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The Fata Morgana of Exchange Rate Regimes: Reconciling the LYS and the RR classifications

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Abstract

This paper provides a comprehensive analysis of the disagreements between the two most popular but also discordant *de facto* exchange rate regime classifications: the Reinhart and Rogoff and the Levy-Yeyati and Sturzenegger classifications. We estimate probabilities of disagreement between the two classifications for the different exchange rate regime categories, and derive a *de facto* synthesis classification, using the Receiver Operating Characteristic analysis. We show that more than a third of the observations are not directly comparable, and relatively few disagreements are directly attributable to the classifications' key variables. Most of the disagreements originate from the different thresholds used by the classifications in the definition of the ERR categories and the interactions between several variables. Given these complexities, the synthesis classification provides a useful framework in terms of greater comparability.

JEL Classification: E52; F33; F4; O24.
Keywords: Exchange rate regimes; Probit model; ROC analysis.

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1 Introduction

Academics and policy-makers have always scrutinized exchange rate regimes (thereafter ERR) as government's important tools for avoiding excessive external imbalances. However, since the early 2000s, there has been a clear ramp-up in this scrutiny. This surge can be explained not only by several financial crises, especially in emerging markets observed in the 1990s and 2000s[1] but also progress in understanding exchange rate policies across the globe and in assigning currencies to an ERR category. Indeed, considerable light has been shed on what countries effectively did for two decades with the development of the *de facto* ERR classifications.[2] Nevertheless, from these different approaches, no modus operandi has emerged about the way to assign a currency to a specific ERR category.[3] It is thus not surprising that empirical evidence on ERR yields mixed results. The most obvious explanation for this is that ERR categories are defined on the basis of their monetary policy frameworks whose content is not always immediately apparent and not easily identifiable. In particular, changes in policy intentions and ERR switches substantially increase the difficulty of determining appropriate ERR categories. Consequently, the *de facto* classifications have their own understanding of what is an ERR category, and they don't necessarily tell the same story about the exchange rate policy followed by the countries —see Table 1.

While the suitability of *de facto* classifications has been questioned (Rose, 2011), one consensus has finally emerged from the literature, articulated around the idea that these classifications were, in fact, measuring different things and, therefore, useful in different contexts. But, while this assertion is probably true, it is still unclear in which context one should favor one classification over another and what is the best way to identify ERR categories across currencies and over time.

Few empirical studies examine the issue of disagreements between the *de facto* classifications. Eichengreen and Razo-Garcia (2013) empirically document the extent of the disagreements across three *de facto* classifications (the BORA, LYS, and RR classifications) and find that disagreements are most prevalent in emerging markets and developing countries. Examining economic and institutional factors, they further show that differ-

[1]Mexico, in 1994, Thailand, Indonesia, and Korea in 1997, Russia and Brazil in 1998, and Argentina and Turkey in 2000.

[2]As noted by Tavlas et al. (2008), more than a dozen *de facto* classifications have been proposed since the early 2000s —e.g. Bubula and Ötker-Robe (2002), Ghosh et al. (2003), Bailliu et al. (2003), Reinhart and Rogoff (2004), Shambaugh (2004), Levy-Yeyati and Sturzenegger (2005), Bénassy-Quéré et al. (2006) and Obstfeld, Shambaugh, and Taylor (2010). Since 1999, the IMF has also adopted a *de facto* classification (IMF, 1999). Up to 2008, the IMF *de facto* classification coincided with the Bubula, Ötker-Robe and Anderson classification (BORA; see Anderson, 2009).

[3]See Tavlas *et al.* (2008) for a survey.

Table 1 — Agreements between the *de facto* ERR classifications

	IMF *de jure*	IMF *de facto*	LYS	OST	RR
IMF *de jure*	100%				
IMF *de facto*	86.11% (5351)	100%			
Levy-Yeyati & Sturzenegger (LYS)	44.95% (3766)	47.85% (4826)	100%		
Obstfeld, Shambaugh & Taylor (OST)	47.31% (5031)	48.25% (6327)	65.79% (4779)	100%	
Reinhart & Rogoff (RR)	46.95% (3766)	52.85% (4826)	57.69% (5011)	71.37% (4779)	100%

Notes: The entries correspond to the percentages of observations on which the classifications agree. The total number of observations used for the pairwise comparisons are reported in parentheses. We dropped all the observations prior to 1974. The IMF *de jure* classification covers the 1974-2006 period. All the classifications are composed of three categories: fixed, intermediate and floating.

ences are most pervasive for countries with well-developed financial markets, low reserves, and open capital accounts. Some other studies try instead to circumvent the differences associated with the categorization of ERR. Gosh et al. (2003) and Couharde and Grekou (2015) focus only on consensual observations across classifications. Such approach is however problematic since it leads to a considerable loss of observations, due to the low overlap between classifications ERR. Finally, alternative works build on those *de facto* classifications to provide consensual parameters, and a more comprehensive ERR identification. Bleaney et al. (2015) focus on the algorithms used to derive the different ERR categorizations. Relying on classifications that discriminate ERR according to the exchange rate behavior, they find that a higher degree of concordance can be achieved through suitable amendments.[4] Specifically, they show that the overlap between the different schemes can be dramatically increased using a common dataset and harmonizing the methodologies and the thresholds that designate the different ERR categories. But, by focusing on classifications based exclusively on the exchange rate behavior, they do not consider the LYS classification, even though it is by far one of the two most popular *de facto* classifications. The scope of their findings is, therefore, seriously reduced. Moreover, by developing a standardized method in delimitating the different ERR categories, the implications of their exercise seem weak. It is obvious that if all classifications had been performed in a similar way (i.e. data, parameters, methodology), their divergence would be no more an issue!

Unlike existing studies, this paper aims to measure and explain how and why the LYS and RR classifications disagree. To do so, we adopt a stepwise approach consisting of

[4]The classifications covered are those proposed by Reinhart and Rogoff (2004), Shambaugh (2004), and Bleaney and Tian (2014).

estimating a full model including all candidate explanatory variables then sequentially removing each variable to determine their specific contribution to the probability of observing a disagreement between the two classifications. Along with this identification process, we derive a synthesis *de facto* classification that integrates both LYS and RR classifications' features in a consistent and complete framework.

Our results indicate that relatively few disagreements (a bit less than a third) are directly attributable to specific variables well-identified in one or both classifications. Instead, disagreements mostly originate from the interactions between several variables. Furthermore, we demonstrate that, although divergent, the LYS and RR classifications are reconcilable within a synthesis classification. This synthesis classification provides a more nuanced picture of the so-called bipolar view. The evolution of *de facto* regimes —especially in Emerging Economies since the late 1990s— has involved a movement toward floats or more tightly "managed" intermediate regimes.

We thus contribute to the literature along three dimensions. First, we develop an original methodological framework that allows the empirical testing and identification of a rich set of sources of disagreements between the LYS and RR classifications. Second, we provide a comprehensive database on a synthesis classification that enables us to reconcile the most discordant *de facto* classifications, and to address the issue of inconclusiveness in studies on ERR. Finally, drawing on this synthesis classification, we document some stylized facts about the evolution and performance of alternative regimes that may pave the way for future empirical works.

The paper proceeds as follows. In Section 2, we summarize the frameworks of the LYS and RR classifications and document the different sources of their disagreements. In Section 3, we develop our methodology and present the data. Section 4 is devoted to the presentation and discussion of the results. In Section 5, we extend and present the synthesis classification before investigating its empirical implication(s). Finally, Section 6 concludes.

2 Overview of the evidence

2.1 The *de facto* exchange rate regime classifications

While both the LYS and RR classifications infer exchange rate regimes based on what countries effectively do, they differ considerably regarding: (*i*) the data (*ii*) the key statistic(s), and (*iii*) the methodology they use for categorizing the different ERR.

The LYS classification combines available information on the exchange rate and reserves' movements to capture the effect of interventions on the exchange rate and determine the *de facto* flexibility of ERR. On the methodology side, it builds on a cluster analysis which partitions data points (a data point corresponding to a given country's currency x at particular time t) into different ERR categories according to their similarity across the following variables: (*i*) *changes in the nominal exchange rate* —measured as the average of the absolute monthly percentage changes in the nominal exchange rate during a calendar year, (*ii*) *the volatility of these changes* —computed as the standard deviation of the monthly percentage changes in the exchange rate, and (*iii*) *the volatility of the net-reserves-to-the monetary base ratio*. The principle that underlies this clustering is that countries experiencing a low volatility of their exchange rates (both in levels and changes) and a high volatility of their reserves should be considered as having a *Fixed* ERR. Floaters should be rather associated with highly volatile exchange rates (both in changes and levels) and stable reserves. By definition, intermediate regimes fall between these two extreme regimes.

The RR classification also considers exchange rate variations, but these are combined with variables reflecting the monetary policy framework to match the monetary policy stance followed by a country. Consequently, this classification relies on the existence of non-unified exchange rate markets (multiple exchange rates and parallel markets), instead of official ones. Moreover, exchange rate variations are based on absolute percent changes in the monthly nominal exchange rate averaged over a longer period of time, five-year rolling windows —two-year in some cases.[5]

Tables 2 and 3 report the different regime categories identified by the RR and LYS classifications. The RR fine classification distinguishes fourteen categories that can be aggregated into five categories within a coarse classification. The LYS classification, by contrast, differentiates only four categories of regimes (plus one associated with *inconclusive determinations*) that can be converted into the usual tripartite categorization: *Fixed*, *Intermediate*, and *Floating*.

2.2 The disagreements between the two classifications

Not surprisingly, the two classifications with their distinctive features lead to significant divergences in the history of regimes. To illustrate this, we collapse the RR classification into three categories to fit the traditional three-way classification. Following the literature, we aggregate the different ERR categories of the RR classification as follows.

[5]In the RR classification, a specific category, the "Freely falling," is distinguished. This category includes observations coupled with (i) a twelve-month rate of inflation above 40 percent, and (ii) a transition from a fixed or quasi-fixed regime to a managed or independently floating regime the 6 months following an exchange-rate crisis.

Table 2 — Reinhart & Rogoff *de facto* classification

Regime	Classification	
	Fine	Coarse
No separate legal tender	1	1
Pre announced peg or currency board arrangement	2	1
Pre announced horizontal band that is narrower than or equal to +/-2%	3	1
De facto peg	4	1
Pre announced crawling peg	5	2
Pre announced crawling band that is narrower than or equal to +/-2%	6	2
De facto crawling peg	7	2
De facto crawling band that is narrower than or equal to +/-2%	8	2
Pre announced crawling band that is wider than or equal to +/-2%	9	3
De facto crawling band that is narrower than or equal to +/-5%	10	3
Moving band that is narrower than or equal to +/-2% (i.e., allows for both appreciation and depreciation over time)	11	3
Managed floating	12	3
Freely floating	13	4
Freely falling	14	5

Table 3 — Levy-Yeyati & Sturzenegger *de facto* classification

Five-way classification		*Three-way classification*
Regime	Code	Regime
Inconclusive determination	5	
Free float	4	Floating ERR
Dirty float	3	Intermediate ERR
Dirty float/Crawling peg	2	
Fix	1	Fixed ERR

Note: we reverse the original LYS classification so that a higher category is associated with more flexibility (except regime 5).

The *Fixed ERR* comprises the categories 1 to 4 (fine classification), the *Intermediate ERR* includes categories 5 to 11, and the *Floating ERR* consists of the remaining categories.[6]

Focusing on this broad classification, Figure 1 shows the importance of the three main ERR categories from 1974 to 2013 according to the two classifications. The distributions of the different ERR are presented by groups of countries according their development level for coherence and clarity.[7] For the advanced economies (AEs), the LYS classification always identifies many more *Float* compared to the RR classification. This gap has increased further since 1999. In contrast, since this year, the RR classification records more *Fixed* ERR — a trend accompanied by a decrease in the share of the *Intermediate*

[6]The "freely falling" category is excluded from the empirical analysis —typical in the literature. This omission represents a loss of 397 observations. Furthermore, note that the "separating line" between the *Intermediate* and the *Float ERRs* is itself a source of disagreements. The selected "line" maximizes the concordance (a gain of 89 points) between the two classifications —and is in accordance with the literature.

[7]We use the IMF categorization, which classifies the world into advanced, emerging and developing economies. See Table A.1 in Appendix A for the complete list of countries.

regime. The pictures for the emerging and developing countries are more similar between the two classifications. For emerging economies (EMEs), the proportion of *Fixed* arrangements shows a general decreasing trend in both classifications —although they are more pronounced in the LYS classification. The share of the *Intermediate* regime is roughly constant over time in the RR classification, refuting the bipolar view. In the LYS classification, there is a movement away from this regime and toward the Float regime. On average, almost half of the observations are categorized as *Intermediate* regimes in the RR classification. In contrast, in the LYS classification, the *Float* regime occupies the largest share of ERR arrangements, especially at the end of the period covered. For developing countries (DCs), the two classifications depict a similar evolution for the *Fixed* regime; the LYS classification, however, records slightly more *Fixed* than the RR classification. Again, the decreasing trend observed in the proportion of *Fixed* arrangements is matched by an increase in the share of *Float* in the LYS classification and of *Intermediate* in the RR classification.

A more explicit way to illustrate the importance of these divergences is to summarize the observations in a two-way contingency table which displays the frequencies of observations assigned to an ERR category by each classification. Table 4 presents these two-way contingency tables across the different groups of countries. Considering the whole sample, the observed rate of agreement between the RR and LYS classifications reaches 57.7%.[8] However, this rate differs considerably across groups of countries. It varies from around 64.4% for DCs to about 52.2% for EMEs and 42.8% for AEs.[9] On average, the agreement between the two classifications is the highest for the *Fixed* regime category, followed by the *Intermediate* category, except among AEs where this latter category presents the lowest rate of agreement. These first findings are consistent with the observation made by most empirical studies that the *de facto* classifications do not overlap very well. However, they refute the conclusion of Eichengreen and Razo-Garcia (2013) that disagreements are most prevalent in EMEs and DCs.

To get a better picture of the disagreements between the two classifications, Table 5 shows the contingency table for the whole sample of countries using the different original categories defined by the two classifications and, more specifically, those of the LYS classification. As reported above, the LYS classification relies on a cluster analysis —based on three variables— to determine the *de facto* ERR. In a nutshell, the algorithm (the Kinetic

[8]The agreement rate is measured as the sum of observations along the diagonal divided by the total number of observations.

[9]Figure B.1 in Appendix B displays the disagreements map. Also, as reported in Figure B.2, there is evidence of increasing discordances over time between the classifications. Indeed, all the four charts indicate an increase in the disagreements, illustrated by the upward trend observed since 1990. This upward trend is, however, less clear for AEs.

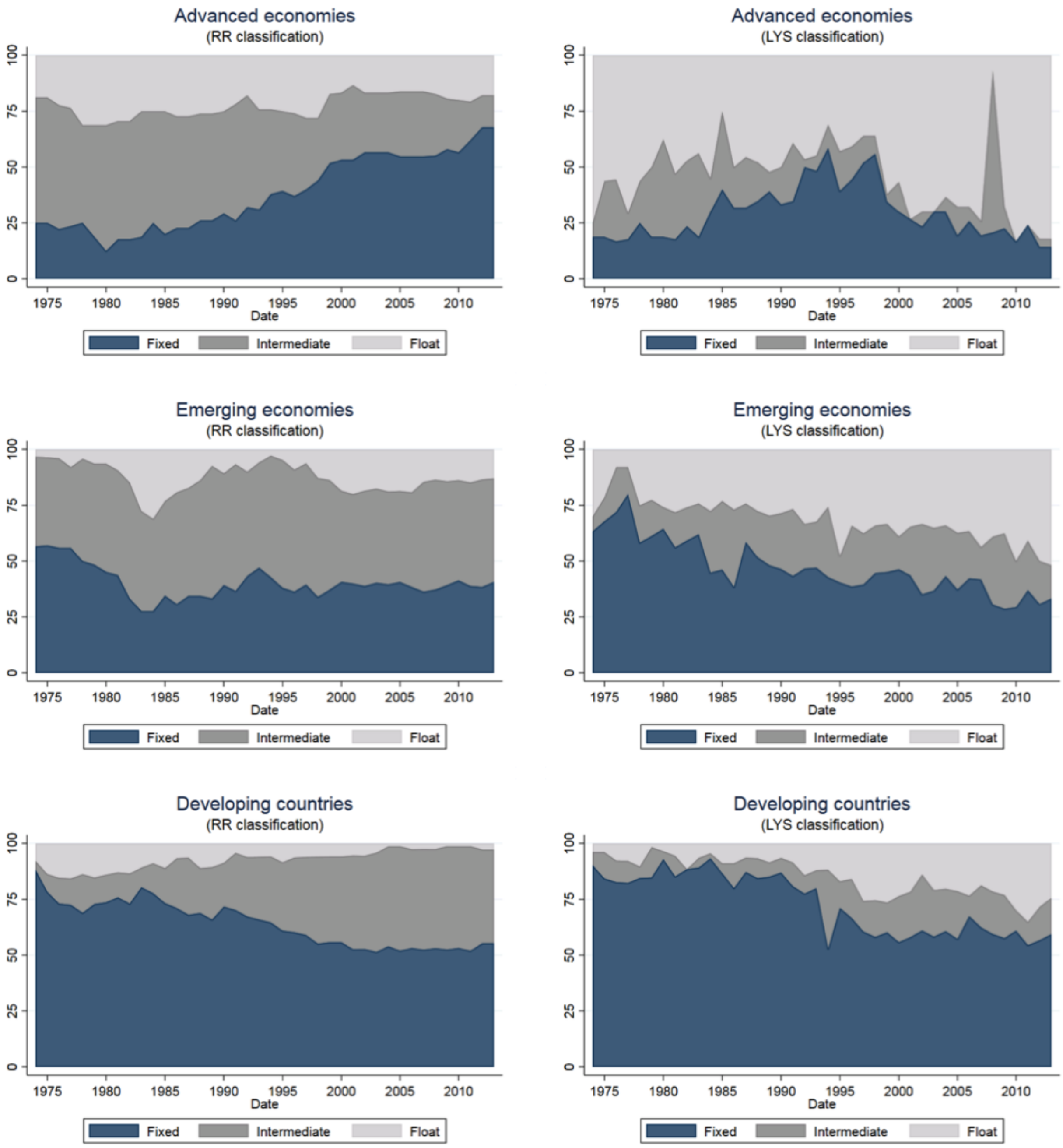

Figure 1 — *De facto* regime distributions over time (% of annual observations)

Monte Carlo) assigns the data to five homogeneous groups, each of them representing an ERR category (except the *Inconclusive determination* group). For comparability purposes —required by the algorithm, the two percent upper-tail of the observations for each of the three key variables are in a first step excluded, and the remaining points are z-normalized then classified.[10] This first stage (or first round) assigns a number of observations to the different ERR and leads to a considerable number of observations classified as "*Inconclu-*

[10]The excluded data points correspond to the outliers.

Table 4 — Two-way contingency tables

All countries

		LYS			
		Fix.	*Inter.*	*Float*	Total
RR	*Fix..*	**2080**	187	289	2556
	Inter.	481	**497**	888	1866
	Float	151	124	**314**	589
	Total	2712	808	1491	5011

Pearson $\chi^2(4) = 1.6e+03$ | $Pr = 0.000$

AEs

		LYS			
		Fix.	*Inter.*	*Float*	Total
RR	*Fix..*	**174**	36	195	405
	Inter.	101	**78**	184	363
	Float	18	27	**167**	212
	Total	293	141	546	980

Pearson $\chi^2(4) = 103.81$ | $Pr = 0.000$

EMEs

		LYS			
		Fix..	*Inter.*	*Float*	Total
RR	*Fix.*	**519**	83	41	643
	Inter.	140	**212**	399	751
	Float	54	52	**109**	215
	Total	713	347	549	1609

Pearson $\chi^2(4) = 602.24$ | $Pr = 0.000$

DCs

		LYS			
		Fix..	*Inter.*	*Float*	Total
RR	*Fix..*	**1387**	68	53	1508
	Inter.	240	**207**	305	752
	Float	79	45	**38**	162
	Total	1706	320	396	2422

Pearson $\chi^2(4) = 924.14$ | $Pr = 0.000$

Note: The different matrices represent the two-way contingency tables between the RR and LYS classifications (whole sample as well as sub-samples). Pearson $\chi^2(.)$ displays the statistics and *p*.value associated to the independence test of rows and columns –in a two-way table.

sives".[11] These latter observations are then, assigned, through a second round procedure, to the different ERR categories. Finally, some observations left unclassified (either "*inconclusive*" or "*unclassified*") are assigned to the different ERR categories on an *ad hoc* basis using additional information. Specifically, observations so far classified as inconclusive and (*i*) exhibiting zero volatility in the nominal exchange rate, or (*ii*) considered as a *de jure* peg by the IMF with an average volatility of the nominal exchange rate smaller than 0.1%, are assigned to the *Fixed* ERR.[12]

In Table 5, each row represents an ERR category defined by the RR classification. Column headers of each sub-table correspond to the data labels from the LYS classification procedure: "*U*" stands for "*Uncontroversial*," i.e. observations classified apart from the methodology using additional information; "*O*" indicates observations labeled as outliers; "*R2*" indicates observations classified in the second round and "*I*" stands for "*Inconclusives*" (more specifically *Fixed inconclusives*). The details of the disagreements between the two classifications —that are of interest for us— are reported in the off-diagonal sub-tables.

[11]The inconclusive category contains observations with low volatility regarding the three key variables.
[12]The same approach is used to classify the countries that have been excluded due to a lack of data.

Table 5 — Two-way contingency table (All countries; zoom-in)

RR classification		***LYS classification***																			
		Fixed						**Intermediate**						**Float**							
Fixed		Total Obs.: 2080						Total Obs.: 187						Total Obs.: 289							
		ERR	*Obs.*	*U*	*O*	*R*2	*I*		**ERR**	*Obs.*	*U*	*O*	*R*2	*I*		**ERR**	*Obs.*	*U*	*O*	*R*2	*I*
	RR	**1**	955	112	32	270	415	**RR**	**1**	30	13	13	1	0	**RR**	**1**	188	187	0	0	0
	RR	**2**	862	68	5	286	372	**RR**	**2**	59	0	6	36	0	**RR**	**2**	41	0	0	12	0
	RR	**3**	1	0	0	1	0	**RR**	**3**	0	0	0	0	0	**RR**	**3**	0	0	0	0	0
	RR	**4**	262	23	3	78	87	**RR**	**4**	98	0	0	91	0	**RR**	**4**	60	0	0	23	0
								LYS	**2**	155	13	0	128	0							
								LYS	**3**	32	0	19	0	0							
Interm.		Total Obs.: 481						Total Obs.: 497						Total Obs.: 888							
		ERR	*Obs.*	*U*	*O*	*R*2	*I*		**ERR**	*Obs.*	*U*	*O*	*R*2	*I*		**ERR**	*Obs.*	*U*	*O*	*R*2	*I*
	RR	**5**	7	0	2	0	0	**RR**	**5**	33	0	1	29	0	**RR**	**5**	10	0	0	3	0
	RR	**6**	14	0	0	1	9	**RR**	**6**	17	0	1	14	0	**RR**	**6**	17	0	0	8	0
	RR	**7**	92	4	13	27	0	**RR**	**7**	168	0	2	155	0	**RR**	**7**	168	0	0	65	0
	RR	**8**	134	6	7	33	24	**RR**	**8**	169	0	5	126	0	**RR**	**8**	416	0	0	123	0
	RR	**9**	5	0	0	0	0	**RR**	**9**	4	0	0	4	0	**RR**	**9**	16	0	0	2	0
	RR	**10**	160	13	2	14	94	**RR**	**10**	75	0	6	25	0	**RR**	**10**	173	0	0	26	0
	RR	**11**	69	15	4	3	12	**RR**	**11**	31	0	0	27	0	**RR**	**11**	88	0	0	24	0
								LYS	**2**	465	0	0	380	0							
								LYS	**3**	32	0	15	0	0							
Float		Total Obs.: 151						Total Obs.: 124						Total Obs.: 314							
		ERR	*Obs.*	*U*	*O*	*R*2	*I*		**ERR**	*Obs.*	*U*	*O*	*R*2	*I*		**ERR**	*Obs.*	*U*	*O*	*R*2	*I*
	RR	**12**	147	22	7	27	38	**RR**	**12**	100	0	5	21	0	**RR**	**12**	189	0	0	11	0
	RR	**13**	5	0	0	2	0	**RR**	**13**	24	0	0	0	0	**RR**	**13**	125	0	0	0	0
								LYS	**2**	103	0	0	21	0							
								LYS	**3**	21	0	5	0	0							

Notes: "*ERR*" stands for the regime categories specified in Table 2 (*LYS* classification) and Table 3 (*RR* classification). "*U*" (resp. "*O*", "*I*") stands observations labeled as Uncontroversial (resp. Outliers, Inconclusive); "*R*2" indicates observations classified in the second round.

We conduct a qualitative content analysis of each type of observations that involves a disagreement. To gain in readability, these different types of disagreement are mapped out, and their evolution over time is also reported in a chart. This exploratory analysis is presented in Appendix B and allows the identification of seven potential sources of divergence between the two classifications. These different sources can jointly trigger several types of disagreement and with varying degrees of importance.

The first source of disagreement comes from the difference in the time horizon considered for the assessment of the exchange rate volatility. By focusing on a five-year rolling window, the RR classification puts exchange rates' changes into a broader historical context and therefore records fewer regime transitions. In contrast, the LYS classification, by emphasizing changes within a year, reports short-term currency market pressures. There is also evidence that the different choices for the reference currency *vis-à-vis* which the volatility of the exchange rate is calculated, and the thresholds delimiting the ERR categories also matter. Finally, the *ad hoc* judgments and the official reserves volatility in the LYS classification, as well as the parallel market exchange rate in the RR classification also explain several of the disagreement points.

Among these potential suspects, it is interesting to observe that several reflect data that imply judgmental decisions: data points that are not classified by the clustering algorithm and labelled as "*Uncontroversial*" and "*Fixed inconclusive*" in the LYS classification and data relying on assumptions in the choice of the reference currency *vis-à-vis* which the volatility of the exchange rate is calculated. These "conditional" observations blur the perimeters of the different ERR categories defined by the two classifications and make the definition of a common conception of regime categories very difficult, if not impossible. Therefore, we remove in a first step these observations to ensure that the classifications are directly comparable and that such a comparison can be performed within a consistent framework.

The number of these "conditional" observations, reported in Table 6, is significant. For the whole sample of countries, they represent 38.8% of the initial observations (1945 among the initial 5011 observations). The exclusion of these observations primarily affects the AEs group, with a loss of 49.2% of the initial observations (from 980 to 498), followed by the DCs group, with a fall of 42.4% of the observations —mostly due to observations labeled as *Fixed inconclusives*. Finally, it reduces the number of observations by a lower percentage for the EMEs group (27.2%).

This adjustment naturally modifies the importance of the disagreement and agreement points between the two classifications for the whole sample and across the different countries' samples. As shown in Table 7, the number of disagreement points is reduced

Table 6 — Observations before and after the corrections

Sample	Total obs.	Among which ...			Obs. after corrections
		U	*I*	*D.R.C.*	
All countries	5011	463	1051	558	3066
AEs	980	220	29	256	498
DCs	2422	167	708	213	1396
EMEs	1609	76	314	89	1172

Note: "*U*" (resp. "*I*") indicates observations labeled as "*Uncontroversial*" (resp. "*Fixed inconclusive*") in the *LYS* classification. "*D.R.C.*" stands for "Difference in the reference currency". The number of observations after the corrections does not necessarily equal the difference between the initial number of observations minus the sum of *U*, *I* and *D.R.C.* given that an observation can be labeled as, e.g. fixed inconclusive while also presenting a difference in the reference currency.

by 30.14% (1481 against an initial total of 2120 points), representing a decrease of 7 percentage points in the rate of disagreement. The agreement rate also decreases, meaning that these "conditional" observations encompass not only disagreement but also agreement points. The RR and LYS classifications agree on 50.7% of the observations, compared to 57.7% previously. Finally, the agreement rate is still higher for DCs (59.6%) and EMEs (47.3%), reaching only 40.0% for AEs.

Table 7 — Two-way contingency tables (after corrections)

All countries

		LYS *Fix.*	*Inter.*	*Float*	Total
RR	*Fix..*	**979**	165	90	1234
	Inter.	269	**460**	805	1534
	Float	66	86	**146**	298
	Total	1314	711	1041	3066

Pearson $\chi^2(4) = 1.2e+03 \mid Pr = 0.000$

AEs

		LYS *Fix.*	*Inter.*	*Float*	Total
RR	*Fix..*	**101**	21	14	136
	Inter.	99	**76**	163	338
	Float	1	1	**22**	24
	Total	201	98	199	498

Pearson $\chi^2(4) = 114.10 \mid Pr = 0.000$

EMEs

		LYS *Fix..*	*Inter.*	*Float*	Total
RR	*Fix.*	**244**	81	31	356
	Inter.	59	**203**	383	645
	Float	15	49	**107**	171
	Total	318	333	521	1172

Pearson $\chi^2(4) = 476.52 \mid Pr = 0.000$

DCs

		LYS *Fix..*	*Inter.*	*Float*	Total
RR	*Fix..*	**634**	63	45	742
	Inter.	111	**181**	259	551
	Float	50	36	**17**	103
	Total	795	280	321	1396

Pearson $\chi^2(4) = 576.49 \mid Pr = 0.000$

Note: The different matrices represent the two-way contingency tables between the RR and LYS classifications (whole sample as well as sub-samples). Pearson $\chi^2(.)$ displays the statistics and *p*.value associated to the independence test of rows and columns –in a two-way table.

The adjusted sample includes 3066 observations that are objectively comparable, i.e. without implying any judgmental decisions. Therefore, this new sample allows a more careful and meaningful analysis of the sources of disagreement between the two classifications.

3 Explaining the disagreements

3.1 The methodology

This paper aims to explain why the classifications diverge from each other for each observed disagreement point —i.e. for a given country i in a particular year t. We empirically explore this issue by assessing how the variables used by the RR and the LYS classifications affect the propensity of these classifications to disagree with each other. However, this exercise immediately implies two potential sources of disagreements, since the two classifications combine different types of information, and none of these classifications can be considered superior to the other. Consequently, as each classification can be designated as the reference classification —i.e. the classification against which the divergences are identified, different sources of disagreements can be derived, as illustrated by the following hypothetical example. Suppose a country A's regime classified, in a particular year t, as *Fixed* by the RR classification but as *Float* by the LYS classification. If the RR classification is considered as the reference classification, the disagreement could be related, for instance, to reserves data used by the LYS classification. If, by contrast, the LYS classification is considered as the reference classification, the source of disagreement could originate from the use by the RR classification of a longer time horizon over which the exchange rate volatility is measured and/or of information on parallel market exchange rates. It follows that the source of the disagreement for any country's regime crucially depends upon the classification chosen as a reference.

To overcome this problem, we provide a *synthesis classification* based on both classifications from which we derive sources of disagreement that are, by definition, independent of the choice of a reference classification. Formally, the synthesis classification is derived by inferring, for a given country's regime in a particular year t, the closest ERR category —i.e. the ERR category with the lowest probability of disagreement between the RR and LYS classifications— once unified the LYS and RR ERR conceptions. By integrating the distinctive characteristics of the classifications into a consistent and complete framework, this synthesis classification will allow us to conclude not on an exclusive source of the disagreement between the two classifications —impossible given the existence of two reference frames—, but rather on the most important one.

Our analysis is thus carried out in two steps. In a first step, the disagreement source specific to each of the reference classification is identified. The results from this step are then used in the second step to derive the synthesis classification. Finally, from this unified framework, we deduct the disagreement sources.

Step 1: the sample-specific disagreement sources[13]

We are interested in identifying the sources of disagreements according to each classification. Our strategy is based on a stepwise approach. We compare the outcomes from a full probit model —including as regressors all candidate variables of disagreements (variables specific to each classification and also reflecting their differences)— with the outcomes from different k nested models —in which the k^{th} explanatory variable is dropped from the model. The dependent variable capturing the disagreement between the two classifications, Y, scores 0 in the absence of disagreements; 1 otherwise.

We consider five samples: a sample of *Fixed* ERR including observations recorded as *Fixed* at least by one classification, a sample of *Floating* ERR including observations reported as *Float* at least by one classification, and three samples of *Intermediate* ERR—(*i*) a *Lower-Intermediate* ERR sample composed of observations recorded as *Intermediate* at least by one classification and *Fixed* by the other one, (*ii*) an *Upper-Intermediate* ERR sample composed of observations recorded as *Intermediate* at least by one classification and *Float* by the other one, and (*iii*) a *Full Intermediate* ERR sample encompassing the two previous samples. Since each sample combines all the observations classified in the same ERR category by both classifications, it includes disagreement and agreement points, the latter constituting the reference group.[14]

There are four important reasons for considering these different samples. Firstly, each of these samples includes two alternative possibilities about the regime category, each being defined by one classification. Secondly, considering a full sample (with $Y = 0$ for consensual points; 1 otherwise) would imply that the consensual points are statistically identical regarding the variables. In other words, the consensual *Fixed*, *Intermediate* and *Float* observations should form a homogenous group. Such an assumption can reasonably not be made.[15] Thirdly, it is very unlikely that all the explanatory variables matter for all types of disagreements. For instance, in the LYS classification, the difference between the *Fixed* and the *Intermediate* ERR involves only the dynamics of the exchange rate

[13] The term "sample-specific" corresponds to the different ERR categories to which a disagreement point belongs —and so to the different classification viewpoints. Using again the country A example above, the *Fixed* (resp. *Float*) sample disagreement sources correspond to the sources identified considering the RR (resp. LYS) classification as the reference. This terminology is preferred as it suits well for the derivation of the synthesis classification (clarifications are provided further below).

[14] Figure A.1 in Appendix A illustrate the different estimation samples.

[15] In the case of intermediate regimes, the distinction between downward and upward disagreements is particularly important to facilitate the statistical discrimination of the observations. Indeed, while the *Fixed* and *Floating* ERR samples imply either lower or higher variability of the variables —hence facilitating statistical one-way discrimination of the observations, the *Intermediate* ERR full sample consists of a mix. The *Lower* (resp. *Upper*) *Intermediate* ERR sample thus consists of disagreements over the choice between the *Fixed* or *Intermediate* regime (resp. the *Intermediate* or *Float* regime).

since both ERR categories display high reserves volatility. On the contrary, the difference between the *Intermediate* and the *Float* ERR is principally based on reserves volatility. Hence, considering only one sample of all observations falling into the intermediate ERR could lead to biased coefficients and inaccurate simulated probabilities. Finally, the *full Intermediate* ERR sample makes possible to assign disagreement points into the *Intermediate* regime. Such a possibility can arise when one of the two classifications identifies an observation as *Fixed* and the other as a *Float*. Indeed, one cannot exclude that this "corner" observation corresponds neither to a $Fixed$ ERR, nor to a $Flexible$ ERR, but instead could be a candidate for the intermediate category of the synthesis classification.

The baseline —full— probit model is performed over all these samples. We first simulate for these baseline models the probabilities of disagreements between the two classifications and then adjust these latter using the Receiver Operating Characteristic (ROC) analysis to assess the performance of the models. The adjusted probabilities will serve as a benchmark for the other sample-specific k submodels.

The Receiver Operating Characteristic (ROC) analysis and the performance of the models

The performance of the probit models is gauged with the so-called ROC curve as a model selection tool. The ROC curve plots the share of disagreements between the two classifications correctly identified by a given model (true positives "TP"; also called *sensitivity* in the ROC jargon) vs. the share of predicted disagreements that are not observed (false positives "FP"; "$1 - specificity$" in the jargon, $specificity$ being the true-negative rate) along contiguous threshold settings.[16] We build a ROC function for each probit model and determine an optimal cut-off probability that corresponds to the highest true positive rate together with the lowest false positive rate.

Once the optimal cutoff value selected, the probabilities of disagreement derived from each model are then adjusted: probabilities higher than or equal to the cutoff value are considered as being equal to 1, while probabilities below the threshold are replaced by 0. This leads to four possibilities, as depicted in Table 8.

We then estimate the different k submodels (the full model in which the k^{th} variable is omitted). The probabilities of disagreements are generated for each model —provided that the null of the likelihood ratio test is rejected. To adjust these probabilities —and thus to compare each k-submodel's outcomes with those of the full model, we also rely on a ROC analysis. First, we compare the cut-off values of the submodels with that of the full model. If the difference is not significant, using the cutoff value of the full model or

[16] Such an analysis is used in the RR classification to differentiate between the different types of pegs.

Table 8 — Observed disagreements and model outcomes

		Adjusted probabilities "$\hat{Y}$"	
		0 (agreements)	1 (disagreements)
Dep. variable "Y"	0 (actual agreements)	True negative "TN"	False Negative "FP"
	1 (actual disagreements)	False negative "FN"	True negative "TP"

Note: The cells in the table indicate the number of true positives (TP), true negatives (TN), false positives (FP) and false negatives (FN), respectively. TPs and TNs are respectively disagreements and non-disagreements that are predicted correctly. FP is a predicted disagreement that does not occur and a FN is a predicted agreement that is actually a disagreement.

that of the submodel leads to the same adjustment of the submodel-based probabilities. However, if the difference is significant, we rely on the submodel's cutoff value. Finally, to derive the contribution of each variable to the disagreements, we compare the changes in the number of disagreement points correctly identified (true positives). Hence, if when removing the explanatory variable k from the full model we no longer detect a true positive, the variable k will be considered as the source of the disagreement —for the selected sample.

Step 2: derivation of the synthesis classification and identification of the disagreement sources

The synthesis classification aims to reclassify a disagreement point which has been classified, by definition, differently in the RR and LYS classifications. As a consequence, we only focus on potential disagreement points (predicted agreements that are actually disagreements "FN", and disagreements that are predicted correctly "TP"), leaving unchanged the consensual points.

We derive the synthesis classification by reconciling the information gathered from Step 1 and generated for the different samples. Given that the probit model is estimated for different samples (the confrontation of the classification viewpoints), analyses in Step 1 yield at least two probabilities for each disagreement point: (i) the probability of disagreement *vis-à-vis* the ERR category i (when considering the sample of the ERR category i), and (ii) the probability of disagreement *vis-à-vis* the ERR category j (when considering the sample of the ERR category j). If the disagreement between the two classifications is related to a corner observation (i.e. *Fixed* in one classification and *Float* in the other), a third probability measuring the distance *vis-à-vis* the *Intermediate* category in the synthesis classification is also estimated.

In our view, the synthesis classification must combine both classifications' schemes into a unique and coherent framework. A disagreement point should therefore be classified in the most probable ERR category, that is, in the ERR category *vis-à-vis* which the probability of disagreement is the lowest.[17] By taking the previous example of the country A's regime (classified in a particular year t as *Fixed* by the RR classification but *Float* by the LYS classification), the synthesis classification would consider the country A's regime as *Fixed* if the probability of disagreement derived from the *Fixed* ERR sample is lower than that derived from the *Intermediate* and *Float* ERR samples. In other words, by applying such a rule (*Rule 1*), we consider that inferring to this disagreement point a *Fixed* ERR is "less false" than including it in another ERR category. Therefore, the disagreement point is assigned to an ERR category according to a unified framework and is recorded in the synthesis classification.

However, a disagreement cannot necessarily be detected in all estimation samples, as illustrated by the following situations: (*i*) the disagreement is not detected by the model in any of the estimation samples ("*3×FN*"), (*ii*) the disagreement is detected in only one of the estimation samples ("*2×FN* & *1×TP*"), (*iii*) the disagreement is detected in two of the estimation samples ("*1×FN* & *2×TP*"), and (*iv*) the disagreement is detected in all the estimation samples ("*3×TP*").[18]

When the disagreement point is not detected in any model —status "*2×FN*" or "*3×FN*" in the case of a corner observation, *Rule 1* shall apply. In the other situations, i.e. when the disagreement point is detected in at least one of the estimation samples, we introduce a refinement to *Rule 1*, conditional on the identification(s) of a single variable as the disagreement source (i.e. precise identification(s)). This refinement is a way to address the so-called *confirmation bias* —or *my-side bias*— which is defined as a tendency to search for, interpret, favor, and recall information in a way that confirms one's preexisting beliefs or hypotheses (Kahneman and Tversky, 1974; Plous, 1993).[19]

[17]Note that we here focus on the probabilities of disagreement, not on the adjusted probabilities.

[18]The four configurations are relevant in the case of a corner observation (i.e., *Fixed* in one classification and *Float* in the other one) as this observation can also fall in the alternative of the *Intermediate* category in the synthesis classification. In other cases, there are two estimation samples and only three configurations are possible: (*i*) "*2×FN*", (*ii*) "*1×FN* & *1×TP*", and (*iii*) "*2×TP*". Explanations about the failure of the models to detect some disagreement points are provided below.

[19]It is a type of cognitive bias and a systematic error inherent to inductive reasoning toward confirmation of the hypothesis under study. In short, it can be considered as a form of selection bias in collecting evidence. Let us illustrate this bias in our context by relying again, tirelessly, on our example of a given country A's regime classified as *Fixed* by the RR classification but *Float* by the LYS classification. Suppose that the disagreement on country A's regime is precisely identified in the *Fixed* ERR sample (i.e. status "*TP*") but not in the *Float* one (i.e. status "*FN*"). This provides prima facie evidence for considering the ERR of country A as closer to a *Float* ERR than a *Fixed* ERR (the disagreement probability being lower in the Float sample). Now, suppose further that the official reserves volatility is identified as the source of the disagreement in the *Fixed* ERR sample. In the face of this new information, one should

Specifically, we use additional information from the submodels, relying on the fact that they quantify the importance of the identified source of disagreement in contrast with the full models. The refinement rule —*Rule 2*— consists in comparing the different sample-specific probabilities, considering the probabilities derived from the submodel excluding the identified source(s) of disagreement in case of precise identification.[20] The refinement rule is in fact a more specific rule describing a context in which the argument from *Rule 1* is not strong enough to select the most probable ERR category.[21]

Once each disagreement point has been assigned to the most probable ERR category, it is possible to identify, from the resulting synthesis classification, the —primary— sources of disagreement. By definition, they correspond to the sources identified in the sample coinciding with the synthesis classification category. Our methodology is summarized in Figure A.2 —in Appendix A.

3.2 The data

The selection of the explanatory variables is relatively straightforward, given that all the variables involved in the two classifications are known. Firstly, the two classifications differ regarding the time horizon over which changes in the nominal exchange rate are calculated. While the LYS classification focuses on the average over a calendar year of the absolute monthly percentage changes in the nominal exchange rate, the RR classification focuses on the absolute percent change in the monthly nominal exchange rate averaged over five-year rolling windows —two-year in some cases. Secondly, the nature of the nominal exchange rate also matters. The LYS classification is based on official exchange rates, while the RR classification uses, in some cases, the parallel market exchange rates. Thirdly, the LYS classification considers the volatility of the official reserves to capture

challenge its beliefs/perceptions rather than sticking to *Rule 1* as another plausible hypothesis could be worth considering. Indeed, considering in this case that the major source of the disagreement is the use by the LYS classification of the reserves volatility is not meaningless. Underlying this, is the proposition that the synthesis classification should record country A as a *Fixed* instead of a *Float* regime. Within our —inductive reasoning— framework both conclusions have their place and are "equally" important. Indeed, it is not about being right, but rather being the more likely. It follows then that the comparisons of the sample-specific probabilities involving precise identification(s) cannot be performed using *Rule 1*.

[20]In our example, this new disagreement probability can be interpreted as the new distance between the country A's regime and the *Fixed* ERR sample. By the way, note that precise identification excludes the case where a disagreement is associated to several variables simultaneously (multiple identification). The sample-specific probability of disagreement is, in this case, that derived from the full model.

[21]While the existence of two rules of decision may be perceived as being *ad hoc* and consequently of nature to be accommodating, *Rule 2* allows for an update/a questioning of beliefs while preserving the general idea of the synthesis classification. Rather than dismissing or embracing new evidence as though nothing else matters, the refinement introduced by *Rule 2* helps taking into account, in a coherent way, the different information hence ensuring a higher degree of consistency.

interventions on the exchange rate market.[22] Finally, the two classifications differ regarding the threshold levels that define the perimeters of the different ERR categories.

While these key variables should theoretically be incorporated in the model to be estimated, it is far more difficult to practically include such variables for the econometric analysis. In particular, while the first three variables can be addressed in a consistent empirical framework, the inclusion of the last variable —the thresholds that determine the different ERR categories— is a whole lot trickier. However, if we assume that the model is perfectly specified —i.e. no omitted variables—, observations misclassified by the model (i.e. false agreements or false disagreements) can reasonably be attributed to the differences between the two classifications in delimiting the different ERR categories. A second issue is accounting for the various sources that explain the differences between the two classifications in the measure of the volatility of exchange rates. These differences can be related either to the nature of the nominal exchange rate (official versus parallel market exchange rates) or to the time horizon considered for the assessment of the exchange rate volatility (year-by-year approach versus five/two-year rolling window). Disentangling the effects of these two sources proves to be complicated. As a result, we simultaneously account for these two effects by computing the difference between the exchange rate volatility measures used by the two classifications:

$$Diff.H/P = \sigma_{Pk} - \sigma_e \tag{1}$$

where σ_{Pk} (resp. σ_e) stands for the measure of exchange rate volatility used in the RR (resp. LYS) classification.

A third issue is raised by the two measures of exchange rate volatility used by the LYS classification: (*i*) the *exchange rate volatility* (σ_e), (*ii*) the *volatility of exchange rate changes* ($\sigma_{\Delta e}$). As can be seen in Table 9, the two measures display very high correlations regardless of the considered sample. To remove the problem of collinearity arising from the inclusion of both measures in the specification, we perform a principal component analysis (PCA) —on the correlation matrix— to obtain the latent variable, i.e. the unobservable variable which underlies the observed collinear variables. As shown in Table C.2.1 in Appendix C, the first latent variable, the first component following the PCA terminology, concentrates 97.6% of the variance in the volatility measures. We thus select

[22] As noted above, the RR classification also considers the inflation rate in its procedure, but this variable is intended only to differentiate the "Freely falling" category —composed of countries whose twelve-month rate of inflation is above 40 percent — from the others. As a reminder, this category has been dropped.

this first component —which we will refer to as "*exchange rate (ER) volatility*"— as an explanatory variable instead of the two volatility measures.

Finally, we also control for the clustering algorithms of the LYS classification by including (*i*) a dummy, *Outlier*, capturing whether the observation is labeled as an outlier, and (*ii*) a dummy, *Round*2, scoring 1 if the observation is classified in the second round, 0 otherwise.[23]

Table 9 — Correlations: volatility of the exchange rate and of the exchange rate changes

Sample	Full sample	Fixed	Intermediate			Float
			Lower	*Upper*	*Full*	
$Corr(\sigma_e, \sigma_{\Delta e})$	0.9503	0.9806	0.9678	0.9113	0.9516	0.9119
[p.value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

The equation (full probit model) to be estimated is thus as follows:[24]

$$Y_i = \alpha + \beta_1 Diff.H/P_i + \beta_2 ER.Volat._i + \beta_3 Reserves_i + \beta_4 Outlier_i + \beta_5 Round2_i + \varepsilon_i \quad (2)$$

The data on the parallel market exchange rates are from Carmen Reinhart.[25] The official nominal exchange rates are downloaded from the *International Financial Statistics* database (IMF). To take into account the effect of the official reserves used by the LYS classification, we have no other choice than relying on a categorical variable derived from the LYS classification regimes. Indeed, despite the indications regarding the sources of the variables in Levy-Yeyati and Sturzenegger (2016), we were not able to collect the data needed to calculate the official reserves volatility for all countries. Nonetheless, the LYS classification, relying on a cluster analysis, allows us to generate a variable regarding the reserves' volatility based on the different regimes. As noted in section 2.1 —and also Table 1— in LYS (2016), the *Floating* ERR category is supposed to exhibit rather stable official reserves compared to the *Intermediate* and *Fixed* ERR. Hence, we compute a binary variable to control the use and the importance of the reserves volatility. As the *Floating* category is the sole with a different level of reserves volatility —compared to the

[23] Again, in the LYS classification, outliers correspond to observations with very high variability —the two percent-upper tail of observations for each of the three classification variables. Similarly, the distinction between first and second round mirrors observations with high and low variability.

[24] It is worthwhile noting that while the different variables can have interactions, we do not include these latter in the model. The reason is that it is difficult to compute standard errors for interaction terms in probit regressions. Furthermore, while this issue of the standard errors can be somehow addressed through a Bayesian probit model —i.e. the uncertainty of interaction terms, such analysis introduce bias regarding the estimated coefficients of the other variables due to its sequential inclusion and exclusion of the variables in the estimated models. The effects of interactions would thus be deduced ("True positive" points not associated to a unique variable).

[25] Website: https://carmenreinhart.com/exchange-rates-official-and-parallel/ (last accessed: November 2020)

other LYS categories, our variable scores 1 for the *Floating* ERR and 0 otherwise.[26]

4 Results

4.1 The full model results

Estimation results of the full model for our different samples are detailed in Table 10. We report both the coefficients (standardized) and the average marginal effects. As expected, the different explanatory variables' coefficients vary significantly from a sample to another thus providing an additional justification for the use of different estimation samples.[27]

The effects of the difference in the time horizon and/or the use of parallel market exchange rates display significant and positive coefficients for the *Fixed* and *Intermediate* ERR samples. This result suggests that a greater difference in the volatility measure increases the likelihood of disagreements between the RR and LYS classifications. The effect is positive and notably stronger in the *Intermediate* —lower— ERR sample —see the average marginal effect. In contrast, the coefficient is significant and negative when considering the *Floating* ERR sample. These opposed signs are in line with expectations. Indeed, the higher the difference —i.e. $\sigma_{Pk} > \sigma_e$ —, the more likely the RR classification will classify the observations as *Flexible*. Thus the probability of observing a disagreement between the two classifications will be lower if the observations are also considered *Flexible* by the LYS classification (i.e. the *Floating* ERR sample).

The *exchange rate volatility* is also associated with a positive sign in the *Fixed* ERR sample: an increase in the volatility increases the predicted probability of disagreement, i.e. the probability of not being classified as a *Fixed* ERR. This result also holds in the *Upper Intermediate* ERR sample. However, in the *Floating* ERR sample, an increase in the exchange rate volatility reduces the likelihood of disagreements.

Reserves, when included, display the highest coefficients and average marginal effects. Except for the *Floating* ERR sample —where it is associated with a negative sign, the use of the reserves volatility in the LYS classification —or the distinction between the level of volatility— significantly increases the likelihood of observing a difference between the two

[26]Our variable capturing the reserves volatility is entirely in line with the country groupings in the LYS classification. In its understanding, it allows us to differentiate *Floating* ERR (here more in the sense of countries that do not intervene in the Forex) from the other categories. Hence the coefficient on "Reserves" can be interpreted as the use of the reserves volatility in the classification process and the importance of the volatility.

[27]For the *Float* sample, the unbalanced dependent variable led us to consider alternative estimation methods. Results indicate that the probit estimates do not suffer from bias. See Appendix C.3.

classifications. This effect is particularly marked in the *Upper Intermediate* ERR sample since the observations are at the border of the low and high official reserves volatility —following the LYS clustering rationale.

Observations labeled as *Outlier* by the LYS classification are associated with a higher probability of disagreement for all the samples, except for the *Upper Intermediate* ERR sample. For this sample, the coefficient displays a negative sign suggesting a relatively low probability of observing a disagreement. As noted above, observations labeled as *Outlier* correspond, in the LYS classification, to observations with very high variability —the two percent-upper tail of observations for each of the three classification variables. Consequently, these outliers are more present in the *Upper Intermediate* ERR sample —most specifically in the dirty float category in the LYS classification— since this category regroups observations with the highest volatility of exchange rate and reserves. Therefore, the obtained negative (resp. positive) sign in the *Upper Intermediate* (resp. other) ERR sample(s) seems coherent.

The round of the classification has a different effect depending on the considered sample. In the *Fixed* and *Intermediate* ERR samples, observations classified in the second round by LYS are associated with a lower predicted probability of disagreement. On the contrary, in the Floating ERR sample, these observations are associated with a higher probability of disagreement. As the second round of the LYS classification focuses on observations with low variability, the observed coefficient signs also appear consistent.

To summarize, estimation results of the various specifications yield coefficients with the expected and intuitive signs. Moreover, the pseudo R-squared are relatively low, except for the *Upper-Intermediate* ERR sample. This suggests that models' performances are quite modest and that the omitted source of disagreement —i.e. the different thresholds used by the two classifications to define the different ERR categories— seems to be essential to explain the divergences between the two classifications. This is especially true for the *Lower Intermediate* ERR sample.[28]

[28]These observations are confirmed by the identification, further downstream, of the sample-specific sources of disagreements (see Appendix C.5 for the full analyses or Table C.5.1.6 for a summary). We do not report these analyses in the paper's body because they only yield intermediate results —without immediate interest.

Table 10 — Probit model results

Sample	Fixed		Intermediate						Float	
			Lower		*Upper*		*Full*			
	Betas	*AME*	*Betas*	*AME*	*Betas*	*AME*	*Betas*	*AME*	*Betas*	*AME*
Diff. Horizon/Premium	0.241**	0.077 **	0.318***	0.107***	0.488***	0.029***	0.316***	0.054***	-0.346***	-0.059***
	(0.098)	(0.031)	(0.063)	(0.020)	(0.093)	(0.005)	(0.066)	(0.011)	(0.064)	(0.011)
E.R. volatility	0.475***	0.152***	-0.039	-0.013	0.607***	0.037***	-0.019	-0.003	-0.773***	-0.133***
	(0.119)	(0.037)	(0.034)	(0.011)	(0.115)	(0.006)	(0.022)	(0.004)	(0.183)	(0.031)
Reserves	6.326***	0.661***	(omitted)		7.849***	0.797***	6.099***	0.387***	-6.237***	-0.157***
	(0.063)	(0.012)			(0.149)	(0.022)	(0.067)	(0.013)	(0.519)	(0.012)
Outlier	0.239*	0.054	0.816***	0.267***	-1.652***	-0.058***	0.757***	0.122***	4.818***	0.121***
	(0.143)	(0.048)	(0.245)	(0.071)	(0.466)	(0.008)	(0.241)	(0.034)	(2.264)	(0.009)
Round 2	-0.516***	-0.172***	-1.219***	-0.438***	-1.437***	-0.115***	-1.348***	-0.249***	0.922***	0.116***
	(0.073)	(0.024)	(0.103)	(0.031)	(0.195)	(0.018)	(0.104)	(0.015)	(0.198)	(0.017)
Constant	-0.159***		0.678***		-0.555***		0.9146***		7.258***	
	(0.053)		(0.078)		(0.137)		(0.077)		(0.538)	
No. Obs.	1569		894		1351		1941		1193	
Pseudo R^2	0.1545		0.1471		0.8279		0.4485		0.1546	

Notes: "Betas" stand for standardized coefficients (except dummy variables). "***" (resp. "**" and "*") indicates statistical significance at 1% (resp. 5% and 10%). Robust standard errors are reported in parentheses. The columns "*AME*" indicate the average marginal effects (Delta-method standard errors). "omitted" indicates that the variables are dropped due to collinearity.

4.2 The disagreement sources

Figure 2 schematically presents a summary of our findings. The identified sources of disagreement are reported at the bottom of the figure. Table 11 details the number and the percentage of disagreements by identified sources and by groups of countries. Figure 3 documents the evolution of the disagreement sources (in % of the total disagreement points by year).

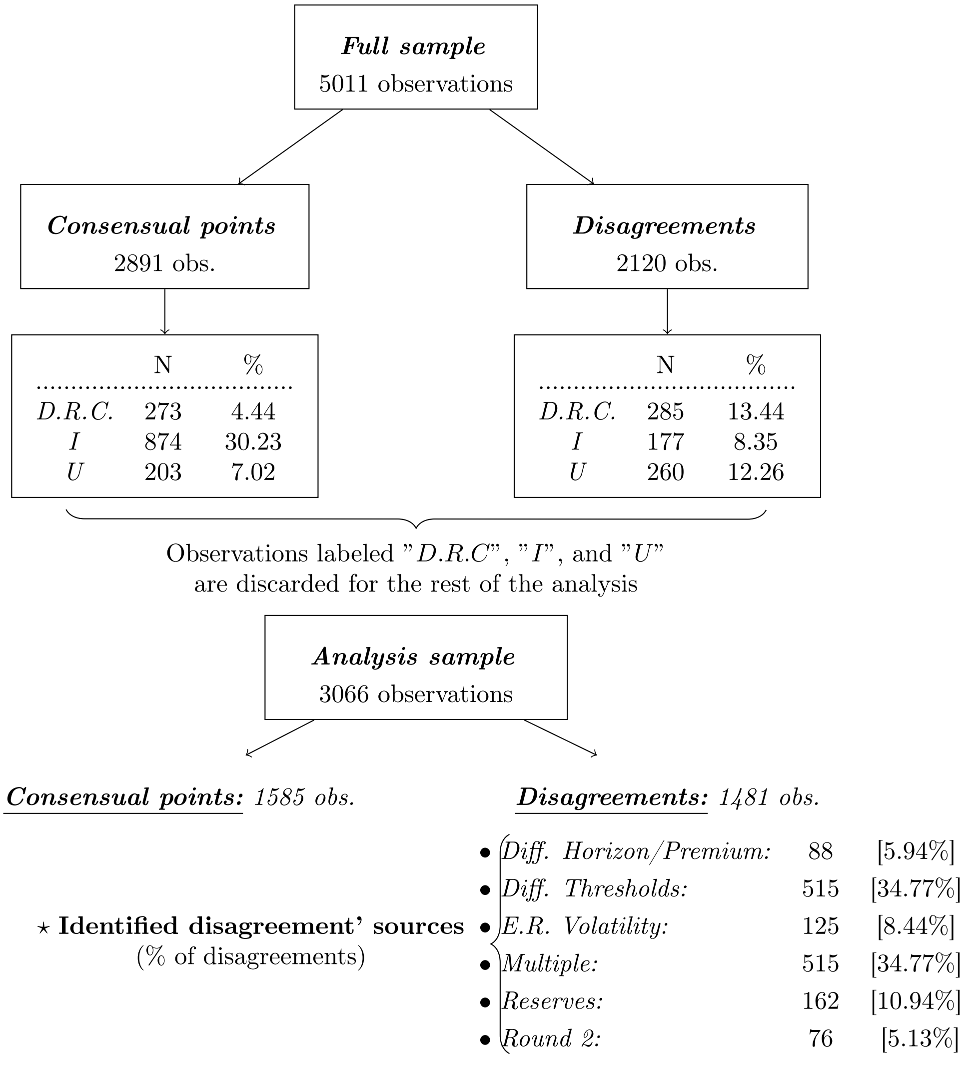

Figure 2 — The disagreement sources (summary)

Note: "*U*" (resp. "*I*") indicates observations labeled as "*Uncontroversial*" (resp. "*Fixed inconclusive*") in the LYS classification. "*D.R.C.*" stands for "Difference in the reference currency". The number of observations after the corrections does not necessarily equal the difference between the initial number of observations minus the sum of *U*, *I* and *D.R.C.* given that an observation can be labeled as, e.g. fixed inconclusive while also presenting a difference in the reference currency.

For the whole sample, the primary vehicles responsible for the disagreements between the LYS and RR classifications are the differences in the thresholds delimiting the ERR

Table 11 — The disagreement sources by development level			
	AEs	EMEs	DCs
Diff. Horizon/Premium	4 [1.34%]	35 [5.66%]	49 [8.69%]
Diff. Thresholds	94 [31.44%]	238 [38.51%]	183 [32.45%]
E.R. Volatility	35 [11.71%]	52 [8.41%]	38 [6.74%]
Multiple	141 [47.16%]	177 [28.64%]	197 [34.93%]
Reserves	19 [6.35%]	79 [12.73%]	64 [11.35%]
Round 2	6 [2.01%]	37 [5.99%]	33 [5.85%]

Note: The figures correspond to the number of occurrences. Percentage (of the disagreements by sample) are reported in brackets.

categories, and the involvement of several sources ("*Multiple*").[29] The first explanation accounts for about two-fifths of the disagreements for EMEs and a third for AEs and DCs (Table 11) and holds particularly at the beginning of the period (Figure 3). The contribution of the second source —i.e. *Multiple*— varies more dramatically across regions: from 28.6% for EMEs to 34.9% for DCs and 47.2% for AEs. As shown in Figure 3, the contributions of these multiple sources have increased since the mid-1980s for high-income countries. The use of the official reserves volatility is the third primary source of disagreements. It is associated with 10.9% of the disagreements —considering the whole sample. The proportion of disagreements explained by this variable varies from 6.35% in AEs to 12.73% in EMEs. The exchange rate volatility —measured by both (*i*) changes in the exchange rate volatility and (*ii*) the volatility of these changes (see section 3.2)— is a relatively minor source of disagreements between the two classifications, accounting for 8.4% of disagreements in the whole sample. However, it is not very meaningful to separate this source of disagreements from the differences in the classifications' thresholds, since the definition of the latter is based on the exchange rate volatility. Similarly, the difference in the time horizon and/or the use of parallel market exchange rates contributes only minimally to the disagreements between the RR and LYS classifications. The proportion of disagreements associated with this explanation reaches 5.9% on average, ranging from 1.3% in AEs to 8.7% in DCs. For AEs, this source of disagreements corresponds to years of financial turmoil (Figure 3) and is primarily related to the difference in the time horizon over which changes in the nominal exchange rate are assessed. Finally, the proportion of disagreements associated with observations classified in the second round by the LYS

[29]It is worth noting the critical role of the LYS classification procedure based on a purely statistical method and its data-determined thresholds.

classification ("*Round 2*") reaches 5.1% when considering the whole sample. For AEs (resp. EMEs and DCs), this variable contributes to 2% of the disagreements (resp. 6% and 5.9%).

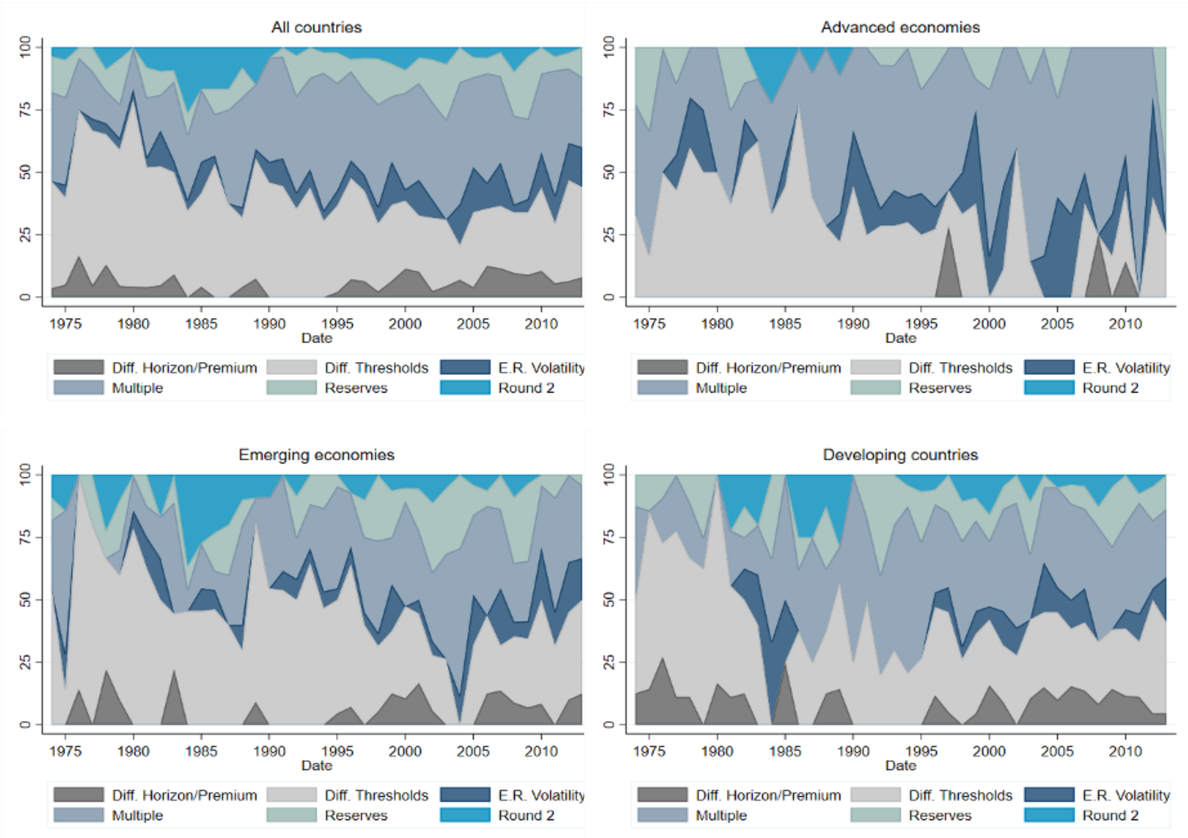

Figure 3 — Evolution of the disagreement sources (% total disagreement points by year)

From our assessment, it is clear that relatively few disagreements observations —30% in total— are related to specific key variables underlying the classifications. Instead, our findings point out the complex nature of the disagreements since they mostly originate from the combination and/or interactions of several variables. This is partly due to the LYS classification that makes joint use of several variables to classify the different ERR categories. Additionally, slightly more than a third of the disagreement points are due to the differences between the two classifications in the definition of the thresholds delimiting the three ERR categories. The complex nature of the disagreements between the two classifications provides additional support for a synthesis classification. Indeed, this latter, by providing a coherent framework, appears as a way to overcome the lack of robustness that often plagues studies on the determinants and performance of ERR.

5 The synthesis classification and the empirical implication(s)

5.1 Extending the synthesis classification

As noted, 1945 observations —corresponding to 38.81% of the original sample— have been so far excluded from the analysis. They have been either classified apart from the LYS classification algorithm —labelled as "*Fixed inconclusive*" and "*Uncontroversial*"— or because they correspond to observations for which there is a difference between the RR and the LYS classifications regarding the reference currency against which the exchange rate volatility is measured. To complete the synthesis classification, we now turn to these specific disagreement points and determine how they can be reclassified within the synthesis classification.

5.1.1 Observations labeled "Fixed inconclusives" and "Uncontroversial"

Observations labeled "*Fixed inconclusives*" in the LYS classification correspond, as aforementioned, to observations left unclassified after the second round. They were classified as *Fixed* ERR provided that they met one of the two following criteria: (*i*) zero volatility in the nominal exchange rate; (*ii*) *de jure* peg with average volatility in the nominal exchange rate smaller than 0.1%. In the same vein, observations, for which one variable was unavailable, have been classified in "*Uncontroversial fix*" and "*Uncontroversial crawling peg*". The euro area countries, on their part, have been classified as "*Uncontroversial float*" on an *ad hoc* basis.

To include these observations in the synthesis classification, we depart from our initial methodology since the LYS classification has classified them solely according to the exchange rate volatility. However, to preserve the unified framework of the synthesis classification, we also account for the difference in the time horizon over which changes in exchange rates are calculated and/or the use of parallel market exchange rates. Our strategy to classify the (fixed) inconclusive and uncontroversial observations relies on the following variables: (*i*) *Diff. Horizon/Premium*, (*ii*) *E.R. Volatility.* Furthermore, since it is impossible to rely on probabilities as before, we here assign each of the *inconclusive* and *uncontroversial* observations to the closest ERR category of the synthesis classification, i.e. the ERR category with the smallest distance between its centroid and the observation.[30] We rely on the Euclidean distance to assess the proximity between each of

[30] Note that we first removed observations for which we have noted a difference in the reference currency. Also, we focus exclusively on the disagreement points.

the observations and the centroids of the ERR categories identified within the synthesis classification:

$$d_{ij} = \sqrt{(X_{1i} - \bar{X}_{1j})^2 + (X_{2i} - \bar{X}_{2j})^2} \tag{3}$$

where d_{ij} is the distance between the observation i and the ERR category j of the synthesis classification. X_1 (resp. X_2) stands for *Diff. Horizon/Premium* (resp. *E.R. Volatility*). $\bar{X}_{kj}$ stands for the centroid value —i.e. mean— of the variable k in the ERR category j.

Figure 4 and Table 12 provide more details about the distribution of the two variables across the ERR categories of the synthesis classification.

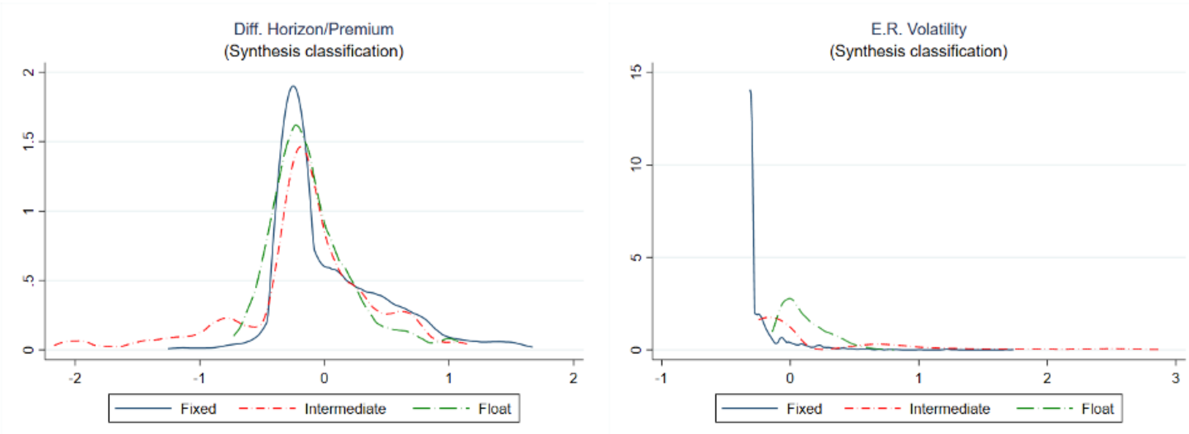

Figure 4 — Distributions of the classification variables (by synthesis classification category)
Notes: Kernel densities. The variables have been normalized. For each category of the synthesis classification, we removed the 2.5% smallest and 2.5% largest observations..

Table 12 — Characterization of the synthesis classification regimes

	Diff. Horizon/Premium			E.R. Volatility		
	Min.	Centroid	Max.	Min.	Centroid	Max.
Fixed	-1.2559	0.0314	1.6685	-0.3135	-0.2177	1.7358
Intermediate	-2.1683	-0.1629	1.1612	-0.2469	0.1951	2.8784
Float	-0.7308	-0.1108	1.0822	-0.1415	0.1029	0.8048

Note: The variables have been normalized. For each category of the synthesis classification, we removed the 2.5% smallest and 2.5% largest observations to obtain the above statistics.

By comparing the centroids, the *Fixed* ERR category displays relatively low exchange rate volatility. The *Intermediate* ERR category, on the other hand, presents the highest volatility in the exchange rate. Finally, the *Float* ERR category falls between the two. Thus, our synthesis classification reproduces a specific feature of the LYS classification: that is, some overlap between the *Fixed* and the *Float* regimes regarding the exchange rate volatility. This overlap is somewhat higher in the synthesis classification since the exchange rate volatility of the *Fixed* regime tends to be higher on average. Indeed, some observations —namely devaluation episodes— are classified as *Fixed* in the synthesis classification but not in the LYS classification. Regarding the difference in the time horizon and/or the use of parallel market exchange rates —calculated as the difference between the exchange rate volatility measured in the RR classification and that calculated in the LYS classification— the centroid value is the highest in the *Fixed* category. Hence, the exchange rate volatility in this ERR category is closer to that prevailing in the RR classification. The centroid values for the *Intermediate* and the *Float* are relatively close. However, the minimum value for the *Float* category is -0.7308 while that of the *Intermediate* category is -2.1683.

The application of this methodology to the *Inconclusive* and *Uncontroversial* observations (354 observations) leads to a reclassification of the exchange rate regime of the euro area countries in the *Fixed* ERR category. This reclassification includes both 187 *Uncontroversial float* and 13 *Crawling peg* in 2008. The latter were initially assigned to the euro area members by the LYS classification. Overall, 200 observations are reclassified in the *Fixed* ERR category, 107 observations in the *Intermediate* category, and 47 observations in the *Floating* ERR category.

5.1.2 Observations with a difference in the reference currency

Differences between the two classifications in the reference currency against which exchange rate changes are measured involve 558 observations, distributed between 273 agreements and 285 disagreements.[31]

Reclassifying these 285 points turns out to be the trickiest part of our exercise. Both classifications survey some potential anchor currencies and select the best anchor according to its methodology. Given that one cannot discredit one anchor for the benefit of another, we compute the two volatility measures of the exchange rate *vis-à-vis* each reference currency: (*i*) à la LYS, and (*ii*) à la RR. We then derive the average volatility *vis-à-vis* each of these anchors and select the anchor currency against which the exchange rate exhibits the lowest volatility. This approach is well suited when a disagreement point is classified as a peg (or to a lesser extent, a soft peg) by one of the classifications. This

[31]Despite the differences in the reference currencies used by the classifications, most of the agreements are mainly the results of: (*i*) the existence of double pegs, i.e. a country is pegged to a currency which is itself pegged to another one (e.g. Luxembourg (1974-98) that had a pegged rate in the form of a monetary union with Belgium, and few countries pegged to the SDR); (*ii*) the LYS classification that classifies a country as a *Float vis-à-vis* an anchor currency while the RR classification considers the domestic currency as the anchor —pure float— (e.g. the Australian dollar, the Deutsche Mark, the Japanese Yen, and the US dollar). The rest of the consensual points are manifestly the result of an important correlation between the reference currencies (e.g. the US dollar and the SDR). As before, we do not reclassify these consensual observations.

approach is also appropriate in discriminating between a soft peg (*Intermediate*) and a more flexible ERR (*Float*).[32]

Once the reference currency selected, we assign the observations to the different ERR categories of the synthesis classification.[33] 126 (resp. 159) observations are thus reclassified in the *Fixed* (resp. *Floating*) ERR category.

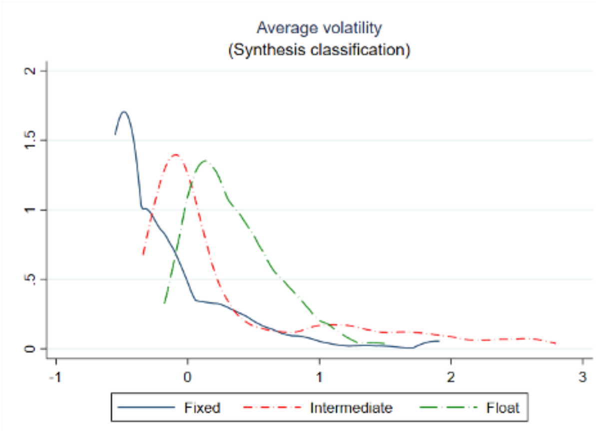

Figure 5 — Distributions of the average volatility (by synthesis classification category)
Note: The variable has been normalized. For each category of the synthesis classification, we removed the 2.5% smallest and 2.5% largest observations.

5.2 The (extended) synthesis classification

Figure 6 depicts the evolution of the ERR categories from 1973 to 2014 for the —extended— synthesis classification as well as the RR and LYS classifications. The synthesis classification seems closer to the RR classification than the LYS classification when looking at the evolution of ERR among AEs. For those countries, the synthesis classification exhibits an upward trend for the *Fixed* ERR category similar to the RR classification. The counterpart of this upward trend is a fall in the share of *Floating* and *Intermediate* regimes. The LYS classification picks up many more *Floats* and less *Fixed* ERR than the other classifications, especially since the European monetary union. This is due mainly to the classification of euro area currency regimes as "*Uncontroversial float*" by the LYS classification since 1999.

[32]Indeed, the chosen reference currency being the one *vis-à-vis* which the domestic currency exhibits the lowest volatility, being considered as a Float against this latter implies the same categorization if one had resorted to the other —not retained— reference currency. Hence, overall, the approach allows us to detect pegs (and soft pegs) for which the reference currency's issue makes sense.

[33]It is worth noting that in deriving the average volatilities, we consider observations from the synthesis classification used to characterize the different clusters (or ERR categories) to which the observations should be associated. This sample excludes observations reclassified in the previous sub-section, i.e. observations labeled "Uncontroversial" and "Fixed inconclusive".

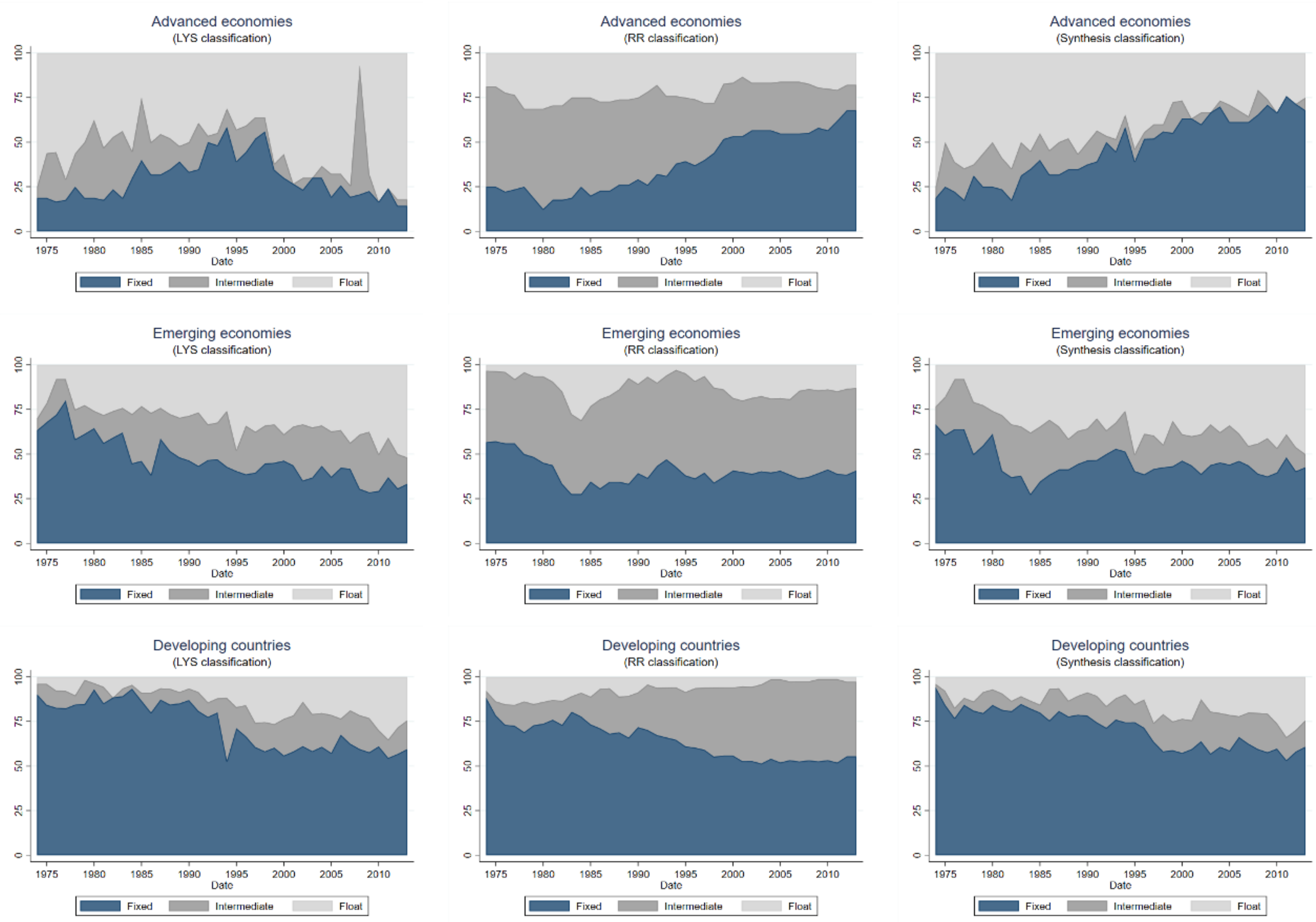

Figure 6 — The regime distributions over time (% annual observations)

For other countries, particularly for EMEs, the synthesis classification matches more the LYS classification. In EMEs, while *Floats* have risen from around 25 percent of all exchange rate regimes in 1973 to about 45 percent in 2014, the proportion of the *Fixed* ERR has remained about one half since the mid-1970s. As a result, the proportion of intermediate regimes recorded by the synthesis classification is relatively small. As in the LYS classification, this category is considerably less prevalent than suggested by the RR classification. Finally, none of the classifications appears to support the bipolar view since the share of intermediate regimes has remained broadly constant in all classifications. Among DCs, the predominance of the *Fixed* ERR is noticeable in all classifications (70% on average) despite a continued downward trend. According the synthesis classification and the LYS classification, those countries have tended to move towards more flexible regimes (both *intermediate* and *float*), while the RR classification shows instead a gradual and continued rise in *intermediate* regimes.

Figure 7 provides some additional insight from the evolution of the different ERR regimes for finer categories. Based on nominal exchange rate volatility —see Table 13, we split the *Fixed* ERR into four sub-categories and the *Intermediate* ERR into three sub-categories, the *Floating* ERR remaining unchanged.[34]

As can be seen, *Fixed* regimes in advanced economies from 1980 to 1998 have been characterized by less rigid arrangements. Indeed, the share of the *Fixed type 1* has remained very low until the euro creation in 1999. Conversely, while declining to the profit of the *Fixed* ERR, changes in the *Intermediate* ERR have been towards less flexible arrangements. In emerging markets, the years following the collapse of the Bretton Woods system are associated with a reduction in the share of *Fixed* ERR, and then with a relatively stable proportion from the late 1980s. The share of *Fixed* ERR *type 2* has gained importance over time, in contrast with less rigid pegs (*types 3* and 4). Still in the EMEs, while the three-way regime distributions (Figure 6) indicate that there has been no disappearance of the *Intermediate* ERR, Figure 7 allows a more nuanced picture of the bipolar view. Since the late 1990s, the movement has been a switch towards either the *Floating* ERR or more tightly "managed" intermediate regimes. Developing countries exhibit a similar pattern regarding the tightening of the *Intermediate* ERR.

[34] We do not distinguish categories within the Floating ERR because it is a perilous exercise. Indeed, given the plurality of the intervention means and the scarcity of the data to control, the distinction often made between free float and managed float does not refer to freely floaters and "floaters" that intervene actively or frequently on the foreign exchange market. Instead, "managed" here refers to the fact that for whatever reason —e.g. a random lack of volatility— the exchange rate variability index does not behave like the indices for the freely floaters —see Reinhart and Rogoff (2004, p.46).

Table 13 — The synthesis classification

Regime	Coarse grid		Type	Finer grid
Fixed	1	1	No volatility at all in the exchange rate	1
		2	Fluctuations contained within a -/+1% band	2
		3	Fluctuations contained within a -/+2% band	3
		4	The year average volatility exceeded -/+2%	4
Intermediate	2	1	Fluctuations contained within a -/+2% band	5
		2	Fluctuations contained within a -/+5% band	6
		3	The year average volatility exceeded -/+5%	7
Float	3		—	8

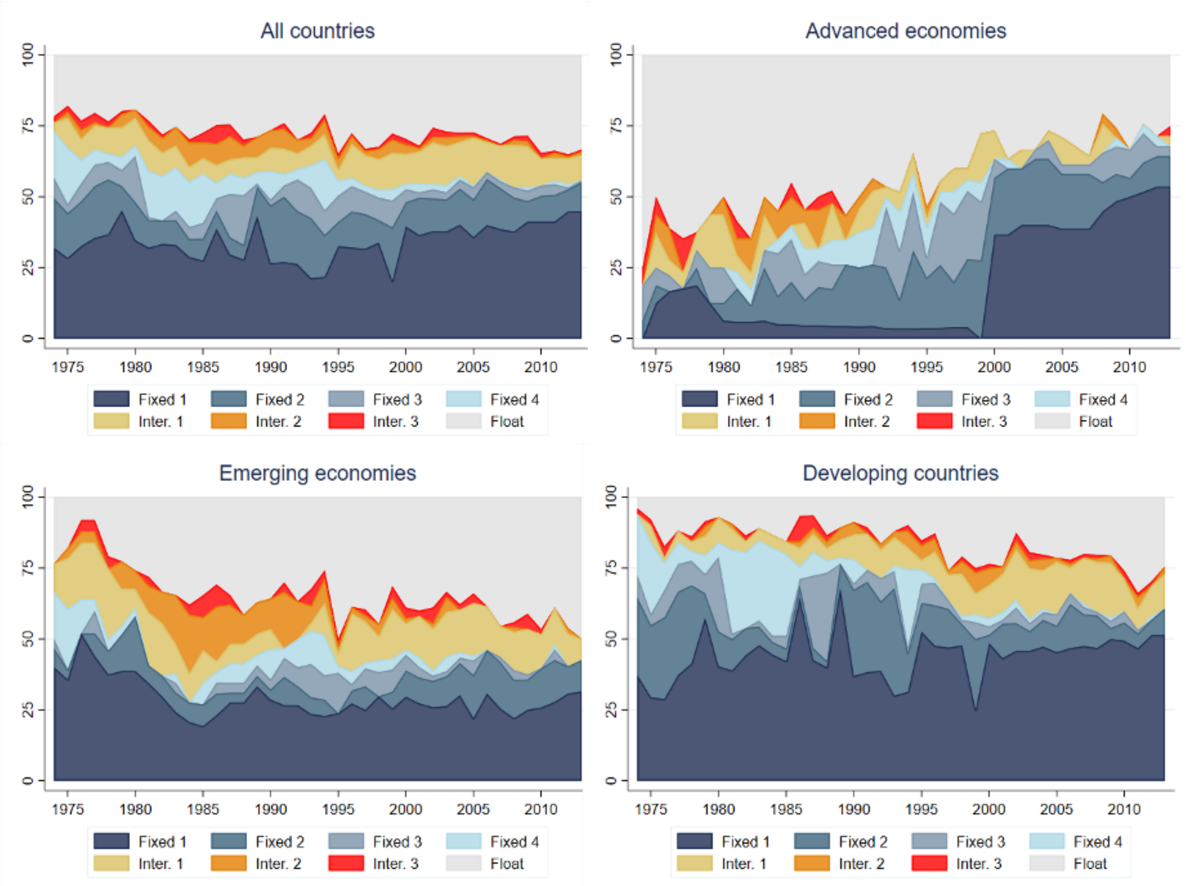

Figure 7 — The finer synthesis classification' categories and their evolutions
Note: The figures in front of the regime indicate the type.

Finally, Table 14 reports the percentage of agreements between the different *de facto* ERR classifications —including the synthesis classification. As expected, the synthesis classification displays a significantly high agreement rate with the LYS and the RR classifications. While the agreement rate between the LYS and the RR classifications is only 57.7%, the synthesis classification (SC thereafter) displays an agreement rate of 85.7% (resp. 71.3%) with the LYS (resp. RR) classification. Furthermore, the SC (*i*) falls between the LYS and RR classifications regarding the agreement with the OST classification, and (*ii*) displays a higher concordance with the IMF *de facto* classification compared to the LYS, RR and OST classifications. Thus, the SC provides, on average, the highest agreement rates among the *de facto* classifications.

Table 14 — Agreements between the *de facto* ERR classifications

	IMF *de jure*	IMF *de facto*	LYS	OST	RR
IMF *de jure*	100%				
IMF *de facto*	86.11% (5351)	100%			
Levy-Yeyati & Sturzenegger (LYS)	44.95% (3766)	47.85% (4826)	100%		
Obstfeld, Shambaugh & Taylor (OST)	47.31% (5031)	48.25% (6327)	65.79% (4779)	100%	
Reinhart & Rogoff (RR)	46.95% (3766)	52.85% (4826)	57.69% (5011)	71.37% (4779)	100%
Synthesis classification (SC)	49.95% (3766)	53.81% (4826)	85.73% (5011)	70.06% (4779)	71.30% (5011)

Notes: The entries correspond to the percentages of observations on which the classifications agree. The total number of observations used for the pairwise comparisons are reported in parentheses. See Table 1 for further details.

Finally, we present in Appendix C.6 Tables and Figures describing the association between ERR and various dimensions of economic performance. The outcomes should be interpreted with suitable caution and not as evidence of a causal relationship between the ERR and economic performances. However, we believe that the reported findings may become an important starting point for future work in this area. This is especially true for the relationship between the ERR categories and the occurrence of crises. While the outcomes of the LYS and the RR classifications cannot be accurately compared, since they result from a complex interaction of both statistical and economic criteria as highlighted in this paper, the SC provides more comparable ERR time-series by removing several statistical sources of disagreement. As a consequence, comparing the SC and the IMF *de facto* classification could be most appropriate by providing a better understanding of the different economic stories underlying each of these classifications.

6 Conclusion

In this paper, we provided a comprehensive analysis of the disagreements between the two most popular but also discordant *de facto* exchange rate regime classifications: the Reinhart and Rogoff and the Levy-Yeyati and Sturzenegger classifications. By investigating this issue, we indirectly cover the whole spectrum of the existing *de facto* classifications since the LYS and RR classifications are the most discordant. First, exploring the data, we show that 39% of the observations classified in both classifications are not directly comparable —due to *ad hoc* classification or to a difference in the choice of the reference currency. After removing these observations, we show that relatively few disagreements (a bit less than one fourth) are directly attributable to variables easily identifiable by one or both classifications. Our findings point out the complex nature of the disagreements that mostly originate from the interactions between the variables. The differences between the two classifications in the definition of the thresholds delineating the ERR categories explain one-third of the disagreement points. This source of disagreement is mainly at stake when discriminating between the *Fixed* and —lower— *Intermediate* ERR categories.

Moreover, we showed that, although divergent, these two classifications are not irreconcilable by developing a synthesis classification that combines the two classifications' ERR conceptions. We believe that this synthesis classification constitutes an essential contribution to the literature. Indeed, by combining different conceptions/definitions of ERR, it provides, on average, the highest agreement rates among the *de facto* classifications which means that it not only conveys more information but also allows for greater objectivity than the existing classifications.

We also used this synthesis classification to revisit some key issues dealing with exchange rate regimes, about which we draw the following conclusions. We first bring an interesting nuance to the so-called "hollowing-out" hypothesis or bipolar view since the synthesis classification indicates that the evolution of ERR —especially in EMEs since the late 1990s, has been a switch towards either the floating ERR or more tightly "managed" intermediate regimes. We also illustrated the relationship between ERR choices and various dimensions of economic performance. These first findings may pave the way for future empirical work. Indeed, the synthesis classification, by providing a more consensual definition of the variables that delineate the ERR categories, can ultimately contribute to a better understanding of the differences between *de facto* classifications and shed new light on some current concerns, such as the determinants and consequences of exchange rate regimes.

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Appendices

A. Data and methodology appendix

Table A.1 — Country list

Advanced economies (AEs):

Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Macao, Malta, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States.

Emerging economies (EMEs):

Algeria, Antigua & Barbuda, Argentina, Aruba, Belarus, Bosnia & Herzegovina, Brazil, Brunei Darussalam, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Czech Rep., Dominican Rep., Ecuador, Egypt, El Salvador, Equatorial Guinea, Estonia, Fiji, Guatemala, Hungary, India, Indonesia, Iran, Iraq, Jamaica, Jordan, Kazakhstan, Kuwait, Latvia, Lebanon, Lithuania, Macedonia (FYR), Malaysia, Marshall Islands, Mexico, Morocco, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Qatar, Romania, Russia, Saudi Arabia, Serbia, Slovakia, South Africa, Sri Lanka, Thailand, Tunisia, Turkey, United Arab Emirates, Ukraine, Uruguay, Venezuela.

Developing countries (DCs):

Afghanistan, Albania, Angola, Armenia, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia, Botswana, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Central African Rep., Chad, Comoros, Congo, Congo D.R., Côte d'Ivoire, Djibouti, Dominica, Eritrea, Ethiopia, Gabon, Gambia, Georgia, Ghana, Grenada, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Kenya, Kiribati, Kyrgyzstan, Lao P.D.R., Lesotho, Liberia, Libya, Madagascar, Malawi, Maldives, Mali, Mauritania, Mauritius, Micronesia, Moldova, Mongolia, Montenegro, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Niger, Nigeria, Oman, Papua New Guinea, Palau, Rwanda, Sao Tome & Principe, Senegal, Seychelles, Sierra Leone, Solomon Islands, St. Kitts & Nevis, St. Lucia, St. Vincent & Grenadines, Sudan, Suriname, Swaziland, Syria, Tajikistan, Tanzania, Togo, Tonga, Trinidad & Tobago, Uganda, Vanuatu, Vietnam, Yemen, Zambia, Zimbabwe.

Note : Country groups are based on the IMF categorization. http://www.ieo-imf.org/ieo/files/completedevaluations/L.%20Annex%201.%20Country%20Group%20Profiles.pdf

			A	**B**	**C**
			LYS classification		
			Fixed	***Intermediate***	***Float***
1	***RR classif.***	***Fixed***	**A1**	**B1**	**C1**
2		***Intermediate***	**A2**	**B2**	**C2**
3		***Float***	A3	**B3**	**C3**

Figure A.1 — Two-way contingency table and estimation samples

Note: The reading of the table is similar to that of the above contingency tables. The diagonal cells (A1 + B2 + C3) (resp. off-diagonal cells) correspond to the agreement (resp. disagreement) points between the two classifications. *Fixed* ERR sample = A1+A2+A3+B1+C1; *Lower Intermediate* ERR sample = A2+B1+B2; *Upper Intermediate* ERR sample = B2+B3+C2; *Float* ERR sample = C1+C2+C3+B3+A3.

Table A.2 — Data description and sources

Variable	Description	Source
Banking, currency, and debt crisis	Dummy variable (1 equals crisis; 0 otherwise)	Laeven and Valencia (2013)
Exchange rate		
• Official bilateral nominal exchange rate		IFS (IMF)
• Market-determined parallel exchange rate		Carmen Reinhart website
Inflation	Annual change in average consumer price index; in percentage	WDI (World bank)
GDP growth rate	Annual real per capita GDP growth rate	WDI (World bank)
Growth volatility	Calculated as three-year centered moving standard deviation of real per capita GDP growth	Authors' calculations based on data from the World bank's WDI

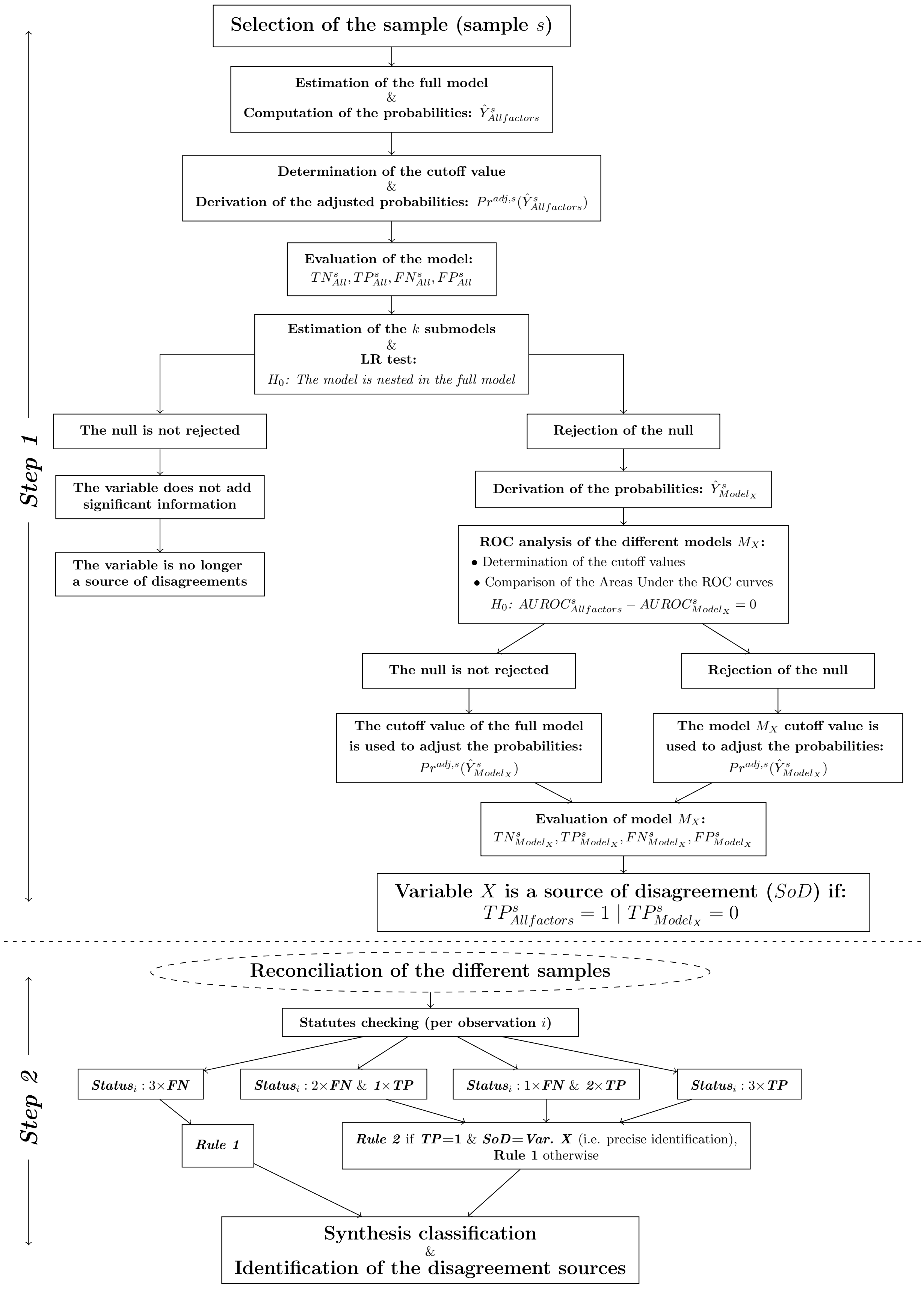

Figure A.2 — The methodology

B. Documenting the disagreements

This appendix is devoted to the exploration of the disagreement points between the two classifications. Each sub-section is dedicated to one of the off-diagonal sub-tables of Table 5.

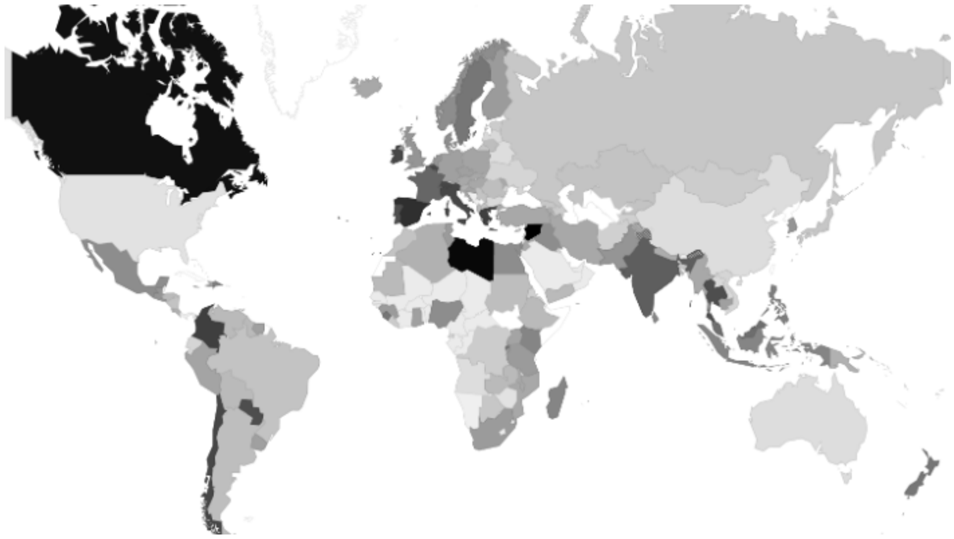

Figure B.1 — Disagreements map

Note: The shades of grey indicate the level of disagreement (number of disagreement points) between the RR and the LYS classifications (i.e. the darker, the more the disagreements)

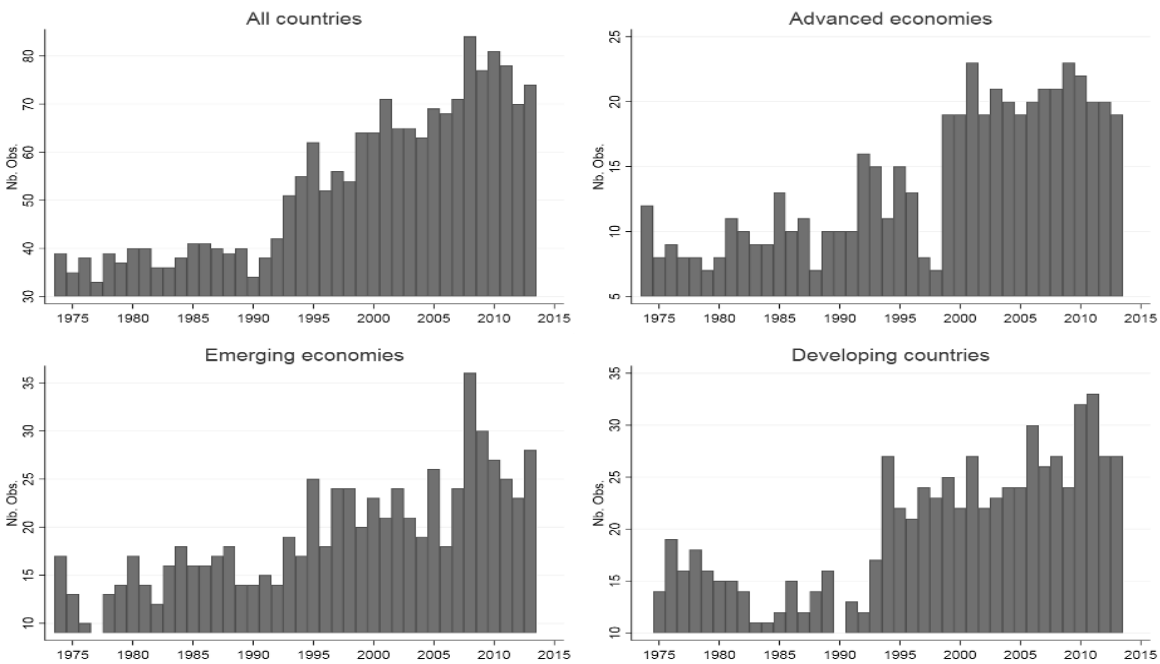

Figure B.2 — Evolution of the classification disagreements (number of observations)

Note: The height of the bars indicate the number of disagreements per year.

B.1. RR class. "*Fixed*" and LYS class. "*Intermediate*"

187 observations are classified as *Fixed* in the RR classification but *Intermediate* in the LYS classification. In the latter classification, 128 of these 187 observations are assigned through the second round procedure, 13 are labeled uncontroversial, and 19 outliers. The charts below reveal both the countries and years for which the disagreements are the most significant. As can be seen, for the euro area member countries, as well as for the CFA zone countries, the divergence between the two classifications is the most important. Some eastern European and Asian countries and few Latin American countries are also concerned by this divergence. The bottom chart further shows that in 1994 and 2008, the difference between the two classifications has been most pronounced.

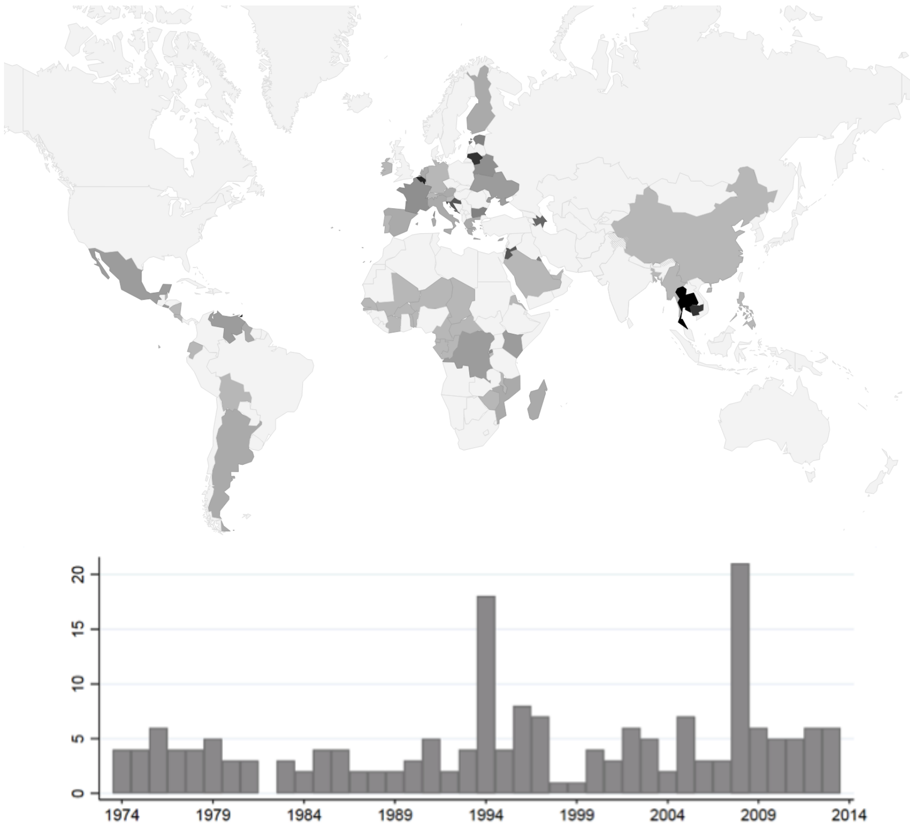

Figure B.1.1 — RR class. "*Fixed*" and LYS class. "*Intermediate*"
Notes: The map (top) displays the countries' coverage and the frequency (as reflected by the shades) of disagreements. The bottom chart displays the number of disagreement by year.

The spike in 1994 corresponds to the 100% devaluation of the CFA franc. During this episode, the ERR of the CFA zone countries were identified as *Fixed* by the RR classification. They were classified as *Intermediate* but also as outliers (13 out of the 19 points) by the LYS classification.[35] The peak in 2018 is related to the ERR of some eurozone countries.[36] For this single year, they have been classified as *Intermediate* —and labeled *uncontroversial* by the LYS classification.

As shown in Table 5, the remaining disagreement points correspond to 128 points classified through the second round procedure and 27 observations without any label. Regarding these latter observations, all of the 27 points correspond either to devaluation episodes (e.g. Costa Rica 1974, Kenya 1981, Philippines 1997, Ecuador 2000) or to changes in the anchor currency(ies) (e.g. Jordan 1975, Burundi 1983, Argentina 1991, Lithuania 2002). The explanation of the remaining disagreement points is less obvious. Note, however, that around a dozen disagreements (per country) are associated with few countries (e.g. Thailand 1978 and 1986-1996; Belgium 1975-76, 1978-1980, 1983-1986 and 1994).

Combining the information in Table 5 and Figure B.1.1 for the above set of disagreement points (i.e. *Fixed* in RR and *Intermediate* in LYS) leads to the following observation: one of the potential sources of disagreements between the two classifications is the difference in the time horizon considered by the classifications. Indeed, adopting a year-by-year approach, the LYS classification does not put the changes in the exchange rates into a historical/broader context and therefore puts too much emphasis on the change within a year.[37]

B.2. RR class. "*Fixed*" and LYS class. "*Float*"

289 observations are classified as *Fixed* in the RR classification but *Float* in the LYS classification. 187 of these 289 observations are labeled *uncontroversial* in the LYS classification, while 35 are assigned through the second round procedure. As can be seen in Figure B.2.1, the European region, and most specifically the Eurozone, is the most concerned by these disagreements. In particular, 187 "*Uncontroversial*" points identified

[35] The remaining 6 points labeled as outliers correspond to one-time devaluations (Rwanda 1974, Mexico 1976, Argentina 1985, Nicaragua 1991, Bulgaria 1997, Venezuela 2011).

[36] More specifically, 13 eurozone countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Slovenia and Spain.

[37] However, this question of the time horizon to consider addresses itself that of the exchange rate regime definition. Should the exchange rate regime reflect only the exchange rate's behavior in a particular year, or should it instead view the change in the exchange rate in a broader context –therefore taking into account economic and political shocks/decisions?

in Table 5 involve the euro area member countries. This fact is consistent with the significant jump in the number of disagreements observed since 1999, when the euro was established —depicted on the bottom chart (Figure B.2.1).[38] As noted by Levy-Yeyati and Sturzenegger (2016), it was a deliberate choice to classify the ERR of eurozone member countries as *Float*, given the behavior of the euro *vis-à-vis* other currencies.[39] In the RR classification, the ERR is instead classified as *Fixed* –to reflect the lack of monetary policy autonomy associated with the introduction of the single currency.

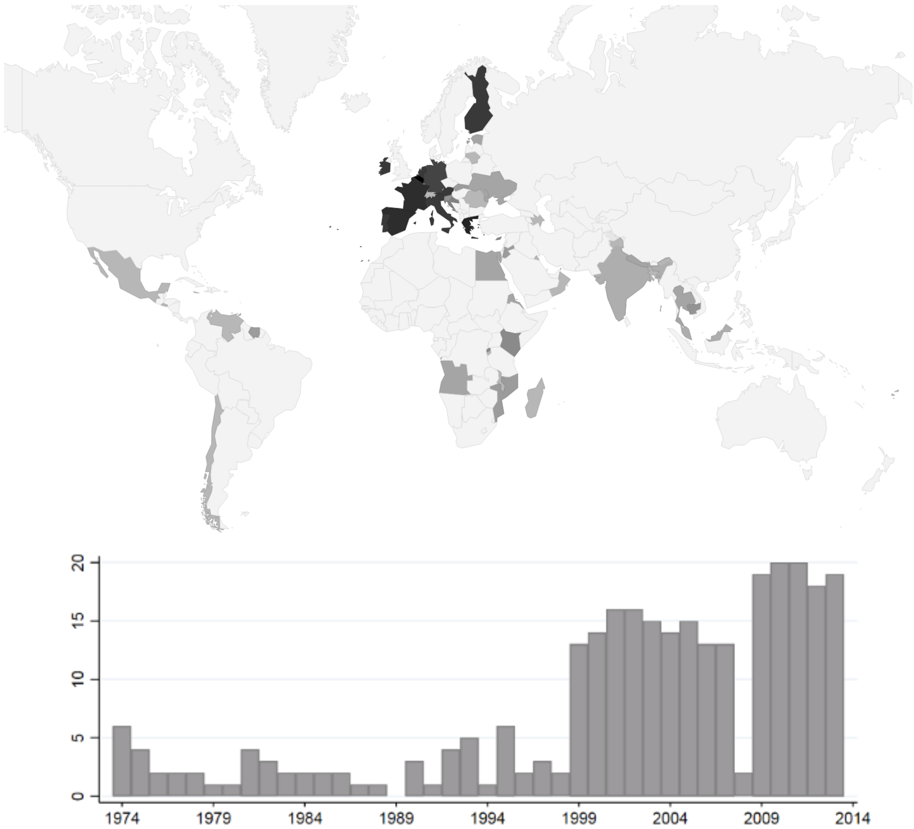

Figure B.2.1 — RR class. "*Fixed*" and LYS class. "*Float*"
Notes: The map (top) displays the countries' coverage and the frequency (as reflected by the shades) of disagreements. The bottom chart displays the number of disagreement by year.

Removing these 187 uncontroversial points associated with the euro area countries leaves 102 disagreement points with a relatively even distribution. Among these 102 disagreement points, one is classified in the RR category 1 (i.e. "No separate legal tender"),[40]

[38]The 2008's fall corresponds, as noted above, to the reclassification of these countries as *Intermediate* in the LYS classification.

[39]The authors acknowledge that the issue of the ERR's classification for the euro area countries (i.e. *Fixed* or *Float*) remains an open question and that the answer depends on the issue at stake.

[40]This disagreement point corresponds to the introduction in 1997 by Eritrea of a new currency pegged to a new anchor (the US dollar).

41 in the RR category 2 (i.e. "Preannounced peg or currency board arrangement") and 60 in the RR category 4 (i.e. "*De facto* peg").

Most of the divergence points classified as *Fixed* –category 2– by the RR classification occur one year before a change in the anchor currency. Other disagreements coincide with a change in the ERR within a year. They also correspond to some devaluation/reevaluation episodes (e.g. frequent devaluations in Kenya between 1982 and 1986; Maldives 2001; Venezuela 2010; reevaluation of the Nepalese rupee in 1993). The picture for the 60 observations classified as *Fixed* category 4 by the RR classification is less clear. However, as the difference between the two classifications involves the two extreme regimes, it is possible to come up with several explanations for the sources of these disagreements. The main reason relies on the difference between the two classifications regarding the reference currency against which the nominal exchange rate volatility is calculated. For instance, in the RR classification, the volatility of the Kenyan shilling is measured *vis-à-vis* the SDR (Special Drawing Rights) from 1976 to 1991. The LYS classification uses the SDR as the reference currency over a different period (between 1975 and 1986). Another explanation is that the volatility measure and, most specifically, the definition of the threshold values delimiting the different ERR categories differ between the two classifications. In fact, contrary to what prevails in the RR classification, the LYS classification threshold values are determined by the algorithm/data. It follows that the same observation will be classified into two distinct regimes as long as the LYS procedure's threshold value will differ from that of the RR classification. The disagreements between the two classifications on the ERR of Belgium in 1974, 1977, 1981-82, and 1993 illustrate this point. Indeed, for this country and over a more extensive period encompassing the disagreement years, the reference currency was the same in the two classifications, changes in foreign reserves were relatively stable, the parallel market premia were negligible, and the dynamics of the official and the parallel market exchange rates were similar. Hence, for this country, the disagreement could only stem from the difference in the threshold values used by the two classifications for delimiting the ERR categories.

B.3. RR class. "*Intermediate*" and LYS class. "*Fixed*"

481 observations are classified as *Intermediate* in the RR classification but as *Fixed* in the LYS classification. Almost 40% of these disagreements correspond to an *ad hoc* categorization in the LYS classification. These observations can be divided into two groups. The first group corresponds to the 139 observations labeled *inconclusives* (more precisely *Fixed inconclusives*) and assigned arbitrarily to the *Fixed* ERR category. This group consists in 18 countries, among which 5 account for more than 60% of the disagreement points: Syria (33 points between 1975 and 2011), Libya (17 points between 1988 and 2013), Egypt (14 points between 1974 and 1988), Brunei Darussalam (12 points between 1999 and 2013), and Paraguay (10 points; from 1974 to 1981 then 1987-1988). The second group corresponds to the 38 observations labeled *uncontroversial* (*Uncontroversial fix*). It includes Afghanistan 2002, Brunei Darussalam 1984-98, Equatorial Guinea 1980-1984, Guinea 1976-82, Hungary 1974 and 1979, Seychelles 1978, Syria 1992-92 and 2012-13, and Vanuatu 1978-1980.[41]

Removing these disagreement points leaves 304 observations, among which 78 are classified through the second round procedure in the LYS classification, and 28 are labeled as outliers.[42] As before, there is a significant concentration of the disagreement points in relatively few countries, Denmark and Norway having the highest score. Denmark (resp. Norway) is associated with 20 (resp. 19) disagreement points over the 1974-1998 period (resp. the 1992-2010 period).[43]

Intuitively, the nature of the divergence between the two classifications (*Intermediate* in the RR classification and *Fixed* in the LYS classification) suggests that the discriminating element(s) comes from how the two classifications assess exchange rate dynamics.[44] However, it is more complicated than it seems because this assessment can vary across several dimensions. The first aspect to investigate is the exchange rate volatility. We

[41] Again, the label "*uncontroversial*" refers to observations classified on an *ad hoc* basis because of the classification variables' unavailability.

[42] Also note that removing the points classified on an *ad hoc* basis considerably reduces the number of disagreement points in the RR category 10 (i.e. "*de facto* crawling that is narrower than or equal $+/-5\%$").

[43] Ireland and Iceland also belong to this top group with respectively 13 (between 1981 and 1996) and 10 (between 1999 and 2013) disagreement points.

[44] Indeed, in the LYS classification, both *Fixed* and *Intermediate* regimes are associated with a high volatility of the reserves.

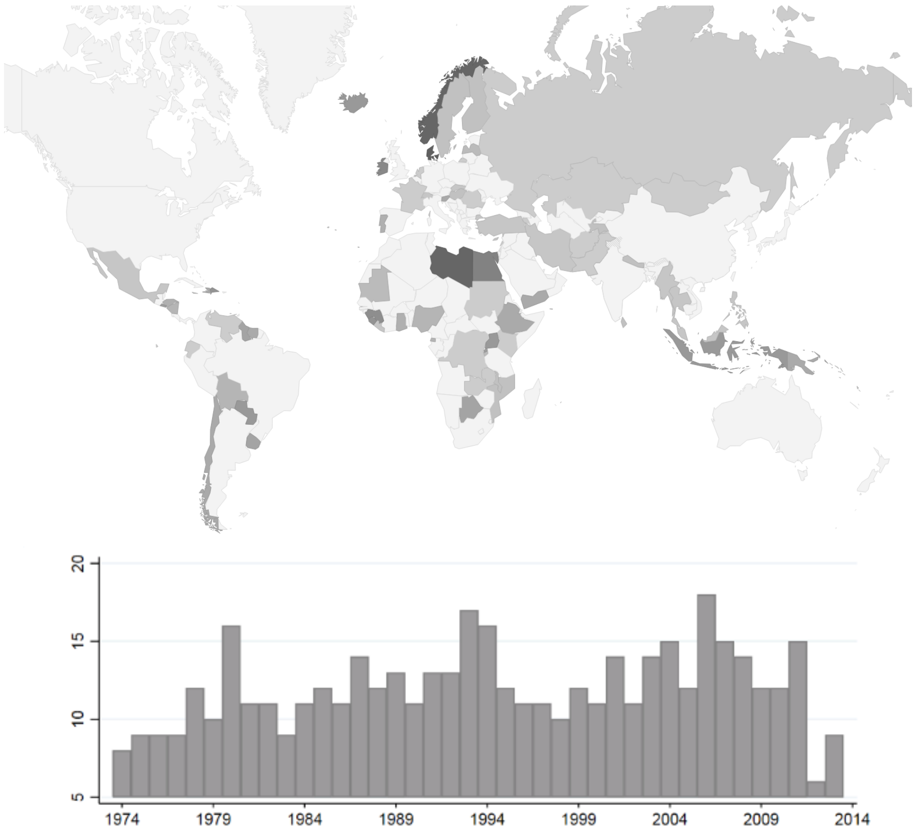

Figure B.3.1 — RR class. "*Intermediate*" and LYS class. "*Fixed*"
Notes: The map (top) displays the countries' coverage and the frequency (as reflected by the shades) of disagreements. The bottom chart displays the number of disagreement by year.

first notice that 40 of the 304 remaining disagreement points coincide with a difference in the reference currency against which the exchange rate volatility is measured.[45] Furthermore, among the 264 remaining disagreement points, 120 can be associated with the parallel market exchange rate in the RR classification. However, among these disagreement points, few display high premia. This fact indicates that the differences between the two classifications in the definition of the threshold values delimiting the ERR categories and/or in the time horizon —over which the exchange rate volatility is measured— can also be considered as potential suspects.[46]

[45]Also note that difference in the reference currency concerns 41 points labeled *Inconclusive*, 1 point labeled *Outlier*, 24 points classified in the second round, and 29 points labeled *Uncontroversial*.

[46]Only 32 (resp. 46) display premia higher than 10% (resp. 5%).

B.4. RR class. "*Intermediate*" and LYS class. "*Float*"

This fourth configuration is by far the one with the highest number of disagreement observations (888 points). It represents 41.7% of the total number of disagreements and covers 108 countries. As can be seen (Figure B.4.1), Canada and India have the highest number of disagreement points (both countries have 25 disagreement points). They are closely followed by Israel (21 points), Colombia-Malaysia-Switzerland (20 points), and Guatemala-Pakistan-Philippines-Sri Lanka-Tunisia (19 points).

Differences in the reference currency against which the nominal exchange rates volatility is calculated explain only 105 disagreement points. The remaining disagreement points do not present any particularity that could be used to isolate specific observations, such as observations labeled *inconclusive* and/or *uncontroversial*. However, the nature of the disagreements gives some intuitions regarding their sources. Specifically, they could be here related to either the way exchange rate dynamics are assessed or the use of the official reserves or even both. Hence, we are forced at this stage of the analysis to adopt a step-by-step approach for the sake of simplicity. Moreover, to facilitate the analysis, we here take a different approach consisting of comparing observations classified *Intermediate* by the two classifications (i.e. consensual *Intermediate* ERR) and observations classified *Float* by the LYS classification but *Intermediate* in the RR. Doing so allows us to compare the dynamics of the key variables for the two groups since, in the LYS classification, the *Float* ERR is associated with highly volatile exchange rates (both in changes and levels) and stable reserves, while the *Intermediate* ERR is associated with highly volatile reserves and exchange rates.[47]

Noticing that the RR classification categories 8 and 10 (resp. "*de facto* crawling band that is narrower than or equal to +/-2%" and "*de facto* crawling band that is narrower than or equal to +/-5%") are those the more affected by the disagreements leads us to focus on the exchange rate volatility. We investigate the effect of using the parallel market premium in the RR classification by comparing the volatility in the changes of both the official and parallel market exchange rates. Among the remaining observations, 347 are associated with the parallel market exchange rate in the RR classification instead of the official in the LYS classification. Moreover, the correlation between the volatility

[47]Except *crawling pegs* which are associated with low volatility of the exchange rate changes.

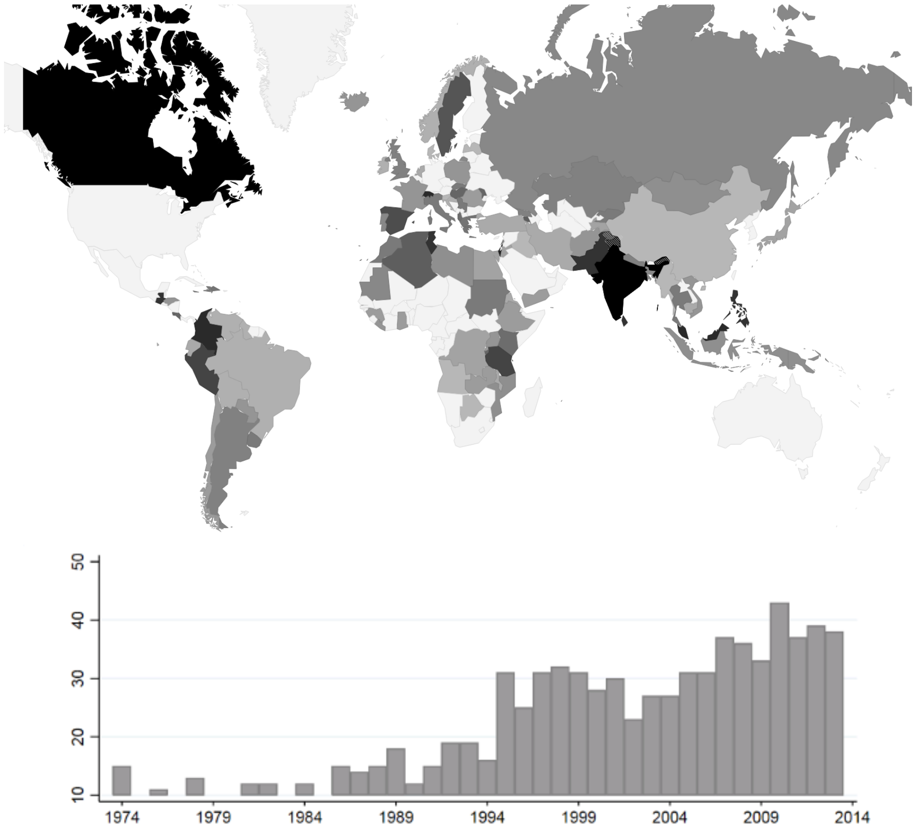

Figure B.4.1 — RR class. "*Intermediate*" and LYS class. "*Float*"
Notes: The map (top) displays the countries' coverage and the frequency (as reflected by the shades) of disagreements. The bottom chart displays the number of disagreement by year.

of parallel market exchange rate movements and that of the official one is low (0.21 on average), arguing, therefore, in favor of using the parallel market exchange rate as a possible explanation for the disagreements.[48] However, this explanation should not hide the potential role of the threshold values delimiting the ERR categories, which are higher in the LYS classification than in the RR classification. Regarding the role that might be played by the use of the official reserves' volatility, we cannot, at this stage, go further than make an assumption. This issue will be addressed further in the empirical analysis as it requires keeping all other variables constant.

B.5. RR class. "*Float*" and LYS class. "*Fixed*"

Among the 151 disagreement points included in this fifth configuration, only 22 observations are labeled as *Uncontroversial* (China in 1987 and 1988; Iraq from 1983 to

[48]We, however, found correlations higher than 0.90 regarding the exchange rate changes.

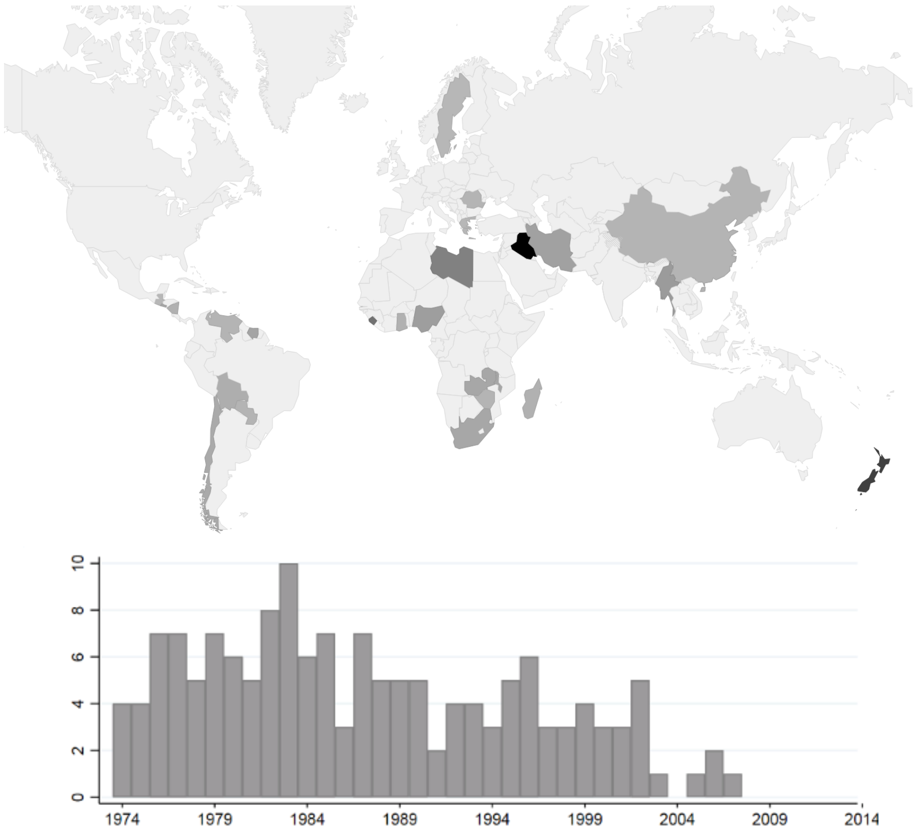

Figure B.5.1 — RR class. "*Float*" and LYS class. "*Fixed*"
Notes: The map (top) displays the countries' coverage and the frequency (as reflected by the shades) of disagreements. The bottom chart displays the number of disagreement by year.

2002), and 38 are labeled as *Fixed inconclusives* in the LYS classification.[49] Removing these 60 data points leaves 91 observations, among which 7 are considered outliers and 27 points are classified via the second round procedure. New Zealand is the country the more concerned by this type of disagreements (i.e. *Fixed* in LYS but *Float* in RR) with 16 points between 1985 and 2006, followed by Sierra Leone (13 points), Libya (10 points) and Nigeria (9 points).

The case of New Zealand appears to be driven by the difference between the two classifications regarding the reference currency against which the exchange rate volatility is measured. Indeed, the RR classification uses as the reference currency the Australian dollar while the LYS classification uses the US dollar. The reference currency's difference also seems to explain the disagreement between the two classifications for Sierra Leone

[49]These points correspond to: Bolivia (1975-76, 1978), El Salvador (1984-85, 1987-89), Guatemala (1987), Iran (1979, 1982-84, 90, 96, 99), Myanmar (1976, 78, 80-84, 92, 95), Paraguay (1982-1983), Suriname (1982-85, 88-90), Venezuela (1983-85).

between 1974 and 1981 (except 1978).[50] Overall, 26 disagreement points can be explained by the difference in the reference currency.

This leaves 66 data points, among which 41 are associated with exchange rate premia greater than or equal to 10% with a correlation between the official and the parallel market exchange rates varying between -0.4 and 1. Hence, for some countries, the use of parallel market exchange rates in the RR classification could also be at stake.

B.6. RR class. "*Float*" and LYS class. "*Intermediate*"

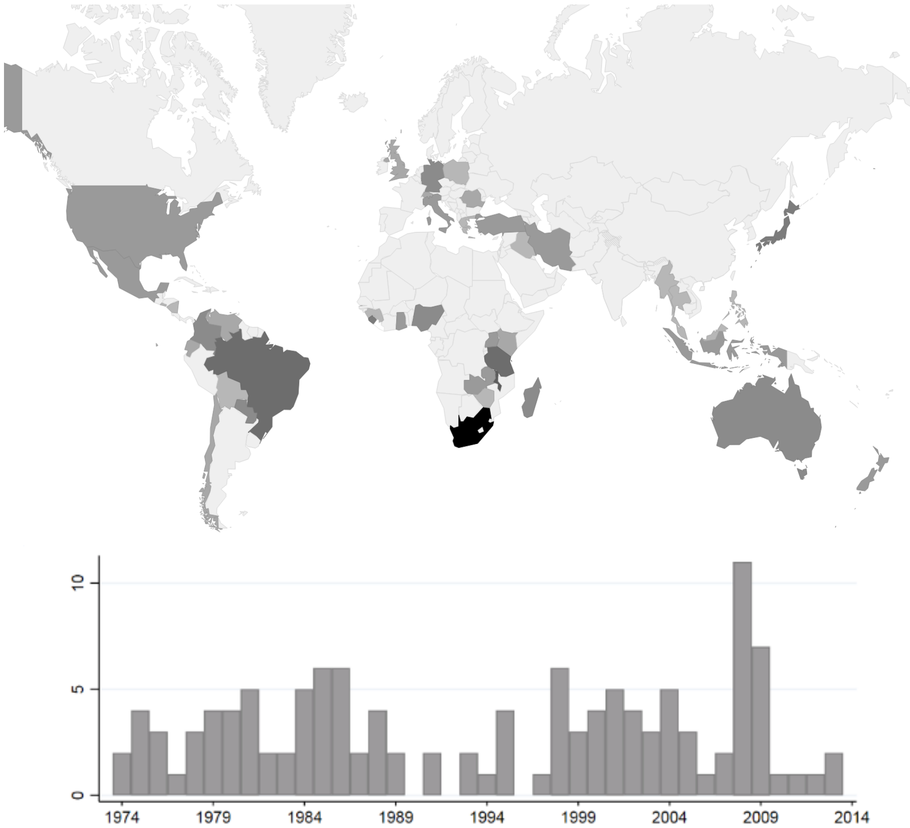

Figure B.6.1 — RR class. "*Float*" and LYS class. "*Intermediate*"
Notes: The map (top) displays the countries' coverage and the frequency (as reflected by the shades) of disagreements. The bottom chart displays the number of disagreement by year.

As can be seen in Table 5, the last type of disagreements consists of relatively few observations. Indeed, only 124 observations are classified as *Float* by the RR classification while being classified as *Intermediate* by the LYS classifications. South Africa appears as the country the more concerned by this disagreement (12 points). It is followed by

[50]Greece in 1982 and Myanmar in 1979 are also concerned.

Malawi (7 points), Brazil, and Tanzania (6 points for each of these countries). Among these 124 disagreement points, 38 are related to a divergence in the reference currency against which the exchange rate volatility is measured.[51]

The remaining 86 data points share the particularity to be all classified as "Dirty float/Crawling peg" (LYS 3-way classification, category 2).[52] This category differs from the *Float* regime —in the LYS classification— due to the volatility of exchange rate changes and the volatility of official reserves. As in subsection 3.4, disentangling the effects of each factor proves to be a difficult/impossible task for such a descriptive analysis. This issue will then also be addressed further in the econometric analysis.

[51]These points correspond to Australia, Germany, Greece, Iran, Italy, Japan, Madagascar, Myanmar, New Zealand, Romania, Sierra Leone, Switzerland, Tanzania, the United Kingdom, the United States, Uganda, and Zambia.

[52]In the RR classification, there are 78 (resp. 7) points in the "Managed floating" (resp. "Freely floating") category.

C. Additional results

C.1. Testing the randomness of the agreements

Given that broadly speaking half the time the two classifications disagree, we deemed relevant to test the randomness of the concordances between the classifications. Indeed, it does not make sense to explain why the classifications diverge if the concordant observations are themselves random. Say differently, before going any further, we have to ensure that we are not seeking logic where there might be none. To do so, we compare our dependent variable —scoring 0 when the LYS and RR classifications concord, 1 otherwise— with simulated variables. More specifically, we draw respectively N —ranging from 1000 to 10000 with an increment of 1000— random dichotomous (0;1) variables of 5011 observations each time and compute for each of the simulated variable the concordance rate with our dependent variable. The distributions of the obtained concordance rates per number of draws are reported in Figure C.1.1. As can be seen, regardless the number of draws, the distribution appears centered around 0.5 suggesting that the simulated data only coincides —in average—with half of the observations of the dependent variable. Given the considerable number of draws, one can therefore conclude that the concordance points between the LYS and the RR classifications are not random. Similar results are obtained when considering the analysis sample.

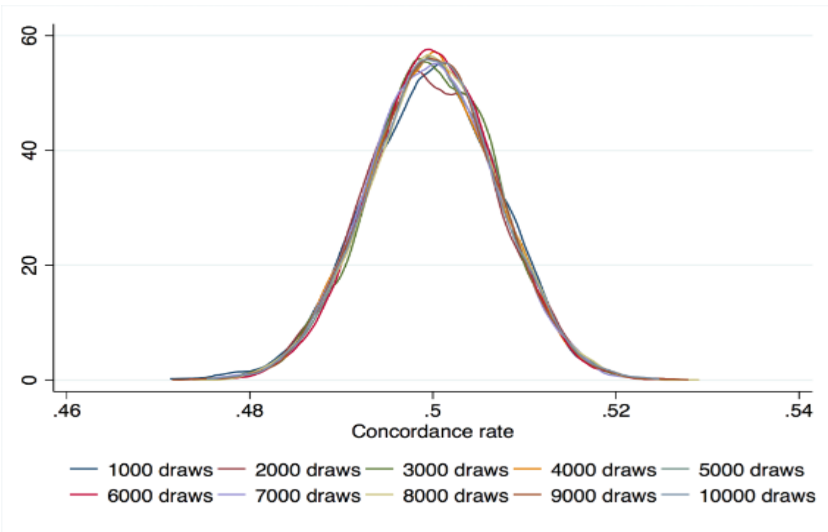

Figure C.1.1 — Distributions of the concordance rates with the simulated data

C.2. Coping with the multicollinearity between the LYS exchange rate volatility measures

Table C.2.1 — Principal components (eigenvalues)

Component	Eigenvalue	Difference	Proportion	Cumulative
Component 1	1.95029	1.90058	0.9751	0.9751
Component 2	0.0497084	.	0.0249	1.0000

Table C.2.2 — Principal components (eigenvectors)

Variable	Component 1	Component 2	Unexplained
Volatility of the ER	0.7071	0.7071	0
Volatility of the ER change	0.7071	-0.7071	0

C.3. Alternative estimation procedures (*Floating* ERR sample)

The issue we address in this appendix is related to the disequilibrium of our dependent variable's categories in the $Float$ ERR sample (146 "0" and 1047 "1") and the potential associated bias. The problem is not specifically the rarity of events, but rather the relatively small number of cases on the rarer of the two outcomes. To assess whether our Probit model-based estimates are biased, we relied on penalized-Logit (Firth method) designed for rare events. To enable comparison —and so to assess the extent of the correction in the penalized-Logit, we also reported Logit estimates.

Instead of comparing the different coefficients (more specifically converted coefficients), we follow Amemiya (1981) and focus on the probabilities. Figure C.3.1 plots in this regards the different estimated probabilities of disagreements —as well as the distributions (kernel estimates) of these probabilities. As can be seen, the simulated probabilities are similar hence indicating that our Probit estimates are not plagued by the disequilibrium of our dependent variable categories.

Table C.3.1 — Logit estimations (*Floating* ERR sample)

Estimation proc.	Logit			Probit
	Robust	No correction	Penalized#	
	Betas (Std. Err.)	Betas (Std. Err.)	Betas (Std. Err.)	Betas (Std. Err.)
Horizon/Premium	-0.591***	-0.591***	-0.593***	-0.346***
	(0.107)	(0.109)	(0.106)	(0.064)
E.R. volatility	-1.282 ***	-1.281***	-1.217***	-0.773***
	(0.394)	(0.268)	(0.241)	(0.182)
Reserves	-16.376***	-16.376	-5.105***	-6.237***
	(0.556)	(386.78)	(1.456)	(0.519)
Outlier	7.469	7.469	4.651	4.817**
	(4.889)	(1140.6)	(3.314)	(2.264)
Round 2	2.015***	2.016***	1.974***	0.922***
	(0.472)	(0.433)	(0.416)	(0.198)
Constant	18.062***	18.062	6.775***	7.258***
	(0.593)	(386.81)	(1.462)	(0.538)
Pseudo R^2	0.1518	0.1518		0.1546
Log likelihood	-376.08	-376.08	-370.95	-374.81

Notes: “*Betas*” stand for standardized coefficients (except dummy variables). “***” (resp. “**” and “*”) indicates statistical significance at 1% (resp. 5% and 10%). Robust standard errors are reported in parentheses. "Equiv." corresponds to the ratio between the considered Logit model and Probit coefficients. #: Firthlogit method.

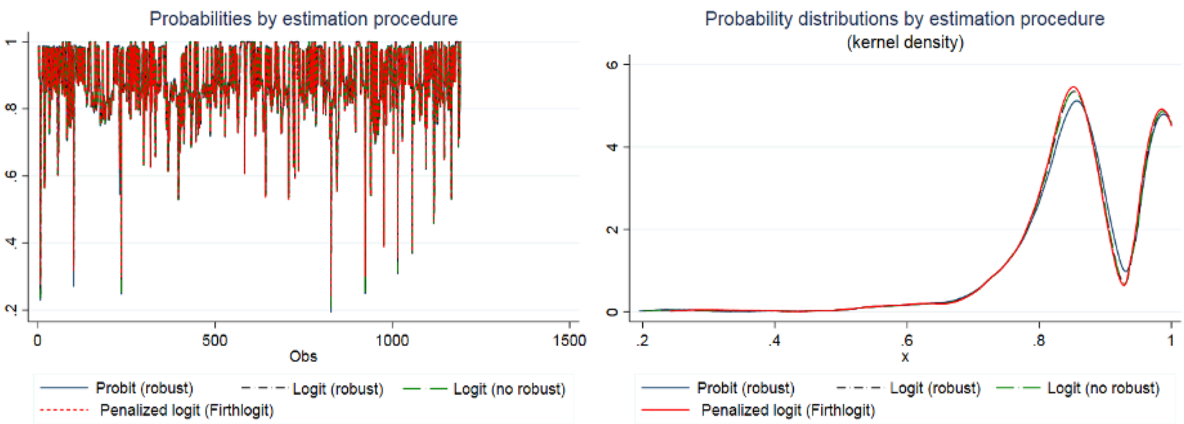

Figure C.3.1 — The different estimation procedures and the simulated probabilities

C.4. Variable correlations

Table C.4.1 — Correlations between the regressors

	Horizon/Premium	ER. Volatility	Reserves	Outlier	Round 2
Fixed ERR sample					
Horizon/Premium	1.0000				
ER. Volatility	-0.3943 (0.000)	1.0000			
Reserves	-0.0117 (0.642)	0.0157 (0.533)	1.0000		
Outlier	-0.1547 (0.000)	0.1340 (0.000)	-0.0612 (0.015)	1.0000	
Round 2	0.0684 (0.007)	-0.1132 (0.000)	-0.0844 (0.001)	-0.2733 (0.000)	1.0000
Lower Intermediate ERR sample					
Horizon/Premium	1.0000				
ER. Volatility	-0.3369 (0.000)	1.0000			
Outlier	-0.3418 (0.000)	0.2651 (0.000)	. .	1.0000	
Round 2	0.3222 (0.000)	-0.2747 (0.0000)	. .	-0.3193 (0.000)	1.0000
Upper Intermediate ERR sample					
Horizon/Premium	1.0000				
ER. Volatility	-0.6489 (0.000)	1.0000			
Reserves	0.0745 (0.006)	-0.1575 (0.000)	1.0000		
Outlier	-0.3304 (0.000)	0.6109 (0.000)	-0.1329 (0.000)	1.0000	
Round 2	0.2447 (0.000)	-0.3921 (0.000)	-0.3864 (0.000)	-0.0993 (0.000)	1.0000
(Full) Intermediate ERR sample					
Horizon/Premium	1.0000				
ER. Volatility	-0.3525 (0.000)	1.0000			
Reserves	-0.0017 (0.942)	-0.0744 (0.001)	1.0000		
Outlier	-0.2718 (0.000)	0.2927 (0.000)	-0.1749 (0.000)	1.0000	
Round 2	0.2215 (0.007)	-0.2408 (0.000)	-0.2494 (0.000)	-0.1660 (0.000)	1.0000
Floating ERR sample					
Horizon/Premium	1.0000				
ER. Volatility	-0.4993 (0.000)	1.0000			
Reserves	-0.1438 (0.000)	-0.3083 (0.000)	1.0000		
Outlier	-0.1630 (0.000)	0.4501 (0.000)	-0.2523 (0.000)	1.0000	
Round 2	0.1822 (0.000)	-0.3097 (0.000)	0.0272 (0.356)	-0.0574 (0.0477)	1.0000

Note: *p*.values are reported in parentheses.

C.5. Identification of the sample-specific sources of disagreements

C.5.1. Summary of the sequential approach results

Table C.5.1.1 — *Fixed* ERR sample

Dependent variable:		**Y = 0**		**Y = 1**	
No. observations:		979		590	
(Percentage)		(62.40)		(37.60)	
Ω		**TN**	**FP**	**TP**	**FN**
		$Pr^{adj}(\hat{Y}_i) = \Omega$			
Model:					
All factors	Obs.	781	198	390	200
Pseudo-$R^2 = 0.1545$	(%)	(79.78)	(20.22)	(66.10)	(33.90)
Excluding ...					
Horizon and/or Premium	Obs.	765	84	366	194
Pseudo-$R^2 = 0.1381$	(%)	(97.95)	(42.42)	(93.85)	(97.0)
E.R. volatility	Obs.	602	187	388	177
Pseudo-$R^2 = 0.1290$	(%)	(77.08)	(94.44)	(99.49)	(88.50)
Reserves	Obs.	781	196	354	199
Pseudo-$R^2 = 0.0698$	(%)	(100)	(98.99)	(90.77)	(99.50)
Round 2	Obs.	460	198	309	22
Pseudo-$R^2 = 0.1298$	(%)	(58.90)	(100)	(79.23)	(11.0)

Notes: The percentage of the observations in models excluding a variable are calculated relative to the number of observations in the full models —i.e. “All factors”.

Table C.5.1.2 — Lower *Intermediate* ERR sample

Dependent variable:		**Y = 0**		**Y = 1**	
No. observations:		460		434	
(Percentage)		(51.45)		(48.55)	
Ω		**TN**	**FP**	**TP**	**FN**
		$Pr^{adj}(\hat{Y}_i) = \Omega$			
Model:					
All factors	Obs.	410	50	241	193
Pseudo-$R^2 = 0.1471$	(%)	(89.13)	(10.87)	(55.53)	(44.47)
Excluding ...					
Horizon and/or Premium	Obs.	407	10	227	191
Pseudo-$R^2 = 0.1183$	(%)	(99.27)	(20.0)	(94.19)	(98.96)
Outlier	Obs.	410	43	225	193
Pseudo-$R^2 = 0.1367$	(%)	(100)	(86.0)	(93.36)	(100)
Round 2	Obs.	261	21	129	102
Pseudo-$R^2 = 0.0888$	(%)	(63.66)	(42.0)	(53.53)	(52.85)

Notes: The percentage of the observations in models excluding a variable are calculated relative to the number of observations in the full models —i.e. “All factors”.

Table C.5.1.3 — Upper *Intermediate* ERR sample

Dependent variable:		**Y = 0**		**Y = 1**	
No. observations:		460		891	
(Percentage)		(34.05)		(65.95)	
Ω		**TN**	**FP**	**TP**	**FN**
		$Pr^{adj}(\hat{Y}_i) = \Omega$			
Model:					
All factors	Obs.	450	10	833	58
Pseudo-R^2 = 0.8279	(%)	(97.83)	(2.17)	(93.49)	(6.51)
Excluding ...					
Horizon and/or Premium	Obs.	450	0	806	57
Pseudo-R^2 = 0.8058	(%)	(100.0)	(0.0)	(96.76)	(98.28)
E.R. volatility	Obs.	450	6	820	57
Pseudo-R^2 = 0.8103	(%)	(100.0)	(60.0)	(98.44)	(98.28)
Reserves	Obs.	444	5	561	50
Pseudo-R^2 = 0.2301	(%)	(98.67)	(50.0)	(67.35)	(86.21)
Outlier	Obs.	450	1	808	57
Pseudo-R^2 = 0.8218	(%)	(100.0)	(10.0)	(97.0)	(98.28)
Round 2	Obs.	449	1	807	57
Pseudo-R^2 = 0.7960	(%)	(99.78)	(10.0)	(96.88)	(98.28)

Notes: The percentage of the observations in models excluding a variable are calculated relative to the number of observations in the full models —i.e. “All factors”.

Table C.5.1.4 — Full *Intermediate* ERR sample

Dependent variable:		**Y = 0**		**Y = 1**	
No. observations:		460		1481	
(Percentage)		(23.70)		(76.30)	
Ω		**TN**	**FP**	**TP**	**FN**
		$Pr^{adj}(\hat{Y}_i) = \Omega$			
Model:					
All factors	Obs.	430	30	1200	281
Pseudo-R^2 = 0.4482	(%)	(93.48)	(6.52)	(81.03)	(18.97)
Excluding ...					
Horizon and/or Premium	Obs.	361	29	1196	209
Pseudo-R^2 = 0.4172	(%)	(83.95)	(96.67)	(99.67)	(74.38)
Reserves	Obs.	415	28	907	251
Pseudo-R^2 = 0.1762	(%)	(96.51)	(93.33)	(75.58)	(89.32)
Outlier	Obs.	430	9	1026	280
Pseudo-R^2 = 0.4430	(%)	(100.0)	(30.0)	(85.50)	(99.64)
Round 2	Obs.	421	7	967	256
Pseudo-R^2 = 0.3466	(%)	(97.91)	(23.33)	(80.58)	(91.10)

Notes: The percentage of the observations in models excluding a variable are calculated relative to the number of observations in the full models —i.e. “All factors”.

C.5.1.5 — *Floating* ERR sample

Dependent variable:		**Y = 0**		**Y = 1**	
No. observations:		146		1047	
(Percentage)		(12.24)		(87.76)	
Ω		**TN**	**FP**	**TP**	**FN**
		$Pr^{adj}(\hat{Y}_i) = \Omega$			
Model:					
All factors	Obs.	123	23	731	316
Pseudo-R^2 = 0.1546	(%)	(84.25)	(15.75)	(69.82)	(30.18)
Excluding ...					
Horizon and/or Premium	Obs.	109	13	604	225
Pseudo-R^2 = 0.1238	(%)	(88.62)	(56.52)	(82.63)	(71.20)
E.R. volatility	Obs.	105	10	546	245
Pseudo-R^2 = 0.1246	(%)	(85.37)	(43.48)	(74.69)	(77.53)
Reserves	Obs.	119	14	571	277
Pseudo-R^2 = 0.0733	(%)	(96.75)	(60.87)	(78.11)	(87.66)
Round 2	Obs.	120	19	685	293
Pseudo-R^2 = 0.1193	(%)	(97.56)	(82.61)	(93.71)	(92.72)

Notes: The percentage of the observations in models excluding a variable are calculated relative to the number of observations in the full models —i.e. “All factors”.

Table C.5.1.6 — The sample-specific sources of disagreements (summary)

Variables	Estimation sample				
	Fixed	Intermediate			Float
		Lower	*Upper*	*Full*	
ER. Volatility	2 (0.34)	—	—	—	123 (11.75)
Horizon and/or Premium	19 (3.22)	8 (1.84)	—	—	69 (6.59)
Multiple	333 (56.44)	105 (24.19)	550 (61.73)	74 (47.44)	334 (31.90)
Outlier	—	16 (3.69)	—	4 (2.56)	—
Reserves	36 (6.10)	—	257 (28.84)	35 (22.44)	159 (15.19)
Round 2	—	112 (25.81)	26 (2.92)	20 (12.82)	46 (4.39)
Total model (TP)	390 (66.10)	241 (55.53)	833 (93.49)	133 (85.26)	731 (69.82)
Diff. in thresholds (FN)	200 (33.90)	193 (44.47)	58 (6.51)	23 (14.74)	316 (30.18)
Total (TP+FN)	590	434	891	156	1047

Note: Entries correspond to the frequencies of the occurrence. Percentages (of the total number of occurrence) are reported in parentheses. Omitted variables have 0 occurrence —or have been discarded following the likelihood ratio test. FN (resp. TP) stands for false negative (resp. true positive).

C.5.2. Auxiliary analyses

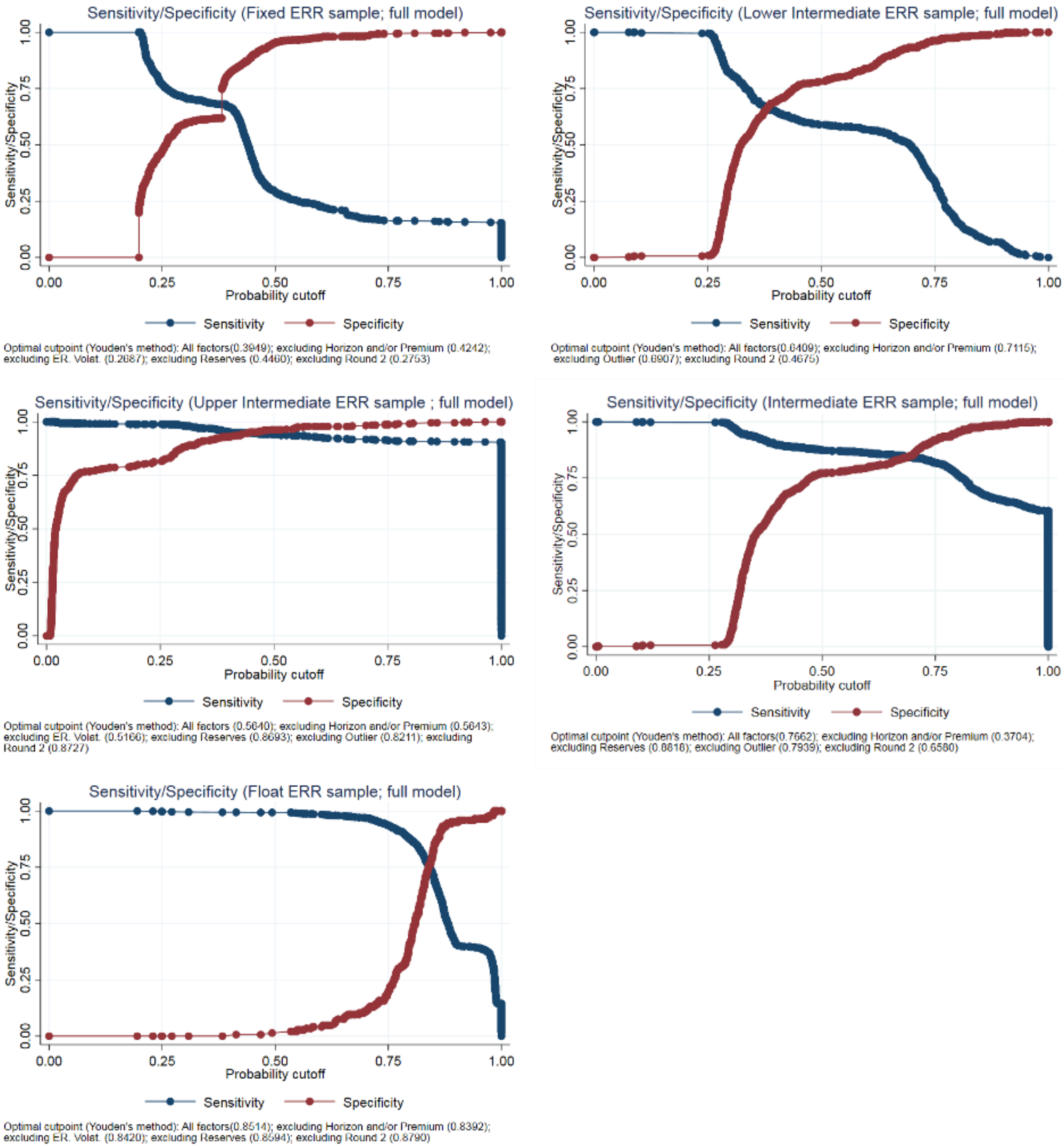

Figure C.5.2.1 — Sensitivity/Specificity *vs.* probability cutoff (by estimation sample)

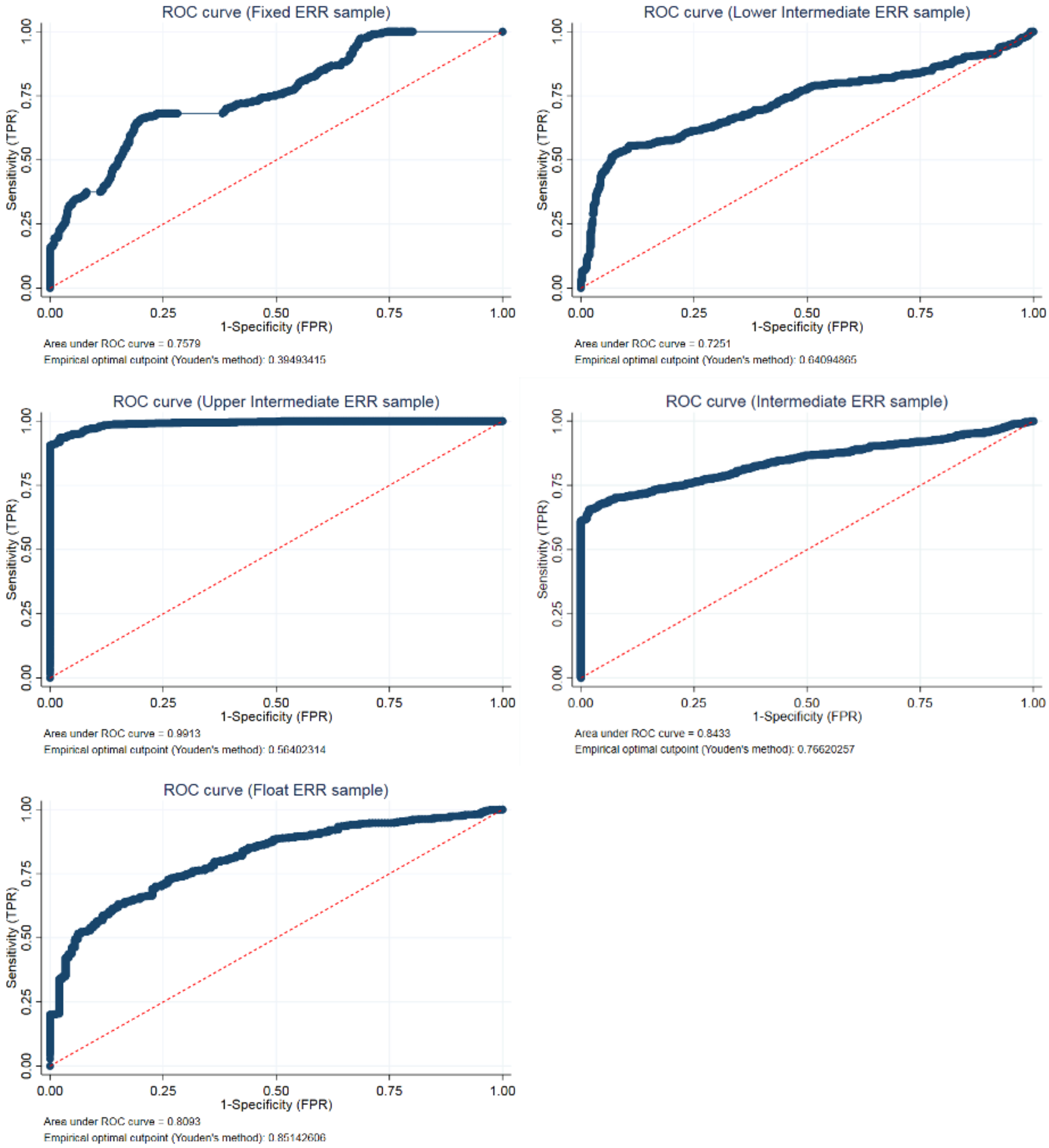

Figure C.5.2.2 — ROC curve (by estimation sample)

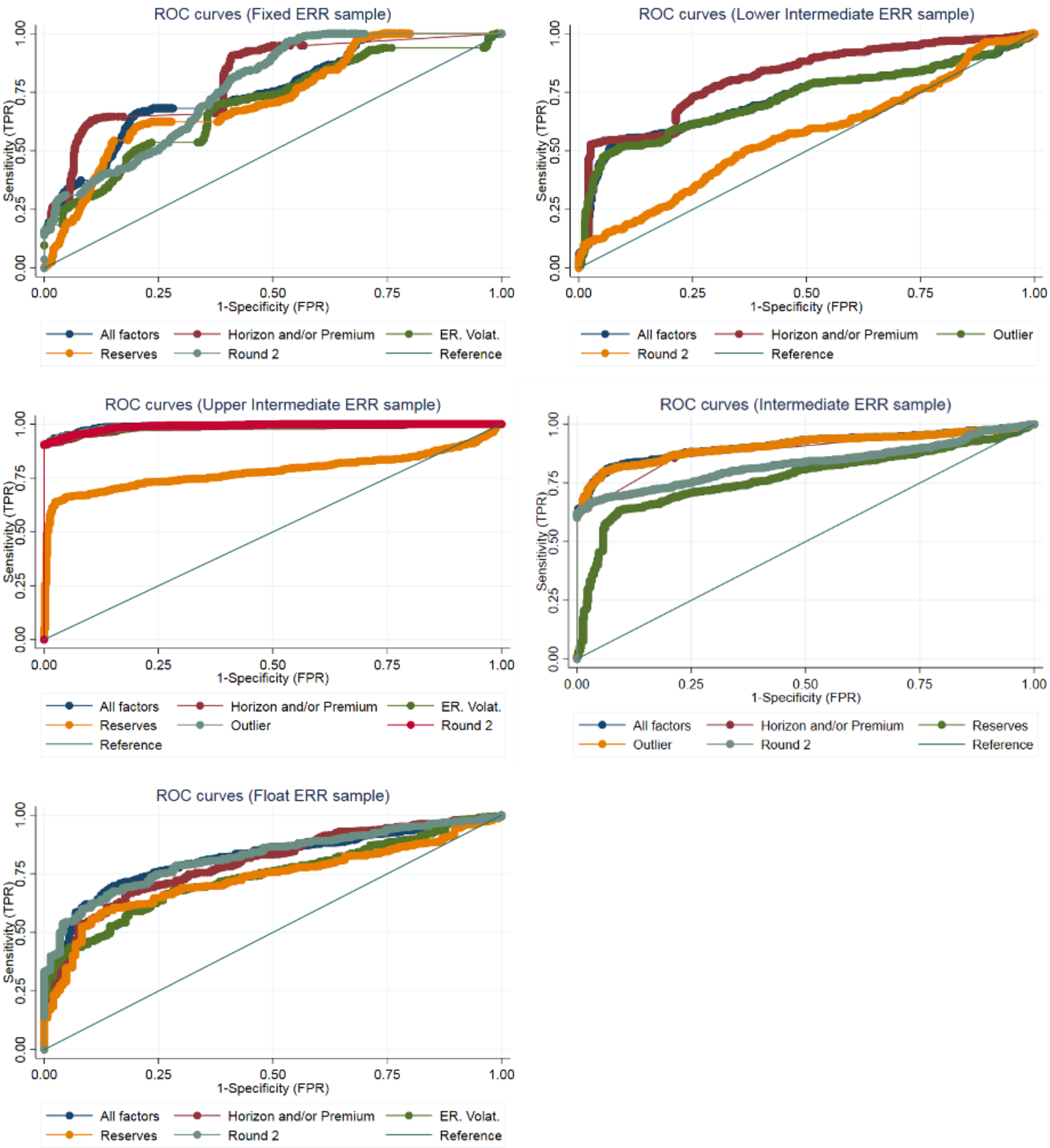

Figure C.5.2.3 — Models and ROC areas (by estimation sample)

Table C.5.2.1 — LR tests

Excluded variable	Fixed	Intermediate *Lower*	Intermediate *Upper*	Intermediate *Full*	Float
Horizon and/or Premium	33.94	35.70	38.36	58.83	27.32
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
E.R. volatility	52.94	3.29	30.56	0.65	26.64
	[0.000]	[0.069]	[0.000]	[0.421]	[0.000]
Reserves	175.97		1035.95	574.09	72.11
	[0.000]		[0.000]	[0.000]	[0.000]
Outlier	2.59	12.86	10.65	11.81	0.00
	[0.1074]	[0.001]	[0.001]	[0.001]	[0.999]
Round 2	51.25	146.55	55.35	206.12	31.36
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

Null: $Model_X$ is nested in $Model_{All factors}$. p.values are reported in brackets.

Table C.5.2.2 — Models and ROC area difference tests (*Fixed* ERR sample)

Model	ROC Area	Std. Err.	χ^2	*df*	*Pr.* $> \chi^2$	Bonferroni *Pr.* $> \chi^2$
All factors (standard)	0.7579	0.0124				
Horizon and/or Premium	0.8113	0.0111	52.7827	1	0.0000	0.0000
ER. volatility	0.6965	0.0138	109.4397	1	0.0000	0.0000
Reserves	0.7227	0.0131	32.9347	1	0.0000	0.0000
Round 2	0.7697	0.0115	1.8496	1	0.1738	0.6953

Note: "Std. Err." stands for standard error. χ^2 indicates the chi-squared statistics associated to the test. "*df*" stands for degree of freedom. The different areas are compared to the full model ROC area.

Table C.5.2.3 — Models and ROC area difference tests (Lower *Intermediate* ERR sample)

Model	ROC Area	Std. Err.	χ^2	*df*	*Pr.* $> \chi^2$	Bonferroni *Pr.* $> \chi^2$
All factors (standard)	0.7251	0.0176				
Horizon and/or Premium	0.8114	0.0144	53.0203	1	0.0000	0.0000
Outlier	0.7218	0.0176	0.8809	1	0.3480	1.0000
Round 2	0.5620	0.0193	59.4244	1	0.0000	0.0000

Note: "Std. Err." stands for standard error. χ^2 indicates the chi-squared statistics associated to the test. "*df*" stands for degree of freedom. The different areas are compared to the full model ROC area.

Table C.5.2.4 — Models and ROC area difference tests (Upper *Intermediate* ERR sample)

Model	ROC Area	Std. Err.	χ^2	*df*	*Pr.* $> \chi^2$	Bonferroni *Pr.* $> \chi^2$
All factors (standard)	0.9913	0.0017				
Horizon and/or Premium	0.9856	0.0026	12.8243	1	0.0003	0.0017
ER. volatility	0.9885	0.0021	4.6350	1	0.0313	0.1566
Reserves	0.7824	0.0125	286.5396	1	0.0000	0.0000
Outlier	0.9901	0.0018	5.9568	1	0.0147	0.0733
Round 2	0.9898	0.0018	4.1107	1	0.0426	0.2131

Note: "Std. Err." stands for standard error. χ^2 indicates the chi-squared statistics associated to the test. "*df*" stands for degree of freedom. The different areas are compared to the full model ROC area.

Table C.5.2.5 — Models and ROC area difference tests (Full *Intermediate* ERR sample)

Model	ROC Area	Std. Err.	χ^2	*df*	$Pr. > \chi^2$	Bonferroni $Pr. > \chi^2$
All factors (standard)	0.9085	0.0065				
Horizon and/or Premium	0.8870	0.0066	30.6812	1	0.0000	0.0000
Reserves	0.7732	0.0110	264.9763	1	0.0000	0.0000
Outlier	0.9069	0.0066	1.9547	1	0.1621	0.6483
Round 2	0.8312	0.0088	90.7793	1	0.0000	0.0000

Note: “Std. Err.” stands for standard error. χ^2 indicates the chi-squared statistics associated to the test. “*df*” stands for degree of freedom. The different areas are compared to the full model ROC area.

Table C.5.2.6 — Models and ROC area difference tests (*Floating* ERR sample)

Model	ROC Area	Std. Err.	χ^2	*df*	$Pr. > \chi^2$	Bonferroni $Pr. > \chi^2$
All factors (standard)	0.8160	0.0151				
Horizon and/or Premium	0.7939	0.0173	2.7442	1	0.0976	0.3904
ER. volatility	0.7382	0.0175	32.1552	1	0.0000	0.0000
Reserves	0.7296	0.0176	84.8478	1	0.0000	0.0000
Round 2	0.8194	0.0146	0.2420	1	0.6228	1.0000

Note: “Std. Err.” stands for standard error. χ^2 indicates the chi-squared statistics associated to the test. “*df*” stands for degree of freedom. The different areas are compared to the full model ROC area.

C.6. Empirical implications of the synthesis classification (supplementary materials)

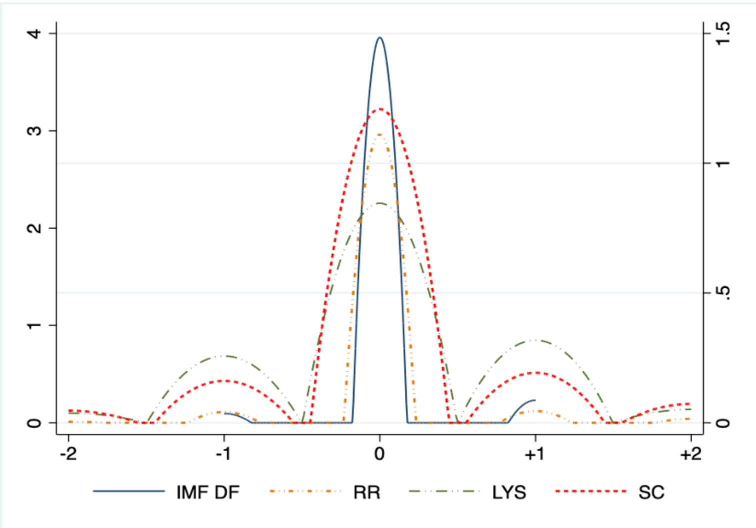

Figure C.6.1 — Change in the ERR in the run-up to a crisis ($t-2$ and $t-1$)

Notes: t corresponds to a crisis year. The x-axis graduations indicate the importance and direction of the regime changes. We consider the different types of crisis defined by Laeven and Valencia (2013).

Figure C.6.2 — Exchange rate regimes, growth and inflation performances

Notes: Entries correspond to the 5% trimmed means and are expressed in percentage. *Growth volatility* is calculated as three-year centered moving standard deviation of real per capita GDP growth. For *Inflation*, we drop the hyperinflation periods —defined as years with inflation above 50%— and currency crisis periods —from t to $t+2$ with t the year of a crisis (see Laeven and Valencia (2013) for the definition of crisis).

Table C.6.1 — Exchange rate regimes, growth and inflation performances

		Average annual real per capita GDP growth				**Average annual growth volatility**				**Inflation**			
		All	AEs	EMEs	DCs	All	AEs	EMEs	DCs	All	AEs	EMEs	DCs
IMF DF	*Fix*	1.39	1.29	2.55	1.07	2.92	2.03	3.04	3.21	4.40	2.50	3.77	5.41
IMF DF	*Intermediate*	2.40	2.45	2.72	2.07	2.55	1.74	2.52	2.98	8.32	6.93	9.16	8.18
IMF DF	*Floating*	2.73	2.11	2.99	2.99	2.12	1.65	2.03	2.60	6.78	3.64	7.32	9.04
IMF DJ	*Fix*	1.61	1.02	2.94	2.57	3.04	3.45	2.92	1.49	4.95	5.81	4.10	2.85
IMF DJ	*Intermediate*	2.71	2.26	2.53	1.72	2.84	2.67	1.70	3.13	10.03	8.53	6.28	8.63
IMF DJ	*Floating*	3.09	2.51	2.86	2.87	1.77	1.59	1.94	2.49	8.48	5.14	7.72	9.11
LYS	*Fix*	2.42	1.58	1.97	2.72	2.89	3.11	2.92	2.15	6.89	6.78	6.50	4.65
LYS	*Intermediate*	2.59	2.98	2.14	2.36	2.32	2.34	1.94	2.49	8.25	8.65	5.86	9.12
LYS	*Floating*	2.97	2.49	3.05	1.67	2.09	2.10	2.76	1.68	8.13	6.89	9.28	4.25
OST	*Fix*	1.90	1.92	2.71	1.52	2.73	1.82	2.79	3.02	6.01	3.58	6.39	6.72
OST	*Intermediate*	3.12	2.56	3.41	3.25	2.12	1.76	2.55	2.02	7.29	5.08	8.03	8.16
OST	*Floating*	1.72	2.12	2.04	2.50	1.78	2.36	2.86	2.39	5.49	8.54	10.70	9.31
RR	*Fix*	1.89	1.89	2.72	1.54	2.06	2.88	3.11	3.09	3.63	5.72	5.75	6.55
RR	*Intermediate*	2.74	2.76	2.92	2.37	2.30	2.79	2.09	1.85	8.13	8.44	8.80	6.29
RR	*Floating*	2.31	1.96	1.78	1.62	2.30	2.01	1.48	2.56	9.16	7.45	3.55	12.60
SC	*Fix*	2.58	2.03	1.60	1.93	2.93	2.07	3.07	2.82	6.07	3.64	6.72	5.87
SC	*Intermediate*	2.61	2.33	2.79	2.83	2.43	2.80	1.82	2.26	9.04	9.24	6.83	9.57
SC	*Floating*	2.62	2.97	2.91	1.91	2.11	2.69	2.10	1.61	7.74	9.23	8.62	5.27

Notes: Entries correspond to the 5% trimmed means and are expressed in percentage. *Growth volatility* is calculated as three-year centered moving standard deviation of real per capita GDP growth. For *Inflation*, we drop the hyperinflation periods —defined as years with inflation above 50%— and currency crisis periods —from t to $t+2$ with t the year of a crisis (see Laeven and Valencia (2013) for the definition of crisis).

Figure C.6.3 — Exchange rate regimes and crisis probabilities

Notes: Probabilities are calculated by dividing the number of occurrences of a crisis under a particular regime by the total number of regime years. The data for crises are obtained from Laeven and Valencia (2013).

Table C.6.2 — Exchange rate regimes and crisis probabilities

		Banking crisis				Currency crisis				Debt crisis			
		All	AEs	EMEs	DCs	All	AEs	EMEs	DCs	All	AEs	EMEs	DCs
IMF DF	*Fix*	2.38	5.99	0.98	1.59	1.14	0.00	0.49	1.75	1.52	0.92	0.98	1.90
IMF DF	*Intermediate*	2.07	0.57	3.91	1.01	1.43	0.86	2.02	1.13	0.64	0.00	1.08	0.50
IMF DF	*Floating*	1.23	2.23	1.15	0.47	1.96	1.11	2.30	2.33	0.41	0.00	0.92	0.23
IMF DJ	*Fix*	1.70	2.12	1.64	0.00	1.70	2.34	0.82	0.00	1.70	2.34	0.82	0.00
IMF DJ	*Intermediate*	2.28	1.17	0.00	0.92	1.83	1.49	0.67	1.66	1.37	0.78	0.00	0.74
IMF DJ	*Floating*	4.43	1.24	2.46	1.05	3.16	1.24	2.29	2.11	1.05	0.00	0.51	0.26
LYS	*Fix*	1.79	1.09	1.27	1.04	0.18	0.70	0.56	0.69	1.25	1.17	1.03	0.00
LYS	*Intermediate*	4.15	3.93	10.64	1.09	5.49	5.14	1.42	8.00	0.67	1.51	0.00	0.00
LYS	*Floating*	2.85	1.67	1.10	0.92	1.71	0.91	0.27	0.55	0.38	0.42	0.55	0.37
OST	*Fix*	1.49	3.32	1.39	0.93	1.12	0.00	1.04	1.52	0.98	0.51	0.70	1.27
OST	*Intermediate*	1.32	0.00	1.21	2.28	0.30	0.38	0.00	0.51	0.20	0.00	0.30	0.25
OST	*Floating*	3.38	3.70	1.85	5.53	2.03	3.80	4.01	5.00	0.00	0.90	0.31	2.11
RR	*Fix*	3.50	1.73	1.80	1.07	0.00	0.99	1.00	1.34	0.50	0.94	0.40	1.34
RR	*Intermediate*	2.28	1.03	3.77	1.66	1.65	1.76	1.82	1.10	0.51	0.15	1.12	0.00
RR	*Floating*	1.00	1.32	1.42	1.68	4.50	3.20	1.42	4.20	2.00	0.94	0.00	0.84
SC	*Fix*	1.91	3.30	1.11	1.77	0.52	0.41	1.51	1.04	0.69	0.41	1.19	0.91
SC	*Intermediate*	2.72	1.05	3.41	4.20	3.18	2.79	1.14	4.20	1.06	0.00	0.00	2.45
SC	*Floating*	1.73	1.06	2.71	1.00	1.58	1.33	2.17	1.00	0.38	0.53	0.54	0.00

Notes: Probabilities are calculated by dividing the number of occurrences of a crisis under a particular regime by the total number of regime years. The data for crises are obtained from Laeven and Valencia (2013).