Inflation, Openness, and Exchange-Rate Regimes

The Quest for Short-Term Commitment

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Abstract

This paper further tests Romer's (1993) extension of Kydland and Prescott's (1977) predictions on dynamic-inconsistency problems with regard to open economies. In a panel data set, I find that openness does not seem to play a role in the short run in restricting inflation, but a fixed exchange-rate regime plays a significant role. This result is robust to the use Reinhart and Rogoff's (2002) exchange rate regime classification. If the openness-inflation relationship arises from the dynamic inconsistency of discretionary monetary policy, the relationship is weaker in countries with fixed exchange-rate regimes.

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1. Introduction

The 1990s probably will be remembered as, among other things, the decade in which average inflation came under control around the world. According to the IMF, average inflation in industrialized economies between 1982 and 1991 was 4.9%; at the end of 1999, it was 0.8% as measured by the GDP deflator (Table I). More remarkably, average inflation in developing countries went from 45.1% between 1982 and 1991 to 6.9% in 1999.

The 1990s also will be remembered as the "globalization" decade. Trade of goods as a percentage of PPP GDP went from 21.2% in 1988 to 28.3% in 1998 (Table II). This increase is yet more striking when analyzed as a percentage of goods production, which increased from 71.9% to 92.1%. Within low- and middle-income countries, the most dramatic increase was, of course, in Eastern Europe. The Latin American region, where trade of goods as a percentage of PPP GDP went from 9.4% to 19.1%, followed closely. High-income countries also experienced an increase in the percentage of goods traded. In the last decade, tariffs across the world have decreased.[1] Although concerns remain about lingering barriers, non-tariff barriers, and other protectionist practices, it is hard to deny that the world has become more integrated.

The obvious question then is are these events related? Romer's (1993) work shows that inflation and openness are negatively and significantly correlated. Using Kydland and Prescott (1977) and Barro and Gordon (1983) type models, he argues that the negative openness-inflation relationship arises from the dynamic inconsistency of discretionary monetary policy.

One of the central issues behind the time inconsistency problem is a government's inability to make binding commitments to future policies. Due to the sequential nature of policy-making, it is generally optimal ex-post for governments to deviate from earlier, ex-ante optimal

[1] See World Bank's *World Development Indicators*.

plans or pre announced policy rules. Private agents sectors, aware that policymakers have incentives to deviate in the future, base their current actions on the expectation that deviations will occur.[2] The final outcome is a sub-optimal high inflation rate.

Without binding commitments that impose high costs for reversing policy, a plan with desirable properties might encounter serious credibility problems. If the policymaker could make binding commitments to pursue particular policies, the time inconsistency problem would be irrelevant.[3] Given the ability to commit, societies can tie policymakers' hands and thereby potentially improve final outcomes.

These considerations give rise to important empirical puzzles. Although we do observe high periods of inflation, we do not see them in all countries at all times. What does this say about the ability to commit? Does it change, or correlate to other policy instruments? What mechanisms enable countries to relax incentive constraints and mitigate the credibility problem?[4] Judging from observed outcomes, the efficiency of such mechanisms varies across societies and time.

Unfortunately, there is little empirical evidence that the mechanism identified by Kydland and Prescott is important to actual inflation. The great contribution of Romer (1993) is that he tests the prediction that the absence of precommitment in monetary policy— given by the degree of openness— leads to inefficiently high inflation.

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[2] At certain point in time t, the policymaker designs an optimal policy rule or plan for a future date t+s. Typically at t+s, the ex-ante optimal plan (optimal given date t constraints) will not be optimal since the policymaker faces different constraints ex-post. If the first plan had achieved a first-best allocation, this implies that the policymaker faces a second-best situation. See Chari, Kehoe, and Prescott (1989).

[3] This implies that there is access to such commitment technology.

[4] Persson and Tabellini (1994) provide analysis and discussion of different applications as well as a survey of the literature

The theoretical reasoning for why more open economies tend to have less inflation follows from Rogoff's (1985) model, which shows that such economies gain less from surprise inflation. Surprise monetary expansions cause the real exchange rate to depreciate, leading to a negative terms-of-trade effect. The more open the economy the more the real exchange depreciates, thus reducing incentives to undertake expansion.

Lane (1997) considers alternative mechanisms that link inflation and openness beyond the large-country terms of trade effects. Using Obstfeld and Rogoff's (1995) new-open-economy-macro-type model with imperfect competition, a floating exchange-rate regime, nominal price rigidity, and a nontraded sector type, he finds that how effectively a surprise monetary shock increases output depends positively on the size of the nontraded sector.[5] The more open the economy, the smaller the non-traded sector. Even if it is too small to influence its terms of trade, a small country's incentive to inflate is lower, thus generalizing Rogoff's arguments. Empirically, Lane (1997) finds, after controlling for country size, that inflation and openness are inversely related, even for countries that face exogenous terms of trade.

Both Romer's and Lane's empirical work considered cross-country averages spanning more than a decade starting in 1973. They tested the long-run commitment effect of openness on restricting the usefulness of discretionary monetary policy.

The question remains, however, whether openness or other mechanisms bind in a short-term horizon. Differences across countries seem to suggest this scenario. Consequently, in contrast to Romer (1993) and Lane (1997), I take advantage of the time-dimension of the data to analyze whether openness serves as a commitment mechanism for restraining inflation in the short run. I control for country and time-fixed effects. Additionally, to solve the time

[5] See Lane (2001) for a survey on the now substantial literature that uses Obstfeld and Rogoff's (1995) framework.

inconsistency problem, I consider the role of other variables that affect the short-term dynamics the drive inflation, in particular the exchange-rate regime.

Romer (1993) argues that choice of exchange-rate regime is not an important determinant of inflation. This certainly would be true for long-term horizons but, as Frankel (1999) observes, fixing the exchange rate has the advantage of providing an observable commitment to monetary policy.[6] Atkenson and Kehoe (2001) formalize the argument that because it is more transparent, the exchange rate has a natural advantage as an instrument for monetary policy. Calvo and Vegh's (1999) work on stabilization programs shows that exchange rate pegs, albeit usually ending in balance of payment crises, enable countries to reduce inflation temporarily. Ghosh, Gulde, and Ostry (1997) empirical work finds pegged exchange rates to be associated with lower inflation.

The other often mentioned advantage of fixing the exchange rate is that it reduces transaction costs and exchange-rate risks that might discourage trade.[7] This argument implies that fixed exchange-rate regimes could be associated with higher levels of trade. Excluding a fixed exchange-rate variable from an analysis that considers the short-term relationship between inflation and openness can thus bias the results.

I use a panel data set of developing and developed countries from 1973 to 1998 (the period after the breakdown of the Bretton-Woods system) to analyze the relationship between inflation and openness and the exchange rate as a commitment device. Ghosh, Gulde, and Ostry (1997) used a similar approach to differentiate exchange-rate regimes across a panel of countries from 1960 to 1990. Whereas they do not, I control for country fixed effects as well as for year

[6] See Frankel (1999), Rogoff (2001), Rose (2000) for discussions of the advantages and disadvantages of alternative exchange rate regimes.

[7] See Frankel (1999).

dummies. In addition, I use a new exchange rate regime classification constructed by Reinhart and Rogoff (2000), which considers parallel exchange rate data when assessing whether a country has de facto maintained a pegged or a flexible exchange rate regime.

In contrast to previous work, I do not find a negative relationship between openness and inflation. I do, though, find a significant negative relationship between a fixed exchange-rate regime and inflation that is robust to the inclusion of other control variables and to Reinhart and Rogoff's (2000) new classification.

A simple explanation for this result can be found in the "classic" argument for fixing the exchange rate: it provides a transparent and easily verifiable nominal anchor for monetary policy. In the short run, openness does not seem to play this role.

The message of the papers is not that a peg inconsistent with fiscal and monetary policies can achieve low, long-term, sustainable inflation. As Obstfeld (1995) notes, "a broad range of empirical studies suggests that reducing domestic inflation and the instability it causes are better addressed through basic reform of the domestic monetary system." This paper argues that, in the short run, a fixed exchange rate has served as a commitment mechanism and thereby limited inflation.

Section 2 presents the theoretical arguments for the empirical analysis. The empirical approach and results are discussed in Sections 3 and 4. The last section presents conclusions.

2. Theoretical Arguments

In their seminal paper, Kydland and Prescott (1977) analyze the tension between ex-ante optimal and ex-post optimal policy and how policy-making consideration of private sector expectations, taken as given, leads to worse outcomes. Barro and Gordon (1983) applied

Kydland and Prescott's (1977) problem of time-consistency of optimal plans to inflation. Since private agents realize that the government has incentives to create surprise inflation, in the time-consistent equilibrium rational inflationary expectations are such that no surprise inflation occurs and the rate of inflation is higher than what is socially optimal.

In a simple reduced form of the standard dynamic inconsistency model for monetary policy, unanticipated monetary shocks affect both prices and real output owing to the existence of information problems, rigid contracts, or incomplete price adjustment.

In general, it is assumed that agents first develop their expectations on inflation and government then chooses its policy. Moreover, government's preferences are to dislike inflation but like higher output levels. The government's objective function is given by

$$U^g = (y_t - y^*)^2 - k\pi^2 \qquad (1)$$

The policy maker maximizes (1) subject to

$$y_t = y_t^* + b(\pi_t - \pi_t^e) \qquad (2)$$

where y denotes actual output, y* the natural or flexible-price equilibrium output level, π inflation, and π^e expected inflation. Expectations are taken as given. Since private agents anticipate that the government has an incentive to generate surprise monetary shocks, the equilibrium inflation level is positive (higher than optimal level), whereas output remains at its natural level.

Romer (1993) uses a Barro-Gordon type model to argue that openness checks government's incentive to engage in unanticipated inflation driven by exchange-rate depreciation. Expansion of domestic output relative to output abroad drives down the relative price of domestic goods (terms of trade effect). Following Rogoff (1985), Romer argues that since the negative effects of real depreciation are greater in more open economies, the benefits of

unanticipated expansion decrease in relation to the degree of openness. In the absence of induced precommitment in monetary policy, more open economies thus tend to have lower inflation rates. Using cross-country data, Romer finds a robust negative link between openness and inflation.

The "new-open economy macro" provides micro-founded models with which to explore the inflation-openness interaction. Obstfeld and Rogoff (1995) show that in a two-country setup in which all goods are traded, with monopolistic competition and nominal rigidities, an unanticipated permanent increase in the domestic money supply increases the level of output and consumption. The international real interest rate falls in proportion to the size of the expanding country and nominal depreciation translates into a decline in the domestic terms of trade. Because of the imperfect competition distortion, an initial increase in demand raises output, outweighing any negative terms of trade effect and increasing welfare.

Price setters take into account expected monetary expansion when forming price expectations. In a Barro-Gordon model, given its preferences for inflation and output, the government, in equilibrium, will not be able to increase output.

In an open economy the output level is lower than in a closed economy because the rise in import prices occasioned by monetary expansion lowers each monopolist's real marginal revenue.[8] The smaller and more open a country, then the smaller the maximum output increases an unexpected monetary expansion can achieve. Additionally, because a small country consumes only an infinitesimal fraction of its goods, monetary expansion would yield no welfare effect although it would lower the relative price of goods and increase output. The smaller and more

[8] Note that in local currency pricing models, prices do not respond to changes in the exchange rate. See Betts and Devereux (1996) and Devereux and Engel (2000).

open an economy, then the lower government's incentive to resort to inflation to increase productivity.

In a non-traded goods version of the model with a floating regime, there might be welfare benefits at home, even in a small country. Lane (1997) considers a model with non-tradable goods in which agent's preferences are given by

$$U = \sum_{t=0}^{\infty} b^{t} \left\{ a \ln c_t^N + (1-a) \ln c_t^T - \frac{k}{2} y_t^{N,i} + \frac{c}{1-e} \left(\frac{M_t}{P_t} \right)^{1-e} \right\} \qquad (3)$$

where c^N, c^T represent consumption of tradables and nontradables, respectively, m is money holding, P is the price index, and $y^{N,J}$ is the production of nontraded good type j produced by agent j with $\alpha, \beta \in (0,1)$, χ, ε, $k > 0$.

Lane defines a more open economy as one with a smaller non-traded sector (higher α) and, thus, one that gains less from monetary expansion. He shows that the equilibrium inflation rate under discretionary monetary policy is an increasing function of the gains to unexpected inflation. The prediction that smaller economies have lower equilibrium inflation rates thus holds even for small economies that face exogenous world prices for tradables and does not depend on the terms of trade mechanism.

In the short run, non-tradable goods output and consumption increase by the amount of the short-run depreciation in the real exchange rate. In this model, money supply changes pass fully through the nominal exchange rate in the long run. Given price rigidities, this translates in the short run, into a one-to-one real depreciation of the exchange rate, which would be increasing in the share of non-tradable goods. Over the long run, after prices adjust to the monetary shock the economy reverts to its initial steady-state. An unanticipated permanent increase in the money stock thus generates a short-run expansion in non-traded output given nominal price rigidities in

the non-traded sector. As time progresses, non-tradable prices adjust and we observe a proportionate increase in the nominal exchange rate and price level. In equilibrium, there are no gains from inflation as agents anticipate it. The greater the potential benefits, however, the higher the actual inflation in equilibrium. The benefits of surprise monetary expansion are thus greater the larger the non-traded sector and the less open the economy.

3. Cross-Section Analysis: 1973-1998

I tested first whether the negative correlation between openness and inflation is robust to expanding the data set. I included in this test, nearly an additional decade of observations over Romer's (1993) analysis. I followed Romer's estimation strategy by regressing inflation on a constant, the degree of openness, and an i.i.d. error term.

$$LINFLATION_i = \alpha + \beta OPENNESS_i + \varepsilon_i \qquad (4)$$

The full sample, which covers 148 countries, is a cross-section from 1973 to 1998. Inflation was measured by the GDP deflator. To reduce the importance of extreme inflation countries - following Romer- the logarithm of average annual inflation was used as the dependent variable. Consumer Price Index data were used as a robustness check. For openness measures I used both share of imports as a percentage of GDP and share of exports as a percentage of GDP.[9] Data were taken from the World Bank Development Indicators. (See Appendix 1.)

Summary statistics on inflation and other key variables are presented in Table III-A. Table III-B shows the correlation between the main variables. Figure 1 plots the correlation between the log of inflation and openness (imports as a percentage of GDP), between 1973 and

1998. The negative correlation persists even after adding more than a decade of observations over Romer's work. We can see that both openness measures (imports as a percentage of GDP as well as exports as a percentage of GDP) are highly inversely correlated with (the log) of inflation (–0.2163 and –0.3175, respectively).

Table IV reports results of the cross-section estimates from 1973 to 1998. Column (1), reports the results of a simple regression between inflation and imports as a percentage of GDP used as the measure of openness. The coefficient on openness is negative and highly significant. Column (2), using exports as a percentage of GDP as an openness measure, shows the results to be robust to the openness measure. Column (3) shows the negative and significant relationship between openness and inflation to be robust to the inclusion of regional dummies (OECD, Latin American, African, and OPEC countries). Columns (4) and (5) introduce the log of GDP per capita in order to control for development level. Once again the openness coefficient remains significant and negative even when controlling for regional differences and the development level. Columns (6), (7), and (8), which exclude countries with average inflation rates above 50%, perform the same analysis using different openness measures and controlling for development level. The results, a robust and negative relationship between openness and inflation, confirm Romer's (1993) findings.

There is, however, debate about the forces that drive the openness-inflation relationship result. Stokey (2002) argues that the 1970s inflationary episode might reflect more than a reputation problem, a misguided response based on "flawed economic analysis" from a time when many economists believed there was a significant trade-off between inflation and growth (Phillips curve analysis). Government officials accommodated the real shocks of the 1970s as

[9] Using total share of traded goods (exports plus imports) as a percentage of GDP yielded similar results, as did

opposed to engineering surprise inflation. The notion that only unanticipated inflation could stimulate output and the subsequent trade-off was not well understood until much later. Adding more than a decade of observations allows one to test whether the negative relationship between inflation and openness was simply a 1970s phenomenon. As can be seen in Table IV, the results after adding data for the late 1980s and 1990s, remain robust. We report in column (10), the estimate uses cross-section averages only for the 1980s and 1990, that is, it excludes the 1970s; the coefficient for the openness measures is negative and significant.

Terra (1998) argues that the negative relationship between openness and inflation across countries is driven by a group of severely indebted countries. She argues that the smaller a country's trade share, the more depreciated the real value of the currency must be to generate a given trade surplus as a share of GDP. The more depreciated the currency, the greater the pressure on the government's budget and the greater the pressure to inflate, thus explaining the negative correlation. Romer's (1998) main counter argument is that the relationship was significant both before and after the debt crisis. As can be seen in Table IV, the results remain robust after controlling for regional dummies and excluding countries with an average inflation rate above 50%.

Summarizing, the main result from the cross-section analysis is that inflation and openness remain negatively and significantly correlated after expanding the number of countries and number of years. These results are robust when using either exports or imports as an openness measure, as reflected in the high correlation between the two measures. The results remain robust after controlling for real-income per capita and regional dummies. Finally, although not reported, the negative relationship is robust when using alternative measures of

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using a 1985 trade share measure estimated by Frankel and Romer (1999).

inflation such as the consumer price index and when using only 1990s data. Over the long run, openness does seem to play an important role as a commitment mechanism that reduces inflation.

This approach, however, raises an important question about the correct time horizon for studying dynamic-inconsistency problems. Are they a long- or a short-run phenomenon? Romer (1993), for example, focuses on the long run, but a study by Alesina and Roubini (1990) uses a short-term horizon profile. Di Tella and MacCulloch (2000), who find in a panel of 21 OECD countries a strong negative correlation between inflation and the welfare state, argue that establishing unemployment benefits makes the monetary authority less concerned about the plight of the unemployed.

4. Panel Analysis

I exploit the time dimension of the data and present the regression analysis controlling for country and time-fixed effect. It could be argued that the correlation in the cross-section analysis might by driven by time-invariant omitted variables that often are difficult to measure, such as institutional variables. Romer (1993), Terra (1998), and Campillo and Miron (1997) considered, in a cross-section, additional variables such as central bank independence and instability, variables that, being available for only a subset of countries and years, are of limited use in a panel investigation. Time and country dummies, however, should capture this difference. Accordingly, I investigate the relation between the log of inflation against openness measures, controlling for country and time-fixed effects.

$$LINFLATION_{it} = \beta OPENNESS_{it} + \eta_i + \lambda_t + \varepsilon_{itww} \qquad (5)$$

where η_I refers to country fixed effect, λ to year fixed effect, and ε_{it} iid is an error term. Table V-A summarizes the key characteristics of the variables in the panel regression, and Table V-B presents the main correlations among the variables.

Table VI reports the main results using annual data. The first interesting result is that the negative relationship between openness and inflation disappears when we control for time and country fixed effects, although this is not significant to all openness measures as seen in columns (1) and (2). Columns (3) and (4) show this result to be robust to the inclusion of the GDP per capita measure. Controlling for time and country fixed effects that capture cyclical and other determinants of inflation, openness does not, in the short-run, seem to be a constraint on policymakers incentives to inflate.

Moving to a shorter-term horizon, leads us to ask what other mechanisms limit the benefits of unanticipated monetary expansions in the short run.

A classical argument for adopting fixed exchange-rate regimes is that doing so creates incentives for policymakers to control monetary supply and, thus, inflation. When monetary policy is set with full discretion inflationary bias can be evident.

A fixed exchange-rate regime can provide a commitment device for a country that pegs its economic policy to a more stable currency and imports its monetary policy. This argument explains why countries such as Spain, Italy, and Portugal were eager to import Germany's monetary discipline and why Argentina adopted a currency board. The stabilization literature reviewed by Calvo and Vegh (1999) shows how often countries have used a fixed exchange rate to provide a nominal anchor to reduce inflation. Over the last four decades, a number of Latin American stabilization programs pegged their exchange rates to the United States dollar. Rogoff

(1998) observed that fixing the exchange rate "has been in far wider use for establishing anti-inflation credibility than as a device for using monetary policy to stabilize output."

As suggested by Calvo and Vegh (1999) and formalized by Atkeson and Kehoe (2001), a fixed exchange-rate regime has the additional advantage of serving as a nominal, easily observed anchor whereby the private sector can directly monitor promises made by the central bank. Atkeson and Kehoe (2001) note that the transparency of the exchange rate regime helps mitigate credibility problems that arise when governments cannot commit to monetary policies. As noted by Canavan and Tommasi (1997), a policymaker might be signaling a preference for lower inflation by choosing a fixed-exchange regime. Giavazzi and Pagano (1988) argued that in the context of the EMS, membership brought significant credibility gains to policymakers in inflation-prone countries. These gains were due to the extra inflation penalty (real appreciation) and reduced the inefficiency that stemmed from public mistrust of the authorities.

A key difference between a fixed and floating exchange rate is that the nominal money supply is an endogenous variable. Under a floating exchange rate, if the money supply were to drop below the level given the by money demand, the excess demand could be satisfied by appreciation. If the central bank fixes the exchange rate and maintains the peg it must prevent changes in the value of the currency by standing ready to buy or sell foreign currency and thereby increase or decrease its foreign reserves. Attempts to change nominal money supply through open-market operations would be futile. Under a fixed exchange-rate regime, if the central bank purchased domestic assets the excess supply of money would be eliminated through private capital flows and foreign reserve losses.

The argument is that by using the exchange rate as a nominal anchor, the monetary authorities tie down the price of trade goods, which will eventually force other prices to come

down. Again, the more open the economy the more efficient the mechanism of pegging the exchange will be as more prices will be "tied down."

All of this assumes, of course, that a country wants to defend the peg and is pursuing policies consistent with this end.[10] Speculative attacks and collapsing exchange rates are clearly part of the game. The effectiveness of the exchange rate peg depends on agents' expectations that the authorities will defend it.[11] In addtition, even given sufficient reserves to defend the peg, the authorities might be unwilling to accommodate an interest rate increase. Obstfeld (1995) found that in most cases the monetary authorities had sufficient reserves to repurchase the entire monetary base.

Summarizing, in the short run, if it wishes to do so, the government can maintain inflation by pegging the exchange rate. A fixed exchange-rate regime, being a highly visible commitment, raises the political cost of monetary growth. Thus, if the openness-inflation relationship arises from the dynamic inconsistency of discretionary monetary policy, fixed exchange-rate regimes should be associated with lower inflation.[12]

The other major advantage of fixing the exchange rate is that doing so reduces transaction costs and exchange-rate risks that discourage trade.[13] The higher exchange-rate variability associated with floating exchange-rate regimes creates uncertainty that can discourage trade and investment. Although the argument that fixing the exchange rate can eliminate excessive

[10] See Tornel and Velasco (1998, 2000) for arguments against the discipline imposed by fixed exchange rates.

[11] See Krugman (1979) and Obstfeld (1986) for first- and second-generation models of speculative attacks.

[12] Campillo and Miron (1996) find in a cross-section between 1973 and 1994 that institutional arrangements (exchange-rate mechanisms) are relatively unimportant. They introduce this variable in the cross-section analysis by creating a dummy variable that takes the value of 2 for countries that were in multilateral exchange-rate systems in 1974, 1 for countries that were in unilateral exchanger-rate systems, and 0 for floating regimes. But by using data for 1974 they fail to capture any regime changes that might have occurred later.

[13] See Frankel (1999).

exchange-rate volatility and risk and encourage trade and investment tends to be downplayed in countries in which exchange-rate risk hedging is possible due to forward markets and other instruments, trade and investment promotion in Europe were clearly a prime motivator of the European Monetary Union. Although the empirical findings on the relationship between trade and fixed exchange rates tend to be ambiguous, we cannot, however, reject the associated theoretical implications. As mentioned by Rose (1999), there is little consensus on the effects of exchange-rate volatility on trade, save that the effects are difficult to estimate. Possible explanations for this difficulty in time-series analysis include the difficulty of measuring exchange rate volatility and using derivatives to hedge risk as well as problems with data sets. Kenen and Rodrik's (1986) find, however, that volatility tends to depress the volume of international trade.[14]

This second line of arguments implies that because fixed exchange-rate regimes should be associated with higher levels of openness and trade and therefore the exclusion of a fixed exchange-rate variable could bias results, that is, the lack of significance could be due to omitted variables.

The basic estimation is a regression of the log of inflation on the degree of openness, a variable that controls for the exchange-rate regime and country and year dummies.

$$LINFLATION_{it} = \beta OPENNESS_{it} + \delta\, DEXCHANGE\ REGIME_{it} + \ + \eta_i + \lambda_t + \varepsilon_{itww} \quad (6)$$

where η_I refers to country fixed effect, λ to year fixed effect, and $\varepsilon_{it\,iid}$ is an error term.

[14] Bacchetta and Van Wincoop (2000), who developed a general-equilibrium framework with deviations from purchasing power parity caused by rigid price setting in the buyer's currency, found that both trade and welfare can be higher under either a fixed or flexible exchange-rate regime depending on the preferences and monetary rules followed under the different regimes.

The exchange-rate regime was taken from the IMF's *Annual Report on Exchange Rate Arrangements and Exchange Restrictions*. The exchange-rate regime was defined as a dummy variable that takes the value of 0 if the country maintained a floating regime, 1 if the country maintained an intermediate regime, and 2 if the country a maintained a fixed regime.

Gosh et al. (1997) differentiate across nine types of exchange-rate regimes for 140 countries from 1960 to 1990 and group these into three regimes: pegged, intermediate, and floating. They regress inflation on the different types of regimes, output growth, turnover of the central bank, openness, and annual dummies. Our work differs from theirs primarily in that our sample period, which ranges from 1973 to 1998, includes the period after the breakdown of the Bretton-Woods system and the regression analysis we perform controls for country fixed effects as well as for year dummies.

Table VII reports the results after controlling for the exchange-rate regime variable. Column (1), reveals the openness measure to be positive but not significant and the exchange-rate regime variable to be both negative and significant. This result, as reported in column (2), is robust to the inclusion of the development variable, log of GDP per capita, which has a negative and significant effect on inflation. Column (3) performs the same calculation excluding the 1970s observation to test for a "misinformation" bias. In this case the openness measure remains positive, but now is significant and both the exchange-rate regime variable and the log of GDP are negative and significant. Column (4) shows the same results when inflationary episodes exceeding 50% are excluded.

In columns (5) and (6), the regression analysis incorporates "floating-exchange-rate" and "intermediate" regime dummies. The floating-exchange-rate dummy has a significant positive value, the intermediate regime dummy has a negative, though not significant, effect. These

findings are consistent with those of Ghosh, Gulde and Ostry (1997), who check for endogeneity of the exchange-rate regime.

Table VII performs a similar exercise using the classification system developed by Reinhard and Rogoff (2000) who considered data based on market-determined parallel exchange rates. As they note, this new method found that the official classification failed to describe actual country practices, as an important number of countries floated the exchange rate while announcing peg regimes and vice versa – several countries that claim to float where the facto pegging. Table VII reports the results of using what they referred to as a coarse grid that distinguished across 5 categories and allows for easy comparisons with the official IMF classification.[15] The least flexible arrangements are assigned lower values in their scale. A novel departure from the standard classification was to create a new category for counties whose twelve-month inflation rate is above 40% - classified as freely falling-. Appendix 1 describes the data further.

Column (1) shows that the exchange rage regime has a positive and significant value. Since their classification assigns higher values to more flexible regime, the result is consistent to the previous findings: less flexible exchange rate regimes have a significant effect in reducing inflation. Again, the result is robust to the inclusion of the level of development and excluding high inflation periods. Since it could be argue that their finer classification of floating regimes into managed, freely floating and falling incorporates inflation information that can bias the results, these regimes were collapsed into one category labeled floating regimes. The results remain robust as seen in columns (5) and (6).

[15] Reinhart and Rogoff (2000) constructed a finer grid of 14 regimes that distinguished between pre-announced policies and the less transparent de facto regimes. Similar results were obtained when using this finer grid.

Summarizing, at short-term horizons, the exchange rate betters openness in restraining inflation, reflecting the greater observability, accountability, and transparency of the exchange rate over openness. A government that decides to pursue an inflationary policy risks undermining the viability of the fixed exchange-rate regime, which can constrain its intentions.[16] The limits openness can impose on an expansionary policy depend on the amount of pass-through and responsiveness of the productive sector, which can vary short term and from one episode to the next.

5. Conclusions

This paper demonstrates empirically, in the short-term, the non-significant role openness seems to play a as a commitment mechanism, and the importance of the exchange-rate regime as a variable that determines the benefits of surprise inflation, even after controlling for country and time-fixed effects as well as correcting for exchange-rate-regime misclassification by the IMF as corrected by Reinhart and Rogoff (2002). This negative and strong relationship between inflation and a fixed exchange-rate regime is consistent with the classical literature, which argues that fixed exchange-rate regimes impose "discipline" on individual countries. It is consistent as well with the literature on dynamic inconsistency problems that suggest that the absence of precommitment in monetary policy leads to inefficiently high levels of inflation. There being a stronger link between the exchange rate and inflation than between inflation and openness in the short- term, inflation might be more effectively restrained through economic cooperation and by integrating the design of macroeconomic policies consistent with maintaining fixed exchange rates. Note, however, that openness serves better in longer horizons as the regression analyses

[16] For a view counter to the conventional wisdom of that fixed exchange-rate regimes impose discipline, see Tornell and Velasco (1998, 2000).

and several failed stabilization programs demonstrate. Opening the markets in the long term of course will not only have efficiency and growth effects, but also help to keep inflation under control.[16]

[17] See Frankel and Romer (1999).

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Data Appendix 1

A1.1 Countries and Samples

1. Sample of countries included in crosssection
2. Sample of countries included in panel

Algeria (1,2), Angola (1,2), Argentina (1,2), Australia (1,2), Bahamas (1), Bahrain (1,2), Bangladesh (1,2), Barbados (1,2), Belgium (1,2), Belize (1,2), Benin (1,2), Bhutan (1), Bolivia (1,2), Botswana (1,2), Brazil (1,2), Bulgaria (1), Bukina Faso (1,2), Burundi (1,2), Cameroon (1,2), Canada (1,2), Cape Verde Is, (1,2), Central African Republic (1,2), Chad (1), Chile (1,2), Colombia (1,2), Comoros (1), Congo (1,2), Costa Rica (1,2), Cyprus (1,2), Denmark (1,2), Djibouti (1), Dominica (1), Dominican Republic (1,2), Ecuador (1,2), Egypt (1,2), El Salvador (1,2), Ethiopia (1,2), Fiji (1,2), Finland (1,2), France (1,2), Gabon (1,2), Gambia (1), Germany (1,2), Ghana (1,2), Greece (1,2), Grenada (1), Guatemala (1,2), Guinea (1,2), Guinea-Bissau (1), Guyana (1,2), Haiti (1,2), Honduras (1,2), Hong Kong (1,2), Hungary (1), Iceland (1,2), India (1,2), Indonesia (1,2), Iran (1,2), Iraq (1), Ireland (1,2), Israel (1,2), Ivory Coast (1,2), Jamaica (1,2), Japan (1,2), Jordan (1,2), Kenya (1,2), Korea (1,2), Kuwait (1,2), Laos (1), Lesotho (1), Liberia (1,2), Luxembourg (1,2), Madagascar (1,2), Malawi (1,2), Malaysia (1,2), Mali (1), Malta (1,2), Mauritania (1,2), Mauritius (1,2), Mexico (1,2), Mongolia (1), Morocco (1), Mozambique (1,2), Myanmar (1,2), Namibia (1,2), Nepal (1), Netherlands (1,2), New Zealand (1,2), Nicaragua (1,2), Niger (1,2), Nigeria (1,2), Norway (1,2), Oman (1,2), Pakistan (1,2), Panama (1,2), Papua N. Guinea (1,2), Paraguay (1,2), Peru (1,2), Philippines (1,2), Poland (1), Portugal (1,2), Puerto Rico (1), Romania (1), Rwanda (1), Saudi Arabia (1,2), Senegal (1,2), Seychelles (1,2), Sierra Leone (1,2), Singapore (1,2), Solomon Is. (1,2), Somalia (1,2), South Africa (1,2), Spain (1,2), Sri Lanka (1,2), St. Kitt and Nevis (1), St. Lucia (1), St. Vincent and Grenada (1), Sudan (1,2), Suriname (1,2), Swaziland (1,2), Sweden (1,2), Switzerland (1,2), Syria (1,2), Tanzania (1), Thailand (1,2), Togo (1,2), Tonga (1), Trinidad and Tobago (1,2), Tunisia (1,2), Turkey (1,2), U.K. (1,2), U.S.A. (1,2), U.S.S.R (1), Uganda (1,2), United Arab E. (1,2), Uruguay (1,2), Vanuatu (1), Venezuela (1,2), Western Samoa (1.2), Yemen (1,2), Zaire (1,2), Zambia (1,2), Zimbabwe (1,2).

A1.2. Data Sources and Descriptions

Inflation: the logarithm of inflation measured by the GDP deflator (source: *World Bank Development Indicators*).

Openness measures: imports as a percentage of GDP and exports as a percentage of GDP (source: *World Bank Development Indicators*).

Output levels and growth: output level and growth data are the growth of real per capita GDP constant dollars (source: *World Development Indicators, World Bank, 2000*).

Exchange rate regime: dummy variable defined as 0 if the country maintained a floating regime; 1 if country maintained an intermediate regime 2 if the country maintained a fixed regime (source: *IMF's Annual Report on Exchange Rate Arrangements and Exchange Restrictions*).

Fixed exchange rate regime: dummy variable defined as 1 if the country maintained a fixed exchange-rate regime, zero otherwise (source: *IMF's Annual Report on Exchange Rate Arrangements and Exchange Restrictions*).

Floating exchange rate regime: dummy variable defined as 1 if the country maintained a floating exchange-rate regime, zero otherwise (source: *IMF's Annual Report on Exchange Rate Arrangements and Exchange Restrictions*).

Intermediate regime: dummy variable defined as 1 if the country did not maintain either a floating or a fixed exchange-rate regime, zero otherwise. (source: *IMF's Annual Report on Exchange Rate Arrangements and Exchange Restrictions*).

Regime-Reinhart-Rogoff: Exchange rate taxonomy constructed by Reinhart and Rogoff (2002) that classifies de facto exchange rates by considering the role of market-determined parallel exchange rates among other variables. The least flexible arrangements are assigned lower values in their scale. The coarse grid differentiates five categories: (1) fixed regimes (no separate legal tender, pre announced peg or currency board arrangement, pre announced horizontal band that is narrower or equal to +/-2%, and de facto pegs), (2) crawling pegs (pre announced and de facto crawling pegs and pre announced crawling band that is wide than or equal to +/-2%,), (3) managed floating (which includes de facto crawling band that is narrower than or equal to +/-5% and moving band that is narrower than or equal to +/-2%), (4) freely floating and (5) freely

falling (a category for counties whose twelve-month inflation rate is above 40%). (source: *Reinhart and Rogoff* (2002).

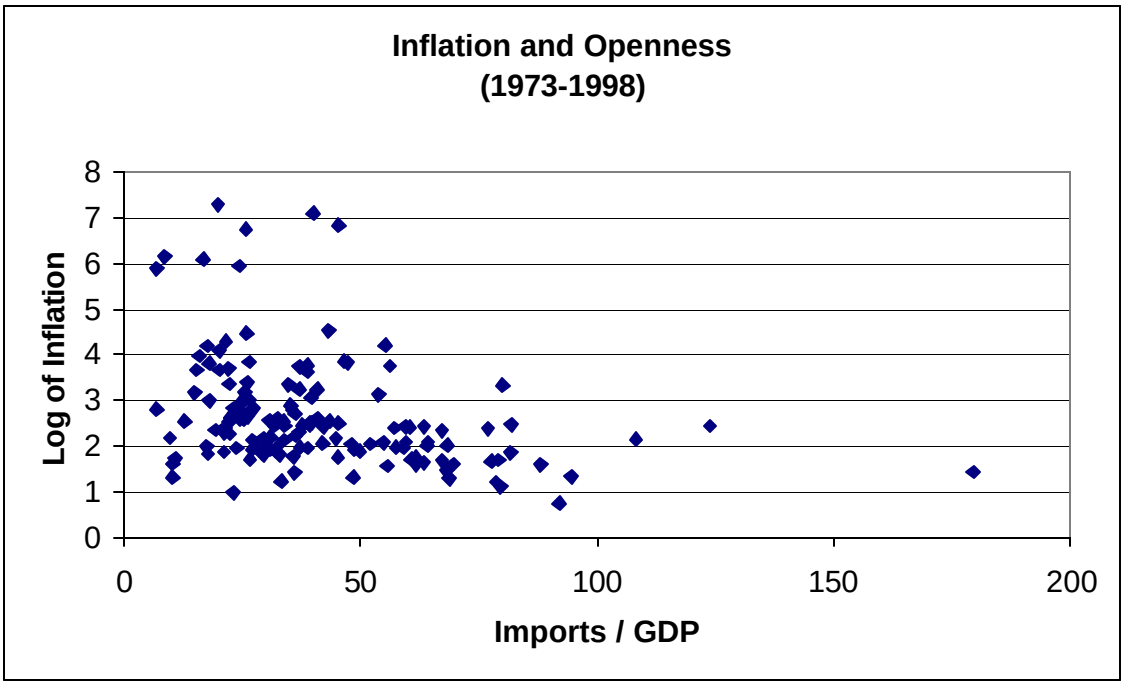
Fixed-Reinhart-Rogoff: dummy variable defined as 1 if Reinhart and Rogoff classified a country as one with a fixed exchange-rate regime -(1)-, zero otherwise (source: *Reinhart and Rogoff* (2002).

Intermediate-Reinhart-Rogoff: dummy variable defined as 1 if Reinhart and Rogoff classified a country as one with an intermediate regime -(2)-, zero otherwise. (source: *Reinhart and Rogoff* (2002).

Floating-Reinhart-Rogoff: dummy variable defined as 1 if Reinhart and Rogoff classified a country as one with a floating regime -(3), (4) and (5)- , zero otherwise (source: *Reinhart and Rogoff* (2002).

Devaluation: annual devaluation in the official exchange-rate regime. (source: *IMF, International Financial Statistics, CD*).

Figure 1



Notes: Countries in this plot, the 148 countries for which all accompanying data are available, form the first sample in Table III. See Appendix 1 for further details.

Table I: Inflation in Selected Regions of the World

	Average 1982-1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
GDP deflator											
Advanced economies	4.9	3.2	2.7	2.2	2.3	1.8	1.7	1.4	0.8	1.4	1.6
Consumer prices											
Advanced economies	4.9	3.5	3.1	2.6	2.6	2.4	2.1	1.5	1.4	2.3	1.3
Developing countries	45.1	42.8	48.7	55.3	23.2	15.4	10.1	10.6	6.9	6.1	5.7
Africa	19.5	47.1	39.0	54.7	35.3	30.2	14.6	10.9	12.3	14.2	12.6
Asia	9.7	8.6	10.8	16.0	13.2	8.3	4.8	7.7	2.5	1.9	2.6
Middle East and Turkey	21.2	26.5	26.6	37.3	39.1	29.6	28.3	28.1	23.7	19.6	17.2
Western Hemisphere	163.0	150	195	200	36.0	21.2	12.9	9.8	8.9	8.2	7.4

Source: IMF *World Economic Outlook*, 2000, 2001.

Table II: Integration with the Global Economy

	Trade in goods			
	% of PPP GDP, 1988		% of PPP GDP, 1988	
World	21.2	28.3	71.9	92.1
Low Income	6.8	8.3	38.6	62.5
Latin America & Caribbean	9.4	19.1	52.3	74.5
Sub-Saharan Africa	15.4	16.8	73.2	99.5
High Income	28.3	38.3	75.2	95.1
Europe (EMU)	41.0	54.4	111.1	106.4

Source: World Bank, *World Development Indicators.*

Table III-A: Descriptive Statistics.

Sample 1: 146 countries (1973-1998)				
	Mean	Std. Dev.	Min	Max
Imports/GDP	41.2	24.6	6.9	179.5
Exports/GDP	34.7	23.7	4.4	179.9
GPD per capita	5166.8	5098.8	382.9	19762.9
Log of Inflation	2.6	1.2	0.7	7.3

Note: See Appendix 1 for definitions of the variables.

Table III-B: Correlations

Sample 1: 146 countries (1973-1998)				
	Imports/ GDP	Exports/ GDP	GPD per Capita	Log of Inflation
Imports/GDP	1.0000			
Exports/GDP	0.9267	1.0000		
GPD per capita	-0.0706	0.0743	1.0000	
Log of Inflation	-0.2163	-0.3175	-0.5436	1.0000

Note: See Appendix 1 for definitions of the variables.

Table IV: Openness and Inflation

Dependent variable — Log of average inflation rate – Cross section: 1973-1998

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Sample	All	All	All	All	All	Infl <50	Infl <50	Infl <50	1980-1998	1980-1998
Imports / GDP	-0.017		-0.019	-0.015	-0.020	-0.009	-0.009	-0.124	-0.140	-0.114
	-4.490		-4.610	-3.920	-4.200	-4.170	-3.790	-3.930	-4.330	-3.440
Exports / GDP		-0.016								
		-4.460								
Log GDP per capita				-0.163	0.101		-0.152	-0.023		-0.233
				-1.920	0.710		-2.400	-0.210		-3.990
Regional Dummies	No	No	No	No	Yes	No	No	Yes	No	No
R^2	0.115	0.099	0.236	0.126	0.236	0.113	0.155	0.227	0.101	0.109
Number of Observations	146.0	146.0	146.0	134.0	134.0	131.0	126.0	126.0	144.0	140.0

Notes: All regressions have a constant term; t-values based on robust are documented below coefficient estimates; variables are described in detail in Appendix 1. Regressions (6), (7), and (8) exclude countries with average inflation higher than 50%. In regressions (9) and (10) data were averaged for 1980-1998.

Table V-A: Descriptive Statistics

Sample 2: Panel data (1973-1998)

Variable	# Observations	Mean	Std.Dev.	Min	Max
Imports as % of GDP	2583	37.6	26.2	1.5	224.2
Exports as % of GDP	2583	33.4	25.3	0.9	215.4
GPD per capita	2314	5405.2	5808.8	250.0	30140.0
Log of Inflation	2459	2.4	1.3	-3.5	10.2
Exchange Rate Regime	2747	1.1	0.9	0.0	2.0
Floating Regime	2747	0.3	0.5	0.0	1.0
Intermediate Rate	2747	0.2	0.4	0.0	1.0
Fixed Regime	2747	0.5	0.5	0.0	1.0
Regime-Reinhart-Rogoff	2374	2.3	1.2	1.0	5.0

Note: Variables are described in detail in Appendix 1.

Table V-B: Correlations

Sample 2: Panel Data (1973-1998)

	Imports % GDP	Exports % GDP	GPD per capita	Log of inflation	Exch. Regime	Floating Regime	Inter. regime	Fixed Regime	Reinhart Rogoff Regime
Imports % GDP	1.0000								
Exports % GDP	0.7875	1.0000							
GPD per capita	0.0366	0.2261	1.0000						
Log of inflation	-0.2262	-0.2503	-0.3139	1.0000					
Exch. regime	0.1749	0.0731	-0.2102	-0.1945	1.0000				
Floating regime	-0.1997	-0.1248	0.1388	0.2324	-0.9423	1.0000			
Interm. regime	0.1298	0.0127	-0.2574	-0.1323	0.9418	-0.7748	1.0000		
Fixed regime	0.1052	0.1675	0.1755	-0.1527	0.0068	-0.3413	-0.3298	1.0000	
Reinhart-Rogoff	-0.2699	-0.2209	0.0089	0.5076	-0.3492				1.0000

Note: Variables are described in detail in Appendix 1.

Table VI : Openness and Inflation

Dependent Variable—Log of average Inflation. Yearly Data - 1973-1998

	(1)	(2)	(3)	(4)
Imports % of GDP	0.004	0.014		
	1.220	4.44		
Exports % of GDP			0.120	0.028
			3.920	9.390
Log GDP per capita		-1.462		-1.741
		-0.020		-10.610
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
R^2	0.482	0.559	0.858	0.572
Number of Observations	2418	2128	2148	2128

Notes: All regressions have a constant term; t-values based on robust are documented below coefficient estimates; variables are described in detail in Appendix 1.

Table VII : Openness and Inflation
Dependent variable—Log of average inflation – Yearly data: 1973-1998

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	All	All	1980-1998	Infl.<50	All	All
Imports % of GDP	0.002	0.012	0.016	0.009	0.002	0.012
	0.680	0.372	4.410	3.460	0.710	3.760
Log GDP per capita		-1.373	-1.438	-0.758		-1.419
		-8.460	-6.570	-6.350		-8.840
Exchange-rate regime	-0.247	-0.227	-0.211	-0.198		
	-7.590	-6.670	-4.880	-7.380		
Floating regime (exch=0)					0.524	0.473
					7.980	6.950
Intermediate regime (exch=1)					-0.101	-0.176
					-1.490	-2.400
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.497	0.571	0.621	0.7056	0.503	0.578
Number of observations	2418	2128	1675	1953	2418	2128

Notes: All regressions have a constant term; t-values based on robust are documented below coefficient estimates. Regressions performed using IMF exchange rate classification; less flexible arrangements were assigned higher values (floating=0, intermediate=1, fixed=2); variables are described in detail in Appendix 1. In regressions (3) data were averaged for 1980-1998. Regression (4) excluded countries with average inflation higher than 50%.

Table VIII : Openness and Inflation
Dependent variable—Log of average inflation – Yearly data: 1973-1998

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	All	All	1980-1998	Infl. <50	All	All
Imports % of GDP	0.005	0.013	0.018	0.010	0.003	0.012
	1.700	4.410	4.950	4.180	1.240	4.290
Log GDP per capita		-0.898	-0.920	-0.569		-1.313
		-6.040	-4.400	-4.530		-8.710
Regime-Reinhart-Rogoff	0.373	0.324	0.350	0.222		
	14.54	12.25	10.96	12.81		
Floating Reinhart-Rogoff (exch=3,4,5)					0.750	0.668
					9.670	8.270
Intermediate Reinhart-Rogoff (exch=2)					0.300	0.339
					4.340	4.750
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.562	0.608	0.659	0.522	0.504	0.574
Number of observations	2125	1894	1491	1748	2125	1894

Notes: All regressions have a constant term; t-values based on robust are documented below coefficient estimates. Regressions use Reinhart and Rogoff (2000) exchange rate regime classification which assigned lower values to less flexible arrangements; variables are described in detail in Appendix 1. In regressions (3) data were averaged for 1980-1998. Regression (4) excluded countries with average inflation higher than 50%.