

## An Application On Interest Rate Pass-Through In TURKEY

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**ABSTRACT:** The objective of this study is to determine the pass-through speed and rate of the changes, regarding the overnight borrowing rate of Central Bank of Republic of Turkey, to bank rates for loans. Therefore, policy interest rates were taken as reference for the period between 2002-2014, when inflation-targeting regime was adopted in Turkey. Vector Autoregression (VAR), co-integration, and Granger causality tests were used during the analysis. Through the Vector Autoregression (VAR) modeling analysis, the resistance of bank interest to the changes in policy interest rate was measured in short term. The existence of a long term relation between the mentioned interests and co-integration was examined, and the speed and level of pass-through effect of the interests were manifested with Error Correction Model. As the conclusion of this research study, it can be mentioned that the pass-through effect to the bank interests is fast and high in the long term in our country, even if the deposit and loan types change. The pass-through effect to the loan interests the household uses has been faster and in higher level compared to the commercial credit.

**KEY WORDS:** Policy Interest Rate, Pass-Through to Interest Rates, Vector Autoregression, Action and Reaction Functions, Co-integration analysis.

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### I INTRODUCTION

In the inflation-targeting regime, which has been applied by some economies recently, the central bank tries to influence the economies by using short term interests, which are considered as the main policy means, via monetary transmission mechanism. The changes in policy interests also make change in other short-term interests and expectations. This change reflects on bank and market interest rates and influences inflation, production level, and total demand by means of transmission mechanism. The pass-through effect of interests, which is the primary phase of the monetary transmission mechanism, can be defined as the reaction speed and degree of bank and market interests to changes in monetary policy interests. Since there is not a Turkish equivalent of pass-through effect of interests, it is used in various definitions such as pass-through effect from policy interests to interests, pass-through effect to market and bank interests, interest rate transmission etc. In interest decisions, the pass-through time and level of monetary policy to other interests in the economy directly or indirectly influences the effectiveness of all kinds of transmission means and it has a quite important role in continuity of the monetary transmission mechanism faultlessly. In other words, the faster and higher the changes in policy interests influence the short and long term real interests, the more power the central banks will have to influence the inflation and the output. In full information and perfect competition conditions, the changes in policy interests are expected to reflect completely and fast on bank and market interests. However, many factors regarding macroeconomic conditions, banks, the status of the financial system, and monetary policy implementations influence the speed and level of the pass-through effect. There is not sufficient number of research studies, sources, or books, which are empirically focusing on pass-through effects of interests, in our country. In this research study, the pass-through effect of changes in policy interests since 2002, when the inflation-targeting regime initiated, until ~~today~~ 2014 to mortgage, commercial, vehicle, and consumer loans of banks by means of Vector Autoregression (VAR) and co-integration analyses. In this study, a longer period is scrutinized compared to other research studies in our country.

### II THEORETICAL FRAMEWORK AND METHOD

The objective of this study is to analyze the pass-through effect of interest rate regarding the period in between January 2002, when the implicit inflation targeting strategy initiated in Turkish economy, and December 2014, within the framework of vector autoregression models (VAR), via variance classification, action and reaction function, co-integration analysis, and Granger causality test.

#### 1.1. Theoretical Framework

In terms of Consumer Loan Interest (i<sub>1</sub>), Mortgage Loan Interest (i<sub>KK</sub>), Vehicle Loan Interest (i<sub>TK</sub>),

Commercial Loan Interest (iT), and Policy Interest (iP), interest rate pass-through effect via VAR process is defined as follows,

$$i_I = \beta_1 + \sum_{i=1}^p \alpha_{1i} i_{I_n} + \sum_{i=1}^p \lambda_{1i} i_{KK_n} + \sum_{i=1}^p \gamma_{1i} i_{TK_n} + \sum_{i=1}^p \delta_{1i} i_{T_n} + \sum_{i=1}^p \theta_{1i} i_{P_n} + \varepsilon_{1t} \quad (1)$$

$$i_{KK} = \beta_2 + \sum_{i=1}^p \alpha_{2i} i_{KK_n} + \sum_{i=1}^p \lambda_{2i} i_{I_n} + \sum_{i=1}^p \gamma_{2i} i_{TK_n} + \sum_{i=1}^p \delta_{2i} i_{T_n} + \sum_{i=1}^p \theta_{2i} i_{P_n} + \varepsilon_{2t} \quad (2)$$

$$i_{TK} = \beta_3 + \sum_{i=1}^p \alpha_{3i} i_{TK_n} + \sum_{i=1}^p \lambda_{3i} i_{I_n} + \sum_{i=1}^p \gamma_{3i} i_{KK_n} + \sum_{i=1}^p \delta_{3i} i_{T_n} + \sum_{i=1}^p \theta_{3i} i_{P_n} + \varepsilon_{3t} \quad (3)$$

$$i_T = \beta_4 + \sum_{i=1}^p \alpha_{4i} i_{T_n} + \sum_{i=1}^p \lambda_{4i} i_{I_n} + \sum_{i=1}^p \gamma_{4i} i_{KK_n} + \sum_{i=1}^p \delta_{4i} i_{TK_n} + \sum_{i=1}^p \theta_{4i} i_{P_n} + \varepsilon_{4t} \quad (4)$$

$$i_P = \beta_5 + \sum_{i=1}^p \alpha_{5i} i_{P_n} + \sum_{i=1}^p \lambda_{5i} i_{I_n} + \sum_{i=1}^p \gamma_{5i} i_{KK_n} + \sum_{i=1}^p \delta_{5i} i_{TK_n} + \sum_{i=1}^p \theta_{5i} i_{T_n} + \varepsilon_{5t} \quad (5)$$

In the mathematical formulations,  $\beta$  symbolizes the constant term, while  $\varepsilon_t$  denotes white noise error term. Interest rate pass-through effect is tested while  $\alpha_{1i}, \lambda_{1i}, \gamma_{1i}, \delta_{1i}, \theta_{1i}$  coefficients are equal to one.

## 1.2. Method

In empirical analysis, firstly the steady states of the variables were examined with ADF unit root test, secondly the system lag was determined via VAR model and VAR estimation was implemented. Subsequently, action-reaction functions were included and variance classification of the variables were made. The implementation was completed with co-integration and Granger Causality test.

## III EMPIRICAL RESULTS

In this study, Consumer Loan Interest (i<sub>1</sub>), Mortgage Loan Interest (i<sub>KK</sub>), Vehicle Loan Interest (i<sub>TK</sub>), Commercial Loan Interest (iT), and Policy Interest (i<sub>P</sub>) rates are used regarding the period in between January 2002 and December 2014, when the implicit inflation targeting strategy was adopted in Turkish economy. All of the data used in the analyses is obtained from the Statistical Data System (EVDS) of the Central Bank of Republic of Turkey, and afterwards seasonally adjusted according to the Tromo-Seats method.

**Table 1 Summary of Time Series Effects of the Variables**

Variable	Seasonal Effect	Calendar Effect
Consumer Loan Interest	NO	Total workdays except Sundays and religious holidays
Mortgage Loan Interest	NO	Total workdays except religious holidays
Vehicle Loan Interest	NO	NO
Commercial Loan Interest	YES (Weak)	NO
Policy Interest	NO	NO

The seasonal effects of all the variables that were used in the model were reported on Table 1. The relevant effects were calendar adjusted seasonally adjusted in R program.

**Table 2 Basic Statistical Values of the Variables**

Basic Statistics	Policy Interest	Vehicle Interest	Loan Mortgage Interest	Loan	Commercial Interest	Loan	Consumer Interest	Loan
Average	15,79	20,62	20,08	20,32		24,80		
Median	13,90	17,93	16,53	17,46		20,86		
Maximum	57,00	57,71	53,85	58,35		74,52		

Minimum	1,50	7,69	7,57	6,51	9,37
Standard Deviation	13,36	11,10	11,74	11,79	13,40
Skewness	1,44	1,51	1,44	1,49	1,66
Kurtosis	4,37	4,42	3,98	4,44	5,21
Jarque-Bera	65,98	72,59	60,26	70,97	103,16
Significance Level	0,00	0,00	0,00	0,00	0,00
Number of Observations (N)	156	156	156	156	156

The basic statistical values of all of the variables are presented on Table 2. Since all of the variables are ( $P < 0,05$ ) according to J-B test statistics, it was observed that they were non-normally distributed.

**Table 3 Correlation Among Variables**

	Policy Interest	Vehicle Loan Interest	Mortgage Loan Interest	Commercial Interest	Loan Consumer Interest
Policy Interest	1	0,980*	0,978*	0,982*	0,979*
Vehicle Loan Int.	0,980	1	0,993*	0,983*	0,989*
Mortgage Loan Int.	0,978	0,993	1	0,983*	0,986*
Commercial Loan Int.	0,982	0,983	0,983	1	0,990*
Consumer Loan Int.	0,979	0,989	0,986	0,990	1

\*  $P < 0,05$

Correlation values among the variables are presented on Table 3. Accordingly, it was observed that there were positive and strong relations among all of the variables.

Before beginning to observe the relation among the interest rates, it is necessary to examine the steady state of the interest rate series. In case the series are not steady, spurious regression results are obtained at the end of the analyses conducted, a high  $R^2$  value and significant t and F values are obtained, which do not reflect the relation in real terms. In order to prevent the continuation of probable transitory shocks' effects in the series; unit root test was applied, which was developed by Dickey and Fuller (1979, 1981, ADF), before implementing VAR, Co-integration, and Granger Causality tests among the variables.

**Table 4 Augmented Dickey Fuller Unit Root Test Results**

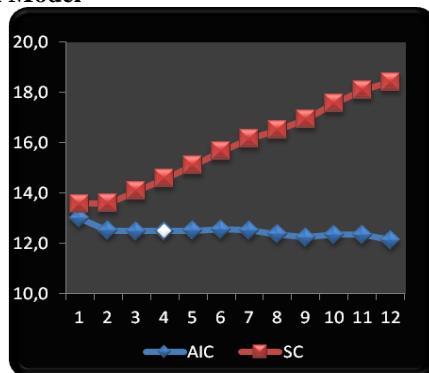
Value Levels I(0)		Lag Length (k)	Constant and Trend Model		Non-Constant and Non-Trend Model	
			t Value	P Value	t Value	P Value
	Consumer Loan Interest	0	-4,382	0,00	<b>-5,269</b>	<b>0,00</b>
	Mortgage Loan Interest	1	-2,815	0,19	-3,317	0,02
	Vehicle Loan Interest	1	-2,566	0,30	-2,798	0,06
	Commercial Loan Interest	2	-3,273	0,07	<b>-4,052</b>	<b>0,00</b>
	Policy Interest	1	-3,214	0,09	-4,419	0,00
Test Critical Value [MacKinnon (1996)]		1% level	-4,02	-3,47	-2,58	
		5% level	-3,44	-2,88	-1,94	
		10% level	-3,14	-2,58	-1,62	

**Note:** Appropriate Lag Length (k) manifests the most available lag lengths chosen according to the Newey-West estimation method, and estimated according to Schwarz Information Criterion and Bartlett kernel methods.

Augmented Dickey and Fuller unit root tests results of the variables are presented on Table 6. In Non-Constant Non-Trend and Constant term including models, the variables are steady I(0) at the level.

**Table 5 System Lag with VAR Model**

Lag Length(k)	AIC	SC
k = 1	12,99	13,58
k = 2	12,51	13,59
k = 3	12,494	14,08
<b>k = 4</b>	<b>12,491</b>	14,58
k = 5	12,51	15,10
k = 6	12,56	15,67
k = 7	12,53	16,16
k = 8	12,36	16,51
k = 9	12,25	16,93
k = 10	12,35	17,56
k = 11	12,34	18,09
k = 12	12,13	18,42

**Scheme 1 System Lag with VAR Model**


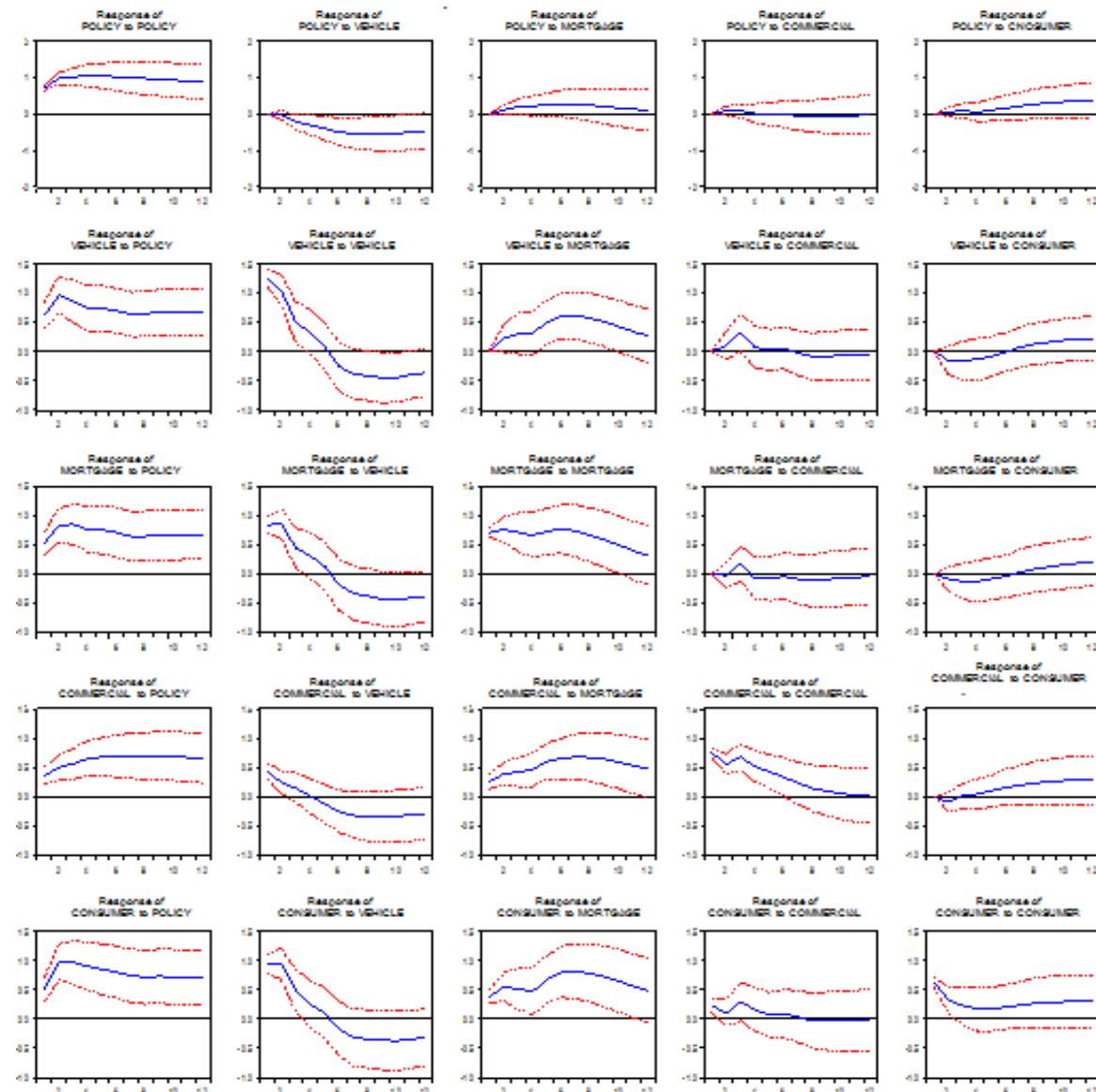
In order to determine the most appropriate lag length of the developed VAR model, lag lengths between 1-12 were tested, the appropriate lag length, which didn't have autocorrelation according to the information criteria of Akaike (AIC) and Schwarz (SC), was determined 12. As the result of the analysis, the appropriate lag length was calculated 4.

**Table 6 VAR Estimation Model**

Period: 2002M05 2014M12 Number of Observations: 152 Standard Error( ) & t-statistics [ ]					
	POLICY	VEHICLE	MORTGAGE	COMMERCIAL	CONSUMER
POLICY (-1)	1,329991 (0,09563) [13,9071]	0,536003 (-0,18524) [2,89353]	0,390678 (0,16114) [2,42449]	0,317371 (-0,1293) [2,45458]	0,602319 (0,17630) [3,41650]
	-0,27167 -0,15314 [-1,77398]	-0,44593 -0,29663 [-1,50331]	-0,23198 -0,25803 [-0,89904]	-0,15164 -0,20705 [-0,73238]	-0,4613 -0,28231 [-1,63405]
	-0,00225 -0,14985 [-0,01498]	-0,01732 -0,29025 [-0,05969]	-0,09289 -0,25249 [-0,36789]	0,033488 -0,20260 [0,16529]	0,012743 -0,27624 [0,04613]
POLICY (-4)	-0,02095 -0,09656 [-0,21696]	0,123117 (0,18703) [ 0,65828]	0,102111 (0,16269) [ 0,62763]	-0,07294 -0,13054 [-0,55872]	-0,04121 -0,17800 [-0,23154]
	-0,16834 -0,08471 [-1,98719]	0,695729 (0,16408) [ 4,24008]	0,025072 -0,14273 [0,17565]	-0,19327 -0,11453 [-1,68748]	0,036485 -0,15616 [ 0,23364]
	-0,072 -0,10465 [-0,68799]	-0,19311 -0,20271 [-0,95262]	-0,24178 -0,17634 [-1,37113]	-0,04655 (-0,14149) [-0,32898]	-0,22968 (-0,19292) [-1,19051]
VEHICLE (-3)	0,174403 -0,09555 [1,82532]	0,351249 -0,18507 [1,89789]	0,325297 -0,16099 [2,02058]	0,057037 (-0,12918) [ 0,44153]	0,290757 (-0,17614) [ 1,65075]
	<b>POLICY</b>	<b>VEHICLE</b>	<b>MORTGAGE</b>	<b>COMMERCIAL</b>	<b>CONSUMER</b>

VEHICLE (-4)	-0,13222 -0,06991 [-1,89131]	-0,49716 -0,13541 [-3,67141]	-0,42909 -0,11779 [-3,64274]	-0,21833 (0,09452) [-2,30998]	-0,47229 (0,12887) [-3,66476]
MORTGAGE (-1)	0,085328 -0,09899 [0,86203]	0,380902 -0,19173 [1,98662]	1,146882 -0,16679 [6,87639]	0,349923 (0,13383) [ 2,61470]	0,501479 (0,18248) [ 2,74820]
MORTGAGE (-2)	-0,02867 -0,12367 [-0,23183]	-0,31231 -0,23954 [-1,30379]	-0,28373 -0,20837 [-1,36166]	-0,28826 (0,16720) [-1,72408]	-0,45751 (0,22797) [-2,00687]
MORTGAGE (-3)	0,070119 -0,12426 [0,56431]	0,185187 -0,24068 [0,76942]	0,231545 -0,20937 [1,10593]	0,057270 (0,16800) [ 0,34090]	0,121106 (0,22906) [ 0,52870]
MORTGAGE (-4)	-0,07805 -0,07993 [-0,97646]	0,123445 -0,15482 [0,79735]	0,014678 -0,13467 [0,10899]	0,178887 (0,10806) [ 1,65539]	0,236997 (0,14734) [ 1,60846]
	0,084848 -0,08717 [0,97336]	0,204627 -0,16885 [ 1,21189]	0,01236 -0,14688 [0,08415]	0,775643 (0,11786) [ 6,58130]	-0,01913 (0,16070) [-0,11903]
	-0,0758 -0,10888 [-0,69624]	0,143327 (0,21089) [ 0,67963]	0,227178 -0,18345 [1,23837]	0,296379 (0,14720) [ 2,01344]	0,245682 (0,20071) [ 1,22408]
	-0,0335 -0,10166 [-0,32956]	-0,4814 (0,19691) [-2,44473]	-0,48572 -0,17129 [-2,83567]	-0,20626 (0,13744) [-1,50067]	-0,29948 (0,18740) [-1,59805]
COMMERCIAL (-4)	0,028369 -0,07921 [0,35814]	0,245037 (0,15343) [ 1,59701]	0,305104 (0,13347) [ 2,28594]	-0,00595 (0,10710) [-0,05560]	0,156975 (0,14603) [ 1,07498]
	0,070879 -0,09727 [0,72866]	-0,2533 (0,18842) [-1,34437]	-0,14772 (0,16390) [-0,90126]	-0,15699 (0,13151) [-1,19371]	0,51077 -0,17932 [2,84839]
	-0,01043 -0,11711 [-0,08907]	0,099186 (0,22683) [ 0,43726]	0,026436 (0,19732) [ 0,13398]	0,197714 (0,15833) [ 1,24876]	0,137134 -0,21588 [0,63523]
	-0,16397 -0,10759 [-1,52401]	-0,04192 (0,20840) [-0,20116]	-0,04304 (0,18128) [-0,23744]	-0,01731 (0,14546) [-0,11897]	-0,00827 (0,19833) [-0,04169]
	0,166788 -0,07499 [2,22417]	0,083226 (0,14525) [ 0,57297]	0,093015 (0,12635) [ 0,73615]	0,025745 (0,10139) [ 0,25393]	0,100204 -0,13824 [0,72485]
	0,734093 -0,33623 [2,18331]	2,961019 (0,65127) [ 4,54650]	2,134710 (0,56653) [ 3,76804]	1,755276 (0,45459) [ 3,86127]	2,391442 -0,61983 [3,85824]
R <sup>2</sup>	0,996779	0,982835	0,988747	0,992297	0,988305
Adj. R <sup>2</sup>	0,996287	0,980214	0,987029	0,991121	0,98652
F-statistics	2026,795	375,0377	575,5389	843,8101	553,5338

The VAR estimations of all of the variables are shown together on Table 8. Adjusted R<sup>2</sup> value, which shows the explanatory power of the models, is observed to be quite high, accordingly it can be mentioned that the explanatory power of the models are very high.

**Scheme 2 Action-Reaction Functions of the Variables**


When the Scheme 2, which depicts the action-reaction functions, is examined; it is observed that the policy and consumer loan interest rates gave significant responses to only the shocks coming from themselves, and that the response times took approximately 2 and 4 months, respectively. The shock given to the policy interest rate affected all of the interest rates in a decreasing manner after 2 months. From the vehicle loan interest rate; its effect on policy interest rate continues for 2 months, decreasing effect on itself continues for 6 months, and increasing effect on mortgage loan rate continues for 6 months. After its 2-month increasing effect on commercial loans, it has a decreasing effect on other periods. From the mortgage loan interest rate; responses to vehicle loans and to itself continues with decreasing effect respectively approximately after 2 months. That mortgage loan interest rate experiences the shock coming from itself for a long time is an important proof of that the variable bears a long memory. The effect of a shock from commercial loan interest rate to cash loan interest rate approximately takes 3 months, while its effect takes around 2 months to itself.

**Table 7 Variance Classification for Policy Interest**

Period	Standard Error	Policy Interest	Vehicle Loan Interest	Mortgage Interest	Commercial Interest	Consumer Interest
1	0,723	100,00	0,00	0,00	0,00	0,00

2	1,219	98,54	0,08	0,80	0,43	0,14
3	1,624	95,27	1,89	1,98	0,50	0,36
4	1,969	93,04	3,65	2,65	0,35	0,32
5	2,279	90,36	5,77	3,15	0,26	0,45
6	2,567	87,07	8,28	3,66	0,21	0,78
7	2,824	84,15	10,38	3,98	0,20	1,28
8	3,057	81,87	12,01	4,04	0,21	1,88
9	3,270	80,05	13,30	3,93	0,21	2,50
10	3,461	78,65	14,22	3,75	0,21	3,17
11	3,632	77,62	14,82	3,53	0,21	3,82
12	3,787	<b>76,82</b>	<b>15,21</b>	<b>3,32</b>	0,19	<b>4,46</b>

According to the Table 7, which presents variance classification for policy interest rate; all of the changes in policy interest rate is originated from itself in the first period. Policy interest rate is highly affected from vehicle, consumer, and mortgage loans at the end of the 12<sup>th</sup> period, while it is relatively less affected from commercial loan interest rates. The variable that affects most the policy interest rate regarding the periods is vehicle interest rate.

**Table 8 Variance Classification for Vehicle Loan Interest Rate**

Period	Standard Error	Policy Interest	Vehicle Loan Interest	Mortgage Interest	Commercial Interest	Consumer Interest
1	1,401	<b>19,32</b>	<b>80,68</b>	0,00	0,00	0,00
2	2,015	32,05	65,83	1,25	0,23	0,64
3	2,292	38,65	55,58	2,66	2,10	1,00
4	2,452	42,66	50,29	3,95	1,90	1,20
5	2,609	45,49	44,51	7,13	1,69	1,18
6	2,777	46,31	40,19	10,93	1,53	1,04
7	2,939	45,88	37,74	14,01	1,38	0,98
8	3,093	45,72	35,91	15,99	1,34	1,05
9	3,241	45,87	34,68	16,98	1,28	1,19
10	3,371	46,27	33,84	17,25	1,24	1,40
11	3,482	46,98	33,07	17,08	1,21	1,66
12	3,581	<b>47,86</b>	<b>32,35</b>	<b>16,68</b>	1,16	1,94

According to the Table 8, which presents variance classification for vehicle loan interest rate; in the first period, 80 % of the changes in vehicle interest rate are originated from itself, and 20 % is from policy interest. Vehicle interest rate is highly affected from policy and mortgage loans at the end of the 12<sup>th</sup> period, while it is affected relatively less from consumer and commercial loan interest rates. The variable that affects most the vehicle interest rate regarding the periods is policy interest rate.

**Table 9 Variance Classification for Mortgage Loan Interest Rate**

Period	Standard Error	Policy Interest	Vehicle Loan Interest	Mortgage Interest	Commercial Interest	Consumer Interest
1	1,219	<b>18,75</b>	<b>47,25</b>	<b>34,00</b>	0,00	0,00
2	1,871	27,70	41,03	30,99	0,02	0,25
3	2,229	33,97	32,86	32,05	0,63	0,50
4	2,470	37,13	28,28	33,28	0,61	0,71
5	2,688	39,11	24,10	35,47	0,62	0,70
6	2,891	39,86	21,27	37,69	0,55	0,62
7	3,071	39,66	20,06	39,13	0,58	0,56
8	3,232	39,77	19,48	39,51	0,66	0,58
9	3,382	40,16	19,44	39,07	0,68	0,66
10	3,513	40,75	19,62	38,13	0,68	0,82
11	3,627	41,62	19,74	36,95	0,67	1,03
12	3,729	<b>42,64</b>	<b>19,79</b>	<b>35,66</b>	0,64	1,27

According to the Table 9, which presents variance classification for mortgage loan interest rate; in the first period, 34 % of the changes in mortgage interest rate are originated from itself, 47 % is from vehicle interest, and 19 % is from policy interest. Mortgage interest rate is highly affected from policy and vehicle loans at the end of the 12th period, while it is affected relatively less from consumer and commercial loan interest rates. The

variable that affects most the mortgage interest rate regarding the periods is policy interest rate.

**Table 10 Variance Classification for Commercial Loan Interest Rate**

Period	Standard Error	Policy Interest	Vehicle Loan Interest	Mortgage Interest	Commercial Interest	Consumer Interest
1	0,978	<b>13,49</b>	<b>20,27</b>	6,73	<b>59,51</b>	0,00
2	1,311	21,65	14,69	12,38	50,69	0,58
3	1,639	25,53	10,19	14,39	49,52	0,38
4	1,894	30,98	7,62	16,53	44,54	0,32
5	2,146	34,00	6,29	20,79	38,46	0,45
6	2,389	35,84	6,23	24,15	33,00	0,79
7	2,616	36,88	6,75	26,91	28,26	1,19
8	2,822	37,73	7,27	28,78	24,52	1,70
9	3,009	38,57	7,75	29,81	21,67	2,21
10	3,171	39,39	8,12	30,27	19,52	2,71
11	3,311	40,24	8,35	30,30	17,91	3,19
12	3,433	<b>41,10</b>	8,51	<b>30,07</b>	<b>16,67</b>	3,65

According to the Table 10, which presents variance classification for commercial loan interest rate; in the first period, 60 % of the changes in commercial interest rate are originated from itself, 20 % is from vehicle loan interest, and 14 % is from policy interest. Commercial interest rate is highly affected from policy and mortgage loans at the end of the 12th period, while it is affected relatively less from consumer and vehicle loan interest rates. The variable that affects most the commercial interest rate regarding the periods is policy interest rate.

**Table 11 Variance Classification for Consumer Loan Interest Rate**

Period	Standard Error	Policy Interest	Vehicle Loan Interest	Mortgage Interest	Commercial Interest	Consumer Interest
1	1,334	<b>14,96</b>	<b>51,01</b>	8,27	2,96	<b>22,80</b>
2	2,011	30,29	44,46	11,05	1,56	12,64
3	2,374	38,42	36,18	12,69	2,70	10,00
4	2,607	43,88	30,97	13,79	2,63	8,74
5	2,834	46,16	26,32	17,49	2,27	7,75
6	3,066	46,35	22,78	21,75	2,04	7,08
7	3,284	45,49	20,82	25,20	1,79	6,70
8	3,480	44,80	19,50	27,52	1,60	6,58
9	3,659	44,54	18,61	28,82	1,46	6,57
10	3,815	44,53	18,08	29,40	1,35	6,64
11	3,947	44,79	17,65	29,50	1,27	6,78
12	4,062	<b>45,26</b>	<b>17,29</b>	<b>29,31</b>	1,20	6,94

According to the Table 11, which presents variance classification for consumer loan interest rate; in the first period, 23 % of the changes in consumer interest rate are originated from itself, 51 % is from vehicle loan interest, and 15 % is from policy interest. Commercial interest rate is highly affected from policy, mortgage, and vehicle loans at the end of the 12th period, while it is affected relatively less from consumer loan interest rates. The variable that affects most the consumer interest rate regarding the periods is policy interest rate.

**Table 12 Co-integration Analysis Results Among the Variables**

Hypotheses	Eigen Values	Trace statistics	Critical value( $\alpha = 0.05$ )	Significance Lev. (P)
Never *	0,1969	79,8940	69,8189	0,0063
Equation 1	0,1346	46,7803	47,8561	0,0629
Equation 2	0,0649	24,9556	29,7971	0,1630
Equation 3	0,0605	14,8248	15,4947	0,0629
Equation 4*	0,0351	5,3940	3,8415	0,0202

**Series:** Policy, Vehicle, Mortgage, Commercial, Consumer;

**Period:** 2002M06 2014M12;

**Number of Observations:** 151.

According to the results of the co-integration analysis conducted, the model is balanced in the short term. As per the long term, consumer loan interest rate will be balanced. The results of the co-integration model used in this

research study can be summarized as follows.

It was estimated that;

$$\begin{array}{cccc} \text{Policy Int.} = 2,138 & \text{Veh. Int.} + 1,176 & \text{Mort. Int.} - 0,836 & \text{Comm. Int.} + 1,027 \\ (0.795) & (0.768) & (0.518) & (0.667) \end{array}$$

Empirical interpretation of the model can be made as follows. Regarding the data used in the 01:2002 -12:2014 period, an average 1 % change in Vehicle interest rate creates 2,138 % increase in real policy interest, an average 1 % change in Mortgage interest rate creates 1,176 % increase in real policy interest, an average 1 % change in Commercial interest rate creates 0,836 % decrease in policy interest, and an average 1 % change in Consumer interest rate creates 1,027 % increase in policy interest.

**Table 13 Results of Granger Causality Test Among the Variables**

Null Hypothesis	Number of Observations	F statistics	Sign.Lev.(P)
VEHICLE is not the Granger Cause of POLICY	152	3,265	<b>0,014*</b>
POLICY is not the Granger Cause of VEHICLE		9,835	<b>0,000*</b>
MORTGAGE is not the Granger Cause of POLICY	152	1,254	0,291
POLICY is not the Granger Cause of MORTGAGE		5,676	<b>0,000*</b>
COMMERCIAL is not the Granger Cause of POLICY	152	1,380	0,244
POLICY is not the Granger Cause of COMMERCIAL		4,227	<b>0,003*</b>
CONSUMER is not the Granger Cause of POLICY	152	1,196	0,315
POLICY is not the Granger Cause of CONSUMER		8,268	<b>0,000*</b>
MORTGAGE is not the Granger Cause of VEHICLE	152	4,227	<b>0,003*</b>
VEHICLE is not the Granger Cause of MORTGAGE		2,365	0,056
COMMERCIAL is not the Granger Cause of VEHICLE	152	6,181	<b>0,000*</b>
VEHICLE is not the Granger Cause of COMMERCIAL		0,530	0,714
CONSUMER is not the Granger Cause of VEHICLE	152	2,692	<b>0,033*</b>
VEHICLE is not the Granger Cause of CONSUMER		5,174	<b>0,001*</b>
COMMERCIAL is not the Granger Cause of MORTGAGE	152	3,283	<b>0,013*</b>
MORTGAGE is not the Granger Cause of COMMERCIAL		0,723	0,578
CONSUMER is not the Granger Cause of MORTGAGE	152	0,198	0,939
MORTGAGE is not the Granger Cause of CONSUMER		4,621	<b>0,002*</b>
CONSUMER is not the Granger Cause of COMMERCIAL	152	0,261	0,902
COMMERCIAL is not the Granger Cause of CONSUMER		2,694	<b>0,033*</b>

Period: 2002M01 2014M12, Lag Length= 4, \* P < 0,05

As the result of the analysis based on the data regarding the 01:2002 -12:2014 period, a two-way change was observed between vehicle and policy interest rate, and between consumer and vehicle interest rate. In other words, a change in vehicle interest rate affects the policy interest, and a change in policy interest rate affects vehicle interest rate. Similarly, a change in vehicle interest rate influences consumer interest rate, and a change in consumer interest rate influences the vehicle interest rate.

A change in policy interest rate influences mortgage interest rate; however, a change in mortgage interest rate does not influence the policy interest rate. Similarly, a difference in policy interest rate influences commercial interest rate; however, a difference in commercial interest rate does not influence the policy interest rate. Accordingly, a change in policy interest rate influences consumer interest rate; however, a change in consumer interest rate does not influence the policy interest rate.

A change in mortgage interest rate influences vehicle interest rate; however, a change in vehicle interest rate does not influence the mortgage interest rate. A change in commercial interest rate influences vehicle interest rate; however, a change in vehicle interest rate does not influence the commercial interest rate. A change in commercial interest rate influences mortgage interest rate; however, a change in mortgage interest rate does not influence the commercial interest rate. A change in consumer interest rate influences mortgage interest rate; however, a change in mortgage interest rate does not influence the consumer interest rate. Lastly, a change in consumer interest rate influences commercial interest rate; however, a change in commercial interest rate does not influence the consumer interest rate.

#### IV CONCLUSION

In this research study, (regarding the period in between January 2002, when the inflation targeting regime was initiated in Turkish economy, and December 2014), the pass-through effect of the changes in overnight borrowing rate of Central Bank of Republic of Turkey, which is the reference policy interest rate, to the loan interests (vehicle, consumer, mortgage, commercial) that the banks provide is examined. In the implementation part of the research, linear time series method was applied to the variables of overnight borrowing rates of Central Bank and interest rates of the bank loans for the period in between January 2002 and December 2014. The variables were seasonally adjusted by means of R program. Augmented Dickey Fuller

(ADF) unit root test was implemented, which was developed in 1981, and it was detected that the variables were steady at the level. In order to determine the lag length of the developed Vector Autoregression (VAR) model, some lag lengths were tested, the most appropriate lag length, which didn't include auto correlation according to Akaike and Schwarz information criteria, was determined to be 12 and as the conclusion of the analysis, the most appropriate lag length was accepted as (4). When the short term responses of the bank loan interests to the shocks in the policy interests were analyzed (Vector Autoregression (VAR) model action-reaction functions were utilized), it was observed that policy interests and consumer loan interests gave significant responses only to the shocks originating from themselves, and these response times took respectively around 2 and 4 months. At the end of the co-integration analysis results, while it was observed that the model was balanced in the short term, it was seen that only consumer loan interest rates were to be balanced in the long term. When the abovementioned analyses were examined, the variables generally gave results corresponding with each other. As the summary, although changes are observed regarding the types of the loans that the banks provide, concerning the mentioned period it can be seen that the pass-through effect to the interest rates of the banks actualized fast and in long term. When the variance classification results for the policy interests were examined, it was observed that the changes in the first period were completely originated from itself, however, it was the vehicle interest rate variable, which generally influenced policy interests most. When the variance classification results of the Vehicle, Mortgage, Commercial, and Consumer loans were examined, it was observed that it was the policy interest, which affected these variables most.

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