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Is Interest Rate Pass-through in Albania Non-linear?

ILDA MALILE
European University of Tirana,
Tirana, Albania

Abstract:

This study tries to investigate the nonlinear effects of the interest rate pass-through in Albania over the period 2002m01: 2013m03, using monthly data. An OLS (Ordinary Least Square) approach is employed to take into account the short-run and the long-run dynamics of such linearity, depending on whether the interest rates enter the regression in level or as first differenced. More specifically, the study attempts to investigate whether responses of wholesale (represented by the interbank and T-bills' yields) and retail interest rates (deposit and credit) to small and large changes in the policy rate are linear or not. This study is a follow-up of the previous two materials which aim to investigate the interest rate pass-through in Albania, and its asymmetric effects. These three studies will constitute the core part of author's PhD thesis, titled; "Analysis on the functioning of the interest rate channel during the years, 2001-2013".A main finding of the study is that in the short-run, the 6- and 12-month T-bills' yields are linearly related to the policy rate, while the 7-day interbank interest rate and the 3-month T-bills' yield show a nonlinear relationship with the policy rate. In the short-run, the nonlinearities effects in retail rates (deposit and credit) are not very clear cut. In the long-run, relationships between the policy rate and other interest rates turn out to be more nonlinear than the short-run ones. We believe that the empirical results of this study might be useful for the increase in the efficiency of monetary policy implementation, providing useful information of the Albanian monetary policy transmission mechanism.

Key Words: interest rate pass through, nonlinearities, monetary policy

JEL Classification: C32, E43, E52

1. Introduction

Monetary policy is proven, theoretically and empirically, to influence economy of a country through various channels. A successful implementation of the monetary policy requires understanding well its transmission process. One of the most studied mechanisms of monetary policy is the interest rate channel, according to which any changes in the policy rate is expected to be reflected in other short- and long-run interest rates, which ultimately will have an effect on aggregate demand and prices. Therefore, a successful monetary policy depends on the velocity and magnitude of pass-through of a change in policy rate to interest rates of interbank, primary market and especially to those of retail market. Though theoretical literature assumes a full and immediate pass-through of policy rate, empirical evidence has shown that such pass-through may be incomplete, sluggish, asymmetric and/or nonlinear due to several reasons, such as: competition in the banking sector, bank regulation and specifics (capital and liquidity requirements, the assessment of credit risk by banks, the level of liquidity in the banking sector, etc. Another reason why the interest rate pass-through might be distorted is in cases when the interest rate is near the zero lower bound, and banks might not follow suit, leading thus to a widening of intermediation spreads. This is mostly due to higher credit risk perceived by banks.

In case of Albania, there have been many studies attempting to investigate the monetary policy transmission mechanism, such as: Kolasi et al.(2010) , Vika(2007), Istrefi and Semi (2007), Tanku(2007), Tanku(2008), Shijaku (2010), Kodra (2010), Mançellari (2009), etc. These studies try to estimate the impact of a change in monetary policy on M3, inflation, gross domestic product, exchange rate, credit to private sector, optimal level of reserve holdings, fiscal indicators, monetary and financial conditions, etc. However, to the best of our knowledge there is no study in the case of Albania which attempts to estimate the specifics of the policy rate interest rate pass-through let alone its asymmetry or non-linearity.

This material is a follow-up of the previous two studies which aim to investigate the interest rate pass-through in Albania in a two-stage process. The first stage consists in the pass-through of any changes in the policy rate to wholesales interest rates, represented by interbank and T-bills' yields, while the second stage consists in the pass-through from the wholesale interest rates to retail interest rates of both, credit and deposits. This series of studies[1] will constitute the core part of author's PhD thesis, titled; "Analysis on the functioning of the interest rate channel during the years, 2001-2013". The very first part of this thesis, "The interest rate pass-through in Albania from monetary policy rate to wholesale interest rates and to retail market rates"[2], aimed to investigate the magnitude and velocity of interest rate pass-through, while checking for any possible effect of the recent financial crisis on such pass-through. The methodology adopted in this material was the Vector Error Correction Mechanism (VECM). The second part of the +thesis[3], using Ordinary Least Squares methodology, aimed to investigate the asymmetric effects of interest rate pass through. More specifically, the paper estimated whether responses of wholesale interest rates (interbank rates and T-bills' yields) and retail interest rates (deposit and credit) to downward and upward changes in the policy rate are symmetric or not. This material aims to add to the first two studies by testing the existence (or not) of nonlinearities in the response of interbank interest rates, and of T-bills' yields to policy rate.

The concept of nonlinearity is used slightly differently in various studies. So, in Beckmann et al (2013), nonlinearity refers to existence of structural breaks, such as banking crisis, which influence the long- and short-run pass through of policy rate. Relying on a database provided by Laeven and Valencia

1 So far three of them, including this one.

2 This paper was presented in the 5th International Conference "The Economies of Balkan and Eastern Europe Countries in the Changed World", held in Istanbul, Turkey on 9-12th May, 2013. The study is in the publishing process, and is available by the author upon request.

3 "Asymmetry of interest rate pass-through in Albania" was submitted at the "3rd International Conference on Human and Social Sciences", organized on September 20-22, in Rome, Italy.

(2012)[4], and using a time-varying coefficient approach in VECM finds that in cases of emerging economies, Beckman et al(2013) finds that the efficiency of monetary transmission improves when a systemic bank crisis occurs, which is reflected in a higher long-run interest rate pass-through. In the short-run, bank crisis are not found to have a clear impact on the interest rate pass-through. However, one observation is very clear, which is that the short-run pass-through is mostly affected after the crisis has ended. Regarding the recent financial crisis, the long-run pass-through is not very much affected, with very few exceptions. A similar definition of linearity is that applied in Durán- Víquez and Esquivel-Monge (2008). This study aimed to estimate the magnitude and the velocity of interest rate pass-through in the Costa Rican economy in the period 1996-2007, while checking if that pass-through altered after October 2006, when the Central Bank of Costa Rica changed its exchange rate regime. The methodology employed in this study consists in non-linear VECM incorporating a dummy variable, aimed to capture the change in the exchange rate regime. The dummy is assigned a value equal to zero for the pre-October 2008 period and a value equal to one for the post-October 2008 period. In case this dummy turns out to be statistically insignificant, then it could be concluded that the interest rate pass-through is constant in the entire period, and that the change in the exchange rate regime has not affected such pass-through.

Other studies define nonlinearity as a varying relationship between two or more variables depending on a threshold. Such definition on linearity is mostly adopted in studies regarding the impact of the public debt in economic activity. So, Baum et al (2012), using a dynamic threshold panel methodology, analyses the long-run impact of public debt on GDP growth in 12 euro area countries for the period 1990-2010. A main finding of the study is that public debt has a positive and statistically significant impact on economic growth, for public debt-to-GDP ratios up to 67%. When the public debt-to-GDP ratio exceeds the 95% level, GDP starts to have a negative impact on the economic activity.

4 The database provided by Laeven and Valencia (2013) identifies episodes of banking crisis for several emerging and industrial countries.

A third definition applied to nonlinearity of interest rate pass-through is used interchangeably with asymmetry, like in Becker et al (2013). These studies try to check whether interest rate (of wholesale or retail market react differently depending on whether the policy rate increases or decreases.

In this study the definition of the nonlinearity refers to how interbank interest rates, T-bills' yields, and retail interest rates react depending on whether changes in policy rate are of small or large magnitudes. A model is said to be linear in parameters if the derivatives of f with respect to the parameters do not depend upon B (eq. 1); in cases when the derivatives are functions of B, then the model is said to be nonlinear (eq. 2).[5]

(Eq.1)

$$Y_t = B_1 + B_2 \log L_t + B_3 \log K_t + \varepsilon_t$$

(Eq.2)

$$y_t = B_1 L_t^{B_2} K_t^{B_3} + \varepsilon_t$$

A very simple and easy technique to check for nonlinearity is to insert in the regression the squared term of the policy rate and compare its estimated coefficient with the estimated coefficient of level term of the policy rate. If the magnitudes of the estimated coefficients are different from each other and statistically significant from each other, then we can conclude there is evidence for nonlinearity.

Literature on nonlinear response of interest rates to policy rate is quite limited, and the most common methodology employed in these few studies regarding non-linearity of the policy rate pass-through are Threshold Autoregressive Models. These models are extensively used in economics, and they are quite popular in the literature regarding nonlinear time series.[6] Clements and Galvao (2001) evaluates whether the term structure of US interest rates is better forecasted when the nonlinearities and asymmetries in the behavior of US short- and long-term rates are taken into account. Employing several models and tests for nonlinear cointegration, the study finds

[5] Eviews 7 Users' Guide II

[6] A detailed explanation on the statistical theory regarding threshold estimation is provided in Hansen (2000).

that model which take into account nonlinearities do not produce better forecasts that those of linear model, except the abnormal cases.

Another study investigating nonlinearities in the interest rate pass-through is that of Becker et al (2010). Employing a threshold cointegration methodology, Becker et al (2013) analyzes the interest rate pass-through in the United Kingdom, in a two-stage framework: the pass-through from the official rate to the money market (1st stage); and from the money market to the retail mortgage rate (2nd stage). In addition to this, Becker et al (2013) checks whether such pass-through differs when different samples are considered. One sample ends early in 2006 and it does not include the credit crunch, and so it can be considered as a normal period. The other sample cover the period between 2006 and 2008 and include a period during which a credit crunch occurred, and so it can be considered a stressful period. The study finds different responses of LIBOR to the base rate and of mortgage rate to LIBOR rate depending on whether the linear or the nonlinear model is used. When assuming a non-linear relationship between interest rates, Becker et al (2013) concludes on a faster disequilibrium correction than the linear model estimates. Also, the nonlinear model improves the fit compared to a linear specification. Both models, linear and nonlinear, do not find any differences in the equilibrium adjustment mechanism when the longer period is considered, which might indicate stability in the presence of some stressed conditions.

The rest of this study briefly explains the data and the methodology employed by the study, and also provides the obtained results having in mind data and methodology limitations. The final section concludes and provides some suggestions for further areas of research or improvement.

2. Data, Methodology, and Empirical Results

The aim of this paper is to complement the first two studies with regard to interest rate pass through in Albania, over the period 2002m01 – 2013m03, using monthly data on interest rates. The focus of the study is to test the existence (or not) of nonlinearities in the response of interest rates in the interbank, primary and retail market to changes in policy rate.

Nonlinearity is defined as the difference in response of wholesale and retail interest rates to small and large changes in policy rate.

The repo rate is represented by the repurchase agreement rate (repo) which is used in open market operation, and it is the main instrument BoA uses to maintain price stability. Repo was introduced in the second half of 2000, and replaced the direct instruments used prior to this year, which consisted in controls on the interest rates of 3-, 6-, and 12-month deposits of state banks. Interbank interest rates are represented by the overnight (o_n) and 7-day interest rate (i_7d)[7]; while the primary market is presented by its three short-term maturities: 3-month (b_3m), 6-month (b_6m) and 12-month T-bills' yields (b_12m).[8] The retail market interest rates are represented by the lending (*i_credit*) and deposit rates (*i_deposit*) denominated in ALL and applied to newly extended loans and newly collected loans. We choose not to use the rates applied to the stock of loans or deposits as they tend to react more slowly to any changes in policy rate or other rates.

The methodology employed in this study is the OLS approach, which allows studying both, the short-run and long-run dynamics of the interest rate pass-through depending on whether interest rates enter the regression in level or in first difference. Assuming that interest rate time series are stationary at first difference - I(1) - , an OLS regression including interest rates time series in level represents the long-run relationship between them, while an OLD regression including interest rates time series in first difference, represents the short-run relationship between them. The nonlinear effects are captured by adding the squared term of policy rate in each OLS specification (short and long-run).

$i = f\,[c, \text{policy rate}, \text{policy rate}^2]$ ..... *long-run* eq. 3

$d(i) = f\,[c, d(\text{policy rate}), (d(\text{policy rate}))^2]$ ..... *short-run* eq. 4

7 Other interbank interest rates (of maturities 2-week, 1-, 2- and 3-month) are not included in the estimation due to their short time series and their sporadic nature.

8 As in preceding studies of the same author, regarding the interest rate pass-through in Albania, yields of obligations are not included in the empirical estimation due to their recent launch in the market which make their time series short.

In case the squared term of the policy rate is statistically insignificant, and has a different magnitude and sign with the policy rate (in level), we conclude that the interest rate pass-through is characterized by linearity. In all other cases, we conclude that interest rate pass-through is nonlinear.

Prior to conducting OLS estimation, unit root tests on each of the interest rate time series are conducted using three tests for robustness check (Tables a, b, c): Augmented Dickey Fuller (ADF), Phillips Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS). Literature on unit root tests (Pelgrin, 2012) suggests that the first two tests are almost similar to each, but they might have some slight differences in finite samples. They are both sensitive to structural breaks, and therefore we have performed a third unit root test, KPSS, which is mostly used in literature in order to get confirmatory results on the unit root process of the time series of our interest. However, our judgment is mostly based on the first two tests (ADF and PP). It is usually believed that interest rates are nonstationary variables, which seems to be proven in the case of Albania. All time series, but credit interest rate, are stationary at first difference at 1% level of confidence, according to the ADF and PP unit root tests[9]. Therefore, they all enter the OLS estimation as I(1) variables. Credit interest rate is the only variable, which according to two tests (ADF and PP) is stationary at level. For this reason, the results regarding the response of credit interest rate to positive or negative changes in monetary policy rate should be taken with some caution.

1) Augmented Dickey Fuller Tests

	in levels			*in first difference*		
Indicators	intercept	trend&intercept	none	intercept	trend&intercept	none
repo_rate	0.9221	0.9014	0.0937	0.0000	0.0000	0.0000
b_3m	0.7098	0.8496	0.1072	0.0000	0.0001	0.0000
b_6m	0.6659	0.8459	0.2163	0.0000	0.0000	0.0000
b_12m	0.5132	0.6014	0.2297	0.0000	0.0000	0.0000
o_n	0.5132	0.6014	0.2297	0.0000	0.0000	0.0000
i_7d	0.8533	0.7322	0.1384	0.0000	0.0000	0.0000
i_credit	0.0064	0.0002	0.4585	0.0000	0.0000	0.0000
i_deposit	0.4399	0.7688	0.2171	0.0000	0.0000	0.0000

[9] KPSS test gives some different results compared to the ADF and PP tests. For more information, see Table 1c of Appendix

2) Phillips Perron Tests

	in levels			*in first difference*		
Indicators	intercept	trend&intercept	none	intercept	trend&intercept	none
repo_rate	0.8393	0.7521	0.1692	0.0000	0.0000	0.0000
b_3m	0.5159	0.5691	0.2856	0.0000	0.0000	0.0000
b_6m	0.5596	0.6833	0.2083	0.0000	0.0000	0.0000
b_12m	0.5998	0.6929	0.2114	0.0000	0.0000	0.0000
o_n	0.3115	0.5888	0.4405	0.0000	0.0000	0.0000
i_7d	0.8400	0.6849	0.1449	0.0000	0.0000	0.0000
i_credit	0.0144	0.0001	0.4862	0.0000	0.0000	0.0000
i_deposit	0.4398	0.7688	0.2161	0.0000	0.0000	0.0000

3) KPSS

	in levels			*in first difference*		
Indicators	intercept	trend&intercept	none	intercept	trend&intercept	none
repo_rate	0.8267	0.1622		0.1103	0.1043	
b_3m	0.7551	0.2017		0.0622	0.0591	
b_6m	0.7868	0.2133		0.0801	0.0682	
b_12m	0.6351	0.1991		0.0824	0.0839	
o_n	0.1334	0.1320		0.0851	0.0694	
i_7d	0.8760	0.1141		0.1085	0.0591	
i_credit	0.8760	0.1141		0.1085	0.0591	
i_deposit	0.5591	0.2235		0.1262	0.0845	

In Table 4, results regarding the short-run relationships between each of the wholesale and retail interest rates with the policy rate are shown. Interest rates enter the equations as I(1) – once differenced. The first column represents the estimated coefficients before the policy rate expressed in level; the second column represents the estimated coefficients before the squared term of policy rate; and the third column shows the adj. R-squared for each of the OLS specification. As shown in the table, the coefficient before the squared term of policy rate is statistically significant, and of similar magnitude (almost) and sign with the coefficient before the policy rate in level in the case of overnight rate, 6-month and 12-month T-bills. This supports the existence of linearity in the short-run response of overnight interest rate, 6- and 12-month T-bills' yields. Another interesting observation is that policy rate seems to have a stronger effect on the 7-day interbank market and on the 3-months T-bills' yield when the policy rate change is large. In the case of retail interest rates, it is not straightforward to judge on linearity of policy rate interest rate pass-through. Squared terms and level terms of policy rate have coefficients which are statistically insignificant, of different magnitudes and sign. This could be due to the fact, that even when not considering the nonlinearities effects, deposit and credit

interest rates are not expected to follow changes in policy rate in the short (immediate)-run.

Table 4. Short-run (non) linearity

SHORT-TERM (IMMEDIATE) LINEARITY			
	repo rate	repo rate^2	Adj. R-squared
overnight (*o_n*)	0.5145***	0.68025**	0.1296
7-day (*i_7d*)	0.2848***	0.4352**	0.1012
3-months T-bills' yield (*b_3m*)	0.3864***	0.8282***	0.1770
6-month T-bills'yield (*b_6m*)	0.4082***	0.3939*	0.0923
12-month T-bills'yield (b_12m)	0.3708**	0.4656*	0.070
credit rate (*i_credit*)	-0.3464	0.9157	0.0142
deposit rate (*i_deposit*)	0.0348	-0.05085	0.00083
***, **, and * denotes significance at 1%, 5%, and 10%, respectively			

In Table 5, results regarding the long-run relationships between each of the wholesale and retail interest rates with the policy rate are shown. Interest rates enter the equations in level. As shown in the table, the long-run relationships seem to be more nonlinear than the short-run relationships. So, in the case of the 3- and 6-month T-bills' yields and the deposit rate, the coefficient before the squared term of policy rate is statistically significant, and with different sign and magnitude with that of the level term of policy rate. The 12-month T-bills yield also shows nonlinearity, but the estimated coefficient of the level term of policy rate is not statistically significant, and might distort slightly our judgment on the nonlinearity. The 7-day interbank interest also shows some kind of nonlinearity, though the estimated coefficients before the policy rate (level and squared term) are statistically insignificant. The response of overnight interest rate to policy rate seems to be more linear, though similarly to the 7-day interbank rate, coefficients of level and squared term of the policy rate are not statistically significant. In the case of the credit interest rate, the squared policy rate has the opposite sign and a much smaller magnitude in absolute terms than the level policy rate, which might indicate some nonlinearity, though being statistically insignificant. This should be taken with extreme caution given that credit interest rate is found to be I(0) and therefore it is not advised to be regressed on I(1) variables.

Table 5. Long-run (non) linearity

LONG-TERM LINEARITY			
	repo rate	repo rate^2	Adj. R-squared
overnight (*o_n*)	0.1317	0.0324	0.4614
7-day (*i_7d*)	0.8812	0.0069	0.9517
3-months T-bills' yield (*b_3m*)	(1.5651)***	0.2145***	0.9164
6-month T-bills'yield (*b_6m*)	(1.01639)***	0.1777***	0.9072
12-month T-bills'yield (b_12m)	-0.3660	0.1233***	0.8180
credit rate (*i_credit*)	1.4964*	-0.0690	0.2817
deposit rate (*i_deposit*)	(0.9192)***	0.1403***	0.8448
***, **, and * denotes significance at 1%, 5%, and 10%, respectively			

3. Conclusions and further areas of research

The aim of this study was to estimate whether the policy rate pass-through in Albania is linear or not, over the period 2002m01 – 2013m03, using monthly data. This study is a follow-up to the previous two materials which focus on estimating the velocity and the magnitude of the interest rate pass-through in Albania, and its asymmetric effects.

The methodology employed in this study is Ordinary Least Square methodology which allows studying the short- and long-run relationship between policy rate and other interest rates, more specifically, those of interbank, primary and retail market, depending on whether the interest rates enter the regression in level or as first differenced. The (non)linearity is captured by inserting the squared term of policy rate in addition to the level term of the policy rate. Based on the statistical significance, magnitude and sign of the squared term of the policy rate coefficient compared to the coefficient of the level term of the policy rate, we conclude on the linearity or nonlinearity of the interest rate pass-through.

A main finding of the study is that in the short-run, the 6- and 12-month T-bills' yields are linearly related to the policy rate, while the 7-day interbank interest rate and the 3-month T-bills' yield show a nonlinear relationship with the policy rate. In the short-run, the nonlinearities effects in retail rates (deposit and credit) are not very clear cut. In the long-run, relationships between the policy rate and other interest rates turn out to be more nonlinear than the short-run ones. We can clearly conclude on the nonlinear response of the policy rate to the 3- and 6-month T-bills' yields and the deposit rate. It is not very obvious to conclude on the nonlinearity in the policy rate pass-through to other interest rates considered in the study (the overnight and 7-day interbank interest rate, the 12-month T-bills' yield, and the credit interest rate).

This study, together with the preceding two studies, is the first one to investigate the policy rate interest rate pass-through in Albania, let alone the asymmetric and nonlinear effects of such pass-through. However, in the future this study needs to be more elaborated and enriched. So, it would be more informative to include more maturities of interbank, primary and especially of the retail market in our empirical analysis, in order to give a full picture on the nonlinearity of the interest

rate pass-through in Albania. Also, we need to use more sophisticated model, like TAR (Threshold Autoregressive) or non-linear vector integration techniques to study both the short- and long-run dynamics of the interest rate pass-through, and the speed of adjustment of any deviation or disequilibrium towards the long-run relationship.

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