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Sacrifice Ratio and Disinflation Cost for Selected OPEC Member Countries: Panel Data Evidence

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Abstract

Average inflation in industrial countries has been low since the early 1990s, reflecting success in stabilizing inflation after the 1970s and early 1980s, impact of the process of globalization on inflation is not limited to advanced and industrialized countries and several developing countries compared to advanced countries experienced these affect with some years lags. In this study output losses for disinflation episode that named sacrifice ratio will estimate by ball method during 1990-2013 for selected OPEC member countries. Panel Cointegration method and Dynamic Ordinary Least Square (DOLS) results show that there are positive relationship between inflation changes with sacrifice ratio and negative relationship between initial inflation and openness with sacrifice ratio. This means that cost of disinflation reduced up to 8 percent by increasing in openness and this value for inflation rate changes causes 11 percent sacrifice ratio change.

Keywords: Sacrifice Ratio, Panel Data, Openness, Ball Estimation Method, Disinflation Policy

Introduction:

By emphasizing the impact of the process of globalization on inflation of countries, analysts argue that opening economies in different ways can affect the performance of national monetary authorities. On the other hand, the integration of the emerging economies of China, India and Southeast Asian countries in the global trading system leads to increase the global supply of labor, geographical relocation of production and consequently increase productivity and become more specialized production based on comparative advantage. Due to cheap labor of these countries, their production penetration to international markets costing less compared to the same generation, caused severe price competition among manufacturers in other countries, which could have been prevented the rise of prices by them or

will lead to increased innovation and productivity by creating an incentive for non-price competition. Price stability is the primary objective of monetary policy in all countries. The high rate of inflation is one of the problems of countries, especially in Iran and so attention to the root causes of inflation seems important for finding suitable solutions and policies to suppress and reduce of that. To achieve low and stable inflation, effective monetary policy tools should be used. In all the analysis made about inflation, globalization and motivation of monetary authority, it is assumed that inflation is only affected by monetary policy in the long term and the monetary authorities are able to determine the desired level of inflation by controlling the volume of money in the economy. Thus, only a desire of monetary authorities for using the inflation in stimulation and increasing production may lead to rise inflation. Because the globalization reduces the ability of monetary authorities to affect on production, their motivation will decrease in resorting to inflation. Different economic conditions such as exchange rate and trade has different effects on output and inflation and these effects hinder these two variables control simultaneously. In the economic literature, the relationship between output and inflation is considered and measured through the Phillips curve. In fact, the sacrifice ratio of decreased production is due to reduction of inflation resulted from the inverse relationship between unemployment and production in the Phillips curve. If severe increase or decline in the relative prices of some items makes skewness in changes distribution of relative prices in the economy, the increase or decrease in short-term inflation can be seen and the Phillips curve is moved up or down. If we accept the integration of economies such as China in the global trading system causes a sharp decline in the relative prices of the products of these countries in importing countries; and on the other hand, this loss is so severe that it creates skewness to the left in the distribution of relative prices. Then it can appear as a positive momentum in the economy and cause displacement of the Phillips curve to the left and also lower inflation. The proposed theory suggests that the slope of Phillips curve has declined by opening of the economy, so the effect of fluctuations of domestic production will reduce inflation. By increasing the share of international trade in the national economy, the prices of many items produced or consumed within the borders of a country are determined by global supply and demand conditions in the global market. Intense competition abroad limits a sharp rise in price by domestic manufacturers in domestic economic boom. The fluctuations of inflation rate and in other words, the slope of the Phillips curve in an open economy are reduced during the business cycle. In the basic theory, open macroeconomics is recognized that rate of openness has a negative correlation with output losses of policies to reduce inflation (Romer, 1993). By strengthening exchange rate of a monetary contraction, it has a larger direct effect on the price level in open economy and therefore the sacrifice ratio will be smaller by more falling inflation (Barro and Gordon, 1983).

This paper considers and measures the sacrifice ratio for disinflation episode in the countries of OPEC. Sacrifice ratio has been calculated by Ball method being calculation of period to period in terms of output losses in return for one percent reduction in trend inflation. The sacrifice ratio has been measured during the years 1990-2013 and finally the conclusions and policy recommendations are presented.

Theoretical basis of research:

Sacrifice Ratio

There are different views on the relationship between output and inflation in different economic schools. In the classical thought school, some people like Bugatti (1987) and Dornbusch (1989) believe that the

inflation reduces rate of save and on the other hand, increases risk of investment. So that the high rate of inflation leads to the misallocation of investment resources for less productive activities (Tabatabai, 1380). Keynesian economists suggest excess aggregate demand relative to aggregate supply as the main reason of inflation and believe to be sought the main reason of increasing demand in both the goods and money. Rising consumer expenditure, increasing independent investment and factors like them in market of the goods are causing excess demand. Of course, in money market, increasing money leads to excess demand and inflation. Keynesian monetary theory shows that the price level is not appropriately increased under the terms of imperfect employment and due to the increase in the amount of money. Rising made in the actual money lowers interest rate and increases investment and actual output. On the other hand, according to Friedman's monetary theory in the short term an unexpected increase in inflation decreases real wages. As a result, employers offer higher nominal wages and because of incomplete information, workers consider it as higher real wages. The difference is similarly encouraging employers to offer higher employment and also workers to accept the higher employment (Akhtar, 1996). Classical quantity theory believing in money neutrality suggests that when governments make changes in the nominal money, compared to the same, prices changes, too. And the real variables such as employment, output and interest rate remain constant. Monetarist school also considers inflation as a monetary phenomenon. This claim means that the continuous growth of money supply in the economy will lead to inflation. On the other hand, the rate of high inflation is not able to continue without amount of money growth for a long time. The sacrifice ratio is the cost of reducing inflation which should suffer economy of output losses or unemployment to occur a decline in inflation. Sacrifice ratio is defined as the ratio of the percent of reduction in actual output or unemployment to changes in the trend inflation. Since this ratio is a key role in setting monetary policy, economists have estimated the sacrifice ratio. Sacrifice ratio is generally estimated through the Phillips curve and the relationship between output and inflation for a long time series (Okun, 1978- Gordon and king, 1982). In another definition, the sacrifice ratio was defined as the ratio of the percentage of increasing unemployment to reduce inflation rate. In fact, there is a relationship between unemployment and real gross production. Since labor produces goods and provides services (while the unemployed does not do that), it can be expected that rising unemployment rate is associated with a decrease in real gross production. There is a negative relation between unemployment and real gross production called Okun's law. According to this law, production is decreased two percent per one percent increase in unemployment (Okun, 1962). Recently, authors presented some studies by focusing on disinflationary data and also through various methods of estimating, and most of differentiation of these studies is measuring potential output that explain in next part.

Estimation of Sacrifice Ratio

Due to limitations of the Phillips curve in calculating sacrifice ratio as well as calculation of the same values for all episodes; regardless cause of changing price resulted from price expectations or policies of the government or central bank, method of Ball is suggested as an alternative. Taking into account factors affecting the price changes for each episode than other ones, this method calculates different sacrifice ratio and leads to the sacrifice rate is not the same for all episodes of disinflation over the time. According to studies, the permanent reduction of inflation increases the long run growth rate of actual output and also the long run welfare of the society (Barr, 1996- Feldstein, 1999). In fact, the sacrifice ratio is short run cost of inflation reduction imposed as production losses to economy.

$$(1)\ SR = \frac{\sum(y_t - y_t^*)}{(\pi_t - \pi_{t-1})}$$

Formula 1 mentioned the denominator of the sacrifice ratio is the change in trend inflation over an episode-the difference between inflation at the peak and at the trough. The numerator is the sum of output

losses-the deviations between actual output and its "full employment" or trend level (Ball, 1994). First step is to detect episodes in which trend inflation falls substantially. Trend inflation is measured for quarterly data from the moving average of actual inflation for nine quarters. Trend inflation in quarter t is the moving average of inflation from t-4 through t+4. Disinflation occurs when trend inflation falls at least 1.5 percentage point from the peak to trough for annual data. Trend output is calculated from the deviation between actual and potential output and in Ball method, it is used a standard statistical filter called Hodric-Presscott for measuring potential output. To calculate potential output, it is assumed that output is at its trend or natural level at the start of a disinflation episode- at the inflation peak. Four quarters after the end of an episode, output is at its trend level- four quarters after an inflation peak. Moreover, trend output grows log-linearly between the two points when actual and trend output are equal. After Ball, economists like Zhang (2001) and Hofstetter (2006) calculated episode-specific sacrifice ratio with different assumptions from Ball's about the inflation persistence and recurrence of long run output. Zhang (2001) criticized limiting the lasting effects in four quarters, because the sacrifice ratio is estimated less than reality and stability is different in countries. He considered the following assumptions:

1. The potential level of output is at the start of disinflation episode.
2. The recession has some long run effects.
3. After the trough actual output returns the potential level.

In contrast to Ball method, the short run and long run losses are not the same in this method, and it is assumed that there may be a strong lasting impression and even in the long run, recession effects on output and unemployment. Addition to the persistence effects, Hofstetter (2006) regards inflation inertia in calculating the sacrifice ratio. In this way, potential output and losses of output may be before starting disinflation episodes. According to graph 1, trend output and actual output is equal in time zero by Ball and Zhang. In Ball method, actual output refers to the trend level a year after the episode T + 1. While in Zhang method, trend output may not reach actual output in T + 1. In Hofstetter, equality of trend output and actual output delayed for one year. In general, the sacrifice ratio will increase from the method of Ball to Hofstetter.

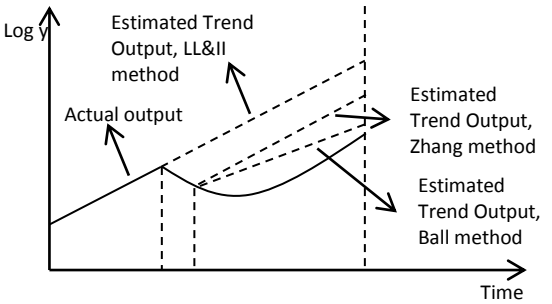


Figure1- comparison of methods Ball, Zhang, Hofstetter.

Variables affecting the sacrifice ratio

In general, all variables affecting the sacrifice ratio are classified in four groups of structural, traditional, institutional, political and external factors. According to countries examined and database in this study, number of these variables are considered.

Table 1: factors influence sacrifice ratio

Structural factors	nominal wage rigidity Openness capital mobility
Traditional factors	Initial inflation Speed of disinflation
Institutional factors	Central bank independence inflation targeting
External and political factors	economic growth relation of trade political factors structural reforms

1. Structural factors: Openness and globalization will affect the sacrifice ratio, but finally according to the degree of openness, influence of the sacrifice rate affects on prices. If an economy has a high degree of openness, changes of the sacrifice rate will be redundant impact on domestic prices.
2. Traditional factors: the initial inflation and speed of reduced inflation are important traditional factors affecting the sacrifice ratio. The first cause of inital inflation or inflation in the beginning of the period is adjusted for inflation. Because the average inflation rate will be influenced by the degree of nominal rigidity and high levels of inflation stickiness reduce prices. Therefore, by adjusting wages and prices, the Phillips curve and the sacrifice ratio are steep and smaller respectively. So, there should be a negative relationship between sacrifice rate and early inflation (Ball, Mankiw and Romer, 1988).
3. Institutional factor: including central bank independence and inflation targeting. Costs of reducing inflation and inflation (sacrifice ratio) could be related to the clarity of monetary policy. Clarity will lead to lower inflation, and moreover, output costs of inflation reduction negatively correlate with the degree of clarity of monetary policy. Central bank independence has a negative effect on the stability of inflation (positive effect on the rate of inflation reduction) and rapid decrease of inflation leads to lower costs of adjusted for inflation. This means that central bank independence has a negative impact on the sacrifice ratio through affecting speed of inflation reduction. The second institutional factor is targeting inflation. It is a framework for monetary policy is determined by a public announcement of the official (or target range) during one or more time horizon for inflation rate as well as by explicit declarations that low and stable inflation is major goal of long-term money policy. Given that inflation targeting debate is a relatively new one and few countries have adopted inflation targeting regime, so the empirical limited studies in this area have been done.
4. External and political factors: economic growth, relation of trade, political factors and structural reforms. Studies in Latin America considers the impact of external factors such as the growth of trade partners and relation of trade on the ratio of dedication. Stability and volatility of terms of trade have negative effect on the ratio of sacrifice. And these economies have greater flexibility and faster economic growth of partners tends to reduce cost of inflation. Political factors may also play a role during adjusted for inflation. In other words, elections and the newly elected government may have appropriate credit conditions in certain short period and the specific time frame can be appropriate to begin reducing inflation and causes the cost of adjusted for inflation reduce. Other factors affecting the sacrifice are

structural reforms, including protection of national markets, facilitating market operations, reducing government intervention in economic activities, and tax reform. Tax reforms do not directly affect on the sacrifice ratio, but it can affect the trendoutput and reduces the cost of adjusted for inflation.

Research Background

A few studies have been done in the sacrifice ratio in domestic studies, but there are rich foreign studies in this case which have not been investigated for the Iranian economy and countries in the same group. Eltajaei and Riahi (1391) in an article entitled "Factors affecting the production cost of adjusted for inflation in developing countries" has calculated the sacrifice ratio for forty developing countries by SVAR structural three variables model for the years 1985- 2008. Using cross-country data shows that the initial inflation and degree of central bank independence have a negative effect on sacrifice ratio, and this ratio receives a positive effect from capital mobility and openness.

Nasirzadeh, Nonezhad and Ebrahami (1391) in an article "openness, output-inflation trade-off and inflation in organization of Islamic cooperation countries", assess the impact of openness on output-inflation trade-off and inflation for the period 2008-1990. It has used the method of least squares (LS) and also heteroskedasticity test, and the results show that openness reduces inflation average of OIC member states and increases output-inflation trade-off.

Farzin Vash and Ali Nejad (1386) in the article "The estimation of sacrifice Ratio of output-inflation (Iran)", considered the effects of monetary policy on growth rate of actual output and inflation through SVAR four-variable method. They concluded that in Iranian economy, after a period of five or six years, achieving the low inflation is possible via higher growth rate, and one percent reduction in inflation is not only lowers the growth of output, but increases it 2.27%. In foreign literature, rich studies have been done for sacrifice ratio. Ball (1994) in an article titled "How to determine the sacrifice ratio" examined the sacrifice ratio from 1994 to 1960 in moderate-inflation countries of the organization of economic cooperation and development (OECD). At first, he studied the structure of sacrifice ratio and then by identifying disinflation episodes and trend inflation, calculated different sacrifice ratio during episodes. The results show that first, the sacrifice ratio is decreasing in the speed of disinflation. Second, the ratio is lower in countries with more flexible labor contracts. The openness does not have any effect on the sacrifice ratio and the initial effects of inflation and incomes policy are not clear.

Bowdler (2009) calculated the sacrifice ratio through the Phillips curve method in the article "openness, exchange rate regime and the Phillips curve" and considered the slope of the Phillips curve from 1998 to 1981 for most countries. Regressions based on the new measures indicate that the Phillips curve slope increases with trade openness amongst countries maintaining flexible and semi-flexible exchange rate regimes, but is unrelated to openness amongst countries maintaining fixed exchange rate regimes.

Daniel and Van Hoose (2013) in an article "exchange rate pass through, openness and sacrifice ratio", assessed the effect of exchange rate pass through, its condition and the effect of openness on the sacrifice ratio for 20 OECD members during years of 2004-1975 using panel data model. The results show that the large exchange rate pass through increases the sacrifice ratio while there is a significant interaction among

exchange rate pass through and openness, and openness exerts an empirically ambiguous effect on the sacrifice ratio.

In article "Sacrifice Ratio and Cost of Inflation for the Indian Economy", Dholakia (2014) suggests that ttraditional concept of the Sacrifice Ratio measures the loss of potential output sustained by the society in the medium term to achieve reduction in the long-run inflation by one percentage point. This concept is critically examined and generalized to include episodes increasing the long-run inflation rate to gain higher growth of output and employment and hence reduction in the poverty proportion in the medium term. Results shows that Sacrifice Ratio turns out to be in a narrow range of 1.8 to 2.1 for deliberate deflation and 2.8 for inflation in India.

Research methodology

Data, Variables and panel data

The population of this research is 10 selected OPEC member countries, Algeria, Ecuador, Iran, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arabic Emirates and Venezuela. Period is used 1990-2013. Time series data from these countries have been collected from WDI, IFS CD, OPEC bulletin, central bank of Iran. The model presented in this research paper inspired by Daniels and VanHoose (2013) is as follows:

(2) SAC = F (inflation, dinflation, Length, Openness, Passthrough)
(3) SAC = C (1)*INF + C (2)*DINF + C (3)*LEN + C (4)*OPEN + C (5)*PASS + C (6)
Sac: dependent variable that show sacrifice ratio measured by divided trend outpour into trend inflation during disinflation episodes.
Inf: independent variable shows initial inflation. Initial inflation is inflation at the start of disinflation episodes.
Dinf: independent variable show changes in inflation from peak to trough.
Len: length shows period of disinflation and define as years of disinflation.
Open: degree of openness as an independent variable measured by divided import into gross domestic product.
Pass: exchange rate pass through estimated by Campa and Goldberg (2005):
$P_t = \alpha + \delta\omega_t + \beta e_t + \varphi Y_t + \varepsilon_t$ (4)
P_t: Local currency import price
e_t: exchange rate
ω_t: primary control variables representing exporter costs
Y_t: vector of other controls

For exchange rate pass through and openness variables we use average data for every countries in final estimation.
Panel data is data from a number of observations over time on a (usually large) number of cross sectional units like individuals, households, firms, or governments. In other words panel data analysis is a method of studying a particular subject within multiple sites, periodically observed over a defined time frame. With repeated observations of enough cross-sections, panel analysis permits the researcher to study the dynamics of change with short time series. The combination of time series with cross-sections can enhance the quality and quantity of data in ways that would be impossible using only one of these two dimensions (Gujarati, 2003). Some more advantages of panel data as given in 'Basic Econometrics' by Gujarati are:

- Since panel data relate to individuals, firms, states, countries, etc. over time, there is bound to be heterogeneity in these units. The techniques of panel data estimation can take such heterogeneity explicitly into account by allowing for individual-specific variables.
- By studying the repeated cross section of observations, panel data are better suited to study the dynamics of change.
- Panel data can better detect and measure effects that simply cannot be observed in pure cross section or pure time series data.
- By making data available for several thousand units, panel data can minimize the bias that might result if we aggregate individuals or firms into broad aggregates.

This study used panel data for estimation model and because of that first variables checking out with unit root test stationary. Unit root test can be done to prevent fake regression estimates. If variables were stationary, estimation does not have fake regression problem and classical tests of t and f statistic test will be valid. But for no stationary variables cointegration test should be done. At least we could estimate model with Dynamic Ordinary Least Square method.

The Analysis of Data

We have used Levin Lin Chu and Im Pesaran Shin such as unit root test and Johansen Fisher test for unbalanced data cointegration analysis. At least DOLS method for estimate model (3).

Results of panel unit root test and cointegration test

Table 1 and 2 show the result of unit root test. The Levin Lin Chu and Im Pesaran Shin as more useful test of panel unit root tested. The null hypothesis is that the series contains a unit root, and the alternative is that the series is stationary.

Table 1: The Levin Lin Chu unit root test results

variables	Level		1st difference		
	Statistic	Prob.	Statistic	Prob.	
SAC	-4.72	0.00	-	-	I(0)
Inf	-4.70	0.00	-	-	I(0)
Dinf	-6.20	0.00	-	-	I(0)
Len	-4.53	0.00	-	-	I(0)
Open	-3.21	0.00	-	-	I(0)
Pass	-1.33	0.09	-6.23	0.00	I(1)

Table 2: Im Pesaran Shin unit root test results

variables	Level		1st difference		
	Statistic	Prob.	Statistic	Prob.	
SAC	-4.11	0.00	-	-	I(0)
Inf	-3.67	0.00	-	-	I(0)
Dinf	-5.02	0.00	-	-	I(0)
Len	-6.69	0.00	-	-	I(0)
Open	-2.77	0.00	-	-	I(0)
Pass	-1.57	0.06	-5.03	0.00	I(1)

According to table 1 and 2 unit root test results show that all variables are stationary. P statistics show that sacrifice ratio, inflation, inflation change, length and openness are stationary at level but pass through is non-stationary at level (but stationary at first difference). After unit root test we should test

cointegration of variables and because of unbalanced data Johansen Fisher test is used. Maximum eigenvalue and trace tests for cointegration show that at whole there is strong cointegrated relation between variables.

Research Findings

According model (3) that introduced we determine the relation of sacrifice ratio on variables like inflation, dinflation, length, openness and pass through. Results are presented in table 3.

Table 3: Results of DOLS estimation model

variables	PASSTHROUGH	OPENNESS	LENGTH	DINFLATION	INFLATION	c
coefficient	-1.435	-0.085	0.359	0.117	-0.102	1.606
probability	0.025	0.015	0.201	0.018	0.012	0.051
T statistics	-2.492	-2.747	1.337	2.649	-2.864	2.116

$$SAC = -0.102INFLATION + 0.117DINFLATION + -0.085OPENNESS + -1.435PASSTHROUG$$

Results show that variables except length was statistically significant. Inflation, openness and pass through have a negative relation and inflation change has a positive relation on sacrifice ratio during 23years in 10 selected countries. P-Value of length is more than 0.05 and there is no clear relation with sacrifice ratio. As results show with a 1% increase in inflation change, sacrifice ratio 0.11 increase and for inflation, openness and pass through with a 1% increase, sacrifice ratio in order 0.1, 0.08 and 1.43 decrease.

Conclusion:

This paper discusses the relationship of sacrifice ratio with the some variables affecting the sacrifice ratio. The sacrifice ratio (output losses) means cumulative reduction of output to non-cumulative inflation in response to contractionary monetary shock. If the national monetary authorities recognized that inflation is high and should be reduced, it can be accomplished by policies such as credit policy of commercial banks restrictions and changes in interest rates. But some economists believe that monetary contraction causes the contraction of economic activity and reduces output. Consideration of the sacrifice ratio and the factors having an impact on this ratio can be used as a policy manual and offers useful information to policy makers about the consequences of the imposed policies. So that the high sacrifice ratio represents relatively severe recession sustain real economic activity. And if the sacrifice ratio is interpreted for output profit, it means that high inflation has been imposed to economy for reaching further growth. This study has calculated sacrifice ratio from 1990 to 2013 for 10 countries of OPEC and estimated cointegration panel data for evaluating the model. It has calculated variable of initial inflation (inflation at the start of disinflation episodes), changes in inflation (inflation differences at the beginning and end of the disinflation episodes), the degree of openness (imports divided by GDP), the degree of exchange rate pass through (calculated using linear logarithmic regression) and length (disinflation periods in year) for the above mentioned countries. By using dynamic ordinary least squares (DOLS), it was concluded that The effect of initial inflation, openness and exchange rate pass through have a negative and positive

relation to the sacrifice ratio and changes of inflation, respectively. Moreover, the variable of length does not a significant relationship with the sacrifice ratio.

Practical suggestions:

The main limitation in these studies is lack of information and statistics related to long periods for reliable and generalized assessing in the future. As well as the specific economic features of each country including the policy of the authorities and the country's ability to reduce inflation and ultimately control it, cause the computational data for countries considered in this study. As a result of these limitations have not provided the possibility of consideration of all the factors that affect sacrifice ratio. Investigating the interactions of variables affecting the sacrifice ratio along with individual effects of these variables for future studies as well as cross-country considerations are recommended for right policy proposal. However, the general policy recommendations are offered in this case. Negative relationship of the sacrifice ratio with trade openness can mean if index of globalization increases in the studied countries, sacrifice ratio should decrease. As wide trade, capital mobility and manufacturing resources and through a positive impact on output and investment and the country's employment level in the world, such relationship can be expected. And the benefits of globalization can be named at first time, leading to low output losses and reduction of inflation. In this case, creating mechanisms of monetary policy clarification, enhancing the credibility of monetary authorities, inflation targeting and reducing the stickiness of wage and price resulting from nominal contracts strengthen this relation. Despite Primary High inflation in many countries, the negative relationship between Initial inflation and sacrifice ratio shows that policy makers, according to high inflation rate in these countries, impose the policy of adjusted for inflation without concern because the more rate of initial inflation, the lower cost of adjusted for inflation. Therefore, monetary authorities for further credibility monetary policy must take measures such as efforts to provide the preconditions for inflation targeting and announcement of specific and explicit inflation targets, especially for Iran, timely notification and clarification in response and studying the successful experiences of industrialized countries.

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