To Float or to Fix: Evidence on the Impact of Exchange Rate Regimes on Growth

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We study the relationship between exchange rate regimes and economic growth for a sample of 183 countries over the post-Bretton Woods period, using a new de facto classification of regimes based on the actual behavior of the relevant macroeconomic variables. In contrast with previous studies, we find that, for developing countries, less flexible exchange rate regimes are associated with slower growth, as well as with greater output volatility. For industrial countries, regimes do not appear to have any significant impact on growth. The results are robust to endogeneity corrections and a number of alternative specifications borrowed from the growth literature. (*JEL* F31, F41)

The choice of exchange rate regime and its impact on economic performance is probably one of the most controversial topics in macroeconomic policy. However, while the implications regarding inflation and policy credibility have received considerable attention, the impact of regimes on economic growth has been the subject of surprisingly little work, probably due to the fact that nominal variables are typically considered to be unrelated to longer-term growth performance.[1]

Even when the economic literature does suggest a link between exchange rate regimes and growth, it does not provide unambiguous implications as to its sign. On the one hand, the lack of exchange rate adjustments under a peg, coupled with some degree of short-run price rigidity, results in price distortions and misallocation of resources (notably, high unemployment) in the event of real shocks. This mechanism underscores the view that fixed exchange rate regimes induce higher output volatility.[2] In addition, as suggested by Guillermo Calvo (1999) and others, the need to defend a peg in the event of a negative external shock implies a significant cost in terms of real interest rates, as well as increasing uncertainty as to the sustainability of the regime, potentially harming investment prospects. While the implications of these channels in terms of long-run growth performance are not obvious, there is some evidence of a negative link between output volatility and growth.[3]

On the other hand, by reducing relative price volatility, a peg is likely to stimulate investment and trade, thus increasing growth.[4] Lower price

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[1] A notable exception is the inflation rate. See, e.g., José De Gregorio (1993) and Nouriel Roubini and Xavier Sala-i-Martin (1995) for theoretical models, and Ross Levine and David Renelt (1992), Robert Barro (1995), and Javier Andrés et al. (1996) for an empirical exploration.

[2] The view that flexible regimes are better suited to insulate the economy against real shocks goes back to Milton Friedman (1953) and William Poole (1970), among others. This view has found support in the empirical literature. See, e.g., Michael Mussa (1986), Marianne Baxter and Alan Stockman (1989), Tamim Bayoumi and Barry Eichengreen (1994), Atish Ghosh et al. (1997), and Christian Broda (2001).

[3] See Garey Ramey and Valerie A. Ramey (1995). Alternatively, Joshua Aizenman (1994) argues, in the context of a theoretical model, that higher output volatility as a result of the adoption of a peg may foster investment and growth.

[4] A survey of the literature on the effects of exchange rate volatility on trade can be found in Hali J. Edison and Michael Melvin (1990). See also Jeffrey Frankel and

uncertainty, usually associated with fixed exchange rate regimes, should also lead to lower real interest rates, adding to the same effect. Moreover, (credible) fixed exchange rate regimes are usually assumed to contribute to monetary policy discipline and predictability, and to reduce a country's vulnerability to speculative exchange rate fluctuations, all factors that are conducive to stronger growth performance.[5]

Thus, although the literature, if anything, seems to offer stronger arguments favoring the idea that fixed exchange rates may lead to higher growth rates, in the end, the question of whether or not there exists a link between regimes and growth can only be resolved as an empirical matter. The purpose of this paper is to address this issue by assessing the relationship between exchange rate regimes and output growth for a sample of 183 countries over the post-Bretton Woods period (1974–2000).

Contrary to what might have been inferred from the literature, we find that, for developing countries, less flexible exchange rate regimes are associated with slower growth. For industrial countries, however, we find that the regime has no significant impact on growth. In addition, our tests confirm the standard view (and previous empirical work) indicating the presence of a negative link between output volatility and exchange rate flexibility for nonindustrial countries.

Our main reference comes from the numerous empirical papers on the determinants of growth, from which we borrow our baseline specification.[6] Also close to our work is the relatively scarce body of literature that directly addresses the relationship between growth and exchange rate regimes. Among the few papers within this group, Mundell (1995) looks at the growth performance for the industrial countries before and after the demise of Bretton Woods, finding that the former period was associated with faster average growth. Arthur J. Rolnick and Warren E. Weber (1997) using long-term historical data, show that output growth was higher under fiat standards than under commodity (e.g., gold) standards. Finally, Ghosh et al. (1997) run growth regressions controlling for the de jure exchange rate regime as defined by the International Monetary Fund (IMF), finding no systematic link between the two.[7]

We improve upon this work in two ways. First, we use a de facto classification of exchange rate regimes that better captures the policies implemented by countries regardless of the regime reported by the country's authorities.[8] In addition, our model specification builds on existing results in the growth literature, focusing on the post-Bretton Woods period and expanding the sample size to include the 1990's.

It is important to stress at this point that we do not intend to revisit previous findings in the growth literature nor to assess their sensitivity to various combinations of explanatory variables or to the inclusion of the exchange regime dummies. Instead, we draw on those findings only to obtain a reasonable set of additional controls to use as a benchmark to test whether the exchange rate regime has a significant impact on growth. We find that, for the group of developing countries, this is indeed the case.

The paper proceeds as follows. Section I describes the data. Section II presents the baseline regressions. Section III details the results of selected robustness tests. Finally, Section IV discusses possible interpretations, and concludes.

I. The Data

Our sample covers annual observations for 183 countries over the period 1974–2000. A list of countries, as well as the definitions and sources for all the variables used in the paper, is presented in Appendix A. With the exception of the political instability, openness, and secondary

Shang-Jin Wei (1998) for a more recent study, and Andrew Rose (2000) and Frankel and Rose (2000) on its indirect effect on growth.

[5] See, e.g., Robert Mundell (1995), Calvo (2000a, b) and, for the particular case of currency boards, Ghosh et al. (2000).

[6] See, e.g., Levine and Renelt (1992), Barro and Sala-i-Martin (1995), and references therein.

[7] However, for some subsamples of countries they find weak evidence that growth rates in fixes are below those in floats. On the other hand, Ghosh et al. (2000) find that currency boards, typically assimilated to hard pegs, tend to grow faster.

[8] For completeness, however, we also present results for the IMF de jure classification on which previous studies were based.

TABLE 1—DE FACTO CLASSIFICATION CRITERIA

	σe	$\sigma_{\Delta e}$	σr
Flexible	High	High	Low
Intermediate	Medium	Medium	Medium
Fixed	Low	Low	High
Inconclusive	Low	Low	Low

TABLE 2—DISTRIBUTION OF REGIMES

	LYS (de facto)			IMF
Regime	All	Industrial	Nonindustrial	(de jure)
Float	662	207	454	505
Intermediate	600	95	503	844
Fix	1,029	141	886	942
Total	2,291	443	1,843	2,291

Sources: IMF (de jure) from the International Financial Statistics. LYS (de facto), from Levy-Yeyati and Sturzenegger (2002).

school enrollment variables, all of our data come from the IMF and the World Bank databases. As data availability varies across countries and periods, tests in each subsection were run on a consistent subsample of observations (which is reported in each case along with the results).

The classification of exchange rate regimes that we use in this paper deserves some comment. Most of the empirical literature on the evolution and implications of alternative exchange rate regimes groups observations according to a de jure classification based on the regime that governments *claim* to have in place, as reported by the IMF in its *International Financial Statistics.* This approach, however, ignores the fact that many alleged floats intervene in the exchange market to reduce exchange rate volatility, while some fixers devalue periodically to accommodate independent monetary policies. To address this problem, we use a de facto classification of exchange rate regimes, based on cluster analysis techniques, that groups countries according to the behavior of three variables closely related to exchange rate policy: (i) *Exchange rate volatility* (σe), measured as the average of the absolute monthly percentage changes in the nominal exchange rate relative to the relevant anchor currency (or basket of currencies, whenever the currency weights are disclosed) over the year; (ii) *Volatility of exchange rate changes* ($\sigma_{\Delta e}$), measured as the standard deviation of the monthly percentage changes in the exchange rate; and (iii) *Volatility of reserves* (σr), measured as the average of the absolute monthly change in dollar denominated international reserves relative to the dollar value of the monetary base in the previous month.[9]

These variables are computed on an annual basis, so that each country-year observation represents a point in the (σe, $\sigma_{\Delta e}$, σr) space. In this space, floats are associated with little intervention in the exchange rate market (low volatility of reserves) together with high volatility of exchange rates. Conversely, observations with little volatility in the exchange rate variables coupled with substantial volatility in reserves correspond to the group of fixes. Finally, intermediate regimes are expected to exhibit moderate to high volatility across all variables, reflecting exchange rate movements in spite of active intervention. In turn, observations are grouped by proximity using cluster analysis according to the four clusters identified in Table 1. Observations that do not display significant variability in either dimension are judged "inconclusives," and left unclassified.[10]

Table 2 shows the regime distribution of the 2,291 classified observations, along with the alternative IMF-based classification for the same group of observations. While the two classifications show a similar number of fixed regimes, countries within each group may differ. The table also shows how regimes are identified according to economic development. While industrial countries are more prone to float, nonindustrial economies tend to use intermediate and fixed regimes more prominently: Almost half of nonindustrial countries are classified as pegs, whereas for industrial countries fixed regimes amount to about one-third of total observations.

[9] For a complete description of the classification methodology and variable definitions we refer the reader to Levy-Yeyati and Sturzenegger (2003).

[10] Inconclusives, which amount to 698 out of 2,989 observations for which there is data for the classification variables, are excluded from the tests. They are used, however, in one of the robustness checks reported in Section III.

TABLE 3—RATE AND VOLATILITY OF REAL PER CAPITA GDP GROWTH (PERCENT PER YEAR)

		IMF			LYS			Industrials			Nonindustrials		
		FLOAT	INT	FIX	FLOAT	INT	FIX	FLOAT	INT	FIX	FLOAT	INT	FIX
Observations		503	843	940	661	598	1,027	207	95	141	454	503	886
ΔGDP	Means	1.0	2.0	1.2	1.9	1.0	1.5	2.3	1.5	2.3	1.7	0.9	1.3
	Medians	*1.7*	*2.3*	*1.1*	*2.2*	*1.5*	*1.5*	*2.5*	*1.7*	*2.3*	*1.9*	*1.5*	*1.3*
GDPV	Means	3.8	3.1	4.8	3.4	4.0	4.3	2.2	1.9	1.8	4.0	4.4	4.7
	Medians	*2.3*	*2.2*	*3.8*	*2.3*	*2.8*	*3.4*	*1.8*	*1.8*	*1.6*	*2.7*	*3.2*	*3.8*

Sources: IMF's International Financial Statistics. Exchange rate classifications: IMF de jure from IFS, LYS de facto from Levy-Yeyati and Sturzenegger (2002).

II. Exchange Rate Regimes and Growth

A. *A First Pass at the Data*

Table 3 provides a first pass at the data, showing the means and medians of the rate of growth of real per capita GDP (ΔGDP) and its volatility (*GDPV*, measured as the standard deviation of the growth rate over a centered rolling five-year period). Observations are grouped by regime according to both the IMF and the de facto classifications. In addition, we show the corresponding statistics for industrial and nonindustrial countries.[11] The table includes the 2,286 observations (out of 2,291 classified by the de facto methodology) for which growth data is available. Since the sample includes many countries which exhibit extraordinary growth volatility (due to, for example, wars or transition to market economies) it seems more reasonable to concentrate the analysis in the medians, which are less sensitive to extreme values.

Simple inspection of the numbers anticipates the main results of the paper. Fixed exchange rates substantially underperform floating exchange rate regimes, under both classifications. In particular, the median annual real per capita growth rate drops from 2.2 percent for floaters to 1.5 percent for pegs, according to the de facto classification, and a similar gap appears using the IMF classification. Note also that the difference in *average* growth, consistent with that of the medians when measured according to the de facto classification, has the opposite sign when based on the IMF. Thus, the de facto criterion appears to capture a more consistent connection between regimes and growth.[12] The aggregate sample, however, masks important differences between industrial and developing countries: As can be seen, the previous result is driven almost entirely by nonindustrial observations. Table 3 also shows that output volatility decreases monotonically with the degree of flexibility of the exchange rate regime when using the de facto classification. This monotonicity property is lost if using the IMF classification. Interestingly, much in the same way as in the case of growth, this link is entirely accounted for by the group of nonindustrial countries, while for industrial ones the regime appears to be irrelevant, or, if anything, to work in the opposite direction.

An alternative cut at the data is reported in Table 4. Here, we split countries into two groups, fast and slow growers, according to whether their average growth performance over the period 1974–2000 was below or above the median. We then examine whether any of these groups is characterized by adopting a particular exchange rate regime. To do that, we identify a country as fix (nonfix) whenever it is assigned a fixed (float or intermediate) regime in more than 50 percent of its available observations. We find that fixes account for 40 percent of the fast growers and 48 percent of the slow growers, again suggesting the presence of a negative link between pegs and growth. Once again, this link is entirely confined to the group of nonindustrial

[11] Industrial and nonindustrial economies are listed in Appendix A.

[12] This may be behind the fact that previous studies based on the IMF's de jure classification failed to find any significant impact of exchange regimes on growth.

TABLE 4—FAST AND SLOW GROWERS

		Full sample		
		Fast growers	Slow growers	*p*-value
Observations		80	81	
ΔGDP	Mean	3.38	−0.14	
	Median	*3.06*	*0.12*	
PERCFIX	Mean	0.40	0.48	0.083[1]
GDPV	Mean	3.43	4.63	0.002[1]
	Median	*3.15*	*4.25*	*0.006*[2]
		Industrials		
		Fast growers	Slow growers	*p*-value
Observations		11	11	
ΔGDP	Mean	2.85	1.69	
	Median	*2.74*	*1.77*	
PERCFIX	Mean	0.42	0.32	0.284[1]
GDPV	Mean	2.02	1.77	0.153[1]
	Median	*1.79*	*1.88*	*0.670*[2]
		Nonindustrials		
		Fast growers	Slow growers	*p*-value
Observations		69	70	
ΔGDP	Mean	3.42	−0.39	
	Median	*3.18*	*−0.01*	
PERCFIX	Mean	0.36	0.55	0.002[1]
GDPV	Mean	4.28	4.46	0.344[1]
	Median	*3.49*	*4.25*	*0.014*[2]

Notes: Full sample—mean growth rate (whole sample): 1.61. Industrials—mean growth rate (whole sample): 2.27. Nonindustrials—mean growth rate (whole sample): 1.50.

[1] Test of means.

[2] Test of medians.

countries. Moreover, note that fast-growing countries within this group are also characterized by smaller output volatility.

B. *Growth Regressions*

We explore the robustness of our initial pass at the data by running a pooled regression for all country-year observations for which data is available. Since it is not our intention to reexamine results profusely analyzed in the growth literature, we choose what we regard as a relatively noncontroversial specification of the growth regression, to which we add the exchange rate regime dummies, *INT* (intermediates), and *FIX* (fixed exchange rates).[13]

Regression results are presented in Table 5.[14] As can be seen the control variables behave largely as expected. Real per capita growth (ΔGDP) is positively correlated with both the

[13] Our baseline specification follow closely those reported in Levine and Renelt (1992), which include the variables most frequently found in the empirical growth literature.

[14] Standard errors reported in the table are corrected by heteroskedasticity, since a simple White test rejected in all cases the null hypothesis of homoskedasticity.

investment-to-GDP ratio (*INVGDP*) and the rate of change of the terms of trade (ΔTT),[15] and negatively correlated with the growth of government consumption [$\Delta GOV(-1)$, lagged to avoid potential endogeneity problems], and political instability (*CIVIL*). Initial per capita GDP (*GDP*74, computed as the average over the period 1970–1973) also comes out with a negative coefficient indicating the presence of conditional convergence. Population (*POP*), a measure of size, appears positively related to growth. The introduction of this control variable is particularly important, since the choice of exchange rate regimes is usually closely linked to country size. Secondary enrollment (*SEC*), population growth (*POPGR*), and openness (*OPENFR*) are not significant, in contrast with previous findings.[16] In all cases, we include three regional dummies: Sub-Saharan Africa (*SAFRICA*), Latin America (*LATAM*), and transition economies (*TRANS*), as well as year dummies (the coefficients of which are omitted for conciseness).[17]

The coefficients of the regime dummies are consistent with the findings of the previous subsection. As a benchmark, we show in the first column the result of the test when regimes are assigned according to the IMF criterion: intermediate regimes grow significantly more than the rest with no difference between floaters and fixers.[18]

In contrast, the results based on the de facto classification unveil a different picture. The regression for the full sample indicates that *growth rates are significantly higher for floaters than for less flexible regimes.* Indeed, the coefficient of the fix dummy indicates that fixers grow on average close to 0.78 percent per year less than floaters.[19] This suggests that, everything else equal, a country that systematically opted to float its exchange rate after the demise of Bretton Woods would have ended up in 2000 with an output 22 percent larger than one that chose to fix.

A more careful analysis, however, reveals that the negative impact of pegs on growth is entirely accounted for by the group of nonindustrial economies. In fact, for these countries, the coefficient of the fix dummy is larger in absolute value than for the general sample, indicating that the average growth rate of pegs is more than 1 percent below that of floats. For industrial countries, on the other hand, neither of the dummies is statistically significant, suggesting that the exchange rate regime is largely irrelevant in these cases.

Given the obvious differences between results conditioning on de jure and de facto regimes, one may wonder whether and to what extent our findings are driven by a particular classification. However, a simple and rather crude test shows that the de jure criterion yields basically the same result once potentially misclassified observations are excluded. More precisely, we restrict the sample to relatively uncontroversial de jure fixes and floats. The former include all de jure fixes with almost no nominal exchange rate variability (in the notation of Table 1, σe) while the latter comprises de jure floats associated with low values of the intervention variable (σr).[20]

[15] While this variable is generally excluded from cross-section regressions, it makes sense to include it when, as in this case, regressions are run on annual data.

[16] See, e.g., Sebastian Edwards (1991) and Barro and Sala-i-Martín (1995). However, Levine and Renelt (1992) cast doubt on the robustness of these links. In order to assure the exogeneity of the openness measure we use Frankel and David Romer's (1999) exogenous trade share. The results are basically the same when more traditional measures are used.

[17] It is important to emphasize at this point that the impact of exchange rate regimes reported in this paper proved to be robust to the inclusion of many other alternative controls suggested by the growth literature. These included the inflation rate, primary school enrollment, the ratio of exports and of imports to GDP, export and import growth, the GDP share of government consumption, the growth of domestic credit, and the ratio of central government deficit to GDP, among others. The results, omitted here, are available from the authors upon request.

[18] For the sake of comparison, the IMF regression includes only those observations that are also classified under the de facto methodology. Although we use a different sample, these results are comparable to those obtained in Ghosh et al. (1997), also based on the IMF classification.

[19] Note the similarity between the coefficient of the regime dummy and the difference in the median growth differential between fixers and floaters in Table 3, despite the fact that the numbers in Table 3 cover a much larger set of countries.

[20] The crude criteria used to pick these uncontroversial observations is not themselves uncontroversial. For "true" fixes (floaters), we require exchange rate (reserves) variabil-

TABLE 5—GROWTH REGRESSIONS
(ANNUAL DATA)

	(i) IMF baseline	(ii) LYS baseline	(iii) LYS industrial	(iv) LYS nonindustrial	(v) IMF	(vi) IMF[1]
INVGDP	10.01***	9.83***	7.06**	10.36***	10.29***	7.73***
	(1.74)	(1.73)	(3.07)	(2.01)	(2.12)	(2.09)
POPGR	−0.28	−0.35*	−0.56	−0.30	−0.34	−0.30
	(0.19)	(0.19)	(0.35)	(0.22)	(0.21)	(0.21)
*GDP*74	−0.37***	−0.43***	−0.34***	−0.77**	−0.38**	−0.71***
	(0.14)	(0.13)	(0.12)	(0.38)	(0.19)	(0.24)
SEC	−0.07	−0.05	2.11*	0.18	−0.84	0.52
	(1.07)	(1.03)	(1.11)	(1.44)	(1.40)	(1.60)
POP	0.19**	0.15*	0.30	0.12	0.30**	0.26**
	(0.08)	(0.08)	(0.21)	(0.09)	(0.12)	(0.11)
GOV(−1)	−1.03***	−0.92**	4.27**	−0.98**	−1.10**	−3.57***
	(0.37)	(0.38)	(2.11)	(0.39)	(0.49)	(0.98)
CIVIL	−0.24*	−0.24*	−0.98***	−0.18	−0.27	−0.14
	(0.14)	(0.14)	(0.23)	(0.16)	(0.20)	(0.17)
ΔTT	0.50***	0.50***	0.52**	0.49***	0.53***	0.82***
	(0.10)	(0.10)	(0.24)	(0.11)	(0.12)	(0.13)
OPENFR	0.55	0.85	−0.49	1.16	1.33	0.23
	(1.20)	(1.26)	(1.15)	(1.62)	(2.12)	(1.19)
SAFRICA	−0.77	−1.06**		−1.12**	−1.23	−1.16*
	(0.50)	(0.47)		(0.51)	(0.75)	(0.61)
LATAM	−1.02***	−1.11***		−0.96**	−1.50***	−0.72
	(0.36)	(0.35)		(0.38)	(0.57)	(0.50)
TRANS	−0.57	−1.37		−1.41	−0.68	−6.25
	(1.80)	(1.70)		(1.79)	(2.45)	(4.93)
INT	0.54*	−0.96***	−0.37	−1.19***		
	(0.32)	(0.33)	(0.29)	(0.45)		
FIX	−0.28	−0.78**	0.13	−1.13**	−0.40	−1.56**
	(0.43)	(0.33)	(0.29)	(0.47)	(0.50)	(0.71)
Observations	1,421	1,421	392	1,029	840	785
R^2	0.177	0.180	0.393	0.171	0.163	0.249

Notes: Robust standard errors are in parentheses. All regressions include year dummies.
* Significant at the 10-percent level.
** Significant at the 5-percent level.
*** Significant at the 1-percent level.
[1] Includes de jure fixes with exchange rate volatility lower than the median for the whole sample ($\sigma_e < 0.3$ percent), and de jure floaters with volatility of reserves lower than the median for the whole sample ($\sigma_r < 6.0$ percent).

The last column of Table 5 reports a fix vs. float regression using this "uncontroversial" IMF sample. An identical regression, using the full IMF sample data, is also presented for comparison in column (v).[21] As the table shows, the link between regimes and growth, absent when the de jure classification is taken at face value, is highly significant after excluding a relatively few (55 out of 840) suspect observations. It is reassuring to see that, as expected, the negative link between regimes and growth is not specific to a particular classification.[22]

ity to be below the median for the whole sample (the thresholds are $\sigma_e < 0.3$ percent and $\sigma_r < 6.0$ percent, respectively). It has to be noted, however, that different (and reasonable low) thresholds for σ_e and σ_r yield comparable results.

[21] De jure intermediates cannot be restricted in an uncontroversial way, and are hence excluded in both regressions.

[22] The correlation between a LYS-based index that takes the values 1, 2, and 3 for floats, intermediates, and pegs, respectively, and a similar index based on the IMF classification, is 0.53. Once controversial observations are excluded, however, this correlation increases to 0.76, reflecting the convergence of both criteria.

TABLE 6—OUTPUT VOLATILITY REGRESSIONS
(ANNUAL DATA)

	(i) All	(ii) Industrial	(iii) Nonindustrial
INVGDPV	22.40***	22.42***	20.74***
	(3.67)	(8.35)	(3.84)
GOVV	1.53***	3.63	1.50***
	(0.38)	(2.92)	(0.38)
TTV	0.02***	−0.03***	0.02***
	(0.00)	(0.01)	(0.00)
OPENFR	−0.41	1.49**	−1.06***
	(0.29)	(0.66)	(0.35)
*GDP*74	0.16***	0.02	0.53***
	(0.05)	(0.06)	(0.09)
CIVIL	0.24***	0.09	0.16**
	(0.05)	(0.17)	(0.06)
SAFRICA	0.70***		0.68***
	(0.19)		(0.20)
LATAM	0.78***		0.44**
	(0.15)		(0.18)
TRANS	1.65***		1.05*
	(0.55)		(0.57)
LYSINT	0.25*	−0.60***	0.58***
	(0.14)	(0.20)	(0.18)
LYSFIX	0.39***	−0.56***	0.80***
	(0.14)	(0.21)	(0.18)
Observations	1,557	405	1,152
R^2	0.226	0.280	0.196

Notes: Robust standard errors are in parentheses. All regressions include year dummies.
* Significant at the 10-percent level.
** Significant at the 5-percent level.
*** Significant at the 1-percent level.

C. *Output Volatility*

To examine the relationship between exchange rate regimes and output volatility, we run regressions exploiting the links suggested by the growth literature. The volatility of real per capita output growth (*GDPV*) is regressed against the volatilities of the investment ratio (*INVGDPV*), the change in government consumption (*GOVV*), and the terms of trade (*TTV*), as well as against measures of openness (*OPENFR*), initial wealth (*GDP*74), and political instability (*CIVIL*). As before, we include regional and year dummies.[23]

The results are reported in Table 6. For the whole sample, the coefficients of all regressors are positive, indicating that higher volatility in macroeconomic fundamentals is associated with higher volatility of GDP. Initial GDP, volatility in investment, government consumption, and terms of trade, the measure of civil liberties and the regional dummies are all significant.

As already documented in the literature, the table also shows that fixed regimes are associated with higher output volatility. However, a closer look reveals that this association is, again, driven by nonindustrial countries.[24] Somewhat surprisingly, for industrial countries the result goes in the opposite direction, both intermediate and fixed exchange rate regimes being characterized by lower output volatility.

Thus, in contrast with what the literature tells us, the evidence on the relationship between output volatility and exchange rate regimes is in fact rather mixed. More precisely, much in the same way as in the case of growth rates, the positive association between fixes and higher output volatility appears to be restricted to developing countries.

III. Robustness

The volatility results discussed above, while mixed, were broadly consistent with the existing literature and empirical evidence. However, the growth results presented in the previous section, while also consistent with at least some of the hypotheses advanced in the literature, are nonetheless controversial. Thus, it is crucial to examine the robustness of the growth results and their sensitivity to alternative specifications.

This section summarizes the various robustness checks that we run to address some of the potential concerns that our findings may give rise to. In particular, we discuss: (a) cross-section regressions covering the whole period, to ensure that the link unveiled using annual data is not driven by short-term cyclical factors,

[23] Two countries with exceptional output volatility, Jordan and Rwanda, were excluded from the sample.

[24] Except for the openness measure that becomes significant, the rest of the coefficients remain relatively stable when we move from the whole sample to the group of nonindustrial countries, with the exception of the initial GDP level (*GDP*74), whose coefficient more than doubles in value. This may be associated with the fact that the more financially developed emerging economies, which have been subject to considerable external shocks particularly during the 1990's, tend to be at the high income end within this group.

(b) a distinction between high and low credibility pegs, (c) the inclusion of additional macroeconomic variables and changes in the sample to test for possible omitted variables, and (d) a correction for potential regime endogeneity.[25] We address each of these checks in turn.

A. *Cross-Section Analysis*

The basic motivation for our choice of frequency was the fact that regimes tend to change rather rapidly over time, making a longer-term regime classification less informative. However, there is an ample literature that stresses the short-run impact of changes in the exchange rate regime on output performance. Thus, a potential criticism may arise from the fact that we use annual data to assess the impact on growth, possibly reflecting the short-term effect of a change in the exchange rate regime, rather than a long-term association between regimes and growth. For example, exchange rate based stabilizations are known to generate short-term output expansions. Similarly, economic performance in the aftermath of a currency collapse may wrongly be assigned to a flexible regime while the origins lay in the preceding period.[26] To address this concern, we estimate single cross-section regressions à la Barro (1991), using averages of the relevant variables over the period 1974–2000, except for those measured at the beginning of period ($GDP74$ and SEC).

The main difficulty posed by this exercise is the computation of the exchange rate regime dummy for those countries that changed their exchange rate policy over the years. We do this in two alternative ways. First we use, for each country, the frequency with which it is classified as a fix ($PERCFIX$). More precisely, according to this measure a value of 1 (0) would correspond to a country for which all available observations are classified as fix (float or intermediate). Second, we use the simple average ($LYSAVG$) of a classification index that assumes the values 1, 2, or 3 whenever an observation is classified as float, intermediate, or fix, respectively. In both cases, a negative coefficient would indicate a negative association between pegs and long-run growth.[27]

Table 7 presents the results. To confirm that the findings reported in the paper are not due to differences in the data, we start from a barebones specification that replicates Levine and Renelt's (1992) "base" specification, and obtain comparable results despite the fact that we use a shorter sample period.[28] Note also that, when the regime dummy is added to this basic set of regressors [column (iii)], it is still highly significant and of the expected sign. We next take this "base" specification including the regime dummy, and expand the sample to include the 1990's [column (iv)]. The results remain unchanged. Finally, in column (v) and (vi), we go back to our baseline specification [similar to that of column (ii) in Table 5] minus the annual change in terms of trade.[29] Again, countries that behaved more frequently as fixes displayed slower average growth rates over the period, a result that is entirely attributable to the subgroup of nonindustrial countries. In column (vii) we replicate regression (vi) this time using the simple average of the classification index for each particular country ($LYSAVG$) as a regime proxy. As the table shows, the new regime measure yields comparable results.[30] Finally, to

[25] The result survived several other robustness checks not reported in the paper for the sake of brevity, such as the exclusion of countries with very high or very low growth rates, the use of subsamples covering shorter periods, or the exclusion of countries with population below certain thresholds.

[26] See, e.g., the extensive literature on exchange rate- vs. money-based stabilization as in Miguel A. Kiguel and Nissan Liviatan (1991), Carlos Vegh (1992), and Calvo and Vegh (1994a, b), to name just a few. On the temporariness of exchange rate choices see Maurice Obstfeld and Kenneth Rogoff (1995) and, particularly, Frankel (1999).

[27] Note that the average measure $LYSAVG$ is hampered by the fact that, as the results in Table 5 suggest, the relationship between regime flexibility and growth may not necessarily be monotonic.

[28] Levine and Renelt's (1992) "base" specification include those variables that are found in most empirical studies and that can thus be regarded as less controversial (denoted as I-variables in their paper). For the sake of comparison, in column (i) of Table 7 we present Levine and Renelt's results, reproduced from column (i) of Table 5 in their paper.

[29] As can be seen, some of the coefficients lose their significance, which goes in line with the sensitivity of traditional growth regressors to the choice of sample and the combination of explanatory variables already stressed in Levine and Renelt (1992).

[30] Replacing $PERCFIX$ by $LYSAVG$ in the other regressions in the Table provides identical results, omitted here for

TABLE 7—CROSS-SECTION GROWTH REGRESSIONS
(PERIOD AVERAGES, 1974–1999)

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
								Five-year averages	
	LR[1] 1960–1989	1974–1989	1974–1989	1974–2000	1974–2000	Nonindustrial 1974–2000	Nonindustrial 1974–2000	1976–2000	Nonindustrial 1976–2000
INVGDP	17.49**	13.79***	15.93***	10.82**	9.24**	10.65**	10.71**	9.66***	10.52***
	2.68	(5.20)	(4.76)	(4.20)	(3.82)	(4.51)	(4.66)	(2.43)	(2.65)
POPGR	−0.38	−0.71***	−0.67***	−0.42**	−0.15	−0.16	−0.17	−0.27	−0.24
	0.22	(0.20)	(0.19)	(0.19)	(0.19)	(0.23)	(0.22)	(0.17)	(0.21)
*GDP*74	−0.35**	−0.57***	−0.51***	−0.26*	−0.57***	−0.60**	−0.65***	−0.44***	−0.63*
	0.14	(0.18)	(0.18)	(0.16)	(0.15)	(0.26)	(0.24)	(0.16)	(0.34)
SEC	3.17**	2.90**	1.91	2.18*	1.10	0.99	1.14	0.37	0.50
	1.29	(0.11)	(1.17)	(1.15)	(1.33)	(1.58)	(1.59)	(1.16)	(1.47)
POP					0.14	0.13	0.10	0.00**	0.00
					(0.12)	(0.14)	(0.14)	(0.00)	(0.00)
GOV(−1)					−1.28	−1.57	−1.39	−1.30*	−1.23*
					(1.08)	(1.16)	(1.15)	(0.70)	(0.73)
CIVIL					−0.39	−0.34	−0.33	−0.28*	−0.24
					(0.25)	(0.29)	(0.29)	(0.15)	(0.16)
OPENFR					0.11***	0.14**	0.14***	0.45	0.77
					(0.03)	(0.05)	(0.05)	(0.44)	(0.67)
SAFRICA					−0.89	−0.72	−0.80	−0.92*	−0.87
					(0.61)	(0.73)	(0.71)	(0.51)	(0.54)
LATAM					−1.17**	−1.03	−1.03	−0.84*	−0.74
					(0.54)	(0.64)	(0.64)	(0.43)	(0.48)
TRANS					0.39	0.43	−0.12	−0.02	0.03
					(0.56)	(0.71)	(0.69)	(1.95)	(2.01)
PERCFIX			−1.37***	−1.13***	−1.30***	−1.89**			
			(0.51)	(0.41)	(0.44)	(0.77)			
LYSAVG							−1.13**	−1.08*	−1.88***
							(0.47)	(0.60)	(0.70)
Observations	101	88	88	97	95	73	73	394	299
R^2	0.46	0.408	0.455	0.374	0.524	0.522	0.523	0.220	0.210

Notes: Robust standard errors are in parentheses. Columns (viii) and (ix) include period dummies.
[1] Levine and Renelt (1992), column (i) of Table 5.
* Significant at the 10-percent level.
** Significant at the 5-percent level.
*** Significant at the 1-percent level.

test whether the results are robust to the window over which the variables are measured, we rerun this last regression using five-year averages of all time varying variables (*LYSAVG* is computed as before, this time for five-year windows) over the period 1976–2000, both for all countries and for the nonindustrial subsample. The results, reported in the last two columns of the table, confirm our previous findings.

brevity. Note that, because of the way in which these dummies are constructed, their coefficients are not directly comparable with each other or with those in the previous sections.

B. *High Credibility Pegs*

The de facto methodology leaves unclassified a number of countries that display very little variability in both the nominal exchange rate and the stock or reserves. It could be argued that credible fixes are less likely to be tested by the market (hence exhibiting a lower volatility of reserves) and, possibly for the same reason, more likely to benefit from a stronger growth performance.[31] If so, by leaving out the so-called

[31] This argument underlies the view that "hard pegs" (economies with a currency board or with no separate legal tender), are preferred to "soft pegs" (economies with con-

"inconclusives," we would be ignoring this credibility dimension and discarding many "good pegs," thus biasing the results towards a negative association between fixed regimes and growth.

A natural way to address this concern is to include these "high credibility" pegs in our regressions. Since the de facto approach is silent as to the regime to be assigned to these observations, we simply classified as fixes all those de facto inconclusives that did not exhibit changes in their exchange rates, as well as those classified by the IMF as de jure fixes which exhibit an average monthly movement in the exchange rate of less than 0.1 percent. In addition we also added countries that comply with the above criteria, even if reserve data are not available.[32]

The two columns of Table 8 report the results of our baseline regression, this time using the expanded group of pegs. The results improve dramatically as the sample size increases. Column (i) shows that while the negative impact of fixed exchange rate regimes decreases somewhat in absolute value, the results remain basically unchanged. Alternatively, we include a new dummy (*UNCONT*) that takes the value of one for these uncontroversial pegs. The value of this term should capture any differential effect on growth corresponding to the presence of a high credibility peg. As shown in column (ii), this new dummy is not significant, suggesting that the distinction between low and high credibility pegs is largely irrelevant as a determinant of growth.

TABLE 8—INCLUDING HIGH CREDIBILITY PEGS

	(i) Adding high credibility pegs	(ii) Are high credibility pegs different?
INVGDP	9.40***	9.45***
	(1.59)	(1.61)
POPGR	−0.39**	−0.39**
	(0.17)	(0.17)
*GDP*74	−0.52***	−0.52***
	(0.15)	(0.15)
SEC	0.28	0.30
	(1.01)	(1.01)
POP	0.23***	0.23***
	(0.08)	(0.08)
GOV(−1)	−0.97***	−0.97***
	(0.37)	(0.37)
CIVIL	−0.25**	−0.25**
	(0.12)	(0.12)
Δ*TT*	0.60***	0.60***
	(0.10)	(0.10)
OPENFR	0.84***	0.81**
	(0.31)	(0.33)
SAFRICA	−1.19***	−1.17***
	(0.41)	(0.42)
LATAM	−0.92***	−0.92***
	(0.31)	(0.31)
TRANS	−1.54	−1.55
	(1.70)	(1.70)
INT	−0.91***	−0.91***
	(0.32)	(0.32)
FIX	−0.60**	−0.65**
	(0.29)	(0.29)
UNCONT		0.14
		(0.36)
Observations	1,754	1,754
R^2	0.183	0.183

Notes: Robust standard errors are in parentheses. All regressions include year dummies.
* Significant at the 10-percent level.
** Significant at the 5-percent level.
*** Significant at the 1-percent level.

C. *Additional Macroeconomic Variables*

It may be argued that countries with the worst economic fundamentals and policy track records are the ones most likely to adopt a peg at any point in time, either in an attempt to gather some policy credibility or as a way to reduce the volatility that results from the lack of such credibility. We do not believe this to be a serious threat to our results, since they are robust to the inclusion of nearly all the variables found to be relevant by the growth literature. Moreover, the use of a de facto classification should dispel concerns about fixes faring worse than their more flexible counterparts due to the presence of currency or banking crises, since failed pegs are by construction excluded from the fixed exchange rate group.

However, in order to address this potential omitted variable problem we conducted two

ventional, adjustable, pegs). On this, see Barry Eichengreen and Ricardo Haussman (1999), Calvo (2000b), and Stanley Fischer (2001). Ghosh et al. (2000) provides empirical evidence in favor of "hard pegs."

[32] Out of the 698 "inconclusives" identified by the de facto methodology, 625 qualify as fixes according to this criterion. In addition we add 419 cases for which reserve data were not available. See Levy-Yeyati and Sturzenegger (2003) for a description of the extended sample.

additional tests. First, to control for weak macroeconomic fundamentals, we included inflation [$INF(-1)$, lagged to reduce potential endogeneity problems], and dummies for currency crises ($CURR$), and bank runs ($BANK$). Both crises variables are taken from Reuven Glick and Michael Hutchison (2001), who construct a currency crash and speculative attack variable and extend Asli Demirguc-Kunt and Enrica Detragiache's (1998) measure of banking crises.

As can be seen in column (i) of Table 9, both the currency crisis and the bank run variables are significant and of the expected negative sign. While the coefficients of the regime dummies are somewhat smaller in absolute value, the exchange rate regime remains a strongly significant determinant of growth performance. This conclusion is further confirmed in column (ii), which presents the results of a similar test using a single cross-section regression, where now inflation (INF) represents the period average.[33]

D. *Dealing with Endogeneity*

The previous tests have documented a robust association between fixed exchange rate regimes and economic growth. However, one may still be worried about the possibility that our results may be reflecting reverse causation, that is, a relationship that goes from growth to the choice of exchange rate regime. We believe that this problem should be relatively minor for a number of reasons. As we discussed above, the economic literature has not associated the choice of regime to growth performance, nor has it considered growth as a major determinant of the exchange rate regime.[34]

Moreover, while one can conceive the case in which the collapse of an unsustainable fixed regime gives way to the recovery of economic fundamentals and the resumption of growth, the empirical literature on financial crises has long linked poor growth with the occurrence of speculative attacks and currency and banking crisis, a channel that is likely to induce a *negative* correlation between growth and exchange rate variability, thus going in the opposite direction of our results.[35] Correcting for endogeneity could

Table 9—Including Additional Macroeconomic Variables

	(i) Baseline specification	(ii) Single cross section
$INVGDP$	10.36***	8.88**
	(1.86)	(3.88)
$POPGR$	−0.40**	−0.14
	(0.19)	(0.20)
$GDP74$	−0.50***	−0.51***
	(0.13)	(0.16)
SEC	0.79	1.23
	(1.06)	(1.25)
POP	0.15*	0.14
	(0.08)	(0.11)
$GOV(-1)$	−0.70	1.28
	(0.53)	(1.19)
$CIVIL$	−0.16	−0.33
	(0.15)	(0.25)
ΔTT	0.48***	
	(0.10)	
$OPENFR$	0.68	0.11***
	(1.36)	(0.03)
$INF(-1)$	−0.00	
	(0.03)	
INF		−0.29***
		(0.10)
$CURR$	−1.07***	0.14
	(0.34)	(1.36)
$BANK$	−1.24***	0.65
	(0.44)	(1.62)
$SAFRICA$	−0.93*	−0.91
	(0.48)	(0.57)
$LATAM$	−0.82**	−1.30**
	(0.36)	(0.50)
$TRANS$	−1.94	−0.11
	(1.74)	(0.66)
INT	−1.00***	
	(0.32)	
FIX	−0.71**	
	(0.33)	
$PERCFIX$		−1.09**
		(0.44)
Observations	1,339	95
R^2	0.202	0.568

Notes: Robust standard errors are in parentheses. Columns (i) and (ii) include year dummies.
* Significant at the 10-percent level.
** Significant at the 5-percent level.
*** Significant at the 1-percent level.

[33] The other variables are also averaged over the period. As before, the change in the terms of trade is excluded.

[34] Edwards (1996) and Frankel (1999) review the determinants of exchange rate regimes, and growth performance is patently missing from the discussion.

[35] This literature, however, is relatively silent on causality. See Frankel and Rose (1996), Demirguc-Kunt and De-

therefore strengthen the results for the fixed group. Similarly, (exchange rate-based) stabilizations that induced an output contraction in the short run may be contributing to create the negative correlation shown by our results. Again, the literature tends to argue against this, indicating that exchange rate-based stabilizations have been largely expansionary in the short run.

At any rate, it should be noted that short-run effects arising from the regime changes should disappear once we consider long-run averages as we did in the single cross-section regressions above. This notwithstanding, our analysis would not be complete if we did not address potential endogeneity problems. We do this in two alternative ways.

First, we test whether our results hold for countries that have had in place a de jure fixed regime since the demise of Bretton Woods period. Since in practice this group corresponds to economies within long-standing currency unions, it seems reasonable to assume that in this case the original regime choice was independent from the growth performance of individual countries during our period of analysis. In column (i) of Table 10, we present the results of the baseline specification, this time including a dummy, *FIXALL*, that singles out observations associated with countries with de jure pegs throughout the period. As can be seen, the negative impact of fixed regimes on growth performance is not reverted for this group of countries.

As an alternative robustness check, we use a feasible generalized two-stage IV estimator (2SIV) suggested by Halbert White (1984). White's procedure provides the most efficient among all IV estimators, allowing at the same time to correct for heteroskedasticity, a problem that we found present in our baseline specification. The methodology requires finding instruments for the regime dummies, and implementing a two-stage procedure. Once consistent estimates of the error terms are obtained, they are used to estimate the variance covariance matrix that is used to compute the estimator that maximizes efficiency while taking into account the potential heteroskedasticity problem.

In order to obtain a cleaner test of the impact of pegs, we apply 2SIV to the baseline specification of Table 5.[36] In the first step, we run a multinomial logit model of the *FIX* and *INT* regime dummies on all the variables included in the growth regression, plus some additional exogenous controls. The choice of these controls is crucial and deserves some comment.

The extension of the growth literature makes it particularly difficult to find variables that have not been related to growth at some point in time, thus casting doubt at their value as instruments for the purposes of our test.[37] For this reason, we restricted ourselves to the use of a few clearly exogenous variables, including the ratio of the country's GDP over the United States' (*SIZE*), the geographical area of the country (*AREA*), an island dummy (*ISLAND*), defined as a dummy for countries with no mainland territory, the level of reserves relative to the monetary base (*RESBASE*) for the earliest year within the period for which data are available and, finally, a regional exchange rate indicator (*REGEXCH*) equal to the average exchange rate regime of the country's neighbors, where the latter are defined as those under the same IMF department.[38] Both size measures are potentially related to the exchange rate regime by the usual argument that smaller countries tend to be more open and thus favor fixed exchange rates. The island variable may relate either to the extraordinary trade propensity of island economies or to their frequent role as international financial centers. A high initial level of reserves has been stressed as a condition for a country to sustain credible pegs. Finally, the regional exchange rate may indicate explicit or implicit exchange rate coordination with countries that typically share strong trade links, as the trade literature has profusely illustrated through the use of gravity models. Table 11 reports the coefficients for these new variables from the logit model. With a few

tragiache (1998), Graciela Kaminsky et al. (1998), Daniel Hardy and Ceyla Pazarbazioglu (1999), Kaminsky and Carmen Reinhart (1999), among many others.

[36] Similar results are obtained when intermediates are excluded. The results, reported in a previous version of this paper, point in a similar direction and are omitted here for conciseness.

[37] This is the case, for example, of the financial depth proxies that were used in previous versions of this paper.

[38] For the computation of this last instrument, the home country is excluded in the computation of the average. Alternative geographical groupings (e.g., continents) yielded identical results.

TABLE 10—DEALING WITH ENDOGENEITY

	(i) OLS	(ii) Baseline 2SIV	(iii) Baseline 2SIV	(iv) Baseline IV
INVGDP	9.91***	11.33***	11.20***	12.14***
	(1.79)	(1.84)	(1.85)	(1.94)
POPGR	−0.34*	−0.34*	−0.33*	−0.33*
	(0.19)	(0.19)	(0.19)	(0.19)
*GDP*74	−0.43***	−0.43***	−0.42***	−0.43***
	(0.13)	(0.14)	(0.14)	(0.14)
SEC	−0.03	0.22	0.29	0.34
	(1.01)	(1.19)	(1.18)	(1.19)
POP	0.15*	0.12	0.15	0.11
	(0.08)	(0.11)	(0.11)	(0.11)
GOV(−1)	−0.93**	−1.28***	−1.30***	−1.47***
	(0.38)	(0.50)	(0.50)	(0.51)
CIVIL	−0.24*	−0.24*	−0.25*	−0.25*
	(0.14)	(0.15)	(0.14)	(0.15)
Δ*TT*	0.50***	0.53***	0.53***	0.53***
	(0.10)	(0.11)	(0.11)	(0.11)
OPENFR	0.91	2.29	2.10	3.01*
	(1.16)	(1.48)	(1.45)	(1.65)
SAFRICA	−1.03**	−0.07	−0.09	0.43
	(0.52)	(0.68)	(0.66)	(0.75)
LATAM	−1.11***	−0.91***	−0.92***	−0.81**
	(0.35)	(0.36)	(0.35)	(0.37)
TRANS	−1.36	−1.47	−1.31	−1.51
	(1.71)	(1.80)	(1.80)	(1.83)
INT	−0.96***	−0.19	0.20	0.23
	(0.33)	(1.75)	(1.73)	(1.78)
FIX	−0.76**	−2.89***	−2.55**	−3.95***
	(0.35)	(1.07)	(1.04)	(1.35)
FIXALL	−0.12			
	(0.63)			
Observations	1,421	1,403	1,403	1,403

Notes: Heteroskedasticity-consistent standard errors are in italics. All regressions include year dummies.

(i) *FIXALL* denotes observations corresponding to economies classified as de jure pegs during the whole period (1974–2000).

(ii) Instruments: *INTFIT* and *FIXFIT*, where *INTFIT* and *FIXFIT* are the estimates of *INT* and *FIX* in a multinomial logit model.

(iii) Instruments: *INTFIT*, *FIXFIT*, *AREA*, *ISLAND*, *REGEXCH*, *RESBASE*, and *SIZE*.

(iv) Instruments: *AREA*, *ISLAND*, *REGEXCH*, *RESBASE* and *SIZE*.

* Significant at the 10-percent level.

** Significant at the 5-percent level.

*** Significant at the 1-percent level.

exceptions, all of these variables are highly significant and of the expected sign (a positive implying a higher propensity to fix).[39]

From the logit model we obtain predicted probabilities for fixed (*FIXFIT*) and intermediate (*INTFIT*) regimes, which are then used as instrument for the regime dummies *FIX* and *INT* in our baseline growth regression. In turn, this regression provides the consistent estimates of the error terms from which we compute the White's efficient covariance matrix and 2SIV estimator.[40]

[39] The result do not change if different combinations of the proposed instruments are considered. Results are available from the authors upon request.

[40] Appendix B shows the exact specification of this covariance matrix, as well as a more detailed description of the methodology.

TABLE 11—COEFFICIENTS FROM THE LOGIT MODEL

	Multinomial logit	
	LYSINT	*LYSFIX*
AREA	−0.13	−0.56***
	(2.68)	(0.12)
ISLAND	−0.33**	0.24*
	(0.15)	(0.14)
REGEXCH	−0.06	1.65***
	(0.19)	(0.20)
RESBASE	0.31**	0.69***
	(0.12)	(0.11)
SIZE	−0.07***	−0.09***
	(0.01)	(0.01)
Observations	2,162	2,162

Notes: Robust standard errors are in parentheses. All regressions include year dummies.
* Significant at the 10-percent level.
** Significant at the 5-percent level.
*** Significant at the 1-percent level.

The results are presented in the second and third columns of Table 10. As the table shows, the negative association between fixed regimes and growth is robust to the correction for endogeneity. Indeed, as was expected from the above discussion, the correction increases the negative impact of pegs on growth, raising the coefficient from close to 0.8 percent to more than 2 percent. In column (iv) the table also reports a simple instrumental variables regression using the regime determinants *AREA*, *ISLAND*, *REGEXCH*, *RESBASE*, and *SIZE* (instead of *FIXFIT* and *INTFIT*) as instruments of *FIX* and *INT*. As can be seen, the results remain basically unchanged although the coefficient becomes suspiciously high. In sum, the presence of a strong independent link which goes from the choice of a peg to a poorer growth performance appears to be robust to potential endogeneity problems.[41]

IV. Conclusion

This paper tried to provide evidence on the implications of the choice of a particular exchange rate regime on economic growth. In contrast with previous findings, ours strongly suggest that exchange rate regimes indeed matter in terms of real economic performance for nonindustrial countries, while this link appears to be much weaker for industrial economies. In particular, we found that, for the former, fixed exchange rate regimes are connected with slower growth rates and higher output volatility, an association that proved to be robust to several alternative specifications and checks.

While we have not specifically tested the hypotheses supporting the existence of a positive link between fixed exchange rates and trade surveyed in Frankel (1999), it is clear that whatever beneficial influence this might have on growth is not sufficient to generate a net positive impact on economic growth. Similarly, the alleged gains in terms of policy stability and predictability frequently attributed to fixed regimes, if present, are at odds with the higher output volatility that characterizes them.

Of the two arguments mentioned in the introduction that point to a negative effect of fixing, the idea that pegs may be subject to costly speculative attacks relates to Calvo's (1999) claim that the external shocks suffered by a country are not unrelated to their exchange rate regime. According to this view, conventional pegs may be exposed to larger and more frequent shocks. In turn, the fix dummy may be capturing the impact of this additional external volatility much in the same way as the political variables in traditional growth equations capture the implications of institutional instability. Two points, however, cast doubt on this potential interpretation of our results. On the one hand, these additional shocks were to some extent tested by controlling for the occurrence of currency and banking crises. In fact, while these variables were found to be significant, their inclusion reduced the size and significance of the regime dummy only marginally. On the other hand, long-standing, high credibility pegs that presumably are less affected by frequent external shocks, did not appear to fare better in terms of growth than their more vulnerable counterparts.

The more traditional argument linking fixed exchange rate with higher output volatility appears to be more promising, particularly in light of our findings that economies where regimes

[41] An additional concern involves the potential endogeneity of the investment ratio, which in turn may be biasing the regime coefficient if investment and regimes are correlated. However, while instrumenting the investment ratio by its lag indeed reduces significantly its explanatory power, it does not alter the regime coefficient nor reduces its significance level.

do have an effect on output growth are the same as those for which it appears to affect its volatility. In turn, this is consistent with the empirical evidence of a negative correspondence between output volatility and growth mentioned in the introduction. Note that this channel does not require that the underlying shocks (or, for that matter, other macro fundamentals such as investment or government consumption) exhibit higher volatility under a peg than under more flexible arrangements, but rather that, for a given distribution of shocks, fixed regimes display a higher output response due to the prevalence of quantity adjustments in the presence of limited nominal flexibility. An alternative, related hypothesis points at a combination of fixed exchange rate regimes and downward price rigidity that, in turn, may induce an asymmetric response to real shocks, dominated by price adjustments when they are positive and quantity adjustments (output contractions) when they are negative. A careful examination of this relatively unexplored channel may help understand the links unveiled in this paper.[42]

The model also casts a negative light on intermediate regimes, which display a relatively poor growth performance compared to floats. However, as this result does not survive an endogeneity correction, our conclusions on this front have to be taken with caution.

As it stands, the paper opens more questions than it answers. If we accept the results reported here, one can only wonder why countries have opted so pervasively for unilateral pegs. Different cuts at the sample, both in terms of countries and periods, will eventually help illuminate the origins of the result. At this point, however, one should be cautious not to read in our results the policy implication that countries should massively adopt floating exchange rate regimes. Fixed exchange rates may in some cases report substantial gains in terms of credibility and inflation performance, particularly in a high inflation context. Additionally, the costs of the transition to a float are not minor and depend heavily on initial conditions. For example, for countries with widespread financial dollarization, a move to a flexible regime may increase output volatility due to the balance sheet effect of fluctuations in the nominal exchange rate. Similarly, our findings are not incompatible with the advocacy of "hard pegs" or full dollarization. Many of the benefits of having a common currency or undertaking outright dollarization are not shared by unilateral pegs, transaction costs being just one example. This notwithstanding, we believe that the evidence presented here is strong enough to influence the debate on exchange rate regimes in the future.

[42] Using a VAR approach, Broda (2001) finds that, under fixed regimes, responses are significantly higher than under floats, and higher for negative than for positive shocks, although not significantly so. The results are confirmed by Edwards and Levy-Yeyati (2002), where the asymmetry of response is found to be statistically significant for all types of regimes. Rudiger Dornbusch (2000), on the other hand, disregards the asymmetry channel as a potentially important explanatory factor.

APPENDIX A

(*a*) *Variables and Sources*

Variable	Definitions and sources
ΔGDP	Rate of growth of real per capita GDP (Source: World Economic Outlook [WEO], series code: W914NGDP_R%)
ΔTT	Change in terms of trade—exports as a capacity to import (constant LCU) (Source: World Development Indicators [WDI]; variable NY.EXP.CAPM.KN)
AREA	Land area (sq. km) (Source: WDI; variable AG.LND.TOTL.K2)
BANK	Banking crises (Source: Glick and Hutchison, 2001)
CIVIL	Index of civil liberties (measured on a 1 to 7 scale, with 1 corresponding to highest degree of freedom) (Source: *Freedom in the world—Annual survey of freedom country ratings*)
CURR	Currency crises (Source: Glick and Hutchison, 2001)
*GDP*74	Initial per capita GDP (average over 1970–1973) (Source: WEO, series code: W914NGDPRPC)
GDPV	Standard deviation of the growth rate over a centered rolling five-year period
$GOV(-1)$	Growth of government consumption (lagged one period) (Source: IMF's International Financial Statistics [IMF], line 91f)
GOVV	Standard deviation of the growth of government consumption over a centered rolling five-year period
INF	Annual percentage change in Consumer Price Index (Source: IMF, line 64)
INVGDP	Investment to GDP ratio (Source: IMF, line 93e/line 99b)
INVGDPV	Standard deviation of the investment to GDP ratio over a centered rolling five-year period
ISLAND	Dummy variable for countries with no mainland territory.
LATAM	Dummy variable for Latin American countries
OPEN	Openness, (ratio of [export + import]/2 to GDP) [Source: IMF, (line 90c + line 98c)/2/line 99b]
OPENFR	Constructed openness (Source: Frankel and Romer, 1999)
POP	Total population (units) (Source: WDI, variable SP.POP.TOTL)
POPGR	Population growth (annual percent) (Source: WDI, variable SP.POP.GROW)
REGEXCH	Average de facto exchange rate regime of the region
RESBASE	Initial Ratio of International Reserves to monetary base (Source: IMF, line 11/line 14)
SAFRICA	Dummy variable for Sub-Saharan African countries
SEC	Total gross enrollment ratio for secondary education (Source: Barro, 1991)
SIZE	GDP in dollars over U.S. GDP (Source: WDI, variable NY.GDP.MKTP.CD)
TRANS	Dummy variable for transition economies
TTV	Standard deviation of the terms of trade over a centered rolling five-year period

[Panel (b) appears on next page.]

APPENDIX A—*Continued.*

(*b*) *List of Countries (183-Country Sample)*

Australia	*Burkina Faso*	*Jamaica*	*Philippines*
Austria	*Burundi*	*Jordan*	*Poland*
Belgium	*Cambodia*	*Kazakhstan*	*Qatar*
Canada	*Cameroon*	*Kenya*	*Romania*
Denmark	*Cape Verde*	*Kiribati*	*Russia*
Finland	*Central African Rep.*	*Korea*	*Rwanda*
France	*Colombia*	*Kuwait*	*Samoa*
Germany	*Comoros*	*Kyrgyz Republic*	*Sao Tome & Principe*
Greece	*Congo, Dem. Rep. of*	*Lao People's Dem. Rep.*	*Saudi Arabia*
Iceland	*Congo, Republic of*	*Latvia*	*Senegal*
Ireland	*Costa Rica*	*Lebanon*	*Seychelles*
Italy	*Cote D'Ivoire*	*Lesotho*	*Sierra Leone*
Japan	*Croatia*	*Liberia*	*Singapore*
Netherlands	*Cyprus*	*Libya*	*Slovak Republic*
New Zealand	*Czech Republic*	*Lithuania*	*Slovenia*
Norway	*Chad*	*Luxembourg*	*Solomon Islands*
Portugal	*Chile*	*Macedonia, Fyr*	*Somalia*
San Marino	*China, P.R.: Mainland*	*Madagascar*	*South Africa*
Spain	*China, P.R.: Hong Kong*	*Malawi*	*Sri Lanka*
Sweden	*Djibouti*	*Malaysia*	*St. Kitts and Nevis*
Switzerland	*Dominica*	*Maldives*	*St. Lucia*
United Kingdom	*Dominican Republic*	*Mali*	*St. Vincent & Grens.*
United States	*Ecuador*	*Malta*	*Sudan*
Afghanistan, I.S. of	*Egypt*	*Marshall Islands*	*Suriname*
Albania	*El Salvador*	*Mauritania*	*Swaziland*
Algeria	*Equatorial Guinea*	*Mauritius*	*Syrian Arab Republic*
Angola	*Estonia*	*Mexico*	*Tajikistan*
Antigua and Barbuda	*Ethiopia*	*Micronesia, Fed. Sts.*	*Tanzania*
Argentina	*Fiji*	*Moldova*	*Thailand*
Armenia	*Gabon*	*Mongolia*	*Togo*
Aruba	*Gambia, The*	*Morocco*	*Tonga*
Azerbaijan	*Georgia*	*Mozambique*	*Trinidad and Tobago*
Bahamas, The	*Ghana*	*Myanmar*	*Tunisia*
Bahrain	*Grenada*	*Namibia*	*Turkey*
Bangladesh	*Guatemala*	*Nepal*	*Turkmenistan*
Barbados	*Guinea*	*Netherlands Antilles*	*Uganda*
Belarus	*Guinea-Bissau*	*Nicaragua*	*Ukraine*
Belice	*Guyana*	*Niger*	*United Arab Emirates*
Benin	*Haiti*	*Nigeria*	*Uruguay*
Bhutan	*Honduras*	*Oman*	*Vanuatu*
Bolivia	*Hungary*	*Pakistan*	*Venezuela, Rep. Bol.*
Bosnia and Herzegovina	*India*	*Palau*	*Vietnam*
Botswana	*Indonesia*	*Panama*	*Yemen, Republic of*
Brazil	*Iran, I.R. of*	*Papua New Guinea*	*Zambia*
Brunei Darussalam	*Iraq*	*Paraguay*	*Zimbabwe*
Bulgaria	*Israel*	*Peru*	

Note: Industrial countries in bold.

APPENDIX B: WHITE'S EFFICIENT 2SIV ESTIMATES

The estimation in Table 10 shows the results corresponding to White's (White, 1984) efficient 2SIV (two-stage instrumental variable) estimator. This procedure delivers the asymptotically efficient estimator among the class of IV estimators, even in the presence of a nonspherical variance covariance matrix (VCV) for the error term in the structural equation. Consider the structural equation for country-year data:

(B1) $$y_{it} = \mathbf{X}\boldsymbol{\delta} + \varepsilon_{it},$$

$$\text{where } i = 1 \cdots J,\ t = 1 \cdots T,$$

where i indicates country and t indicates time. The matrix $\mathbf{X}$ includes both endogenous and exogenous variables. In our specification y corresponds to the real per capita GDP growth rate and $\mathbf{X}$ includes both the exogenous regressors in the growth equation as well as the endogenous regime dummy. The White heteroskedasticity test mentioned in footnote 14 suggests that the VCV matrix of ε_{it}'s ($\boldsymbol{\varepsilon}$) is nonspherical, i.e.,

(B2) $$\mathbf{V}(\boldsymbol{\varepsilon}) = \boldsymbol{\Omega}.$$

As is well known we can estimate consistently our parameter of interest, $\boldsymbol{\delta}$, by finding the value of $\boldsymbol{\delta}$ that minimizes the quadratic distance from zero of $\mathbf{Z}'(\mathbf{y} - \mathbf{X}\boldsymbol{\delta})$, i.e.,

(B3) $$\hat{\boldsymbol{\delta}} = \min_{\boldsymbol{\delta}} (\mathbf{y} - \mathbf{X}\boldsymbol{\delta})'\mathbf{Z}\mathbf{R}\mathbf{Z}'(\mathbf{y} - \mathbf{X}\boldsymbol{\delta}),$$

where $\mathbf{Z}$ indicates a set of instrumental variables. $\mathbf{R}$ corresponds to any symmetric positive definite matrix, which must be chosen appropriately, however, in order to achieve asymptotic efficiency. The estimator corresponding to the minimization problem is:

(B4) $$\hat{\boldsymbol{\delta}} = (\mathbf{X}'\mathbf{Z}\mathbf{R}\mathbf{Z}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{Z}\mathbf{R}\mathbf{Z}'\mathbf{y}.$$

It can be shown that the limiting distribution of $\hat{\boldsymbol{\delta}}$ is

(B5) $$\sqrt{T}(\hat{\boldsymbol{\delta}} - \boldsymbol{\delta}) \approx N(0,\ \text{plim}[(\mathbf{Q}'\mathbf{R}\mathbf{Q})^{-1} (\mathbf{Q}'\mathbf{R}\mathbf{V}\mathbf{R}\mathbf{Q})(\mathbf{Q}'\mathbf{R}\mathbf{Q})^{-1}]),$$

where

(B6) $$\mathbf{Q} = \text{plim}\,\frac{\mathbf{Z}'\mathbf{X}}{T},$$

$$\mathbf{V} = \text{var}(T^{-1/2}\mathbf{Z}'\boldsymbol{\varepsilon}).$$

Proposition 4.45 in White (1984) proves that choosing $\mathbf{R} = \mathbf{V}^{-1}$ provides the asymptotically efficient IV estimator. In this case, the distribution of the estimator is

(B7) $$\sqrt{T}(\hat{\boldsymbol{\delta}} - \boldsymbol{\delta}) \approx N(0,\ \text{plim}(\mathbf{Q}'\mathbf{V}^{-1}\mathbf{Q})^{-1}).$$

Thus, if we choose $\mathbf{R}$ to obtain the asymptotically efficient estimator, we need an estimator of $\mathbf{V}$. However, because the ε_{it}'s are not observable, we need consistent estimators of the errors in order to construct a feasible estimator for the VCV. Thus the procedure is as follows. We first run a multinomial logit regression for the regime dummies, our endogenous variables. This multinomial logit equation includes the exogenous variables in the original structural equation plus the additional exogenous variables discussed in the text, which are correlated with the choice of regime. The estimated probabilities of the regimes are used as an instrument of the regime dummies in the original specification.[43] This simple IV estimator is used to obtain a consistent estimate for the ε_{it}'s ($\hat{\varepsilon}_{it}$), which are then used to obtain a consistent estimate of $\mathbf{V}$, $\hat{\mathbf{V}}$, as:

(B8) $$\hat{\mathbf{V}} = \text{var}(T^{-1/2}\mathbf{Z}'\hat{\boldsymbol{\varepsilon}}),$$

which allows for heteroskedasticity. Using $\hat{\mathbf{V}}$ we can implement the estimator $\hat{\boldsymbol{\delta}}$ as in (B4) and compute its VCV matrix as in (B7).

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[43] We thank Jerry Hausman for suggesting this procedure to us.

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