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Empirical Evidence on the Convergence of Interest Rates for IFRS 4: SPSM Using the Panel KSS Test

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1. Introduction

This note examines the interest rate convergence among a panel of 20 countries defined by Quantitative Impact Study 5 (QIS 5), an official report for the International Financial Reporting Standards (IFRS) on the insurance industry, called IFRS 4, assumes that the long-term interest rates for individual countries of an economic region would be expected to converge to a constant level. While conventional panel unit root tests only validate overall interest rate convergence among the panel under study, this paper aims to clearly identify how many countries and which countries show interest rate convergence. Our empirical study provides evidence that the interest rate convergence holds only in 3 out of the 20 countries under study.

To remedy the low power of the conventional augmented Dickey-Fuller (Dickey and Fuller, 1981) unit root tests, panel-based unit root tests have been developed, but these suffer the serious drawback of being non-informative in terms of the number of series that are stationary processes when the null hypothesis is rejected. To classify a whole panel into a group of stationary series and a group of non-stationary series, this paper adopts the Sequential Panel Selection Method (SPSM) proposed by Chortareas and Kapetanios (2009). This method uses a sequence of panel unit root tests to distinguish between stationary and non-stationary series. For a large panel such as the data in this study, as Chortareas and Kapetanios (2009) state, if more than one series is actually non-stationary, then the use of panel methods to investigate the unit root properties of the set of series may indeed be more efficient and powerful compared to univariate methods. In each trial of SPSM, we use Kapetanios et al. (2003) accounting for non-linear adjustment

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by an ESTAR model for the occasions where time series data may revert to their mean only when they are sufficiently far away from it but behave as non-stationary processes when they are close to it.

The remainder of this study is organized as follows. Section 2 presents the data. Section 3 describes the methodology and the empirical findings. Section 4 presents the conclusion and policy implications.

2. Data

This study employs 10-year government bond yields at monthly frequency for 21 countries (Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, US, Denmark, United Kingdom, Sweden, Norway, Australia, Canada, Taiwan, and Thailand) over the period January 1995 to July 2011 from the International Monetary Fund database. Following Lee and Wu (2004), we first derive the interest rate differential between country k (for $k=1,\ldots,N$) and $N+1$, that is, $X_{k,t}=i_{k,t}-i_{N+1,t}$, where $i_{k,t}$ is the nominal interest rate in country k at time t. We adopt the US interest rate as a benchmark $r_{N+1,t}$. For each country k, we examine the null hypothesis that interest rates differentials $X_{k,t}$ are I(1), implying interest rate divergence between country k and $N+1$. Rejection of a unit root indicates that shocks to interest rate differentials are temporary, implying that interest rates converge. Conversely, failure to reject the unit root null hypothesis indicates evidence against interest rate convergence.

3. Methodology and Empirical Results

The SPSM proposed by Chortareas and Kapetanios (2009) is based on the following steps.

(1) The panel KSS test is first applied to all interest rate differences in the panel. If the unit root null cannot be rejected, the procedure is stopped, and all the series in the panel are nonstationary. If the null is rejected, go to Step 2.

(2) Remove the series with the minimum KSS statistic since it is identified as being stationary.

(3) Return to Step 1 for the remaining series, or stop the procedure if all the series are removed from the panel.

The final result is a separation of the whole panel into a set of mean-reverting series and a set of non-stationary series.

In each SPSM trial, following Kapetanios et al. (2003), the regression equation for the unit root test is presented by:

$$\Delta X_{k,t}=\xi+\delta_k X_{k,t-1}^3+\sum_{i=1}^{p}\theta_i\Delta X_{k,t-1}+v_t,\quad t=1,2,\ldots,T. \tag{1}$$

In this framework the null and alternative hypotheses are expressed as $\delta_k=0$ versus $\delta_k<0$ for some country k.

Tables 1 and 2 report the results for the first and second generation panel unit root tests. Generally, conventional panel unit root tests indicate the significant evidence of the interest rate convergence among the 20 countries.

Table 1. First Generation Panel Unit Root Tests

	t_{ρ}^{*}	$\hat{\rho}$	t_{ρ}^{*B}	t_{ρ}^{*C}	
Levin et al. (2002)	–6.538***	–0.035***	–6.226***	–6.203***	
	(0.000)	(0.000)	(0.000)	(0.000)	
	t_bar_{NT}	$W_{t,\ bar}$	$Z_{t,\ bar}$	$t\_bar_{NT}^{DF}$	$Z_{t,\ bar}^{DF}$
Im et al. (2003)	–2.435	–4.814***	–4.711***	–1.359	0.903
		(0.000)	(0.000)		(0.817)
	P_{MW}	Z_{MW}			
Maddala and Wu (1999)	109.535***	7.774***			
	(0.000)	(0.000)			

Notes: *** indicates significance at the 1% level. P-values are in parentheses.

Table 2. Second Generation Panel Unit Root Tests

	$\hat{r}$	$Z_{\hat{e}}^{C}$	$P_{\hat{e}}^{C}$	MQ_{C}	MQ_{f}
Bai and Ng (2004)	3	–0.364	36.741	3	3
		(0.642)	(0.618)		
	t_{a}^{*}	t_{b}^{*}	$\hat{\rho}_{pool}^{*}$	t_{a}^{*B}	t_{b}^{*B}
Moon and Perron (2004)	–15.761***	–7.359***	0.967	–15.955***	–7.478***
	(0.000)	(0.000)		(0.000)	(0.000)
	P_{m}	Z	L^{*}		
Choi (2002)	21.270***	–10.505***	–13.392***		
	(0.000)	(0.000)	(0.000)		
	P^{*}	$CIPS$	$CIPS^{*}$		
Pesaran (2007)	8	–0.714	–0.766		
		(0.990)	(0.990)		

Notes: *** indicates significance at the 1% level. P-values are in parentheses.

Table 3 (without time trend) shows that the SPSM procedure using the panel KSS test supports interest rate convergence for 3 out of the 20 countries (Finland, Sweden, and Norway). Similarly, Table 4 (with time trend) shows the procedure supports interest rate convergence for the same 3 out of the 20 countries. The major empirical implication is that the interest rate convergence is country-specific and occurs only in these few countries along with nonlinearity trend presented by the ESTAR function. Overall, only 3 out of the 20 interest rate differentials move toward the same interest rate pattern, which does not imply decreasing interest rate differences across these countries. The interest rate gaps among remaining 17 countries are empirically permanent.

Table 3. Panel KSS Unit Root Test

Sequence	OU statistic	Min. KSS statistic	Series
1	–2.0510 (0.0104)**	–4.4865	Finland
2	–1.9228 (0.0520)*	–4.2558	Sweden
3	–1.7932 (0.0406)**	–3.9161	Norway
4	–1.6483 (0.2942)	–3.4809	Spain
5	–1.5066 (0.4826)	–2.9955	Italy
6	–1.3750 (0.6208)	–2.8304	France
7	–1.2592 (0.7862)	–2.7485	Austria
8	–1.1384 (0.6654)	–2.5878	Belgium
9	–1.0042 (0.8100)	–2.3897	Taiwan
10	–0.8602 (0.8672)	–2.3213	Canada
11	–0.7073 (0.9810)	–2.1960	Denmark
12	–0.5279 (0.9576)	–2.0026	Netherlands
13	–0.3194 (0.9968)	–1.7782	Luxembourg
14	–0.0790 (0.9988)	–1.6369	Germany
15	0.2042 (0.9994)	–1.5027	Australia
16	0.5724 (1.0000)	–1.4755	Thailand
17	1.0912 (1.0000)	–1.2157	United Kingdom
18	1.9468 (1.0000)	–1.1248	Greece
19	3.4826 (1.0000)	2.1430	Portugal
20	4.8221 (1.0000)	4.8221	Ireland

Notes: * and ** denote significance at 10% and 5% levels, respectively. The maximum lag is set to be 8. There are 5000 bootstrap replications. P-values are in parentheses. The OU statistic is the invariant average KSS $t_{i,\,NL}$ statistic (Ucar and Omay, 2009).

Table 4. Panel KSS Unit Root Test with Trend

Sequence	OU statistic	Min. KSS statistic	Series
1	–1.8037 (0.0150)**	–3.8953	Finland
2	–1.6936 (0.0180)**	–3.5678	Sweden
3	–1.5895 (0.0672)*	–2.9502	Norway
4	–1.4731 (0.1058)	–2.9375	Austria
5	–1.3808 (0.2094)	–2.9187	Canada
6	–1.2770 (0.3278)	–2.8515	Belgium
7	–1.1597 (0.4160)	–2.7582	Italy
8	–1.0296 (0.5300)	–2.7219	France
9	–0.8855 (0.6856)	–2.5744	Spain
10	–0.7186 (0.9360)	–2.3795	Taiwan
11	–0.5330 (0.9424)	–1.9645	Netherlands
12	–0.3278 (0.9768)	–1.9286	Luxembourg
13	–0.1233 (0.9766)	–1.8467	Denmark
14	0.1347 (0.9984)	–1.6538	Germany
15	0.4649 (0.9982)	–1.6505	Australia
16	0.8886 (0.9982)	–1.5808	Thailand
17	1.5234 (0.9988)	–1.3249	United Kingdom
18	2.5582 (0.9992)	–0.2488	Greece
19	3.9616 (1.0000)	3.7009	Portugal
20	4.2224 (1.0000)	4.2224	Ireland

Notes: * and ** denote significance at 10% and 5% levels, respectively. The maximum lag is set to be 8. There are 5000 bootstrap replications. P-values are in parentheses. The OU statistic is the invariant average KSS $t_{i,\,NL}$ statistic (Ucar and Omay, 2009).

4. Conclusions

The major empirical implication is that the interest rate convergence is country-specific and occurs only in some few countries (Finland, Sweden, and Norway) along with nonlinearity trend presented by the ESTAR function. Overall, only 3 out of the 20 interest rate differentials move toward the same interest rate pattern, which does not imply decreasing interest rate differences across these countries. The interest rate gaps among remaining 17 countries are empirically permanent and worthy of concern for quantitative measures dictated by QIS 5 for the implementation of IFRS 4.

This note also provides evidence to show that the assumption about the convergence of long-term interest rates for individual countries made by the IFRS might not correct. Nonstationary interest rate differentials across countries indicate that there is no equilibrium relationship between nominal interest rates of the countries in this study. As such, the UFR, defined by QIS 5 as the average long-term expected interest rate over economic regions, will change dramatically, which may violate the principle of stability set by QIS 5 itself. The yield curves in these regions may be subject to variability and cause volatile insurers' financial reports and even unstable capital requirements. In practice, the assumption of a convergent UFR documented in QIS 5 seems oversimplified and should be considered more prudently. It is also notable that the yield curve extrapolation techniques suggested by QIS 5 are sensitive to the determination of the UFR level. To circumvent all these problems, we suggest that QIS 5 consider the economic heterogeneity among the economic regions adopting IFRS 4. The International Accounting Standards Board may further authorize local insurance bureaus and insurers to individually verify the term structure or even more region-specific economic assumptions, such as the long-term real rate of interest, long-term inflation expectations, bond term premium, and a technical convexity adjustment. Overall, the interest rate differential still exists for the concern of the IFRS 4 implementation.

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