Economics Letters 123 (2014) 206–211

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Regime shifts and the Canada/US exchange rate in a multivariate framework[☆]

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HIGHLIGHTS

- This study re-evaluates the monetary approach for the Canada/U.S. exchange rate.
- We apply a multivariate Markov-switching vector error correction approach.
- The model can be verified but not each coefficient is in line with theory.
- Our findings show that different fundamentals matter at different points in time.

ARTICLE INFO

Article history:
Received 2 September 2013
Received in revised form
3 February 2014
Accepted 9 February 2014
Available online 19 February 2014

JEL classification:
F31

Keywords:
Bayesian econometrics
Cointegration
Exchange rates
Monetary approach
Markov-switching vector error correction model

ABSTRACT

This study re-evaluates the monetary approach for the Canada/U.S. exchange rate and shows that its basic structure can be verified although the coefficients are not consistently in line with theory. Our findings also indicate that exchange rate adjustment is subject to regime shifts.

1. Introduction

The so-called exchange rate disconnect puzzle, which refers to the weak link between exchange rates and fundamentals, has triggered various lines of research focusing on the empirical modeling of nonlinear exchange rate dynamics (Sarno, 2005).[2] Markov-switching models, which depend upon a stochastic switching process, have turned out to be a useful tool for modeling exchange

☆ Thanks for valuable comments on a previous version of the paper are due to an anonymous reviewer.

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2 From a methodical point of view, recent research on nonlinear empirical exchange rate modeling in terms of long-run relationship between exchange rates and fundamentals can be roughly separated into three different kinds of framework: Markov-switching models, smooth transition models and models with structural breaks or time-varying coefficients. The first two frameworks focus on deviations in the exchange rate from a fundamental value which assumes cointegration with implied restrictions and without modeling the long-run structure separately. Compared to Markov-switching models, a smooth transition approach allows for endogenously determined changes in the adjustment coefficients. See Sarno and Taylor (2002) for an overview.

http://dx.doi.org/10.1016/j.econlet.2014.02.005
0165-1765/

Table 1
First step of the MS-VECM.

Panel (a): $I(1)$-analysis (rank test) with 4 lags and restricted constant

$K-r$	r	Eig. value	Trace	5% crit. val.	5% crit. val.$^{\alpha}$	p-value	p-value$^{\alpha}$
9	0	0.246	434.775	208.267	198.790	0.000	0.000
8	1	0.190	303.172	169.405	160.786	0.000	0.000
7	2	0.147	205.015	134.543	129.475	0.000	0.000
6	3	0.105	130.583	103.679	99.184	0.000	0.000
5	4	0.077	78.613	76.813	73.985	0.036	0.022
4	5	0.046	41.336	53.945	52.798	0.410	0.336
3	6	0.025	19.486	35.070	34.690	0.757	0.702
2	7	0.012	7.732	20.164	19.379	0.842	0.822
1	8	0.005	2.324	9.142	8.727	0.714	0.688

Panel (b): Cointegration vectors

	s	m	m^f	y	y^f	i	i^f	p	p^f	c
β_1		-0.320^{***}		-0.679^{***}		-0.051^{***}		1		
		(-13.327)		(-24.674)		(-11.767)				
β_2			-0.119^{***}		-0.917^{***}		-0.028^{***}		1	
			(-3.622)		(-26.053)		(-5.114)			
β_3	1					-0.768^{***}	0.589^{***}	13.268^{***}	-15.794^{***}	13.268^{***}
						(-12.046)	(8.718)	(10.249)	(-10.147)	(10.249)
β_4	1	1.265^{***}	-1.265^{***}	-0.841^{***}	-1.271^{***}					9.709^{***}
		(11.329)	(-11.329)	(-2.062)	(-3.097)					(13.647)

Panel (c): Test of restricted model: $\chi^2(10) = 15.049$ [0.130]

Panel (d): Tests for autocorrelation

LM(1):	$\chi^2(81)$	= 218.715	[0.000]	LM(3):	$\chi^2(81)$	= 109.972	[0.018]
LM(2):	$\chi^2(81)$	= 112.084	[0.013]	LM(4):	$\chi^2(81)$	= 73.359	[0.715]

Note: Panel (a) reports Johansen (1988, 1991) cointegration tests. 5% crit. val.$^{\alpha}$ and p-value$^{\alpha}$ refer to a simulation with $T = 400$ and 2500 replications. r denotes the cointegration rank. Critical values are taken from MacKinnon et al. (1999). Panel (b) shows the estimates of the cointegration vectors with t-statistics in parentheses. Panel (c) reports the test for over-identifying restrictions, which is a likelihood ratio (LR) test [p-value]. Panel (d) displays LR tests on autocorrelation, which are distributed as χ^2, with degrees of freedom in parentheses [p-value].
* Rejection of the null hypothesis at the 10% significance level.
** Rejection of the null hypothesis at the 5% significance level.
*** Rejection of the null hypothesis at the 1% significance level.
s denotes the Canada/U.S. exchange rate, m the monetary aggregate, y the industrial production, i the three-month money market rate, p the CPI, and c the constant. In addition, the superscript f denominates the foreign economy (i.e. the U.S.)

rates. While Engel (1994) deals with the forecasting performance of these, the studies of Sarno et al. (2004) and Sarno and Valente (2006) analyze a different exchange rate adjustment to fundamentals deviations according to the canonical monetary exchange rate model and purchasing power parity (PPP). In two related studies Frömmel et al. (2005a,b) reformulate the monetary model in annual changes and allow for variation in the long-run coefficients itself. In a recent paper Cheung and Erlandsson (2005) provide unambiguous general evidence for the presence of Markov-switching dynamics in exchange rates for monthly frequencies.

This study contributes to the literature by adopting a Markov-switching vector error correction approach to exchange rate modeling from a novel perspective: instead of focusing on a one-equation-reduced form of the monetary approach, we carry out a structural identification in a multi-dimensional cointegration space and allow for regime-switching adjustment to all established equations simultaneously. Hence, our approach: (1) does not neglect relevant variables and dynamics, which may result in biased coefficient estimates as pointed out in La Cour and MacDonald (2000) and De Vita (2002). (2) Does not impose restrictions on the adjustment parameters for the nominal exchange rate to those equations, an aspect which has been highlighted by Moersch and Nautz (2001). (3) Disentangles long-run and short-run dynamics and allows for different regime-dependent stochastic adjustment patterns.

To the best of our knowledge, no study has focused on all these issues simultaneously so far. According to De Vita (2002), who focus on a related research question in a linear framework, we examine the Canada/U.S. exchange rate. Previous research has suggested that the monetary approach is unable to explain movements for the Canada/U.S. exchange rate over the recent floating period (Cushman, 2000). Reconsidering this finding from a new perspective is an interesting research topic. The rest of this paper is organized as follows: the next section gives a brief theory and literature review. Section 3 provides the data, methodology and results while Section 4 concludes.

2. Theory and literature review

The monetary exchange rate approach consists of at least three equations. First, PPP is assumed to hold (Dornbusch, 1976; Frenkel, 1976; Bilson, 1978):

$$s_t = p_t - p_t^f, \quad (1)$$

where s_t denotes the logarithm of the nominal exchange rate expressed as the domestic price of the foreign currency and p_t and p_t^f are logarithms of the domestic and the foreign price levels. The second ingredient stems from the money market equilibrium for both economies:

$$m_t - p_t = \gamma y_t - \phi i_t, \quad \text{and} \quad m_t^f - p_t^f = \gamma^f y_t^f - \phi^f i_t^f, \quad (2)$$

with m_t and y_t being logarithms of the money supply and real income, and i_t being the short-term interest rate, respectively (Dornbusch, 1976; Bilson, 1978). Again, the superscript f denotes the foreign economy (in our case the U.S.). Combining Eqs. (1) and (2) provides:

$$s_t = \beta_1 m_t - \beta_1^f m_t^f - \beta_2 y_t + \beta_2^f y_t^f + \beta_3 i_t - \beta_3^f i_t^f. \quad (3)$$

From this starting point, several possible formulations exist if it is assumed that uncovered interest rate parity (UIP) holds so that the interest rate differential can be substituted by the expected change of the exchange rate. If the expected change in the exchange rate is considered as stationary, the nominal exchange rate is driven only