Inflation targeting and disinflation costs in emerging market economies

Stojanovikj, Martin and Petrevski, Goran

Integrated Business Faculty – Skopje, Saints Cyril and Methodius University of Skopje, Skopje, North Macedonia

2 March 2020

Inflation Targeting and Disinflation Costs in Emerging Market Economies

Martin Stojanovikj,

Integrated Business Faculty – Skopje,

E-mail: martin_stojanovik@yahoo.com

Goran Petrevski (Corresponding author),

Ss. Cyril and Methodius University in Skopje, Faculty of Economics,

Postal address: Krste Misirkov Blvd. 9V, 1000 Skopje

E-mail: goran@eccf.ukim.edu.mk

Abstract

In this paper, we study whether adopting Inflation Targeting (IT) in Emerging Market Economies (EMEs) affects the output costs of disinflation, controlling for a number of additional factors. Based on a sample of 170 disinflation episodes in 44 EMEs over the 1970-2017 period, we provide strong evidence that adopting IT is associated with a higher sacrifice ratio in EMEs. In addition, we find that gradual disinflation may be less costly in EMEs. Moreover, we show that trade openness is associated with a lower sacrifice ratio, while both central bank independence (CBI) and external shocks have adverse effects on the sacrifice ratio. Our main findings are robust to alternative classifications of the IT regime, alternative definitions of disinflation episodes, different thresholds for high inflation, different peak levels of trend inflation rate, across various specifications of the empirical model, as well as for both the entire sample and the sub-sample covering the post-1990s period.

Key words: Inflation Targeting, Sacrifice Ratio, Disinflation, Emerging Market Economies.

JEL codes: E52, E58

1. Introduction

During the past three decades, an increasing number of industrialized countries and emerging market economies have adopted IT as a monetary policy strategy. Within this regime, the central bank focuses on price stability as its predominant policy goal, by announcing explicit numerical targets for medium-term inflation. The proponents of this monetary policy strategy argue that it offers several benefits for EMEs: it enhances central bank credibility, it reduces inflation persistence, it helps anchoring inflation expectations, it contains a high degree of flexibility, it enables policy makers to cope with short-run circumstances and adverse shocks, and it involves lower economic costs in the face of policy failures (Bernanke and Mishkin 1997, Mishkin and Schmidt-Hebbel 2002, Batini and Laxton 2007, Mishkin and Schmidt-Hebbel 2007). As a result, the above features suggest that IT may be superior compared to alternative monetary policy strategies in the sense that it reduces the inflation-output volatility and leads to lower disinflation costs.

This paper investigates the relationship between IT and the sacrifice ratio in EMEs, controlling for a number of additional factors, which are referred to as common determinants of the sacrifice ratio in the empirical literature. We provide strong evidence that adopting IT might have adverse effects on the costs of disinflation in EMEs. In calculating sacrifice ratios, we employ a slightly modified version of the approach used in Ball (1994). Based on this methodology, we have identified 170 disinflation episodes in 44 EMEs, i.e., 78 disinflation episodes during 1970-1990 and 92 disinflation episodes in the 1990-2017 period. The main findings from our study can be summarized as follows: first, we provide strong evidence that adopting IT is associated with a higher sacrifice ratio in EMEs; second, we find that gradual disinflation may be less costly in EMEs; third, we show that trade openness is associated with a lower sacrifice ratio, while more independent central banks and adverse external shocks tend to increase the sacrifice ratio. Our main findings are robust to alternative classifications of the IT regime, alternative definitions of disinflation episodes, different thresholds for high inflation, different peak levels of trend inflation rate, across various specifications of the empirical model, as well as for both the entire sample and the sub-sample covering the post-1990s period. Yet, we find that the results are sensitive to the filtering method employed for estimating trend output.

The rest of the paper is structured as follows: Section 2 reviews the relevant literature; Section 3 explains the issues related to the data collection process and calculation of the sacrifice ratio; Section 4 presents the baseline specification of the empirical model and discusses the main findings; the robustness analysis is presented in Section 5; and all findings are summarized in Section 6.

2. Literature Review

Over time, a considerable empirical literature has been accumulated on the determinants of sacrifice ratios in both OECD and developing countries. In these regards, there is much less evidence on the relationship between IT and the sacrifice ratio, especially for the recent inflation targeters among the EMEs.

The surge in the empirical literature on the real costs of disinflation has been initiated by Ball (1994), who provided a modified measure of the sacrifice ratio. Based on several assumptions with regards to the behavior of trend output in the sample of OECD countries, he proposed a simple measure of the sacrifice ratio calculated by dividing the cumulated output loss (the sum of deviations of actual output from trend output) by the change in trend inflation during each disinflation episode. He estimated the sacrifice ratios for a sample of 19 OECD countries during 1960-1991, finding that its main determinants are the speed of disinflation and nominal wage rigidity. Later on, most of the empirical literature has basically followed the Ball's approach in measuring the sacrifice ratio. The non-exhaustive list of studies incudes: Chortareas et al. 2003, Temple 2002, Brumm and Krashevski 2003, Down 2004, Diana and Sidiropoulos 2004, Daniels et al. 2005, Daniels and VanHoose 2013, Caporale and Caporale 2008, Hofstetter 2008, Senda and Smith 2008, Caporale 2011, Mazumder 2014, and Roux and Hofstetter 2014).

As mentioned above, the main features of the IT regime suggest that it promises to offer a less costly device for controlling inflation. However, the empirical support to this proposition seems to be rather limited. For instance, Mishkin and Posen (1997) analyze the experiences with IT in New Zealand, Canada, and the UK, pointing out that IT might have served to lock-in the gains from previous disinflation rather than to facilitate the disinflation itself. Bernanke et al. (1999) and Ball and Sheridan (2003) show that there is no credibility bonus for the countries that have adopted IT as their monetary strategy. They conclude that IT appears to have no significant effect on the disinflation process though their findings might be potentially sensitive with respect to the definition of the starting date of the implementation of IT. Similarly, based on a sample of OECD countries, Roux and Hofstetter (2014) find evidence that IT only matters if disinflations are slow, while fast disinflations make IT irrelevant in terms of the sacrifice ratio. Chortareas et al. (2003), too, provide evidence that IT does not affect sacrifice ratios in OECD countries.

Gonçalves and Carvalho (2008) examine the effect of IT on the sacrifice ratio in both OECD and developing countries. Their study shows that, generally, IT lowers the sacrifice ratio, but this effect is stronger in OECD countries, i.e. the results for the developing countries are not robust to the model specification. In a subsequent study on a sample of 25 OECD countries, Gonçalves and Carvalho (2009) confirm that adopting IT reduces the disinflation costs. However, Brito (2010) criticizes the methodological approach in Goncalves and Carvalho (2009) and finds that IT isn't a determinant of the sacrifice ratio in OECD countries. Moreover, employing the Philips curve-based approach for a sample of EMEs, Brito and Bystedt (2010) provide evidence on the negative relationship between IT and sacrifice ratios. Based on a large sample of 189 countries over 1969-2009, Mazumder (2014) suggests that the determinants of sacrifice ratios vary between OECD and non-OECD countries but provides evidence that adopting IT is found to be statistically insignificant in both the OECD and developing countries.

A number of papers attempt to identify the importance of some specific factors for the size of sacrifice ratio. For instance, Jordan (1997, 1999), Baltensperger and Kugler (2000), Brumm and Krashevski (2003), Diana and Sidiropoulos (2004), and Daniels et al. (2005) study the relationship between CBI and the sacrifice ratio; Temple (2002), Daniels, et al. (2005), Daniels and VanHoose (2006, 2009, 2013), and Bowdler (2009) investigate the interaction between openness and the sacrifice ratio; Chortareas, et al. (2003) explore how central bank transparency affects sacrifice ratio: while Daniels et al. (2006) and Bowdler and Nunziata (2010) focus on the effects of labor market institutions on sacrifice ratios.

3. Methodology and Data

3.1 Calculating the Sacrifice Ratio

The sacrifice ratio provides an approximation of the real output costs associated with disinflation. In this regard, there are several approaches to measure disinflation costs. For instance, Hutchison and Walsh (1998) measure the sacrifice ratio based on the Phillips curve. One issue with this particular method is that it limits the inflation-output trade-off to be equal during the periods of accelerating inflations and the periods of disinflation, which is not the case for our sample of countries where different factors are responsible for the movement of inflation in opposite directions. Cecchetti and Rich (2001) employ three different structural VAR models to calculate the sacrifice ratio. On the other hand, Ball (1994) relies on the trend inflation to identify peaks and troughs, so that the period from a particular peak to the trough is identified as a disinflation episode. Furthermore, given the tendency of the Hodrick-Prescott filter to minimize the deviations of actual output from the trend, Ball (1994) proposes a log-linear method of deriving these deviations. Summing them for all the years comprising a particular disinflation episode and dividing by the change in trend inflation during the same period results in the sacrifice ratio. This method, although not unsusceptible to criticism, has been widely used in the empirical literature. Besides the original form as proposed by Ball (1994), two additional variations have emerged in the subsequent literature. Zhang (2005) argues that Ball's measure does not include the long-lasting effects that accompany each disinflation episode. Therefore, he proposes a slightly modified measure of the sacrifice ratio, relying upon the Hodrick-Prescott filter, and assuming that potential output grows throughout the particular episode at the rate implied by the Hodrick-Prescott filter at the beginning of the disinflationary episode. Further on, Hofstetter (2008) builds upon this approach, with the additional assumption that output is at its trend level one year prior to the year the disinflation episode starts, thus trying to capture an even larger portion of the longer-lasting effects of disinflation. In our study, we follow Ball (1994) in calculating the sacrifice ratio with a slight modification, which better reflects the specific features of disinflation episodes in EMEs, and potentially increases the computational power and accuracy within our sample.

Working with annual data, particularly for the inflation rate, provides a challenge in adopting the original approach of Ball (1994). Though providing estimates for both quarterly and annual data for OECD countries, Ball (1994) bases the calculations of sacrifice ratios on the availability of quarterly data of inflation, which are not available for the majority of EMEs in our sample. Therefore, we depart from his method slightly in the initial stage and follow Mazumder (2014) in using annual data for inflation, and then calculating trend inflation as a 3-year centered moving average. From an economic standpoint this methodological tweak suits our analysis, since it provides a theoretically adequate setup for estimating the effect of adopting IT on the sacrifice ratio resting on the premise that inflation targets are implemented in the medium-term of two to three years (Hammond, 2012). In this way, we allow for the central bank behavior in each period to be both forward and backward looking and more adapted to the focal period of the central bank policy actions (the medium-term). In addition, Mazumder (2014) provides evidence of the proximity of the sacrifice ratio measurements from this approach to the original sacrifice ratios in Ball (1994).

In our baseline model, we follow Ball (1994) and identify disinflation episodes as periods in which trend inflation rate falls from peak to trough for at least 1.5 percentage points. Subsequently, a peak occurs in the year in which the trend inflation rate is higher than the rate in both the preceding and succeeding years, while a trough occurs in the year in which the trend inflation is lower than the rate in both the preceding and succeeding years. Using this methodology, we have identified 170 disinflation episodes in 44 EMEs, which are listed in Table A1. Specifically, there are 78 disinflation episodes during 1970-1990 and 92 disinflation episodes in the 1990-2017 period. The average rate of change in trend inflation per episode, as calculated by the 3-year moving average trend inflation rate, is 75.62% during 1970-1990, and 37.28% for the 1990-2017 period. This evidence suggests that the macroeconomic conditions have become more favorable for the EMEs over the past three decades, so that although there has been a larger number of disinflation episodes, they have been less challenging. The comparison with Mishkin and Savastano (2002), Hofstetter (2008), and Mazumder (2014) shows that we are able to identify the majority of disinflation episodes across the same countries in all three datasets.

The sacrifice ratio is calculated as the sum of the deviations in actual output from trend output divided by the change in trend inflation rate over each disinflation episode. Ball (1994) estimates trend output based on the following three assumptions: 1) output is at its trend level at the start of a disinflation episode, 2) output is at its trend level four quarters after an inflation trough, and 3) output grows log-linearly between these two points when trend and actual output are equal. We identify our trend output level following the first two assumptions. We suspect that the approximation of a log-linear growth rate in trend output between these two points provides smaller output values throughout the disinflation period for the sample of EMEs, thus producing a downward bias on the estimates. This is indeed the case in our results in Tables 1-6, where the estimates by the Ball's method always exhibit smaller magnitude, although, with respect to the statistical significance of the coefficients, the results are identical to our baseline estimates. The empirical literature points to the well-known stylized fact that output volatility in EMEs is much higher compared to OECD countries (Ramey and Ramey 1995, Blanchard and Simon 2001, Kose et al. 2003a, 2003b). A logarithmic transformation of the sort provided by Ball (1994) tends to offer a more adequate approximation of smaller values, while potentially underestimating the size of the output gap in our sample characterized with higher output volatility. Hence, we measure the sacrifice ratio by calculating the output gap for each year during a disinflation episode as the difference between trend and actual output over trend output, instead of working with log-levels of output. Although it potentially improves the accuracy of our calculations of the sacrifice ratio, the results provided in Sections 4 and 5 show that this modification does not alter the results in any significant way. However, the sacrifice ratios calculated by the aforementioned modification and the original Ball's method are not robust when experimenting with the Hodrick-Prescott and Hamilton (2018) filters for estimating trend output.

3.2 Data Issues

We work with annual data, primarily due to data availability, and our sample comprises of 44 EMEs during 1970-2017.[1] The macroeconomic conditions across the countries within the sample have varied from being highly volatile during the first two decades to the relatively stable

[1] Specifically, the sample consists of the following countries: Argentina, Algeria, Brazil, Botswana, China, Costa Rica, Cote d'Ivoire, Chile, Colombia, Czech Republic, Croatia, Dominican Republic, Ecuador, Egypt, El Salvador, Ghana, Guatemala, Hungary, Israel, Indonesia, India, Jordan, Lebanon, Malaysia, Morocco, Mexico, Nigeria, Pakistan, Panama, Peru, Philippines, Poland, Russia, Serbia, Singapore, South Africa, South Korea, Tanzania, Thailand, Turkey, Tunisia, Uruguay, Ukraine, and Venezuela.

macroeconomic conditions prevailing since the mid-1990s. The average output volatility, as measured by the standard deviation of real GDP growth, was 0.5 during 1970-1990, and then it declined to 0.4 in the post-1990 period. Despite the distinctive heterogeneity, we proceed working with the entire sample in order to exploit all available information. At the same time, in order to control for the potential factors behind this volatility, our regression model includes several variables, commonly present in empirical studies, such as: trade openness, domestic and external shocks, and political factors (Broner and Ventura 2006, Kraay and Ventura 2007, Loayza and Raddartz 2007). In addition, as a robustness check, we provide estimates for the 1990-2017 sub-sample, too.

In the regression model, IT is measured as a binary variable (equal to 1 if country i is an inflation targeter in period t, and 0 otherwise). Here, we rely on the classification provided by Hammond (2012) in selecting the year in which a particular country decided to adopt this monetary strategy, notwithstanding the actual month in which the decision was officially implemented. The official dates of IT adoption for the 17 EMEs are presented in Table A2. Calvo and Mishkin (2003) argue that, when faced with weak fiscal and financial institutions, low credibility of monetary institutions, currency substitution and liability dollarization, and vulnerability to sudden stops of capital inflows, EMEs need a strong commitment to IT in order to exploit its benefits. In this regard, having a clear institutional commitment to the inflation target along with transparent and accountable monetary framework is what distinguishes fully-fledged targeters from the other countries adopting this regime. Hence, in the baseline model, we rely on the implementation of full-fledged IT, while in the robustness checks we provide estimates based on the more flexible IT regime.

In order to calculate the index of central bank independence (CBI), we use the data provided by Gariga (2016). The weighted CBI-index is more suitable to our analysis as it covers all the countries in our sample for the entire time period. The political variable included in the regression model is a categorical variable taking the values of 0, 1 or 2, referring to governments controlled by left-wing parties, centrist governments, and right-wing governments, respectively. The data for this variable has been taken from Beck et al. (2001), while all the remaining data have been extracted from the World Bank World Development Indicators.

3.3. Model Specification

The baseline specification of our model is as follows:

$$y_i = \alpha + \gamma IT_i + \beta_k \sum_{k=1}^{n} X_{i,k} + \varepsilon_i \qquad (1),$$

where: y_i is the sacrifice ratio for a particular disinflation episode; α is the constant; IT_i is a dummy variable for the IT regime whose values equal 1 if the country i is an inflation targeter during a particular disinflation episode, and 0 otherwise; $\sum_{k=1}^{n} X_{i,k}$ are the control variables; while ε_i is the disturbance, following the normality assumption, $\varepsilon_i \sim (0, \sigma^2)$. We estimate the specification with OLS, using robust standard errors, which are consistent in the potential presence of heteroskedasticity and serial correlation.

Ball (1994) identifies the speed of disinflation (*Speed*) as the main determinant of the sacrifice ratio. The sign and the significance of the regression coefficient in front of this variable theoretically differ between the sharp regime-shift approach and the gradualist approach to disinflation. On the one hand, the traditional view is that gradual disinflation is less costly because it allows for an adjustment of wages and prices (Taylor 1983). On the other hand, Sargent (1983) argues that sharp shifts in monetary regimes decrease disinflation costs due to the enhanced policy credibility and the accompanying quick adjustment of inflation expectations. We measure *Speed* by the change in trend inflation over the duration of an inflation episode. Further on, we follow Ball (1994) and augment the baseline regression by decomposing the *Speed* variable into the change in trend inflation during a particular episode (*Change*) and the duration of each disinflation episode (*Length*). For OECD countries, the empirical studies generally confirm that the faster the disinflation process, the lower the output costs, i.e., credible disinflations are associated with smaller output losses (Ball 1994, Boschen and Weiss 2001, Diana and Sidiropoulos 2004, Daniels et al. 2005, Zhang 2005, Hofstetter 2008, Daniels and VanHoose 2009 and 2013, Gonçalves and Carvalho 2009, Mazumder 2014, Roux and Hofstetter 2014, and Katayama et al. 2019). On the other hand, Andersen and Wascher (1999) show that speed of disinflation does not matter in OECD countries; Mazumder (2014) confirm this conclusion for non-OECD countries; Gonçalves and Carvalho (2008) obtain similar results for both developed and developing countries;; while Caporale (2011) finds that the speed of disinflation may, in fact, increase sacrifice ratios.

A priori, the association between *CBI* and disinflation costs is ambiguous. On the one hand, more independent central banks are capable of anchoring inflation expectations, which reduces disinflation costs. On the other hand, higher CBI should be associated with lower average inflation and lower inflation variability, which leads to less frequent price and wage adjustments, thus making disinflation more costly due to the flatter Phillips curve (Walsh 1995). The early empirical evidence (Debelle and Fisher 1994, Jordan 1997 and 1999, Posen 1998) suggest that higher CBI increases the output loss of disinflation (the so-called "Credibility-Sacrifice Ratio Puzzle"). Nevertheless, some recent empirical studies (Baltensperger and Kugler 2000, Brumm and Krashevski 2003, Diana and Sidiropoulos 2004, and Mazumder 2014) find that CBI reduces output losses of disinflation in OECD countries, whereas Daniels et al. (2005), Daniels and VanHoose (2009, 2013) provide opposite evidence.

The rationale for including trade openness (*Openness*) in the regression is due to Romer (1993), who argues that openness makes the Phillips curve steeper, i.e. it worsens the output-inflation trade-off. Specifically, in open economies, monetary contraction exerts a larger direct pressure on the price level through the exchange-rate appreciation. Consequently, following a negative monetary shock, the decline in inflation is larger in open economies, leading to lower sacrifice ratios. On the other hand, Daniels and VanHoose (2006) show that, in the presence of nominal rigidities, openness may increase the sacrifice ratio. As for the empirical evidence, Ball (1994), Temple (2002), Daniels et al. (2005), and Daniels and VanHoose (2013) find a negative and/or insignificant relationship between openness and sacrifice ratio in OECD countries, while Mazumder (2014) supports this result for the developing countries. Daniels and VanHoose (2009) provide evidence on the positive association between openness and sacrifice ratios.

In small open economies, foreign exogenous shocks (*Shocks*) may have strong effects on domestic inflation, thus making the calculation of the sacrifice ratio biased. For instance, during a particular disinflation episode, a favorable supply shock may lead to a larger decline in inflation for a given monetary policy action. In this case, the reduced sacrifice ratio is partially caused by the favorable supply shock and not by monetary policy. Ball (1994) estimates the sacrifice ratio employing a method which smooths out supply shocks, identifying them as part of the error term. Nevertheless, deemed an important aspect in the model, he performs two types of estimations to check for their presence in the data and fails to find any strong evidence which would indicate that they bias the results. As our sample consists of EMEs, we consider foreign shocks as an important determinant of the sacrifice ratio. It is well-known that these countries operate under unfavorable macroeconomic environment compared to the advanced economies, i.e. they are frequently exposed to adverse external shocks, which result in large inflation-output volatility (Fraga et al. 2003). Therefore, we control for foreign shocks in two ways: first, by including the changes in oil prices as a regressor in the baseline specification, and second, by estimating the model for the period of 1990-2017, which is arguably characterized by a more stable macroeconomic environment. Andersen and Wascher (1999), Boschen and Weiss (2001) and Hofstetter (2008), too, include oil prices among the determinants of the sacrifice ratio, serving as a proxy variable that controls for the external shocks. Yet, the empirical evidence provided in these papers seems to be rather inconclusive.

Initial inflation is included as a standard determinant of the sacrifice ratio. Both Lucas (1973) and Ball et al. (1988) show that trend inflation influences the output-inflation trade-off in the sense that higher inflation reduces the degree of downward nominal rigidity and thus steepens the Phillips curve. Therefore, higher initial inflation should be associated with lower output costs of disinflation. Ball (1994), Andersen and Wascher (1999), Temple (2002), Zhang (2005), Hofstetter (2008), Gonçalves and Carvalho (2008, 2009), and Mazumder (2014) all provide empirical support to the aforementioned proposition for both developed and developing countries. On the other hand, Hofstetter (2008), Daniels and VanHoose (2009), and Caporale (2011) fail to confirm these findings.

Nominal wage rigidity is another variable we control for, in order to isolate the effects of IT on the sacrifice ratio. As mentioned above, within New Keynesian models, nominal rigidities exert critical influence on the inflation-output trade-off, the speed of disinflation, and the sacrifice ratio. In these regards, initial inflation may serve as a proxy for the extent of nominal rigidity since wage contracts tend to be shorter at high inflation rates. Due to the lack of available labor market data for EMEs, we adopt the convention put forth by Hofstetter (2008), who uses the 10-year inflation history as a proxy for nominal wage rigidity, expecting a negative association between this variable (*Nominal Rigidity*) and the sacrifice ratio.

In principle, one should expect to find a positive relationship between government debt (*Debt*) and the sacrifice ratio. Indeed, Durham (2001), Brito (2010) and Roux and Hofstetter (2014) provide empirical evidence that supports this proposition for the developed countries, though Durham (2001) and Mazumder (2014) find opposite results for the developing economies. Finally, following Caporale and Caporale (2008) and Caporale (2011), in order to control for the effects of political factors, we include a dummy variable (*Party*), which takes three values: zero if the government is controlled by left-wing parties, one in case of a centrist government, and two for right-wing parties. As right-wing governments are known to be inflation-averse, the expected coefficient in front of this variable is negative.

4. Estimation Results

We follow Ball (1994) as our initial estimation strategy. Table 1 contains some basic estimates (columns 1 and 2) along with the estimation of the full specification of equation (1), presented in the last column. As it can be seen, in all cases, the effect of *IT* on the sacrifice ratio is positive and highly significant. Hence, this finding suggests that the real costs of disinflation in EMEs that have adopted IT are larger compared to EMEs with different monetary strategies. As it will be shown in the following section, this result remains valid in a variety of different specifications and subsampling. In column (1) the variable *Speed* has the expected sign, but it is not statistically significant. We expand this variable in column (2) by decomposing it into the difference in trend inflation during a disinflationary episode (*Change*) and the duration of an episode (*Length*). This has resulted in a slight improvement in the explanatory power of the regression, as evidenced by the adjusted R-squared coefficient, which has increased from 0.056 to 0.079. In columns (2) and (3), we find a negative association between the length of disinflation episodes and the sacrifice ratio. Therefore, we provide empirical support to gradualism as a viable pathway for making disinflation less costly (Taylor 1983). The magnitude of *Length* is -0.0017 in column (3) which, given its standard deviation of 2.7 years, implies that the prolongation of a disinflationary episode by one additional year has an economically important influence on sacrifice ratio.

Table 1. Determinants of sacrifice ratio in EMEs, 1970 - 2017

	(1)	(2)	(3)
IT	0.0175*** (0.006)	0.0186*** (0.006)	0.016*** (0.006)
Speed	0.00005 (0.0011)	-	-
Change	-	0.0003 (0.0002)	0.0002 (0.0002)
Length	-	-0.0016* (0.0008)	-0.0017** (0.0007)
CBI	-	-	0.029*** (0.0107)
Party	-	-	-0.0025 (0.0017)
Openness	-	-	-0.011* (0.006)
Shocks	-	-	0.014* (0.008)
Constant	-0.00013 (0.0019)	0.0076** (0.0033)	0.0016 (0.005)
Sample size	164	164	140
Adjusted R^2	0.056	0.079	0.216

Notes: Sacrifice ratio is the dependent variable; OLS estimates with HAC standard errors in parentheses; ***, **, and * indicate 1%, 5% and 10% level of significance, respectively.

In what follows, we provide a brief comment on the control variables included in the regression model (column 3). As for *CBI*, we find a positive and highly significant effect on the sacrifice ratio, which implies that disinflation seems to be more costly in EMEs with more independent central banks. This result reaffirms previous claims in the empirical literature put forth by Debelle and Fisher (1994), Jordan (1997), and Posen (1998), among others. According to Walsh (1995), with more independent central banks, nominal contracts tend to be longer reflecting the lower inflation expectations. As a result, higher *CBI* both shifts the Phillips curve inwards and makes it flatter, which increases the sacrifice ratio. Further on, the coefficient of *Openness* is negative suggesting that EMEs which are more open to international trade experience lower disinflation costs. Finally, we find that external shocks exert statistically significant and economically important effects on the sacrifice ratio, thus supporting our choice to include this variable in the regression model. As it can be seen, adverse external shocks, as proxied by changes in the oil price, make disinflation in EMEs more costly.

5. Robustness Analysis

The main finding from Table 1 is that adopting IT is associated with higher disinflation costs in EMEs. In this section, we check the robustness of this conclusion, initially by including additional control variables commonly found in the empirical literature, which could possibly add to the explanatory power of the regression model. In this exercise, first we retain the same time period of analysis (1970-2017), while further on we estimate the empirical model on a shorter sub-sample (1990-2017).

Table 2. Robustness checks, 1970-2017

	(1)	(2)	(3)	(4)
Inflation Targeting (IT)	0.0116** (0.005)	0.0161*** (0.006)	0.0160*** (0.006)	0.0141** (0.006)
Change	-0.0005 (0.0002)	0.0002 (0.0002)	0.0005 (0.0005)	-0.0002 (0.0002)
Length	-0.0018** (0.0008)	-0.0017** (0.0008)	-0.0017** (0.0008)	-0.0016** (0.0007)
CBI	0.029*** (0.011)	0.029*** (0.011)	0.029*** (0.011)	0.033** (0.0129)
Party	-0.003 (0.002)	-0.0025 (0.0017)	-0.0025 (0.0017)	-0.0047** (0.0022)
Openness	-0.011* (0.006)	-0.0115* (0.006)	-0.0115* (0.006)	-0.0154** (0.0072)
Shocks	0.0144* (0.008)	0.0150 (0.010)	0.0143* (0.008)	0.009 (0.0124)
Debt	-	0.0008 (0.004)	-	-
Initial Inflation	-	-	-0.0003 (0.0005)	-
Nominal Rigidity	-	-	-	0.0023* (0.0012)
Constant	0.0019 (0.005)	0.0011 (0.006)	0.0018 (0.0054)	0.0031 (0.007)
Sample size	140	140	140	112
Adjusted R^2	0.191	0.210	0.210	0.243

Notes: Sacrifice ratio is the dependent variable; OLS estimates with HAC standard errors in parentheses; ***, **, and * indicate 1%, 5% and 10% level of significance, respectively.

In column (1) of Table 2, we estimate the same specification as before, while allowing for a less formal implementation of the IT regime, following Bernanke et al. (1999). As it can be seen, both the sign and statistical significance of all regression coefficients remain virtually the same as in our base specification (presented in column 3 of Table 1). In other words, according to our results, the form of implementing the IT regime (full-fledged versus lite-IT), does not in any way alter its effect on the sacrifice ratio. In columns (2), (3), and (4) of Table 2, we proceed by augmenting the baseline regression model with additional variables extracted from the empirical literature, while retaining our initial measure of *IT*, i.e., considering only full-fledged IT regimes. In column (2) we control for the fiscal position as proxied by the debt/GDP ratio. As expected, the coefficient of *Debt* has a positive sign, indicating that a higher debt level during a disinflation episode increases the sacrifice ratio in EMEs. Yet, note that this effect is not statistically significant. Initial inflation, too, has the expected coefficient, as implied by economic theory, but neither is this effect significant (column 3). Regarding nominal rigidities, we find a positive and significant effect, but we are rather cautious in its interpretation (column 4). Since the data on nominal wage rigidity is not available for EMEs, we employ the proxy variable used in Hofstetter (2008) and Mazumder (2014), namely the 10-year inflation history prior to each disinflation episode. The rationale behind this approach is that the countries with long history of high inflation tend to develop some mechanisms, allowing prices and wages to adjust frequently (for instance, indexation of nominal contracts). Therefore, these countries are characterized by a lower degree of nominal rigidities. Yet, in column (4), the regression coefficient before inflation history is counterintuitive, i.e. contrary to both theory and empirical evidence, thus potentially raising concerns with respect to the validity of this proxy variable. Simultaneously, there is room for an alternative interpretation of the above finding: the long history of high inflation in EMEs is associated with deeply rooted inflation expectations and low credibility of disinflation policies, which results in high sacrifice ratios. As for the rest of the control variables, we obtain similar results as above.

In Table 3, we provide various estimates for the sub-sample over the 1990-2017 period. It is well known that EMEs experienced a highly volatile macroeconomic environment in the 1970s and 1980s, followed by a period of greater stability. Since the regression estimates presented above are based on the whole sample, comprising the highly volatile period, they could suffer from problems related to sample heterogeneity or potential heteroskedasticity. Therefore, in order to check for the potential sensitivity of our results, we have re-estimated our base specification for the post-1990s sample (column 5). All results are fundamentally unaltered. Again, in column (1) we allow for a less formal implementation of the IT regime. Notwithstanding the definition, the relation between *IT* and the sacrifice ratio remains positive and statistically significant. Also, the magnitude of the regression coefficient before *IT* remains stable across the two samples. In columns (2)-(4), we augment the baseline specification by including three control variables, respectively. The results obtained are basically equivalent to the ones in Table 2, once again confirming the robust relationship between *IT* and the sacrifice ratio. An apparent pattern emerging from Table 3 refers to the effect of external shocks. While the regression coefficient in front of *Shocks* remains positive, as expected, it is not statistically significant anymore. These results are probably related to the more stable macroeconomic environment in the post-1990s period, making the effect of external shocks negligible. Additional peculiarity is the relation between *Party* and the sacrifice ratio, which remains negative, but now it is statistically significant across Table 3. Therefore, for the sub-sample covering the recent period we are able to provide evidence that disinflation costs in EMEs are lower under right-wing governments, which is consistent with the findings by Caporale and Caporale (2008) and Caporale (2011). Note that the statistical significance of *Party* in the post-1990s period partly reflects the profound political changes within our sample. Specifically, it was only after 1990s that ring-wing political parties emerged in the former communist countries. Consequently, the divide between right and left-wing governments is more evident in the post-1990s period.

Table 3. Robustness checks, 1990-2017

	(1)	(2)	(3)	(4)	(5)
Inflation Targeting (IT)	0.011* (0.0057)	0.015** (0.0063)	0.014** (0.0065)	0.012* (0.0064)	0.015** (0.0062)
Change	0.0003 (0.0005)	0.0003 (0.0005)	0.043 (0.0381)	-0.0008* (0.0004)	0.0003 (0.0004)
Length	-0.002** (0.0009)	-0.002** (0.0009)	-0.002** (0.0009)	-0.002** (0.0009)	-0.002** (0.0009)
CBI	0.031** (0.0153)	0.031* (0.0161)	0.030** (0.0151)	0.032** (0.0160)	0.031** (0.0152)
Party	-0.005** (0.0025)	-0.004* (0.0023)	-0.005* (0.0024)	-0.007** (0.0025)	-0.004* (0.0023)
Openness	-0.022** (0.0091)	-0.022** (0.0093)	-0.023** (0.0092)	-0.022** (0.0093)	-0.022** (0.0092)
Shocks	0.016 (0.0216)	0.016 (0.0228)	0.0164 (0.0208)	0.012 (0.0236)	0.015 (0.0208)
Debt	-	0.002 (0.0069)	-	-	-
Initial Inflation	-	-	-0.043 (0.0383)	-	-
Nominal Rigidity	-	-	-	0.003** (0.0012)	-
Constant	0.014 (0.0105)	0.012 (0.0123)	0.018 (0.0118)	0.015 (0.0108)	0.0132 (0.0100)
Sample size	79	79	79	73	79
Adjusted R^2	0.244	0.263	0.270	0.279	0.273

Notes: Sacrifice ratio is the dependent variable; OLS estimates with HAC standard errors in parentheses; ***, **, and * indicate 1%, 5% and 10% level of significance, respectively.

Compared to developed countries, disinflation episodes in EMEs are characterized by both higher peak inflation and trend inflation. For instance, initial inflation has a mean of 77.5% in our sample. In what follows, we check for the sensitivity of our results to various peak levels of trend inflation. Dornbusch and Fischer (1993) and Burton and Fischer (1998) define episodes of moderate inflation as periods with inflation rates in the range of 15% - 30%, lasting at least 3 years. Fischer et al. (2002) term an inflation episode in the range of 25% - 50% as moderate to high, while Bruno and Easterly (1998) identify all two-year periods with inflation rates beyond 40% as inflation crises. Table 4 provides the estimates from the regression based on different peak levels of trend inflation during disinflation episodes, both for the entire sample and for the post-1990s sub-sample subsequently. Column (1) considers only disinflation episodes with trend inflation at the peak of each disinflation episode less than (or equal to) 20%. In this way, we identify 84 and 58 disinflation episodes for the two samples, respectively. As it can be seen, taking different thresholds for the peak trend inflation does not affect our findings, i.e., the relation between *IT* and the sacrifice ratio remains positive and statistically significant. In columns (2)-(4), we set the threshold for trend inflation at the peak of disinflation episodes at 30%, 40% and 50%, respectively. As we allow for higher peak trend inflation, the magnitude of the coefficient of *IT* remains remarkably stable. Additionally, note that, with higher trend inflation, external shocks become statistically significant in the whole sample (columns 3 and 4), which points to the potentially close relationship between disinflation episodes and external shocks in EMEs during the highly volatile pre-1990s period.

Table 4. Estimates with different peak levels of trend inflation rate

1970-2017				
	(1)	(2)	(3)	(4)
Inflation Targeting (IT)	0.015** (0.0065)	0.017*** (0.0062)	0.016*** (0.0059)	0.016*** (0.0060)
Change	0.011 (0.0722)	0.018 (0.0380)	0.002 (0.0102)	0.004 (0.0211)
Length	-0.002 (0.0021)	-0.002* (0.0011)	-0.002** (0.0009)	-0.002* (0.0010)
CBI	0.033** (0.0134)	0.029** (0.0123)	0.030** (0.0120)	0.029** (0.0119)
Party	-0.002 (0.0031)	-0.003 (0.0024)	-0.003 (0.0022)	-0.003 (0.0021)
Openness	-0.013** (0.0062)	-0.013** (0.0061)	-0.012** (0.0062)	-0.012** (0.0061)
Shocks	0.022 (0.0137)	0.017 (0.0110)	0.017* (0.0105)	0.017* (0.0099)
Constant	0.004 (0.0093)	0.003 (0.0068)	0.003 (0.0065)	0.003 (0.0063)
Sample size	84	109	116	119
Adjusted R^2	0.251	0.228	0.219	0.221
1990-2017				
	(1)	(2)	(3)	(4)
Inflation Targeting (IT)	0.014* (0.0072)	0.015** (0.0066)	0.014** (0.0064)	0.014** (0.0064)
Speed	-0.057 (0.0760)	-0.029 (0.0451)	-0.043 (0.0445)	-0.020 (0.0222)
Length	-0.001 (0.0019)	-0.002 0.0012	-0.001 (0.001)	-0.002* (0.0010)
CBI	0.035** (0.0171)	0.033** (0.0166)	0.035** (0.0168)	0.033** (0.0159)
Party	-0.005 (0.0033)	-0.005* (0.0027)	-0.005* (0.0027)	-0.005* (0.0159)
Openness	-0.025** (0.0093)	-0.024** (0.0090)	-0.023** (0.0093)	-0.022** (0.0092)
Shocks	0.014 (0.0122)	0.024 (0.024)	0.023 (0.0237)	0.018 (0.0217)
Constant	0.015 (0.0122)	0.013 (0.0108)	0.012 (0.0108)	0.013 (0.0104)
Sample size	58	69	71	74
Adjusted R^2	0.295	0.288	0.274	0.274

Notes: Sacrifice ratio is the dependent variable; OLS estimates with HAC standard errors in parentheses; ***, **, and * indicate 1%, 5% and 10% level of significance, respectively.

Since the formula for calculating the sacrifice ratio includes the deviations from potential output in the numerator, this procedure clearly leaves the possibility for any errors in the estimates of potential output open, which would translate in the magnitude of sacrifice ratios. Table 5 provides evidence on the sensitivity of our results with respect to the filter used in detrending output. In columns 1-2, we employ the original Ball (1994) method for calculating the sacrifice ratio, for the two samples, respectively. By comparing the results in these two columns with those reported previously, we cannot detect any fundamental differences. Again, we find that adopting the IT regime in EMEs is associated with larger sacrifice ratios. Similarly, the coefficients of the remaining variables not only retain their signs and levels of significance, but they follow the same patterns as those reported in Tables (2-4). We proceed checking for the potential sensitivity of our results to the estimation of potential output by employing the Hodrick-Prescott filter (columns 3-4) and the Hamilton (2018) filter (columns 5-6). As Ball (1994) argues the Hodrick-Prescott filter has the tendency of minimizing the deviations between trend and cyclical output, thus exerting a downward bias on the obtained sacrifice ratio values. Indeed, Table 5 confirms that the effect of IT on the sacrifice ratio is sensitive on the method selected for measuring the output gap. Specifically, when potential output is measured by applying both the Hodrick-Prescott and the Hamilton filter, the coefficient of IT loses its statistical significance. Also, note that the adjusted R-squared deteriorates sharply as we move from left to right across Table 5, supporting the findings in Ball (1994), Temple (2002), and Mazumder (2014) that the alternative methods for calculating the sacrifice ratio may be less accurate.

Table 5. Robustness checks with alternative methods for estimating trend output

	(1) Ball 1970-2017	(2) Ball 1990-2017	(3) Hodrick-Prescott 1970-1990	(4) Hodrick-Prescott 1990-2017	(5) Hamilton 1970-2017	(6) Hamilton 1990-2017
Inflation Targeting (IT)	0.007*** (0.0025)	0.006** (0.0027)	0.009 (0.0089)	0.004 (0.0100)	0.011 (0.008)	0.015* (0.0089)
Change	0.00007 (0.0008)	0.0001 (0.0004)	-0.0002 (0.0002)	-0.0003 (0.0008)	0.0001 (0.0001)	0.0004 (0.0008)
Length	-0.0008** (0.0003)	-0.0008** (0.0004)	0.0011 (0.0011)	0.0012 (0.0012)	-0.0005 (0.0008)	-0.0009 (0.0008)
CBI	0.012*** (0.0046)	0.013* (0.0066)	0.001 (0.0205)	-0.020 (0.0268)	0.009 (0.0167)	0.032 (0.0238)
Party	-0.001 (0.0007)	-0.002** (0.0010)	0.0008 (0.0050)	0.0009 (0.0060)	-0.002 (0.0029)	-0.003 (0.0036)
Openness	-0.005** (0.0025)	-0.009** (0.0038)	0.0046 (0.0055)	0.0042 (0.0110)	0.0014 (0.0087)	-0.012 (0.0115)
Shocks	0.0058* (0.0037)	0.007 (0.0092)	-0.025 (0.0163)	0.046 (0.0507)	0.0016 (0.0133)	-0.029 (0.0294)
Constant	0.001 (0.0022)	0.006 (0.0043)	-0.008 (0.0098)	0.002 (0.0172)	-0.0011 (0.0087)	-0.002 (0.0157)
Sample size	140	78	140	79	137	77
Adjusted R^2	0.215	0.270	0.028	0.068	0.019	0.048

Notes: Sacrifice ratio is the dependent variable; OLS estimates with HAC standard errors in parentheses; ***, **, and * indicate 1%, 5% and 10% level of significance, respectively.

Temple (2002), Gonçalves and Carvalho (2008, 2009), Brito (2010), and Mazumder (2014) follow Ball (1994) in identifying as disinflation episodes only the periods in which trend inflation has fallen by at least 1.5 percentage points from peak to trough (2 percentage points when using quarterly data). In Table 6, following Cecchetti's comments in Ball (1994) as well as Cecchetti (2001) and Hofstetter (2008), we examine the sensitivity of our baseline estimation (reported in Table 1, column 3) to alternative definitions of disinflation episodes. In column (1) we consider only disinflation episodes with a change in trend inflation from peak to trough in a disinflationary episode equal to or greater than 2 percentage points. By applying this threshold, we have identified 130 disinflation episodes in total. Again, the coefficient of *IT* is positive and statistically significant, indicating that the relation between *IT* and the sacrifice ratio remains stable under this restriction. The apparent pattern of stability of this coefficient is evident in columns (2) and (3), too in which we define disinflation episodes as the periods with declines in trend inflation equal to or greater than 3 and 5 percentage points, respectively. As we only restrict our attention to the episodes in which the change in trend inflation is equal to or greater than 10 percentage points (column 4), we observe that *IT* does not affect the sacrifice ratio. However, we consider this result dubious, given the low number of identified disinflation episodes (49), and the ambiguous specification of this model as shown by the negative adjusted R-squared coefficient. Finally, note that, as the change in trend inflation throughout the inflationary episode is additionally restricted to greater than 3 percentage points (column 2) and greater than 5 percentage points (column 3), the length of the disinflation episode no longer matters for the sacrifice ratio. In other words, it seems that, when the disinflation is larger, i.e., trend inflation is reduced substantially, it does not matter whether the disinflation is quick or gradual.

Table 6. Sacrifice ratio and different rates of difference in trend inflation from peak to trough, 1970 – 2017

	(1)	(2)	(3)	(4)
Inflation Targeting (IT)	0.016** (0.0062)	0.013*** (0.0051)	0.014** (0.0067)	0.0085 (0.0120)
Change	0.0002 (0.0002)	0.0001 (0.0002)	0.0002 (0.0002)	0.0002 (0.0002)
Length	-0.0017** (0.0008)	-0.001 (0.0008)	-0.0011 (0.0008)	-0.0009 (0.0008)
CBI	0.026** (0.0109)	0.017* (0.0102)	0.017 (0.0120)	0.0115* (0.0058)
Party	-0.0022 (0.0018)	-0.0024 (0.0015)	-0.0023 (0.0016)	-0.0035* (0.0021)
Openness	-0.013** (0.0062)	-0.0049* (0.0029)	-0.0057* (0.0031)	0.0016 (0.0022)
Shocks	0.0157* (0.0086)	0.0104 (0.0066)	0.0111 (0.0073)	-0.00001 (0.0054)
Constant	0.0033 (0.0053)	0.0004 (0.0048)	0.0007 (0.0056)	-0.0004 (0.0055)
Sample size	130	111	91	49
Adjusted R^2	0.228	0.075	0.046	-0.032

Notes: Sacrifice ratio is the dependent variable; OLS estimates with HAC standard errors in parentheses; ***, **, and * indicate 1%, 5% and 10% level of significance, respectively.

6. Conclusion

In this paper, we study the relationship between IT and the sacrifice ratio in EMEs, controlling for a number of additional factors, which may affect the cost of disinflation. In calculating the sacrifice ratio, we employ a slightly modified version of the approach used in Ball (1994). Using this methodology, we have identified 170 disinflation episodes in 44 EMEs, i.e. 78 disinflation episodes during 1970-1990 and 92 disinflation episodes in the 1990-2017 period. We provide strong evidence that adopting IT in EMEs is associated with higher output costs during disinflation episodes. In addition, we find that gradual disinflation may be less costly in EMEs. Also, we show that trade openness is associated with lower sacrifice ratios, while both more independent central banks and adverse external shocks lead to higher sacrifice ratios. Our main findings are robust to alternative classifications of the IT regime (full-fledged versus lite-IT), alternative definitions of disinflation episodes (different thresholds for the cumulative decline in trend inflation during an episode), different thresholds for high inflation, different peak levels of trend inflation rate, across various specifications of the empirical model, as well as for both the entire sample and the sub-sample covering the post-1990s period. Yet, we find that the results are sensitive to the filtering method employed for estimating trend output, i.e., the regression estimates lose their statistical significance when we apply both the Hodrick-Prescott and the Hamilton filter.

References

Ball, L. (1994), "What Determines the Sacrifice Ratio?". In: N. Gregory Mankiw, ed., *Monetary Policy*. Chicago: The University of Chicago Press, 155-182.

Ball, L. Mankiw G.N., Romer, D. (1988). The New Keynesian Economics and the Output – Inflation Trade-off. *Brookings Papers on Economic Activity*, 1, 1-65.

Ball, L. M., Sheridan, N. (2004). Does Inflation Targeting Matter? In: Ben S. Bernanke and Michael Woodford, eds., *The Inflation-Targeting Debate*. Chicago: University of Chicago Press, 249-282.

Batini, N. Laxton, D. (2007). "Under What Conditions Can Inflation Targeting Be Adopted? The Experience of Emerging Markets." In: Frederic Mishkin and Klaus Schmidt-Hebbel, eds., *Monetary Policy under Inflation Targeting*. Chile: Central Bank of Chile, 467-506.

Beck, T. Clarke, G., Groff A., Keefer, P., Walsh, P. (2001). New tools and new tests in comparative political economy - the database of political institutions. *The World Bank Economic Review*, 15(1), 165-176.

Bems R., Caselli F., Grigoli F., Gruss B., Lian W. (2018). Is Inflation Domestic or Global? Evidence from Emerging Markets. IMF Working Paper, 18/241.

Bernanke B., Mishkin S. F.(1997), "Inflation Targeting: A New Framework for Monetary Policy?", *Journal of Economic Perspectives*, 11(2), pp. 97-116.

Bernanke, B., Laubach, R., Mishkin, S. F., Posen A. (1999). *Inflation Targeting: Lessons from the International Experience*, Princeton University Press.

Blanchard, O., Simon, J. (2001). The Long and Large Decline in U.S. Output Volatility. MIT Department of Economics Working Papers.

Boschen, J., Weiss, C. (2001). The Ex Ante Credibility of Disinflation Policy and the Cost of Reducing Inflation. *Journal of Macroeconomics*, 323-347.

Bowdler, C. (2009). Openness, exchange rate regimes and the Phillips curve. *Journal of International Money and Finance*, *28*(1), 148-160.

Bowdler, C., & Nunziata, L. (2010). Labor market structures and the sacrifice ratio. *Journal of Macroeconomics*, *32*(3), 816-826

Brito, R. D. (2010). Inflation targeting does not matter: another look at OECD sacrifice ratios. *Journal of Money, Credit and Banking*, *42*(8), 1679-1688

Brito, R. D., Bystedt, B. (2010). Inflation targeting in emerging economies: Panel evidence. *Journal of Development Economics* 91, 198-210.

Broner, F., Ventura J. (2006). Globalization and Risk Sharing. Discussion Paper 5820. Centre for Economic Policy Research, London, United Kingdom.

Bruno, M., Easterly W. (1998). Inflation Crisis and Long-Run Growth. *Journal of Monetary Economics*, 41, 3-26.

Brumm, H., Krashevski R. (2003). The Sacrifice Ratio and Central Bank Independence Revisited. *Open Economies Review* 14, 157–168.

Burton, D., Fischer, S. (1998). Ending Moderate Inflations. *In: Moderate Inflation: The Experience of Transition Economies*. International Monetary Fund and Bank of Hungary.

Calvo, G., & Mishkin, F. (2003). The mirage of exchange rate regimes for emerging market countries. *Journal of Economic Perspectives*, 17(4), 99-118.

Caporale, B., Caporale T. (2008). Political Regimes and the Cost of Disinflation. *Journal of Money, Credit and Banking,* 40, 1541–1554.

Caporale, T. (2011). Government Ideology, Democracy and the Sacrifice Ratio: Evidence from Latin American and Caribbean Disinflations. *Open Economics Journal, 4*, 39–43.

Cecchetti S., Rich R. (2001). Structural estimates of the US sacrifice ratio. *Journal of Business and Economics Statistics*, 19: No. 4, 416-427.

Chortareas, G., Stasavage, D. and Sterne, G. (2003). Does Monetary Policy Transparency Reduce Disinfation Costs? *Manchester School*, 71(5), 521-540.

Daniels, J. P., Nourzad, F., & VanHoose, D. D. (2005). Openness, central bank independence, and the sacrifice ratio. *Journal of Money, Credit, and Banking*, *37*(2), 371-379.

Daniels J, Nourzad F, VanHoose D (2006) Openness, centralized wage bargaining, and inflation. European Journal of Political Economy, 22, 969–988

Daniels, J. P., & VanHoose, D. D. (2006). Openness, the sacrifice ratio, and inflation: Is there a puzzle?. *Journal of International Money and Finance*, *25*(8), 1336-1347.

Daniels, J. P., & VanHoose, D. D. (2009). Trade openness, capital mobility, and the sacrifice ratio. *Open Economies Review*, *20*(4), 473-487.

Daniels, J. P., & VanHoose, D. D. (2013). Exchange-rate pass through, openness, and the sacrifice ratio. *Journal of International Money and Finance*, *36*, 131-150.

Debelle, G. Fischer S. (1994). How Independent Should a Central Bank Be? *In J. Fuhrer (ed.) Goals, Guidelines, and Constraints Facing Monetary Policymaker*, Federal Reserve Bank of Boston.

Diana, G., & Sidiropoulos, M. (2004). Central bank independence, speed of disinflation and the sacrifice ratio. *Open Economies Review*, *15*(4), 385-402.

Dornbusch, R., Fisher S. (1993). Moderate Inflation. *The World Bank Economic Review*, 7(1), 1-44.

Durham, J. (2001). Sacrifice ratios and monetary policy credibility: do smaller budget deficits, inflation-indexed debt, and inflation targets lower disinflation costs? *Finance and Economics Discussion Series 2001-47*, Board of Governors of the Federal Reserve System

Fischer, S., Sahay, R., Végh C. (2002). Modern Hyper - and High Inflations. *Journal of Economic Literature*, Vol. 40, 837-880

Gariga, C. A., (2016). Central Bank Independence in the World: A New Data Set. *International Relations*, 42(5), 849-868.

Gonçalves, C. E. S., & Carvalho, A. (2008). Inflation targeting and the sacrifice ratio. *Revista Brasileira de Economia*, *62*(2), 177-188.

Gonçalves, C. E. S., & Carvalho, A. (2009). Inflation targeting matters: Evidence from OECD economies' sacrifice ratios. *Journal of Money, Credit and Banking*, *41*(1), 233-243.

Hamilton, D. J. (2018). Why You Should Never Use the Hodrick-Prescott Filter? *Review of Economics and Statistics*, 100(5), 831-843.

Hammond, G. (2012). State of the Art of Inflation Targeting. Bank of England – Centre for Central Banking Studies.

Hodrick, R., Prescott, E. (1997). Postwar U.S. Business Cycles: An Empirical Investigation. *Journal of Money, Credit and Banking,* 29, 1–16.

Hofstetter, M. (2008). Disinflations in Latin America and the Caribbean: A free lunch? *Journal of Macroeconomics*, 30(1), 327–345.

Hutchinson M., Walsh C. (1998). The output inflation trade-off and central bank reform: evidence from New Zealand. *Economic Journal*, 108(448), 703-725

Jordan, T. (1997). Disinflation costs, accelerating inflation gains, and central bank independence. *Weltwirtschaftliches Archiv*, 133, 1-21

Katayama, H., Ponomareva, N., Sharma, M. (2019). What determines the sacrifice ratio? A Bayesian model averaging approach. *Oxford Bulletin of Economics and Statistics*, *81*(5), 960-988.

Kose, M. A., Otrok C., Whiteman, C. (2003a). International Business Cycles: World, Region, and Country-Specific Factors. *American Economic Review*, Vol. 93, No. 4, 1216–39.

Kose, M. A., Prasad, E. S., Terrones, M. E. (2003b): Financial Integration and Macroeconomic Volatility. *IMF Staff Papers*, 50, 119-42.

Kraay, A., Ventura J. (2007). Comparative Advantage and the Cross-Section of Business Cycles. *Journal of the European Economic Association*, 5(6), 1300-1333.

Loayza, N., Raddatz C. (2007). The Structural Determinants of External Vulnerability. *World Bank Economic Review,* 21(3), 359-387.

Mazumder, S. (2014). Determinants of the Sacrifice Ratio: Evidence from OECD and non-OECD Countries, *Economic Modelling,* 40, 117-135.

Mishkin, S. F., Savastano, A. M. (2002). Monetary Policy Strategies for Emerging Market Countries: Lessons from Latin America. *Comparative Economic Studies*, 44, 45-82.

Mishkin. S. F., Schmidt-Hebbel, K. (2002), "A Decade of Inflation Targeting in the World: What Do We Know and What Do We Need to Know?", in: *Inflation Targeting: Design, Performance, Challenges*, 2002. Santiago: Central Bank of Chile, 171-219.

Mishkin. S. F., Schmidt-Hebbel, K. (2007), "Monetary Policy under Inflation Targeting: An Introduction", in Frederic S. Mishkin and Klaus Schmidt-Hebbel, eds., *Monetary Policy under Inflation Targeting*. Santiago, Chile: Central Bank of Chile, 1-22.

Mishkin. S. F., Posen, A. S. (1997), "Inflation Targeting: Lesson from four Countries." Federal Reserve Bank of New York *Economic Policy Review*, 3, 9-117.

Posen, A. S. (1995). Declarations Are Not Enough: Financial Sector Sources of Central Bank Independence. NBER Macroeconomics Annual 10, ed. Ben S. Bernanke and Julio J. Rotemberg. Cambridge: MIT Press, 253-74.

Posen, A. S. (1998). Central Bank Independence and Disinflationary Credibility: A Missing Link? *Oxford Economic Papers*, 50(3), 335-59.

Ramey, G., Ramey, V. (1995). Cross-Country Evidence on the Link between Volatility and Growth. *American Economic Review*, 85(5), 1138–51.

Romer, D. (1993). Openness and Inflation: Theory and Evidence. *Quarterly Journal of Economics*, 158(4), 869-903.

Rossi, S. (2004). Inflation targeting and sacrifice ratios: the case of the European Central Bank. *International Journal of Political Economy*, 34(2), 69-85.

Roux, N. D., & Hofstetter, M. (2014). Sacrifice ratios and inflation targeting: the role of credibility. *International Finance*, 17(3), 381-401.

Sargent T. (1983). Stopping Moderate Inflations: The Methods of Poincare and Thatcher. In: Dornbusch and Simonsen (eds.), *Inflation, Debt, and Indexation*, Cambridge, Mass., MIT Press.

Senda, T., & Smith, J. K. (2008). Inflation History and the Sacrifice Ratio: Episode-Specific Evidence. *Contemporary Economic Policy*, *26*(3), 409-419.

Taylor, J., (1983). Union Wage Settlements during a Disinflation. *American Economic Review*, 73, 981-993.

Walsh, C. E. (1995). Central bank independence and the costs of disinflation in the European Community. In: B. Eichengreen, J. Frieden and J. von Hagen (eds.) *Monetary and Fiscal Policy in an Integrated Europe*. Heidelberg, New York, and London: Springer, pp. 12-37.

Zhang, L. (2005). Sacrifice Ratios with Long-Lived Effects. *International Finance*, 8, 231-262.

APPENDIX

Table A1. Sacrifice Ratios in selected EMEs (1970-2017)

Country	Start of episode	Length of episode (years)	Initial trend inflation (%)	Change in trend inflation (%)	Sacrifice Ratio
Brazil	1989	4	1669.19	565.14	0.000184
	1993	6	1651.74	1646.75	-0.00011
	2002	6	10.001	5.50	0.018669
Chile	1974	9	410.761	391.799	-0.00062
	1984	2	25.940	2.593	0.002511
	1986	3	23.354	6.156	0.005157
	1990	14	21.616	19.498	-0.04345
	2007	4	5.505	3.804	0.018859
Colombia	1976	2	25.690	1.891	0.010614
	1978	2	25.233	2.417	-0.00256
	1981	5	26.242	6.544	0.016471
	1991	16	25.850	23.887	0.012526
	2007	7	5.611	2.916	0.034991
Czech Republic	1997	8	9.351	7.772	0.037939
	2007	4	3.915	2.445	0.008896
	2011	5	2.226	1.780	0.066701
Hungary	1991	3	28.947	7.285	0.008136
	1995	11	23.547	18.802	0.014873
	2008	3	6.071	1.738	0.049109
	2011	5	4.812	4.777	0.019937
Israel	1975	2	36.766	1.688	0.002094
	1985	5	241.978	224.084	-0.000022
	1990	5	18.809	7.697	-0.00316
	1995	6	11.223	8.748	-0.00852
	2001	4	2.637	2.093	0.034621
Mexico	1983	3	75.412	5.602	-0.01177
	1987	7	110.741	99.999	0.000482
	1996	11	30.001	26.139	-0.01012
Peru	1984	3	128.253	13.205	0.003697
	1989	14	3849.12	3847.64	0.000094
Philippines	1973	4	19.649	11.029	0.003979
	1980	3	16.272	5.161	-0.00294
	1984	4	27.824	21.464	0.009695
	1990	5	14.561	5.385	0.025983
	1995	9	8.231	4.951	0.021133
Poland	1982	4	49.407	34.916	n/a
	1990	14	296.399	294.409	n/a
	2010	6	3.538	4.033	-0.0013
South Africa	1981	3	14.518	1.695	0.031079

	1986	4	17.036	3.093	-0.01461
	1990	11	14.795	9.388	0.042744
	2002	4	6.958	5.420	0.007625
	2008	4	7.832	2.897	0.019512
South Korea	1975	3	21.627	8.332	-0.00252
	1980	6	19.080	20.296	0.003543
	1991	4	8.039	2.857	0.020136
	1997	4	5.626	3.246	0.041347
	2009	7	3.456	2.472	-0.04471
Thailand	1974	3	15.051	9.357	0.004791
	1980	6	14.088	12.375	-0.00147
	1997	4	6.475	5.307	0.030825
	2007	2	4.116	1.827	-0.00662
Turkey	1979	4	73.234	40.519	0.002511
	1985	2	42.655	3.179	0.003574
	1995	11	91.580	82.788	0.004786
	2007	4	9.599	2.503	0.080468
Ghana	1977	3	81.874	22.673	-0.00347
	1980	2	73.672	10.715	-0.0017
	1982	4	87.224	62.379	0.002014
	1988	5	32.133	14.450	0.000054
	1996	4	44.636	27.227	-0.00032
	2002	2	24.799	6.760	0.00028
	2004	3	18.139	5.884	-0.00252
	2008	4	15.502	6.648	0.013257
Indonesia	1974	5	30.233	18.434	0.002319
	1980	7	15.511	8.903	-0.00361
	1998	4	28.385	19.355	0.00246
	2002	3	10.052	2.294	0.00377
	2006	6	9.989	5.066	0.000454
Dominican R.	1974	4	14.241	6.208	-0.00854
	1980	3	11.147	4.217	0.000771
	1985	3	45.336	2.691	-0.00515
	1990	4	46.066	40.143	0.000134
	1996	2	8.744	2.568	-0.00394
	2003	4	28.045	22.076	0.003031
	2007	2	8.120	2.043	-0.00546
	2011	5	6.196	4.371	0.021366
China	1994	6	18.553	19.162	-0.00494
	2011	6	3.783	2.106	-0.02002
Costa Rica	1974	4	20.886	16.327	0.004568
	1982	4	53.267	40.320	0.000076
	1991	3	23.180	8.146	-0.00547
	1995	8	18.082	8.125	-0.00029
	2005	12	12.528	11.724	-0.0285

Cote d'Ivoire	1978	7	19.002	15.073	0.010526
	1987	4	7.852	7.209	-0.00509
	1995	6	14.285	11.754	-0.02509
	2012	4	2.933	2.125	-0.00588
Ecuador	1974	5	17.232	5.588	-0.02761
	1984	3	35.882	9.043	-0.00461
	1989	7	60.794	35.893	-0.00212
	2000	7	62.005	59.349	-0.00039
Egypt	1981	2	15.320	1.580	-0.01433
	1987	3	20.407	1.846	0.001053
	1990	4	19.255	7.962	0.00425
	1994	8	11.995	9.432	-0.01035
	2009	4	13.781	4.917	-0.00833
El Salvador	1975	3	14.341	3.631	0.000709
	1980	4	15.407	3.223	0.067253
	1986	14	26.376	24.598	-0.00473
	2007	4	5.108	2.653	0.014483
India	1973	5	17.330	16.262	0.004238
	1982	4	10.957	3.421	-0.00844
	1987	2	8.971	1.823	-0.00945
	1991	4	11.543	2.610	0.014634
	1997	6	9.791	5.830	-0.0048
Lebanon	2012	4	5.458	6.351	-0.00351
Malaysia	1974	3	10.792	6.822	0.009541
	1981	6	7.398	6.940	-0.01965
	1997	6	3.807	2.401	0.112926
	2007	4	3.692	1.870	0.026147
Morocco	1975	2	11.326	1.653	-0.01341
	1981	4	10.809	2.015	-0.00868
	1985	4	9.636	6.860	-0.00502
	1994	5	5.843	3.990	0.020571
	2007	4	3.011	2.045	-0.00575
Nigeria	1976	6	24.450	11.623	-0.04174
	1982	5	17.241	9.093	0.032184
	1988	4	38.756	17.102	-0.00092
	1994	6	62.344	54.495	0.001263
	2004	4	15.631	7.231	0.000978
	2011	4	12.259	3.743	-0.00665
Pakistan	1974	4	23.546	15.736	0.003051
	1980	7	10.695	6.094	-0.00876
	1995	8	11.695	8.577	0.005612
Tunisia	1990	4	7.493	2.649	-0.01427
	1994	7	4.984	2.439	0.00058
Uruguay	1974	4	85.205	34.082	-0.00067
	1979	4	58.289	24.211	-0.0134

	1986	2	70.723	3.343	-0.00945
	1990	11	98.315	93.388	-0.00956
	2003	4	14.170	7.766	0.00075
Panama	1974	4	9.668	5.423	0.020093
	1980	8	9.699	9.270	-0.09853
Singapore	1974	3	14.847	13.561	0.001991
	1980	7	6.928	7.056	-0.02938
	1990	10	3.077	2.707	-0.11373
Algeria	1978	6	13.621	6.745	0.005672
	1985	4	10.323	2.771	0.020316
	1993	9	27.086	25.091	0.009633
	2011	4	5.775	2.124	0.004315
Botswana	1980	6	13.932	5.041	-0.02229
	1992	9	14.088	6.451	-0.01893
Croatia	1989	3	695.238	279.497	n/a
	1992	5	744.109	744.934	n/a
	1999	5	5.009	3.177	0.012166
	2007	4	4.055	2.169	-0.00053
	2012	4	2.626	3.239	0.022001
Guatemala	1974	4	14.483	4.037	0.011244
	1980	4	11.200	8.449	0.000279
	1986	3	22.647	11.132	0.000345
	1990	10	28.592	22.657	-0.00065
	2007	4	8.245	4.268	0.005628
Jordan	1975	3	14.302	3.306	-0.00888
	1980	7	11.019	9.627	-0.00475
	1990	5	16.687	13.625	-0.00306
	1997	4	4.210	3.195	0.011443
	2007	2	8.322	2.330	-0.00356
	2009	2	6.023	3.267	0.000411
Russian Fed.	1999	8	44.744	34.290	0.001378
	2008	6	11.588	5.038	0.03415
Serbia	2000	5	69.526	57.186	0.001959
	2005	7	12.957	4.753	-0.06564
	2012	4	8.721	7.188	0.003189
Tanzania	1974	4	18.684	10.338	n/a
	1985	4	33.953	4.958	n/a
	1989	4	30.954	5.681	-0.01639
	1994	11	28.930	23.905	0.018824
Ukraine	2000	4	20.948	15.953	0.003655
	2008	5	17.982	15.220	0.01764

Table A2. Dates of adopting inflation targeting for 17 EMEs

Country	Year of adoption
Brazil	1999
Chile	1999
Colombia	1999
Czech Republic	1998
Hungary	2001
Israel	1997
Mexico	1999
Peru	2002
Philippines	2002
Poland	1998
South Africa	2000
South Korea	1998
Thailand	2000
Turkey	2006
Ghana	2007
Indonesia	2005
Serbia	2009