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Abstract: Our empirical analysis reveals a strong systematic inverse link between financial openness and CPI inflation in over 100 countries, adding weight to the argument that inflation in financially open economies is lower. Trade openness in contrast bears no systematic relationship to inflation.

Keywords: Financial Openness, Trade Openness, Inflation, Capital Controls

JEL Classifications: E3, E5, F3

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A series of influential papers (e.g. Romer (1993), Lane (1997)) examine the hypothesized negative connection between trade openness and inflation in a cross-country context during the 1970s and 1980s. This paper explores the connection between an alternative measure of openness - financial openness - and inflation over the 1997-2016 period. Our results point to a much closer inverse linkage between inflation and financial rather than trade openness in a sample of more than 100 countries.

2. A Simple Model

To illuminate how financial openness impacts inflation, we propose a stripped-down small open economy model. It consists of a Phillips curve, an interest rate parity relation, and a Taylor rule:[1]

$$\pi = \kappa y + bq + u \qquad (1)$$

$$r = r^f - \phi(r^f - r + \varepsilon) - q + \varepsilon \qquad (2)$$

$$r = \gamma_1 y + \gamma_2 r^f + \gamma_3 \pi \qquad (3)$$

$\pi =$ rate of (domestic) inflation, y = output gap, q = real exchange rate (an increase denotes a depreciation of the domestic currency) , r = real rate of interest, r^f = exogenous foreign real rate of interest. All parameters are positive. u and ε are white noise disturbances.

In addition to the output gap, the real exchange rate exerts a direct effect on the rate of inflation in equation (1), the Phillips curve (e.g. Svensson (2000), Ball (1999), Froyen and Guender (2017, 2018)). The term $\phi(r^f - r + \varepsilon)$ in the parity condition of equation (2) indicates that the policymaker has the ability to impose an interest equalization tax. Such a tax has been applied at times to curb undesirable large capital flows that destabilize nominal and real exchange rates and possibly endanger the health of the domestic financial sector (Dornbusch (1986), Benavie and Froyen (1991), Blanchard (2016), and Davis and Presno (2017)). Setting ϕ = 1 equalizes interest returns on domestic and foreign assets, thereby stifling cross-border capital movements, and thus allows the policymaker to stabilize the exchange rate. In the absence of such a tax ($\phi = 0$), capital flows freely and the real exchange rate responds to the shocks of the model.[2] In essence, the size of the parameter ϕ reflects the inverse degree of openness of the capital account which is an important barometer of financial openness of an economy. Monetary policy is implemented via a Taylor-type rule as shown by equation (3). The parameter γ_2 indicates the extent to which the stance of domestic monetary policy follows the "world" interest rate (Klein and Stambaugh (2015), Davis and Presno (2017)).

Combining equations (1) – (3) yields the following relation between the rate of inflation and its drivers:

[1] The model is intentionally kept simple to focus on the key issue. For this reason, forward-looking inflationary expectations or lags of inflation are omitted in the Phillips curve as is the expected real exchange rate in the parity condition. The inflation target is normalized to zero.

[2] The policymaker observes the risk premium shock when setting the tax parameter ϕ.

$$\pi = \left(\frac{\kappa - (1-\phi)\gamma_1 b}{1+\gamma_3 b(1-\phi)}\right) y + \frac{(1-\phi)b}{1+\gamma_3 b(1-\phi)}\left((1-\gamma_2)r^f + \varepsilon\right) + \frac{u}{1+\gamma_3 b(1-\phi)} \quad (4)$$

The factors that influence the rate of inflation are aggregate demand through the output gap (*y*), the foreign interest rate (r^f) and a risk premium shock (ε), as well as a cost-push shock (*u*). Notice that the tax parameter ϕ affects the response of inflation to all four factors.

To appreciate how financial openness is related to inflation, consider two extreme cases. First, let $\phi = 0$. The capital account is completely open. There are no barriers to the movement of capital and the standard parity condition holds. In this case, equation (4) takes the following form:

$$\pi = \left(\frac{\kappa - \gamma_1 b}{1+\gamma_3 b}\right) y + \frac{b}{1+\gamma_3 b}\left((1-\gamma_2)r^f + \varepsilon\right) + \frac{u}{1+\gamma_3 b} \qquad (5)$$

For the case where the full interest equalization tax applies the capital account is essentially closed and $\phi = 1$. Equation (4) reduces to:

$$\pi = \kappa y + u \qquad (6)$$

Equation (6) underscores that when cross-border capital movements are suppressed through the equalization tax, the behavior of inflation coincides with the standard representation of a closed-economy Phillips curve.

A simple comparison of coefficients reveals the relationship between financial openness and inflation. Comparing the coefficients on the two factors that are common to both equation (5) and equation (6), the output gap and the cost-push shock, we find that

$$\left(\frac{\kappa - \gamma_1 b}{1+\gamma_3 b}\right) < \kappa \qquad (7a)$$

$$\left(\frac{1}{1+\gamma_3 b}\right) < 1. \qquad (7b)$$

The response of inflation to the output gap and a cost-push shock is smaller in a more financially open economy.[3]

In marked contrast, under a completely open capital account the foreign interest rate and a risk premium shock affect the rate of inflation. The effect of the former factor on inflation can be dampened by choosing a non-trivial value for the policy parameter γ_2 , $0 \leq \gamma_2 \leq 1$.[4]

3. Empirical Analysis

The seeming ambiguity in the relationship between financial openness and inflation in the model prompts us to examine the connection empirically. Our sample comprises 139 countries and covers the 1997-2016 period. The cross-country dataset consists of annual

[3] Typical parameter values for $\kappa, \gamma_1, \gamma_3$ and *b* are 0.1, 0.5, 1.5, and 0.1, respectively.

[4] It must be borne in mind that the policymaker has an extra degree of freedom through the ability to set the tax parameter. Choosing $\gamma_2 = 1$ still leaves room for responding to the output gap and the rate of inflation in the Taylor rule.

observations drawn from the World Bank database (2019a, b) and the KOF (Swiss Institute of Technology). The latter compiles a comprehensive index that tracks the degree of financial openness of economies worldwide (Gygli, Haelg, and Sturm (2019)).[5] This index will serve as our measure of financial openness.

In line with previous investigations (e.g. Romer (1993), Lane (1997)) we posit that openness influences trend inflation. For this reason, we employ average inflation in the test equation which also includes a set of control variables:

$$\ln(\pi^{CPI}) = \alpha + \beta_1(financial\ openness) + \beta_2 \ln(GDP) + \beta_3 \ln(GDP\ per\ capita) + \beta_4(political\ stability) + \beta_5(exchange\ rate\ volatility) + \beta_6(measure\ of\ central\ bank\ independence) + \beta_7(D^{IT}) + e \quad (8)$$

$\ln(\pi^{CPI})$= natural log of average inflation in a country over the sample period.[6] Financial openness of a country's economy is represented by the KOF financial globalization index. Other factors that are thought to affect the rate of inflation are described next. The inclusion of a country's level of GDP (in log form) is meant to capture the terms of trade effect. Lane (1997) hypothesizes that this effect is negative and moves in line with the level of GDP. Per capita GDP (in log form) captures the level of development of a country. The more advanced a country is, the better its ability to raise revenue through taxes other than the printing press, resulting in lower inflation. The third control variable is a political stability index[7] based on the likelihood of politically motivated instability and violence. Greater political stability is conjectured to lead to lower inflation. To account for the possible effect of exchange rate regimes on inflation, we also add the standard deviation of the nominal exchange rate to the test equation.[8] The final control variables are measures of the degree of central bank independence and a distinction between inflation-targeting and non-inflation targeting central banks. Greater independence and an explicit commitment to targeting inflation should be associated with lower inflation outcomes.

Table 1 shows the empirical estimates of the relevant coefficients, their standard errors, and the adjusted R^2. We estimate different variants of the test equation, beginning with a simple specification and adding one explanatory variable at a time. Inspection of the reported coefficient estimates of financial openness reveals that they are consistently negative and statistically significant in all estimated specifications. CPI inflation is inversely

[5] The KOF financial globalization index (measured on a scale from 0 to 1) is based on two separate, equally weighted sub-indices of de facto and de jure measures of financial openness. The de facto measure takes account of cross-border flows and stocks of foreign assets and liabilities, foreign direct and portfolio investment, international debt, international reserves, and international income payments. The de jure measure reflects the incidence of investment restrictions, international investment agreements, and, importantly, capital account openness where the latter is measured by the Chinn-Ito index (2008). The KOF measure of financial openness is thus more comprehensive than the Chinn-Ito index.

[6] The natural log transformation is used to reduce the positive skew of the dependent variable.

[7] The original scale ranging from -2.5 to 2.5 is adjusted to a scale of 1 to 5 for easier interpretation.

[8] An alternative would be to test the effect of the exchange rate regime on inflation. But this would necessitate distinguishing between different versions of fixed and floating exchange rate regimes (even within a country) over the sample period.

related to the degree of financial openness. This result is robust to the inclusion of several control variables in the regression equation, some of which are systematically related to the inflation rate. In the larger sample of 137 (135) countries political stability is inversely related to inflation while neither the terms of trade effect (ln GDP) nor the stage of development effect (ln GDPcap) appear to matter. Higher nominal exchange rate variability (vis-à-vis the US Dollar) is positively correlated with inflation over the 1997-2016 sample period. Although the estimated coefficient is statistically significant its size is very small which suggests that its positive effect on inflation is economically insignificant. Columns (4) and (5) show the results for the estimated regression for a smaller sample of countries (107) that includes a *de facto* measure of central bank independence (turnover of central bank governors) and a dummy variable for inflation-targeting central banks. A higher turnover rate of central bank governors is positively correlated with inflation, with the estimated coefficient statistically significant at the 10 and 5 percent level, respectively.[9] In this smaller sample the strong link between political stability and inflation vanishes. To examine the potential downward effect on inflation by the widespread adoption of explicit inflation targets in nearly 30 countries over the sample period, we add a dummy variable (D^{IT}) to the regression.[10] As indicated in column (5), the estimated coefficient, while negative, is not statistically different from zero. The final two columns employ alternative measures of financial openness (CI open) and central bank independence (CBIW). In column (6), the coefficient on the Chinn-Ito index of capital account openness bears no systematic negative relationship to inflation in a sample of 104 countries. A similar result applies in an even smaller sample of 82 countries to the coefficient on a *de jure* measure of central bank independence CBIW compiled by Dincer and Eichengreen (2014).

It is evident that the stage of the development effect and the political stability effect depend to some degree on the composition of the sample.

4. A Comparison with Trade Openness

As described in the introduction, previous contributions to the literature concentrated on trade openness as a potential important factor driving inflation. KOF also compiles a measure of trade openness, which is distinct from financial openness, for countries around the globe.[11] In this section, we re-estimate the earlier regression equation with trade openness replacing financial openness. The sample of countries remains the same. The econometric results appear in Table 2.

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[9] We employ this measure of (lack of) CBI for comparative purposes and because it is available for more than 100 countries. Both Romer (1993) and Lane (1997) use the reported turnover rate in the empirical parts of their paper. An alternative measure of CBI for 82 of the countries included in this study is considered below.

[10] $D^{IT} = 0$ for non-inflation targeting central banks; $D^{IT} = x$ for inflation-targeting central banks where $0 < x \leq 1$. For a central bank that began to target inflation at some point during the sample period, x represents the number of years since adoption of inflation targeting relative to the length of the sample period. A list of the inflation-targeting countries and the adoption dates of the regime appears in Ilzetzki et al. (2017).

[11] The KOF trade globalization index encompasses de facto and de jure measures of trade openness. The de facto index considers trade in goods, trade in services (both measured as a share of GDP), and trade partner diversity; the de jure index is compiled from information on trade regulations, tariffs and taxes as well as trade agreements.

Inspection of the second row of Table 2 shows that the estimated coefficient on trade openness is statistically insignificant in all but one of the specifications estimated. Trade openness matters marginally in only one estimated specification. Apart from the stage of development effect, which seems to be more pronounced if paired with trade openness, the coefficient estimates of Table 2 are similar to those of Table 1. Interestingly though, the adjusted R^2 is consistently higher in the estimated specification that includes KOF financial openness rather than trade openness.

5. Conclusion

Our empirical analysis shows that of the two measures of openness the one tracking the exposure of the financial system in a country to the outside world is more relevant for the behavior of inflation. We find a strong systematic inverse link between financial openness and CPI inflation in over 100 countries, adding weight to the argument that inflation in financially open economies is lower.

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Table 1: Financial openness and CPI inflation. 1997-2016.

OLS estimates
Dependent variable: ln (CPI inflation)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
constant	-1.565**	-1.091	-0.983	0.111	-0.002	0.780	0.860
	(0.731)	(0.774)	(0.685)	(0.712)	(0.791)	(0.670)	(0.798)
Financial Openness	-2.331***	-1.780***	-1.562**	-1.479*	-1.680**		-1.978**
	(0.592)	(0.633)	(0.640)	(0.783)	(0.761)		
Ln (GDP)	0.047	-0.004	-0.010	-0.037	-0.019	-0.049	-0.064
	(0.032)	(0.034)	(0.033)	(0.032)	(0.033)	(0.033)	(0.040)
Ln (GDPcap)	-0.139	-0.015	-0.028	-0.138	-0.200**	-0.254**	-0.064
	(0.100)	(0.105)	(0.104)	(0.113)	(0.100)	(0.106)	(0.121)
Pol. Stability		-0.279***	-0.277***	-0.122		-0.145	-0.258***
		(0.101)	(0.101)	(0.098)		(0.099)	(0.103)
Exch. Rate Volatility			2.997E-05***	0.0001***	1.019E-04***	0.0001***	2.680E-05***
			(1.840E-06)	(3.650E-05)	(3.775E-05)	(2.940E-05)	1.520E-06
C B Gov. Turnover				1.446*	1.530**	1.559**	
				(0.752)	(0.757)	(0.775)	
IT Countries					0.083		
					0.166		
CI Open						-0.066	
						0.060	
CBIW							0.348
							(0.247)
n	137	137	135	107	107	104	82
Adj. R^2	0.27	0.30	0.36	0.44	0.43	0.42	0.49

Notes:

1. Japan and Brunei were dropped from the sample because of extremely low CPI inflation rates. As a result, the sample size decreases from 139 to 137. After adding exchange rate volatility to the test equation the sample decreases to 135 (Serbia and the West Bank/Gaza). Adding the turnover of central bank governors, an inverse measure of central bank independence, reduced the sample size from 135 to 107 countries due to the unavailability of this measure for mostly developing countries. Capital account openness(CI open) is measured by the Chinn- Ito index and available for 104 of the countries included in our sample. Employing the CBIW measure of central bank independence developed by Dincer and Eichengreen (2014) causes the sample size to shrink further to 82.
2. Removing OPEC countries from the sample increases the importance of financial openness. Its coefficient becomes statistically significant at the 1% level in column (3) and at the 5% level in column (4). However, the coefficient on ln (GDPcap) becomes insignificant in column (5), as do the coefficients on exchange rate volatility and the turnover of central bank governors in columns (4) and (5).
3. * (**) [***] denotes statistical significance at 10 (5) and [1] percent level, respectively.

Table 2: Trade openness and CPI inflation. 1997-2016.

OLS estimates
Dependent variable: ln (CPI inflation)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
constant	-0.891	-0.400	-0.353	0.740	-0.671	0.849	1.869***
	(0.720)	(0.623)	(0.605)	(0.645)	(0.735)	(0.732)	(0.633)
Trade Openness	-0.423	0.142	0.059	-0.804	-1.054*	-0.839	-0.774
	(0.563)	(0.568)	(0.546)	(0.568)	(0.550)	(0.638)	(0.831)
Ln (GDP)	0.048	-0.016	-0.024	-0.055*	-0.036	-0.030	-0.095
	(0.033)	(0.033)	(0.032)	(0.030)	(0.033)	(0.035)	(0.036)
Ln (GDPcap)	-0.343***	-0.152	-0.138	-0.196**	-0.273***	-0.264***	-0.148
	(0.093)	(0.102)	(0.100)	(0.092)	(0.079)	(0.103)	(0.131)
Pol. Stability		-0.390***	-0.380***	-0.153			-0.310***
		(0.107)	(0.102)	(0.105)			(0.103)
Exch. Rate Volatility			3.090E-05***	0,0001***	0.0001***	0.0001***	2.82E-05***
			(2.431E-06)	(2.410E-05)	(2.610E-05)	(2.980E-05)	(1.41E-06)
C B Gov. Turnover				1.453**	1.528**	1.436*	
				(0.731)	(0.724)	(0.770)	
IT Countries					0.076		
					(0.162)		
CI Open						-0.055	
						(0.064)	
CBIW							0.166
							(0.313)
n	137	137	135	107	107	104	82
Adj. R^2	0.19	0.26	0.33	0.41	0.40	0.42	0.44