# Could the Exchange Rate Regime Reduce Macroeconomic Volatility?

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## 1. Introduction

The literature which studies the exchange rate regime properties has flourished after the Asian, Russian, Brazilian and Argentinean Crises. The traditional discussion between fully fixed and fully flexible exchange rate systems (i.e. the so-called corner solutions) is again in a prominent position in international macroeconomic literature. According to some authors, recent crisis episodes are a clear demonstration of the superiority of flexible exchange rates since those crises occurred, in most of the cases, in countries with some kind of pegged system. But this is not an opinion that everyone shares. For instance, Calvo et al. (2003) suggest that the recent Argentinean Collapse could be understood by a sudden stop in capital flows magnified by the fact that Argentina is a relatively closed economy with a very high liability dollarization.

There exist several papers which theoretically and empirically study the exchange rate regime and macroeconomic performance. Among the performance indicators, real volatility has not received much attention. This is because working on volatility is not a straightforward task since there is not a unique way to define it or measure it. The aim of this paper is to investigate the relationship between the exchange rate regime and macroeconomic volatility by using intensively different panel data methodologies.

The main result is that exchange rate regimes are non-neutral. We found that pegged regimes are systematically associated with higher real volatility once the others factors that affect volatility are taken into account. Furthermore, our data shows an inverse relationship between the degree of flexibility in the exchange rate regime and real volatility.

The robustness of the previous conclusion is checked by means of two samples that have different characteristics. The first sample is composed by those countries for which it is possible to construct a volatility measure with annual frequency. The second sample incorporates much more countries but in this case the number of temporal observations within each country is reduced. Additionally, the empirical findings do not change when different exchange rate regime classifications or alternative panel data techniques are used. The empirical analyses is carried out in the post Bretton Woods period, 1974-2000.

The structure of the paper is as follows: in section 2 the issue of exchange rate regimes and its relationship with nominal and real volatility is discussed. Following this, literature concerning real volatility determinants is reviewed. In section 4 several methodological issues are clarified. The results of the paper are shown in section 5. The final section presents our conclusions.

## 2. Exchange rate regime selection: nominal volatility and real volatility.

Since the abandonment of the Bretton Woods system, we have seen several types of exchange rate agreements which make it almost impossible to establish a clear cut line between fixed and flexible exchange rate regimes. Some typical examples are: managed floating, crawling pegs, crawling bands, currency boards, dollarization, pegged-but adjustable-systems, etc (Frenkel, 1999; Edwards, 2002).

The traditional way of studying the exchange rate regime selection stresses the importance of analyzing the sources of macroeconomic shocks. According to Poole (1970), a flexible exchange rate is the preferred system when the main source of disturbances is the goods market. This is consistent with the Keynesian view of exchange rate regime selection which stresses the importance of achieving the internal and external equilibriums by using the nominal exchange rate simultaneously. As it is known, in a context of price stickiness, a negative shock under a fixed exchange rate requires a price deflation which has contractive effects. But under a flexible exchange rate, the real exchange rate could adjust by means of the nominal exchange rate without generating a recession (Edwards, 2001a). On the contrary, if the main source of

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economic disturbances comes from the monetary market through instability in monetary policy or money demand, the optimal decision is to have a fixed exchange rate.

An illustrative example of this type of reasoning is found in the stochastic IS-LM model of Weber (1981). This is a model for a small country in a world of full capital mobility. Under a fixed exchange rate system the country has a lower output volatility if the shock variance of money demand is large in relation to the variance in the rest of the shocks. Conversely, if the shock in the IS curve is large in relation to the other shocks then, flexible exchange rates will be a superior smoothing mechanism than fixed regimes.

Obstfeld (1985), suggests that the properties of exchange rate systems as output smoothing mechanisms should be considered jointly with the ability of each system to reduce real exchange rate volatility and to induce coherent fiscal and monetary policies. In this sense, more recent works on regime selection such as Frenkel (1995) or Edwards (1996) stress the existing trade-off between credibility and flexibility. Under a floating exchange rate there exists the ability of accommodating internal and external shocks using monetary policy. However, this flexibility is achieved at the price of a low credibility level which tends to be associated with an inflationary bias. In a credible or reliable fixed exchange rate regime, economic agents believe that the major objective of the monetary policy is to maintain the pegged rate, so they reduce their expectations over wages and prices and thus, the economy is conducted to a low inflation equilibrium.

Eichengreen (1994), draws attention to the conflicts between full capital mobility and fixed exchange rate regimes which are particularly significant for developing economies. Frenkel (1999), Edwards (2001b) or Fanelli (2001) highlight the existence of an unholy trinity among independent monetary policy, full capital mobility and fixed exchange rate systems. In this view, the higher capital mobility and financial integration could have caused the slow abandonment of fixed systems in the years following the Bretton Woods collapse because the resistance of policymakers to introduce mechanisms to protect against the volatility in international capital flows.

More recently, some models of the so-called "new open economy macroeconomics" initiated by Obstfeld and Rogoff (1995), start to include some conclusions about the exchange rate regime selection. According to Lane (2001), the salient characteristic of these types of models is the introduction of nominal rigidities or market imperfection in a context of general dynamic equilibrium and solid microfoundations.

In this new line of research, there were examined different characterizations of: i) nominal rigidities -in the goods or in the labor market-; ii) market structure -perfect or monopolistic competition-; and iii) currency pricing denomination -seller or buyer currency-. The small economy model of Devereux (1998), challenges the idea that fixed exchange rate systems reduce the economy ability to adjust to macroeconomic shocks. Even when there are sticky prices, there is no trade-off between exchange rate regime and output volatility.

Devereux and Engel (2000) analyze pricing mechanisms. A floating exchange rate is always preferable when prices are set in consumer currency, because this allows it insolating domestic consumption from monetary external shocks. On the contrary, a pegged exchange rate is the best option if prices are set in producer currency and the country is relatively small or has a great deal of risk aversion. Obstfeld and Rogoff (2000) model, has shown that there are not welfare differences between an optimal floating and an optimal pegging since neither of them system can reduce the effects of uncertainty on productivity shocks.

The model of Collard and Dellas (2001) introduces price stickiness and proceeds to compare three exchange rate agreements: an optimal floating, a unilateral peg and a bilateral peg. Regarding the effects of each regime over real volatility, the conclusion is that the results depend on both exchange rate regime and the degree of price stickiness. Real volatility under different exchange rate systems tends to be small for typical calibration values of price stickiness.

This revision of theoretical arguments does not reach a clear conclusion concerning the superiority in terms of real volatility of a particular exchange rate regime. In this context, the contributions that can be established from an empirical analysis are highly relevant. In this sense, some papers studied the relationship between

the most important macroeconomic performance indicators and the exchange rate regime.

In respect to the relationship of inflation and the exchange rate regime, Edwards (1993) studies the performance of 53 developing countries during the period 1980-1989. The dependent variable in this investigation is the inflation rate, and there is a control set composed by variables such as political instability, geographical characteristics or the tax system structure. Edwards results suggest that countries with fixed exchange rates experimented lower inflation rates than those counties with floating exchange rates. The author intended to validate the idea that fixed systems induce more macroeconomic discipline by introducing, the growth rate of the monetary supply as the dependent variable. The result is that effectively fixed system encourages monetary discipline.

Ghosh et al. (1997) examine the effect of the exchange rate regime over inflation and GDP growth using data from 136 countries during the years 1960-1989. They conclude that both inflation level and inflation volatility are considerably lower under a pegged exchange rate. However, they also show that there does not exists an inflationary bias in those countries which had a full flexible exchange rate and a high per capita income. This last result means that the relationship between inflation and the degree of flexibility in the exchange rate regime could be non-monotonically positive. Turning to GDP growth performance, the authors did not find statistically significant differences among exchange rate agreements. This last result could be explained by two effects that act in opposite directions: investments rates are higher under a fixed exchange rate but the growth of foreign trade is lower in this case.

A study of the IMF in the same year (IMF, 1997) obtains similar results to the previous quoted paper: inflation rate level and inflation volatility is lower in countries with fixed exchange rate regimes in relation to countries that have flexible exchange rate agreements. This difference was reduced during the nineties.

The paper of Domaç et al. (2001) stresses the issue of endogenity or "reverse causality" to represent a major problem for the empirical analysis of the exchange rate regime. Having recognized this issue, they proceed to estimate a probit model which studies regime selection and then they used its results to investigate the relationship between the exchange rate system and various macroeconomic indicators. Their sample includes twenty-two transition economies and the general results is that countries which: i) have lower budget deficits; ii) are more open to international trade; and iii) implement -to a large extent- market friendly reforms, tend to adopt fixed exchange rate regimes.

Baxter and Stockman (1989) initiated the research on the relationship between exchange rate agreements and real macroeconomic variables. Their results suggest that there is little evidence of changes in the most important real macroeconomic variables (i.e. consumption, exports or industrial production) under different exchange rate systems. These results contribute to empirically support the idea of exchange rate neutrality (Helpman, 1981; Lucas, 1982).

Using data of OECD countries, Flood and Rose (1995) concluded that output volatility is not statistically different between fixed and flexible exchange rate regimes. However, real exchange rate volatility is considerably higher under a floating exchange rate. As it was stated by Dornbusch (1989) this is an important result since if real exchange rate movements reveal changes in equilibrium prices, then it is difficult to explain how equilibrium prices are so much volatile than quantities.

Basu and Taylor (1989) researched on output, consumption, investment and current account volatility using historical data from fifteen countries. The authors distinguish four clearly differentiated historical periods: the gold standard period (1870-1914); the inter-war period (1919-1939); the Bretton Woods period (1951-1971) and the recent floating period (1974-1998). The volatility of the main economic variables increases more than a fifty percent in the inter-war period in relation to the gold standard period. In the Bretton Woods period the volatility of these variables is similar to that observed during the gold standard. In the recent floating period the lowest volatility levels are found. These results highlight the fact that an adequate empirical treatment of the exchange rate regime should consider only periods in which the global

characteristics (i.e. “the rules of the games”) were homogenous.

The papers of Ghosh et al. (1997) and Levy Yeyati and Sturzenegger (2001) explore the relationship between the exchange rate regime and macroeconomic indicators in a broad sample of developed and developing countries. Both papers differ in a great number of issues but they share a similar conclusion: fixed exchange rate systems are positively associated to output volatility. However, we believe that both the methodological way to obtain volatility measures and the exchange rate regime classification employed in those papers raise serious questions which necessitates the exhaustive revision of their results.

## 3. Real volatility: measurement and determinants

Real volatility does not mean the same thing to different authors and they have proposed several ways to measure it. Ramey and Ramey (1995) utilize the standard deviation in the annual GDP growth rate as a volatility measure. On the contrary, Gavin and Hausman (1996) define macroeconomic volatility as the standard deviation of GDP level. Pritchett (1998) suggests that the standard deviation of GDP growth rate could be an unsatisfactory proxy of real volatility and proposes the use of higher order measures such as the standard deviation of the first difference in the annual GDP growth rates.

Similarly, there is no academic consensus about a correct and complete list of macroeconomic volatility determinants. For instance, Easterly et al. (2000) advocate the inclusion of trade openness, financial deepening, prices volatility and political stability in a real volatility regression. They show that trade openness and nominal volatility are positively related to real volatility. Additionally, the relationship between financial deepening (measured by domestic credit to GDP) and real volatility has a non-linear form.

Mobarak (2001) estimates several volatility regressions which include various explanatory variables. The democracy index, the GDP growth rate and the Gini coefficient are the robust variables and, in every case, there exists a positive association between each variable and the real volatility.

Denizer et al. (2001) put particular emphasis on the link between finance and macroeconomic volatility. They include variables which measure: i) the size of the financial system; ii) the importance of the banks in the financial system; and iii) the extent to which financial services are provided by the private sector. The general conclusion is that more developed financial systems imply less output growth volatility. But this conclusion does not hold in the case of Rodrik (2001). In his analysis of Latin America and the Caribbean, financial factors seem not to matter for real volatility and, instead, the role of private capital flows is highly relevant.

Summing up, there are several variables with potential effects on real volatility. All of them are significant because they control the effect of the exchange rate regime over real volatility not to occur by means of a third variable. In section 4, the details about the variables that we include in the empirical model in conjunction with other methodological issues are explained.

## 4. Methodological issues

Our study intends to provide substantial empirical evidence on the relationship between the exchange rate regime and the real volatility by correcting previous errors and improving the empirical methods and the econometric techniques. In this section, we will analyze: 1) those issues concerning the appropriate measurement of real volatility; 2) the exchange rate regime classification; 3) the control variable set; and 4) the econometric methodology.

### 4.1. Searching for a correct real volatility measurement

Any empirical paper which tries to investigate the effect of the exchange rate regime over real volatility needs to exploit information in panel data form. To this end, it is necessary to construct a real volatility series for each country included in the analysis. Previous works on this field proposed the use of mobile standard deviation (i.e. rolling standard deviation) of the per capita GDP growth as a proxy of real volatility. Of course, the main advantage of that procedure is to reduce significantly the information losses (i.e. the

possibility of annual data for each country).

However, there are significant methodological limitations which must be considered. Firstly, it is not clear in which way each standard deviation should be assigned to a particular year. Additionally, it is not easy to determine how many years would be appropriate to include in the rolling window. Secondly, the volatility series will present a very high autocorrelation level because of the way in which they are constructed (see Table 1, Panel A). This autocorrelation could potentially affect the quality of the estimations. Third, it is possible for the rolling methodology to alter the true relationship between the exchange rate regime and the real volatility. This occurs because the exchange rate regime changes over time. An example will clarify this issue. Let us assume that the flexible exchange rate regimes generate a low level of real volatility in relation to fixed and intermediate regimes. Let's consider a country which in a particular year, say 1986, had a flexible exchange rate system. This hypothetical country had in the years 1984, 1985, 1987 and 1988, a fixed exchange rate system. In this case, a five-year centered rolling standard deviation should exhibit a large value for the year 1986 –since there are four years of intermediate exchange rates which induce large real volatility- just at the moment that the flexible system reduces the real volatility of the economy.

We try to solve the problems of "rolling" methodology has by moving in two directions. The first direction consist of a construction of an intra-annual real volatility measurement. This variable could be assimilated as a short-term real volatility. To generate this volatility measurement, we employ data of industrial production. This variable is highly correlated with real output, but has the advantage that it is produced on a monthly basis. The real volatility proxy is the standard deviation of the log-differences in the seasonal-adjusted industrial production index.

The second direction to avoid the problems of the rolling standard deviation is to divide the total sample into different sub-periods. A similar criterion is used by Easterly et al. (2000) and Denizer el al. (2001). The idea is to divide the total sample and compute the standard deviation of the variable of interest within each sub-period. The possibility of comparing the empirical results obtained with two different proxies of real volatility gives us an indirect test of the robustness of our empirical results.

To emphasize the importance of the autocorrelation problem which the previous papers in this field have, we have introduced Table 1. In this table it can be observed how a correct measure of real volatility does not exhibit a systematic standard of first order autocorrelation. On the contrary, a centered five-year rolling standard deviation shows, in every case, high first order autocorrelation coefficients.

As it can be seen in Table 1, first order autocorrelation coefficients are systematically higher when a real volatility measure by a rolling procedure is used[1]. In the case of the rolling standard deviation of per capita GDP growth rate, the Q Ljung-Box statistic systematically rejects the null of no first order autocorrelation.

As already mentioned in the introductory section, our analysis is concentrated in the post Bretton Woods period (1974-2000). In this way, we eliminate the effect on a national regime of different "global exchange rate regime". Working on the intra-annual volatility measure, leaves us a relatively large sample of 45 countries. For each country there is a maximum of 27 temporal observations.

To implement the idea of dividing the total sample, we consider that it is reasonable to take periods of three-year each so there is a maximum of 9 temporal observations for each country. In this case, our proxy of real volatility is the standard deviation of the annual per capita GDP growth rates. Thus, we have a second sample which has much more countries (153 countries in total).

[1] The selection of countries of Table 1 intends to be representative of the total 45 countries for which it is possible to compute the intra-annual volatility measurement. Other countries selection, will give us very similar results.

**Table 1. First order autocorrelation of rolling volatility and intra-annual volatility.**

| Panel A: Rolling Volatility | | | | |
|---|---|---|---|---|
| Country | First order Autocorrelation | Q Statistic | P value | Total observations |
| Chile | 0.645 | 11.696 | 0.001 | 25 |
| France | 0.701 | 13.808 | 0.000 | 25 |
| Mexico | 0.684 | 12.221 | 0.000 | 23 |
| South Africa | 0.807 | 18.130 | 0.000 | 25 |
| Sweden | 0.666 | 12.459 | 0.000 | 25 |
| United States | 0.730 | 14.984 | 0.000 | 25 |
| Part B: Intra-Annual Volatility | | | | |
| Country | First order Autocorrelation | Q Statistic | P value | Total observations |
| Chile | 0.381 | 4.0873 | 0.043 | 25 |
| France | 0.093 | 0.244 | 0.621 | 25 |
| Mexico | 0.026 | 0.017 | 0.895 | 23 |
| South Africa | -0.289 | 2.342 | 0.126 | 25 |
| Sweden | -0.107 | 0.322 | 0.570 | 25 |
| United States | 0.432 | 5.2445 | 0.002 | 25 |

4.2. Alternative exchange rate regime classifications.

The effect of the exchange rate regime on macroeconomic volatility will depend on the way in which they are classified. We propose to incorporate all the available possibilities to obtain the most robust results.

The IMF *Annual Report on Exchange Arrangements and Exchange Restrictions* contain information about the exchange rate regime that the country declares. Using this information, we construct a *de jure* exchange rate regime classification that distinguishes three categories: fixed, intermediate and floating exchange rates.

An alternative classification was built by Levy Yeyati and Sturzenegger (2002). They suggest considering the fact that several countries do not take, in actual practice, those actions which are compatible with their original commitment. In this sense, they propose a *de facto* classification of exchange rate regimes. This classification is constructed by analyzing the behavior of three crucial variables: nominal exchange rate volatility, the volatility of the log-differences in the nominal exchange rate and the volatility of the international reserves. Floating exchange rates are associated with low international reserves volatility and high nominal exchange rate volatility. Conversely, with pegged exchange rates there are low exchange rate volatility and high reserves volatility.

Recently, Vuletin (2001) and Carrera and Vuletin (2002) have proposed a new exchange rate regime classification that considers both the actual behavior (deeds) and the declared intentions (words) of the exchange rate system. This last classification is described in Table 2. Thus, is possible to check the consistency of the country in the running of their regime.

**Table 2. New Exchange Rate Regime Classification (Vuletin, 2000; Carrera and Vuletin, 2002).**

| | *de Facto Classification* | | | |
|---|---|---|---|---|
| | Fixed | Intermediate | Flexible | Inconclusive |
| *de jure Fixed* | a | b | c | d |
| *de jure Intermediate* | e | f | g | h |
| *de jure Flexible* | e | f | g | h |

This classification is composed of eight categories. Among them the most remarkable are: a) *de jure* fixed regimes which act consistently with his original commitment; b) *de jure* fixed regimes which do not behave consistently and present considerable movements in their international reserves; c) *de jure* fixed regimes which act as floating regimes. This means they show substantial nominal exchange rate volatility and little volatility in international reserves. This category and the previous one can be grouped as the "inability of pegging" category; e) the "fear of floating" category. In this case, the country performs as if the exchange rate were be fixed but no such commitment exist in practice. The reason a policymaker acts in that way is that he could utilize the nominal exchange rate instrument without breaking any previous obligation; f) here we find economies that have substantial movements in their reserves and considerable variations in the nominal exchange rate but they are not engaged with the exchange rate fixation; g) this is the closest category to the idea of a pure flexible exchange rate regime. This is the other polar consistent exchange rate regime. They promise allows the parity to float and acts in a way consistent with their commitment.

By introducing this new classification, the debate on exchange rate regime properties is notably enriched. This is because it is possible to establish a comparison between consistent and inconsistent exchange rate regimes. Furthermore, this classification allows us to evaluate the consequences -in terms of real volatility- that are unable to maintain an explicit commitment to the nominal exchange system or a fear of floating behavior.

Our dataset, which is composed of sub-periods of three-year each, requires the proper classification of its exchange rate regime. Our criterion is to classify any particular period as a fixed (flexible or intermediate) exchange rate period if at least two of the three years the country had a fixed (flexible or intermediate) exchange rate regime.

4.3. Control variables.

We have selected the control variables by taking into consideration the need to maintain an elevated number of observations and attending the results of the previous studies[2]. Those variables are:

*PPP per capita GPD*. As in the works of Rodrik (2001) or Denizer et al. (2001) we include a control variable associated with the standard of living. Agenor et al. (2000) have shown that in developing countries the observed level of output volatility is considerably higher than that observed in the major industrial economies.

*Squared PPP per capita GDP*. We are interested in checking the possibility of a non-linear relationship between real volatility and economic development.

*Economic growth.* Denizer et al. (2001) found a positive relation between economic growth and macroeconomic volatility.

*Trade Openness.* This variable is measured as the ratio of total trade –imports plus exports- to gross domestic product. Easterly et al. (2000) and Levy Yeyati and Sturzenegger (2002) suggest that more open countries are exposed to higher volatility.

[2] In the first section of the appendix we describe our data sources.

*Nominal volatility.* This variable is obtained as the standard deviation of the inflation rate. Previous studies have found that higher instability in nominal variables tend to positively affect the real macroeconomic volatility[3]. Conversely, other literature admits that a trade-off between nominal and real volatility could exist. Thus, it is theoretically admissible to observe that the sign or the nominal volatility variable is negative.

*Investment volatility.* Investment is the more volatile component of the aggregate demand and so its variability will determine the output variability.

*Terms of trade volatility.* Our proxy in this case is the standard deviation of the terms of trade adjusted by trade openness. External shocks are a primary source of instability especially in countries which have a non-diversified productive structure in the tradeable sector.

*Institutions.* Alesina and Wagner (2003) present suggestive evidence which indicates that those countries with a poor institutional settings have serious difficulties to maintain fixed exchange rates. Moreover, those economies that have developed institutions exhibit fear of floating. We think that institutions such as government effectiveness, political stability or rule of law determine the context in which a country evolves and so, the ability of the policymakers to reduce cyclical fluctuations. Kaufmann et al. (2003) present information regarding six institutional aspects which we have grouped in a unique institutional index. This variable is considerably different to those previously presented since it does not change over time. To include this variable we will need a particular econometric treatment.

### 4.4. Econometric Methodology

As was established we have two samples of different characteristics which include different proxies of real volatility. Our first sample is composed by 45 countries which have industrial production statistics. Only the fact that a country produces this kind of information indicates that this sample is composed of a group of countries that has relatively trustworthy national statistics. For that reason, we consider that the empirical results obtained from this sample are the most reliable of our investigation. In relation to this, our second sample constructed by three-year divisions give us the possibility of checking the consistency of the empirical findings. In this second sample the total number of countries is 153.

We present both the fixed effects and the random effects panel data estimators. Additionally, it is incorporated information about the F test and the Hausman test. The inclusion of the institutional index is done independently by means of the random effect estimator because the characteristic makes it indistinguishable a fixed effect from.

Moreover, the fact that we have an important number of temporal observations in the first sample allows us to utilize the Arellano and Bond (1991) GMM estimator. This methodology is used in dynamic panel data models and offers a proper treatment to the endogenity problem. The endogenity control is achieved by using "internal instruments", that is, instruments based on the lagged values of the explanatory variables. The Arellano and Bond estimator is consistent if the lagged variables are valid instruments of the first differences of the explanatory variables. In relation to this, we present information concerning the Sargan test and the second order serial correlation test on the error term. We also include a dynamics by incorporating the lagged values of the explained and the explanatory (except for the exchange rate regimes) variables.

## 5. Empirical results

To clarify the exposition the presentation of the results has been divided into three parts. In the first, we show an unconditional analysis of the observed real volatility levels under each exchange rate regime. This unconditional analysis is done for our two samples. In the second part, we present the regression results obtained when the sample employed is that which includes the intra-annual volatility. In the final part, the estimations for the three-year sub-periods sample are reveled.

[3] For instance, the papers of Rodrik (2001) and Easterly et al. (2000).

5.1. Unconditional analysis

It is interesting to start the study of the influence of the exchange rate regime over real volatility by an unconditional statistic description of real volatility according to the three exchange rate regime classifications used in this paper.

In Table A.1 presented in section 2.1 of the appendix, the main characteristics of the intra-annual real volatility in the total sample of 45 countries are summarized. Two kinds of comparisons emerge from Table A.1. The first of them is a comparison between *de jure* and *de facto* exchange rate regime classification. In this case, it can be observed that *de facto* fixed regimes are less volatile than the *de jure* fixed regimes. Just the opposite is found in the case of intermediate systems regimes: *de facto* intermediate systems are more volatile than *de jure* intermediate systems. Additionally, there is not evidence of dissimilarities in the volatility levels between *de facto* and *de jure* flexible exchange rates. These differences stress the significance of utilizing a new exchange rate classification that combines "deeds" and "words".

The second comparison is the most relevant to our proposals and is referred to as the differences in the real volatility levels within a particular exchange rate regime classification. In this case both *de jure* and *de facto* classifications show the same order in terms of real volatility: fixed systems are the more volatile followed by the intermediate regimes. Flexible systems have the lowest real volatility level.

The unconditional analysis of the real volatility under the new exchange rate regime classification reveals some interesting results. First, the real volatility is lowest in those countries which had, during the same period, a consistent floating regime (category e in Table 2) and highest in those countries which had a consistent pegged regime (category a in Table 2). Second, it seems that a fear of floating behavior has no negative consequences in terms of real volatility since; in this case, the volatility level is closer to that observed in the pure floating regime than in a consistent fixed regime. The fact that in such a exchange rate regime it is possible to use the monetary policy instrument in some special occasions could explain the previous finding. Lastly, there are no significant real volatility differences between a consistent pegged exchange rate and a regime which exhibits "inability of pegging" (categories b and c in Table 2). This is a very provocative conclusion. Probably, the most striking differences between a reliable fixed regime and a case in which it is impossible to maintain such commitment are evident in terms of nominal volatility.

In Table A.2 we perform the same type of analysis using the second sample in which we measure real volatility by a three-year standard deviation of per capita GDP growth rates. The results are very similar to those described above, so we will not review them in depth.

Until now, we can only establish preliminary conclusions since the exact relationship between the exchange rate regime and real volatility could be affected by other variables which are not considered in the unconditional results. Consequently, we turn to the regression results.

5.2. Regression results: intra-annual volatility

In section 3 of the Appendix we present six tables that contain the empirical regression results. The first three tables have our intra-annual real volatility estimations. The difference in each of these three tables is that we have changed the exchange rate regime classification. Furthermore, each table contains several columns in which we introduce different estimation techniques. In particular, the fixed effects estimator is placed in column one; the random effect estimator is placed in column two; in column three we show the random effects estimator when it is added the variable that measures the institutional setting; and finally, in column four are the estimations obtained by the Arellano and Bond method.

Since the exchange rate regime is measured by a group of binary variables it is important to note that in every case the omitted category is that which identifies a flexible exchange rate regime. Thus, a statistically significant coefficient with a positive sign for any of the included binary variables will indicate that this exchange rate regime generates more real volatility than a flexible exchange rate.

The results obtained when the *de jure* exchange rate regime classification is employed are shown in Table A.3, section 7.2.2 of the appendix. Independently from the econometric method utilized, we observe that a fixed exchange rate produce a higher real volatility level than a flexible exchange rate. In the case of the intermediate systems, there are not statistically significant differences regarding flexible systems.

Concerning the control variables, it is convenient to note the Hausman test which warnings us about the inconsistency of the random effect estimator. Therefore we prefer to discuss the results of the fixed effects estimator in this case.

We observe that nominal volatility and investment volatility are positively associated to real macroeconomic volatility. It seems that there is no trade-off between nominal and real volatility Additionally, a higher economic growth will reduce real volatility. This result is contrary to the findings of Denizer et al. (2001).

Following some previous papers, we find that trade openness positively affects real volatility. In relation to this last result, it is not easy to explain why the terms of trade volatility variable is not statistically significant. We consider that the fact of measuring real volatility by industrial production indexes implies to constraint the sample to a group of countries in which the productive structure is quite diversified (and possibly exports are diversified). In those countries, the terms of trade variations tends to be relatively low and not as disturbing as in a small country which produces only a few commodities. This means that the results regarding the terms of trade volatility variable would change in our second sample, because it includes a high number of small non-productively-diversified countries.

The introduction of the institutional index is done in the third column of Table A.3. Its effect is the expected one: better institutions reduce real volatility. In addition, it can be seen that the inclusion of the institutional index reduces the statistical significance of the variables that measure the standard of living, probably as a consequence of the higher correlation of both variables. However, it is important to highlight that the results concerning the rest of the explanatory variables are not substantially modified by the introduction of the institutional setting.

The results obtained using the Arellano and Bond GMM estimator regarding the signs of the estimated coefficients and its statistical significance, are rather similar to those obtained by the fixed effect estimator. Particularly, pegged *de jure* exchange rates are more associated to higher real volatility than more flexible systems. Both the Sargan test and the second order autocorrelation test validate the usage of lagged explanatory variables as estimation instruments. The estimated coefficient of the lagged dependent variable (i.e. lagged real intra-annual volatility) reveals a low first order autocorrelation pattern.

In Table A.4 we present the same type of empirical analysis but we have replaced the *de jure* exchange rate classification by the *de facto* classification. The conclusion on the exchange rate system is identical to the previous one: fixations generate higher real volatility than a floating. The variable that identifies the intermediate regimes is not statistically significant in all of the employed econometric methods. There is only one difference in the control set in relation to the case in which a *de jure* classification is used: trade openness is now not statistically significant in the fixed effects estimation.

The new exchange rate classification that combines deeds and words is introduced in the estimations shown in Table A.5. We observe that a consistent fixing behavior will produce more real volatility than a consistent floating behavior. Additionally, it is relevant to mention that all the coefficients of the exchange rate regime variables are positive, so any regime generates more real volatility than the consistent flexible case. The regime that identifies the inability of pegging case (categories b and c of Table 2) also has a positive and statistically significant coefficient. Furthermore, it can be proved that no statically significant differences exist between the consistent fixed regime and the case of inability of fixing. We have noted before the attractiveness of this result.

The binary variable that identifies the fear of floating behavior (category e in table 2) is not statistically significant in the fixed effects estimation but this is not the case in the GMM estimation. The f category

in Table 2 (i.e. consistent intermediate regimes) is not significant in any of the estimated regressions.

5.3. Regression results: three-year volatility

The main advantage of our second sample is that it is composed of a very large number of countries. However, the need to separate by sub-periods to avoid the problems of previous papers, reduces considerably the number of temporal observations within each country. As a consequence, the Arellano and Bond estimator is not implemented in this second sample. If the results obtained using this second sample do not change a great deal, our previous findings would pass an important robustness indirect test.

As in the case of the intra-annual volatility we firstly analyze the empirical results obtained with the *de jure* classification (see Table A.6 in section 2 of the appendix). Here, the Hausman test confirms the consistency of the random effects estimator. The variable of the *de jure* fixed exchange rates is positive but not statistically significant in the fixed effects regression but it is significant in the random effects estimation (with or without the inclusion of the institutional index). Again, as in the case of the intra-annual volatility, *de jure* intermediate regimes do not generate more volatility than *de jure* flexible exchange rate systems.

Regarding the control variables, the conclusions are similar to those established before. Nominal volatility and investment volatility are positively associated to output volatility. Moreover, economic growth reduces real volatility and trade openness increases it. The coefficient of the terms of trade volatility variable is now positive and statistically significant in each econometric specification. This supports the explanation previously presented regarding the lack of significance in the intra-annual volatility sample. Both per capita GDP and its square have the expected signs and are statistically significant in the fixed effect regression. The institutional index is not relevant in this case and its inclusion eliminates the significance of the variables that measures the living standard. This is again a symptom of high correlation between these variables.

In Table A.7 the results of the *de facto* exchange rate classification are exposed. Once more, fixed regimes increase real volatility in respect to flexible regimes. Thus, the conclusion that a fixation will carry a real volatility problem gains strength and robustness due to the repetition of the same result regarding such exchange rate regime. An interesting issue is that the *de facto* intermediate regime variable has a positive and significant coefficient. This did not occur when it was utilized a *de jure* classification.

The regressions that incorporate the exchange rate classification that takes into account the consistency between deeds and words are shown in Table A.8. Repeatedly, consistent fixations produce more real volatility than a pure floating policy. It is important to note that in this three-year volatility sample the only category that is statistically significant is precisely the consistent pegged category. Regarding the control set, we do not observe major differences. In fact, the main characteristic of our control variables is that all of them are relevant, and there are consistent results when both the sample utilized and the econometric technique employed are changed.

As a way of reviewing the large amount of empirical information of our study, we have constructed Table 3 and Table 4. In these tables, it is summarized the sign and its statistical significance -symbolized by one, two or three stars- of the different exchange rate regimes under each classification and econometric method.

**Table 3. Summary of empirical findings, intra-annual real volatility.**

| | Estimation method | | | |
|---|---|---|---|---|
| Exchange Rate Regime | FE | RE | RE + Institutions | GMM |
| Fixed *(de jure)* | (+)*** | (+)*** | (+)*** | (+)*** |
| Intermediate *(de jure)* | (-) | (-) | (-) | (-) |
| Inconclusive (*de jure)* | (+) | (+)* | (+) | (+)*** |
| Fixed (*de facto)* | (+)* | (+)*** | (+)*** | (+)** |
| Intermediate *(de facto)* | (+) | (+) | (+) | (-) |
| Inconclusive *(de facto)* | (+)* | (+)** | (+)** | (+)** |
| Fixed*J*-Fixed*F (a)* | (+)*** | (+)*** | (+)*** | (+)*** |
| Fixed*J*-Interm*F (b)* | (+)** | (+)** | (+)*** | (+)*** |
| Fixed*J*-Flexible*F (c)* | (+)*** | (+)*** | (+)*** | (+)*** |
| Fixed*J*-Incon*F (d)* | (+)*** | (+)*** | (+)*** | (+)*** |
| Interm*J*-Fixed*F or* Flexible*J*-Fixed*F (e)* | (+) | (+)** | (+)** | (+)*** |
| Interm*J*-Interm*F or* Flexible*J*-Interm*F (f)* | (+) | (+) | (+) | (+) |
| Interm*J*-Incon*F or* Flexible*J*-Incon*F (h)* | (+)* | (+)* | (+)* | (+)*** |

**Table 4. Summary of empirical findings, three-year real volatility.**

| | Estimation method | | |
|---|---|---|---|
| Exchange Rate Regime | FE | RE | RE + Institutions |
| Fixed *(de jure)* | (+) | (+)*** | (+)*** |
| Intermediate *(de jure)* | (+) | (+) | (+) |
| Inconclusive (*de jure)* | (+) | (+) | (+) |
| Fixed (*de facto)* | (+)** | (+)** | (+)** |
| Intermediate *(de facto)* | (+)** | (+)* | (+)* |
| Inconclusive *(de facto)* | (+)* | (+) | (+) |
| Fixed*J*-Fixed*F (a)* | (+)** | (+)*** | (+)*** |
| Fixed*J*-Interm*F (b)* | (+) | (+) | (+) |
| Fixed*J*-Flexible*F (c)* | (+) | (+) | (+) |
| Fixed*J*-Incon*F (d)* | (+)** | (+)** | (+)** |
| Interm*J*-Fixed*F or* Flexible*J*-Fixed*F (e)* | (+) | (+) | (+) |
| Interm*J*-Interm*F or* Flexible*J*-Interm*F (f)* | (+)* | (+) | (+) |
| Interm*J*-Incon*F or* Flexible*J*-Incon*F (h)* | (+) | (+) | (+) |

It can be observed in these two tables the coherence of the results regarding alternative exchange rate classifications. Our main conclusion here is that exchange rate regime is non-neutral, at least from a point of view in which the effect of regime over macroeconomic real volatility is stressed. Our evidence gives support to the idea that an exchange rate fixation constraints the economic policy capability of reducing business cycle amplitude. This is to say there is a direct relationship between the exchange rate regime rigidity and the real volatility.

## 6. Conclusions

In the fixed vs. flexible exchange rate regime debate, a main aspect is to determine the ability of each regime to adjust to the different shocks which an economy suffers from. Particularly, the potential ability of reducing

real volatility is a very controversial issue in the selection of any regime.

There are different theoretical models that deal with the relationship between real volatility and exchange rate regime. Some of these models could be included in the Mundell-Fleming-Dornbusch tradition and others in the "new open economy macroeconomics" literature. Neither of them is capable of establishing a univocal result regarding the appropriate regime in order to reduce the real volatility. In that context, the empirical tests on such relationship are extremely relevant.

We only used data corresponding to post Breton Wood era, because our scope is to understand the behavior of domestic exchange rate regime under a homogeneous global exchange rate (flotation among the main currencies). Regarding the previous studies in this field, it was shown that a measurement of real volatility based on a rolling window generates three important problems: a bias towards the existence of autocorrelation, an assignment problem and a distortion in the relationship between regime and volatility. The methodology that is proposed in this paper does not suffer from this weakness.

Another main point of this paper is the usage of two different samples with different definitions of volatility in order to test the robustness of our hypothesis. Three different exchange regime classifications were used in order to focus on different aspects: declared behavior, real behavior and the consistency between both of them. As an additional methodological improvement we employed different econometric methods for panel data, including the GMM estimator of Arellano and Bond (1991) for dynamic panel data which allows us to control potential endogenity problems. The main conclusions of the empirical analysis are:

1) The exchange rate regime is not neutral regarding its effects on real volatility. This result is opposed to the so-called "neutrality of exchange rate regimes" view -established, on theoretical grounds, by Devereux (1998) and Obstfeld and Rogoff (2000) and, empirically by Baxter and Stockman (1989) and Flood and Rose (1995)- which postulates the inexistence of a trade-off between flexibility and real volatility.

2) Quite the opposite, it seems to be an inverse association between the degree of exchange rate flexibility and real volatility. Most likely, this lower variability could be the result of a bigger room for countercyclical monetary policy in more flexible exchange rate regimes.

3) There is an important strand of literature that remarks the advantages of a consistent (and then credible) fix exchange rate regime. However, it was shown that the volatility of such arrangements is higher than a consistent floating and is not substantially different[4] from the volatility of an inconsistent fixation.

4) The result that consistent fixers are incapable of reducing volatility could be explained by the fact that, even in a highly credible framework, there are nominal rigidities which limit the adjustment speed of prices to a new equilibrium after a shock occurs. Then, for the policymaker the impossibility of using nominal devaluation gives up a tool useful for coordinating relative prices adjustments. An alternative explanation, taking in mind a Barro-Gordon model of policy selection, is that the policymaker puts a high weight on the nominal stability target. So, the higher real volatility, the higher will be the cost of nominal instability.

5) The results we obtained are robust in the sense they are valid in the non-conditional and the conditional analyses. The control variables included in the regression analysis are highly relevant and very stable across samples and under different estimation techniques.

6) Among these variables we found that, higher openness, investment volatility and terms of trade volatility increase the real volatility. On the contrary, growth, development and good institutional setting reduce real volatility. Notably, there is a positive nominal association between nominal volatility and real volatility. This means that the well-known trade-off between nominal and real volatility does not exists in our samples. Probably, this result is explained by the behaviour of developing countries that implemented non-credible

[4] In some estimations, the real volatility under a consistent fix is even higher than under a "inability of fixing regime".

exchange rate based stabilization plans (Calvo and Vegh, 1994). In this fashion, countries first suffer a consumption boom with temporary stable prices, and then a collapse with devaluation and recession.

7) The countries characterized with"fear of floating" pathology are those that behave as having a fixed regime but retain the possibility of adjusting the exchange rate without breaking any commitment. At least in terms of real volatility, this seems a better strategy when compared with consistent fixation. Taking this asymmetry into account to model an economy, implies comparing the inflationary bias with the degree of flexibility to adjust to shocks. To have this discretionary power requires mature institutions capable of guaranteeing effective punishment to avoid the political cycle. As we see, solid instuitions could effectively contribute, *caeteris paribus*, to reduce real volatility.

Further research is needed in order to contrast this results with those obtained with a different analysis of volatility, for example with models of conditional volatility. Another interesting issue could be to separate by developed and developing countries, especially because in the latter the excess of volatility is one of the main problems in macroeconomics.

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## 7. Appendix.

### 7.1. Data sources

We constructed the *de jure* exchange rate regime classification using the available information of the *IMF Annual Report on Exchange Arrangements and Exchange Restrictions*. Levy Yeyati and Sturzenegger (2002) *de facto* classification was adjusted to our sample characteristics. Industrial production data were employed to construct intra-annual real volatility measurements. The original data was from the *IMF IFS CD-Rom*. The institutional index was built using *Aggregate Governance Indicators 1996-2002* database of Kaufmann et al. (2003). The rest of the control variables data source was the *W B Development Indicators CD-Rom*.

### 7.2.Empirical results

*7.2.1. Unconditional analysis*

**Table A.1. Unconditional analysis of intra-annual volatility (alternative exchange rate agreements)**

| Exchange Rate Regime | Intra-annual real volatility | |
|---|---|---|
| | Mean | Number of observa (%) |
| Fixed *(de jure)* | 0.052 | 244 (27%) |
| Intermediate *(de jure)* | 0.030 | 311 (35%) |
| Flexible (*de jure)* | 0.027 | 319 (36%) |
| Inconclusive (*de jure)* | 0.064 | 11 (1%) |
| Fixed (*de facto)* | 0.041 | 263 (30%) |
| Intermediate *(de facto)* | 0.034 | 154 (17%) |
| Flexible *(de facto)* | 0.027 | 283 (32%) |
| Inconclusive *(de facto)* | 0.043 | 184 (21%) |
| Fixed*J*-Fixed*F (a)* | 0.062 | 76 (9%) |
| Fixed*J*-Interm*F (b)* | 0.052 | 25 (3%) |
| Fixed*J*-Flexible*F (c)* | 0.049 | 24 (3%) |
| Fixed*J*-Incon*F (d)* | 0.047 | 118 (13%) |
| Interm*J*-Fixed*F or* Flexible*J*-Fixed*F (e)* | 0.033 | 186 (21%) |
| Interm*J*-Interm*F or* Flexible*J*-Interm*F (f)* | 0.029 | 126 (14%) |
| Interm*J*-FlexibleF *or* Flexible*J*-Flexible*F (g)* | 0.024 | 254 (29%) |
| Interm*J*-Incon*F or* Flexible*J*-Incon*F (h)* | 0.036 | 64 (7%) |
| Inconclusive *(de jure) (i)* | 0.064 | 11 (1%) |

**Table A.2. Unconditional analysis of three-year volatility (alternative exchange rate agreements)**

| Exchange Rate Regime | Three-year real volatility | |
|---|---|---|
| | Mean | Number of observa (%) |
| Fixed *(de jure)* | 3.798 | 50 (51%) |
| Intermediate *(de jure)* | 2.332 | 144 (13%) |
| Flexible (*de jure)* | 2.657 | 335 (31%) |
| Inconclusive (*de jure)* | 3.573 | 56 (5%) |
| Fixed (*de facto)* | 3.688 | 450 (41%) |
| Intermediate *(de facto)* | 2.768 | 132 (12%) |
| Flexible *(de facto)* | 2.292 | 176 (17%) |
| Inconclusive *(de facto)* | 3.312 | 327 (30%) |
| Fixed*J*-Fixed*F (a)* | 4.194 | 336 (31%) |
| Fixed*J*-Interm*F (b)* | 2.946 | 21 (2%) |
| Fixed*J*-Flexible*F (c)* | 2.474 | 21(2%) |
| Fixed*J*-Incon*F (d)* | 3.270 | 172 (16%) |
| Interm*J*-Fixed*F or* Flexible*J*-Fixed*F (e)* | 2.099 | 101 (9%) |
| Interm*J*-Interm*F or* Flexible*J*-Interm*F (f)* | 2.665 | 103 (9%) |
| Interm*J*-FlexibleF *or* Flexible*J*-Flexible*F (g)* | 2.251 | 152 (14%) |
| Interm*J*-Incon*F or* Flexible*J*-Incon*F (h)* | 3.23 | 123 (11%) |
| Inconclusive *(de jure) (i)* | 3.573 | 56 (5%) |

*7.2.2. Regression results*[***]

**Table A.3. Regression analysis of the intra-annual volatility and the *de jure* classification.**

| | | Fixed Effects | Random Effects | RE + Institutions | GMM |
|---|---|---|---|---|---|
| Intra-annual volatility | t-1 | | | | .1347781*** |
| ***Fixed (de jure)*** | | .0072085*** | .0088296*** | .0092563*** | .0097861*** |
| ***Intermediate (de jure)*** | | -.001068 | -.0014805 | -.0013571 | -.0006917 |
| ***Inconclusive (de jure)*** | | .0067608 | .0127956* | .0116158 | .0225341*** |
| Per capita GDP | t | -2.00$^{e}$-07 | -1.03e-06*** | -8.12e-07** | 2.55e-06 |
| | t-1 | | | | -2.81e-06 |
| Per capita GDP^2 | t | 1.69e-12 | 2.14e-11** | 1.56e-11 | -2.27e-11 |
| | t-1 | | | | 2.61e-11 |
| Economic Growth | t | -0.0003272* | -.0002877 | -.0002887 | -.0004092*** |
| | t-1 | | | | .0002333*** |
| Trade Openness | t | .0001045* | .0001753*** | .0002136*** | .0002178** |
| | t-1 | | | | .0000151 |
| Nominal Volatility | t | 9.77e-06*** | .0000105*** | .0000106*** | .0000132*** |
| | t-1 | | | | -2.11e-06*** |
| Terms of Trade Volatility | t | -2.97e-18 | -2.20e-18 | -2.99e-18 | -3.65e-18 |
| | t-1 | | | | 9.23e-18* |
| Investment Volatility | t | .0001767*** | .0002323*** | .0002371*** | .0002622*** |
| | t-1 | | | | -.0000445** |
| Institutional Index | | | | -.0018778*** | |
| Constant | | .0282819*** | .0302373*** | .0304433*** | -.0001101 |

[***] In all the cases, one star, two stars and three stars following the coefficient value indicates that the variable is statistical significant at the level of 10%, 5% and 1%.

| | | | | |
|---|---|---|---|---|
| F-Test over Fixed Effects (p value) | 0.0000 | | | |
| Hausman Test (p value) | | 0.0000 | | |
| Sargan Test (p value) | | | | 1 |
| Second Order Ser Corre Test (p value) | | | | 0.5464 |
| Number of countries | 45 | 45 | 45 | 44 |
| Number of observations | 884 | 884 | 884 | 794 |

**Table A.4. Regression analysis of the intra-annual volatility and the *de facto* classification.**

| | | Fixed Effects | Random Effects | RE + Institutions | GMM |
|---|---|---|---|---|---|
| Intra-annual volatility | t-1 | | | | .1631572*** |
| ***Fixed (de facto)*** | | .0037881* | .0057927*** | .0056398*** | .002463** |
| ***Intermediate (de facto)*** | | .001125 | .0015725 | .0016399 | -.0005445 |
| ***Inconclusive (de facto)*** | | .0038175* | .0043739** | .0044975** | .0046871** |
| Per capita GDP | t | -4.72e-07 | -1.30e-06*** | -1.11e-06*** | 2.46e-06 |
| | t-1 | | | | -3.24e-06 |
| Per capita GDP^2 | t | 6.98e-12 | 2.58e-11** | 2.08e-11* | -2.23e-11 |
| | t-1 | | | | 3.69e-11 |
| Economic Growth | t | -.0003615** | -.0003593** | -.0003592** | -.0003959*** |
| | t-1 | | | | .0001863** |
| Trade Openness | t | .0000711 | .0001472*** | .0001802*** | .0002629*** |
| | t-1 | | | | -.0000122 |
| Nominal Volatility | t | 9.38e-06*** | 9.90e-06*** | 9.88e-06*** | .0000127*** |
| | t-1 | | | | -2.73e-06*** |
| Terms of Trade Volatility | t | -3.48e-18 | -3.49e-18 | -4.22e-18 | -1.50e-18 |
| | t-1 | | | | 1.16e-17* |
| Investment Volatility | t | .0001835*** | .0002331*** | .000237*** | .0001604*** |
| | t-1 | | | | -.0000153 |
| Institutional Index | | | | -.0017443*** | |
| Constant | | .032104*** | .0340897*** | .0346884*** | -.0001316 |
| F-Test over Fixed Effects (p value) | | 0.0000 | | | |
| Hausman Test (p value) | | | 0.0000 | | |
| Sargan Test (p value) | | | | | 1 |
| Second Order Serial Correlation Test (p value) | | | | | 0.9372 |
| Number of countries | | 45 | 45 | 45 | 45 |
| Number of observations | | 884 | 884 | 884 | 794 |

**Table A.5. Regression analysis of the intra-annual volatility and the "deeds and words" e classification.**

| | | Fixed Effects | Random Effects | RE + Institutions | GMM |
|---|---|---|---|---|---|
| **Intra-annual volatility** | t-1 | | | | .0232627 |
| **Fixed*J*-Fixed*F* *(a)*** | | .0127767*** | .0174332*** | .0173183*** | .0125672*** |
| **Fixed*J*-Interm*F* *(b)*** | | .0083942** | .0097062** | .010135*** | .0089827*** |
| **Fixed*J*-Flexible*F* *(c)*** | | .0114112*** | .0120158*** | .0123096*** | .0119386*** |
| **Fixed*J*-Incon*F* *(d)*** | | .0075311*** | .0087462*** | .0091491*** | .0108101*** |
| **Interm*J*-Fixed*F* *or* Flexible*J*-Fixed*F* *(e)*** | | .0034527 | .0045776** | .0043708** | .0038642*** |
| **Interm*J*-Interm*F* *or* Flexible*J*-Interm*F* *(f)*** | | .000895 | .0011144 | .0011614 | .0005245 |
| **Interm*J*-Incon*F* *or* Flexible*J*-Incon*F* *(h)*** | | .0049547* | .0049791* | .0048195* | .0082299*** |
| **Inconclusive *(de jure) (i)*** | | .0097922 | .0167802** | .0153672** | .0122888 |
| Per capita GDP | t | -2.64e-07 | -1.11e-06*** | -8.88e-07** | 1.21e-06 |
| | t-1 | | | | -8.25e-07 |
| Per capita GDP^2 | t | 2.26e-12 | 2.20e-11** | 1.62e-11 | -4.91e-12 |
| | t-1 | | | | -8.20e-12 |
| Economic Growth | t | -.000358** | -.0003415* | -.0003391* | -.0002405* |
| | t-1 | | | | .0001243 |
| Trade Openness | t | .0000994 | .0001605*** | .0001966*** | .0003505*** |
| | t-1 | | | | -.000068 |
| Nominal Volatility | t | 9.72e-06*** | .0000106*** | .0000107*** | .0000147*** |
| | t-1 | | | | -7.81e-07 |
| Terms of Trade Volatility | t | -3.33e-18 | -2.60e-18 | -3.33e-18 | -3.84e-18 |
| | t-1 | | | | 1.21e-17* |
| Investment Volatility | t | .000172*** | .0002244*** | .0002285*** | .0002664*** |
| | t-1 | | | | -.0000596* |
| Institutional Index | | | | -.0017684*** | |
| Constant | | .0270295*** | .0290983*** | .0293323*** | -.000319 |
| F-Test over Fixed Effects (p value) | | 0.0000 | | | |
| Hausman Test (p value) | | | 0.0009 | | |
| Sargan Test (p value) | | | | | 1 |
| Second Ord Serial Corr Test (p value | | | | | 0.2769 |
| Number of countries | | 45 | 45 | 45 | 45 |
| Number of observations | | 884 | 884 | 884 | 794 |

**Table A.6. Regression analysis of the three-year volatility and the *de jure* classification.**

| | Fixed Effects | Random Effects | RE + Institutions |
|---|---|---|---|
| ***Fixed (de jure)*** | .3902872 | .5647605*** | .6088268*** |
| ***Intermediate (de jure)*** | .144109 | .1680785 | .2403761 |
| ***Inconclusive (de jure)*** | .2977773 | .3994986 | .4347739 |
| Per capita GDP | -.0002566*** | -.0001375*** | -.0000857 |
| Per capita GDP^2 | 5.20e-09** | 2.53e-09 | 1.38e-09 |
| Economic Growth | -.1218885*** | -.1078566*** | -.1039856*** |
| Trade Openness | .017086*** | .0097842*** | .0097412*** |
| Nominal Volatility | .0004156* | .0004155* | .0004118* |
| Terms of Trade Volatility | 1.41e-15* | 1.22e-15** | 1.13e-15* |
| Investment Volatility | .0443824*** | .0479362*** | .0481529*** |

| | | | |
|---|---|---|---|
| Institutional Index | | | -.0531623 |
| Constant | 2.221928*** | 2.201679*** | 1.988452*** |
| F-Test over Fixed Effects (p value) | 0.0000 | | |
| Hausman Test (p value) | | 0.2583 | |
| Number of countries | 153 | 153 | 153 |
| Number of observations | 1085 | 1085 | 1085 |

**Table A.7. Regression analysis of the three-year volatility and the *de facto* ex classification.**

| | Fixed Effects | Random Effects | RE + Institutions |
|---|---|---|---|
| ***Fixed (de facto)*** | .6405379** | .6843389** | .6674965** |
| ***Intermediate (de facto)*** | .7228701** | .6116308* | .5835576* |
| ***Inconclusive (de facto)*** | .5089666* | .4448619 | .4304618 |
| Per capita GDP | -.0002787*** | -.0001521*** | -.0000857 |
| Per capita GDP^2 | 5.65e-09*** | 2.73e-09* | 1.96e-09 |
| Economic Growth | -.1229025*** | -.1098957*** | -.1039856*** |
| Trade Openness | .0164582*** | .0094832** | .0097412*** |
| Nominal Volatility | .0004218* | .0004229* | .0004118* |
| Terms of Trade Volatility | 1.44e-15* | 1.23e-15** | 1.17e-15** |
| Investment Volatility | .0443565*** | .0477893*** | .0479979*** |
| Institutional Index | | | -.0347251 |
| Constant | 2.086946*** | 2.131091*** | 2.02517*** |
| F-Test over Fixed Effects (p value) | 0.0000 | | |
| Hausman Test (p value) | | 0.2619 | |
| Number of countries | 153 | 153 | 153 |
| Number of observations | 1085 | 1085 | 1085 |

**Table A.8. Regression analysis of the three-year volatility and the "deeds and words" classification**

| | Fixed Effects | Random Effects | RE + Institutions |
|---|---|---|---|
| **Fixed*J*-Fixed*F* *(a)*** | .8024967** | .9786878*** | .9645182*** |
| **Fixed*J*-Interm*F* *(b)*** | .7924898 | .6045765 | .5551793 |
| **Fixed*J*-Flexible*F* *(c)*** | .2299258 | .0473842 | .0317877 |
| **Fixed*J*-Incon*F* *(d)*** | .7994541** | .6884678** | .6937768** |
| **Interm*J*-Fixed*F* *or* Flexible*J*-Fixed*F* *(e)*** | .5650638 | .220929 | .1648171 |
| **Interm*J*-Interm*F* *or* Flexible*J*-Interm*F* *(f)*** | .6912955* | .553257 | .5112606 |
| **Interm*J*-Incon*F* *or* Flexible*J*-Incon*F* *(h)*** | .4373632 | .3235823 | .2747181 |
| **Inconclusive *(de jure) (i)*** | .7018093 | .6755002 | .6560373 |
| Per capita GDP | -.0002609*** | -.0001266*** | -.0000818 |
| Per capita GDP^2 | 5.26e-09** | 2.31e-09 | 1.34e-09 |
| Economic Growth | -.1208653*** | -.1072362*** | -.1037833*** |
| Trade Openness | .0173525*** | .0092273*** | .009109*** |
| Nominal Volatility | .0004117* | .0004278* | .000422* |
| Terms of Trade Volatility | 1.43e-15* | 1.28e-15** | 1.20e-15** |
| Investment Volatility | .0443575*** | .047623*** | -.0433074 |
| Institutional Index | | | -.0433074 |
| Constant | 1.854202*** | 1.957147*** | 1.822115*** |
| F-Test over Fixed Effects (p value) | 0.0000 | | |
| Hausman Test (p value) | | 0.2516 | |
| Number of countries (Number of observations) | 153 (1085) | 153 (1085) | 153 (1085) |