

# Network Effects of Countries Exchange Rate Regime Choices: A Spatial Analysis

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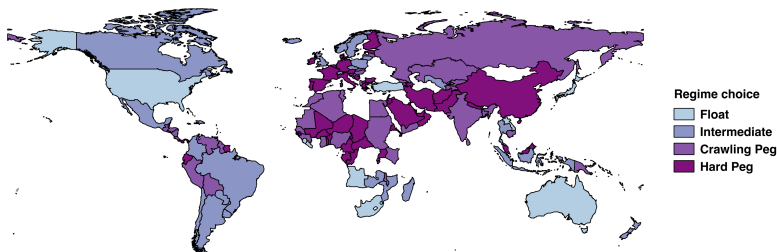
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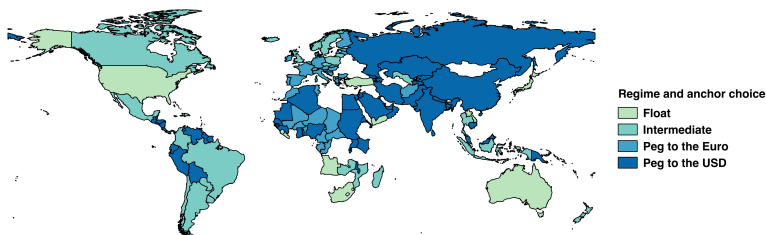
# Motivation

Figure: Countries' ERR choices in the year 2004



# Motivation

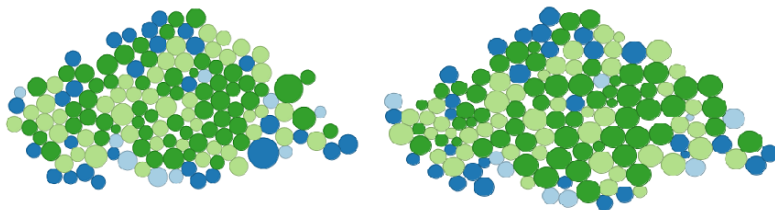
Figure: Countries' ERR and anchor currency choices in the year 2004



# Motivation

**Figure:** Cartogram map of countries' ERR choices

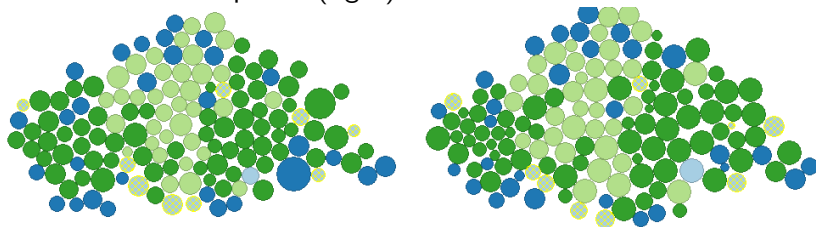
The colour of each country represent the choice of ERR and the size of each country represents trade openness (left) and veto points (right) instead of area.



# Motivation

**Figure:** Cartogram map of countries' anchor currency and ERR choices

The colour of each country represent the choice of ERR and the size of each country represents trade openness (left) and veto points (right) instead of area.



# Motivation

- This paper studies two issues of countries' exchange rate regime (ERR) choices: why countries peg and, if they peg, how they choose their anchor currency.
- Previous studies focus on the use of country-specific factors to explain countries exchange rate regime choices.
- It is possible that large swings in regime choices are caused by network effects: a few countries change their ERR and other countries follow.
- If this snowball effect is true for countries decisions, we should be able to observe spatial autocorrelations among countries' ERR choices.

# Theories

- Optimum Currency Area
- Impossible trinity
- Policy crutch
- Sustainability hypothesis

# Literature on Determinants of countries' ERR choice

**Table:** Comparison of studies on the determinants of ERR

	Juhn and Mauro (2002)	Levy Yeyati et. al (2010)	Meissner and Oomes (2009)
Dataset	Cross-sectional 2000	Panel 1974-2004	Panel 1990-1998
Methodology	Multinomial Logit	Multinomial Logit	Multinomial Logit
ERR Classification	De jure and LYS (1999)	LYS (1999), RR (2004)	RR (2004)
OCA	-	***	-
Financial	-	**	-
Political	-	***	-
Network Effects	/	/	***

*Note: - insignificant, / not relevant, \* significant at 10% level,  
\*\* significant at 5% level, \*\*\* significant at 1% level.*

# Network Effects

Meissner and Oomes (2009) is the first paper to explicitly study the role of network effects on countries' ERR choices.

- Network externalities are actually implicit in OCA view.
- The paper uses the trade-weighted number of trade partners who peg to the same anchor currency as a measure of trade externalities and conclude that currency network effects exist.
- This network externality may lead to multiple equilibria, which may cause path dependence and coordination failure (Arthur (1989)).

# Spatial Econometrics

- The basic form of the spatial autoregressive model is  $y = \rho Wy + X\beta + \epsilon$ , in which the impact of neighbours  $\rho Wy$  is on the right hand side.
- Neighbours here can be those with geographical proximity, economic closeness or institutional similarity.
- Time dependence is one key motivation for adopting spatial analysis (LeSage and Pace (2008)).

# Data Generating Process

$$y_t = \rho W y_{t-1} + X\beta + \epsilon_t \quad (1)$$

$$y_t = \rho W(X\beta + \rho W y_{t-2} + \epsilon_{t-1}) + X\beta + \epsilon_t \quad (2)$$

$$y_t = (I_n + \rho W)X\beta + \rho^2 W^2(\rho W y_{t-3} + X\beta + \epsilon_{t-3}) + \epsilon_t + \rho W \epsilon_{t-1} \quad (3)$$

.....

$$y_t = (I_n + \rho W + \rho^2 W^2 + \dots + \rho^{q-1} W^{q-1})X\beta + \rho^q W^q y_{t-q} + u_t \quad (4)$$

- As  $q$  becomes larger,  $\rho^q W^q$  becomes small.
- $\lim_{q \rightarrow \infty} E(y) = (I_n - \rho W)^{-1} X\beta$
- The data generating process (DGP) turns out to be  $y = \rho W y + X\beta + \epsilon$ .

# Estimation

- Latent dependent variable  $y^*$  with spatial autocorrelations follows a multivariate truncated normal distribution (TMVN):  $y^* \sim TMVN(\mu, \Omega)$ , where  $\mu = (I_n - \rho W)^{-1} X \beta$  and  $\Omega = [(I_n - \rho W)(I_n - \rho W)]^{-1} \epsilon^2$
- LeSage (2000) proposes to use the Bayesian MCMC sampling scheme to obtain the posterior distribution for  $y^*$  and estimators for coefficients  $\rho$  and  $\beta$ .
- Country-specific independent variables must be controlled for and included in  $X$ .
- The algorithm and code for SAR MNP model are provided by LeSage (2000) and Wang et al. (2014).

# Weighting Matrix

- Geographical distance
- Trade flows:  $W_{ij} = (\text{exports}_{ij} + \text{import}_{ij}) / (\text{export}_j + \text{import}_j)$
- Past colonial experience: dummy variable for countries with past colonial history

## Data

Table: Data Description and Source

Variable Name	Measure	Calculation	Source
Logsize	Economic size	Log of GDP	IFS
Openness	Trade openness	(import+export)/GDP	IFS
ToTshocks	Real shocks	Standard deviation of the logarithm of terms of trade	WDI series
KAopen	Financial development	Measure of capital openness	Chinn and Ito (2007)
FXreserve	Foreign exchange reserve position	Foreign exchange reserve in USD	External wealth of national data set
Liability	Foreign liability	Foreign debt assets as percentage of GDP	External wealth of national data set
Vetopoints	Political weakness	Extent of institutionalized constraints on the decision-making powers of chief executives	Polcon_2005
YearsInOffice	Political strength	Number of years for the incumbent administration has been in office	Database of political institutions
HighInflation	Inflation history	Dummy variable for countries with inflation greater than 10% in the past year	IFS
Trade Weighting Matrix	Instrumented bilateral trade volume	$W_{ij} = (exports_{ij} + export_{ij}) / (export_j + import_j)$	Melitz and Toubal (2014)
Geo Weighting Matrix	Geographical distance		CEPII Database
Institutional Weighting Matrix	Colonial Experience	Dummy variable for countries sharing a common colonizer in the history	Melitz and Toubal (2014)
Dependent Variable	ERR	De facto regime	Reinhart and Rogoff (2004)

# ERR choices

Table: Determinants of ERR choices

	W_Trade			W_Dist			W_Common colonizer		
	Crawling pegs	Intermediates	Free floats	Crawling pegs	intermediates	Free floats	Crawling pegs	intermediates	Free floats
Log of GDP	0.889 (1.231)	0.426 (1.469)	16.667*** (3.882)	-1.109 (1.926)	-3.174 (2.614)	-6.754 (9.040)	-0.125 (0.808)	-1.789 (1.047)	1.395 (2.726)
Trade openness	0.001 (0.004)	-0.003 (0.005)	-0.024 (0.009)	-0.002 (0.006)	-0.006 (0.007)	-0.031* (0.016)	0.001 (0.006)	-0.001 (0.006)	-0.017 (0.034)
Terms of trade shocks	-5.029 (3.224)	-6.461 (4.344)	4.549 (7.137)	-6.941 (6.097)	-8.044 (8.024)	-21.003 (13.904)	-3.616 (2.220)	-1.268 (3.189)	-0.728 (7.335)
Capital account openness	-1.308 (1.195)	-0.657 (1.502)	-16.169*** (3.412)	-0.133 (1.115)	2.633 (1.808)	1.225 (4.662)	-0.545 (0.737)	1.997** (1.034)	-4.393 (2.845)
Debt to GDP ratio	0.006 (0.007)	0.023*** (0.009)	0.056*** (0.011)	0.011 (0.016)	0.014 (0.020)	0.084 (0.054)	0.002 (0.011)	0.000 (0.006)	0.056*** (0.013)
Log of foreign reserve	0.628 (0.506)	0.344 (0.480)	-4.227*** (1.257)	1.154 (1.152)	1.078 (1.117)	-0.556 (1.221)	0.765 (0.347)	0.638** (0.378)	-0.876 (0.759)
High inflation	0.410 (0.485)	2.089*** (0.561)	2.979*** (0.990)	0.402 (0.877)	1.843 (1.354)	2.674 (1.818)	-0.031 (0.327)	0.908*** (0.399)	0.686 (0.825)
Veto points	-1.639* (0.912)	-3.154*** (0.973)	-1.916 (1.811)	-1.535 (1.623)	-2.974 (2.268)	-3.799 (2.869)	-0.715 (0.565)	-1.557*** (0.742)	-0.303 (1.669)
Years in office	0.013 (0.025)	-0.097*** (0.044)	-0.420*** (0.087)	0.021 (0.034)	-0.086 (0.065)	-0.484 (0.333)	0.027 (0.038)	-0.045 (0.044)	-0.235 (0.102)
Rho	0.508*** (0.125)			0.247 (0.253)			0.419*** (0.160)		
Log likelihood	-1971.400			-1922.500			-369.485		
No. of Draws	3,000								
No. of burn-ins	1,000								
No. of observations	156								

Note: The base category is hard pegs. The standard errors are reported in the brackets. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

# ERR and anchor currency choices

Table: Determinants of ERR and anchor currency choices

	W_Trade			W_dist			W_common colonizer		
	Peg to the Euro	intermediates	Free floats	Peg to the Euro	intermediates	Free floats	Peg to the Euro	intermediates	Free floats
Log of GDP	2.749*** (0.956)	0.046 (0.899)	22.838*** (5.590)	1.494 (3.885)	-3.910 (3.565)	-23.755*** (8.800)	0.968 (1.126)	-1.594 (1.044)	2.974 (2.576)
Trade openness	-0.002 (0.003)	-0.007*** (0.003)	-0.055*** (0.013)	-0.009 (0.011)	-0.010 (0.009)	-0.072*** (0.021)	0.004 (0.004)	0.000 (0.003)	-0.018 (0.012)
Terms of trade shocks	-2.512 (2.292)	-2.045 (2.499)	6.596 (6.423)	-21.626 (13.278)	-17.706 (11.800)	-51.587*** (13.510)	0.211 (2.893)	0.171 (2.880)	11.906 (11.026)
Capital account openness	-1.458 (0.922)	0.062 (0.870)	-21.662*** (5.338)	3.616 (4.052)	7.462 (4.056)	9.320*** (3.854)	0.987 (1.060)	2.372*** (1.020)	-6.271 (3.715)
Debt to GDP ratio	-0.005 (0.006)	0.024*** (0.007)	0.100*** (0.019)	-0.054*** (0.025)	-0.018 (0.025)	0.208*** (0.051)	-0.020 (0.007)	-0.003 (0.005)	0.061*** (0.030)
Log of foreign reserve	-0.619* (0.360)	0.378 (0.376)	-4.130*** (1.371)	-2.759 (1.532)	-1.375 (1.258)	-6.326*** (2.252)	-0.395 (0.415)	0.175 (0.386)	-1.625*** (0.803)
High inflation	-1.654*** (0.554)	1.183*** (0.377)	2.454*** (1.157)	-2.011 (1.630)	2.447*** (1.122)	5.568*** (1.396)	-1.523*** (0.619)	0.568 (0.367)	-0.745 (1.196)
Veto points	1.307*** (0.653)	-2.166*** (0.752)	-6.599*** (1.521)	1.796 (1.987)	-4.028*** (1.968)	-10.050*** (3.147)	1.743*** (0.773)	-0.823 (0.747)	-0.424 (1.407)
Years in office	-0.074*** (0.022)	-0.091*** (0.025)	-0.665*** (0.127)	-0.293 (0.226)	-0.312 (0.176)	-1.169*** (0.195)	-0.043 (0.024)	-0.050 (0.031)	-0.340 (0.247)
Rho	0.537*** (0.060)			0.767*** (0.148)			0.589*** (0.102)		
Log likelihood	-2414.200			-689.211			-420.981		
No. of Draws	3,000								
No. of burn-ins	1,000								
No. of observations	156								

Note: The base category is pegging to the USD. The standard errors are reported in the brackets. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

# Robustness check

Table: The eurozone

	ERR choices			ERR and anchor currency choices		
	Crawling Pegs	Intermediates	Free floats	Peg to the Euro	Intermediates	Free floats
Log of GDP	2.523*** (0.621)	9.259*** (0.769)	3.807*** (0.954)	4.140*** (1.732)	1.379 (1.604)	1.590 (0.956)
Trade openness	0.014*** (0.003)	0.028*** (0.004)	-0.009 (0.005)	-0.008 (0.005)	-0.001 (0.005)	-0.017*** (0.005)
Terms of trade shocks	-3.960*** (1.507)	8.902*** (2.153)	-1.880 (2.388)	-3.066 (3.142)	-0.150 (3.061)	-0.937 (2.755)
Capital account openness	-2.608*** (0.610)	-7.882*** (0.714)	-5.125*** (0.899)	-2.049 (1.467)	-0.782 (1.424)	-1.365 (0.934)
Debt to GDP ratio	-0.002 (0.004)	0.098*** (0.008)	0.041*** (0.006)	-0.002 (0.007)	0.041 (0.015)	0.026*** (0.007)
Log of foreign reserve	-0.758 (0.248)	-5.732*** (0.468)	-1.967*** (0.379)	-1.263 (0.621)	-1.300 (0.807)	-0.943*** (0.399)
High inflation	0.218 (0.251)	5.726*** (0.478)	2.739*** (0.390)	-1.574*** (0.629)	2.076*** (0.808)	1.254*** (0.421)
Veto points	-0.486 (0.442)	-12.697*** (0.789)	-4.440*** (0.667)	1.501 (0.926)	-4.273*** (1.685)	-2.395*** (0.805)
Years in office	0.006 (0.013)	-0.511*** (0.039)	-0.066*** (0.025)	-0.101*** (0.038)	-0.141* (0.073)	-0.079*** (0.026)
Rho	0.670*** (0.033)			0.612*** (0.072)		
Log likelihood	-1963.200			-366.151		
No. of Draws	3,000					
No. of burn-ins	1,000					
No. of observations	146					

Note: The base category is hard pegs and pegging to the USD for the left and right regression respectively. The standard errors are reported in the brackets. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

# Summary of the results

The spatial autocorrelation coefficients in above models vary between 0.4 and 0.8 and are mostly significant at 95% level.

**Table:** Summary of results for idiosyncratic factors

		ERR choices			ERR and anchor currency choices		
		Crawling pegs	Intermediate	Free floats	Peg to the euro	Intermediate	Free floats
OCA	Log of GDP				+		
	Trade openness			—		—	—
	Terms of trade shocks	—					
Financial	Capital account openness	—					
	Debt to GDP ratio		+	+***	—		+***
	Log of foreign reserve			—	—		—***
Political	High inflation		+***	+	—***	+	
	Veto points	—	—***	—	+	—	—
	Years in office		—	—	—	—	—

Inconsistent results are not reported.

# Conclusion

The main conclusion of this paper is twofold:

- Currency network effects are strong, so countries are likely to follow the ERR choices of their neighbours.
- we re-examine the country-specific determinants proposed by earlier studies and find some of them significant.

# Conclusion

- From this research we can also see how sensitive the results are to methodology and data selection in ERR studies. Thus previous studies fail to come up with conclusive evidence which would allow us to be sure about the positive determinants of countries' ERR.
- As currency network effects are strong, countries would face multiple equilibria which may lead to path dependence along with coordination failure, and thus are highly likely to be locked in suboptimal equilibria as demonstrated in Meissner and Oomess game theory model.
- This study might explain some of the facts described in Quah and Crowley (2012) and Stockman (1999) .

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