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Sacrifice Ratios, Benefice Ratios, and Globalization: Evidence from a New Set of Estimates

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Abstract

This paper revisits the effect of globalization on the output-inflation trade-off, using a new data set of 1114 sacrifice and benefice ratios for a large cross-section of 118 countries over the time period 1966−2007, which is calculated following the approach of Jordan (1997). In line with previous studies our estimates suggest that larger (dis)inflations, effected over a short period, starting from high levels of inflation are associated with smaller sacrifice and benefice ratios. Globalization in terms of financial and trade openness has increased sacrifice and benefice ratios, with financial openness superseding the role of trade openness in importance since the 1990s.

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1. Introduction

Recent studies suggest that globalization (in terms of trade and financial openness) has reduced inflation through its effect on the sacrifice (benefice) ratio, which is defined as output loss per percentage point reduction in inflation over a disinflation period (output gain per percentage point increase in inflation during an inflation period). But while there is some consensus emerging on the view that globalization has dampened inflation, there is no agreement on how a country's sacrifice ratio is affected through globalization. From a theoretical perspective, both a negative (Romer (1993), Lane (1997)) and positive (Razin and Loungani (2007), Daniels and VanHoose (2006) and (2009)) relationship between the sacrifice ratio and openness are conceivable and may be reconciled with a dampening effect of globalization on inflation. A negative effect can arise from larger negative terms-of-trade effects from monetary expansions in more open economies as in Romer (1993). Under imperfect competition as in Daniels and VanHoose (2006), a positive effect on the sacrifice ratio arises since increased openness contributes to a reduced pricing power of domestic firms. Hence, the relationship between the sacrifice ratio and globalization remains an empirical issue, but the empirical literature is ambiguous so far.

Temple (2002) fails to find a robust relationship between trade openness and the sacrifice ratio and questions the link between inflation and openness. Bowdler (2009) finds a negative effect of trade openness, whereas Daniels et al. (2005) show that once central bank independence is controlled for, openness becomes a significant determinant of the sacrifice ratio (with a positive sign). However, evidence on the role of financial openness is still sparse. Daniels and VanHoose (2009) and Badinger (2009) established a positive effect of financial openness on the the sacrifice ratio and the output-inflation trade-off respectively.

So far, most previous studies on the effects of openness on sacrifice ratios have used the data set by Ball (1994), which is restricted to 65 sacrifice ratios (disinflation periods) for 19 OECD countries over the period $1960-1991$.[1] Studies using larger cross sections of countries have used the regression approach suggested by Lucas (1973) and Ball et al. (1988) to calculate (time-invariant) output-inflation tradeoffs.

In light of the partly conflicting results on the relation between sacrifice ratios and globalization, the lack of comprehensive evidence on the role of financial openness, and the restricted country and time coverage of previous studies, more empirical work on this subject using new and extended data on sacrifice and benefice ratios seems warranted.

The present paper provides new evidence on the determinants of sacrifice and benefice ratios in general, and on the effect of globalization in terms of financial and trade openness in particular. We calculate a new data set of sacrifice and benefice ratios for a set of 118 countries over the period $1966-2007$, following the approach suggested by Jordan (1997), which is less data demanding than the one of Ball (1994). This is the most comprehensive data set on sacrifice and benefice ratios used so far, which allows us to substantially increase the number of observations and to focus on episodes where the sacrifice and benefice ratios have the correct sign. We set up an encompassing model for both inflation and disinflation periods and test for differences between the effects of alternative explanatory variables during inflation and disinflation periods, time periods, and groups of countries.

[1] Bowdler (2009) provides an update until 1998.

The remainder of this article is organized as follows: Section II describes the calculation of the sacrifice and benefice ratios and sets up the empirical model. Section III presents the estimation results. Section IV concludes.

2. Calculation of Sacrifice and Benefice Ratios

Following Jordan (1997), sacrifice (benefice) ratios are defined as cumulative output loss (gain) relative to potential output, divided by the decrease (increase) in inflation over disinflation (inflation) episodes.[2] Episodes are defined by peaks and troughs of trend inflation, which are identified by three criteria. A year t is a peak (trough) if i) trend inflation is higher (lower) than in $t-1$ and $t+1$, ii) the inflation difference between peaks and troughs must be at least 1.5 percentage points, and iii) a peak (trough) must be followed by a trough (peak), which fulfills condition ii). By construction, each inflation (disinflation) episode is followed by a disinflation (inflation) episode.

For each country, trend inflation is defined as moving 8-quarter average of relative CPI changes.[3] Potential output is assumed to be equal to actual output at the beginning of each episode, and trend output growth is set to average annual output growth over the (country-specific) sample period. Data on CPI inflation and real GDP come from the IFS database of the IMF, supplemented by the World Bank's WDI database where no data on real output was available in the IFS database.

In contrast to Ball (1994), the approach by Jordan (1997) divides the whole period into alternating inflation and disinflation episodes, where each episode must have a change in trend inflation of at least 1.5 percentage points. This rules out that one disinflation period is broken up into two consecutive disinflation periods, where the inflation rate at the end of the first episode is (almost) the same as the one in the second episode. Moreover, Jordan (1997) assumes constant growth of trend output, whereas Ball calculates trend growth assuming that actual and potential output is the same at the beginning of and one year after the disinflation episode, making the estimates very sensitive with respect to output values in a particular year. Comparing the approach by Jordan (1997) to the regression approach of Ball et al. (1988), which is based on the theoretical model by Lucas (1973), its advantage is that it allows to calculate time-varying measures of both sacrifice and benefice ratios, without running into a degrees of freedom problem (which, of course, comes at the cost of imposing more restrictive assumptions on the stochastic properties of the model).

Our sample comprises 118 countries over the period $1966-2007$.[4] Overall, we identify 1114 inflation and disinflation episodes, of which a subset of 600 sacrifice and benefice ratios show the correct (positive) sign. Our large sample allows us to focus on correctly signed ratios, where changes in inflation and output growth are most likely to reflect demand side effects of restrictive (expansionary) monetary policy rather than shocks

[2]Hence, for a given period, the sacrifice (benefice) ratio is inversely related to the output-inflation trade-off parameter in a standard Lucas supply curve.

[3]Quarterly inflation rates are only available for a small subset of countries; however, the IFS of the IMF provides annual inflation rates at a quarterly frequency, such that we can calculate (annual) 8 quarter averages of inflation as average of two consecutive (mid-year) annual inflation rates.

[4]We always use to longest time period, for which data on CPI inflation and real GDP were available in the IFS and WDI database. Hence, depending on data availability, for some countries, the series start after 1966 or end before 2007.

from the supply side, fiscal policy changes, or economic or financial crises, which might systematically distort and aggravate the interpretation of the estimates.

3. Empirical Model and Data

Our baseline empirical model is an augmented version of Ball et al. (1988), including trade and financial openness as measures of globalization:

$$\begin{aligned}\ln R_{i,t_i} = \beta_0 + \beta_1 \ln(Y/L)_{i,t_i} + \beta_2 \pi_{i,t_i} + \beta_3 L_{i,t_i} + \beta_4 \ln|\Delta\pi_{i,t_i}| + \beta_5 \ln TO_{i,t_i} + \beta_6 \ln FO_{i,t_i} \\ + \beta_7 D^{BR} + \beta_8 \ln(Y/L)_{i,t_i} \times D^{BR} + \beta_9 \pi_{i,t_i} \times D^{BR} + \beta_{10} L_{i,t_i} \times D^{BR} \\ + \beta_{11} \ln|\Delta\pi_{i,t_i}| \times D^{BR} + \beta_{12} \ln TO_{i,t_i} \times D^{BR} + \beta_{13} \ln FO_{i,t_i} \times D^{BR} + u_{i,t_i}.\end{aligned} \tag{1}$$

The dependent variable $\ln R_{i,t_i}$ is country i's sacrifice (benefice) ratio during the disinflation (inflation) period starting in period t_i.[5] In our analysis, we include only correctly signed benefice and sacrifice ratios, which allows us to use a log specification and mitigate problems related to outliers from high inflation periods and heteroskedasticity. While there is no reason to focus on disinflation periods (i.e., on sacrifice ratios) only a priori from a theoretical perspective (West, 2008), we will nevertheless explicitly test for parameter heterogeneity with respect to inflation and disinflation episodes by including interaction terms of all variables with the dummy D^{BR}, taking a value of 1 if the observation reflects an inflation episode (benefice ratio) and zero otherwise. Central bank independence, which has been included in previous studies, is omitted from our baseline model, since this would substantially reduce our sample size for reasons of data availability, both in the cross-country and time dimension.[6] Instead we include real GDP per capita at the beginning of the inflation (disinflation) episode $\ln(Y/L)_{i,t_i}$ as indicator of the level of development and the quality of institutions, π_{i,t_i} is initial inflation (in percent/100), L_{i,t_i} is the length of the (dis)inflation episode in years, and $|\Delta\pi_{i,t_i}|$ is the absolute change in inflation over the respective episode. Finally, TO_{i,t_i} is initial trade openness, defined as imports plus exports as share of GDP, and FO_{i,t_i} is initial financial openness, defined as external assets plus liabilities as share of GDP. Real GDP per capita and trade openness come from the Penn World Tables 6.2, financial openness from Lane and Milesi-Ferretti (2006).

4. Estimation Results

We start from a general version of equation (1), allowing all parameters to differ between disinflation and inflation episodes by including interactions terms of all variables with

[5] There is more than one episode for each country, but we do not add another index to t_i for the sake of notational simplicity.

[6] We experimented with smaller sub samples including initial central bank independence (using the Cukierman et al. (1992) and Polillo and Guillén (2005) data), but even in the parsimonious equations, we could not identify a significant effect of CBI. Another variable that is not available for our sample of countries and time period is wage duration; while including this variable might be desirable from a theoretical perspective, previous studies have found no crucial role of this variable (e.g., Daniels et al. (2005)).

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Table 1: *Estimation Results for Equation (1)*

	Dependent variable $\ln R_{i,t_i}$										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
D^{BR}	-0.342	-0.388**	-0.254	-0.249	-0.250	-0.510	-0.416	-0.216	-0.183	-0.435	-0.434
	(0.228)	(0.191)	(0.219)	(0.218)	(0.219)	(0.326)	(0.336)	(0.241)	(0.251)	(0.270)	(0.268)
$\ln(Y/L)_{i,t_i}$	0.080	0.037	0.029	0.019	0.021	-0.054	-0.074	0.081	0.070	-0.578	-0.760*
	(0.049)	(0.046)	(0.049)	(0.049)	(0.049)	(0.091)	(0.090)	(0.055)	(0.060)	(0.456)	(0.387)
π_{i,t_i}	-0.015***	-0.011**	-0.016***	-0.011**	-0.014***	-0.003	-0.008	-0.022***	-0.023***	-8.316***	-5.163*
	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.007)	(0.005)	(0.005)	(0.006)	(2.893)	(2.910)
$\pi_{i,t_i} \times D^{BR}$	-0.884**	-0.747*	-0.956**	-0.755*	-0.861**	-0.596	-0.885	-1.180**	-1.100**		
	(0.406)	(0.386)	(0.407)	(0.407)	(0.402)	(0.603)	(0.669)	(0.460)	(0.453)		
L_{i,t_i}	0.194***	0.202***	0.198***	0.198***	0.197***	0.280***	0.287***	0.137***	0.138***	0.137***	0.125***
	(0.037)	(0.035)	(0.035)	(0.035)	(0.034)	(0.048)	(0.047)	(0.038)	(0.039)	(0.040)	(0.033)
$L_{i,t_i} \times D^{BR}$	0.160***	0.172***	0.116**	0.115**	0.115**	0.144*	0.132*	0.158***	0.119*		
	(0.055)	(0.046)	(0.056)	(0.056)	(0.056)	(0.077)	(0.079)	(0.059)	(0.063)		
$\ln\lvert\Delta\pi_{i,t_i}\rvert$	-0.784***	-0.788***	-0.792***	-0.791***	-0.787***	-0.919***	-0.910***	-0.707***	-0.739***	-0.459**	-0.619***
	(0.052)	(0.048)	(0.050)	(0.050)	(0.050)	(0.096)	(0.094)	(0.061)	(0.064)	(0.211)	(0.187)
$\ln TO_{i,t_i}$		0.193***		0.199**		0.124		0.240***		0.182	
		(0.062)		(0.086)		(0.145)		(0.071)		(0.117)	
$\ln FO_{i,t_i}$			0.111**	0.034			0.258***		0.070		0.286***
			(0.052)	(0.065)			(0.092)		(0.074)		(0.081)
$\ln$ TO$_{i,t_i}$+$\ln$ FO$_{i,t_i}$					0.100***						
					(0.033)						
Constant	0.344	-0.041	0.859*	0.104	0.503	1.067	1.599*	-0.616	0.530	6.729	9.270**
	(0.462)	(0.468)	(0.448)	(0.564)	(0.450)	(0.903)	(0.839)	(0.563)	(0.545)	(4.775)	(3.980)
R^2	0.490	0.550	0.547	0.551	0.550	0.609	0.621	0.498	0.481	0.371	0.453
RMSE	1.158	1.034	1.050	1.046	1.046	1.040	1.034	1.055	1.082	0.891	0.807
N	582	574	501	501	501	187	180	389	323	109	89

[1] * p<0.10, ** p<0.05, *** p<0.01

[2] Columns (6) and (7) refer to the period after 1990, columns (8) and (9) to the period before 1990. Columns (10) and (11) show the results for the OECD sub sample.

the dummy D^{BR}. To ensure that our results are not driven by outlying observations, we exclude observations where the standardized residuals exceeded an absolute value of three in all specifications. Accounting for data availability of the explanatory variables, this yields a data set with more than 500 observations in the baseline regressions, which is the most comprehensive data set used in this strand of the literature so far.

The corresponding (restricted) baseline specification is given in column (1) of table 1 and confirms findings of previous studies: the length of the (dis)inflation episode has a positive effect, initial inflation has a negative effect, and both are larger in magnitude for benefice ratios (inflation periods). The size of (dis)inflation is associated with smaller sacrifice and benefice ratios. $\ln(Y/L)_{i,t_i}$ has a positive sign but turns out insignificant with a p-value slightly above 10 percent. The interaction term with D^{BR} turned out significant only for the length of the episode L_{i,t_i} and initial inflation π_{i,t_i}, suggesting a difference between disinflation and inflation episodes.

In columns (2) and (3), we add trade and financial openness, respectively. Both variables enter significantly with a positive sign. Moreover, the interaction with D^{BR} turned out insignificant for both openness measures, suggesting that the effect of globalization on the output-inflation trade-off does not differ significantly between inflation and disinflation episodes.[7] Column (4) includes trade and financial openness jointly; as expected, the high degree of collinearity between the two variables increases the standard errors, yielding an insignificant effect for one of the two measures. Since an F-test cannot reject that the parameters of the two openness measures are identical, column (5) shows the restricted specification, including a joint openness measure which turns out significant and where again the interaction with D^{BR} is insignificant.

Columns (6) and (7) report the results including trade and financial openness for the period (with the starting year of the (dis)inflation episode) as of 1990; columns (8) and (9) show the corresponding results for the period up to 1990. Interestingly, trade openness turns out insignificant in the more recent period as of 1990, whereas financial openness is insignificant in the period before 1990. This result turns out to be very robust and holds up when we exclude high inflation episodes (with initial inflation larger than 30 percent), when we drop the insignificant interaction terms in columns (6) and (7), and also when we use the full data set including outliers.

The final two columns (10) and (11) show the results for the subgroup of OECD countries used, e.g., in Temple (2002) and Daniels et al. (2005), where insignificant interaction terms have been dropped. It turns out that for the OECD countries, the strong role of financial openness is confirmed, while trade openness is less robust and rendered insignificant with a p-value slightly above 10 percent.

5. Conclusions

This paper constructs a new data set of 1114 output-inflation trade-offs for a large cross-section of 118 countries, covering the time period $1966-2007$ and distinguishing between sacrifice ratios (disinflation episodes) and benefice ratios (inflation episodes). Our estimates confirm several findings of previous studies, namely a positive effect of the length

[7] Note that columns (2) and (3) show the restricted models without insignificant interaction terms for the sake of brevity.

of (dis)inflation episodes, a negative effect of the initial level of inflation, and a negative effect of the magnitude of (dis)inflation. Moreover, we find i) a positive (and–in statistical terms–quantitatively identical) effect of globalization on benefice ratios and sacrifice ratios, suggesting that the output-inflation trade-off is a proper variable in this strand of the literature and ii) that globalization has affected sacrifice and benefice ratios primarily trough the channel of trade openness before 1990 and primarily through the channel of financial openness since 1990. Also for the sub sample of OECD countries we find a stronger role of financial openness, both in terms of economic and statistical significance. Overall, this suggests that increased attention should be paid to financial openness in future theoretical and empirical research on the effects of globalization on the output-inflation trade-off.

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Appendix

Table A1: *Summary Statistics*

	R_{i,t_i} [PPP$/%]	$(Y/L)_{i,t_i}$ [PPP$ per person]	π_{i,t_i} [%]	L_{i,t_i} [years]	$\lvert\Delta\pi_{i,t_i}\rvert$ [%]	$\ln TO_{i,t_i}$ [%]	$\ln FO_{i,t_i}$ [%]
	Full sample (116 countries, 582 observations)						
mean	3.17	7709	67.79	3.69	49.59	71.53	151.30
median	1.24	4405	7.12	3.00	7.27	60.22	86.46
min	0.00	436	-7.05	1.00	1.50	0.85	11.91
max	68.06	46246	12231.30	24.00	12107.61	425.34	10192.20
std.dev.	5.63	7714	711.90	2.70	542.32	46.56	484.43
	OECD (19 countries, 109 observations)						
mean	5.01	18101	6.45	5.17	6.38	59.72	269.16
median	2.50	17614	4.74	4.00	5.03	51.90	92.43
min	0.15	6355	-6.45	1.00	1.50	9.96	21.70
max	59.48	39674	21.52	24.00	25.00	225.12	10192.20
std.dev.	7.87	5294	5.63	3.53	4.57	39.82	1081.20
	Non-OECD (97 countries, 473 observations)						
mean	2.74	5314	81.93	3.34	59.55	74.25	125.92
median	1.05	3458	8.01	2.00	8.09	64.60	85.40
min	0.00	436	-7.05	1.00	1.57	0.85	11.91
max	68.06	46246	12231.30	16.00	12107.61	425.34	2221.93
std.dev.	4.89	6013	789.15	2.35	601.25	47.60	179.37