factor is needed, and no industry-specific fixed effect is included since the purpose was not to identify the difference in industry productivity growth between industries. On the other hand, the regressions were estimated with almost the same set of control variables. The detailed information can be found in Table 5 and Table 6. The panel of country and time-period observations is unbalanced.

Using this benchmark the equation to be estimated is:

\[ y_{it} - y_{i,t-1} = (\alpha - 1)y_{i,t-1} + \gamma IT_{i,t} + \beta' Z_{i,t} + \varepsilon_{i,t} \]  \hspace{1cm} (4)

where \( y_{it} \) is the 5-year growth rate of output (GDP); \( IT_{i,t} \) is the dummy variable which equals to 1 for IT countries and to 0 for non-IT countries; \( Z_{it} \) is a set of control variables; and \( \varepsilon_{i,t} \) is the error term.

IT dummy variable is constructed as an average of dummy variables during the corresponding years.

\[ \frac{1}{5} \sum_{t=0}^{\text{a}} IT_{t+i} = IT_{t+5} \]  \hspace{1cm} (5)

6.4.1. Results

The results are presented for the full sample; but also for subsamples of advanced and non-
advanced countries. However, for each regression the period coverage is different. The periods coverage for each regression are presented in Table 5 and Table 6.

### Table 5 IT Effects on Growth: 2-step GMM Estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation targeting</td>
<td>1.059</td>
<td>1.672***</td>
<td>0.147</td>
<td>0.019</td>
<td>-0.029</td>
</tr>
<tr>
<td>Initial real GDP (log(initial real GDP))</td>
<td>-1.149**</td>
<td>-0.905</td>
<td>-0.363</td>
<td>-0.762</td>
<td>1.402*</td>
</tr>
<tr>
<td>Control variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education (secondary enrolment, in logs)</td>
<td></td>
<td>-3.377</td>
<td>0.135</td>
<td>1.435</td>
<td></td>
</tr>
<tr>
<td>Government burden (government expenditure/GDP, in logs)</td>
<td></td>
<td>2.194</td>
<td>6.04</td>
<td>5.944</td>
<td></td>
</tr>
<tr>
<td>Lack of price stability (inflation rate, in logs)</td>
<td>-1.755**</td>
<td>1.891</td>
<td>-0.027</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflation rate (log(100+inflation rate))</td>
<td>0.82</td>
<td>2.939</td>
<td>2.331</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagged real GDP (previous period’s real GDP, in logs)</td>
<td>-0.002***</td>
<td>0.002</td>
<td></td>
<td>-1.835</td>
<td>1.182</td>
</tr>
<tr>
<td>Time-effect</td>
<td>-0.384***</td>
<td>-0.4***</td>
<td>0.327</td>
<td>0.143</td>
<td>0.783</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.073</td>
<td>0.062</td>
<td>0.327</td>
<td>0.4</td>
<td>0.877</td>
</tr>
<tr>
<td></td>
<td>41/370</td>
<td>41/370</td>
<td>23/88</td>
<td>23/88</td>
<td>23/77</td>
</tr>
</tbody>
</table>

**Notes:** Non-overlapping 5-year averages is used as the unit of observation. Regression [1.1] and [1.2] includes only lack of price stability and inflation rate respectively as control variables. Regression [1.3], [1.4] and [1.5] all include government burden and education as control variables; but in addition [1.3] includes inflation rate; [1.4] price stability and [1.5] stability and previous period’s 5-year average real GDP.

**Source:** Author’s own calculations.
In Table 5, regression [1.1] illustrates the effects of initial wealth, previous period’s wealth and price stability on economic growth. The poorer the country is the higher its long-run growth rate. This result is consistent with the convergence theory. In regression [1.2], inflation rate is used as a control variable instead of price stability. In contrast to regression [1.1], regression [1.2] shows that IT is positive and significant, implying that countries adopting IT attain higher growth rates. Although the reasoning behind this contradiction is ambiguous, the result is quite interesting since it is the only GMM regression that IT coefficient is statistically significant. In regression [1.3], [1.4], and [1.5] the set of control variables including average years of secondary schooling as a proxy of human capital, inflation, size of government expenditure (government expenditure as a percentage of GDP) to control for macroeconomic stability are introduced. The results indicate that IT does not have any causality effect on growth rate.

Table 6 IT Effects on Growth: 2-step GMM Estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects

<table>
<thead>
<tr>
<th>Dependent variable: Real GDP Growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>[2.1]</td>
</tr>
<tr>
<td>Inflation targeting</td>
</tr>
<tr>
<td>-0.148</td>
</tr>
<tr>
<td>0.387</td>
</tr>
<tr>
<td>Control variables</td>
</tr>
<tr>
<td>Initial real GDP (log(initial real GDP))</td>
</tr>
<tr>
<td>0.596*</td>
</tr>
<tr>
<td>0.413</td>
</tr>
<tr>
<td>Lagged real GDP (previous period’s real GDP, in logs)</td>
</tr>
<tr>
<td>-1.266***</td>
</tr>
<tr>
<td>0.368</td>
</tr>
<tr>
<td>22.508**</td>
</tr>
<tr>
<td>10.518</td>
</tr>
<tr>
<td>No. of countries/Observations</td>
</tr>
<tr>
<td>46/184</td>
</tr>
<tr>
<td>SPECIFICATIONS TEST</td>
</tr>
<tr>
<td>(a) Sargan test</td>
</tr>
<tr>
<td>0.45</td>
</tr>
<tr>
<td>0.000</td>
</tr>
<tr>
<td>0.350</td>
</tr>
</tbody>
</table>

*** means significant at 1%; ** means significant at 5%; * means significant at 10%.
Notes: Non-overlapping 5-year averages is used as the unit of observation. Regression [2.1], [2.2] and [2.3] include whole sample, advanced countries and non-advanced countries respectively.
Source: Author’s own calculations

Table 6 presents the similar regressions with Table 5 using the data of 1985-2010 period. Regression [2.1] includes the whole sample and indicates that there is a significant negative relationship between the previous period’s real GDP growth and a positive relationship
between initial real GDP and growth. Analogous with the results in Table 5, IT does not seem to have an impact on growth. Regression [2.2] presents the results for advanced countries subsample. Also here, the results suggest a negative relation between previous period’s real GDP and growth. Regression [2.3] shows the results for non-advanced countries subsample. It also indicates negative relation between previous period’s real GDP and growth. However, in contrast to regression [2.2], the coefficient is not statistically significant.

These results show that, although there is correlation between IT and the economic performance of the economy, there is no evidence that adopting IT causes an improvement in the economy. This aspect may be explained by two alternative explanations. First, it may be because IT does not improve economic activity directly. But rather, it provides stability in inflation and reduces the uncertainty in markets. Therefore, through stability channel, it indirectly causes the economy to operate with better outcomes. Second explanation could be, as indicated in the previous literature, that IT countries may be performing better; because they already have a stronger economic structure with better economic outcomes or they have the capacity that can make the most use of implementing IT to upgrade their economic performance.

7. Conclusion

The vast empirical literature following Bernanke and Mishkin (1997) and de Carvalho Filho (2010) generally finds detectable difference in economic performance between IT and non-IT countries.

The monetary policy of IT countries appears to be more suited to dealing with the crisis. Relative to other countries, IT countries lowered nominal interest rates by more. With this monetary stimulus, they on average have dodged the deflation bullet better than their counterparts. Most probably as a result of that, they managed to perform better on unemployment rates and had relatively stronger industrial production performance. For GDP growth rates, advanced IT countries had higher GDP growth rates than their non-IT peers. The same argument is valid for non-advanced countries sample. This difference hit top just after the global financial crisis.

The results presented in this paper is not necessarily at odds with the prescriptions of the
standard IT literature. However, it does not support the argument that IT causes better outcomes in the economy. Despite the evidence demonstrates that IT countries have better economic performance in general and in the global financial crisis in particular, it does not establish a causality relationship. The classical literature holds that inflation targeting improves performance with various explanations. The analysis here shows that this prescription has to be modified to allow for the fact that IT countries’ better performance are amplified in advanced countries with more substantial markets. Clearly, more fully articulated structural models are needed to properly measure the causality relation between IT and economic performance outcomes, which in turn remains an important challenge for future research.

REFERENCES


DATA APPENDIX

Full sample countries are: Argentina, Australia, Austria, Belarus, Belgium, Brazil, Canada, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Ecuador, Estonia, Finland, France, Georgia, Germany, Greece, Guatemala, Hong Kong, China, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Korea, Lithuania, Luxembourg, Macao China, Malta, Mauritius, Mexico, Morocco, Netherlands, New Zealand, Norway, Peru, Philippines, Poland, Portugal, Romania, Russia, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Tunisia, Turkey, United Kingdom, United States, Venezuela.

Advanced countries are listed as: Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong-Kong SAR, China, Iceland, Ireland, Israel, Italy, Korea, Japan, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States.

Non-advanced countries are listed as: Argentina, Brazil, Bulgaria, Chile, China, Colombia, Ecuador, Estonia, Guatemala, Hungary, India, Indonesia, Iran, Jamaica, Lithuania, Mauritius, Mexico, Morocco, Peru, Philippines, Poland, Russia, South Africa, Sri Lanka, Thailand, Tunisia, Turkey, Venezuela.

The IT countries are listed as the following (n=25): Australia, Brazil, Canada, Chile, Colombia, Costa Rica, Hungary, Iceland, Indonesia, Israel, Republic of Korea, Mexico, New Zealand, Norway, Peru, Philippines, Poland, Romania, Slovak Republic, South Africa, Sweden, Switzerland, Thailand, Turkey, and United Kingdom.

Advanced IT countries are listed as the following (n=12): Australia, Canada, Czech Republic, Finland, Iceland, Israel, Republic of Korea, New Zealand, Norway, Slovakia, Sweden, Switzerland, United Kingdom.

Non-advanced IT economies are listed as the following (n=13): Brazil, Chile, Colombia, Guatemala, Hungary, Indonesia, Mexico, Peru, Philippines, Poland, Romania, South Africa, Thailand and Turkey.