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STRUCTURAL BREAKS AND THE EXPECTATIONS HYPOTHESIS OF THE TERM STRUCTURE: SOME EMPIRICAL EVIDENCE FOR THE PHILIPPINES (2001-2017)

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ABSTRACT

This paper extends the empirical investigation of Tronzano (2018b) applying a cointegration test allowing for a structural break in the long-run equilibrium relationship. In line with Tronzano (2018b) the null hypothesis of absence of cointegration is strongly rejected for all interest rates maturities, while a significant structural break is detected at the end of 2008. A decrease in risk premium components is documented after the 2008 structural break, while the "symmetry" restriction is only supported after this regime-shift. Overall, the policy prescriptions from this analysis are in line with those outlined in Tronzano (2018b) supporting a monetary policy strategy based on interest rate smoothing.

Contribution/ Originality: This study contributes in the existing literature allowing for one break in the cointegrating relationship underlying the Philippine term structure of interest rates, thus exploring the structural effects of the 2007/2008 global financial crisis.

1. INTRODUCTION AND MOTIVATION

The Expectations Hypothesis of the Term Structure (EHTS) plays a crucial role in the study of the relationship between interest rates at different maturities. According to the EHTS, the return on a long-term financial asset is determined by current and expected returns on this asset over the shortest maturities.

Two main versions of the EHTS are usually addressed in the literature. An earlier formulation, known as the "Pure Expectations" theory, posits agents risk neutrality and emphasizes the exclusive role of short-term expectations in driving long-term interest rates. A latter formulation ("Liquidity Premium" version) relies instead on risk aversion, thus assuming that agents require a significant risk premium component (increasing in the time to maturity) to compensate for the risk associated with investments in long-term financial instruments.

Since the EHTS implies an equilibrium relationship between yields at various maturities, assessing the validity of the EHTS has relevant implications for the validity of the monetary policy transmission mechanism. The conventional approach to monetary policy relying on inflation targeting assumes in fact that the Central Bank controls a short-term policy rate, and that monetary impulses are transmitted to the real sector by means of equilibrium adjustments operating through the yield curve (see, e.g. Clarida *et al.* (1999)).

The diffusion of inflation targeting policies in many emerging market economies in recent years has prompted a large wave of empirical research assessing the validity of the EHTS in these countries. A quite robust result in this literature is that, notwithstanding the existence of a long-run equilibrium relationship between nominal yields at various maturities, the "Pure Expectations" version of the EHTS is usually rejected.

Focusing on Asian economies during the recent financial markets liberalization period, for instance, Buigut and Rao (2010) provide evidence against the "Pure Expectations" version for Hong Kong, while similar evidence is documented in Tronzano (2015a;2015b) for India, Tronzano (2015c) for Malaysia, and Tronzano (2018a) for Korea. Quite interestingly, as far as Asian economies are concerned, the above results related to single-country case studies find further support inside a panel cointegration framework. Panel data techniques implemented in Guerello and Tronzano (2016) document indeed a significant influence of an international global factor (i.e. a time-varying global risk premium component) on the long-run equilibrium driving the yield curve.

In a recent paper published on this review, I provide a first assessment about the validity of the EHTS in the Philippines since the official introduction of an inflation targeting regime (Tronzano, 2018b).

The main results achieved in this paper may be summarized as follows. In line with the EHTS, there is strong support for the existence of cointegration between nominal interest rates at different maturities. Moreover, in line with the "Pure Expectations" version of this theory, no significant risk premium component is detected. However, differently from another important empirical feature characterizing the validity of the EHTS (see, e.g. Campbell and Shiller (1987;1991); Engsted and Tanggaard (1994)) the "zero-sum" or "symmetry" restriction on cointegrating vectors is strongly rejected. This means that, although the Philippine term structure is driven by one common stochastic trend, short and long-run interest rates do not cointegrate with a cointegrating vector (1, -1). In other words, notwithstanding the existence of cointegration, the long-run equilibrium relationship does not display equi-proportional yields movements.

The empirical evidence of Tronzano (2018b) is highly robust, since cointegration tests are performed both in a bivariate and in a multivariate framework and rely on alternative estimation techniques.

A closer data base inspection, however, reveals that the cointegrating relationship characterizing the Philippine term structure might have undergone a significant structural break during the sample period (2001-2017). This sample includes in fact one relevant exogenous event, namely the US subprime financial crisis (2007-2008), which exerted major spillover effects on emerging Asian economies due to their increased market integration with the rest of the world.

In the light of the above considerations, the present paper revisits the empirical evidence obtained in Tronzano (2018b) using a cointegration technique which allows for a potential structural break in the long-run equilibrium relationship.

More specifically, the main purpose of this analysis is to investigate whether the hypothesized structural break associated with the 2007/2008 global financial crisis has generated significant regime shifts in the cointegrating parameters.

This issue is important because a regime shift in cointegrating parameters has relevant implications on the existence of risk premium components at different maturities, their quantitative dimension before and after the international financial crisis, and the validity of the "zero-sum" or "symmetry" restriction on cointegrating vectors.

The outline of the paper is as follows. Section 2 performs a visual data inspection. Section 3 revisits the empirical evidence of Tronzano (2018b) applying a cointegration test allowing for a potential structural break in the long-run equilibrium relationship under alternative model's specification. I first present the test statistics for the existence of cointegration, and then discuss the estimates of various parameters before and after the identified breakpoints. Section 4 concludes, summarizing the new results and discussing how they affect the policy implications outlined in Tronzano (2018b).

2. VISUAL INSPECTION OF THE PHILIPPINE TERM STRUCTURE

Figure 1 (reproduced from Tronzano (2018b)) provides an overview of the Philippine term structure of interest rates from 2001M4 to 2017M2. The lower plot (continuous line) refers to the 3-months Treasury Bills rate (assumed as a proxy for the policy rate), whereas the remaining two upper plots (dotted lines) refer, respectively, to the 6-month and to the 1-year Treasury Bills rates. As observed in Tronzano (2018b) this figure provides some informal evidence supporting the existence of cointegration.

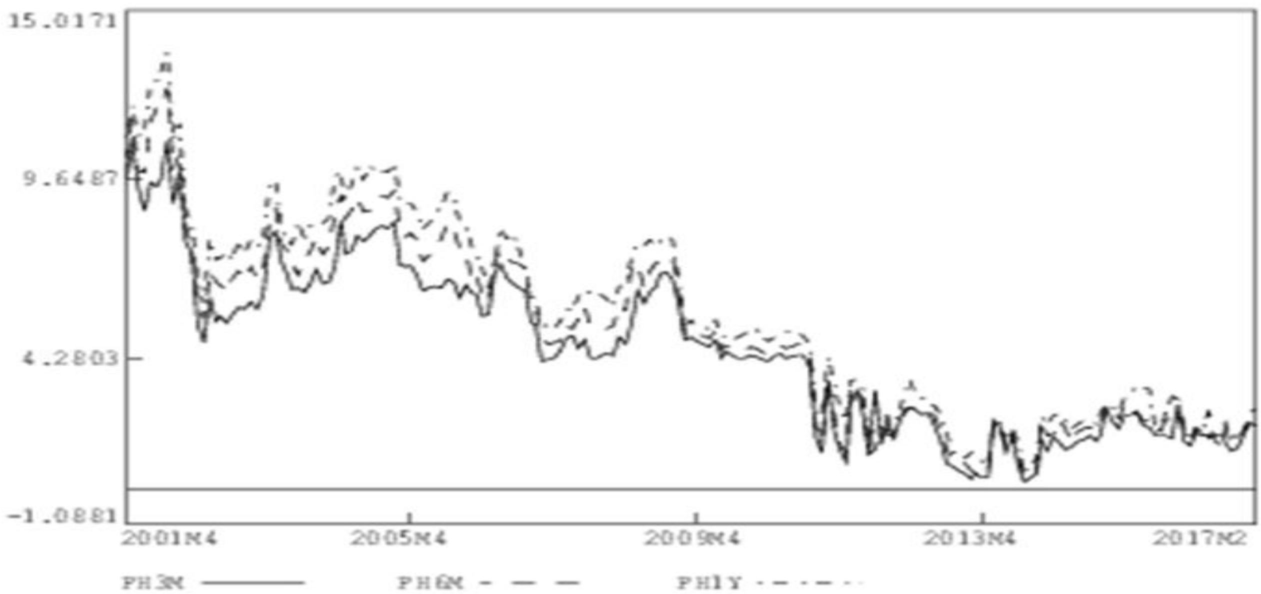

Figure-1. Philippine Term Structure of Interest Rates Monthly Data: 2001.4 – 2017.2
Source: Thomson Reuters – Datastream. See Tronzano (2018b) for a complete description of the data set.

Focusing on Figure 1 in more detail, the following relevant features stand out.

During the former half of the sample (i.e. approximately until the end of 2008), there is a more erratic data pattern, characterized by relatively high volatility and a looser link between the 3-months interest rate and nominal rates at longer maturities. Conversely, during the second half of the sample (i.e. since the beginning of 2009 onwards), we observe a downward shift in the level of the equilibrium relationship, and a closer link between the 3-months interest rate and yields at longer maturities.

Overall, Figure 1 suggests the existence of a structural break in the cointegrating relationship around the last months of 2008, involving both the level and the slope coefficients of the cointegrating regression.

Quite interestingly, this potential regime shift reflects both the contagion effects of the 2007/2008 global financial crisis and the consequent expansionary reaction implemented by monetary authorities.

The steady increasing trend of nominal interest rates at all maturities since the first months of 2008, documented in Figure 1, well captures the contagion effects on the Philippine bond markets originating from the US subprime mortgage crisis.[1] As discussed in Guinigundo (2010) tensions on the Philippine government bond

[1] The 2007/2008 global financial crisis generated also other relevant contagion effects on Philippine financial markets, involving the equity market, reaching an all-time low at the end of 2008 (48.3 % decline year-on-year), and the foreign exchange market. Guinigundo (2010) section 3, provides a detailed overview of these developments.

market culminated in the last quarter of 2008, when investors fears intensified as a consequence of the Lehman Brothers collapse and growing evidence of a global recession.[2]

The term structure pattern since January 2009 onwards, on the other hand, is characterized by an abrupt trend reversal and huge interest rates declines extending until the end of 2010.

This pronounced downward shift reflects the expansionary monetary measures implemented by the Philippine Central Bank in order to "*infuse appropriate levels of liquidity to maintain the efficient functioning of the financial market and help avert the shrinkage of domestic markets*" (Guinigundo, 2010). More specifically, domestic authorities implemented six policy rates reduction since the end of December 2008, cutting policy rates by 200 basis points as a whole, and introduced further liquidity-enhancing measures from November 2008 to March 2009. Overall, these expansionary measures proved to be highly effective, boosting business and consumer confidence and generating a steady rate of liquidity growth in 2009.[3]

To sum up, the visual inspection of the Philippine term structure points out one potential structural break, located towards the end of 2008, in the long-run equilibrium relationship driving nominal interest rates. This potential regime shift appears closely related to the spillover effects associated with the US subprime crisis and the expansionary measures implemented by domestic monetary authorities.

Drawing on the above discussion, the next section extends the empirical investigation carried out in Tronzano (2018b) testing for the existence of a structural break in the term structure equilibrium relationships through appropriate econometric techniques.

3. STRUCTURAL BREAKS AND THE EXPECTATIONS HYPOTHESIS OF THE TERM STRUCTURE

3.1. Cointegration Tests Allowing for Structural Breaks

Tronzano (2018b) explores the existence of cointegration inside a bivariate econometric framework through the following cointegrating regression:

$$i_t^{(n)} = \alpha + \beta\, i_t^{(m)} + \varepsilon_t \qquad [1]$$

where the upper scripts denote the time to maturity (n > m), $i_t^{(n)}$ and $i_t^{(m)}$ are the long and the short-term interest rates, α and β are parameters, and ε_t is the disturbance term.

Drawing on Section 2, the present section extends the analysis of Tronzano (2018b) applying a cointegration test allowing for a structural break in the cointegrating relationship at an unknown point in time. More specifically, I apply the residual-based approach developed in Gregory and Hansen (1996) which is particularly suitable in the present context since it allows exploring different kinds of shifts in the cointegrating regression.

In order to model structural change, the following dummy variable is introduced:

$D_{t\tau} = 0$ for $t \le \tau T$

$D_{t\tau} = 1$ for $t > \tau T$

where T is the sample size and $\tau \in (0,1)$ is an unknown parameter denoting the timing of the structural break.

Adapting this framework to the issues addressed in this paper, equation [1] may be reformulated as follows, assuming three different kinds of structural breaks:

Model 1: Level shift (C)

$$i^{(n)}_t = \alpha_1 + \alpha_2 D_{t\tau} + \beta\, i^{(m)}_t + \varepsilon_t \qquad [2]$$

[2]The additional premium for holding Philippine bonds over US Treasuries increased by 335 basis points during 2008, reaching an all-time peak during the last quarter as a consequence of depressed risk appetite and negative spillover effects from developed economies into emerging financial markets (see Guinigundo (2010) section 3, Table 5).

[3]See Guinigundo (2010) sections 4-5, for a more detailed analysis of these policies and their effects on selected economic and financial indicators in 2009.

Model 2: Level shift with trend (C/T)

$$i^{(n)}_t = \alpha_1 + \alpha_2 D_{t\tau} + \gamma t + \beta i^{(m)}_t + \varepsilon_t \quad [3]$$

Model 3: Regime shift (C/S)

$$i^{(n)}_t = \alpha_1 + \alpha_2 D_{t\tau} + \beta_1 i^{(m)}_t + \beta_2 i^{(m)}_t D_{t\tau} + \varepsilon_t \quad [4]$$

where all variables retain their previous meanings, t is a linear time trend, and $D_{t\tau}$ is the above defined dummy variable.

The former model (Eq. [2]) assumes a potential break in the constant term of the long-run equilibrium regression. More specifically, α_1 is the constant term before the break, and $\alpha_1 + \alpha_2$ represents its value after the break date. The second model (Eq. [3]) assumes an identical regime-shift, but introduces a deterministic time trend in the cointegrating regression. The third model (Eq. [4]) assumes a more general regime-shift, where both the constant and the slope coefficients change at an unknown point in time. More specifically, β_1 is the slope coefficient before the break, while $\beta_1 + \beta_2$ represents its value after the break.

This approach involves a recursive estimation of each candidate cointegrating equation, and a computation of various unit root tests on residuals across all possible break points. The test statistics to assess the existence of cointegration in the presence of a structural break are the smallest values (i.e. the largest negative values) of ADF, Z_α and Z_t obtained across each possible break point in a sample of dimension T, namely:

$ADF^* = \inf_{\tau \in T} ADF(\tau)$

$Z_\alpha^* = \inf_{\tau \in T} Z_\alpha(\tau)$

$Z_t^* = \inf_{\tau \in T} Z_t(\tau)$

Significant values of these statistics reject the null hypothesis of absence of cointegration against the alternative hypothesis cointegration in the presence of one regime shift. Table 1 reports the values of the residual-based tests outlined above.

Table-1A. Residual-based Tests allowing for Regime Shifts.
Cointegrating Regressions Normalized on 6-Month Interest Rate

Models	ADF	Z_α	Z_t
[C]	-6.50*** [2008.9]	-116*** [2008.8]	-9.01*** [2008.8]
[C/T]	-6.50*** [2008.9]	-116*** [2008.8]	-9.03*** [2008.8]
[C/S]	-8.93*** [2008.9]	-116*** [2008.8]	-9.07*** [2008.8]

Table-1B. Residual-based Tests allowing for Regime Shifts.
Cointegrating Regressions Normalized on 1-Year Interest Rate

Models	ADF	Z_α	Z_t
[C]	-7.27*** [2008.7]	-82.8*** [2008.7]	-7.27*** [2008.7]
[C/T]	-7.06*** [2008.10]	-79.1*** [2008.10]	-7.06*** [2008.10]
[C/S]	-7.36*** [2008.10]	-84.0*** [2008.10]	-7.36*** [2008.10]

*** : Test statistics significant at 1% level.

Optimal number of lags to compute test statistics selected through RMSE, AIC, PC and SC information criteria. Estimated breakpoints in square brackets below each test statistic.

Approximate asymptotic critical values for regime-shifts models are reported in Gregory and Hansen (1996) table 1, p. 109. For the case of one explanatory variable (m=1), these critical values are as follows:

Model C ADF^*, Z_t^*: -4.34 (10%); -4.61 (5%); -5.13 (1%)

Z_α^*: -36.19 (10%); -40.48 (5%); -50.07 (1%)

Model C/T ADF^*, Z_t^*: -4.72 (10%); -4.99 (5%); -5.45 (1%)

Z_α^*: -43.22 (10%); -47.96 (5%); -57.28 (1%)

Model C/S ADF*, Z_t*: -4.68 (10%); -4.95 (5%); -5.47 (1%)

Z_α*: -41.85 (10%); -47.04 (5%); -57.17 (1%).

The upper section (Table 1A) reports, for each structural break model, the test statistics obtained normalizing the cointegrating regression on the shortest maturity (6-months), whereas the lower section (Table 1B) displays the same information with reference to the longest maturity (1-year).

As shown in this table, these results are highly homogeneous across alternative regime-shifts models and different time horizons. The null hypothesis of absence of cointegration is consistently rejected, at a 1% significance level, by all tests statistics. These findings provide strong support to the existence of significant regime-shifts at all maturities. Moreover, since all models generate significant test statistics, these regime-shifts involve both the constant and the slopes terms of the cointegrating regressions.

The estimated breakpoints location provides very interesting results. As shown in Table 1, these breakpoints are always located during the second half of 2008. More specifically, the minimum values of residual-based tests are found in 2008.8-2008.9 in the case of the short-term maturity, and in 2008.7-2008.10 in the case of the long-term maturity. Therefore, closely in line with previous visual data inspection, these results confirm the existence of significant structural breaks during the second half of 2008.

As discussed before, these structural breaks reflect the huge tensions on domestic bond markets originating from the US subprime crisis and the subsequent strong monetary policy reaction implemented by the Philippine Central Bank. The econometric analysis carried out in the present section reveals, therefore, that the contagion effects arising from the US financial crisis and the subsequent strong monetary response by domestic authorities generated significant regime-shifts both in the constant and in the slope coefficients of the Philippine term structure.

3.2. Estimated Parameters and Wald Tests on Parameters Restrictions

The previous analysis shows that the policy rate is cointegrated with nominal interest rates at all maturities and that this equilibrium relationship exhibits a significant structural break during the second half of 2008.

The present section complements this empirical evidence analyzing the estimated coefficients of various regime-shifts models and implementing Wald tests on some important restrictions on parameters consistent with alternative versions of the EHTS.

This analysis represents an interesting extension of the investigation performed in Tronzano (2018b) which neglects the occurrence of structural breaks in the cointegrating relationships underlying the Philippine term structure. In this perspective, the results presented in this section are useful to reassess the validity of the policy prescriptions outlined in Tronzano (2018b).

Table 2 contains the estimated parameters from the alternative regime-shifts models. In the upper section (Table 2A), the cointegrating regression is normalized on the 6-month interest rate, assuming a structural break in 2008.9.

Table-2A. Cointegrating Regressions Normalized on 6-Month Interest Rate. Estimated Parameters: Breakpoint 2008M9

Models	α_1	α_2	γ	β	β_1	β_2
Model [C]	0.66 (5.74)	-0.52 (-6.06)	-	1.04 (62.18)	-	-
Model [C/T]	0.66 (3.40)	-0.52 (-5.01)	0.00017 (0.013)	1.04 (46.1)	-	-
Model [C/S]	0.46 (2.96)	-0.25 (-1.45)	-	-	1.069 (45.9)	-0.062 (-1.87)

Table-2B. Cointegrating Regressions Normalized on 1-Year Interest Rate.
Estimated Parameters: Breakpoint 2008M10

Models	α_1	α_2	γ	β	β_1	β_2
Model [C]	1.22 (7.93)	-0.84 (-7.33)	-	1.07 (48.05)	-	-
Model [C/T]	1.78 (7.14)	-0.64 (-4.74)	-0.0045 (-2.81)	1.02 (35.07)	-	-
Model [C/S]	0.95 (4.64)	-0.46 (-2.05)	-	-	1.115 (36.7)	-0.0894 (-2.01)

t-statistic in parentheses below estimated parameters values.

In the lower section (Table 2B), the cointegrating regression is normalized on the 1-year interest rate, assuming a structural break in 2008.10.[4]

Consider, first, the models where the structural break involves only the constant term (models [C] and [C/T]).

The constant terms before the structural break (α_1 coefficients) are always positive and statistically significant, denoting the existence of relevant risk premium components. These components reflect, at least partially, the contagion effects associated with the global financial crisis. Moreover, these components are consistently higher for nominal interest rates at longer maturities, in line with the "Liquidity Premium" version of the EHTS (compare the α_1 estimates of Table 2A with those of Table 2B).

The structural break documented for the second half of 2008 marks a sharp reduction in the constant terms of all cointegrating regressions, as witnessed by the negative estimates of the α_2 parameter for all maturities and all model's specification. This reduction in risk premium components reflects the spillover effects from the largely expansionary monetary policies implemented by major industrialized countries, as well as the liquidity injections carried out by Philippine authorities in order to avoid the shrinkage of domestic financial markets.

However, although greatly reduced, risk premium components remain significantly positive even after the 2008 structural break. This is apparent from the Wald tests which (almost) always reject the null hypothesis that $\alpha_1 + \alpha_2 = 0$ (see Tables 3A - 3B, second column).[5]

Overall, therefore, a first important result is that risk premium components have been significantly positive along the whole sample, although strongly expansionary monetary policies contributed to a significant reduction of these components since the end of 2008. This result differs from Tronzano (2018b) where no significant risk premium component is detected.

Consider now the model where the structural break affects both the constant and the slope coefficients (model [C/S]). In line with previous results, model [C/S] confirms, for both maturities, the existence of significant risk premium components exhibiting a notable downward shift since the end of 2008. Turning to the slope coefficients, model [C/S] provides further interesting insights.

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[4] As discussed in Section 3.1, residual-based tests suggest, for the 6-month maturity, either 2008.8 or 2008.9 as potential breakpoints (see Table 1A). Analogous results are obtained for the 1-year maturity, where the suggested breakpoint location is either in 2008.7 or in 2008.10 (see Table 1B). However, since the estimated parameters are broadly unaffected by these (slightly) different breakpoints locations, the results presented in Table 2 assume, respectively, a breakpoint in 2008.9 for the 6-months maturity, and a breakpoint in 2008.10 for the 1-year maturity. This allows to save space and to greatly simplify the discussion of empirical findings. Additional results for alternative breakpoints locations are available from the author upon request.

[5] The only exception is represented by model [C/T] in the case of the 6-months maturity, where the null hypothesis $\alpha_1 + \alpha_2 = 0$ is not rejected. Note however that, in this case, the linear time trend is not statistically significant suggesting that, for the 6-months maturity, model [C/T] does not provide a satisfactory description of the data generating process. This is further confirmed by the values of the Akaike Information Criterion and the Schwarz Bayesian Criterion pointing out that, for the 6-months maturity, model [C/T] ranks consistently worse than model [C] and model [C/S].

Table-3A. Cointegrating Regressions Normalized on 6-Month Interest Rate.
Wald Tests on Models Parameters: Breakpoint 2008M9

Models	$\alpha_1 = 0$	$\alpha_1 + \alpha_2 = 0$	$\beta = 1$	$\beta_1 + \beta_2 = 1$
Model [C]	32.98 [0.000]	6.74 [0.009]	5.40 [0.02]	-
Model [C/T]	11.56 [0.001]	0.382 [0.537]	2.99 [0.083]	-
Model [C/S]	8.78 [0.003]	10.34 [0.001]	-	0.090 [0.763]

Table-3B. Cointegrating Regressions Normalized on 1-Year Interest Rate.
Wald Tests on Models Parameters: Breakpoint 2008M10

Models	$\alpha_1 = 0$	$\alpha_1 + \alpha_2 = 0$	$\beta = 1$	$\beta_1 + \beta_2 = 1$
Model [C]	63.04 [0.000]	28.50 [0.000]	10.91 [0.001]	-
Model [C/T]	50.99 [0.000]	16.59 [0.000]	0.478 [0.489]	-
Model [C/S]	21.54 [0.000]	29.86 [0.000]	-	0.656 [0.418]

Marginal significance levels in square brackets behind test statistics.

The slope coefficients before the structural break (see β_1 estimates in Tables 2A-2B) are always significantly higher than one suggesting that, during this period, the "symmetry" restriction is rejected. This result mimics the empirical evidence obtained in Tronzano (2018b) documenting the absence of equi-proportional yields movements and strong overshooting effects for nominal interest rates at longer maturities.

According to model [C/S], however, the end-2008 regime-shift involved also a significant decrease in the slope coefficients at all maturities (see β_2 estimates in Tables 2A-2B, which turn out to be significantly lower than zero). Moreover, according to the Wald tests, the null hypothesis that $\beta_1 + \beta_2 = 1$ cannot be rejected neither at the 6-months nor at the 1-year maturity (see Tables 3A-3B, last columns). This evidence shows that the rejection of the "symmetry" restriction is confined to the former part of the sample whereas, after the structural break, the "symmetry" restriction is fully supported by data.

Overall, therefore, a further important result of this paper is that, after the 2008 structural break, the Philippine term structure of interest rates is characterized by equi-proportional yields movements at all maturities. The validity of the "symmetry" restriction since the end of 2008 is not documented in Tronzano (2018b) since the econometric approach used in that paper does not allow for the potential occurrence of regime-shifts.

4. CONCLUDING REMARKS AND POLICY IMPLICATIONS

This paper extends the empirical investigation about the Philippine term structure carried out in Tronzano (2018b) using a cointegration technique allowing for one break in the long-run equilibrium relationship. Accounting for a potential regime-shift is important, in this context, because visual data inspection suggests the existence of a structural break towards the end of 2008, as a consequence of the spillover effects from the US subprime crisis and the subsequent expansionary measures implemented by domestic and international monetary authorities.

The main empirical findings may be summarized as follows.

In line with Tronzano (2018b) the null hypothesis of absence of cointegration is strongly rejected across the whole spectrum of assets maturities. Moreover, in line with preliminary data inspection, residual-based tests detect a regime-shift located in the second half of 2008, involving both the constant and the slope coefficients of the cointegrating regressions.

Differently from Tronzano (2018b) significant risk premium components are detected before the 2008 structural break. These components turn out to be quantitatively higher at the longer end of the maturity spectrum, as suggested by the Liquidity Premium theory. A reduction in the values of risk premium components is apparent after the 2008 structural break, although they still remain positive and statistically significant.

Last but not least, the "symmetry" restriction is strongly rejected before the 2008 structural break, whereas the same restriction is consistently supported after this regime-shift. Therefore, differently from Tronzano

(2018b) the econometric approach taken in the present paper points out a significant decrease in slope coefficients towards the end of 2008, providing evidence more favourable to the EHTS during the second half of the sample period.

The policy implications are broadly in line with those outlined in Tronzano (2018b) albeit with some relevant qualifications.

An important message of this paper is that the macroeconomic conditions for an inflation targeting regime, relying on a short-term policy rate, have significantly improved in the Philippines in more recent years. The structural break identified at the end of 2008 documents, in fact, a consistent reduction in risk premium components and the existence of equi-proportional movements between the (exogenous) policy rate and market interest rates. Taken as a whole, this empirical evidence highlights a more stable macroeconomic environment, where monetary impulses are more efficiently transmitted through the term structure of interest rates.

The empirical evidence reveals, however, that risk premia at various maturities remained statistically significant even during the last part of the sample, notwithstanding the expansionary monetary policy implemented by domestic authorities as a reaction to the 2007-2008 global financial crisis.

This finding supports a monetary policy strategy based on interest rate smoothing, in line with the policy prescription advocated in Tronzano (2018b).

It is well known that, differently from the standard assumption of the "weak" form of the EHTS (according to which term premium components are maturity-specific, but constant over time), risk premia components exhibit a great deal of variation over time. Recent research in the field of affine structure models provides strong theoretical motivations for the existence of time-varying risk premia, mostly related to inflation uncertainty and other structural economic factors (Gürkaynak and Wright, 2012). On the empirical side, moreover, a large body of empirical evidence has accumulated showing that risk premia at various maturities are time-varying and largely unstable (see, among others, Christensen *et al.* (2007) and Rudebusch *et al.* (2007)).

Time-varying risk premia generate intrinsic uncertainty in the monetary policy transmission mechanism, since the monetary impulses stemming from the policy rate are negatively affected by random disturbances. Under these circumstances, a gradual adjustment of the policy rate allows to smooth out the impact of policy rate movements on the term structure, thus minimizing unforeseen monetary policy effects and excessive volatility in market interest rates.

In this perspective, the main policy implication outlined in Tronzano (2018b) namely the need for a gradual approach in the implementation of monetary policy, retains its validity also in the light of the new results obtained in the present paper.

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REFERENCES

Buigut, S. and V.K. Rao, 2010. Expectations hypothesis and the term structure of Hong Kong interbank rates. International Research Journal of Finance and Economics, 39: 72-85.

Campbell, J.Y. and R.J. Shiller, 1987. Cointegration and tests of present value models. Journal of Political Economy, 95(5): 1062-1088. Available at: https://doi.org/10.1086/261502.

Campbell, J.Y. and R.J. Shiller, 1991. Yield spreads and interest rate movements: A bird's eye view. The Review of Economic Studies, 58(3): 495-514. DOI https://doi.org/10.2307/2298008.

Christensen, J.H.E., F.X. Diebold and G.D. Rudebusch, 2007. The affine arbitrage-free class of Nelson-Siegel term structure models. Federal Reserve Bank of San Francisco Working Paper N. 2007-20.

Clarida, R., J. Galí and M. Gertler, 1999. The science of monetary policy: A new Keynesian perspective. Journal of Economic Literature, 37(2): 1661-1707.

Engsted, T. and C. Tanggaard, 1994. Cointegration and the US term structure. Journal of Banking & Finance, 18(1): 167-181. Available at: https://doi.org/10.1016/0378-4266(94)00084-0.

Gregory, A.W. and B.E. Hansen, 1996. Residual-based tests for cointegration in models with regime shifts. Journal of Econometrics, 70(1): 99-126. Available at: https://doi.org/10.1016/0304-4076(69)41685-7.

Guerello, C. and M. Tronzano, 2016. The expectations hypothesis of the term structure of interest rates and monetary policy: Some evidence from Asian countries. Applied Economics, 48(55): 5405-5420. Available at: https://doi.org/10.1080/00036846.2016.1178845.

Guinigundo, D., 2010. The impact of the global financial crisis on the Philippine financial system: An assessment. Bank for International Settlements (BIS) Paper, No. 54: 317-342.

Gürkaynak, R.S. and J.H. Wright, 2012. Macroeconomics and the term structure. Journal of Economic Literature, 50(2): 331-367.

Rudebusch, G.D., B.P. Sack and E.T. Swanson, 2007. Macroeconomic implications of changes in the term premium. Federal Reserve Bank of St. Louis Review, 89(4): 241-269. Available at: https://doi.org/10.20955/r.89.241-270.

Tronzano, M., 2015a. The term structure of interest rates in India: Evidence from the post-liberalization period (1996-2013). Economia Internazionale, 68(2): 275-295.

Tronzano, M., 2015b. The expectations hypothesis of the term structure: further empirical evidence for India (1996-2013). Economia Internazionale, 68(3): 401-421.

Tronzano, M., 2015c. The expectations hypothesis of the term structure in emerging financial markets: Some evidence for Malaysia (1999-2015). Economia Internazionale, 68(4): 521-550.

Tronzano, M., 2018a. Does the expectations hypothesis of the term structure hold in Korea after the Asian financial crisis? Some empirical evidence (1999-2017). Economia Internazionale, 71(2): 191-226.

Tronzano, M., 2018b. The expectations hypothesis of the term structure in the Philippines: An empirical note (2001-2017). Asian Economic and Financial Review, 8(5): 704-716.