FIW – Working Paper

FIW Working Paper N°10
January 2008

Globalization, the Output-Inflation Tradeoff, and Inflation

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Abstract

This paper provides a comprehensive assessment of the relation between inflation and globalization, measured in terms of trade and financial openness. Using a large crosssection of 91 countries covering the period 1985-2004, we establish two main empirical regularities. Both higher trade and financial openness i) reduce central bank's inflation bias,yielding lower average inflation, and ii) are associated with a larger output-inflation tradeoff. This evidence is at odds with the standard Barro-Gordon framework, which would require globalization to have a negative effect on the output-inflation tradeoff to yield lower equilibrium inflation, but it is consistent with a recent strand of new Keynesian models emphasizing the role of imperfect competition and wage rigidities. Moreover, our findings do not hold up for the OECD subsample, which suggests that a group of highly developed countries has been successful in creating an institutional framework for central banks that eliminates distortions due to the time inconsistency problem.

JEL classification: E58, F41, F10, F30;
Keywords: Globalization, Trade, Financial Openness, Inflation;

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I. Introduction

Has globalization changed inflation? There is little agreement on this issue. Kenneth Rogoff argues "that globalization – interacting with deregulation and privatization – has played a strong supporting role in the past decade's disinflation" (Rogoff, 2003a, p. 54), which has reduced average global inflation from 30 percent in the early 1990s down to some 4 percent today. In contrast, Laurence Ball argues that "there is little reason to think that globalization has affected inflation significantly. 'Modest' and 'limited' probably overstate these effects." (Ball, 2006, p. 1). These two opposite views are indicative of how severely the profession is split on this question.

In the present context, the relevant definition of globalization is the increase in trade and financial openness – the two main channels through which it may have changed inflation according to theoretical considerations.[1] As Ball (2006) points out, the increase in openness to trade has been a gradual process, starting long before changes in inflation behaviour have been attributed to globalization. A more recent and pronounced phenomenon is the rapid increase in international capital flows: after a gradual increase since the early 1970s, both portfolio and foreign direct investment expanded rapidly since the early 1990s, outpacing the relatively modest increase in trade (see Lane and Milesi-Feretti, 2006). Against this background, it is noticeable, that – with few exceptions – the previous literature on inflation and openness has primarily considered the role of trade.

In his seminal paper, Romer (1993) finds a negative link between openness to trade and inflation, using a large cross-section of 114 countries over the period 1973 to 1988 (though the effect of trade becomes insignificant, when only the subsample of OECD countries is considered). This finding is backed by a theoretical model, which shows that the output-inflation tradeoff worsens if an economy opens up to trade, thereby reducing the incentive of

[1] A further channel not considered in this paper is migration, which is emphasized in a recent model by Razin and Binyamini (2007).

monetary authorities to inflate. According to the standard time-inconsistency argument by Barro and Gordon (1983) this will show up in lower equilibrium inflation. In Romer (1993), the theoretical link between openness and inflation operates through a depreciation triggered by the effect of an output expansion on world prices. This negative terms of trade effect is larger in more open economies.

Lane (1997) uses a small open economy model with nominal rigidities and imperfectly competitive goods markets in non-tradable sectors with sticky prices to show that a monetary expansion model will be associated with a real depreciation, even if world prices are unchanged. In empirical terms, using the Romer data he shows that the negative openness-inflation link is strengthened and does also hold up for OECD countries, when country size is controlled for. More recent studies such as Gruben and McLeod (2004), who use a panel data approach to control for country-specific effects, have basically confirmed the negative relation between inflation and openness to trade. Using a similar approach, Gruben and McLeod (2002) also find measures of capital account restrictions to be negatively related to inflation for a large sample of countries.

Nevertheless, the literature is not without ambiguities. In particular, it remains unclear through which channels openness affects inflation. At the heart of the models by Romer (1993) and Lane (1997) is a negative link between openness and the output-inflation tradeoff. Considering sacrifice ratios from 65 disinflation periods in 19 OECD countries from the period 1960 to 1991, which were calculated by Ball (1994), Temple (2002) fails to find a robust relation with openness. Even more puzzling, Daniels et al. (2005) – using the same dataset, shows that once central bank independence is controlled for, openness to trade has a significant *positive* effect on the sacrifice ratio. This finding cannot be reconciled with the negative effect of openness on inflation found by Romer and Lane; in their models, a larger sacrifice ratio would imply an increase in equilibrium inflation!

Two recent models, both exhibiting new Keynesian features such as wage rigidities and imperfect competition, have suggested an explanation for this apparent contradiction. Daniels and VanHoose (2006) embed the standard time inconsistency model in the framework of a multisector, imperfectly competitive open economy model, and show that openness to trade increases the sacrifice ratio but reduces the inflation bias.

A further important paper by Razin and Loungani (2007), shows that *both* financial and trade openness reduce the relative weight attached to the output gap in the representative households utility based loss function in a new Keynesian open economy macro model. As a result, globalization tends to induce policy makers, guided by the representative household's objective function, to putting greater emphasis on reducing inflation than on narrowing output gaps. Again this model suggests that greater openness (now both to trade and capital flows) increases the sacrifice ratio but lowers the inflation bias. Razin and Loungani (2007) also provide some tentative empirical evidence in favour of their model, regressing the sacrifice ratios by Ball (1994) on measures of capital and current account restrictions from Quinn (1997). While they find evidence for a positive link, it remains unclear whether there is a separate role for capital account restrictions (if included along with current account restrictions, only the latter variable remains significant).

While the theoretical models by Daniels and VanHoose (2006) and Razin and Loungani (2007) are appealing, a comprehensive empirical assessment is missing. Previous studies have either considered the effect of openness on inflation or the sacrifice ratio, but not both. Studies considering inflation only (such as Romer (1993), Lane (1997), McLeod (2002, 2004)) cannot identify the transmission channel of the openness-inflation link. On the other hand, studies considering the effect on the sacrifice ratio (Daniels et al. (2005), Razin and Loungani (2007)) cannot rule out that a positive link of openness with the sacrifice ratio might be associated with higher inflation. Hence, both hypotheses should be tested on the same sample.

As far as financial openness is concerned, there is only little evidence. To our knowledge, there are only two studies, both of them looking at the effect of policy based variables (capital account restrictions) on inflation (Gruben and McLeod (2002) for a large panel of countries) and the sacrifice ratio (Razin and Loungani (2007) for the Ball dataset); results are somewhat inconclusive, in particular, if both current and capital account restrictions are considered.[2] Moreover, no previous study has considered measures of de facto financial openness, in spite of the fact that a comprehensive and high quality dataset on financial openness has been developed over the last years by Lane and Milesi-Feretti (2006).

A further drawback is that the vast majority of studies use data up to the end of the 1980s, thereby omitting potentially valuable information: Gruben and McLeod (2004) find that the (trade) openness-inflation link appears to have strengthened in the 1990s; a possible explanation that can be explored with our sample is that trade openness in their study may also capture the effects of financial openness, which has increased particularly strongly in the 1990s. Finally, in most studies comparably little efforts have been devoted to addressing the likely endogeneity of both openness measures or to check instrument quality.

This paper aims at closing this gap in the literature by undertaking a comprehensive reassessment using a large cross-section of 91 countries and more recent data from 1985 to 2004. The same sample of countries is employed to assess the effect of openness on inflation and the output-inflation tradeoff, which allows us to design a more explicit model test. We consider financial openness and trade openness jointly, using both de jure (i.e. policy based) and de facto measures of openness, thereby paying careful attention to endogeneity concerns, instrument validity, and instrument quality.

[2] In Razin and Loungani (2007), who use OLS, capital controls become insignificant if both variables are included. Gruben and McLeod (2002) argue that instrumenting for capital controls (using GDP and area) does not change the results (though they do not instrument for openness to trade).

The remainder of the paper has two main parts. Section II briefly reviews the theoretical background, sets up the empirical models and motivates our identification strategy. Section III presents the estimates of i) the effects of trade and financial openness on inflation, ii) the effects of trade and financial openness on the output-inflation tradeoff. The final section IV summarizes the results and concludes.

II. Trade Openness, Financial Openness, the Output-Inflation Tradeoff and Inflation: Measurement and Identification

1. Theoretical Background and Empirical Model

Our empirical testing strategy is guided by two classes of models. A conclusion shared by all of them is that more open economies exhibit lower trend inflation. However, the two model classes differ with respect to their predictions concerning the relation between openness and the output-inflation trade off.

In the first group of models (Romer (1993) and Lane (1997)), increased openness to trade lowers inflation by making the Phillips curve *steeper*, i.e. the output-inflation tradeoff smaller; underlying this mechanism is the negative terms of trade effect of a real depreciation, which is triggered by a monetary expansion. Romer's model applies mainly to countries that are large enough to affect international prices. Lane (1997) shows that this is not a necessary assumption; using a model with imperfectly competitive goods markets and sticky prices in the non-tradeables sector he shows that the output gains from unexpected inflation are smaller in more open economies. Again, one would expect openness to be associated with lower inflation and a smaller output-inflation tradeoff. A further implication of Lane (1997) is that – for a given level of openness – the larger a country, the more reduces the terms of trade effect the benefits from surprise inflation. A negative effect of country size on inflation would point to the relevance of this effect.

The second class of models is provided by Daniels and VanHoose (2006) and Razin and Loungani (2007). In the model by Daniel and VanHoose (2006), characterized by economy-wide monopolistic competition, increased openness reduces the pricing power of domestic firms. As a consequence the output-inflation tradeoff becomes larger. At the same time, the reduced pricing power lowers the output effects, induced by unexpected price increases through a monetary expansion. Hence, one would expect openness to trade to be associated with lower inflation and a larger output-inflation tradeoff. Also note that the model predicts that a higher sensitivity of domestic spending with respect to a real depreciation reduces the output-inflation tradeoff but increases the inflation bias. In larger countries, where trade is a smaller share of domestic spending, terms of trade changes have lower output effects ceteris paribus. Hence, country size should reduce the inflation bias and *increase* the sacrifice ratio.

The same implication follows from the theoretical model by Razin and Loungani (2007), which is an important contribution in two respects. First, by showing that increased openness reduces the relative weight attached to the output gap in the representative households utility based loss function, it provides another link through which openness lowers the inflation bias: reduced correlation between fluctuations of the output gap and consumption in more open economies. Second, it shows that this effect materializes both through increased openness to trade (by specialization in production and diversification of consumption) as well as increased openness to capital flows (by allowing households to smooth consumption). This enriches the testable hypotheses: *both* trade and financial openness should be negatively related to inflation and positively related to the output-inflation tradeoff.

The first empirical model, emerging from these theoretical considerations, relates inflation (π) to openness (*OPEN*) – trade openness ($OPEN^{Trade}$), financial openness ($Open^{Fin}$) or both, country size, which we measures in terms of population (*Pop*) and area, and a set of control variables (**X**):

$$\ln \pi = \alpha_0 + \alpha_1 OPEN + \alpha_2 \ln Pop + \alpha_3 \ln Area + \boldsymbol{\gamma}\mathbf{X} + u \qquad (1)$$

Following previous studies (e.g. Romer (1993), the following controls will be included: central bank independence (*CBI*) as well as political instability (*PINST*) to account for the institutional environment; and (initial) real GDP per worker (*RGDPWOK*) as indicator of economic development, which might capture a variety of factors affecting inflation. Consequently, $\mathbf{X} = [CBI, PINST, \ln RGDPWOK]$.

It should be added that a negative link between trade openness and inflation is consistent with all models discussed above. However, establishing a robust link between inflation and financial openness would be supportive of the model by Razin and Loungani (2007), which is the first to deliver a thorough foundation for this relationship.

The testing strategy can be sharpened by considering the effect of openness (and size) on the output-inflation tradeoff. The predictions regarding this relationship – taking a negative effect of openness on inflation as given – discriminate between the two classes of models: The traditional models by Romer (1993) and Lane (1997) predict a negative relationship between trade openness and the output-inflation tradeoff, whereas the models by Daniels and VanHoose (2006) and Razin and Loungani (2007) predict a positive relationship. Razin and Loungani (2007), in addition, postulate a positive link between the output-inflation tradeoff and financial openness. Moreover, country size should have a negative effect on the output-inflation tradeoff according to Lane (1997) and a positive effect according to Daniels and VanHoose (2006).

Hence, the second class of models we are going to test relates the output-inflation tradeoff (θ) to openness – again trade and (or) financial openness, and country size:

$$\theta = \beta_0 + \beta_1 OPEN + \beta_2 \ln Pop + \beta_3 \ln Area + \boldsymbol{\delta}\mathbf{W} + \varepsilon \,. \qquad (2)$$

The matrix **W** is a set of control variables, whose choice is guided by Ball et al. (1988), who find both theoretically and empirically that mean inflation and the variability of aggregate demand are negatively related to the output-inflation trade-off: The reason is that higher mean inflation and more variable demand cause firms to adjust prices more frequently, making prices more flexible. As a result, nominal shocks have lower real effects, leading to a lower output-inflation tradeoff. Hence, two controls will be included: mean inflation (π) and the variability of aggregate demand (σ^{AD}), measured as standard deviation of the log differenced nominal GDP series, i.e. $\mathbf{W} = [\pi, \sigma^{AD}]$.

We will use a cross-section of 91 countries over the period 1985-2004 to estimate models (1) and (2). A more detailed description of the sample, the variables and data sources is given in section 2. Note that any testing strategy with an aim to discriminate between the two classes of models described above, has to be based on the estimation of both models (1) and (2). A negative effect of openness on inflation does not reveal the transmission channels of this relationship. Looking at the output-inflation tradeoff alone is not sufficient, since a larger output-inflation tradeoff could be associated with higher inflation (e.g. in Romer, 1993) or lower inflation (e.g. in Daniels and VanHoose, 2006). So far, no empirical study has simultaneously considered these two issues for the same sample of countries and time period.

2. Measurement and Data

2.1 Inflation and the Output-Inflation Tradeoff

Measurement of inflation is straightforward; we follow the standard approach using the log of the average annual change in the log of the GDP deflator. As an alternative measure, we will also consider the log of the average annual change in the log of the consumer price index (see section II, subsection 3).

A much more difficult task is to measure output-inflation tradeoffs, i.e. the responsiveness of output to prices, or the sacrifice ratio, defined as ratio of output losses to the reduction in trend inflation over a disinflation. The two measures are clearly related. Ceteris paribus, a larger sensitivity of output with respect to changes in the price level is associated with a larger sacrifice ratio.[3] I a narrower sense, however, the sacrifice ratio is restricted to disinflation episodes (which might differ from the benefice ratio, i.e. the output gains from inflating, see Jordan (1997)). Ball (1994) has calculated sacrifice ratios from 65 disinflation periods in 19 OECD countries and de facto all studies on the link between openness and the sacrifice ratio have employed this data set. While the Ball measures are appealing due to its careful calculation, they have also been criticized (see the comment by Cecchetti (1994)).

From a practical point of view, a serious limitation of the Ball dataset is that it covers only OECD countries and the period from 1960 to 1991. This conflicts with our goal to use a large cross-section of countries. Even more importantly, as West (2007) points out in his comment on the empirical test by Razin and Loungani (2007), according to the theoretical model, there is no particular reason to focus on disinflations. The same holds true for the other models underlying our analysis. As a consequence we will focus on the average output-inflation tradeoffs.

We opt for a simple approach, which has been widely used to estimate average output-inflation tradeoffs across countries, e.g. by Lucas (1972) and Ball et al. (1988). It is based on a regression of real GDP (Y^R) on its lag, a time trend (t) and the growth of nominal GDP (Y):

$$\ln Y^R = \omega_0 + \omega_1 \ln Y^R_{-1} + \omega_2 t + \theta \Delta \ln Y + \upsilon \,. \qquad (3)$$

Equation (3) is estimated for each country for our sample period from 1985 to 2004 (or – for a few countries – for slightly shorter subperiods due to restrictions on data availability). The

[3] Looking at it another way, one could also say that the Phillips curve flatter. However, a "Phillips curve interpretation" does not really apply in the present context. In the standard Barro-Gordon model, the output inflation trade-off arises from the aggregate supply curve, which is in turn obtained by aggregating the supply curves of profit maximizing, price taking firms. There is a clear link to Phillips curve. In the model by Daniels and VanHoose (2006) with imperfect competition there is no aggregate supply curve (and thus no standard Phillips curve); in this model the output-inflation trade-off is governed by the relation between aggregate output produced by profit maximizing, price setting firms and the overall level of prices they set.

parameter θ measures the output inflation trade-off. If it is zero, nominal shocks show up completely in prices; if it is one, prices are completely rigid, such that nominal shocks translate into proportionate changes of real GDP. To put it another way: the larger θ, the stronger the responsiveness of output to changes in the price level.

The main advantage of this approach is its simplicity and that the data requirements are not demanding; nominal and real GDP data are available for a large cross-section of countries. At the same time, equation (3) is well founded through the theoretical model by Ball et al. (1988). Nevertheless, it should be noted that this estimation approach is not without problems; in particular, the time series properties of the variables in (3) may give rise to some non-stationarity concerns (though time series and panel unit root test yield ambiguous results). Still, this appears to be the most suitable approach to obtain estimates for a large cross-section of countries, and while the point estimates should not be overstressed they should be indicative of the cross-country variation in average output-inflation trade-offs for our sample.

Our estimates suggest that there is considerable variation in output-inflation tradeoffs across countries, ranging from –0.449 to 0.997. Of our 91 estimated output-inflation tradeoffs, 17 (that is 18 percent) take a negative value. Comparing our results with those of Ball et al. (1988), who estimate the same equation for 43 countries over the period 1948 to 1986, 10 of their 43 coefficients (23 percent) are negative. The average of our estimates is 0.31, theirs is 0.24. Finally, the correlation between their estimated tradeoffs and ours amounts to 0.44.

2.2. Measures of Globalization

In this paper globalization is used to denote the increase in trade and financial integration. Basically, there are two approaches to measure integration. One can use de facto measures of integration, focussing on policy outcomes or on de jure measure of integration, i.e. policy variables. Since trade and capital account policy affect inflation through their effect on openness, de facto measures provide a more direct way to test this relationship. Temple (2002, p. 455) argues that "predictions of the theory are based on the importance of trade relative to GDP, not trade policy, so throughout this paper 'openness' should be interpreted in the former sense." A similar point can be made for financial openness.

Consistent with this line of argument, most previous studies on trade openness use the import share in real GDP and omit policy variables; in contrast, the view studies on financial openness use solely policy measures, mainly based on Quinn (1997), who derives measures for restrictions on the current and capital account by translating qualitative IMF descriptions into quantitative measures using certain coding rules. For both variables, labelled *Current* and *Capital*, a higher value points to fewer restrictions.

In line with the argumentation by Temple (2002), our main approach will be to use de facto measures of integration: as basic measure of openness to trade we use real exports plus imports as share of GDP. An advantage of this variable over the import share used in most previous studies is that comparable figures in real terms are available for a more comprehensive sample through the Penn World Tables. But the correlation between $OPEN^{Trade}$ and *Imports* is 0.91, suggesting that the choice makes little difference. We will return to this point below in the robustness analysis (section III, subsection 3).

We measure financial openness in terms of total foreign assets and liabilities as share of GDP, which we calculate from the dataset by Lane and Milesi-Feretti (2006). They construct estimates of external assets and liabilities for 145 countries over the period 1970–2004 (distinguishing between foreign direct investment, portfolio equity investment, official reserves, and external debt). Surprisingly, none of the studies on financial openness and inflation has considered this standard measure of financial openness using the Lane and Milesi-Feretti dataset so far.

Regarding functional form, there is no theoretical guide as to whether use levels or logs. The results are very similar both in terms of statistical significance and average elasticities of the openness variables; ultimately, we opted for the use of the variables in levels since this yielded a slightly better goodness of fit. In addition, this makes our results easier comparable with previous studies, most of which adopted a level approach.

Of course, we would also like to know to what extent policy is affecting inflation. The question will be addressed using the policy variables as instruments for de facto openness measures in a two stages least squares estimation, consistent with the theoretical assumption that current and capital account policy affect inflation through their effect on openness – in econometric terms, through the first stage regression. The assumptions required for this approach to be valid are discussed more in detail below.

2.3 Central Bank Independence and Political Instability

We use the most common measure of central bank independence by Cukierman et al. (1992); it is an index between 0 and 1 (maximum independence), which is based on an aggregation of 16 characteristics of central bank charters which are related to the independence of central banks from the exertion of political power. They provide data for some 70 countries by decade from 1940 to the 1980s. Polillo and Guillén (2005) have extended this measure for many of the countries for the period from 1990 to 2000.

Regarding political instability many previous studies use data from the Barro-Lee dataset, based on the number of revolutions or assassinations. Since their data on these variables end in the 1980s, we use an alternative variable: government crisis, defined as rapidly developing situations that threaten to bring the downfall of the present regime, which is based on the Cross National Times Series Data Archive and employed by Aisen and Veiga (2005). It is available for all countries of our sample up to 1999.

2.4 Sample and Descriptive Statistics

The approach pursued here is to use a possibly large cross-section of countries, referring to the time period from 1985 to 2004. Our most comprehensive sample, for which the main variables (inflation and openness) and the "core control variables" (size, real GDP per worker, and political instability) are available, comprises 91 countries.[4] Including measures of capital and current account restrictions reduces our sample to 73 countries; measures of central bank independence are available for only 47 countries. All variables used in the estimation of our cross section models are period averages (except Z^{Open} which refers to 1990 and initial real GDP per worker which refers to 1985). A detailed list of countries, and a description of the variables and data sources is given in Appendix A1.

Our 91 country sample shares 88 countries with the 113 countries in Romer (1993); the three countries not included in the Romer study are China, Hungary, and Chad. Regarding the time dimension our sample refers to the period 1985 to 2004; that is, it actually starts where the time periods in many of the other studies (such as Romer, 1993; Lane 1997; but also the studies based on the Ball dataset) end.

< Table 1 here >

Table 1 summarizes the properties of the key variables. There is considerable variation in the average inflation rates, which range from 1.3 to 45.4 percent. Also the pairwise correlations are indicative: more liberal current and capital account policies are associated with more trade and higher stocks of foreign assets and liabilities; both the policy based measures and the de facto measures of openness are negatively correlated with inflation and positively correlated with the output-inflation tradeoff. Central bank independence is negatively related with

[4] Countries that experienced financial crises or hyperinflations in our period of investigation were excluded from the sample right from the beginning (Argentina, Bolivia, Brazil, Congo, Nicaragua and Peru). Moreover, Japan with an average inflation close to zero turned out as influential outlier and was excluded from the sample.

inflation, political instability shows a positive relationship. The scatter plots in Figures 1 and 2 highlight the potentially important roles of trade openness and financial openness in explaining the cross-country variation in inflation performance.

< Figure 1 here >

< Figure 2 here >

3. Endogeneity Concerns, Identification, and Instrument Quality

While the prima-facie evidence in section 2 is suggestive it does not tell us anything about causality. One complication in the estimation is that our variables of main interest, i.e. trade and financial openness are likely to be endogenous. For trade, this point has already been made by Romer (1993)[5]. Similar concerns apply to financial openness: Low inflation countries, for example, may be viewed as more attractive by investors and thus have higher capital inflows, both in the form of portfolio and direct investments.

Hence, it will be important to test for endogeneity and to check whether the results hold up if the model is estimated using instrumental variable (IV) techniques. Romer (1993) suggests using country size as instrument for openness to trade. This is no feasible approach in our setting: According to the theoretical models we refer to, country size is an important control variable in the main regression (both according to Lane (1997) but also indirectly through the exchange rate sensitivity of domestic demand according to Daniels and VanHoose (2006)); consequently, size is no longer available as an instrument. The approach pursued by Lane (1997) is to use the openness measure by Lee (1993), which is obtained by forming

[5] As example, how this could generate a negative correlation between inflation and openness, Romer argues that countries adopting protectionist policies (i.e. are relatively closed) may also adopt other policies favouring particular interest groups; this could lead to large budget deficits and hence to high rates of inflation (Romer 1993, p. 885)

fitted values from a regression of openness on area, distance, tariffs, and the black market premium. Since policy variables are included in this construction, is it unlikely to purge the endogeneity from the variable.

Frankel and Romer (1999) suggest a more convincing instrument for trade openness, which exploits the exogeneity of geography. It is an aggregate measure of distance ("proximity"), calculated from the predicted values of a gravity model that includes geographical variables only. The identifying assumption is that geography has no direct effect on trade (in the present context: inflation), *once* country size (in terms of population and area) is controlled for. No study on the link between inflation and trade has employed this instrument so far. Frankel and Rose (2002) have updated the Frankel and Romer (1999) instrument for a large cross-section of countries; their estimates refer to 1990, which is close to our sample midpoint. We will use their estimates as instrument for trade openness and refer to it as Z^{Open}.

Moreover, we argue that the same reasoning can be used to construct an instrument for financial openness. Guerin (2006) has shown that the gravity model works well not only for trade but also for FDI and portfolio investment and that geography plays a significant role in determining the spatial allocation of trade, FDI and portfolio investment. It would suggest itself to parallel the construction of the Frankel and Romer instrument, using bilateral financial flows as dependent variable in a geographical gravity model. Unfortunately, there is not sufficient data for our large cross-section of countries. Consequently, we use the same instrument (Z^{Open}) for both trade and financial openness.[6] Hence, in the simplest case, our first stage regressions will be given by

[6] A drawback is that we cannot identify the effects of trade and financial openness separately in one equation. However, even if sufficient data were available, this instrument for financial openness would certainly be highly correlated with the trade instrument, such that an attempt to identify the separate effects of trade and financial openness in one equation by these two instruments would almost certainly run into a weak instruments problem.

$$OPEN^{Trade} = \varphi_0 + \varphi_1 Z^{OPEN} + \varphi_2 \ln Pop + \varphi_3 \ln Area + \upsilon \text{, and} \quad (4a)$$

$$OPEN^{Fin} = \kappa_0 + \kappa_1 Z^{OPEN} + \kappa_2 \ln Pop + \kappa_3 \ln Area + \eta \,. \quad (4b)$$

Depending on the specification of the main model, further exogenous variables from the second stage regression will have to be included in (4a) and (4b). As a first indication of the relevance of the instrument, we note that - as can be seen from Table 1 – the correlation between Z^{Open} and $OPEN^{Trade}$ ($OPEN^{Fin}$) is 0.71 (0.57).

Razin and Loungani (2007) use least squares in their regression of the sacrifice ratio on current and capital account restrictions, arguing that (the initial values of the) policy based variables may be viewed as predetermined. This is a debatable assumption, of course, but if one is willing to join this argument, one could follow their example and use policy based variables directly, or – the approach we will purse – include the policy based variables as instruments in the first stage regression.

$$OPEN^{Trade} = \varphi_0 + \varphi_1 Z^{OPEN} + \varphi_2 \ln Pop + \varphi_3 \ln Area + \varphi_4 Current + \upsilon \text{, and} \quad (5a)$$

$$OPEN^{Fin} = \kappa_0 + \kappa_1 Z^{OPEN} + \kappa_2 \ln Pop + \kappa_3 \ln Area + \kappa_4 Capital + \eta \,. \quad (5b)$$

Apart from linking openness to geography and policy through the first stage regression, another advantage is that the model becomes overidentified; under the maintained assumption that geography is exogenous in the present context, which is relatively innocuous, this allows us to check the exogeneity of the policy variables by testing for overidentifying restrictions. To give a first impression of instrument quality, we note that the correlation between $Open^{Trade}$ ($Open^{Fin}$) and *Current* (*Capital*) is 0.21 (0.48).

Instrument validity is a necessary but not a sufficient condition for two stages least estimates to produce reliable estimates. Recent work (e.g. Staiger and Stock, 1997; Stock, Wright, and Yogo, 2002; Andrews, Moreira, and Stock, 2004) has shown that the use of two stages least squares with 'weak' instruments may lead to estimates with large bias and size distortions. Hence, it will be important to check instrument quality. We have already shown that the instruments are reasonably correlated with the endogenous variables. A more relevant issue is the partial correlation of our instruments with the endogenous variables, controlling for the exogenous regressors in our main equation.

In order to check the quality of the instruments we will use the test developed by Stock and Yogo (2004). They provide critical values, depending on the number of endogenous variables and the number of instruments, to test the null that the quality of the instruments is below a certain level in terms of the maximum tolerable size distortion of a conventional Wald test and – for overidentified models – also in terms of the maximum tolerable bias relative to OLS. They provide four critical values depending on the quality level (tolerable bias, size distortion). Hence the null is that the quality of the instruments is below that of a pre-specified level. For the case of one endogenous regressor, the Stock-Yogo test is simply the F-statistic on excluding the instrument(s) in the first stage regression. For models with two (or more) endogenous variables, the these F-statistics are only indicative, since even if the instruments are strongly related to the endogenous variables, the predicted values from the first stage regressions may be highly collinear. Stock and Yogo (2004) suggest using the Cragg-Donald statistic, a matrix analog to the F-statistic in the first stage regression, and also provide the critical values to test for weak instruments. For exactly identified models and models with one overidentifying restriction, as it is the case throughout this paper, critical values are only available for he size criterion.[7]

[7] For two stages least squares, the critical values corresponding to the four quality levels (lowest to highest) are: 5.53, 6.66, 8.96, and 16.38 (one endogenous variable, one instrument); 7.25, 8.75, 11.59, and 19.93 (one endogenous variable, two instruments). For two endogenous variables, and three instruments (Cragg-Donald test), the critical values are: 5.45, 6.40. 8.18, and 13.43 (Stock and Yogo, 2004, p. 40).

III. Estimation Results

1. Openness and Inflation

We start from the most parsimonious variant of model (1), relating inflation to trade and financial openness, respectively, as well as country size. We then successively add three control variables to the regression: first, political instability and real GDP per worker, which are available for the full sample. Then we include central bank independence, which reduces our sample to 47 countries.

1.1 Separate Results for Trade Openness and Financial Openness

Table 2 and Table 3 show both the least squares and IV results for the effect of trade and financial openness on inflation, using Z^{Open} as instrument. The last column shows also the two stages least squares (2SLS) estimates, using both Z^{Open} and *Current* (*Capital*) as instruments. In most models, the Hausman test rejects the orthogonality of error term with openness. This result is certainly also due to the fact that the "other openness" variable is not included in the main model: For example, in the models including trade openness (Table 2), financial openness is omitted (and its effect thus captured by the error term) and vice versa. Since the two openness measures are correlated, we would expect the Hausman test to reject exogeneity.

Moreover, since the instrument Z^{Open} is correlated with both openness measures, *both* the least sqaures and the IV estimates of the parameter of trade openness are likely to be upward biased, capturing the effects of financial openness on inflation as well. But the IV estimates are still informative, since they eliminate the (possible) bias induced by the omission of relevant variables other than financial openness, as well as the bias due to simultaneity and measurement error. The same reasoning applies to Table 3 where trade openness is omitted.

< Table 2 here >

< Table 3 here >

Note that the F-tests from the first stage regressions given at the bottom of the Table do not point to a weak instruments problem. Even in the worst cases – these are the two stages least squares estimates where *Current* (*Capital*) are used as additional instruments – we can reject the null that instrument quality is below the lowest (second lowest) level respectively. In most other models we can even reject that instrument quality is below the highest level.

The IV estimates suggest that both openness measures have a negative and sizeable effect on inflation. On average, an increase in trade (financial) openness by one percentage point leads to a (relative) decrease in inflation by 1.1 (0.36) percent. Comparing our results for $Open^{Trade}$ with that of other studies using large cross-sections, this is roughly half the effect obtained by Romer (1993) accounting for the differences in the definition of the openness variables (Romer uses the import share whereas we include exports as well). This is plausible in light of the fact that Romer omits country size. The magnitudes of our coefficients are very similar to that obtained by Lane (1997) who adds country size (in terms of GDP) to the Romer model. Results are less easily to compare with the specification by Gruben and McLeod (2004), but their estimated effect of openness turns out clearly lower; this is not surprising, since they use a panel approach, which allows them to control for country-specific effects and since they use a specification with 5 years spans, which is likely to miss some long run effects.

The role of size is difficult to judge, since the results differ across models. Focusing on an increase in both measures, i.e. an increase in size holding population density constant, there is weak evidence for a negative effect of size on inflation, but the joint p-value of both area and population is hardly below conventional significance levels.

Turning to the results for the control variables, political instability (government crises) shows the expected sign but is insignificant in all models. Central bank independence mainly shows the wrong (positive) sign but is insignificant in all models at conventional levels. This apparently surprising result can be explained by its relation with real GDP per worker (*RGDPWOK*). As Romer (1993) argues, *RGDPWOK* as a general indicator of economic development may capture various other influences on inflation. Central bank independence appears to be one of them: The correlation between *RGDPWOK* and *CBI* is 0.41 (see Table 1); in fact, when *RGDPWOK* is excluded, CBI becomes negative in many models although it remains insignificant at conventional levels. Since the role of central bank independence is not of primary interest in this paper, we do not pursue this issue further here, but we will continue to include *CBI* (along with *RGDPWOK*) as control variable.

1.2 Results for Models Including Both Variables Simultaneously

One important message we take from the separate estimates is that the least squares estimates are downward biased (compared with our IV estimates); still the separate estimates, both least squares and IV, may exhibit an upward bias after all, since the coefficient will also capture the effect of the other openness variable.

< Table 4 >

The first two columns in Table 4 show the least squares estimates of model (1), including both openness measures, with political instability and real GDP per worker as controls. The estimates point to a significant effect of each openness variable on inflation. To account for the likely endogeneity of both variables, we estimate the model by two stages least squares (2SLS), using *Capital* and *Current* as instruments in addition to Z^{Open}. Notice first, that the Hausman test does not reject exogeneity any more, in contrast with the models where only one openness measures was included. There are two possible interpretations: One might argue that the model excluding the "other" openness measure is misspecified and that the endogeneity issues is resolved, once the effect of the other openness variable is "taken out of the error term" and included in the main model. This would imply that there are no other relevant omitted variables and that reverse causality or measurement error are not an issue here. Alternatively, one could argue that the failure to reject exogeneity is due to a low power of the Hausman test, given that the partial correlation between the additional instruments (*Capital* and *Current*) and the openness measures is fairly small.

The second column gives the 2SLS estimates; both openness measures remain negative and have approximately the same coefficient; but as expected the standard errors becomes fairly large such that the coefficients are rendered insignificant.[8] In terms of the Stock-Yogo test, the Cragg-Donald statistic is 1.83, i.e. we cannot reject the null that instrument quality is below the lowest level. Hence, instrument quality is too weak to produce reliable results. A possible answer to this problem is to use limited information maximum likelihood (LIML) estimation, which – as Stock and Yogo (2004) show – is far superior to 2SLS in the presence of weak instruments. But even if we use the critical values for LIML estimation, the Cragg-Donald statistic does not reject the null that instrument quality is below the lowest level (critical value: 3.09). And as expected, the qualitative results do not change when the model is estimated by LIML.

Still, we believe that the estimates suggest that both openness measures are relevant, which is particularly supported by the Hausman test. Consequently, both variables should be properly included in the main model. The problem is that we have only one good instrument for two endogenous variables. In order to resolve this issue, we proceed with a restricted variant of model (1). In particular, we assume that the parameters of the two openness variables are equal, which appears to be justified by a visual inspection of the two coefficients. More formally, we cannot reject the null that the parameters of $Open^{Trade}$ and

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[8] The least squares estimates are shown for a larger sample (91 countries), since the two instruments *Capital* and *Current* are only available for a smaller subsample of 73 countries. For the comparison of the estimates, this is not relevant in the present cases, since the least squares estimates for the 73-coutnry sample are de facto identical to that for the 91-country sample.

$Open^{Fin}$ are equal, not even at the the 10 percent level, irrespective whether the models is estimated least squares or 2SLS.[9]

Columns three and four of Table 4 show the least squares and IV results of the restricted models, using Z^{Open} as instrument for $Open^{Trade}$ and $Open^{Fin}$. The compound openness measure turns out significant at the one percent level now. This holds true in the next two columns as well, where *CBI* is included as control. Notice, that the Hausman test still does not reject exogeneity, despite the fact that the instrument Z^{Open} is of high quality. In terms of the F-statistics from the first stage regression, we can always at least reject that instrument quality is below the second highest level. As expected, including *Capital* and *Current* as additional instruments would weaken instrument quality (see the last column for the model including CBI, where the two policy measures are included in the first stage regression). Nevertheless, a noteworthy result (which, of course, has to be judged against the weak instrument quality) is that the OID test does not reject the orthogonality of *Capital* and *Current* with the error term.

2. Openness and the Output-Inflation Tradeoff

We now turn to the results for model (2). The details for the estimates using the two openness measures separately are given in the Appendix (see Table A2.1 and A2.2), but they can be summarized succinctly as follows. Both openness measures are positively related to the output-inflation tradeoff (though this relationship will also capture indirect effects, e.g. of $Open^{Trade}$ on θ through $Open^{Fin}$). In the (small sample) models including CBI, the p-value of $Open^{Trade}$ is slightly above the 10 percent level. Exogeneity is rejected in most models and the least square estimates are downward biased. Instrument quality is fine, and – as before –

[9] One could ask whether this is justifiable in light of the fact that the coefficients are similar when both variables are included but rather different when the variables are included separately. For the ceteris paribus effects of both variables to be the same, these results require that financial openness is stronger related to trade openness than trade openness to financial openness, which is not implausible in our view.

including *Current* and *Capital* only weakens instrument quality. The controls (level of inflation, variability of aggregate demand) show the expected negative sign though they are not always significant.

< Table 5 >

We now turn to the results, when both openness variables are included in the model. Column 1 in Table 5 gives the least squares estimates without controls except country size. The coefficient of financial openness is positive and statistically significant; the coefficient of trade openness is insignificant, however. This holds up for all variants of the models. As before, the problem is that we cannot instrument both variables using Z^{Open}, *Current*, and *Capital*; instrument quality is too low to yield reliable results (the Cragg-Donald statistics is 2.539, which is clearly below the critical value for the lowest quality level). The 2SLS results are given in the second column; as expected the standard errors become very large. Again LIML estimation is no feasible way out and produces qualitatively similar results.

We proceed with a restricted variant of model (2), which appears to be justifiable in the present context as well, given that the null the parameters of $Open^{Trade}$ and $Open^{Fin}$ are equal cannot be rejected at the 10 percent level, neither in least squares nor in the 2SLS estimation. (The same holds true when controls are included). Columns three and four show the least squares and IV estimates (using Z^{Open} as only instrument) with the level of inflation and the variability of aggregate demand included as controls. Instrument quality is fine (we can easily reject that instrument quality is below the highest level) and the joint openness measure turns out positively significant at the 10 percent level. This result holds up for the smaller sample with *CBI* included. (For completeness, we also show the 2SLS results with *Current* and *Capital* included as additional instruments).

As far as country size is concerned, the joint effect of population and area is positive but rarely significant. Mean inflation has significant negative effect as expected, whereas the variability of aggregate demand shows the expected sign but is insignificant. Finally, as in the model for inflation, we do not find a significant effect of *CBI* on the output-inflation tradeoff.

Some doubts remain on the independent role of $Open^{Trade}$ in this equation. Neverthelss, our reading of the results is that that trade openness and financial openness are both relevant determinants of the output-inflation tradeoff: First, the hypothesis that the coefficients are equal cannot be rejected. Second, from the separate estimates we conclude that $Open^{Trade}$ is downward biased, which may explain the insignificant results. Third, the results are consistent with that of the model using inflation as dependent variable. Finally, the Hausman test often rejects when one of the openness variables is omitted, while it does not when both $Open^{Trade}$ and $Open^{Fin}$ are included: This suggests that both variables are relevant in the main model. Finally, it is hard to believe for theoretical reasons that financial openness matters but trade openness does not, given that both variables are motivated by a similar model framework.

As far as size is concerned, results are similar to the regressions for inflation. Size tends to be positively related to the output-inflation tradeoff, but in most specifications only population or area are weakly significant and the two size variables are hardly significantly jointly.

While the negative effect of openness on inflation is consistent with all theoretical models discussed above, the significant positive effect of openness (as well as the weak positive effect of size) on the output-inflation tradeoff is at odds with the models by Romer (1993) and Lane (1997) but supportive to the models by Daniels and VanHoose (2005) and Razin and Loungani (2007); the latter model receives strong support for the fact that it provides the only rigorous motivation for an effect of financial openness, which turns out particularly strong.

3. Robustness

In Table 6 we show the results for alternative specifications of model (1) with *RGDPWOK* and *PINST* included as controls. As before, adding *CBI* does not change the qualitative conclusions such that the results can be regarded as representative. Moreover, we show only the results of the IV estimates, using Z^{Open} as instrument; throughout the least squares estimates show smaller standard errors, lower p-values and a better fit. We focus on the relationship between inflation and openness here (model 1); results of the corresponding robustness analysis for model (2) relating openness and the output-inflation trade off are very similar and thus relegated to the Appendix (see Table A2.3).

< Table 6 >

We start by considering alternative measures of openness. So far, we have used the broadest measures of trade and financial openness (imports plus exports as well as total foreign assets and liabilities as share of GDP). As mentioned before, this choice is motivated partly by the availability of better data, and also by the fact that it improves instrument the quality of our instrument Z^{Open}, in particular with respect to $Open^{Fin}$. A possible drawback is that this choice implies a slight departure from the theoretical models underlying the empirical analysis. Regarding trade openness, most models focus on imports (marginal propensity to import), though the transmission channel in Razin and Loungani (2007) (diversification of production, specialization, and the implied mismatch with the structure of consumption) can also be measured from the export side. As far as financial openness is concerned, the channel through which it affects inflation according to Razin and Loungani (2007) is that it allows consumer to smooth consumption. Thus, FDI assets and liabilities, which are included in our measure $Open^{Fin}$, are hardly relevant in this context.

To check the sensitivity of this choice, the first two columns in Table 6 show that IV estimates of models (1), using the import share as measure of $Open^{Trade}$, and narrower measures of financial openness for $Open^{Fin}$, defined as portfolio equity and debt assets plus liabilities as share of GDP. As can be seen, the results hold up: both openness measures show an economically and statistically significant effect on inflation. Considering the model, where only trade in terms of imports is included, the results are very close to that of Lane (1997), whose main estimates also range around the value of -2.

If both variables are included, results are the same as for the more general measures: $Open^{Fin}$ remains significant at the one percent level, while $Open^{Trade}$ becomes insignificant. Again, the hypothesis that the parameters are equal cannot be rejected, such that we use a restricted variant of model (1). Column three shows the corresponding results: the narrower compound openness measure turns out significant again.

We next consider, whether the use of a CPI based inflation measure instead of the GDP deflator makes any difference. Column four of Table 6 shows the estimates (for the restricted model using both openness measures). Again, the results hold up; in fact, the significance level of the openness measures improves.

We now turn to the analysis of subsample stability, both with respect to the time and the cross-section dimension. First, we spilt the time span used so far (1985 to 2004) into two subperiods: 1985-1994 and 1995-2004. As shown in columns five and six, the openness measure is still significant, though its effect appears to have fallen in the 1990s. This is in contrast with the results by Gruben and McLeod (2004) who argue that the link has strengthened. The most likely explanation for this discrepancy is that their estimates also capture the effects of financial openness with has strengthened in the 1990s.

While we have checked our results for outliers, we also rerun the regression, excluding all countries with an average inflation larger than 30 percent. Results for this reduced sample of 85 countries are essentially unchanged as can be seen from column 7 in Table 6.

Finally, we check whether results hold up if we focus on the 25 OECD countries contained in our sample. As can be seen in the last column of Table 6 the inflation-openness link gets lost. The small number of observations and the weak instrument quality does not appear to be the reason; the same result is obtained when the models is estimated least squares, where the p-value of the openness variable is 0.47. Similarly, again if $Open^{Trade}$ and

$Open^{Fin}$ are included separately, no significant effect on inflation can be found irrespective whether the model is estimated by IV or least squares. This result is enforced by the fact that the same result holds up for the analysis of the link between the output-inflation tradeoff and openness. And for completeness, we add that including CBI makes no difference as well.

Our results call into question that globalization has significantly affected the inflation performance of highly developed OECD countries, supporting the view of Ball (2006). The most likely explanation already suggested by Romer (1993) is that for our timer period considered, the time inconsistency problem has been successfully resolved by this small group of countries though the creation of a proper institutional framework for central bank behaviour.

Notice, that this finding is in contrast with the results by Daniels et al. (2006), who identify a positive link between trade openness and the sacrifice ratio for OECD countries, and also with those of Lane (1997), where the negative effect of trade openness on inflation holds up for the OECD subsample. Results are not easy to compare due to differences in the specification: Daniels et al. (2006), for example, focus on disinflations using the Ball (1994) dataset and do not control for country size; Lane (1997) uses a different measure of country size (GDP) and other instrumental variables (see the discussion in section II, subsection 3). Nevertheless, in our view the most appealing explanation for the discrepancy of our results with those of previous studies is the different time period considered: Daniels et al. (2006) used data from disinflation episodes between 1960 to 1991; the cross-section used by Lane (1997) covers the time period from 1973 to 1988, whereas our sample refers to the more recent period from 1985 to 2004. It is not implausible to assume that – at least most of the OECD countries considered – the attitudes of central banks have strongly shifted to towards maintaining low inflation (vs. stabilizing the output gap or stimulating activity) over the last decades, with the consequence that otherwise relevant determinants of the inflation bias (such as openness) do not play a role any more in shaping central bank behaviour.

At the same time, the differences of our result to that of previous studies suggest that it might an interesting avenue for future research to develop a larger set of estimates of output-inflation tradeoffs and to look for systematic differences in the effect of openness on inflation between groups of countries and with respect to disinflation vs. inflation periods. Another interesting issue to be addressed in future research would be to provide an empirical assessment of the effects of migration on inflation, a third important channel through which globalization may have affected inflation performance according to the recent model by Razin and Binyamini (2007).

IV. Conclusions

This paper provides comprehensive empirical evidence for a link between globalization and inflation, using a large cross-section of countries covering the period 1985-2004. Endogeneity concerns are address in a instrumental variable procedure, exploiting the exogeneity of geography to identify the ceteris paribus effect of globalization in terms of trade and financial openness on inflation and the output-inflation tradeoff.

We find several interesting results: Countries which are more open both to international trade and financial flows show lower rates of inflation, and – at the same time – a larger output-inflation tradeoff. This is at odds with the role of trade in a standard Barro-Gordon framework as considered by Romer (1993) or Lane (1997); in these modes, for trade to have a negative effect on inflation, it would have to be associated with a smaller output-inflation tradeoff. Moreover, these models do not explain why financial openness should be negatively related to inflation.

Our results support a recent strand of the new Keynesian literature, in particular the models by Daniels and VanHoose (2005) and Razin and Loungani (2007). Both models predict a negative effect of globalization on inflation and a positive effect on the output-inflation trade off. In Daniels and VanHoose (2005) the transmission channel is that trade reduces the pricing power of firms, and thereby also the output effects of a surprise inflation. In Razin and Loungani (2007), *both* financial and trade openness reduce the relative weight attached to the output gap in the representative households utility based loss function. As a result, globalization tends to induce policy maker's, guided by the representative household's objective function, to putting greater emphasis on reducing inflation than on narrowing output gaps. This model receives strong support through our results since the link between financial openness and inflation (the output-inflation tradeoff) is particularly robust.

The effects of globalization on inflation are also economically significant. Increasing trade or financial openness by one percentage point reduces average inflation by -.2 to -0.4 percent. The magnitude of this effect is roughly in line with previous studies, bearing in mind that most of them considered only the effect of trade but omitted financial openness.

A further important result, which is in contrast to previous studies using data up to the end of the 1980s, is that we do not find a robust relation between openness and inflation for our subsample of 25 OECD countries. The apparently opposite views by Rogoff and Ball quoted in the introduction can be reconciled with this evidence. Since the global disinflation over the last decades is mainly due to the improved inflation performance of developing rather than the highly developed countries, Rogoff is certainly right to stress the disciplinating force globalization has exerted on central bank behaviour. Ball, though referring to Rogoff, considers primarily the US experience and that of OECD countries, where no empirical link between inflation and openness can be identified. At least since the mid 1980s, these countries appear to have resolved the time inconsistency problem by creating an institutional framework supporting central bank behaviour that is uncoupled from otherwise relevant determinants of the inflation bias.

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Appendix

A1. Data Description

Our final sample comprises 91 countries, for which the main variables are available, and refers mainly to the period 1985-2004. Data on inflation, nominal and real GDP, and import shares are taken from the Word Development Indicators. Initial real GDP per worker in 1985 and real openness (i.e. real exports plus real imports over real GDP) are taken from the Penn World Tables 6.2. Financial openness is calculated from data by Lane and Milesi-Feretti (2006). Data on central bank independence is from Cukierman et al. (1992) for the period 1950 to 1989, and from Polillo and Guillén (2005) for the period 1990 to 2000. The geographical trade instrument is from Frankel and Rose (2002) and refers to 1990. Data on political instability (indicator of government crises) is from Aisen and Veiga (2005). Data on capital and current account restrictions are from Quinn (1997). I wish to thank Dan Quinn and Jose Veiga for sharing their data with me. I also wish to thank Jeffrey Frankel and Andrew Rose, Alex Cukierman as well as Simon Polillo and Mauro Guillén for making their data available through their webpage.

List of Countries

ARE	United Arab Emirates	KOR	Korea
AUS	Australia	KWT	Kuwait
AUT	Austria	LKA	Sri Lanka
BEL	Belgium	MAR	Morocco
BEN	Benin	MDG	Madagascar
BFA	Burkina Faso	MEX	Mexico
BGD	Bangladesh	MLI	Mali
BWA	Botswana	MLT	Malta
CAN	Canada	MOZ	Mozambique
CHE	Switzerland	MUS	Mauritius
CHL	Chile	MWI	Malawi
CHN	China,P.R.: Mainland	MYS	Malaysia
CIV	Côte d'Ivoire	NER	Niger
CMR	Cameroon	NGA	Nigeria
COG	Congo, Republic of	NLD	Netherlands
COL	Colombia	NOR	Norway
CRI	Costa Rica	NPL	Nepal
CYP	Cyprus	NZL	New Zealand
DEU	Germany	OMN	Oman
DNK	Denmark	PAK	Pakistan

List of Countries (continued)

DOM	Dominican Republic
DZA	Algeria
ECU	Ecuador
EGY	Egypt
ESP	Spain
ETH	Ethiopia
FIN	Finland
FRA	France
GAB	Gabon
GBR	United Kingdom
GHA	Ghana
GRC	Greece
GTM	Guatemala
HND	Honduras
HTI	Haiti
HUN	Hungary
IDN	Indonesia
IND	India
IRL	Ireland
IRN	Iran, Islamic Republic of
ISL	Iceland
ISR	Israel
ITA	Italy
JAM	Jamaica
JOR	Jordan
KEN	Kenya
PAN	Panama
PHL	Philippines
PNG	Papua New Guinea
PRT	Portugal
PRY	Paraguay
RWA	Rwanda
SAU	Saudi Arabia
SDN	Sudan
SEN	Senegal
SGP	Singapore
SLV	El Salvador
SWE	Sweden
SWZ	Swaziland
SYR	Syrian Arab Republic
THA	Thailand
TTO	Trinidad and Tobago
TUN	Tunisia
TUR	Turkey
UGA	Uganda
URY	Uruguay
USA	United States
VEN	Venezuela, Rep. Bol.
ZAF	South Africa
ZMB	Zambia
ZWE	Zimbabwe

A2. Estimation Results

< Table A2.1 here >

< Table A2.2 here >

< Table A2.3 here >

Table 1. *Descriptive Statistics and Correlation Matrix of Selected Variables*

a) Basic statistics		Mean	Median	Maximum	Minimum	Std. Dev.	Obs.
(1)	π	9.82	5.59	45.39	1.26	9.96	91
(2)	θ	0.31	0.20	1.00	-0.45	0.33	91
(3)	$OPEN^{Trade}$	0.72	0.61	3.31	0.20	0.44	91
(4)	*Imports*	0.30	0.26	1.48	0.09	0.18	91
(5)	$OPEN^{Fin}$	1.69	1.37	6.95	0.39	1.26	91
(6)	*Capital*	65.69	66.88	100.00	20.31	23.02	73
(7)	*Current*	71.58	73.44	100.00	25.00	21.56	73
(8)	Z^{Open}	0.21	0.16	0.98	0.02	0.16	91
(9)	*CBI*	0.44	0.45	0.77	0.14	0.15	50
(10)	*PINST*	0.15	0.07	1.47	0.00	0.23	91
(11)	*RGDPWOK*	21793	15457	81060	1363	18947	91

b) Correlations		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	$\ln \pi$	1.00	-0.55	-0.38	-0.22	-0.42	-0.41	-0.35	-0.32	-0.08	0.08	-0.45
(2)	θ		1.00	0.26	0.21	0.43	0.37	0.33	0.33	0.04	-0.02	0.43
(3)	$OPEN^{Trade}$			1.00	0.91	0.57	0.21	0.21	0.71	-0.12	-0.16	0.30
(4)	*Imports*				1.00	0.48	0.15	0.15	0.74	-0.08	-0.20	0.19
(5)	$OPEN^{Fin}$					1.00	0.48	0.43	0.57	0.10	-0.05	0.39
(6)	*Capital*						1.00	0.85	0.42	0.31	0.00	0.64
(7)	*Current*							1.00	0.35	0.31	0.00	0.61
(8)	Z^{Open}								1.00	0.11	-0.02	0.36
(9)	*CBI*									1.00	0.09	0.41
(10)	*PINST*										1.00	0.03
(11)	$\ln RGDPWOK$											1.00

Notes: A description of the data and a list of countries are provided in the Appendix.

Table 2. *Inflation and Trade Openness*

Dependent variable is ln π

	LS	IV	LS	IV	LS	IV	2SLS
Constant	-1.534	0.337	1.631	2.053	3.952^{**}	6.843^{***}	6.338^{***}
	(0.745)	(0.269)	(1.144)	(1.258)	(1.865)	(1.880)	(1.985)
$OPEN^{Trade}$	-0.928^{***}	-1.651^{***}	-0.707^{***}	-0.944^{***}	-0.601^{***}	-1.565^{***}	-1.397^{***}
	(0.188)	(-3.561)	(0.176)	(0.363)	(0.000)	(0.000)	(0.470)
ln *Pop*	0.015	-0.012	-0.055	-0.058	-0.213^{***}	-0.170^{*}	-0.178^{**}
	(0.070)	(-0.149)	(0.075)	(0.077)	(0.072)	(0.088)	(0.082)
ln *Area*	-0.056	-0.145^{*}	-0.031	-0.061	0.026	-0.181^{*}	-0.145
	(0.064)	(-1.743)	(0.059)	(0.079)	(0.069)	(0.095)	(0.089)
PINST			0.297	0.246	0.385	0.111	0.159
			(0.364)	(0.363)	(0.357)	(0.345)	(0.347)
ln *RGDPWOK*			-0.323^{***}	-0.307^{***}	-0.534^{***}	-0.491^{***}	-0.499^{***}
			(0.088)	(0.094)	(0.130)	(0.151)	(0.144)
CBI					1.127^{*}	0.315	0.457
					(0.638)	(0.865)	(0.797)
Hausman (p-value) [1)]		(0.070)		(0.466)		(0.072)	(0.021)
OID (p-value) [2)]							(0.512)
IQual (F-Test)		32.049		26.208		12.719	8.661
Adj. R^2	0.123		0.243		0.383		
SEE	0.867	0.903	0.806	0.810	0.672	0.766	0.737
Observations	91		91		47		

Notes: *, **, *** denote significance at the 10, 5, and 1 per cent level; heteroscedasticity-robust standard errors in parenthesis. IV estimates use Z^{Open} as instrument for $Open^{Trade}$. 2SLS estimate uses *Current* as additional instrument. [1)] Heteroscedasticity-robust Hausman test for endogeneity (H_0: $Open^{Trade}$ (*Current*) is exogenous). [2)] Heteroscedasticity-robust test of overidentifying restrictions (H_0: Z^{Open}, *Current* are valid instruments).

Table 3. *Inflation and Financial Openness*

Dependent variable is ln π

	LS	IV	LS	IV	LS	IV	2SLS
Constant	-2.365^{***}	-1.161	0.604	0.752	2.759^{*}	3.367^{**}	3.190^{**}
	(0.635)	(0.898)	(1.070)	(1.104)	(1.491)	(1.456)	(1.423)
$OPEN^{Fin}$	-0.303^{***}	-0.534^{***}	-0.212^{***}	-0.350^{***}	-0.245^{***}	-0.488^{***}	-0.417^{***}
	(0.066)	(0.124)	(0.068)	(0.129)	(0.067)	(0.156)	(0.111)
ln *Pop*	0.027	0.009	-0.047	-0.047	-0.210^{***}	-0.180^{*}	-0.189^{**}
	(0.071)	(0.076)	(0.075)	(0.076)	(0.074)	(0.093)	(0.086)
ln *Area*	-0.011	-0.063	0.012	-0.018	0.040	-0.074	-0.041
	(0.062)	(0.071)	(0.056)	(0.067)	(0.055)	(0.090)	(0.069)
PINST			0.406	0.378	0.478	0.401	0.423
			(0.374)	(0.379)	(0.367)	(0.427)	(0.408)
ln *RGDPWOK*			-0.296^{***}	-0.246	-0.442^{***}	-0.323^{**}	-0.358^{***}
			(0.097)	(0.108)	(0.128)	(0.156)	(0.141)
CBI					1.392^{**}	1.151	1.221^{*}
					(0.599)	(0.814)	(0.722)
Hausman (p-value) [1)]		(0.047)		(0.220)		(0.109)	(0.078)
OID (p-value) [2)]							(0.452)
IQual (F-Test)		25.514		16.282		10.256	9.368
Adj. R^2	0.148		0.240		0.445		
SEE	0.855	0.897	0.807	0.822	0.638	0.710	0.675
Observations	91		91		47		

Notes: *, **, *** denote significance at the 10, 5, and 1 per cent level; heteroscedasticity-robust standard errors in parenthesis. IV estimates use Z^{Open} as instrument for $Open^{Fin}$. 2SLS estimate uses *Capital* as additional instrument. [1)] Heteroscedasticity-robust Hausman test for endogeneity (H_0: $Open^{Fin}$ (*Capital*) is exogenous). [2)] Heteroscedasticity-robust test of overidentifying restrictions (H_0: Z^{Open}, *Capital* are valid instruments).

Table 4. *Inflation, Trade and Financial Openness*

Dependent variable is ln π

	LS	2SLS[3)]	LS	IV[4)]	LS	IV[4)]	2SLS[5)]
Constant	1.441	1.768	0.967	1.103	3.394**	4.194***	3.843**
	(1.173)	(2.060)	(1.060)	(1.110)	(1.485)	(1.470)	(1.476)
$OPEN^{Trade}$	-0.509***	-0.208	-0.207***	-0.255***	-0.227***	-0.372***	-0.308***
	(0.188)	(0.866)	(0.055)	(0.089)	(0.055)	(0.103)	(0.067)
$OPEN^{Fin}$	-0.149**	-0.278	Restr.	Restr.	Restr.	Restr.	Restr.
	(0.070)	(0.253)					
ln *Pop*	-0.053	-0.095	-0.049	-0.050	-0.202***	-0.178**	-0.188**
	(0.074)	(0.078)	(0.074)	(0.074)	(0.071)	(0.082)	(0.076)
ln *Area*	-0.039	-0.011	-0.013	-0.030	0.000	-0.100	-0.056
	(0.059)	(0.081)	(0.058)	(0.069)	(0.058)	(0.082)	(0.063)
PINST	0.309	0.418	0.362	0.343	0.419	0.332	0.370
	(0.362)	(0.397)	(0.367)	(0.369)	(0.358)	(0.389)	(0.374)
ln *RGDPWOK*	-0.283***	-0.306***	-0.283***	-0.263**	-0.441***	-0.363***	-0.397***
	(0.096)	(0.120)	(0.096)	(0.102)	(0.128)	(0.141)	(0.127)
CBI					1.219*	0.952	1.069
					(0.607)	(0.770)	(0.683)
Hausman (p-value) [1)]		(0.910)		(0.530)		(0.172)	(0.224)
OID (p-value) [2)]		(0.186)					
IQual (F-Test)		9.626, 11.545		24.683		16.145	9.154
Adj. R^2	0.261		0.259		0.462		
SEE	0.796	0.722	0.797	0.800	0.628	0.663	0.639
Observations	91	73	91		47		

Notes: *, **, *** denote significance at the 10, 5, and 1 per cent level; heteroscedasticity-robust standard errors in parenthesis. [1)] Heteroscedasticity-robust Hausman test for endogeneity (H_0: $Open^{Trade}$ is exogenous). [2)] Heteroscedasticity-robust test of overidentifying restrictions (H_0: Z^{Open}, *Current* are valid instruments). [3)] Z^{Open}, *Capital*, and *Current* used as instruments for $Open^{Trade}$ and $Open^{Fin}$. [4)] Z^{Open} used as instrument for $Open^{Trade}$ and $Open^{Fin}$ (restricted model). [5)] Z^{Open}, *Capital*, and *Current* used as instruments for $Open^{Trade}$ and $Open^{Fin}$ (restricted model).

Table 5. *The Output-Inflation Tradeoff, Trade and Financial Openness*

Dependent variable is θ

	LS	2SLS[3)]	LS	IV[4)]	LS	IV[4)]	2SLS[5)]
Constant	-0.206 (0.358)	-0.102 (0.547)	0.002 (0.246)	-0.116 (0.355)	0.177 (0.493)	-0.118 (0.640)	-0.628 (0.740)
$OPEN^{Trade}$	0.062 (0.101)	-0.274 (0.334)	0.079*** (0.018)	0.094*** (0.035)	0.060*** (0.025)	0.085* (0.043)	0.128** (0.053)
$OPEN^{Fin}$	0.110*** (0.025)	0.246** (0.096)	Restr.	Restr.	Restr.	Restr.	Restr.
$\ln Pop$	0.036 (0.027)	0.027 (0.029)	0.019 (0.026)	0.021 (0.025)	-0.016 (0.025)	-0.014 (0.025)	-0.012 (0.028)
$\ln Area$	-0.004 (0.025)	-0.004 (0.042)	0.008 (0.021)	0.012 (0.026)	0.032 (0.030)	0.047 (0.042)	0.074 (0.046)
π			-0.463 (0.326)	-0.440 (0.347)	-1.438** (0.599)	-1.340** (0.565)	-1.171** (0.573)
σ^{AD}			-1.200* (0.674)	-1.177* (0.676)	-0.931 (0.676)	-0.852 (0.662)	-0.717 (0.652)
CBI					0.008 (0.220)	0.017 (0.230)	0.033 (0.260)
Hausman (p-value) [1)]		(0.097)		(0.546)		(0.458)	(0.057)
OID (p-value) [2)]		(0.806)					(0.163)
IQual (F-Test)		10.792, 16.915		33.455		14.938	8.030
Adj. R^2	0.163		0.340		0.404	0.392	
SEE	0.3	0.347	0.267	0.268	0.261	0.264	0.279
Observations	91	73	91			47	

Notes: $^{*, **, ***}$ denote significance at the 10, 5, and 1 per cent level; heteroscedasticity-robust standard errors in parenthesis. [1)] Heteroscedasticity-robust Hausman test for endogeneity (H_0: $Open^{Trade}$ is exogenous). [2)] Heteroscedasticity-robust test of overidentifying restrictions (H_0: Z^{Open}, *Current* are valid instruments). [3)] Z^{Open}, *Capital*, and *Current* used as instruments for $Open^{Trade}$ and $Open^{Fin}$. [4)] Z^{Open} used as instrument for $Open^{Trade}$ and $Open^{Fin}$ (restricted model). [5)] Z^{Open}, *Capital*, and *Current* used as instruments for $Open^{Trade}$ and $Open^{Fin}$ (restricted model).

Table 6. *Robustness Analysis: Inflation and Openness (Model (1))*

	$Open^{Trade}$ *in Imports*	$Open^{Fin}$ without FDIs	Restricted variant	CPI inflation	Subperiods 1985-1994	1995-2004	Excluding high inflation countries	OECD Countries
Constant	2.226	0.997	1.286	1.545	0.817	1.023	0.465	14.860
	(1.378)	(1.126)	(1.121)	(1.281)	(1.528)	(0.944)	(1.076)	(2.602)
$OPEN^{Trade}$	-2.073**		-0.411**	-0.312***	-0.439**	-0.210***	-0.278***	-0.063
	(0.904)		(0.159)	(0.105)	(0.196)	(0.073)	(0.087)	(0.086)
$OPEN^{Fin}$		-0.513**	restr.	restr.	restr.	restr.	restr.	restr.
		(0.214)						
ln *Pop*	-0.021	-0.067	-0.061	-0.027	-0.045	-0.131*	-0.001	-0.169*
	(0.085)	(0.079)	(0.076)	(0.084)	(0.094)	(0.070)	(0.069)	(0.081)
ln *Area*	-0.077	-0.019	-0.031	-0.075	-0.052	0.019	-0.083	0.105
	(0.090)	(0.070)	(0.070)	(0.078)	(0.087)	(0.059)	(0.065)	(0.112)
PINST	0.145	0.543	0.477	0.459	0.202	0.499	0.248	0.494**
	(0.397)	(0.405)	(0.389)	(0.434)	(0.359)	(0.335)	(0.348)	(0.218)
ln *RGDPWOK*	-0.345***	-0.247**	-0.269**	-0.261**	-0.161	-0.263***	-0.178*	-1.693***
	(0.092)	(0.116)	(0.108)	(0.122)	(0.119)	(0.089)	(0.097)	(0.236)
Hausman (p-value) [1)]	(0.057)	(0.090)	(0.141)	(0.363)	(0.335)	(0.435)	(0.407)	(0.953)
IQual (F-Test)	33.782	9.010	13.852	24.683	13.990	25.208	21.844	6.983
SEE	0.862	0.858	0.830	0.881	0.937	0.791	0.716	0.444
Observations	91	90	90	90	88	91	85	25

Notes: *, **, *** denote significance at the 10, 5, and 1 per cent level; heteroscedasticity-robust standard errors in parenthesis. IV-estimates use Z^{Open} as instrument for $Open^{Trade}$ and $Open^{Fin}$. 1) Heteroscedasticity-robust Hausman test for endogeneity (H_0: $Open^{Fin}$ ($Open^{Trade}$) is exogenous).

Appendix Tables

Table A2.1 *The Output-Inflation Tradeoff and Trade Openness*

Dependent variable is θ							
	LS	IV	LS	IV	LS	IV	2SLS
Constant	-0.058	-1.094	0.339	-0.396	1.009*	-0.284	-0.816
	(0.373)	(0.581)	(0.321)	(0.503)	(0.554)	(0.852)	(1.034)
$OPEN^{Trade}$	0.225**	0.626***	0.103	0.385**	-0.039	0.328	0.479
	(0.093)	(0.220)	(0.077)	(0.180)	(0.096)	(0.231)	(0.303)
$\ln Pop$	0.034	0.049	0.016	0.028	-0.019	-0.022	-0.023
	(0.028)	(0.038)	(0.026)	(0.031)	(0.025)	(0.030)	(0.035)
$\ln Area$	-0.009	0.040	-0.005	0.027	-0.010	0.061	0.091
	(0.026)	(0.037)	(0.024)	(0.032)	(0.031)	(0.054)	(0.063)
π			-0.926**	-0.740	-2.458***	-2.019**	-1.838**
			(0.419)	(0.468)	(0.880)	(0.814)	(0.893)
σ^{AD}			-1.139*	-1.024	-0.836	-0.852	-0.858
			(0.578)	(0.632)	(0.958)	(0.758)	(0.822)
CBI					-0.032	0.232	0.341
					(0.259)	(0.293)	(0.328)
Hausman (p-value) [1)]		(0.023)		(0.052)		(0.069)	(0.027)
OID (p-value) [2)]							(0.129)
IQual (F-Test)		32.049		27.598		10.343	5.777
Adj. R^2	0.049		0.268		0.376		
SEE	0.320	0.349	0.281	0.297	0.267	0.301	0.332
Observations	91		91		47		

Notes: *, **, *** denote significance at the 10, 5, and 1 per cent level; heteroscedasticity-robust standard errors in parenthesis. IV estimates use Z^{Open} as instrument for $Open^{Trade}$. 2SLS estimate uses *Current* as additional instrument. [1)] Heteroscedasticity-robust Hausman test for endogeneity (H_0: $Open^{Trade}$ and (*Current*) is exogenous). [2)] Heteroscedasticity-robust test of overidentifying restrictions (H_0: Z^{Open}, *Current* are valid instruments).

Table A2.2 *The Output-Inflation Tradeoff and Financial Openness*

Dependent variable is θ

	LS	IV	LS	IV	LS	IV	2SLS
Constant	-0.087 (0.260)	-0.526 (0.416)	0.123 (0.215)	-0.025 (0.324)	0.223 (0.427)	-0.029 (0.594)	-0.313 (0.635)
$OPEN^{Fin}$	0.118*** (0.022)	0.203*** (0.059)	0.095*** (0.020)	0.123*** (0.046)	0.080** (0.030)	0.110*** (0.054)	0.145** (0.061)
$\ln Pop$	0.034 (0.026)	0.041 (0.028)	0.017 (0.025)	0.020 (0.025)	-0.014 (0.024)	-0.012 (0.024)	-0.009 (0.026)
$\ln Area$	-0.010 (0.023)	0.009 (0.030)	0.002 (0.020)	0.008 (0.025)	0.028 (0.027)	0.041 (0.039)	0.057 (0.039)
π	-0.010 (0.023)	0.023 (-0.449)	-0.477 (0.322)	-0.446 (0.348)	-1.430** (0.568)	-1.338** (0.537)	-1.659** (0.681)
σ^{AD}			-1.220* (0.670)	-1.191* (0.681)	-0.871 (0.666)	-0.777 (0.644)	-0.582 (0.579)
CBI					-0.043 (0.217)	-0.054 (0.224)	-0.061 (0.241)
Hausman (p-value) [1)]		(0.068)		(0.414)		(0.470)	(0.114)
OID (p-value) [2)]							(0.086)
IQual (F-Test)		25.514		23.622		10.519	8.632
Adj. R^2	0.169		0.350		0.428		
SEE	0.299	0.315	0.265	0.267	0.256	0.259	0.267
Observations	91		91		47		

Notes: *, **, *** denote significance at the 10, 5, and 1 per cent level; heteroscedasticity-robust standard errors in parenthesis. IV-estimates use Z^{Open} as instrument for $Open^{Fin}$. 2SLS estimate uses *Capital* as additional instrument. 1) Heteroscedasticity-robust Hausman test for endogeneity (H_0: $Open^{Fin}$ (*Capital*) is exogenous). 2) Heteroscedasticity-robust test of overidentifying restrictions (H_0: Z^{Open}, *Capital* are valid instruments).

Table A2.3 *Robustness Analysis: The Openness-Inflation Tradeoff and Openness*

	Imports as $Open^{Trade}$	$Open^{Fin}$ without FDIs	Restricted variant	Subperiods 1985-1994	1995-2004	Excluding high inflation countries	OECD Rich
Constant	-0.378	-0.020	-0.077	-0.076	0.311	0.062	-0.203
	(0.504)	(0.334)	(0.350)	(0.562)	(0.421)	(0.357)	(0.813)
$OPEN^{Trade}$	0.901**		0.143**	0.130*	0.049	0.074**	0.047
	(0.445)		(0.057)	(0.077)	(0.037)	(0.036)	(0.052)
$OPEN^{Fin}$		0.169**	restr.	restr.	restr.	restr.	restr.
		(0.069)					
$\ln Pop$	0.015	0.021	0.020	0.048	0.037	0.021	0.057
	(0.030)	(0.026)	(0.025)	(0.033)	(0.040)	(0.026)	(0.042)
$\ln Area$	0.037	0.007	0.012	-0.008	-0.031	0.008	0.016
	(0.036)	(0.026)	(0.027)	(0.033)	(0.036)	(0.028)	(0.051)
π	-1.061**	-0.670	-0.732	-0.271	-0.356	-1.151**	-0.757
	(0.452)	(0.481)	(0.463)	(0.233)	(0.262)	(0.545)	(0.607)
σ^{AD}	-0.844	-1.240*	-1.177*	-1.842***	-0.922	-1.430	-2.127
	(0.645)	(0.684)	(0.661)	(0.630)	(0.770)	(0.810)	(1.296)
Hausman (p-value) [1)]	(0.038)	(0.180)	(0.261)	(0.320)	(0.611)	(0.880)	(0.956)
IQual (F-Test)	28.412	14.312	20.068	19.568	30.929	28.271	9.089
SEE	0.298	0.279	0.273	0.371	0.374	0.264	0.239
Observations	91	91	91	91	91	85	25

Notes: *,**,*** denote significance at the 10, 5, and 1 per cent level; heteroscedasticity-robust standard errors in parenthesis. IV-estimates use Z^{Open} as instrument for $Open^{Trade}$ and $Open^{Fin}$. [1)] Heteroscedasticity-robust Hausman test for endogeneity (H_0: $Open^{Fin}$ ($Open^{Trade}$) is exogenous).

Figure 1. *Trade Openness and Inflation*

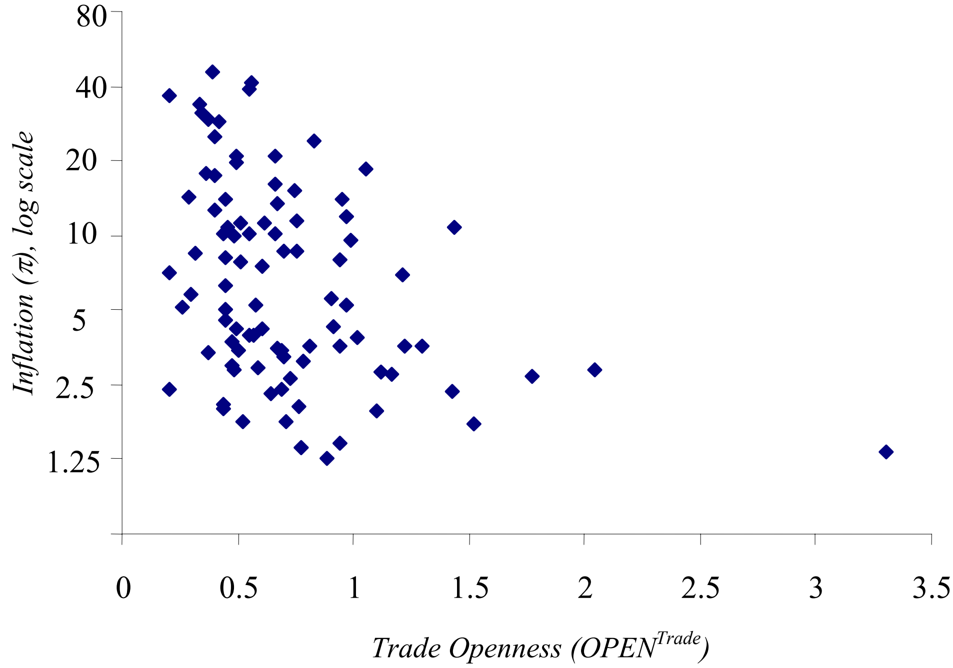

Figure 2. *Financial Openness and Inflation*