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Determinants of the sacrifice ratio: Evidence from OECD and non-OECD countries☆

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ABSTRACT

This paper measures sacrifice ratios for all countries in the world over an approximately forty year time period, in addition to exploring the determinants of worldwide sacrifice ratios. We test the most commonly-cited determinants: the speed of disinflation, openness, inflation targeting, central bank independence, and political factors for both OECD and non-OECD countries. We find that the speed of disinflation is the most important determinant of OECD sacrifice ratios, but puzzlingly has no effect on non-OECD nations' disinflation costs. Instead we find evidence that greater central bank independence and more openness are associated with lower non-OECD sacrifice ratios. We also find that the ratio of government debt to GDP – a variable that is not important when it comes to OECD countries – is highly significant for non-OECD economies. Specifically, we find that higher indebtedness is associated with lower sacrifice ratios in non-OECD nations, suggesting that greater levels of debt do not lead to higher expectations of inflation. Furthermore we find evidence that the negative impact of debt on non-OECD sacrifice ratios is being driven by middle income economies.

1. Introduction

The authority that conducts monetary policy in any given nation typically faces the task of controlling the rate of inflation. For example, in the United States, the Federal Reserve implemented contractionary monetary policy to deal with inflation in the early 1970s, the mid-1970s, and the early 1980s. However, such disinflationary policy does not come without cost. The cost of disinflation can be quantified by the sacrifice ratio, which measures the amount of real GDP that must be given up in order to reduce the inflation rate by one percentage point. This therefore raises two key issues that macroeconomists face: first, we wish to measure the magnitude of output losses that are incurred during disinflation episodes, and second, we wish to examine the determinants of the sacrifice ratio.

To that end, a great deal of research has been devoted to both measuring the sacrifice ratio and examining its determinants. The seminal paper in this body of research is Ball (1994), who was instrumental in establishing a method of selecting time periods that we can label as "disinflationary." Thereafter, Ball proceeds to specify a method in which the sacrifice ratio can be computed, namely by computing the ratio of the sum of deviations of trend output from actual output, to the change in trend inflation over the given disinflation episode. This method of computing sacrifice ratios is by far and away the most widely-accepted and commonly-used technique of estimating disinflation costs, and continues to be used by prominent papers in the literature. We therefore proceed in this paper to use the Ball (1994) method of computing sacrifice ratios for our sample of countries.

Ball (1994) also examines the determinants of the sacrifice ratio, and finds that the speed of disinflation (as determined by the amount of disinflation and length of the disinflation episode) and flexible wage-setting are both responsible for lowering the costs of disinflation, while he argues that the initial level of inflation at the start of a disinflation episode is not quantitatively important. Other researchers have also examined a large variety of factors that may possibly be important for determining the sacrifice ratio. Key factors that are tested in the literature are: the degree of trade openness (Temple, 2002), the role of inflation targeting (Goncalves and Carvalho, 2009), the amount of central bank independence (Jordan, 1997), and political factors such as ideology and democracy (Caporale, 2011).

Despite the various determinants of the sacrifice ratio that are tested, one overarching theme appears in the literature. Almost all of these papers focus their analysis exclusively on advanced, industrialized, or specifically, OECD economies. Meanwhile, the question of what determines the sacrifice ratio has not been adequately addressed for non-OECD countries which also include the developing and emerging

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economies of the world. Examination of non-OECD sacrifice ratio data remains to be an important but under-researched area in the literature. Thus the goal of this paper is to fill this void by measuring the sacrifice ratio on a far larger scale than has been done in the literature. In particular, this paper computes the sacrifice ratio for every single country in the world, spanning across four different decades.[1] This represents a far wider scope of countries than is typically considered in the literature, while also maintaining a sample across a substantial period of time.

This then allows us to investigate the determinants of the sacrifice ratio for both OECD and non-OECD economies. We examine all of the typical determinants that have been suggested by the existing literature that focuses primarily on OECD countries. Namely, we test whether the change in inflation, the length of the disinflation episode, the initial level of trend inflation, the degree of openness, inflation targeting, the independence of the central bank, and political factors are important in determining the sacrifice ratio. We find that the speed of disinflation – namely, the amount of disinflation and length of the episode – is always economically and statistically significant in determining OECD sacrifice ratios, while there is little robust evidence of any other important determinants.

However we find a puzzle emerges when we test for the determinants of non-OECD sacrifice ratios: the speed of disinflation is not a significant determinant of non-OECD sacrifice ratios. Instead, we find that higher central bank independence and greater trade openness both are negatively and significantly associated with the costs of disinflation in non-OECD economies. In other words, there is evidence that a "credibility bonus" does exist in non-OECD economies, where greater separation between monetary policymakers and the political regime allows for reductions in inflation at lower output costs. This suggests that greater independence of monetary authorities is a policy that should be encouraged in non-OECD economies. We also find that greater openness in non-OECD countries enables disinflation to take place in a less costly manner. This agrees with the Romer (1993) hypothesis that increases in output that come from an increase in inflation are negatively related to openness, implying a negative relationship between openness and the sacrifice ratio. While Romer applied this idea to developed economies, we find evidence that this prediction holds true for other economies as well.

We also examine the role of the ratio of central government debt to GDP, and find this to be a highly robust determinant of the sacrifice ratio in non-OECD countries. This is true of multiple measures of debt-to-GDP ratios. Somewhat curiously, however, higher levels of debt in non-OECD economies are associated with lower sacrifice ratios. This suggests two things to us. First, although output typically falls during a disinflation episode, a higher level of government debt enables output to be stabilized and perhaps actually increased, even during a disinflation. This appears to indicate that the rise in government debt is accompanied by some other factor that enables output to expand while inflation falls, such as an increase in productivity or some other favorable supply shock. Second, in theory we would expect higher levels of indebtedness to lead to higher inflation expectations and thus larger output costs of disinflation. Therefore the finding of a negative impact of debt on the sacrifice ratio in non-OECD nations suggests that higher levels of debt have not led to higher inflation expectations, which has enabled these economies to mitigate the output costs of disinflation. The exact mechanism by which this occurs remains an interesting area for future work. Further investigation does reveal, however, that the negative impact of debt on non-OECD sacrifice ratios is being driven by middle income economies.

The rest of this paper is organized as follows: Section 2 briefly reviews the relevant literature concerning sacrifice ratios, and Section 3 presents our estimates of worldwide sacrifice ratios. Sections 4 and 5 then examine the determinants of the output costs of disinflation in OECD and non-OECD countries respectively, while Section 6 examines the role of debt. Section 7 re-estimates our main specifications by income groups, and finally we conclude in Section 8.

2. Existing literature

2.1. Measurement of the sacrifice ratio

The most prominent method by which sacrifice ratios are computed in the literature follows the work of Ball (1994). The first step taken is to identify disinflation episodes.[2] Trend inflation is defined as a centered, eight-quarter moving average of actual quarterly inflation. In other words trend inflation for a given year is the average of the four quarters of inflation of that year and the two quarters on either side. To identify disinflation episodes, we then identify peaks and troughs in trend inflation. An inflation peak is one where trend inflation in year t is higher than trend inflation in years $t-1$ and $t+1$ and an inflation trough is one where trend inflation in year t is lower than trend inflation in years $t-1$ and $t+1$. Finally, Ball defines a disinflation episode as one that starts at an inflation peak and ends at an inflation trough, where trend inflation falls at least 1.5 percentage points. This rule of looking at disinflations where inflation falls by at least 1.5 percentage points is designed to separate significant aggregate demand policy changes from smaller changes that result from shocks (Senda and Smith, 2008).

The sacrifice ratio is then computed as the ratio of the sum of deviations between trend output and actual output, to the change in trend inflation over the disinflation episode. Trend output is measured in the following way, following Ball (1994). First we assume that output is at its trend (or natural level) at the beginning of a disinflation episode. Second, we assume that output returns to trend one year after the end of the episode. The purpose of this second assumption is to capture the persistent effects of disinflation. In other words, output appears to return to trend with a lag. Finally, Ball assumes that trend output grows in a log-linear fashion between the inflation peak and the year after the end of the disinflation episode. The numerator of the sacrifice ratio is then the sum of the differences between this log-linear fitted line for trend output and the log of actual output. The denominator of the sacrifice ratio is then simply the change in trend inflation over the course of the disinflation episode.

Some researchers estimate the sacrifice ratio based on a Phillips curve (such as Hutchison and Walsh, 1998; Fischer, 1996), and use this model to derive a relationship between output and inflation. However the major problem with this approach is that it constrains the inflation-output tradeoff to be the same during periods of disinflation as it is during periods of accelerating inflation. If the sacrifice ratio is influenced by factors that are unique to disinflations, this constraint becomes an invalid one. For this reason, the vast majority of the literature now stays clear of estimating sacrifice ratios based on the Phillips curve.

Others have also estimated the sacrifice ratio in different ways, but most of these alternative methods are essentially variations of Ball (1994). Two prime examples of this are Zhang (2005) and Hofstetter (2008). Zhang (2005) argues that the Ball (1994) method ignores long-lived effects that can accompany a disinflation episode. Zhang instead measures trend output by calculating a Hodrick and Prescott (1997) (HP) filter of log real GDP, and then computes the growth rate of the HP filter. Zhang then assumes that potential output grows at this rate at the beginning of the disinflation episode, thus giving an alternative method of computing trend output. Hofstetter (2008) is a further extension of Zhang (2005) that agrees with the notion of long-lived effects, but instead assumes that output is at trend one year prior

[1] The number of countries in the world varies according to the source. For example, at the time of writing, the United Nations report 193 member countries, whereas the U.S. State Department lists 195 countries. This paper examines 189 countries.

[2] In this paper we will use annual data, hence we focus on the annual data method of computing sacrifice ratios.