# The Openness-Inflation Puzzle Revisited

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Dynamic panel estimates show the negative relation between trade openness and inflation found by Romer (1993) but questioned by Terra (1998) became more robust in the 1990s, both among high income OECD and developing countries. Trade openness was also associated with less variable inflation during the 1990s and had a stronger disinflation effect in economies with floating exchange rates.

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Romer (1993) finds closed economies tend to have higher inflation. Central banks in economies more open to trade, Romer argues, find currency fluctuations caused by money surprises more painful and therefore exercise more restraint than their closed economy counterparts. While some question this "dynamic inconsistency" story,[1] the openness-inflation correlation itself has generated considerable interest. Temple (2002) calls it one of the modern "puzzles" of international macroeconomics. But Terra (1998) challenges Romer's empirical findings, arguing that the openness inflation correlation is confined to severely indebted countries and, even then, is only evident during the 1980's debt crisis period. Romer (1993) himself finds no significant inflation-openness relationship among OECD economies.[2]

This note revisits Romer and Terra's findings in a more general dynamic panel setting using data from the 1990s. Our results suggest the negative openness-inflation correlation strengthened in the 1990s across all country groups. And contrary to Terra's (1998) hypothesis, except during 1980s, the inflation-openness relationship is more significant among less indebted countries. More open economies also tend to have less variable inflation, albeit only in the 1990s. Arellano-Bover GMM panel system estimates using five-year averages suggest causality runs from openness to lower inflation, as Romer (1993) argued. The disinflation effect of openness appears to be stronger in countries with floating exchange rates. These results support the view that trade openness is associated with lower inflation, particularly during the worldwide disinflation of the 1990s.

Our panel consists of five-year averages for inflation and import shares over the period 1971-2000, effectively encompassing Romer and Terra's 1973-89 cross-country averages.

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[1] D. Romer himself is now among the skeptics, see his *Advanced Macroeconomics* 2nd edition, page 492.
[2] Lane (1997), however, finds that after controlling for country size, inflation is negatively correlated with openness among OECD countries. Similar results are reported in Table 3 below.

Following Terra (1998) we focus mainly on the bivariate inflation and openness relationship, though in a more general dynamic panel framework.[3] Table 1 addresses Terra's hypothesis regarding the role of external debt by separating countries into severely and less indebted and reporting results for the 1980s debt crisis and other periods separately.[4] The four upper right entries of Table 1 tell the story. Consistent with Terra (1997), there is a strong inflation-openness correlation among severely indebted countries in the 1980s. But outside the debt crisis period, the pattern reverses. Excluding the 1980s, the coefficient for the severely indebted countries is larger: -.30 compared to -.10 for less indebted countries, but is no longer statistically significant even at the 10% level. For the not-severely-indebted countries the import share coefficient is, on the other hand, highly significant.

Table 2 tests the robustness of the inflation-trade openness relationship. Changes in five-year average inflation rates and import shares are regressed on lagged values of the same variables, plus some time period dummies using Arellano and Bover's (1995) GMM dynamic panel system estimator. Note that lagged changes in trade shares predict inflation, but the reverse is not true. When import shares increase, inflation tends to fall in the next period. Equation 2.6 tests for spurious correlations caused by inflation induced real exchange rate changes. The openness measure in Equation 2.6 is the "open" variable from the Penn World Tables Version 6.1: total imports plus exports over GDP.[5] The Penn World Tables' trade shares are measured in constant

[3] These results are robust to the addition of structural variables such as per capita income, latitude, total PPP GDP (size) and regional dummies see Gruben and McLeod (2002) and Lane (1997). However, many of the variables used in these cross-country regressions are not available in time series or for the 1990s (central bank independence measures for example).

international prices, and therefore are less influenced by short-term real exchange rate fluctuations. The negative inflation-openness correlation holds for this broader openness measure as well.[6]

Following Romer (1993), a number of models explaining why openness might reduce inflation have been proposed. Lane (1997) and Guender and McCaw (2000) stress nominal rigidities or market imperfections that cause nominal exchange rate movements to have real effects. Similarly, Temple (2001) and Bowdler (2003) focus on exchange rate movements that worsen the tradeoff between money surprises and unemployment. To see if nominal exchange rate fluctuations play a role, Equation 2.4 splits the import-share among three classifications of exchange rate regime (fixed, moderately flexible and floating). These classifications are not perfect, due to the five year averages. If a country had a flexible rate regime for four of the five years, for example it classified as flexible for that period. The magnitude of the inflation-openness coefficient increases with the degree of exchange rate flexibility. The difference between the pure floating and the near fixed exchange rate regime coefficient is significant at the 5.1% level.

Terra (1997) argues that highly indebted countries use seigniorage to pay off debt, a strategy that is less inflationary in more open economies. To test this proposition, Equation 2.3 splits the import share variable into three country groups defined by levels of external indebtedness. The coefficient for severely indebted countries is higher than that for the less indebted countries, but differences among the coefficients are not significant even at the 10% confidence level.

The inflation-openness correlation appears to strengthen in the 1990s. The time-varying coefficients reported in Table 3 suggest that countries most open to trade saw the greatest reduction

[6] Using the World Bank WDI 2002 imports of goods and services over its PPP GDP estimates yields similar results, but the World Bank WDI only includes PPP GDP estimates from 1975 on, so using the PWT 6.1 openness measures provides a larger sample.

in their inflation rates during the 1990s.[7] Additional evidence for the 1990s is provided by Equation 2.5 where the dependent variable is now the coefficient of variation[8] for inflation. After 1985, economies more open to trade also had less variable inflation.

To summarize, the inflation-trade openness correlation appears to have strengthened during the 1990s and is more robust than earlier research suggested—extending even to the OECD countries. Yet the origin of this relationship remains something of a puzzle. David Romer (2000, p. 492) now seems less convinced this correlation emanates from the "inconsistency of optimal [central bank] plans." Other explanations are being explored. Bowdler (2003) finds openness makes the short-term Phillips curve steeper in OECD countries. Temple (2002) argues that it generally does not. Gruben and McLeod (2001) argue openness raises the interest rate elasticity of money demand, reducing the optimal inflation tax. Another possible explanation is disinflation contagion: with U.S. and OECD inflation falling during the 1990s, the disciplining effect of import competition may have enabled more open economies to lower inflation faster. Whatever its cause, that greater openness to trade is associated with lower inflation should provide some comfort to those who fear globalization and flexible exchange rates increase macroeconomic instability.

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[7] / Between the late 1980s and the late 1990s, the weighted average import share for the 118 countries in our sample rose from 19% to 24% of GDP while the weighted average inflation rate fell from 70% to 5%.

[8]/ The coefficient of variation is the standard deviation of the log of one plus the inflation rate divided by mean inflation for 1986-90, 1991-95 and 1996-2000.

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Table 1

**Inflation and Openness to Trade: 1971-2000 5-year Averages**

| | **Pooled OLS:** **Period:** | **1971-2000** [2/] | **1981-1990** | **71-80 & 91-00** |
|---|---|---|---|---|
| | Country Group | **All Years** | **Debt Crisis** | **Non-Debt Crisis** |
| **1.1** | **Not Severely Indebted Countries** | **-0.09** | **-0.064** | **-0.10** |
| | | *(.022)*** | *(.033)** | *(.028)*** |
| | Number of observations | 472 | 165 | 307 |
| **1.2** | **Severely Indebted Countries** | **-0.61** | **-1.14** | **-0.30** |
| | | *(0.23)*** | *(0.47)*** | *(0.23)* |
| | Number of observations | 193 | 70 | 123 |
| **1.3** | **All Countries** | **-0.23** | **-0.35** | **-0.17** |
| | | *(0.05)*** | *(0.11)*** | *(0.058)*** |
| | Number of observations | 665 | 235 | 430 |

1/ Standard errors in parentheses. **Significant at the 5% or *10% level. Openness is imports of goods and services as a percent of GDP converted to dollars using market exchange rates as reported in the World Bank's WDI 2002 CD-Rom. The 118 country sample is Romer's (1993) 114 countries plus Hungary, Grenada, The Solomon Islands and Cape Verde – as added by Terra (1998). The five-year averages include 1971-75,76-80,…96-00. Missing WDI deflators and import shares were supplemented with *IMF's International Financial Statistics November 2002* CD-Rom data for Bahrain, Cape Verde, Democratic Republic of the Congo, Cyprus, Ethiopia, Grenada, Guyana, Jordan, Kuwait, Iran, Liberia, Oman, Panama, Solomon Islands, Somalia, Sudan, Yemen, and Zimbabwe. Taiwan data is from Council for Economic Planning and Development, Taiwan Statistical Data Book 2001. This data set is available at www.fordham.edu/economics/mcleod.

2/ Similar results are obtained for fixed and random effects panel estimates. Bivariate pooled OLS are reported here to be as consistent as possible with the methods of Romer (1993) and Terra (1998).

## Table 2:
## Panel Regressions: Five-year Averages 1971-2000

| Dependent Variable: | 2.1 Log Import share | 2.2 Inflation [1/] log(1+π) | 2.3 Inflation [1/] log(1+π) | 2.4 Inflation [1/] log(1+π) | 2.5 Coefficient of Variation[6/] | 2.6 Inflation [1/] log(1+π) |
|---|---|---|---|---|---|---|
| **Estimation Method** | **GMM-SYS[5/]** | **GMM-SYS[5/]** | **OLS** | **OLS** | **SUR** | **OLS** |
| Trade Openness<br>Lagged: previous 5 yr period | **0.41** [1/]<br>*(0.20)* | **-0.17**<br>*(.05)* | | | **-5.0**<br>*(1.23)* | **-0.12** [7/]<br>*(0.03)* |
| Lagged Inflation<br>(previous 5 year period) | **-0.04**<br>*(.05)* | **0.45**<br>*(.14)* | | | **-0.21**<br>*(0.65)* | |
| Import Share—LICs [2/]<br>(less indebted countries & OECD) | | | **-0.21**<br>*(.046)* | | | |
| Import Share- SICs<br>(Severely Indebted Ctys) | | | **-0.25**<br>*(.063)* | | | |
| Openness: fixed Rate Regimes[3/]<br>(import share for fixed regimes) | | | | **-0.21**<br>*(0.05)* | | |
| Openness: Floating fx Regimes [3/]<br>(import share for flex rate regimes) | | | | **-0.3**<br>*(.07)* | | |
| Constant | **1.84**<br>*(.68)* | **0.67**<br>*(.19)* | **0.25**<br>*(0.03)* | **0.27**<br>*(.04)* | **5.85**<br>*(1.91)* | **0.25**<br>*(.03)* |
| Number of Observations | 657 | 659 | *660* | *535* | 328 | 616 |
| Sargan Test (P-value) | 0.08 | 0.34 | | | | |
| 1st Order Serial-Correlation (p-value) | 0.09 | 0.06 | | | | |
| Coefficient Difference [4/] (Wald test) | | | **0.04**<br>*(0.05)* | **0.09**<br>*(.048)* | | |

1/ To cope with deflation episodes, inflation is measured as the natural log of one plus the average annual change in the GDP deflator.

2/ Less, severely and moderately indebted country classifications are those of Terra (1998). Equation 2.3 includes a moderately indebted group coefficient of -.20 (.07) but the difference is less significant statistically than that between less and severely indebted countries.

3/ Classification of countries into fixed, floating and semi-fixed regimes uses LaFluer's (2002) 8-level classification to classify countries into three groups: fixed, flexible and semi-fixed. For equation 2.4 the openness coefficient for the semi-fixed group was -.28 (.08). As La Fluer's regime index is only available 1975-2000, our sample is reduced to five 5-year intervals.

4/ The Wald test null hypothesis is equal coefficients for the two import share variables reported above. The difference and standard error are reported here. The significance levels for the equation 2.3 and 2.4 tests are 36% and 5.1% respectively

5/ This Arrellano and Bover (1995) system-GMM estimator regresses levels and changes in inflation/import shares on lags of the same variables, using lagged levels as instruments for changes and vice versa. The Sargan tests validate this instrument set, but this was not the case before we took the log of the import share and added a time period dummy. The 71-75 and 96-00 time period dummies were significant with coefficients of -.037 (.017) and -.05 (.02) respectively.

6/ The coefficient of variation is standard deviation over the mean inflation for each five-year interval. The sample period for this equation 1986-2000 – prior to 1986 this relationship disappears, due in large part to the extreme variations Latin American inflation.

7/ The openness variable in this equation is the Penn World Tables v. 6.1 "openness" variable: imports plus exports over $PPP GDP.

# Table 3

## Inflation-Openness Over Time

| | Openness-Inflation Coefficient by Period [1/] | | | | | |
|---|---|---|---|---|---|---|
| Dependent Variable: log (1+π ) | Constant | 76-80 | 81-85 | 86-90 | 91-95 | 96-00 |
| (3.1) No Severely Indebted Countries (497 observations) | **0.17** (0.16) | **-0.09** (0.65) | **-0.07** (0.05) | **-0.14** (0.052) | **-0.14** (0.051) | **-0.19** (0.051) |
| (3.2) All countries (665 observations) | **0.26** (.025) | **-0.28** (0.11) | **-0.22** (.084) | **-0.19** (.084) | **-0.17** (0.083) | **-0.32** (0.084) |
| (3.3) Severely Indebted Countries (178 observations) | **0.5** (0.09) | **-1.03** (0.45) | **-0.8** (0.35) | **-0.3** (0.35) | **-0.16** (0.31) | **-0.74** (0.31) |
| (3.4) 27 OECD Countries (160 observations) | **0.13** (0.16) | **-0.05** (0.07) | **-0.07** (0.61) | **-0.13** (0.06) | **-0.18** (0.065) | **-0.21** (0.066) |

1/ Standard errors are in parentheses. These are OLS estimates for six 5-year intervals, 1971-2000.