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The determinants of the choice of exchange rate regimes in Latin America: a mixed multinomial logit approach

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ABSTRACT

The choice of the exchange rate regime is one of the most significant monetary policy decisions that any economic authority has to make nowadays. Indeed, there have been many studies from a theoretical and empirical point of view, but the only common conclusion would be the lack of consensus. In the past this topic has been modeled by binary probit or cross-sectional multinomial logit models, both of which have weaknesses in the assumptions of the choices. In this paper, such issue is faced by means of a panel mixed multinomial logit model, which allows for substitution pattern among the three types of exchange rate regimes: fixed, intermediate, and flexible. Three types of choice determinants are explored: those stated by the Optimum Currency Area (OCA) theory, types of shocks and vulnerability to currency crises, using a sample of 21 Latin American countries for the period 1980-2004.

KEYWORDS: Exchange Rate Regimes, Optimum Currency Area, Shocks, Vulnerability to Crises, Latin America, Mixed Multinomial Logit Model.

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Introduction

The choice of the exchange rate regime (ERR hereafter) is one of the most relevant economic decisions that any economic authority has to face nowadays. Indeed, a wide empirical literature has arisen in order to identify the most important factors that determine this decision.

In a previous study (Alvarez et al. 2007) we have reviewed 41 papers in this field of research, extending and updating the survey of Juhn and Mauro (2002). In line with these authors, the main conclusion of our survey is the lack of a consensus with regard to the factors that affect the choice of a certain ERR. This is clearly observed in Table 1, which shows the main explanatory variables used in the 41 reviewed studies and the empirical findings with regard to the probability that such variables are significant and positively correlated with the choice of a free floating or flexible exchange rate regime. Table 1 shows that only one variable, the size of the economy, presents a clear influence in the choice of a flexible exchange rate regime along the 41 examined papers.

There are several reasons that may explain this failure (Alvarez et al., 2007). The first explanation takes into account the classification of exchange regimes. Many authors use the classification of the IMF. Since many problems come up with such classification, other alternatives as Reinhart and Rogoff (2003) or Levy-Yeyati and Sturzenegger (2003) are also commonly used.

A second possible explanation for the diversity in results is sample and explanatory variables choices. Measures for regime exchange determinants are especially diverse in the literature, due to the fact that there are many different definitions. For instance, this is the case of proxies for political instability.

Another problematic matter is related to the state-dependence effect. Traditional approaches consider that the choice of the exchange rate regime takes place in each period. Nonetheless, a most appropriate approach states that once the choice has been made, it will be kept until significant changes in the independent variables take place. In other words, the choice in each period is highly correlated with the past choice. The inclusion of such issues in the model may potentially be problematic in the estimation

Some other problems arise from possible multicolinearity between regressors, non-stationary time series, and the simultaneous estimation of long-term and short- term variables.

It is also important to take into account the differences in the employed econometric techniques. Given the nature of the dependent variable, discrete choice models (logit and probit) are mostly used. While some of these models impose strict independence among the choices, ERR classification into fixed, intermediate, and flexible is not always a clear issue.

Nonetheless, recent econometric developments have led to more flexible models, such as Mixed Logit, which allow to relax the assumption of independence among the choices (Hensher et al., 2005). Such feature makes this model appealing for the analysis of ERR determinants.

Within this framework, this paper examines the impact of several macroeconomic factors on the choice of exchange rate regimes by Latin American countries, using a Mixed Multinomial Logit with panel data which will allow us for substitution patterns among the considered ERR (fixed, intermediate, and flexible). In particular, we test the influence of three types of choice determinants: those stated by the Optimum Currency Area (OCA) theory, types of shocks and vulnerability to currency crises.

Table 1. **SURVEY OF EXPLANATORY VARIABLES IN EMPIRICAL LITERATURE**
(a positive coefficient indicates a trend towards a flexible exchange rate regime)

EXPLANATORY VARIABLES		POSITIVE* (+)	NEGATIVE (-)	NON-SIGNIFICANT	TOTAL
Optimum Currency area Theory Factors	Openness	12	19	10	41
	Economic development	10	5	6	21
	Size of the economy	21	2	5	28
	Inflation differential	5	2	5	12
	Capital mobility	0	4	3	7
	Geographical trade concentration	5	9	7	21
	International financial integration	5	2	4	11
OTHER FACTORS (MACRO, EXTERNAL AND ESTRUCTURAL)	Growth	4	3	1	8
	Negative growth	1	1	0	2
	Inflation	8	3	4	15
	Moderate to high inflation	2	4	0	6
	Reserves	4	9	10	23
	Capital control	4	5	6	15
	Terms of trade volatility	3	2	4	9
	Variability in export growth	2	0	0	2
	External variability openness	0	1	0	1
	Real exchange rate volatitlity	3	2	1	6
	Product diversification	3	3	3	9
	Current account	2	3	1	6
	External debt	5	6	0	11
	Growth of domestic credit	5	4	1	10
	Money shocks	2	3	1	6
	Foreign price shocks	2	0	1	3
	Financial development	4	4	1	9
	Fiscal balance	0	2	0	2
	Central government balance	0	0	2	2
HISTORICAL AND POLITICAL FACTORS	Political instability	10	1	4	15
	Central bank independence	1	0	1	2
	Party in office has majority	2	4	0	6
	Number of parties in coalition	1	0	1	2
	Coalition government	1	0	2	3
	Political regime (Dem/Dic)	4	1	2	7
	Electoral system (proportional / M)	2	0	0	2
	Expansive fiscal policy	0	1	0	1

Source: Alvarez et al. (2007)

In the next section, the mixed logit model is briefly described, followed by data sources. Then estimation results are presented and, finally, we draw some conclusions and make some suggestions for future work.

Modelling framework: A Mixed Logit approach

In this paper, we formulate a mixed multinomial logit model of exchange rate for the choice among the three following regimes: flexible, intermediate, and fixed. To our knowledge, only twice has this model been implemented on this particular topic (Von Hagen and Zhou, 2004; Wong, 2005).

Unlike standard multinomial logit, the mixed logit allows for correlation of errors across time, choice, and country, which makes the model appealing for discrete choice situation in a macroeconomic setting with panel elements. Moreover, it allows to relax the Independence from Irrelevant Alternatives (IIA) assumption, which says that the ratio of the choice probabilities is independent of the presence or absence of any other alternative in a choice set.

There are good reasons to think that the exchange rate regime choice violates this assumption, as a current float regime may have a higher likelihood of switching to an intermediate rather than a fixed regime, or vice versa, also depending on country-specific characteristics. Therefore, the mixed model seems to be an appropriate modelling strategy.

In this framework, we attempt to estimate the following relationship between regime choice and its determinants:

$P(Y_{it} = j) = f$ (Optimum Currency Area factors, Vulnerability to shocks and crises)

which says the regime choice, depending on the country and the time of the decision-making, is a function of factors described by the Optimum Currency Area (OCA) theory, types of shocks and vulnerability to currency crises.

Consider a sample of N countries. Each country i faces a choice among J alternatives (Y_{it} = J, where J can be 0, 1, 2, each represents fixed, intermediate, flexible

regime) in each of T periods (t = 1, 2, . .. T). Countries choose their regimes based on the principle of utility maximization, which implies that

$$P(Y_{it} = J) = P(U_{itj} > U_{itk}) \quad j,k = 0, 1, 2 \text{ and } j \neq k$$

$$U_{itj} = \beta_j x_{it} + u_{itj}$$

$$u_{itj} = a_{ij} + e_{itj}$$

where x_{it} is a vector of explanatory variables, and the error term u_{itj} consists of two components: e_{itj} is assumed to be identically independently distributed (i.i.d.)over time, countries, and regimes; while aij represents unobserved characteristics that varies across countries and regime choices, and is assumed to be randomly distributed across countries and constant over time. In particular aij is assumed to follow a bivariate normal distribution with covariance matrix Ω.

To account for the dynamic linkage in regime choices, we specify the following dynamic model is:

$$U_{itj} = \beta_j x_{it} + \gamma_{kti} d + u_{itj} \text{ where } k = 0, 2$$

$$u_{itj} = a_{ij} + e_{itj}$$

where *d* represents the dummy for either the lagged fixed or lagged flexible regime[**].

Assume that the distribution of the error term e_{itj} is i.i.d. Type I extreme value, the probability of the regime choice given a_{ij} and the vector x_{it} of exogenous variables is

$$\int_{b_i} P(Y_{it} = j \mid a_{ij}, x_{it}) f(a_{ij}) \, d a_{ij}$$

where $P(Y_{it} = j \mid a_{ij}, x_{it}) = e^{\beta x_{it} + a_{ij}} / 1 + e^{\beta x_{it} + a_{ij}}$ $\quad j = 1, 2, \beta_0 = 0$

[**] We exclude the dummy for lagged intermediate to avoid the perfect multicollinearity problem.

Models of this form are called mixed logit because the choice probability is a mixture of logit with f as the mixing distribution. The underlying computation of the unconditional probabilities requires the evaluation of high-dimension integrals, hence the integral are approximated by simulation.

The idea of simulation is to draw from the distribution that is being integrated over, in our case, a_{ij}. We assumed above that a_{ij} has mean 0 and have covariance matrix ? . So essentially, the simulation is to take draws from ? .

Let $a^{(1)}$ be the first draw from the distribution. The next step is to compute the logistic function $P(a^{(1)})$. Repeat this process until R number of independent and identically distributed random variables $P(a^{(i)})$ have been generated. The desired estimate would be the average of these random variables. Written more formally, it is:

$E [P (Y_{it} = j)] = 1/R? _i P(a^{(i)})$ where i = 1, …, R

By the law of large number, as $R \rightarrow 8$, the average of the simulated probabilities would be a consistent estimate of the true probabilities.

Data

In this study we use panel data which reports to 21 Latin American countries for the period 1980 - 2004[††]. With regard to the dependent variable we follow the IMF classification, distinguishing three types of ERR: fixed, intermediate, and flexible. The definition of the explanatory variables together with data sources are shown in Table 2. In particular, we test the influence of three types of choice determinants: those stated by

[††] Our sample of countries consists of the following: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Dominican Republic, Trinidad and Tobago, Uruguay and Venezuela.

the Optimum Currency Area (OCA) theory, types of shocks and vulnerability to currency crises.

TABLE 2. Explanatory variables

VARIABLES		CODE	DEFINITION	SOURCE
State dependency	Intermediate regime in t-1	*d2*	*dummy* variable that takes value 1 in the case of intermediate regime in the previous period	Own elaboration
	Flexible regime in t-1	*d3*	*dummy* variable that takes value 1 in the case of flexible regime in the previous period	Own elaboration
Optimum Currency area Theory	Size of economy	*lgdp*	Logarithm of GDP	IFS/IMF
	Openness	*openness*	(Exports + Imports)/GDP	IFS/IMF
	Trade concentration	*xshare*	Share of total exports to 3 largest trading partners	EIU
Types of Shocks	Current Account	*cacc*	Current Account Balance/GDP	IFS/IMF
	Inflation	*inf*	Average annual inflation rate	IFS/IMF
	Nominal effective exchange rate	*neer*	Nominal effective exchange rate standard deviation in the last 3 years	IFS/IMF
	Terms of trade	*toftrade*	Terms of trade Annual Variation	EIU
Vulnerability to exchange rate crises	Fiscal balance	*fb*	Fiscal balance	IFS/IMF
	External Debt	*fxdebt*	External Debt /GDP	IFS/IMF
	External Debt (% exports)	*netfxexp*	Net External Debt /exports	EIU
	M2/GDP	*M2gdp*	Money supply/GDP	IFS/IMF
	Currency crisis	*crisis*	*dummy* variable that takes value 1 in the case of crisis episodes defined following Frankel and Rose (1996)	Own elaboration

Results

Tables 3-5 show the results of the estimation of the models. The first important consideration lies in the crucial role of the previous ERR choice to explain the current regime. Lagged dependent variables (d2 and d3) are statistically significant in all the estimations, which seems to confirm the existence of a strong inertia in the choice of the ERR.

Table 3. Latin America, período 1980-2004.
Optimum Currency Area Theory

Regime		Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Intermediate	a	-3,61098	0,91466	-3,95	0,000	-5,40367	-1,81829
	lgdp	0,27982	0,09171	3,05	0,002	0,10006	0,45957
	openness	0,00247	0,00125	1,97	0,048	0,00002	0,00493
	xshare	-0,00977	0,01172	-0,83	0,405	-0,03273	0,01320
	d2	5,24328	0,51826	10,12	0,000	4,22751	6,25906
	d3	2,84351	0,58912	4,83	0,000	1,68886	3,99816
Flexible	a	-5,18942	1,03643	-5,01	0,000	-7,22078	-3,15805
	lgdp	0,15100	0,09690	1,56	0,119	-0,03892	0,34092
	openness	0,00350	0,00145	2,42	0,015	0,00067	0,00634
	xshare	0,01291	0,01179	1,09	0,274	-0,01020	0,03602
	d2	4,13936	0,73155	5,66	0,000	2,70554	5,57318
	d3	6,27356	0,70154	8,94	0,000	4,89858	7,64855
S_{11}	0.03238						
S_{21}	-0.00379						
S_{22}	0.00182						

Table 3 presents the results for the Optimum Currency Area Theory model. We find that the variables "size of the economy" and "openness" are both statistically significant with a positive sign. Therefore, those countries with higher levels of Gross Domestic Product per capita and openness (measured as the sum of imports and exports of goods as a percentage of GDP) are more likely to choose flexible exchange rate regimes. It is important to take into account that the positive sign of "openness" contrasts the OCA theory.

With respect to the types of shocks (Table 4), only those regarding the current account turn out to be significant. The positive sign indicates a larger tendency to flexibility in the case of current account deficit.

Table 4 Latin America, período 1980-2004. Types of *shocks*

Regime		Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Intermediate	a	-2,595325	0,452445	-5,74	0,000	-3,482100	-1,708550
	cacc	0,068346	0,032508	2,10	0,036	0,004632	0,132060
	inf	-0,000003	0,000327	-0,01	0,992	-0,000644	0,000638
	neer						
	toftrade	0,018363	0,018416	1,00	0,319	-0,017731	0,054457
	d2	5,879678	0,626645	9,38	0,000	4,651476	7,107880
	d3	3,353415	0,675082	4,97	0,000	2,030280	4,676551
Flexible	a	-3,615500	0,646659	-5,59	0,000	-4,882928	-2,348072
	cacc	0,086560	0,043574	1,99	0,047	0,001157	0,171962
	inf	0,000052	0,000618	0,08	0,933	-0,001160	0,001263
	neer						
	toftrade	0,000973	0,022871	0,04	0,966	-0,043854	0,045800
	d2	4,418351	0,825681	5,35	0,000	2,800046	6,036656
	d3	6,627213	0,760783	8,71	0,000	5,136106	8,118320
S_{11}	0.17486						
S_{21}	-0.02108						
S_{22}	0.00254						

Table 5 presents the results for the model that includes the variables related to the vulnerability to crises. A first point to highlight is that the existence of currency crises in previous periods increase the tendency to flexibility, whereas the variable that represents the fear to float, that is "external debt", shows its influence in the opposite direction, with a negative sign. A second interesting point is the significant negative impact of the variable "money supply" on the probability of intermediate-flexible regimes with respect to the fixed regime. This might be interpretated as a sign of the inconsistent monetary policies that have been applied in Latin American over the last two decades.

Table 5. Latin America, período 1980-2004. Vulnerability to crises.

regime		Coef.	Std. Err.	z	P>z	[95% Conf.	Interval
Intermediate	*a2*	-2,248722	0,576949	-3,90	0,000	-3,379521	-1,117923
	fb	-0,000890	0,001222	-0,73	0,467	-0,003286	0,001506
	fxdebt						
	netfxexp	-0,001009	0,000518	-1,95	0,051	-0,002024	0,000006
	M2gdp	-0,003759	0,001114	-3,37	0,001	-0,005943	-0,001576
	crisis	1,748476	0,601211	2,91	0,004	0,570125	2,926828
	d2	5,688675	0,626550	9,08	0,000	4,460660	6,916690
	d3	3,901544	0,778401	5,01	0,000	2,375906	5,427181
Flexible	*a3*	-2,993492	0,768196	-3,90	0,000	-4,499129	-1,487855
	fb	0,003923	0,003689	1,06	0,288	-0,003307	0,011153
	fxdebt						
	netfxexp	-0,001539	0,001233	-1,25	0,212	-0,003956	0,000878
	M2gdp	-0,002954	0,000939	-3,15	0,002	-0,004795	-0,001113
	crisis	0,306635	0,711732	0,43	0,667	-1,088335	1,701604
	d2	4,306499	0,864147	4,98	0,000	2,612802	6,000195
	d3	6,950929	0,904814	7,68	0,000	5,177528	8,724331
S_{11}	0.27289						
S_{21}	-0.01840						
S_{22}	0.00124						

In order to improve these first results certain issues must be considered: on one hand, the inclusion of institutional and political variables as possible explanatory factors; on the other hand, checking the robustness of the results with alternative specifications of the dependent variable, as well as the analysis of the sensitivity of results using different samples of countries.

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