EXAMINATION OF BOND RISK PREMIA FROM THE BANKING PERSPECTIVE

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ABSTRACT

EXAMINATION OF BOND RISK PREMIA
FROM THE BANKING PERSPECTIVE

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Banks are considered as the marginal and sophisticated investors of financial markets. This is evident in the Haddad and Sraer (2020) study that examines the US government bond excess returns. This study extends the Haddad/Sraer analysis to the Turkish government bond market. According to the forecasting results, exposure ratio provides explanatory power over bond excess returns, especially for longer maturities. On the other hand, output gap and industrial growth present strong in-sample forecasting power for shorter-term maturities. The inclusion of macroeconomic variables into the regression along with exposure ratio increases the significance and explanatory power of exposure ratio for the explanation of bond excess returns. Output gap is the most contributive in-sample forecasting macro variable in terms of the explanation of bond excess returns. Together with output gap and exposure ratio, the inclusion of consumer price index (CPI), producer price index (PPI) or consumer confidence index improves the statistical and economic significance of in-sample regression results.

Keywords: Bond Risk Premia, Bond Excess Return, Exposure Ratio, Income Gap, Government Bond Market, Yield, Government Bond Market, Yield Curve

ÖZ

TAHVİL RİSK PRİMLERİNİN
BANKACILIK PERSPEKTİFİNDEN İNCELENMESİ

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Bankalar, finansal piyasalarda marjinal ve gelişmiş yatırımcılar olarak kabul edilmektedir. Bu durum, Amerikan devlet tahvilleri fazla getirilerini inceleyen Haddad ve Sraer (2020) çalışmasında ortaya çıkmaktadır. Bu çalışma, Haddad/Sraer analizlerini Türk devlet tahvil piyasalarını inceleyerek genişletmektedir. Tahmin sonuçlarına göre, özellikle daha uzun vadelerde, açıkta kalma oranının tahvil fazla getirilerini açıklayıcı gücü bulunmaktadır. Öte yandan, çıktı açığı ve sanayi üretiminin de daha kısa vadelerde tahvil fazla getirilerini açıklayıcı gücü bulunmaktadır. Regresyon analizlerinde, makro değişkenlerin açıkta kalma oranına eklenmesi, tahvil fazla getirilerinin açıklanmasında açıkta kalma oranının tahmin gücünü artırdığı gözlenmektedir. Tahvil fazla getirilerinin açıklanmasında, çıktı açığının en çok katkı sağlayan in-sample makro değişken olduğu gözlenmektedir. Tüketici fiyat endeksi, üretici fiyat endeksi veya tüketici güven endeksi, açıkta kalma oranı ve çıktı açığına eklendiği zaman, in-sample regresyon sonuçlarının istatistiki ve ekonomik önemini artırmaktadır.

Anahtar Kelimeler: Tahvil Risk Primi, Tahvil Fazla Getirileri, Açıkta Kalma Oranı, Gelir Açığı, Devlet Tahvili Piyasası, Getiri Eğrisi

To My Family

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LIST OF ABBREVIATIONS

BIS	Bank for International Settlements
CPI	Consumer Price Index
FED	Federal Reserve Board
FX	Foreign Exchange
GDP	Gross Domestic Product
IP	Industrial Production
MBS	Mortgage-backed Securities
PPI	Producer Price Index
RMSE	Root Mean Squared Error
RSA	Rate-sensitive Assets
RSL	Rate-sensitive Liabilities
TRY	Turkish Lira
US	United States
USD	United States Dollar

CHAPTER 1

INTRODUCTION

Investors and researchers in economics and finance have taken a keen interest in examining all asset risk and return characteristics. Regardless the type of asset, i.e. equity, fixed-income security, derivative instrument, commodities, or any other type, all constituents of the economies examine the expected future returns of these assets and any possible reasons/explanations embedded in data to help forecast these returns.

Fixed income securities are an essential component of the financial markets. Not only do investors place substantial importance on bond markets, but researchers have conducted numerous studies regarding these markets. The research on bond markets has primarily focused on the understanding of yield curve, graphical representation of the yields on fixed-income securities having the same credit quality but different maturity, or risk premia (excess returns)[1], the difference between the return of holding a long-term bond for a shorter period over the exact short-term period yield.

Most of the studies regarding bond markets are mainly concentrated on government bond markets. The main reason is that the government bond markets have several crucial characteristics. Firstly, government bonds are an essential funding source for governments. In other words, they form an integral part of fiscal policy.

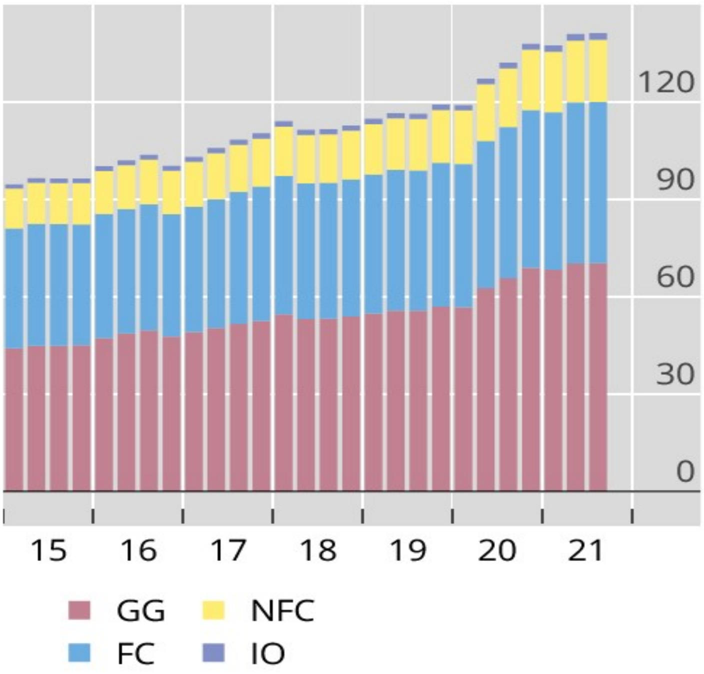
[1] In this study, the terms bond risk premia and bond excess returns are used interchangeably.

Secondly, government bonds enhance the implementation of monetary policy. Central banks achieve inflation and monetary targets with the help of these securities. Finally, the yield curve, created by government bonds traded in financial markets, provides a benchmark for borrowers in markets. Government bonds in domestic markets are the safest (theoretically default-free) fixed-income instruments, and as a result, financial or non-financial firms can benefit from yield curves to understand their borrowing costs and realize the credit risk embedded in the spreads between their bonds and government bonds[2].

Most importantly, government bond securities reserve a strong place globally. Figure 1.1 displays the sector composition of outstanding government bonds globally. As of the end of third quarter of 2021, outstanding government bonds in the world are more than USD 70 trillion and constitute almost 50% of the entire bond markets. The significance of government bond market can quickly be figured based on historical developments of the bond markets globally.

As mentioned, the government bond markets are a great interest of researchers in terms of assessing yield curves and bond excess returns. The studies concerning excess returns can be grouped into three main categories. These are examination of excess returns in terms of outlook of the yield curve, macroeconomic developments and supply conditions of Treasury market. However, no study had been conducted regarding the relation between bond risk premia and financial intermediaries until Haddad and Sraer [30]. The research regarding the relationship between risk premia and intermediaries has mainly focused on equity markets. However, the substantiality of bond markets, which could be seen in Figure 1.1, should make researchers to assess the possible effects of financial intermediaries into the patterns of bond risk premia. In that respect, Haddad and Sraer [30] developed a theoretical framework where income gap, the difference between rate-sensitive assets and liabilities normalized by total assets, has a significant forecasting power over bond

[2] For a detailed discussion, please refer to IMF's "Developing Government Bond Markets – A Handbook" (2001). The link is provided below:
https://www.elibrary.imf.org/view/books/069/01709-9780821349557-en/01709-9780821349557-en-book.xml



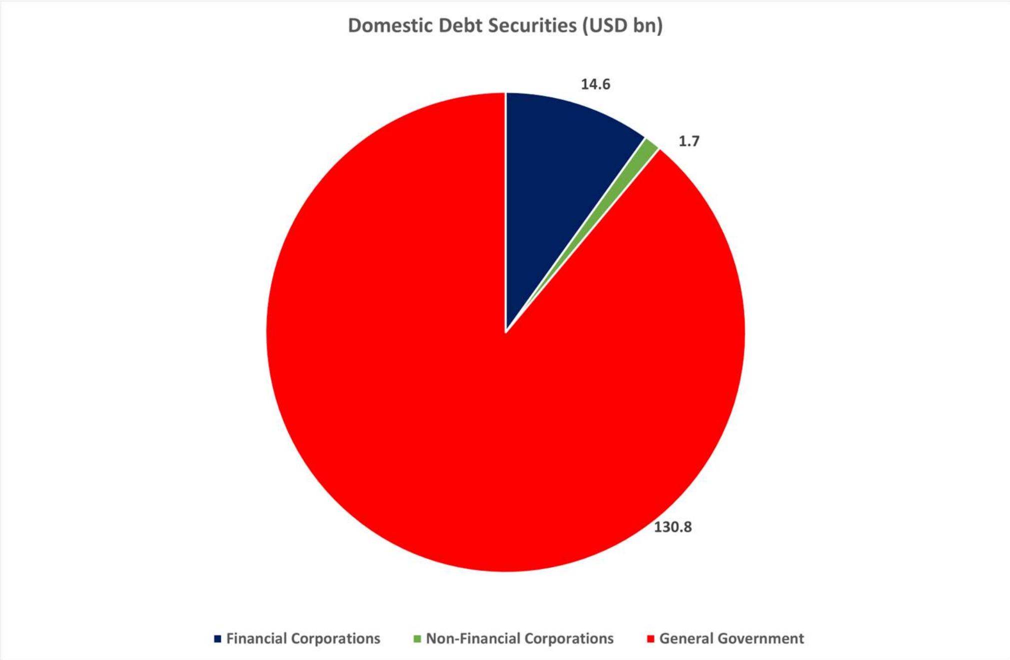
Source: Bank for International Settlements

Figure 1.1: Amount of Bonds Outstanding in trillions of USD by Sector of Issuer. This figure displays the notional amounts of fixed-income instruments issued globally. The terms here correspond the following: GG – general government, NFC – non-financial corporations, FC – financial corporations, IO – other securities.

excess returns and tested this for banks in the United States. According to that study, banks might be regarded as marginal and sophisticated investors in financial markets and their views (from a risk management perspective) regarding bond excess returns determine the composition of long-term and short-term rate-sensitive assets in their balance sheets.

In the lights of the discussion above, this study analyzes the relation between the government bond excess returns and their linkages to the banks' balance sheet in Turkey, based on the study conducted by Haddad and Sraer [30]. There are three main reasons to choose this topic for this study.

First of all, government borrowing is an essential component of the fixed-income markets in Turkey. Figure 1.2 shows the composition of bonds in terms of the issuer as of the end of second quarter of 2021. Government bonds constitute almost 89%



Source: Bank for International Settlements

Figure 1.2: The Distribution of Domestic Debt Securities in Turkey. This figure displays the notional amounts of fixed-income instruments issued in Turkey based on the type of the issuer. The amounts are stated by USD.

of fixed-income securities in Turkey. In other words, one can state that the government in Turkey is the main issuer of the fixed-income securities. This can show the significance of government bonds in Turkey from the perspective of investors, researchers and policy makers. They all could utilize the findings of this study in the forecasting of government bond excess returns in Turkey.

Secondly, Haddad and Sraer [30] developed an enlightening framework to forecast the bond risk premia. They conducted their study for government bond excess returns in the United States. So far, no further studies have examined this topic in different countries. Especially, examining this issue for an emerging market would help researchers and investors understand the effect of banking system in government bond markets in those markets. As far as is known, this is the first study to examine this relationship for an emerging market.

Thirdly, the studies regarding government bond risk premia in Turkey have focused mainly on explaining bond excess returns in terms of macroeconomic developments and global financial variables[3]. Even though these studies contribute a lot to the bond risk premia literature for Turkey, they all examined it from a macroeconomic perspective, so miss the financial intermediaries perspective. Therefore, as far as is known, this will be the first study to conduct the relationship between Turkish government bond excess returns and banking system.

The outcomes of this study might interest researchers examining government bond market and/or banking system and policy makers such as central bankers and authorities related to the fiscal policy.

As explained, this study examines the relationship between government bond excess returns and banking system in Turkey. One might expect that banks are marginal and sophisticated investors in financial markets. From a risk management perspective, their exposure to interest rate risk should be compensated by an increase in the expected excess returns of government securities. Haddad and Sraer [30] developed a framework to demonstrate this relationship. Their findings suggest that income gap has a significant explanatory power over bond excess returns. However, as it will be seen throughout this study, exposure ratio, the difference between rate-sensitive assets and liabilities normalized by total equity, does provide better forecasting results compared to the income gap. Haddad and Sraer [30] followed income gap as the forecasting variable and indicated that income gap's statistical properties, its reaction to banks' net income to changes in interest rates and its high correlation with exposure ratio are the main reasons to utilize income gap for their studies. Even though these reasons should intuitively hold, income gap is not as applicable as exposure ratio to Turkish bond government market. A strong possible reason could be the currency composition of the bank assets. Throughout the section 4.3, it will be seen that foreign exchange-denominated assets hold a significant portion

[3] For further discussion, please refer to Başçı and Ekinci (2005), Akgiray et al. (2016), Çepni and Güney (2019), and Çepni et al. (2020).

in banks' balance sheet, but FX portion of the equity is close to zero. Therefore, this study will utilize exposure ratio to forecast the bond excess returns but explain both the income gap and exposure ratio throughout the study.

This study will run regressions of one-year excess returns on government bonds on the exposure ratio available at the beginning of the period. Exposure ratio will be calculated on an asset-weighted basis from the banking data and the sample period will be from the second quarter of 2006 and first quarter of 2021. This is mainly due to the data availability. Banking data are obtained from the website of "The Banks Association of Turkey" (Türkiye Bankalar Birliği). According to the forecasting results, exposure ratio provides explanatory power over bond excess returns, especially for longer maturities.

This study will also run regressions of one-year excess returns on government bonds on several macroeconomic variables to follow the literature explaining the relationship between macroeconomic variables & bond risk premia and to check the robustness of the results of exposure ratio. From these macroeconomic variables, output gap and industrial growth were found to have strong in-sample forecasting power for the explanation of bond risk premia for shorter-term maturities. On the other hand, exposure ratio is better in the explanation of bond excess returns for maturities 6 or more years.

The inclusion of macroeconomic variables into the regression along with exposure ratio increases the significance and explanatory power of regressions for the explanation of bond excess returns. Output gap is the most contributive in-sample forecasting macro variable in terms of the explanation of bond excess returns. Together with output gap and exposure ratio, the inclusion of consumer price index (CPI), producer price index (PPI) or consumer confidence index improves the statistical and economic significance of in-sample regression results.

For out-of sample forecasting, exposure ratio (for longer maturities) and consumer confidence index (for shorter maturities) provide better results for single variable regressions. For two-variable regressions, exposure ratio and industrial growth provide better forecasting and for three-variable regressions, exposure ratio, output gap and consumer confidence index provide better forecasting results.

The rest of this study is as follows. Chapter 2 will explain the related literature regarding bond risk premia, financial intermediaries and income gap. Chapter 3 will firstly introduce the calculation of income gap, exposure ratio, yield curve and excess returns, then present the theoretical framework of this study based on Haddad and Sraer [30]. Afterwards, Chapter 4 will provide the data, model estimation results and in-sample and out-of-sample regression results. Finally, Chapter 5 will finish this study by concluding remarks.

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CHAPTER 2

LITERATURE REVIEW

A vast number of researchers in finance and economics have taken a keen interest in analyzing bond risk premia and financial intermediaries. However, no study had been conducted regarding the relation between bond risk premia and income gap until Haddad and Sraer [30]. This situation forces this study to examine bond risk premia and income gap (financial intermediaries) literatures separately.

2.1. Literature regarding Bond Risk Premia

Literature in examining bond risk premia is sprawled out to three main dimensions.

The first dimension in this area is the classical view of estimating bond risk premia based on the outlook of the yield curve. The common ground of these studies is the rejection of expectations hypothesis – the hypothesis that long-term yields are basically based on current and future short-term rates – and despite this rejection, they all agreed upon the informative content of the yield curve into forecasting bond excess returns. Among those studies, however, one could indisputably notice slight differences in approach. For instance, Fama and Bliss [24] emphasized the predictive power of the spreads between n-year forward rates and one-year yield over one-year excess returns of an n-year bond. Campbell and Shiller [12] argue the predictability of bond excess returns based on slope, the yield spread between long- and short-term bonds, and find that when the spreads are high, short-term rates tend to hike and long-term rates tend to decline. Cochrane and Piazzesi [14] discovered a tent-shaped combination of forward rates that can meaningfully estimate the bond excess returns for maturities up to 5 years. More recent studies towards this dimension have different approaches compared to early ones. Bauer and Hamilton [10] introduce robust bond risk premia and reveal that only level and slope factors are robust estimators of bond excess returns and those factors already subsume macroeconomic indicators in explaining yield curve. On the other hand, Joslin and Konchitchki [36] discover that the volatility of the yield curve, determined by interest rate options, could have explanatory power over the future bond excess returns. This study also shows that the shape of the yield curve could be estimated by examining the bond excess returns for holding long maturity bonds.

Another dimension in this literature is capturing the variations of bond excess returns by the changes of several macroeconomic variables. Researchers have been trying to address the power of macroeconomic indicators to analyze excess returns in Treasuries, having paid attention mostly to inflation and output variables. The challenge faced by those studies is that macroeconomic indicators might not affect bond risk premia as anticipated or they are already latent in yield curve factors. In other words, if macroeconomic indicators have an impact on bond excess returns, they do so through the channels of yield curve factors, namely level, slope and curvature. Factor representation is a direct and tractable way of measuring the effect of these variables in bond excess returns (Ang and Piazzesi [6]). However, it should be noted that macroeconomic variables do not capture all the variations in yield curve factors. Regarding the effect of macroeconomic indicators, Bauer and Hamilton [10] pointed out that the effect of macro variables over bond excess returns could be observed within the yield curve factors level and slope which already have better explanatory power on excess returns. On the other hand, bond excess returns have been found to be explained by the business cycles according to Fama and Bliss [24], Cooper and Priestley [15], Ludvingson and Ng [40] and Duffee [21]. Those studies have shown the tendency of higher risk premia during the strong economic phases against the tendency of lower or even negative risk premia during weak times. In this context, output gap could (Cooper and Priestley [15]) be a good estimator to examine the business cycles. On the other hand, inflation or inflation expectations seem to be more prepotent for excess returns on Treasuries according to Ang and Piazzesi [6], Ludvingson and Ng [40], Haubrich et al. [32], Cieslak and Povela [13] and Duffee [22]. Those studies would breakdown the nominal yield curve into the risk premium and expectations hypothesis components. Expectation hypothesis term can be decomposed into inflation expectations and maturity-specific interest rate cycles. Comprehensibly, these studies have revealed the strong explanatory power of inflation and inflation expectations over bond excess returns. Haubrich et al. [32] contributed to this literature by introducing a new model regarding the term structure of interest rates driven by three state variables (short-term real rate, inflation expectations and inflation's central tendency) and four volatility factors, by using Treasury yields, inflation forecasts and inflation swap rates. Duffee [22] stresses out the significance of news for the excess returns. Within macroeconomic perspective, Piazzessi [48] argues the possibility that one should jointly look at the yield curve and monetary policy decisions. Government bond yields and monetary policy act endogenously. Decisions taken by FED have a considerate effect on the yield curve and yield curve models should include those decisions. Another study was conducted by Bretscher et al. [11], discussing the predictive power of fiscal policy for yield curve and bond risk premia. They found out that an increase in the government expenditures, along with the volatility, would boost the bond excess returns after controlling yield curve factors and maturity-weighted public debt. In addition, the shocks to government spending would result in higher inflation risk premium.

The last dimension in bond risk premia research is focusing on supply conditions of Treasury market where researchers have put forward the significance of market conditions for the past 10 years. During early 2010s, most of these studies scrutinized central bank interventions, specifically FED's quantitative easing policy, the unconventional monetary policy implemented aftermath of global financial crisis in 2008. That policy had certain impacts on financial markets, particularly on fixed income markets according to Krishnamurthy and Vissing-Jorgensen [38], Gagnon et al. [26], Swanson [50], D'Amico and King [18], and the findings of those studies are somewhat similar. The high amount of purchase of Treasury and other fixed-income securities had lowered the interest rates on these securities and this effect was more prevalent in government yield curve. Yield on these securities diminish as a reaction of the purchases on the same or similar maturity government bonds. Gagnon et al. [26] interpreted this mechanism and found out that asset purchases implemented by FED worked through the channel of risk premium by reducing investors' exposure to fixed-income securities. By purchasing a fixed-income security, a central bank would decrease the amount of that security held by households, corporates or institutional investors and then boost the amount of short-term and free reserves held by private sector. The results of other studies concerning market supply conditions in Treasuries are as follows. Greenwood and Vayanos [29] analyze the changes in the supply and maturity of the government bonds and their impact on yield curve and bond excess returns. The shocks in bond supply could impact term structure since they might alter the duration risk of government bonds. Defining maturity-weighted debt to GDP ratio as the supply factor, an increase in the supply of government bonds would lift yield curve and excess returns and that this effect is more prevalent for longer maturity bonds and in a more risk averse environment. Moreover, Hanson [31] and Malkhozov et al. [41] discuss the effects of duration of the mortgage-backed securities (MBS) on yield curve and excess returns. Both these studies conclude that fluctuations in MBS duration explain the variation in bond risk premia, peculiarly at longer maturities. Drechsler et al. [20] present a dynamic asset pricing framework displaying the impact of central bank interventions to the bond risk premia. By altering the nominal interest rate, central banks could adjust the liquidity premium in financial markets. They do so such that lower nominal rates would diminish the liquidity premium which in return diminishes the cost of taking leverage and boosts risk taking which causes a decline in risk premia. Following open market operations, central banks adjust the liquidity supply in the markets to ensure the necessary shifts in nominal rates and affect bond risk premia.

2.2. Literature regarding Financial Intermediaries and Income Gap

The analysis of risk premia of various asset classes from a perspective of financial intermediaries has gathered significant attention from the researchers in the past 10 years. The focus, on the other hand, has been mostly towards equity markets. Prominent studies within this area are concentrated on the balance sheets of financial intermediaries, namely the leverage or equity ratios. The leverage ratios – repos on dealers' balance sheets (Adrian and Shin [3]), leverage of security broker-dealers (Adrian et al. [1]), the book value of the leverage of security broker-dealers (Adrian et al. [2]) – as well as the equity ratios – equity position of intermediaries normalized by GDP (Muir [46]), equity capital constraints (He and Krishnamurthy [33]), real capital stock (Adrian and Boyarchenko [4]), equity capital ratio (He et al. [34]) – have explanatory power over pricing, returns and risk premia of various asset classes, including equity, bond, their portfolios, even sophisticated asset classes such as derivatives, commodities and currencies. As a result, financial intermediaries can be regarded as a marginal investor, like almost all these studies profess. The main motivation of this argument may be the fact that financial intermediaries benefit from extensive data, low transaction costs, trading in various asset classes by complex models (Adrian et al. [1]). In addition, Başak and Pavlova [8] claim that trades by institutional investors significantly affect asset prices and these trades do create significant effects such as index effects and asset-class effects. The aim of dominating the benchmark indices is the main reason of their actions and leaning their portfolios towards the stocks of benchmark indices is how they create those phenomenal effects. Institutional investors act like professional asset managers managing portfolios for mutual funds, hedge funds, pension funds, endowments etc.

Income gap is an important measure in bank analysis and has been utilized by many professionals in banking industry, yet no academic study was conducted at this topic until Gomez et al. [28] and Haddad and Sraer [30]. Gomez et al. [28] discuss the importance of income gap with respect to the transmission of monetary policy and banking sector. Banks with a greater income gap would have greater earnings and experience less contraction of their lending activities during the times FED increases the policy rates. Haddad and Sraer [30] shifted bond risk premia literature to financial intermediary perspective by analyzing income gap and found that this ratio would significantly affect risk premia in US Treasury market.

CHAPTER 3

METHODOLOGY AND THEORETICAL FRAMEWORK

Before delving into theoretical discussion, it is essential to apprehend the fundamental objects of this study, which are income gap and bond excess returns.

3.1. Income Gap and Exposure Ratio

Banks are at the center of the economic activity. They provide funds to the constituents of the economy, i.e. households, corporates, government etc., among many other services. They obtain these funds from various types of investors to ensure financial stability. As a result, the nature of their business is to invest in assets such as loans and fixed-income securities from the funds collected such as deposits, money market funds and debt-issuances. This type of a business model thus makes their financial statements differ from those of non-financial firms. Especially, a bank's leverage happens to be tremendously higher than that of a firm operating in a non-financial industry since the business itself is borrowing and lending, so the natural course would be ending up with high leverage ratios. On the other hand, banks' fundamental source of income is the interest income from different assets and excluding operating expenses (such as personnel costs, occupancy expenses and sales and advertising costs), their main cost is interest expenses. So, it is crystal clear that an analyst or researcher would not analyze a bank's financial performance like s/he does for a non-financial firm. This part briefly explains two crucial financial statements of banks, balance sheet and income statement[4], and then introduces the main concerns of this study, income gap and exposure ratio.

3.1.1. A General Overview of Banks' Balance Sheet and Income Statement

A bank has four types of assets: (i) loans, (ii) investment securities, (iii) noninterest cash and due from banks, and (iv) other assets (Koch and MacDonald, [37]). Loans are the most essential type of assets and they bring forth the highest amount of income for banks. They can be granted to any type of borrower, such as individuals, businesses, governments, not-for-profit organizations etc. Investment securities are the assets that are held for meeting liquidity needs, profiting from interest rate movements, using as collaterals. Noninterest cash and due from banks are vault cash, deposits held at central banks or other banks and used for meeting customer withdrawals and reserve requirements. The remaining assets (property, plant and equipment, and other tangible & intangible assets) are negligible considering the amount of loans, investment securities and noninterest cash and due from banks.

On the liabilities side of bank balance sheet, excluding shareholder's equity, a bank has three main sources of funding instruments. Deposits are the fundamental category of liability for banks and the primary source of interest expenses. Funds borrowed from other financial institutions and central banks reflect a significant portion of liabilities. Banks might enter into, for example, repurchase agreements to obtain funds from other banks. Securities issued are significant source of funding for banks, particularly for greater ones. Other liabilities might include provisions and current or deferred tax liabilities that have no significant influence on the balance sheet considering the magnitudes of main sources of liabilities.

[4] Undoubtedly, there are two other significant financial statements, cash flow statement and statement of shareholders' equity, that affect the analysis of banks. However, they are beyond the scope of this study.

Table 3.1 illustrates a sample balance sheet. Despite having different magnitudes among different banks, the abovementioned components share the highest importance on almost all banks' balance sheets.

Table 3.1: Akbank Unconsolidated Balance Sheet 2020

	ASSETS	Note (Section Five)	CURRENT PERIOD (31/12/2020) TL	FC	Total
I.	**FINANCIAL ASSETS (Net)**		46.162.992	96.196.853	142.359.845
1.1	**Cash and Cash Equivalents**		4.892.544	52.719.140	57.611.684
1.1.1	Cash and Balances with Central Bank	(I-a)	4.398.630	43.277.684	47.676.314
1.1.2	Banks	(I-d)	5.749	9.441.668	9.447.417
1.1.3	Money Markets		488.179	-	488.179
1.1.4	Expected Loss Provision (-)		14	212	226
1.2	**Financial Assets at Fair Value Through Profit or Loss**	(I-b)	1.108.586	7.912.516	9.021.102
1.2.1	Government Debt Securities		12.612	167.331	179.943
1.2.2	Equity Instruments		-	158.714	158.714
1.2.3	Other Financial Assets		1.095.974	7.586.471	8.682.445
1.3	**Financial Assets at Fair Value Through Other Comprehensive Income**	(I-e)	23.665.110	29.417.592	53.082.702
1.3.1	Government Debt Securities		23.067.781	21.352.442	44.420.223
1.3.2	Equity Instruments		15.610	607	16.217
1.3.3	Other Financial Assets		581.719	8.064.543	8.646.262
1.5	**Derivative Financial Assets**	(I-c, I-l)	16.496.752	6.147.605	22.644.357
1.5.1	Derivative Financial Assets at Fair Value Through Profit or Loss		11.758.273	6.147.605	17.905.878
1.5.2	Derivative Financial Assets at Fair Value Through Other Comprehensive Income		4.738.479	-	4.738.479
II.	**FINANCIAL ASSETS MEASURED AT AMORTISED COST (Net)**		204.405.636	74.269.325	278.674.961
2.1	**Loans**	(I-f)	183.882.588	69.435.940	253.318.528
2.2	**Lease Receivables**	(I-k)	-	-	-
2.3	**Factoring Receivables**		-	-	-
2.4	**Other Financial Assets Measured at Amortised Cost**	(I-g)	34.523.108	7.361.951	41.885.059
	Government Debt Securities		34.523.108	6.693.715	41.216.823
	Other Financial Assets		-	668.236	668.236
2.5	**Expected Credit Loss (-)**		14.000.060	2.528.566	16.528.626
III.	**ASSETS HELD FOR SALE AND RELATED TO DISCONTINUED OPERATIONS (Net)**	(I-r)	173.416	-	173.416
3.1	Held for Sale Purpose		173.416	-	173.416
3.2	Related to Discontinued Operations		-	-	-
IV.	**EQUITY INVESTMENTS**		2.094.996	7.525.427	9.620.423
4.1	**Investments in Associates (Net)**	(I-h)	14.795	-	14.795
4.1.1	Associates Valued Based on Equity Method		-	-	-
4.1.2	Unconsolidated Associates		14.795	-	14.795
4.2	**Subsidiaries (Net)**	(I-i)	2.080.201	7.525.427	9.605.628
4.2.1	Unconsolidated Financial Subsidiaries		2.080.201	7.525.427	9.605.628
4.2.2	Unconsolidated Non-Financial Subsidiaries		-	-	-
4.3	**Joint Ventures (Net)**	(I-j)	-	-	-
4.3.1	Joint Ventures Valued Based on Equity Method		-	-	-
4.3.2	Unconsolidated Joint Ventures		-	-	-
V.	**PROPERTY AND EQUIPMENT (Net)**	(I-m)	5.938.700	17.800	5.956.500
VI.	**INTANGIBLE ASSETS (Net)**	(I-n)	1.168.363	9	1.168.372
6.1	Goodwill		-	-	-
6.2	Other		1.168.363	9	1.168.372
VII.	**INVESTMENT PROPERTY (Net)**	(I-o)	-	-	-
VIII.	**CURRENT TAX ASSET**		-	-	-
IX.	**DEFERRED TAX ASSET**	(I-p)	88.226	-	88.226
X.	**OTHER ASSETS (Net)**	(I-s)	2.701.666	5.357.392	8.059.058
	TOTAL ASSETS		262.733.995	183.366.806	446.100.801

	LIABILITIES	Note (Section Five)	CURRENT PERIOD (31/12/2020) TL	FC	Total
I.	DEPOSITS	(II-a)	108.487.593	160.082.602	268.570.195
II.	FUNDS BORROWED	(II-c)	257.770	36.006.231	36.264.001
III.	MONEY MARKETS		3.600.713	15.407.153	19.007.866
IV.	SECURITIES ISSUED (Net)	(II-d)	7.564.687	11.593.289	19.157.976
4.1	Bills		5.125.237	-	5.125.237
4.2	Asset Backed Securities		-	-	-
4.3	Bonds		2.439.450	11.593.289	14.032.739
V.	FUNDS		-	-	-
5.1	Borrower Funds		-	-	-
5.2	Other		-	-	-
VI.	FINANCIAL LIABILITIES AT FAIR VALUE THROUGH PROFIT OR LOSS		-	-	-
VII.	DERIVATIVE FINANCIAL LIABILITIES	(II-b, II-g)	11.232.111	3.784.919	15.017.030
7.1	Derivative Financial Liabilities at Fair Value Through Profit or Loss		10.888.507	3.449.654	14.338.161
7.2	Derivative Financial Liabilities at Fair Value Through Other Comprehensive Income		343.604	335.265	678.869
VIII.	FACTORING LIABILITIES		-	-	-
IX.	LEASE LIABILITIES (Net)	(II-f)	505.660	-	505.660
X.	PROVISIONS	(II-h)	2.361.273	55.589	2.416.862
10.1	Restructuring Provisions		-	-	-
10.2	Reserve for Employee Benefits		535.221	-	535.221
10.3	Insurance Technical Provisions (Net)		-	-	-
10.4	Other Provisions		1.826.052	55.589	1.881.641
XI.	CURRENT TAX LIABILITY	(II-i)	1.477.891	93.789	1.571.680
XII.	DEFERRED TAX LIABILITY		-	16.161	16.161
XIII.	LIABILITIES FOR ASSETS HELD FOR SALE AND RELATED TO THE DISCONTIUED OPERATIONS (Net)		-	-	-
13.1	Held for Sale Purpose		-	-	-
13.2	Related to Discontinued Operations		-	-	-
XIV.	SUBORDINATED DEBT INSTRUMENTS	(II-j)	-	6.718.414	6.718.414
14.1	Loans		-	-	-
14.2	Other Debt Instruments		-	6.718.414	6.718.414
XV.	OTHER LIABILITIES	(II-e)	8.067.980	5.867.983	13.935.963
XVI.	SHAREHOLDERS' EQUITY	(II-k)	63.786.711	(867.718)	62.918.993
16.1	Paid-in capital		5.200.000	-	5.200.000
16.2	Capital Reserves		5.400.628	-	5.400.628
16.2.1	Share Premium		3.505.742	-	3.505.742
16.2.2	Share Cancellation Profits		-	-	-
16.2.3	Other Capital Reserves		1.894.886	-	1.894.886
16.3	Accumulated Other Comprehensive Income or Loss Not Reclassified Through Profit or Loss		3.470.625	852.351	4.322.976
16.4	Accumulated Other Comprehensive Income or Loss Reclassified Through Profit or Loss		4.093.628	(1.720.069)	2.373.559
16.5	Profit Reserves		39.354.663	-	39.354.663
16.5.1	Legal Reserves		1.772.027	-	1.772.027
16.5.2	Status Reserves		-	-	-
16.5.3	Extraordinary Reserves		37.306.183	-	37.306.183
16.5.4	Other Profit Reserves		276.453	-	276.453
16.6	Income or (Loss)		6.267.167	-	6.267.167
16.6.1	Prior Periods' Income or (Loss)		-	-	-
16.6.2	Current Period Income or (Loss)		6.267.167	-	6.267.167
	TOTAL LIABILITIES AND SHAREHOLDERS' EQUITY		207.342.389	238.758.412	446.100.801

A bank's income statement has two fundamental items, interest income and interest expense. Even though banks acquire considerable amounts of funds from noninterest income such as servicing fees, trading and other investment banking activities, and spend noninterest expenses (most of the times they are greater than interest expense) such as personnel, occupancy and sales and advertising cost,

Table 3.2: Akbank Unconsolidated Income Statement 2020

	INCOME AND EXPENSE ITEMS	Note (Section Five)	CURRENT PERIOD (01/01-31/12/2020)
I.	INTEREST INCOME	(IV-a)	33.456.476
1.1	Interest on Loans	(IV-a-1)	23.229.974
1.2	Interest on Reserve Requirements		96.440
1.3	Interest on Banks	(IV-a-2)	283.530
1.4	Interest on Money Market Transactions		542.863
1.5	Interest on Marketable Securities Portfolio	(IV-a-3)	9.266.768
1.5.1	Fair Value Through Profit or Loss		15.133
1.5.2	Fair Value Through Other Comprehensive Income		5.365.876
1.5.3	Measured at Amortised Cost		3.885.759
1.6	Financial Lease Interest Income		-
1.7	Other Interest Income		36.901
II.	INTEREST EXPENSE (-)	(IV-b)	13.925.781
2.1	Interest on Deposits	(IV-b-4)	8.913.962
2.2	Interest on Funds Borrowed	(IV-b-1)	1.037.241
2.3	Interest Expense on Money Market Transactions		1.639.318
2.4	Interest on Securities Issued	(IV-b-3)	1.907.768
2.5	Interest on Leases		88.567
2.6	Other Interest Expenses		338.925
III.	NET INTEREST INCOME (I - II)		19.530.695
IV.	NET FEES AND COMMISSIONS INCOME		3.865.536
4.1	Fees and Commissions Received		4.897.270
4.1.1	Non-cash Loans		439.666
4.1.2	Other		4.457.604
4.2	Fees and Commissions Paid (-)		1.031.734
4.2.1	Non-cash Loans		4.422
4.2.2	Other		1.027.312
V.	DIVIDEND INCOME	(IV-c)	4.763
VI.	TRADING INCOME /(LOSS) (Net)	(IV-d)	(618.777)
6.1	Trading Gains/ (Losses) on Securities		403.345
6.2	Gains/ (Losses) on Derivative Financial Transactions		(4.067.523)
6.3	Foreign Exchange Gains / (Losses)		3.045.401
VII.	OTHER OPERATING INCOME	(IV-e)	1.373.338
VIII.	GROSS OPERATING INCOME (III+IV+V+VI+VII)		24.155.555
IX.	EXPECTED CREDIT LOSS (-)	(IV-f)	6.860.487
X.	OTHER PROVISION EXPENSES (-)		2.619.366
XI.	PERSONNEL EXPENSE (-)		2.843.740
XII.	OTHER OPERATING EXPENSES (-)	(IV-g)	4.842.876
XIII.	NET OPERATING INCOME/(LOSS) (VIII-IX-X-XI-XII)		6.989.086
XIV.	EXCESS AMOUNT RECORDED AS INCOME AFTER MERGER		-
XV.	INCOME/(LOSS) FROM INVESTMENTS IN SUBSIDIARIES CONSOLIDATED BASED ON EQUITY METHOD		956.126
XVI.	INCOME/(LOSS) ON NET MONETARY POSITION		-
XVII.	PROFIT/LOSS BEFORE TAX FROM CONTINUED OPERATIONS (XIII+...+XVI)	(IV-h)	7.945.212
XVIII.	TAX PROVISION FOR CONTINUED OPERATIONS (±)	(IV-i)	1.678.045
18.1	Current Tax Provision		2.061.984
18.2	Deferred Tax Expense Effect (+)		1.013.470
18.3	Deferred Tax Income Effect (-)		1.397.409
XVIII.	CURRENT PERIOD PROFIT/LOSS FROM CONTINUED OPERATIONS (XVII±XVIII)	(IV-j)	6.267.167
XIX.	INCOME FROM DISCONTINUED OPERATIONS		-
20.1	Income from Non-current Assets Held for Sale		-
20.2	Profit from Sales of Associates, Subsidiaries and Joint Ventures		-
20.3	Income from Other Discontinued Operations		-
XX.	EXPENSES FOR DISCONTINUED OPERATIONS (-)		-
21.1	Expenses for Non-current Assets Held for Sale		-
21.2	Loss from Sales of Associates, Subsidiaries and Joint Ventures		-
21.3	Expenses for Other Discontinued Operations		-
XXI.	PROFIT/LOSS BEFORE TAX FROM DISCONTINUED OPERATIONS (XIX-XX)	(IV-h)	-
XXII.	TAX PROVISION FOR DISCONTINUED OPERATIONS (±)	(IV-i)	-
23.1	Current Tax Provision		-
23.2	Deferred Tax Expense Effect (+)		-
23.3	Deferred Tax Income Effect (-)		-
XXIII.	CURRENT PERIOD PROFIT/LOSS FROM DISCONTINUED OPERATIONS (XXII±XXII	(IV-j)	-
XXIV.	NET INCOME/(LOSS) (XIX+XXIV)	(IV-k)	6.267.167
	Earning/(Loss) per share (in TL full)		0,01205

these are beyond the scope of this study. This study concerns the interest-related income and expense items as income gap is a measure of a bank's interest rate sensitivity[5].

Table 3.2 illustrates a sample income statement. This illustrates that the profitability performance of a bank lies behind its success of managing net interest income.

3.1.2. Interest Rate Sensitivity and Calculation of Income Gap and Exposure Ratio

Banks need to consistently assess and manage several risks to ensure the continuation of their operations. According to the definitions set forth by Federal Reserve Board, these risks consist of, (i) the risk of a borrower or counterparty defaults (credit risk), (ii) the risk of negative performances or condition as a result of market movements such as interest rates, foreign exchange rates or equity prices (market risk), (iii) the risk of not providing sufficient funds for obligations (liquidity risk), (iv) the risk of facing significant operational problems (operational risk), (v) the risk of losses resulting from unenforceable contracts or false judgements from legal disputes (legal risk), and (vi) the risk of negative publicity causing decreases of customer base and revenues (reputational risk). Management of all these risks are indispensable for sustainability of bank operations, but especially, market risk has to be carefully assessed since it might cause dramatic losses for a bank unless proper hedging is assured. Assuming a bank has a relatively slight portion in foreign exchange based or equity assets, the management of interest rate risk is the cornerstone of market risk management activities of a bank. However, it should be kept in mind that this is not the case for banks in Turkey, the focus of this study. As it will be seen in "Section 4.3. Results and Interpretation", FX-denominated assets yield a significant portion on their

[5] For further discussion, please refer to Koch and MacDonald [37].

balance sheets and that makes income gap not a meaningful metric to gauge interest rate sensitivity.

Interest rate risk can be interpreted as the bank's potential to face changes in net earnings or value of equity in case of a change in interest rates. Interest rate risk management is crucial for banks since it is impossible to foresee interest rates constantly and accurately (Koch and MacDonald [37]). Most banks benefit from two models to assess their interest rate risk, i.e. how changes in market rates would engender fluctuations in their earnings. The first model is GAP and earnings sensitivity analysis, in which the changes in interest rates is analyzed with respect to its effects on income statement and balance sheet, and the second model is duration GAP and economic value of equity analysis, where changes in interest affect shareholders' equity by focusing on the changes in market values of assets and liabilities. The latter is beyond the scope of this study, thus the GAP analysis itself will be the main concern.

GAP is basically sensitivity of a bank's earnings to the changes in interest rates. With respect to GAP analysis, income gap ratio occupies a notable place by bank managers and analysts. Even though this is a recent topic for the researchers such as Gomez et al. [28] and Haddad and Sraer [30], income gap ratio has been significant for the industry to gauge and control interest rate risk. According to the definitions made by Mishkin and Eakins [44] and Haddad and Sraer [30], the income gap is calculated as follows:

$$GAP = RSA - RSL \tag{1}$$

$$Income\ Gap = \frac{RSA - RSL}{Total\ Assets} \tag{2}$$

In the equations above, RSA and RSL refer to rate-sensitive assets and liabilities, respectively. They purport assets and liabilities that will either mature or reprice within one year (or the reference time bucket). The key thing to note here is that an asset or liability would be rate-sensitive within a time frame if: (i) it matures,

(ii) it refers to an interim or partial principal payment, (iii) the interest applied to outstanding principal will change during the interval, and (iv) the interest applied will change some base rate or index alters (Koch and MacDonald [37]).

Based on the formulas (1) and (2), one can easily infer that an increase in a bank's income gap would correspond to a lower exposure to longer-term assets. Conversely, a lower income gap would refer to a higher exposure to longer-term assets which would mean lower sensitivity of earnings with respect to the changes in interest rates.

From an exposure perspective, it is noteworthy to mention one other ratio for the scope of this study. During the section "Theoretical Framework", there is a measure that will be used to explain the relation between interest-rate exposure and bond excess returns from the perspective of banks' equities. Also, it will be seen throughout this study (especially, in the chapter "Data and Results") that this ratio is better at forecasting the bond risk premia compared to income gap. This ratio is named as exposure ratio (g_t) and conceptually, it denotes the sensitivity of a bank's assets as a percentage of its equity. This exposure ratio, or g_t, will be defined as follows:

$$g_t = 1 - Income\ gap_t \times \frac{A_t}{E_t} \tag{3}$$

where A_t and E_t refer to total assets and equities of a bank at time t, respectively. By adding equity, exposure ratio eliminates total assets to calculate the interest rate sensitivity of a bank. In other words, income gap divides "RSA-RSL" by total assets and exposure ratio divides it by total equity. Exposure ratio reveals the interest rate sensitivity of a bank from equity perspective and it could refer more meaningful results in explaining this sensitivity. This is because equity figure of a bank could show how vulnerable a bank to detrimental losses that can significantly harm or even cause a bankruptcy while total assets itself does not show this vulnerability. Considering the highly leveraged operating environment of banks, dividing the rate sensitivity metric to total equity (or net worth) could be more relevant for risk analysis of banks.

Within the section “Theoretical Framework and Model”, this study will explain the association between exposure ratio (or income gap) and bond excess returns. Yet, it would be useful to explain this intuitively. Banks need to be compensated appropriately to shift their portfolios from shorter-term securities to longer-term securities. In other words, they need to be compensated to absorb the interest-rate risk of long-term securities (or assets in general). This could be observed from banks’ balance sheets. As the banks hold more long-term assets, which means either lower income gap or higher exposure ratio for them, they should be rewarded with higher bond excess returns. Therefore, the association between bond excess returns and bank balance sheets could be formed by analyzing the rate-sensitive assets and liabilities by normalizing their difference by total assets or equity.

It will be seen throughout Chapter 4 that exposure ratio is better at forecasting bond excess returns compared to income gap. The reasons behind that will be shared during that chapter. From now on, it should be noted that exposure ratio will be the cornerstone of this study.

3.2. Bond Excess Returns

Before examining the calculation of bond excess returns, it would be pertinent to give insight into the yield curve and the yield curve framework to be chosen for this study. As it will be explained throughout the following sections, Nelson-Siegel Framework was chosen to analyze the yield curve and returns of Turkish Treasury bonds.

3.2.1. Yield Curve and Its Components within Nelson-Siegel Framework

Yield curve is the graphical representation of the yields on fixed-income securities with same credit quality but different maturity. Putting it differently, it shows the pricing of a fixed-income security with different maturities, showing the pricing behavior against the maturity risk. Yield curve concept lies at the heart of economics and finance literature and most market participants have been studying the yield curve of Treasury securities due to their highly liquid essence and immunity from default risk (Fabozzi [23]). Researchers, investors, and policymakers utilize yield curves of different countries to determine investors' risk assessment towards government securities, anticipate the trajectory of the economy and presume the course of actions by policymakers and market participants.

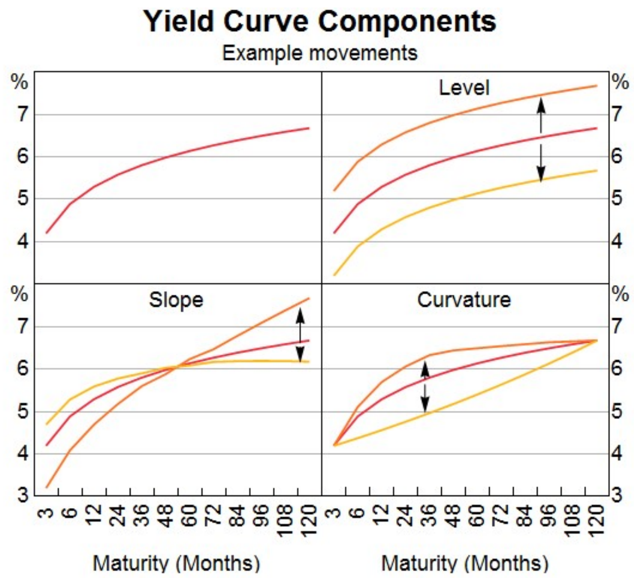
To mathematically illustrate the yield curve, it would be necessary to define the price and yield of a zero-coupon bond. The price of a zero-coupon bond at time t is calculated as follows:

$$P_t(n) = \exp(-n * y_t(n)) \tag{4}$$

$$y_t(n) = -\frac{1}{n} * \ln(P_t(n)) \tag{5}$$

In the equations above, $P_t(n)$ denotes a zero-coupon bond price at time t with n years of maturity. $y_t(n)$, on the other hand, refers to a continuously compounded zero-coupon rate to a bond with price $P_t(n)$. The yields $y_t(n)$'s combined at different maturities construct the zero-coupon yield curve of a fixed-income security.

For the visual comprehension of yield curve, it is essential to understand the three yield curve factors. Movements of Treasury bond yields could be captured by these three factors – level, slope, and curvature – (Litterman and Scheinkman [39]). Level corresponds to the point the yield curve at the longest maturity available, in other words the long end of the yield curve. Theoretically, it refers to the yield of a security at an infinite maturity. Slope factor depicts the steepness of the yield curve. In other words, it shows the difference between the long and short ends of the yield curve, theoretically corresponding to the difference between the yield of a security at infinity and zero point. Finally, the curvature shows the relationship between the short end, intermediate point and long end of the yield curve. It can be approximated by the weighted difference between two spreads (Giese [27]). Figure 3.1 shows the graphical representation of level, slope and curvature factors.



Source: Reserve Bank of Australia

Figure 3.1: Yield Curve Factors for Illustration

Yield curve models can be grouped into two categories, function-based and spline-based models, where former refers to defining yield curve based on a single-piece function and latter corresponds to fitting yield curve propped up piecewise polynomial functions. According to a study conducted by Bank for International Settlements (BIS) [7], most central banks apply function-based models, specifically models introduced by Nelson and Siegel [47] and Svensson [49]. Since this study concerns the predictions of bond excess returns in Turkish treasury market, the applicable study for Turkish markets should be followed.

Accordingly, as several studies[6] have shown, Nelson-Siegel model is the most applicable model with that respect.

Following the discussions made by Nelson and Siegel (1987) and Diebold and Li (2006), the yield curve equation and the price of a zero-coupon bond are as follows:

$$y_t(n) = \beta_1 + \beta_2 * \left(\frac{1-\exp(-n/\tau)}{n/\tau}\right) + \beta_3 * \left(\frac{1-\exp(-n/\tau)}{n/\tau} - \exp(-n/\tau)\right) \tag{6}$$

As it is described for equations (4) and (5), $y_t(n)$ and $P_t(n)$ denote the continuously compounded zero-coupon rate and its respective bond price at time t with n years of maturity. On the other hand, β_1, β_2, β_3 and τ correspond to the model parameters to be estimated. The parameters β_1, β_2, β_3 could be attributed to level, slope, and curvature factors, respectively (Diebold and Li [19]). Specifically, β_1 corresponds to the level factor since $y_t(\infty) = \beta_1$. Moreover, slope factor is related to the β_2 parameter. It is shown by the difference "$y_t(\infty)$ - $y_t(0)$", which equals $-\beta_2$. Finally, the curvature factor's connection to this equation can be understood by β_3's little effect on short and long end of the curves, but strong effect in medium-term of the curve.

Upon understanding the equation (6) and its relation to the yield curve factors, it is necessary to show how the parameters in that equation are derived. To obtain the optimal parameters, ordinary least squares is applied by a fitting procedure. To do so, the daily fitted yields calculated based on the equation (6) are compared to the actual daily yields of bonds traded in the financial markets. By minimizing the sum of squared differences between fitted and actual bond yields will show the optimal parameters for equation (6). Mathematically, this process is described by the below equations:

$$P_t^{i,fitted} = \sum_{j=1}^{M} CF_{t_j}^{i} * \exp\left(-y_t^{i,fitted} * (t_j - t)\right) \tag{7}$$

[6] For further discussion, please refer to Akıncı et al. (2006), Kanlı et al. (2013), Çepni and Küçüksaraç (2017), and Güney et al. (2018)

$$min_{\beta} \sum_{j=1}^{M} (y_t^i - y_t^{i,fitted})^2 \quad (8)$$

$P_t^{i,fitted}$ and $y_t^{i,fitted}$ denote the fitted price and yield of a bond i at time t. M corresponds to the number of bonds traded in financial markets. Equation (8) is basically the explanation of fitting by utilizing ordinary least squares.

3.2.2. Bond Excess Return and Its Calculation

Having finished the discussion regarding yield curve, it is time to introduce the method for bond excess returns. This study follows the discussions of Cochrane and Piazzesi [14] to define bond excess returns. The idea of excess return stems from borrowing at short-term rate and investing those proceeds in a long-term bond and closing the entire position at the end of the maturity of the borrowing period. The general convention is borrowing at 1-year rate (or short-selling a 1-year bond) and investing in an n-year bond. For some studies, 3-month rate is also considered as the reference borrowing rate and this study utilizes 3-month Treasury rates to calculate the annual bond excess returns of Turkish treasury market, compatible with Haddad and Sraer [30].

The log holding return of buying a zero-coupon n-year bond at time t and selling the same bond 1 year later as an n – 1 year bond at t + 1 is as follows:

$$r_{t+1}^n = \ln(P_{t+1}^{n-1}) - \ln(P_t^n) \quad (9)$$

Formula (9) displays the return of an n-year bond and the yield of a 1-year bond should be subtracted to calculate excess returns. As a result, bond excess return can be calculated in the following formula:

$$rx_{t+1}^n = r_{t+1}^n - y_t^1 \quad (10)$$

y_t^1 refers to 1-year yield of a bond at time t.

Formulas (9) and (10) may be further extended to quarterly and monthly calculations. These calculations are shown at below formulas:

$$rx_{t+1}^n = r_{t+1}^n - y_t^{1/4} \quad (11)$$

$$rx_{t+1}^n = r_{t+1}^n - y_t^{1/12} \quad (12)$$

These quarterly and monthly calculations should be summed up to obtain a 1-year excess return.

$$rx_{t+4}^n = \sum_{i=1}^{4} rx_{t+i}^n \quad (13)$$

$$rx_{t+12}^n = \sum_{i=1}^{12} rx_{t+i}^n \quad (14)$$

As it will be seen within the section 4.3, 1-year bond excess returns will be calculated according to (13), meaning that the cumulated quarterly returns for 4 consecutive quarters. The investment position will be composed of borrowing at the 3-month zero-coupon rate and buying n-year zero-coupon bonds. Each position will be closed at the end of the borrowing period and excess returns are calculated based on the summation of bond excess returns of 4 consecutive quarters. This calculation methodology follows the calculations made in Haddad and Sraer [30]. Considering the fact that banks disclose their financial statements quarterly, this calculation methodology is the most appropriate one to calculate bond excess returns and forecast them from bank financial statements.

3.3. Theoretical Framework and Model

Throughout this section, the assumptions regarding bank balance sheet and government bond yields will be specified. Yet, it would be beneficial to present the fundamental theories regarding the term structure of the interest rates.

There are a few theories regarding the term structure (Fabozzi [23]). “Pure expectations” theory states that forward rates exclusively represent the expected future spot rates. Whether the spot rates in the future rise, decline or stay steady depends on the forward rates available today. On the other hand, “liquidity theory” claims that pure expectations theory does not take into account the risk premium or liquidity premium of holding bonds with longer maturities. Forward rates should contain a liquidity premium, along with the future spot rate expectations, and this premium should increase as the maturity of the bond increases. Furthermore, “preferred habitat theory” accepts the view of the "liquidity theory” in terms of the existence of the risk premium in the forward rates. However, this theory does reject the view that liquidity premium should rise uniformly with maturity. According to “preferred habitat theory”, when demand and supply of funds in a given maturity of a bond do not match, investors and borrowers would shift their maturity horizons, provided they are compensated by an appropriate risk premium. This theory states that the term structure of interest rates is determined by expectations of future spot rates and a risk premium (positive or negative), to induce investors to shift out their preferred habitat. Lastly, “market segmentation theory” generally follows the “preferred habitat theory”, except that the shape of the yield curve is determined by the supply and demand conditions of maturity sectors of bonds[7].

Having explained the different views for the term structure of interest rates, this study will continue with the assumptions of the theoretical framework. It should be noted that the "preferred habitat theory”, with the incorporation of banking system, forms a basis to the model this study follows. The formulas and

[7] For further discussion, please examine Fabozzi [23].

assumptions regarding those formulas are completely taken from Greenwood and Vayanos [29] and Haddad and Sraer [30].

3.3.1. Bank Assets

The classification of banks assets could be made in several ways. In this study, banks are assumed to have two types of assets. These are, short-term assets, producing an instantaneous rate of return, r_t, and long-term assets, generating a stream of payments, $\theta e^{-\theta\tau}$dt at each date $\tau \geq t. \theta$ is a controlling parameter for the maturity of long-term assets, where the coupon payments add up to 1 and the average maturity of long-term assets is $1/\theta$.

The classification of bank assets based on the maturity represents all types of assets that banks have. The saving and investment instruments such as loans, corporate and Treasury bonds, commercial paper can be included within this classification. On the other hand, this classification also subsumes the categorization of fixed- or variable-rate assets. Variable-rate assets are an equivalent of rolling over short-term assets at the instantaneous rate of return, so they can be classified together with the short-term assets.

Long-term assets, regardless of their types, can be priced and modeled by the same category. Whether they are loans, bonds, commercial paper does not make a significant difference in pricing these securities. Zero-coupon bonds, falling into long-term asset category, can be utilized to price long-term assets that banks possess. A portfolio having $\theta e^{-\theta\tau}$ bonds of each maturity τ could replicate a unit long position in long-term assets. Cash flow structures of other asset types such as loans could be replicated same as these zero-coupon bonds. These Treasury bonds do not have to have a higher share on the long-term assets of the banks, they are rather an instrument to specify the long-term assets and gauge the price of the interest rate risk as it will be seen throughout section “3.3.3. Equilibrium Yield Curve”.

Since this study's model is established in a continuous-time setting, the yield of a zero-coupon bond will be $y_t^\tau = -\log(P_t^\tau) / \tau$, where the price is denoted as P_t^τ. The instantaneous rate of return, r_t, could be defined as the limit of y_t^τ as τ approaches to 0.

3.3.2. Bank Equity and Decision Function

This study explains the bond risk premia from a banking perspective. Thus, it would be beneficial to explain banks' equity (net worth) evolution and optimization problem to choose the optimal amount of long-term assets.

Banks, like all corporations operating in other industries, try to maximize their shareholders' wealth. Their actions and decision serve the aim of maximizing their equity value. As a result, the amount (or share) of bonds (long-term assets) that banks hold in their portfolios can be analyzed in that respect. Banks should optimize their holdings in long-term assets so that they can maximize their net worth. A bank's net worth evolution can then be formulized as follows:

$$dE_{i,t} = \int_0^\infty X_{i,t}^\tau \frac{dP_t^\tau}{P_t^\tau} d\tau + (E_{i,t} - \int_0^\infty X_{i,t}^\tau \, d\tau) r_t dt \tag{15}$$

In the equation (15), the term $E_{i,t}$ denote the net worth of a bank i at time t, $dE_{i,t}$ then symbolizes the change in net worth. $X_{i,t}^\tau$, refers to the net position of banks in bonds of maturity τ. Therefore, the first part of the equation (15) depicts the return from investing in bonds (long-term assets) at the rate of return of the bonds and the latter part shows the return from remaining assets at the instantaneous rate. As it is explained in the previous section, short-term assets and variable-rate long-term assets could be formulized in the same setting where they have the return at the instantaneous rate, r_t.

Maximization of equity will require banks to optimize their holdings in long-term assets, in other words to optimize all assets in their portfolios. Portfolio optimization could be regarded as a two-part process. The first one involves the determination of risk aversion and the second part is the security selection based on the estimates regarding their future returns (Markowitz [42]). Risk aversion refers to the degree to which investors prefer returns with low uncertainty (or risk) to those with high uncertainty. It is an essential part of the portfolio optimization process for all types of investors. Banks should include a risk aversion parameter to optimally select assets in their portfolios, so they consider this parameter in terms of choosing the amount of bonds (long-term assets) they are going to invest[8]. Consequently, banks' optimization problem becomes the following function, in line with Markowitz mean-variance criterion[9]:

$$\max_{\{X_{i,t}^{\tau}\}_{\tau}} \mathbb{E}(\mathrm{dE}_{i,t}) - \frac{\gamma}{2E_{i,t}} var(dE_{i,t}) \tag{16}$$

The term $\mathrm{E}_{i,t}$ describes the bank equity at time t, same with equation (15). On the other hand, the parameter γ denotes the risk-aversion degree, or risk-aversion coefficient of a bank, and it is a significant component of the model described in the next section. This coefficient could be construed in two different ways. The first interpretation is that it stems from the actual risk aversion of bank managers or their career concerns. The more they are keen to take risks in their portfolios, the lower this coefficient would be, or vice versa. Another explanation for γ coefficient states that this is a Lagrange multiplier on a no-default setting for a bank or a regulatory risk constraint. Regulatory constraints may force bank managers to be more risk-averse even though they are motivated to take high risks

[8] It should be noted that in general, banks are assumed to be risk-neutral instead of risk-averse. Some studies like Nishiyama (2007) also pointed out that according to the data, banks are nearly risk-neutral. In this study, the risk aversion parameter is included to see the bank-decision making of long-term asset holdings. It is obvious that this parameter could be a relatively high number or close to zero, suggesting that banks could be seen as risk-neutral investors of the financial markets. Within the data and results chapter, it will be seen that in practice banks can be regarded as risk-averse components of the financial markets due to relatively high risk-aversion parameter. This could mean that in practice banks display a risk-averse behavior since they are heavily regulated corporations both domestically and internationally and operate in a highly leveraged environment. As a result, risk-aversion behaviors seems to be inevitable and proper hedging is required not to suffer from market risks.

[9] For further discussion, please refer to Markowitz [43].

in selecting their assets. Both these assumptions are correct to a certain degree. For instance, while looking at the annual reports of banks, one could easily notice that most banks in the world (regardless of its size or region they are operating) put a great emphasis on assessing and managing the interest rate risk. From another perspective, Basel framework for banks and regulatory agencies' reports in developed and emerging markets clearly express the vital importance of managing the interest rate risk. Regardless of the origin, banks' risk aversion stance is the essential part of theoretical framework of this study.

3.3.3. Equilibrium Yield Curve

This study is going to follow Haddad and Sraer [30] in terms of deriving the relation among short rate, yield curve and investment decisions of banks. The equilibrium condition follows the "preferred-habitat theory" explained at the beginning of this chapter. This theory is introduced by Modigliani and Sutch [45] and later formulized by Vayanos and Vila [51], and this study follows them, with an incorporation of banking system. According to preferred-habitat view, risk premium is affected by the expected change in the long-term rate and supply shocks of long- and short-term bonds issued by primary borrowers. Investors generally prefer shorter-term Treasury securities and thus should be compensated by appropriate risk premiums to shift their portfolios to longer-term maturity Treasury instruments.

Back to the equilibrium, the relation among short rate, yield curve and investment decisions of banks should hold in the equilibrium of an economy where banks make their risk management decisions based on (15) and (16). Since the banks try to solve the same optimization problem, explained by (15) and (16), the optimal holdings of long-term assets per dollar of equity, depicted by $x_{i,t}^{\tau} = \frac{X_{i,t}^{\tau}}{E_{i,t}}$, should be same across the banks, assuming that they possess the same risk-aversion level. This could also be expressed as follows:

$$x_{i,t}^{\tau} = g_t \theta e^{-\theta\tau} \qquad (17)$$

where g_t is the net amount of long-term assets of the banks, divided by their equity.

The term g_t could be integrated into the equilibrium conditions of the changes in the instantaneous rate and the term itself should also be modelled with the same logic for consistency. In order to model the equilibrium of the changes in the short-term rate, many studies have adopted Ornstein-Uhlenbeck process. It is a Gauss-Markov process with mean-reverting (where the drifts of the process occur towards its mean) adjustments in a continuous-time setting. This study utilizes the Ornstein-Uhlenbeck process to model the equilibria conditions for both the short-term rate and term g_t. The equilibria of the joint dynamics, thus, are the following:

$$dg_t = -\kappa_g(g_t - \bar{g})dt + \sigma_g dW_{g,t} \qquad (18)$$

$$dr_t = -\kappa_r(r_t - \bar{r})dt - \kappa_{g\to r}(g_t - \bar{g})dt + \sigma_r dW_{r,t} \qquad (19)$$

In (18) and (19), the terms $\bar{g}$ and $\bar{r}$ refer to the long-term means of g_t and r_t, respectively and σ_g and σ_r correspond to their volatilities. The coefficients κ_g and κ_r are positive constants and denote the respective speeds of mean reversion. On the other hand, the coefficient $\kappa_{g\to r}$ is deliberately added to the model to examine the possibility that the exposure g_t could forecast the changes in the short rate. $W_{r,t}$ denotes the Brownian motion. It should be noted that the changes in r_t are taken exogenous, even though it could be modeled by macroeconomic developments or Central Bank interventions, and the focus of this study is to examine whether the movements in r_t affect the bond yields.

Having specified the equilibria dynamics for short-term rate and exposure g_t, it is time to introduce the model regarding the term structure of the interest rates.

Following Haddad and Sraer [30], the term structure of the interest rate could be modeled linearly and the relation between yields, short-term rate r_t and the net exposure g_t are defined as follows:

$$-\,l\,n(P_t^\tau) = \; y_t^\tau = \; A_r(\tau)r_t + \; A_g(\tau)g_t + C(\tau) \tag{20}$$

The terms $A_r(\tau)$ and $A_g(\tau)$ refer to the exposure of yields of bonds with maturity τ to the short rate and long-lived assets, respectively and are coefficients that are an endogenous outcome of the model computed in the equilibrium. This formula indicates that the excess return of a bond is determined by the bond's sensitivities to the short rate and the proportion of net long-term assets in banks' balance sheets.

Plugging the law of motions of g_t and r_t, the expected Treasury bond returns, denoted by μ_t, could be expressed as follows:

$$\mu_t^\tau = \; A_r'(\tau)r_t + \; A_g'(\tau)g_t + \; C'(\tau) + \; A_r(\tau)\kappa_r(r_t - \bar{r}) + \; A_r(\tau)\kappa_{g\to r}(g_t - \bar{g}) + \; A_r(\tau)\kappa_g(g_t - \bar{g}) + 0.5A_r(\tau)^2\sigma_r^2 + \; 0.5A_g(\tau)^2\sigma_g^2 \tag{21}$$

Having defined the terms g_t, r_t and constants κ_g, κ_r and $\kappa_{g\to r}$, a set of ordinary differential equations can be derived. Particularly, A_r solve the following system, with conditions $A_r(0) = 0$ and $1 = \; A_r'(\tau) + \; \kappa_r A_r(\tau)$:

$$a(x) = \; y' + b(x)y \text{ and } u(x) = \; e^{\int b(x)dx} \Rightarrow$$

$$1 = a(x),\, \kappa_r = b(x) \; and \;\; y = \; A_r(\tau),$$

$$(\tau) = e^{\int \kappa_r d\tau} = e^{\kappa_r \tau}$$

$$e^{\kappa_r \tau} = \; e^{\kappa_r \tau} A_r'(\tau) + \; \kappa_r e^{\kappa_r \tau} A_r(\tau)$$

Integrating both parts, the following is obtained:

$$\int e^{\kappa_r \tau}\, d\tau = \; \int (e^{\kappa_r \tau} A_r'(\tau) + \; \kappa_r e^{\kappa_r \tau} A_r(\tau))d\tau$$

$$\frac{e^{\kappa_r \tau}}{\kappa_r} = \int \frac{d(e^{\kappa_r \tau} A_r(\tau))}{d\tau} d\tau$$

$$\frac{e^{\kappa_r \tau}}{\kappa_r} = e^{\kappa_r \tau} A_r(\tau) + c$$

$$A_r(\tau) = \left(\frac{e^{\kappa_r \tau}}{\kappa_r} - c\right) / e^{\kappa_r \tau}$$

Since $A_r(0) = 0$, $0 = (\frac{1}{\kappa_r} - c) \Rightarrow c = \frac{1}{\kappa_r}$

$$A_r(\tau) = (\frac{e^{\kappa_r \tau}}{\kappa_r} - \frac{1}{\kappa_r})/e^{\kappa_r \tau} = \frac{1 - e^{-\kappa_r \tau}}{\kappa_r} \tag{22}$$

With the same logic, A_g solve the following system, with conditions $A_g(0) = 0$ and $A_r(\tau)\left(\gamma\sigma_r^2 I_r - \kappa_{g\to r}\right) = A_g'(\tau) + (\kappa_g - \gamma\sigma_g^2 \int_0^\infty \theta e^{-\theta u} A_g(u) du)\, A_g(\tau)$

$$A_g(\tau) = \frac{Z}{\kappa_r}\left(\frac{1 - e^{-\overline{\kappa}_g \tau}}{\overline{\kappa}_g} - \frac{e^{-\kappa_r \tau} - e^{-\overline{\kappa}_g \tau}}{\overline{\kappa}_g - \kappa_r}\right) \tag{23}$$

where

$$Z = \gamma\sigma_r^2 \frac{1}{\theta + \kappa_r} - \kappa_{g\to r} \tag{24}$$

$$\overline{\kappa}_g = \kappa_g - \gamma\sigma_g^2 \int_0^\infty \theta e^{-\theta u} A_g(u) du = \kappa_g - \gamma\sigma_g^2 \frac{Z}{\kappa_r}(\frac{1}{\theta + \overline{\kappa}_g} - \frac{1}{\overline{\kappa}_g - \kappa_r}(\frac{\theta}{\theta + \kappa_r} - \frac{\theta}{\theta + \overline{\kappa}_g})) \tag{25}$$

Obviously, A_r is positive and increasing. To assess A_g, its derivative needs to be examined.

$$A_g'(\tau) = Z \frac{e^{-\kappa_r \tau} - e^{-\overline{\kappa}_g \tau}}{\overline{\kappa}_g - \kappa_r} \tag{26}$$

A_g and A'_g are the same sign of Z.

Based on expected return of a bond with a maturity of τ, given by (21) and applying Ito's Lemma to (20), first-order condition of banks could be written as follows:

$$\mu_t^\tau - r_t = A_r(\tau)\lambda_{r,t} + A_g(\tau)\lambda_{g,t} \qquad (27)$$

$$\lambda_{j,t} = \gamma\sigma_j^2 \int_0^\infty x_{i,t}^\tau A_j(\tau) d\tau \qquad (28)$$

Based on (27) and (28), a bond's expected instantaneous rate of return in excess of the short rate, is a linear function of two factors, bond's sensitivities to the short rate ($A_r(\tau)$) and banks' long-lived assets ($A_g(\tau)$). This shows that a bank demands a risk premium that is proportional to the exposures of the bond to the fundamental shocks of the economy and banking industry. The coefficients $\lambda_{r,t}$ and $\lambda_{g,t}$ correspond to the compensation for bearing these risks, which can also be interpreted as the market price of these risks. This compensation is affected by risk aversion parameter, volatility and the total exposure accumulated through bonds of various maturities.

Having defined the equilibrium yield curve and banks' first-order condition, this study introduces the following propositions to conclude the theoretical framework.

Proposition 1: *Within an equilibrium state of an economy, where the instantaneous rate and banks' balance sheet conditions hold based on (18) and (19), the expected excess return of a τ-maturity bond is proportional to the net position in banks' long-term assets*:

$$\mu_t^\tau - r_t = g_t * \left(c_r A_r(\tau) + c_g A_g(\tau) \right) = g_t * \phi(\tau) \qquad (29)$$

c_r and c_g are constants and $\phi(\tau) > 0$.

It is already shown that A_r is positive and increasing and A_g is of the same sign of Z and monotone. Based on (28), it is easy to follow that the constants c_r and c_g are of the same sign with respect to their A_j coefficients. This would yield the result of having a positive $\phi(\tau)$ meaning an expected excess return of a τ-maturity bond that is proportional and with same sign to the exposure of banks' long-term assets.

Proposition 1 indicates that the more banks hold long-term assets, the more they tend to lose since the market value of those assets go down when interest rates go up. As a result, banks are inclined to hold less long-term zero-coupon bonds since their profits would decline. Thus, the expected excess returns of bonds must adjust to compensate the level to bear this risk. In equilibrium, the expected excess return should be correlated with the banks' net exposure to long-term assets.

Proposition 2: *Within an equilibrium state of an economy, where the instantaneous rate and banks' balance sheet conditions hold based on (18) and (19), the expected excess return of a τ-maturity bond becomes more sensitive as the maturity of the bond increases. In other words, $\phi(\tau)$ is strictly increasing in τ.*

As previously shown for Proposition 1, A_r is positive and increasing and A_g is of the same sign of Z and monotone. The terms c_r *and* c_g are of the same sign with respect to their coefficient, which would yield the result that combining with A_r and $A_g's$ monotonicity, the term $\left(c_r A_r(\tau) + c_g A_g(\tau) \right)$ becomes monotonic. Since it is a positive term, it also becomes strictly increasing as τ increases.

Proposition 2 expresses that holding g_t stable, a higher maturity of long-term assets would mean a higher bond excess return. This expression is consistent with duration perspective of bonds. Keeping everything else same, bonds with higher maturity have higher durations, i.e., a higher sensitivity to the changes in interest rates, so these bonds are riskier compared to the short-term bonds. Thus, banks are less willing to hold bonds of larger maturities even if they tend to hold long-term assets, given the risk premia is constant. They need to be rewarded appropriately for bearing the risk of holding longer-term bonds.

Proposition 3: : *Within an equilibrium state of an economy, where the instantaneous rate and banks' balance sheet conditions hold based on (18) and (19),* $\mathrm{A_g}(\tau)$*, is of the same sign as* $\gamma\sigma_r^2\frac{1}{\theta+\kappa_r} - \kappa_{g\to r}$ *(Z) and the exposure of bond prices to the long-term assets of banks,* g_t*, is an unspanned factor if and only if* $\kappa_{g\to r} = \gamma\sigma_r^2\frac{1}{\theta+\kappa_r}$.

As previously shown, $A_g(\tau)$, is of the same sign as Z. According to (23), $A_g(\tau)$ is a multiple of Z, meaning that as Z becomes 0, $A_g(\tau)$ becomes 0, as well. The only condition providing this is the $\kappa_{g\to r}$ becoming equal to $\gamma\sigma_r^2\frac{1}{\theta+\kappa_r}$. In that case, $A_g(\tau)$ will be equal to 0 and the exposure of banks to long-term assets (or income gap) would have no effect on bond risk premia.

From propositions 1, 2 and 3, there is a link between bond risk premia and bank's balance sheet composition. This link is created through the risk management decision by bank managers. During the times where banks hold larger long-term assets, banks expect to benefit from higher excess returns from these assets. Especially, propositions 1 and 2 show that banks do not have a reason to hold long-term bonds when they are not compensated accordingly, considering the risk-aversion component in their portfolio decisions.

The propositions of the model not only showed the link of bond risk premia and bank balance sheet, but also have given two testable hypotheses.

The first testable hypothesis is a higher portion of long-term assets in banks' balance sheets would indicate higher bond risk premia (Proposition 1). This could easily be observed from banks' balance sheets and bond excess returns by comparing the times where banks hold larger shares of long-term assets in their portfolios.

The second hypothesis is that the effect of holding more long-term assets in banks' portfolios is stronger in bonds with higher maturities (Proposition 2). This effect can easily be tested by comparing the $\phi(\tau)$'s over different maturities.

Having defined the propositions, this study now completes the model and will explain the findings in data in the following chapter.

CHAPTER 4

DATA AND RESULTS

4.1. Data

As explained before, the main concern of this study is the examination of income gap and exposure ratio (g_t), the ratios that could be derived from the balance sheets of banks. Since Turkish bond excess returns and their relations to banking system in Turkey are analyzed in this study, the relevant data are obtained from the website of "The Banks Association of Turkey" (Türkiye Bankalar Birliği). They provide the quarterly financial statements of all banks operating in Turkey. These financial statements may be found via the statistical reports section of their website[10].

As the forecasting variable, Haddad and Sraer [30] utilized the average income gap of the banks in the US, with more than USD 1 billion of total consolidated assets, instead of aggregate or asset-weighted income gap. They justify this condition by stating that some banks do not report their interest-rate derivative positions, which would distort the income gap ratio over time since not including these derivative positions would not truly reflect the rate sensitive exposure position of a bank. Considering that study's time horizon, 1986-2014, this approach could be comprehendible since a lot of banks worldwide did not disclose their derivative positions until 2000s. However, this approach would still distort

[10] For detailed information, please visit the link below:
https://www.tbb.org.tr/tr/bankacilik/banka-ve-sektor-bilgileri/istatistiki-raporlar/59

the gap data since it is meaningless to calculate an equal-weighted average for banks with huge total

asset discrepancies. In addition, this study analyzes the bond risk-premia in Turkey between the second quarter of 2006 and first quarter of 2021. Banks in Turkey have been disclosing their off-balance sheet positions in terms of their interest rate risk since 2002 and income gap and exposure ratios obtained from banks contain information from interest-rate derivatives. Therefore, this study utilizes the asset-weighted income gap and exposure ratio. An asset weighted ratio depicts a more proper picture for the interest rate exposure of banks in Turkey since it truly reflects the aggregated exposure positions of banks compared to an equally weighted ratio, considering the differences in scales of the bank balance sheets. The income gap and exposure ratios are calculated for each bank and then aggregated based on their consolidated assets on a quarterly basis.

Banks disclose their interest rate exposure within their quarterly financial statements under the section of "Interest rate sensitivity of assets, liabilities and off-balance sheet items based on repricing dates." As an example, the interest rate sensitivity of Yapi Kredi Bankasi within the financial statement of the period December 2019 is shown on Table 4.1. This table is a standard disclosure table for all banks in Turkey for their interest rate sensitivity.

Consistent with the definitions in chapter 3, this study calculates the gap, normalized by total assets, for a 1-year period for all banks in Turkey. Due to data availability, the sample period of this study for bond excess returns is between the first quarter of 2006 and first quarter of 2021, meaning that bank data is obtained between the last quarter of 2004 and last quarter of 2019. Lastly, the sample data consist of the banks with an average total asset of more than USD 20 billion over the sample period which would be the 9 largest banks in Turkey. This type of selection is indeed not arbitrary. Not only have those banks been the largest ones within the industry for many years, but they also have mainly been market-makers of government bond market. In addition, they form more than 83% of the entire

Turkish banking system throughout the years in terms of total assets and more than 90% of the banking system in terms of total deposits[11].

The government bond data, used to extract the yield curve of Turkish government bonds are obtained from Bloomberg terminal on a quarterly basis.

Table 4.1: Interest rate sensitivity of assets, liabilities and off-balance sheet items based on repricing dates – Yapi Kredi Bank for period 31.12.2019.

Current Period	**Up to 1 Month**	**1-3 Months**	**3-12 Months**	**1-5 Years**	**5 Years and Over**	**Non interest bearing**	**Total**
Assets							
Cash (cash in vault, effectives, cash in transit, cheques purchased) and balances with the Central Bank of the Republic of Turkey	19.217.128	-	-	-	-	24.268.802	**43.485.930**
Banks	11.976.949	1.489.545	801.074	64.231	-	12.879.989	**27.211.788**
Financial assets at fair value through profit/loss	-	162	4.536	13.874	75.296	479.329	**573.197**
Receivables from money markets	10.803.630	-	-	-	-	-	**10.803.630**
Financial assets at fair value through other comprehensive income	2.795.718	5.877.816	9.044.577	6.900.060	2.202.096	80.345	**26.900.612**
Loans (1)	34.443.764	32.068.141	76.404.792	86.334.621	14.039.572	1.189.720	**244.480.610**
Financial assets measured at amortised cost	6.066.570	3.938.811	5.053.572	3.709.314	10.839.870	-	**29.608.137**
Other assets	953.026	1.413.564	1.165.593	1.238.766	308.582	23.051.585	**28.131.116**
Total assets	**86.256.785**	**44.788.039**	**92.474.144**	**98.260.866**	**27.465.416**	**61.949.770**	**411.195.020**
Liabilities							
Bank deposits	3.857.173	49.427	12.299	-	-	1.138.876	**5.057.775**
Other deposits	134.497.570	28.344.401	8.846.851	2.285.622	272.471	51.767.007	**226.013.922**
Funds from money market	5.201.232	317.793	789.863	-	-	-	**6.308.888**
Miscellaneous payables	-	-	-	-	-	14.697.241	**14.697.241**
Marketable securities issued	3.123.877	13.806.731	8.290.583	-	-	-	**25.221.191**
Funds borrowed from other financial institutions	6.624.057	19.373.853	14.005.520	3.711.567	1.658.498	-	**45.373.495**
Other liabilities(2)	4.826.893	13.827.593	863.319	14.687.916	5.557.515	48.759.272	**88.522.508**
Total liabilities	**158.130.802**	**75.719.798**	**32.808.435**	**20.685.105**	**7.488.484**	**116.362.396**	**411.195.020**
Balance sheet long position	**-**	**-**	**59.665.709**	**77.575.761**	**19.976.932**	**-**	**157.218.402**
Balance sheet short position	**(71.874.017)**	**(30.931.759)**	-	-	-	**(54.412.626)**	**(157.218.402)**
Off-balance sheet long position	14.532.346	35.990.412	-	-	-	-	50.522.758
Off-balance sheet short position	-	-	(5.150.258)	(38.927.418)	(5.444.707)	-	(49.522.383)
Total position	**(57.341.671)**	**5.058.653**	**54.515.451**	**38.648.343**	**14.532.225**	**(54.412.626)**	**1.000.375**

[11] Please visit the website https://www.tbb.org.tr/tr/bankacilik/banka-ve-sektor-bilgileri/istatistiki-raporlar/59 for further information.

Table 4.2: Descriptive Statistics. This table is comprised of the summary statistics of the variables on a quarterly basis. Bond excess returns for different maturities are calculated based on yield curve data obtained from Bloomberg terminal. Macroeconomic variables – output gap, real sector confidence index, capacity utilization ratio, industrial growth, consumer confidence index, consumer price index and producer price index – data are obtained from Bloomberg terminal, as well. The data that are utilized to calculate income gap and exposure ratio are obtained from the website of The Banks Association of Turkey. The sample period is from the first quarter of 2006 and first quarter of 2021, it thus contains 61 observations.

Variable	# of obs	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
$rx^{(2)}$	61	0.0099	0.0087	0.0864	0.3206	3.3575	1.3698
$rx^{(3)}$	61	0.0075	0.0050	0.1276	0.2431	3.3562	0.9232
$rx^{(4)}$	61	0.0046	0.0028	0.1643	0.2058	3.3812	0.8000
$rx^{(5)}$	61	0.0016	-0.0013	0.1978	0.1904	3.4617	0.9105
$rx^{(6)}$	61	-0.0014	0.0015	0.2293	0.1820	3.6094	1.2803
$rx^{(7)}$	61	-0.0045	-0.0154	0.2594	0.1721	3.8157	1.9922
$rx^{(8)}$	61	-0.0075	-0.0103	0.2888	0.1567	4.0622	3.1173
$rx^{(9)}$	61	-0.0104	-0.0078	0.3179	0.1346	4.3277	4.6649
$rx^{(10)}$	61	-0.0133	-0.0159	0.3471	0.1063	4.5936	6.5695
Income Gap	61	-0.0494	-0.0433	0.0382	-0.2417	2.8911	0.6242
Exposure Ratio	61	1.5352	1.4841	0.3659	0.1320	3.0716	0.1902
Output Gap	61	0.0000	0.0054	0.0399	-1.4080	6.5082	51.4367
Real Sec. Conf. Ind.	61	0.0076	-0.0019	0.1580	1.5361	11.8721	224.0542
Cap. Util. Growth	61	0.0010	-0.0062	0.0411	0.5364	3.1084	2.7133
IP Growth	61	0.0536	0.0618	0.0915	-0.4277	3.6950	3.0874
Cons. Conf. Ind. Growth	61	-0.0254	-0.0220	0.1080	0.1699	3.2508	0.4534
CPI	61	0.0950	0.0881	0.0350	2.2207	9.1268	145.5435
PPI	61	0.0997	0.0850	0.0804	2.2181	9.4458	155.6207

As it will be seen in Section 4.3, macroeconomic variables will be analyzed against bond excess returns in regression analysis. The reasons for that will be shared during the next section. It should be noted that the data for these macroeconomic variables are obtained from Bloomberg terminal on a quarterly basis.

Table 4.2 presents the descriptive statistics for income gap, exposure ratio, excess returns over maturities of 2-10 years and some macroeconomic indicators. There are a few noteworthy issues from these statistics. Firstly, it is interesting to note that excess returns for bonds up to maturities of 5 years are positive, but these returns are negative for bonds with maturities more than 5 years. Furthermore, the volatility of bond excess returns increases with maturity. Moreover, the average income gap of the banks throughout the sample period is negative. This means that for the sample period, banks in Turkey held less short-term assets than short-term liabilities and they extensively possessed longer-term assets in their balance sheets. In other words, they tend to borrow shorter-term funds and invest those in longer-term loans or securities.

4.2. Model Estimation

The theoretical model, along with its assumptions and parameters, is extensively explained in section 3.3. This model expresses the relation between the yield curve (and excess return) and parameters (κ_g, κ_r, $\kappa_{g\to r}$, σ_r, σ_g, $\phi(\tau)$, γ) introduced within theoretical framework. To estimate the parameters, the discrete-time versions of equations (18) and (19) need to be presented:

$$y_{t+1}^1 - y_t^1 = -\kappa_r y_t^1 - \kappa_{g\to r} g_t + \epsilon_{r,t} \tag{30}$$

$$g_{t+1} - g_t = -\kappa_g g_t + \epsilon_{g,t} \tag{31}$$

It is important to remember that κ_g, κ_r, $\kappa_{g\to r}$ are the parameters presented in Section 3.3. On the other hand, $\epsilon_{r,t}$ and $\epsilon_{g,t}$ denote the regression residuals whose standard deviations represent the parameters σ_r and σ_g, respectively. In addition, y_t^1 represents the yield on 1-year government bond based on the formula (4). The parameters are estimated using linear regressions at the annual frequency and their confidence intervals are corrected by parametric bootstrap method. Moreover, $\phi(\tau)$, defined at Proposition 1, at maturities from 2 to 10 is estimated using the same linear regression with parametric bootstrapping. The controlling parameter θ for the maturity of long-term assets is assumed to be 0.10, meaning that $1/\theta$, the time to maturity of the long-term asset, is set to be 10 years. This selection has two main explanations. First of all, it is in line with the selection of Haddad and Sraer [30]. But more importantly, as it can be discerned from Figure 4.1, risk aversion coefficient displays high variation until the maturity of long-term assets is 10 years.

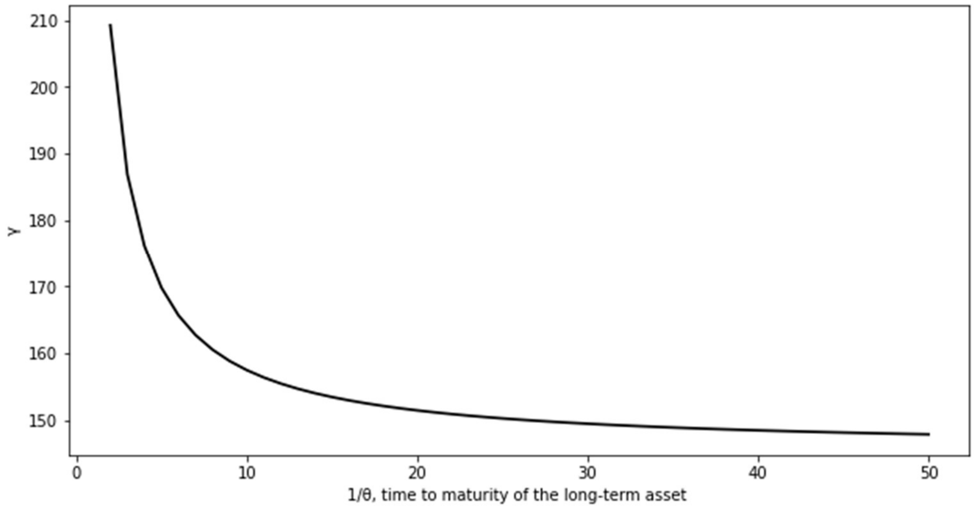


Figure 4.1: Sensitivity Analysis on Calibration of Duration. This figure displays different estimates of the risk-aversion parameter γ for alternative calibration of $1/\theta$, time to maturity of the long-term asset. γ exhibits high volatility between 0-10 years of time to maturity. After 10 years, it shows a relatively steady behavior. Therefore, this study chooses time to maturity of the long-term asset as 10 years.

After 10 years, this coefficient levels off and displays a steady behavior. That is the main reason this study chooses 0.10 as the controlling parameter θ. Table 4.3 presents the model's parameter estimates using 95% confidence intervals and Table 4.4 shows the estimates of $A_r(\tau)$ and $A_g(\tau)$ at various maturities. The estimations shown at Table 4.3 and Table 4.4 present a few noteworthy findings. To begin with, all the assumptions of this study's theoretical framework hold. The constants κ_g, κ_r and $\kappa_{g\to r}$, integral parts of the Ornstein-Uhlenbeck process described in equations (18) and (19), were found to be positive as assumed. Moreover, $A_r(\tau)$, the exposure of yields of bonds with maturity τ to the short rate and denoted in Formula (22), is positive and increasing with maturity. On the other hand, it was shown that $A_g(\tau)$, the exposure of yields of bonds with maturity

τ to the long-lived assets and denoted in (23), must increase in absolute value as maturity increases and have the same sign of Z, denoted in (24). Table 4.4 shows

Table 4.3: Parameter Estimates. This table shows the model's parameter estimates with their bootstrapped 95% confidence intervals. The parameters are estimated using linear regressions at the annual frequency and their confidence intervals are corrected by parametric bootstrap method. The controlling parameter θ for the maturity of long-term assets is assumed to be 0.10, meaning that $1/\theta$, the time to maturity of the long-term asset, is set to be 10 years.

Parameter	**Estimates**	**95% Confidence Interval**
κ_r	1.1751	0.8192 - 1.5072
κ_g	0.4699	-0.0379 - 0.8694
$\kappa_{g\to r}$	0.094	0.0579 - 0.1322
σ_r	0.0255	0.0188 - 0.0394
σ_g	0.3106	0.2294 - 0.4807
$\phi(2)$	0.0763	-0.0487 - 0.2230
$\phi(3)$	0.1218	-0.0975 - 0.3737
$\phi(4)$	0.1668	-0.1232 - 0.5199
$\phi(5)$	0.2129	-0.0262 - 0.4709
$\phi(6)$	0.2604	-0.0416 - 0.6302
$\phi(7)$	0.3092	0.0305 - 0.6334
$\phi(8)$	0.3589	0.0380 - 0.7133
$\phi(9)$	0.4094	0.0576 - 0.8089
$\phi(10)$	0.4607	-0.0137 - 0.9145
Z	-0.0140	
γ	157.4681	

Table 4.4: Estimates of $A_r(\tau)$ and $A_g(\tau)$. This table shows the components of $\phi(n)$ – A_r (n) and A_g (n) – at different maturities. The same calculation method with Table 5 applies here. A_r (n) and A_g (n) are estimated using linear regressions at the annual frequency.

Parameter	**Estimates**	**Parameter**	**Estimates**
A_r (2)	0.7698	A_g (2)	-0.0091
A_r (3)	0.8259	A_g (3)	-0.0128
A_r (4)	0.8433	A_g (4)	-0.0149
A_r (5)	0.8486	A_g (5)	-0.0161
A_r (6)	0.8503	A_g (6)	-0.0168
A_r (7)	0.8508	A_g (7)	-0.0171
A_r (8)	0.8509	A_g (8)	-0.0173
A_r (9)	0.8510	A_g (9)	-0.0173
A_r (10)	0.8510	A_g (10)	-0.0174

this increase and A_g has a negative sign (at all maturities) same with Z, which can be seen on Table 4.3. Additionally, $\phi(\tau)$ is positive at all maturities. The findings shown so far based on data are consistent with the assumptions for Proposition 1. The increase of $\phi(\tau)$ with maturity verifies the Proposition 2. Finally, Proposition 3, Z is different from 0, holds and g_t is a spanned factor of bond excess returns.

The risk aversion parameter, γ, is explained in section 3.3.2. and estimated by minimizing the squared distance between the estimated average $\phi(\tau)$ across maturities and average theoretical $\phi(\tau)$ across maturities[12]. Based on Table 4.3, the risk aversion parameter is 157.4681. Compared to the findings of Haddadi and Sraer [30][13], who examined the risk aversion in US banks and/or arbitrageurs, the absolute risk aversion parameter in banks in Turkey are strongly high. This high risk-aversion could be interpreted in two different ways. Firstly, the economic crisis of Turkey in 2001, causing bankruptcies of several banks, culminated in the autonomy of Banking Regulation and Supervision Agency and this created a powerful regulation and surveillance mechanism for Turkish banks. Considering the data sample period, a higher risk aversion coefficient for Turkish banks should not be surprising. Secondly, banks in Turkey have been adapting to the standards set forth by Basel Committee on Banking Supervision. Basel supervisions require banks to hold capital that is proportional to their risk-weighted assets. Clearly, banks in Turkey possess assets that have lower credit ratings compared to those in the United States, meaning that they have proportionally higher risk-weighted assets which requires holding more capital as a percentage of total assets. Figure 4.1 presents the different estimates of risk aversion parameter γ under the different assumptions of $1/\theta$, the time to maturity of the long-term asset. This figure depicts that the maturity of long-term assets increases as the risk-aversion of banks decreases. Mathematically, this could be verified using the equations (24) and (25).

[12] The average $\phi(\tau)$ can be calculated by the following: $\frac{1}{9}\sum_{\tau=2}^{10}\phi(\tau)$.

[13] 19.22 for banks in the US. Please also remember that the sampling period for that study is between 1986 and 2014.

Intuitively, one can expect that while the risk-aversion of investors goes down, they shift their investments into longer-term securities, provided that they are rewarded by higher returns. This is in line with the assumptions of the preferred-habitat view.

4.3. Results and Interpretation

This study utilizes the following linear regression equation with heteroskedasticity and autocorrelation consistent Newey-West estimator using quarterly data:

$$rx^{n}_{t\to t+4} = a^{n} + b^{n} * X_{t} + \epsilon^{n}_{t+4} \text{ for n = 2, 3, 4, 5, 6, 7, 8, 9 and 10.} \quad (32)$$

In equation (32), $rx^{n}_{t\to t+4}$ denotes the excess return of a zero-coupon bond with maturity of n years from quarter t to quarter t+4 and is calculated according to (13). X_t will denote aggregated $Income\ Gap_t$ or $Exposure\ Ratio_t$ (g_t). This corresponds to an exposure (or income gap) ratio available at the beginning of quarter t. Figures 4.2 and 4.3 depict the evolution of income gap, exposure ratio and bond excess returns over sample period.

Before examining the regression results, the relation of income gap and exposure ratio to the bond excess returns could be evaluated by analyzing Figures 4.2 and 4.3. Both income gap and exposure ratio show cyclicality and display similar patterns with bond excess returns. However, exposure ratio seems to be more related to bond excess returns throughout the sample period.

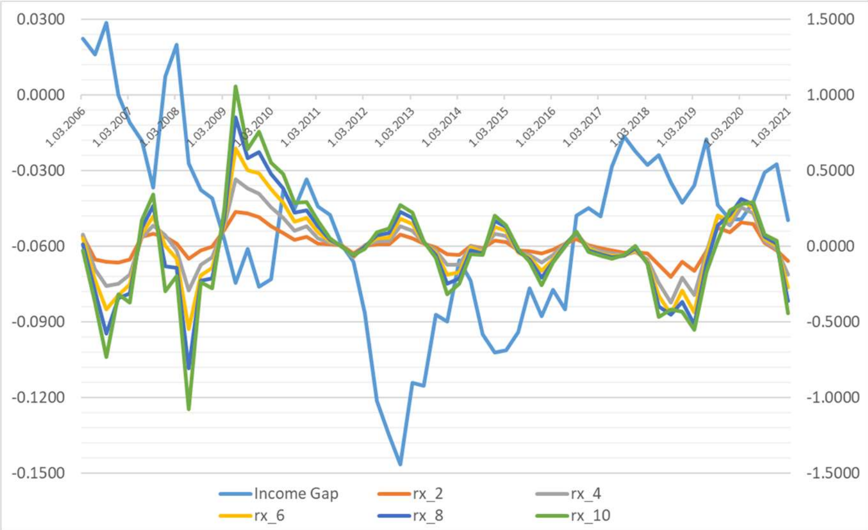


Figure 4.2: Income Gap and Bond Excess Returns. This figure displays the time series of income gap of banks in Turkey (left hand side of the y-axis) and Turkish government bond excess returns (right hand side of the y-axis). Income gap of a bank corresponds to the difference between rate-sensitive assets and rate-sensitive liabilities normalized by total assets and is calculated on an asset-weighted basis. Quarterly balance sheet (interest rate sensitivity of assets, liabilities and off-balance sheet items) data are obtained from the website of "The Banks Association of Turkey". The sample data consist of the banks with an average total asset of more than USD 20 billion over the sample period which would correspond to the 9 largest banks in Turkey. Those banks are the largest ones within the banking industry in Turkey and they also have mainly been market-makers of Turkish government bond market. Income gap. rx(n) denotes the excess one-year return of zero-coupon government bonds in Turkey with maturity n years. The bond data is obtained from Bloomberg terminal and yield curve is constructed based on Nelson-Siegel framework.

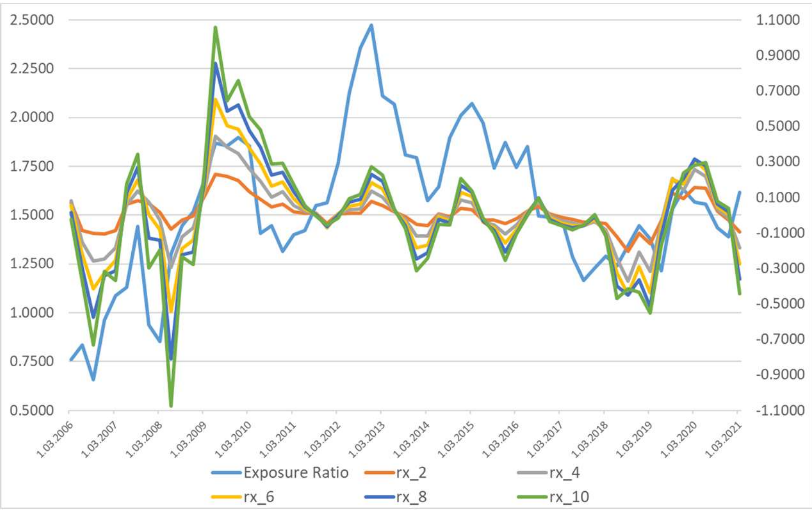


Figure 4.3: Exposure Ratio and Bond Excess Returns. This figure plots the time series of exposure ratio of banks in Turkey (left hand side of the y-axis) and Turkish government bond excess returns (left hand side of the y-axis). Exposure ratio of a bank corresponds to the difference between rate-sensitive assets and rate-sensitive liabilities normalized by total equity and is calculated on an asset-weighted basis. Quarterly balance sheet (interest rate sensitivity of assets, liabilities and off-balance sheet items) data are obtained from the website of "The Banks Association of Turkey". The sample data consist of the banks with an average total asset of more than USD 20 billion over the sample period which would correspond to the 9 largest banks in Turkey. Those banks are the largest ones within the banking industry in Turkey and they also have mainly been market-makers of Turkish government bond market. rx(n) denotes the excess one-year return of zero-coupon government bonds in Turkey with maturity n years. The bond data is obtained from Bloomberg terminal and yield curve is constructed based on Nelson-Siegel framework.

Table 4.5: Income Gap and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on income gap of banks in Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Income gap corresponds to the asset-weighted income gap of banks, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-value of the income gap, number of observations, adjusted R-squared, standard errors of the constant and income gap are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	-0.0135	−0.0327	-0.0521	−0.0716
	(0.0225)	(0.0328)	(0.0415)	(0.0490)
Income Gap	-0.4731*	−0.8120**	−1.1476**	−1.4817**
	(0.2517)	(0.3717)	(0.4756)	(0.5703)
p-value	0.0651	0.0329	0.019	0.0118
Observations	61	61	61	61
Adjusted R-squared	0.0276	0.0432	0.0556	0.0664

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.0910	-0.1101*	-0.1290*	-0.1475*	-0.1656**
	(0.0559)	(0.0622)	(0.0683)	(0.0744)	(0.0805)
Income Gap	-1.8124***	-2.1381***	-2.4581***	-2.7724***	-3.0814***
	(0.6595)	(0.7458)	(0.8312)	(0.9167)	(1.0034)
p-value	0.0079	0.0057	0.0045	0.0037	0.0032
Observations	61	61	61	61	61
Adjusted R-squared	0.0759	0.0840	0.0908	0.0961	0.1002

Table 4.6: Exposure Ratio and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, exposure ratio, p-value of the exposure ratio, number of observations, adjusted R-squared, standard errors of the constant and exposure ratio are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	−0.1064**	−0.1783**	−0.2476***	−0.3155***
	(0.0490)	(0.0709)	(0.0893)	(0.1057)
Exposure Ratio	0.0757**	0.1210**	0.1643***	0.2066***
	(0.0323)	(0.0467)	(0.0591)	(0.0704)
p-value	0.0224	0.012	0.0072	0.0047
Observations	61	61	61	61
Adjusted R-squared	0.0876	0.1055	0.1193	0.1315

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.3821***	-0.4474***	-0.5113***	-0.5739***	-0.6354***
	(0.1208)	(0.1353)	(0.1496)	(0.1639)	(0.1784)
Exposure Ratio	0.2480***	0.2885***	0.3282***	0.3671***	0.4052***
	(0.0810)	(0.0913)	(0.1014)	(0.1115)	(0.1215)
p-value	0.0033	0.0025	0.002	0.0017	0.0015
Observations	61	61	61	61	61
Adjusted R-squared	0.1423	0.1515	0.1589	0.1646	0.1686

As it can be seen from the regression results, income gap of banks does not have a significant explanatory power over the bond excess returns, whereas exposure ratio of banks does. Table 4.5 and 4.6[14] present the main findings regarding the estimation of equation (32). Table 4.5 shows that income gap is statistically significant at 90% to predict the bond excess returns at all maturities. The negative coefficients of income gap at all maturities are consistent with the assumptions of this study. As banks expect higher bond excess returns, they shift their portfolios into long-term assets and vice versa. As a result, when banks have higher income gaps, the bond excess returns should be lower, which is verified in Table 4.5. Except for 2-year maturity, income gap is statistically significant at

[14] More detailed versions of Table 4.5 and 4.6 can be found at the appendix.

95% at all maturities. In addition, the predictive power of income gap increases with maturity. However, as Table 4.6 shows, based on the adjusted R-squares, the predictive power of the exposure ratio (g_t) presents more robust results than the income gap at all maturities. Not only is exposure ratio statistically significant at 95% (it is statistically significant at 99% for bonds with maturities more than 3 years), but it also indicates higher explanatory power and more robust regression results compared to the income gap. Furthermore, the positive and increasing coefficients of exposure ratio at all maturities, are consistent with the assumptions of the model, which is also shown in section 4.2. As banks expect higher bond excess returns, they shift their portfolios into long-term assets and consequently they have higher exposure ratios and vice versa.

Why did exposure ratio provide better forecasting results compared to income gap? This is a hard issue to clarify, especially considering that both ratios show the difference between rate-sensitive assets and rate-sensitive liabilities. The only main difference between those ratios is one shows GAP by normalizing total assets, and the other by total equity. Those two ratios denote the same thing by different denominators. Furthermore, it would not be surprising to see that the correlation coefficient between income gap and -g_t is 0.9813, meaning that they almost perfectly move together. This relation is more evident in Figure 4.4, showing that they have been moving in the opposite directions very strongly. Having look at those issues, it is compelling to explain their different behaviours into explaining bond excess returns. The only plausible explanation behind that could be the composition of total assets and equities of banks in Turkey.

Considering the fluctuations in Turkish Lira (Figure 4.6) especially starting from 2012, normalizing bank gap by total assets might distort its forecasting power for Turkish government bond market due to the impact of FX-denominated assets (Figure 4.5) in banks' balance sheets. On the other hand, normalizing gap by

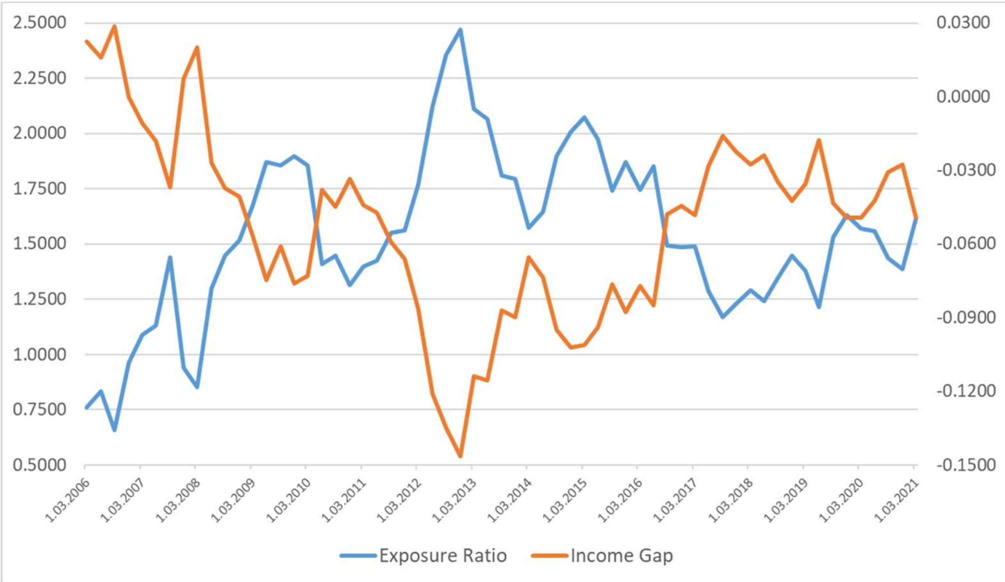


Figure 4.4: Income Gap and Exposure Ratio.

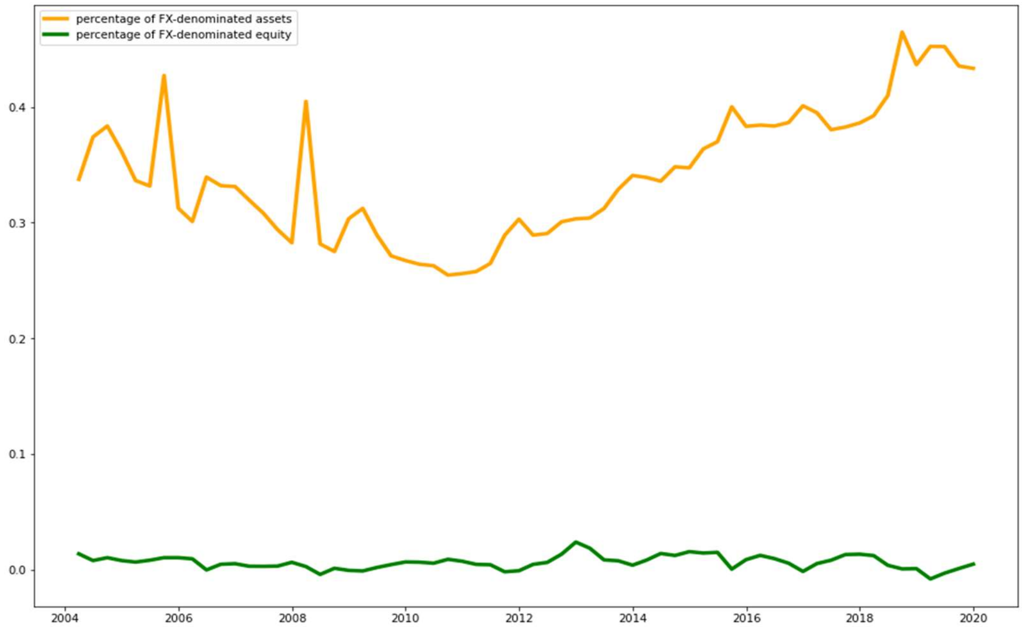


Figure 4.5: Percentage Evolution of FX-dominated assets and equity. This figure plots the time-series evolution of FX-denominated assets and equity portions of the consolidated banking system in Turkey. The data for this figure are obtained from “Banking Regulation and Supervision Agency” (Bankacılık Düzenleme ve Denetleme Kurumu). This figure shows a relatively strong FX-denomination in assets of the banks in Turkey whereas FX-denominated equity has been floating around 0 throughout the sample period of this study.

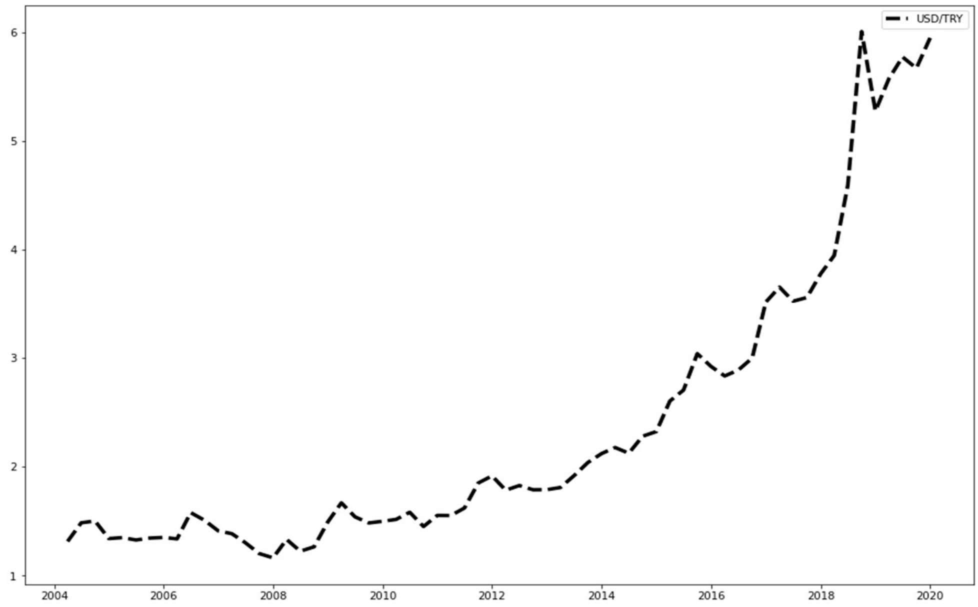


Figure 4.6: Evolution of USD/TRY

equity, like exposure ratio does, could yield better forecasting estimates considering the percentage of FX-denominated equity (Figure 4.5). FX-denominated assets floated around 0.3 and 0.5 throughout the sample period, but FX-denominated equity is close to 0 during this period. Since this study examines the bond excess behaviour of Turkish government zero-coupon bonds, it could be more meaningful to examine the relationship between bond excess returns and banking balance sheets from exposure ratio, that contains less exposure to movements in foreign exchanges. Thus, in the light of its higher forecasting power and the possible reason behind that, from now on, this study will follow exposure ratio (g_t) to forecast the bond excess returns.

The estimation results presented in Table 4.6 are worth examining. From the significance statistics, one can infer that exposure ratio is statistically significant at 95% (99% for bonds with maturities 4 or more years) to forecast bond excess returns at all maturities. In addition to this, the explanatory power of this ratio increases with maturity. Positive and increasing b^n (equation (32)) coefficients justify this significance economically from the discussion held throughout chapter 3. For example, $b^{(2)}$ is equal to 0.0757 and statistically significant with a p-value of 2.24%. One standard deviation increase in exposure ratio would correspond to

277 bps increase in excess returns of bonds with 2-year maturities. For bonds with 6-year maturities, $b^{(6)}$ is equal to 0.2480. and statistically significant with a p-value of 0.33%. One standard deviation increase in exposure ratio would correspond to 907 bps increase in excess returns of bonds with 6-year maturities. For bonds with 10-year maturities, $b^{(10)}$ is equal to 0.4052 and statistically significant with a p-value of 0.15%. One standard deviation increase in exposure ratio would correspond to 1,483 bps increase in excess returns of bonds with 10-year maturities. The adjusted R-squares range from 10% to 18% with an increasing predictive power as the bond maturity increases. Looking at these results, the sample data verifies that a higher exposure ratio can be associated with higher bond excess returns since banks (or investors) need to be compensated for shifting their portfolios from shorter-term assets to longer-term assets. The future expectations regarding higher bond risk premia could change banks' perspective into holding more long-term assets and when they do so, they tend to purchase more long-term Treasury securities. This would increase bond prices and as a result bond excess return. Also, one could also notice that the effect of holding more long-term assets is prevalent with bonds of higher maturities.

The equation (32) will be examined with macroeconomic variables that have potential to affect the Turkish government bond risk premia. Intuitively thinking, one might involve some macroeconomic variables to compare their forecasting powers compared to the forecasting power of the variable that is the scope of the study. However, this inclusion is beyond that reason. In Literature Review chapter, this study explained the potential effects of several macroeconomic variables into forecasting bond excess returns in several studies. In general, those studies showed that output gap and inflation (or expectations for inflation) seem to be the most prepotent variables to explain bond excess returns. As a result, it will be very beneficial to have a look at the possible effects of macroeconomic variables and compare these results to the effects of exposure ratio. Different from those studies, this study chooses to entertain the possibility that other macroeconomic indicators could affect bond risk premia[15]. Therefore, a lot of macroeconomic variables are regressed against bond excess returns based on (32) and those producing statistically insignificant results are omitted. The regression results with macroeconomic variables that could have statistical and/or economic significance are provided in this study. The macro variables, producing statistically and economically significant results, are output gap, rate of capacity utilization, real sector confidence index, industrial production, consumer price index, producer price index, consumer confidence index. The changes in these variables are separately regressed against bond excess returns at the same time horizon with exposure ratio for consistency. The results of these regressions are presented at the tables 4.7, 4.8, 4.9, 4.10, 4.11, 4.12 and 4.13[16].

Table 4.7: Output Gap and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on output gap of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Output gap corresponds to difference between actual GDP and potential GDP, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-value of the output gap, number of observations, adjusted R-squared, standard errors of the constant and output gap are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Data are obtained from Bloomberg terminal. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	0.0099	0.0075	0.0046	0.0016
	(0.0145)	(0.0212)	(0.0272)	(0.0327)
Output Gap	-0.9955***	-1.4746***	-1.8898***	-2.2548***
	(0.2843)	(0.4151)	(0.5298)	(0.6334)
p-value	0.0009	0.0008	0.0007	0.0007
Observations	61	61	61	61
Adjusted R-squared	0.1980	0.1992	0.1975	0.1935

[15] It should be noted that those studies either examine the relationship between bond excess returns and macroeconomic variables through factor models or explain yield curve factors through macroeconomic variables or factors composed of these variables. Similar with those studies, an extensive analysis of why or how each individual variable affects bond excess returns is beyond the scope of this study.

[16] More detailed versions of these tables can be found at the appendix.

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.0014	-0.0045	-0.0075	-0.0104	-0.0133
	(0.0380)	(0.0431)	(0.0482)	(0.9129)	(0.0582)
Output Gap	-2.5752***	-2.8557***	-3.1007***	-3.3147***	-3.5020***
	(0.7300)	(0.8225)	(0.9130)	(1.0031)	(1.0938)
p-value	0.0008	0.001	0.0012	0.0016	0.0022
Observations	61	61	61	61	61
Adjusted R-squared	0.1874	0.1794	0.1698	0.1592	0.1479

Table 4.8: Change in Capacity Utilization Rate and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on change in capacity utilization rate of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Capacity utilization rate corresponds to the realized portion of a country's potential output, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, change in capacity utilization rate, p-value of the change in capacity utilization rate, number of observations, adjusted R-squared, standard errors of the constant and change in capacity utilization rate are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Data are obtained from Bloomberg terminal. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	0.0168	0.0186	0.0195	0.0199
	(0.0179)	(0.0263)	(0.0338)	(0.0408)
Cap. Util. Rate	-0.4809	-0.6378	-0.7430	-0.8198
	(0.3889)	(0.5835)	(0.7667)	(0.9425)
p-value	0.2216	0.2792	0.3369	0.3883
Observations	61	61	61	61
Adjusted R-squared	0.0366	0.0266	0.0187	0.0127

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	0.0201	0.0200	0.0198	0.0194	0.0190
	(0.0474)	(0.0537)	(0.0598)	(0.0657)	(0.0715)
Cap. Util. Rate	-0.8805	-0.9314	-0.9759	-1.0158	-1.0522
	(1.1115)	(1.2739)	(1.4303)	(1.5818)	(1.7290)
p-value	0.4317	0.4678	0.498	0.5235	0.5454
Observations	61	61	61	61	61
Adjusted R-squared	0.0083	0.0049	0.0022	0.0000	-0.0019

Table 4.9: Change in Real Sector Confidence Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on change in real sector confidence index of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Real sector confidence index corresponds to the tendencies in the manufacturing industry based on the expectations of senior managers regarding their expectations for the industry, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, change in real sector confidence index, p-value of the change in real sector confidence index, number of observations, adjusted R-squared, standard errors of the constant and change in real sector confidence index are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Data are obtained from Bloomberg terminal. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	0.0112	0.0092	0.0068	0.0041
	(0.0168)	(0.0249)	(0.0321)	(0.0389)
Real Sec. Conf. Ind.	-0.1676	-0.2307	-0.2825	-0.3265
	(0.1414)	(0.2141)	(0.2790)	(0.3386)
p-value	0.2407	0.2856	0.3154	0.3388
Observations	61	61	61	61
Adjusted R-squared	0.0785	0.0660	0.0582	0.0523

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	0.0014	-0.0014	-0.0042	-0.0070	-0.0098
	(0.0451)	(0.0511)	(0.0569)	(0.0626)	(0.0681)
Real Sec. Conf. Ind.	-0.3639	-0.3956	-0.4221	-0.4444	-0.4630
	(0.3943)	(0.4470)	(0.4971)	(0.5453)	(0.5920)
p-value	0.3598	0.3798	0.3993	0.4184	0.4373
Observations	61	61	61	61	61
Adjusted R-squared	0.0471	0.0421	0.0373	0.0327	0.0282

Table 4.10: Industrial Production Growth and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on industrial production growth of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Industrial production growth measures the changes in price-adjusted output of the manufacturing industry, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, industrial production growth, p-value of the industrial production growth, number of observations, adjusted R-squared, standard errors of the constant and industrial production growth are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Data are obtained from Bloomberg terminal. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	0.0333*	0.0414*	0.0473	0.0516
	(0.0169)	(0.0243)	(0.0312)	(0.0381)
IP Growth	-0.4365***	-0.6331***	-0.7958***	-0.9327***
	(0.1361)	(0.2086)	(0.2751)	(0.3377)
p-value	0.0022	0.0036	0.0053	0.0076
Observations	61	61	61	61
Adjusted R-squared	0.2001	0.1924	0.1828	0.1722

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	0.0548	0.0569	0.0583	0.0591	0.0593
	(0.0450)	(0.0519)	(0.0589)	(0.0661)	(0.0733)
IP Growth	-1.0482**	-1.1453**	-1.2271**	-1.2961**	-1.3547**
	(0.3976)	(0.4556)	(0.5122)	(0.5679)	(0.6231)
p-value	0.0107	0.0147	0.0198	0.0261	0.0337
Observations	61	61	61	61	61
Adjusted R-squared	0.1609	0.1489	0.1367	0.1245	0.1127

Table 4.11: Change in Consumer Price Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on changes in consumer price index (CPI), with heteroskedasticity and autocorrelation consistent Newey-West estimator. CPI is a price index based on the prices of a weighted average basket of consumer goods and services, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, changes in CPI, p-value of the changes in CPI, number of observations, adjusted R-squared, standard errors of the constant and changes in CPI are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Data are obtained from Bloomberg terminal. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	-0.0542*	-0.0816*	-0.1013*	-0.1141
	(0.0276)	(0.0431)	(0.0572)	(0.0704)
CPI	0.6740**	0.9377**	1.1144**	1.2183*
	(0.2936)	(0.4310)	(0.5504)	(0.6558)
p-value	0.0253	0.0336	0.0474	0.0682
Observations	61	61	61	61
Adjusted R-squared	0.0586	0.0501	0.0402	0.0302

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.1211	-0.1229	-0.1203	-0.1140	-0.1045
	(0.0826)	(0.0940)	(0.1048)	(0.1151)	(0.1251)
CPI	1.2594*	1.2465	1.1877	1.0901	0.9602
	(0.7503)	(0.8365)	(0.9167)	(0.9927)	(1.0658)
p-value	0.0985	0.1415	0.2002	0.2766	0.3713
Observations	61	61	61	61	61
Adjusted R-squared	0.0205	0.0117	0.0041	-0.0023	-0.0074

Table 4.12: Change in Consumer Confidence Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on changes in consumer confidence index, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Consumer confidence index is an indicator for future developments of households' consumption and saving, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, changes in consumer confidence index, p-value of the changes in consumer confidence index, number of observations, adjusted R-squared, standard errors of the constant and changes in consumer confidence index are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Data are obtained from Bloomberg terminal. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	0.0015	-0.0039	-0.0090	-0.0138
	(0.0157)	(0.0238)	(0.0312)	(0.0380)
Cons. Conf. Ind.	-0.3295**	-0.4453*	-0.5344*	-0.6067
	(0.1528)	(0.2314)	(0.3036)	(0.3719)
p-value	0.0351	0.0591	0.0836	0.1081
Observations	61	61	61	61
Adjusted R-squared	0.1556	0.1276	0.1087	0.0947

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.0184	-0.0227	-0.0268	-0.0307	-0.0344
	(0.0444)	(0.0504)	(0.0562)	(0.0617)	(0.0671)
Cons. Conf. Ind.	-0.6668	-0.7177	-0.7611	-0.7985	-0.8310
	(0.4374)	(0.5010)	(0.5633)	(0.6247)	(0.6858)
p-value	0.1327	0.1573	0.1818	0.2062	0.2305
Observations	61	61	61	61	61
Adjusted R-squared	0.0835	0.0739	0.0655	0.0579	0.0511

Table 4.13: Change in Producer Price Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on changes in producer price index (PPI), with heteroskedasticity and autocorrelation consistent Newey-West estimator. PPI is a price index based on the prices of a weighted average basket of producer goods and services, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, changes in PPI, p-value of the changes in PPI, number of observations, adjusted R-squared, standard errors of the constant and changes in PPI are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	-0.0182	-0.0323	-0.0436	-0.0522
	(0.0193)	(0.0301)	(0.0403)	(0.0502)
PPI	0.2810*	0.3991*	0.4839	0.5401
	(0.1570)	(0.2299)	(0.2931)	(0.3500)
p-value	0.0787	0.0878	0.1041	0.1281
Observations	61	61	61	61
Adjusted R-squared	0.0526	0.0473	0.0401	0.0321

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.0584	-0.0623	-0.0643	-0.0647	-0.0637
	(0.0597)	(0.0689)	(0.0777)	(0.0863)	(0.0948)
PPI	0.5710	0.5799	0.5700	0.5442	0.5052
	(0.4024)	(0.4521)	(0.4999)	(0.5469)	(0.5935)
p-value	0.1612	0.2046	0.2589	0.3238	0.398
Observations	61	61	61	61	61
Adjusted R-squared	0.0238	0.0159	0.0087	0.0023	-0.0030

An extensive analysis of these tables would be beyond the scope of this study. Notwithstanding, from those tables, it is clear that capacity utilization rate, real sector confidence index and inflation variables do not have stronger statistical significance and explanatory power compared to exposure ratio. The macro variables output gap, industrial growth, and consumer confidence index, however, do possess statistical significance and stronger explanatory power over exposure ratio for shorter term maturities. Especially, output gap and industrial growth has strong in-sample forecasting power for the explanation of bond risk premia consistent with the findings of Fama and Bliss [24], Cooper and Priestley [15], Ludvingson and Ng [40] and Duffee [21]. On the other hand, exposure ratio is better in the explanation of bond excess returns for maturities 6 or more years.

It is noteworthy to mention that increasing economic activity could be associated with decreasing bond excess returns, observable especially in variables output gap, industrial production growth and consumer confidence index. For example, 1 standard deviation increase in output gap correspond to 397 bps, 1,028 bps and 1,397 bps decreases in excess returns for bonds with 2, 6 and 10 years maturities, respectively. On the other hand, increases in price levels could be attributed to increases in bond excess returns, observable in variables CPI and PPI.

One can infer this such that macroeconomic indicators themselves would be not enough for the analysis of bond excess returns. Exposure ratio should be included in this context.

As a result, this study extends equation (32) with the inclusion of macroeconomic indicators to exposure ratio as independent variables. Along with the exposure ratio, all macroeconomic variables presented above are regressed against the bond excess returns at maturities from 2 to 10 years. Among these variables, capacity utilization rate and real sector confidence index did not contribute to the regression results presented above. Only the results that have statistical and economic significance and contribute to the regression results presented before are included in this study. Also, it has been paid attention that macroeconomic variables that have comparatively higher correlation coefficients not placed together in the same regression to avoid multicollinearity. Therefore, this study presents the correlation matrix among the macroeconomic variables and output gap, which could be found at Table 4.14. Based on Table 4.14, it should be noted that the variable pairs industrial growth & output gap, real sector confidence index & capacity utilization rate, real sector confidence index & industrial growth, real sector confidence index & consumer confidence index, industrial growth & consumer confidence index, consumer price index & consumer confidence index and consumer price index & producer price index do show strong correlations and might cause multicollinearity when regressed together.

Table 4.14. Correlation Matrix among Variables

	Exposure Ratio	Cap. Util. Rate	Output Gap	Real Sector Conf. Index	IP Growth	CPI	Cons. Conf. Index	PPI
Exposure Ratio	1	-0.2865	0.2678	-0.3377	0.0628	-0.1477	-0.1450	-0.0335
Capacity Utillization Rate	-0.2864	1	0.1136	0.4669	0.3284	-0.0421	0.2596	0.0283
Output Gap	0.2678	0.1136	1	0.1626	0.5755	-0.2815	0.2819	-0.1210
Real Sector Confidence Index	-0.3377	0.4669	0.1626	1	0.6624	-0.2690	0.6379	-0.2263
Industrial Growth	0.0628	0.3284	0.5755	0.6624	1	-0.2498	0.4748	-0.0533
Consumer Price Index	-0.1477	-0.0421	-0.2815	-0.2690	-0.2498	1	-0.4141	0.8968
Consumer Confidence Index	-0.1450	0.2596	0.2819	0.6379	0.4748	-0.4141	1	-0.3351
Producer Price Index	-0.0335	0.0283	-0.1210	-0.2263	-0.0533	0.8968	-0.3351	1

Therefore, these pairs are not regressed together and other variable pairs and groups are regressed to see the forecasting power of variables over bond excess returns[17].

The regression results where the independent variables are output gap, with the inclusion of 1 or 2 macroeconomic variables, are presented in tables 4.15, 4.16, 4.17, 4.18, 4.19 and 4.20[18].

[17] It should be noted that this study also utilizes regressions with interaction term. However, with the inclusion of macroeconomic variables, those regressions did not produce statistically or economically significant results.
[18] More detailed versions of these tables can be found at the appendix.

Table 4.15: Exposure Ratio, Output Gap and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey and output gap of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, output gap is the difference between actual GDP and potential GDP, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-values of the exposure ratio and output gap, number of observations, adjusted R-squared, standard errors of the constant, exposure ratio and output gap are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Exposure ratio data is obtained from the website of "The Banks Association of Turkey" and remaining data are obtained from Bloomberg terminal. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	-0.1016**	-0.1713***	-0.2386***	-0.3048***
	(0.0427)	(0.0607)	(0.0753)	(0.0879)
Exposure Ratio	0.0726**	0.1165***	0.1584***	0.1996***
	(0.0275)	(0.0394)	(0.0493)	(0.0581)
Output Gap	-0.9761***	-1.4435***	-1.8476***	-2.2015***
	(0.2397)	(0.3350)	(0.4123)	(0.4774)
p-value (Exposure ratio)	0.0107	0.0045	0.0021	0.0011
p-value (Output gap)	0.0001	0.0001	0.0002	0.0002
Observations	61	61	61	61
Adjusted R-squared	0.2819	0.3006	0.3124	0.3204

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.3699***	-0.4338***	-0.4966***	-0.5582***	-0.6189***
	(0.0995)	(0.1109)	(0.1225)	(0.1346)	(0.1474)
Exposure Ratio	0.2400***	0.2797***	0.3186***	0.3568***	0.3945***
	(0.0664)	(0.0745)	(0.0827)	(0.0910)	(0.0996)
Output Gap	-2.5112***	-2.7811***	-3.0157***	-3.2195***	-3.3967***
	(0.5360)	(0.5925)	(0.6501)	(0.7109)	(0.7759)
p-value (Exposure ratio)	0.0006	0.0004	0.0003	0.0002	0.0002
p-value (Output gap)	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	61	61	61	61	61
Adjusted R-squared	0.3250	0.3261	0.3239	0.3190	0.3119

Table 4.16: Exposure Ratio, Industrial Production Growth and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey and industrial production growth of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, industrial production growth measures the changes in price-adjusted output of the manufacturing industry, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-values of the exposure ratio and industrial production growth, number of observations, adjusted R-squared, standard errors of the constant, exposure ratio and industrial production growth are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Exposure ratio data is obtained from the website of "The Banks Association of Turkey" and remaining data are obtained from Bloomberg terminal. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	-0.0751*	-0.1331**	-0.1909**	-0.2492***
	(0.0433)	(0.0603)	(0.0738)	(0.0853)
Exposure Ratio	0.0700**	0.1128***	0.1540***	0.1945***
	(0.0268)	(0.0378)	(0.0469)	(0.0548)
IP Growth	-0.4213***	-0.6086***	-0.7624***	-0.8906***
	(0.1198)	(0.1780)	(0.2300)	(0.2784)
p-value (Exposure ratio)	0.0115	0.0042	0.0017	0.0008
p-value (IP Growth)	0.0009	0.0012	0.0016	0.0022
Observations	61	61	61	61
Adjusted R-squared	0.2770	0.2863	0.2900	0.2915

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.3079***	-0.3666***	-0.4250***	-0.4831***	-0.5409***
	(0.0961)	(0.1069)	(0.1182)	(0.1302)	(0.1429)
Exposure Ratio	0.2345***	0.2738***	0.3125***	0.3505***	0.3880***
	(0.0624)	(0.0698)	(0.0775)	(0.0854)	(0.0937)
IP Growth	-0.9974***	-1.0860***	-1.1593***	-1.2201**	-1.2706**
	(0.3247)	(0.3701)	(0.4152)	(0.4604)	(0.5059)
p-value (Exposure ratio)	0.0004	0.0002	0.0002	0.0001	0.0001
p-value (IP Growth)	0.0032	0.0048	0.0071	0.0104	0.0148
Observations	61	61	61	61	61
Adjusted R-squared	0.2908	0.2881	0.2835	0.2773	0.2699

Table 4.17: Exposure Ratio, Changes in Consumer Confidence Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey and changes in consumer confidence index of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, consumer confidence index is an indicator for future developments of households' consumption and saving, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-values of the exposure ratio and changes in consumer confidence index, number of observations, adjusted R-squared, standard errors of the constant, exposure ratio and changes in consumer confidence index are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Exposure ratio data is obtained from the website of "The Banks Association of Turkey" and remaining data are obtained from Bloomberg terminal. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	-0.1067**	-0.1788**	-0.2481***	-0.3161***
	(0.0471)	(0.0699)	(0.0896)	(0.1073)
Exposure Ratio	0.0707**	0.1143***	0.1563***	0.1975***
	(0.0272)	(0.0403)	(0.0516)	(0.0620)
Cons. Conf. Ind.	-0.3166**	-0.4245*	-0.5059*	-0.5706
	(0.1464)	(0.2203)	(0.2873)	(0.3499)
p-value (Exposure ratio)	0.0120	0.0063	0.0037	0.0023
p-value (CCI)	0.0347	0.0589	0.0836	0.1084
Observations	61	61	61	61
Adjusted R-squared	0.2334	0.2232	0.2183	0.2167

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.3827***	-0.4480***	-0.5120***	-0.5747***	-0.6362***
	(0.1238)	(0.1397)	(0.1554)	(0.1710)	(0.1867)
Exposure Ratio	0.2380***	0.2779***	0.3170***	0.3554***	0.3932***
	(0.0719)	(0.0815)	(0.0911)	(0.1007)	(0.1103)
Cons. Conf. Ind.	-0.6234	-0.6669	-0.7032	-0.7336	-0.7592
	(0.4094)	(0.4667)	(0.5227)	(0.5777)	(0.6324)
p-value (Exposure ratio)	0.0016	0.0012	0.0010	0.0008	0.0007
p-value (CCI)	0.1333	0.1584	0.1837	0.2092	0.2348
Observations	61	61	61	61	61
Adjusted R-squared	0.2165	0.2164	0.2158	0.2143	0.2119

Table 4.18: Exposure Ratio, Output Gap, Consumer Price Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey, output gap of Turkey and changes in consumer price index (CPI) of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, output gap is the difference between actual GDP and potential GDP, CPI is a price index based on the prices of a weighted average basket of consumer goods, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-values of the exposure ratio, output gap and changes in CPI, number of observations, adjusted R-squared, standard errors of the constant, exposure ratio, output gap and changes in CPI are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Exposure ratio data is obtained from the website of "The Banks Association of Turkey" and remaining data are obtained from Bloomberg terminal. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	-0.1715***	-0.2690***	-0.3550***	-0.4323***
	(0.0447)	(0.0665)	(0.0856)	(0.1033)
Exposure Ratio	0.0792***	0.1257***	0.1694***	0.2116***
	(0.0276)	(0.0396)	(0.0496)	(0.0585)
Output Gap	-0.9032***	-1.3416***	-1.7261***	-2.0684***
	(0.2466)	(0.3587)	(0.4551)	(0.5396)
CPI	0.6286***	0.8790***	1.0476***	1.1477**
	(0.1981)	(0.2896)	(0.3716)	(0.4467)
p-value (Exposure ratio)	0.0057	0.0024	0.0012	0.0006
p-value (Output gap)	0.0005	0.0004	0.0004	0.0003
p-value (CPI)	0.0024	0.0036	0.0066	0.0128
Observations	61	61	61	61
Adjusted R-squared	0.3354	0.3476	0.3511	0.3506

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.5020***	-0.5649***	-0.6219***	-0.6738***	-0.7214***
	(0.1205)	(0.1378)	(0.1556)	(0.1741)	(0.1932)
Exposure Ratio	0.2525***	0.2920***	0.3304***	0.3677***	0.4041***
	(0.0670)	(0.0753)	(0.0837)	(0.0923)	(0.1013)
Output Gap	-2.3733***	-2.6443***	-2.8849***	-3.0989***	-3.2898***
	(0.6159)	(0.6868)	(0.7548)	(0.8216)	(0.8885)
CPI	1.1891**	1.1801**	1.1283*	1.0405	0.9228
	(0.5178)	(0.5880)	(0.6594)	(0.7333)	(0.8106)
p-value (Exposure ratio)	0.0004	0.0003	0.0002	0.0002	0.0002
p-value (Output gap)	0.0003	0.0003	0.0003	0.0004	0.0005
p-value (CPI)	0.0254	0.0495	0.0925	0.1614	0.2597
Observations	61	61	61	61	61
Adjusted R-squared	0.3467	0.3401	0.3312	0.3205	0.3087

Table 4.19: Exposure Ratio, Output Gap, Changes in Consumer Confidence Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey, output gap of Turkey and changes in consumer confidence index of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, output gap is the difference between actual GDP and potential GDP, consumer confidence index is an indicator for future developments of households' consumption and saving, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-values of the exposure ratio, output gap and changes in consumer confidence index, number of observations, adjusted R-squared, standard errors of the constant, exposure ratio, output gap and changes in consumer confidence index are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Exposure ratio data is obtained from the website of "The Banks Association of Turkey" and remaining data are obtained from Bloomberg terminal. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	-0.1027**	-0.1727***	-0.2402***	-0.3065***
	(0.0424)	(0.0618)	(0.0780)	(0.0922)
Exposure Ratio	0.0695**	0.1124***	0.1538***	0.1945***
	(0.0264)	(0.0384)	(0.0484)	(0.0572)
Output Gap	-0.7998***	-1.2184***	-1.5900***	-1.9208***
	(0.2399)	(0.3446)	(0.4308)	(0.5051)
Cons. Conf. Ind.	-0.2342*	-0.2991	-0.3422	-0.3729
	(0.1293)	(0.1958)	(0.2564)	(0.3135)
p-value (Exposure ratio)	0.0109	0.0049	0.0024	0.0012
p-value (Output gap)	0.0015	0.0008	0.0005	0.0004
p-value (CCI)	0.0754	0.1323	0.1873	0.2391
Observations	61	61	61	61
Adjusted R-squared	0.3523	0.3504	0.3494	0.3487

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.3717***	-0.4357***	-0.4986***	-0.5603***	-0.6210***
	(0.1055)	(0.1184)	(0.1314)	(0.1448)	(0.1587)
Exposure Ratio	0.2347***	0.2741***	0.3128***	0.3509***	0.3885***
	(0.0655)	(0.0735)	(0.0814)	(0.0895)	(0.0978)
Output Gap	-2.2134***	-2.4705***	-2.6952***	-2.8913***	-3.0625***
	(0.5739)	(0.6424)	(0.7138)	(0.7903)	(0.8726)
Cons. Conf. Ind.	-0.3955	-0.4126	-0.4258	-0.4360	-0.4440
	(0.3685)	(0.4227)	(0.4766)	(0.5310)	(0.5860)
p-value (Exposure ratio)	0.0008	0.0005	0.0004	0.0003	0.0002
p-value (Output gap)	0.0007	0.0004	0.0003	0.0002	0.0002
p-value (CCI)	0.2877	0.3331	0.3755	0.4150	0.4518
Observations	61	61	61	61	61
Adjusted R-squared	0.3468	0.3429	0.3367	0.3509	0.3184

Table 4.20: Exposure Ratio, Output Gap, Producer Price Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey, output gap of Turkey and changes in producer price index (PPI) of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, output gap is the difference between actual GDP and potential GDP, PPI is a price index based on the prices of a weighted average basket of producer goods, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-values of the exposure ratio, output gap and changes in PPI, number of observations, adjusted R-squared, standard errors of the constant, exposure ratio, output gap and changes in PPI are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Exposure ratio data is obtained from the website of "The Banks Association of Turkey" and remaining data are obtained from Bloomberg terminal. A more detailed version of this table can be found at the Appendix.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
Constant	-0.1361***	-0.2206***	-0.2990***	-0.3729***
	(0.0424)	(0.0616)	(0.0781)	(0.0932)
Exposure Ratio	0.0743***	0.1189***	0.1614***	0.2029***
	(0.0271)	(0.0387)	(0.0484)	(0.0570)
Output Gap	-1.0139***	-1.4976***	-1.9137***	-2.2761***
	(0.2235)	(0.3271)	(0.4182)	(0.4999)
PPI	0.3197***	0.4572***	0.5593***	0.6311***
	(0.0965)	(0.1416)	(0.1865)	(0.2326)
p-value (Exposure ratio)	0.0082	0.0033	0.0015	0.0008
p-value (Output gap)	0	0	0	0
p-value (PPI)	0.0016	0.0021	0.004	0.0088
Observations	61	61	61	61
Adjusted R-squared	0.3620	0.3753	0.3789	0.3775

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	- 0.4428***	- 0.5091***	- 0.5720***	- 0.6320***	- 0.6895***
	(0.1078)	(0.1225)	(0.1377)	(0.1534)	(0.1698)
Exposure Ratio	0.2436***	0.2834***	0.3223***	0.3605***	0.3979***
	(0.0651)	(0.0732)	(0.0813)	(0.0898)	(0.0986)
Output Gap	- 2.5911***	- 2.8636***	- 3.0984***	- 3.3004***	- 3.4741***
	(0.5754)	(0.6469)	(0.7166)	(0.7859)	(0.8559)
PPI	0.6761**	0.6977**	0.6993*	0.6840	0.6545
	(0.2801)	(0.3293)	(0.3802)	(0.4325)	(0.4863)
p-value (Exposure ratio)	0.0004	0.0003	0.0002	0.0002	0.0002
p-value (Output gap)	0	0	0.0001	0.0001	0.0002
p-value (PPI)	0.019	0.0385	0.0711	0.1193	0.1837
Observations	61	61	61	61	61
Adjusted R-squared	0.3721	0.3633	0.3518	0.3385	0.3240

From those tables, it could be observed that the inclusion of the macroeconomic variables does not have a significant effect on the b^n estimations of the exposure ratio based on (32). The coefficients of exposure ratio are positive and increasing with the maturity, along with having similar estimates while macroeconomic indicators are included. However, the predictive power of regressions changes dramatically with the inclusion of some macroeconomic variables. The addition of output gap into the regression boosts to the adjusted R-squared to an average of 31.35%. With the inclusion of industrial production growth, the adjusted R-squared has an average of 28.38%. Considering the average R-squared number of exposure ratio – 15.10% – the inclusion of output gap provides significant contributions to regressions forecasting bond excess returns. Except for 2-year bonds, where the exposure ratio is significant at 95%, both exposure ratio and output gap have statistical significance at 99% and the F-statistic of that regression is significant even at 99.99%. The AIC number presents more robust results compared to only including exposure ratio. Even though the inclusion of industrial growth or consumer confidence index provide better results, output gap is the most contributive in-sample forecasting macro variable in terms of the explanation of bond excess returns.

In addition to output gap, the inclusion of CPI, PPI or consumer confidence index slightly improves the predictive power of the regression results. Especially, the inclusion of PPI to the exposure ratio and output gap will provide an average adjusted R-square of 36.04% and present better AIC number compared to including only exposure ratio and output gap. However, the statistical significance of PPI decreases below 95% for bond maturities from 8 years. Yet, the F-statistic of that regression is significant even at 99.99%.

From the regression results, macroeconomic indicators may be considered as confounding variables. However, upon adjusting these indicators, neither the association between bond excess returns and exposure ratio alters significantly, considering the changes in b^n estimations, nor does exposure ratio’s positive and increasing behaviour display any irregularities. On the other hand, Table 4.14 shows the correlation coefficients among variables. By looking at these correlations, exposure ratio exhibits a weak linear correlation with these variables. Unfortunately, there has not been any literature examining the relationship between banking GAP and macroeconomic indicators. Thus, in the light of regressions results and relation among variables, there is no significant evidence that macroeconomic variables cause a spurious association between bond excess returns and exposure ratio.

4.4. Out-of-Sample Forecasts

The discussion in the previous section has been about the in-sample forecasting results of bond excess returns over income gap, exposure ratio, macroeconomic variables, and their combinations. The out-of-sample forecasting results should also be introduced within this context to better understand the predictive power of those variables explaining bond excess returns. A widely used measure (or loss function) in literature is root mean squared error (RMSE) and this study calculates RMSE for bond excess returns to analyze the out-of-sample forecasting accuracy.

RMSE measures the differences between predicted values of the model and values observed. It shows how related a fitted line to the data points. It is calculated as follows:

$$RMSE = \sqrt{\frac{\sum[(realization\ at\ t+h)-(forecast\ for\ t+h\ at\ t)]^2}{number\ of\ forecasts}} \quad (33)$$

In the formula (33), h refers to the number of periods ahead for forecasting. In other words, “t+h” shows the estimation point compared to the time t. For example, if h equals 1, this means that the forecasts are made for 1 period ahead. In line with the in-sample regressions, at which the independent variables 4 quarters before the dependent variables, this study will utilize “h” as 4 based on the strong forecasting power of variables by 4 quarters. The forecasting period, on the other hand, will be 20 periods. Considering the sample period of this study is 61 in total, selecting 20 as the forecasting period will be reasonable.

Generally, while conducting RMSE analysis, researchers often choose a benchmark variable to assess the comparative forecasting power of variables. Autoregressive (AR) models are a good choice in that respect and AR (4) is selected for this study.

The results of RMSEs of variables are presented in Table 4.21. Compatible with the previous section, exposure ratio, output gap, industrial production, real sector confidence index, consumer price index, consumer confidence index, producer price index and their combinations are selected as forecasting variables.

Table 23 shows outperformance of exposure ratio and macro variables compared to the autoregressive models. For one independent variable regressions, consumer confidence index and exposure ratio indicate strong out-of-sample forecasting powers. Between 2- and 6-year bond excess returns, consumer confidence index yields the highest forecasting results compared to the other variables, while between 7- and 10-year bond excess returns, exposure ratio is the strongest forecasting variable. This manifests that not only does exposure ratio show strong forecasting power in sample, but it also succeeds great performance out-of-sample, compared to the other macroeconomic variables. In addition, industrial growth also presentssignificant estimation results compared to the other macroeconomic variables. For two variable regression models, exposure ratio, along with the macro variables industrial growth and consumer confidence index, provides significant estimationresults. Especially, exposure ratio and industrial growth together accomplishes, on average, 21.75% better forecasting results compared to the autoregressive models. These two ratios together show the best forecasting combinations (except for 2-year bonds) among all variables. For three variable regression models, exposure ratio, output gap and consumer confidence index together yield the best estimation results. However, it should be noted that their predictive success is smaller than exposure ratio and industrial growth (or consumer confidence index). Thus, 2-variable regression models provide better forecasting results compared to the 1- and 3-varible regression models. Also, it should be noted that as the bond maturity increases, RMSE scores increase for all variables (with their combinations). This points weaker estimation success for bond excess returns as the maturity increases.

Table 4.21: Root Mean Squared Error Numbers. This table shows the root mean squared error (RMSE) numbers of the out-of-sample regression results of Turkish government bond excess returns on various variables. The numbers corresponding to AR(4) row are the absolute RMSEs. Numbers in other rows are stated as a percentage of AR(4) for their corresponding columns. Therefore, a value less than 1 indicates better forecasting performance compared to AR(4) and a value more than 1 means poorer forecasting performance compared to AR(4).

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$
AR (4)	0.0972	0.1379	0.1701	0.1957
g(t) (Exposure Ratio)	0.9410	0.9337	0.9274	0.9191
Output Gap	1.0171	1.0138	1.0141	1.0159
CUR (Capacity Util. Rate)	1.0177	1.0160	1.0147	1.0124
RSCI (Real Sec. Conf. Ind.)	0.9584	0.9579	0.9570	0.9545
IP (Ind. Production Growth)	0.9259	0.9227	0.9217	0.9211
CPI	0.9804	0.9711	0.9700	0.9724
CCI (Cons. Conf. Ind.)	**0.9032**	**0.9068**	**0.9083**	**0.9068**
PPI	0.9655	0.9701	0.9797	0.9907
g(t) & Output Gap	0.9422	0.9306	0.9246	0.9200
g(t) & IP	0.8554	**0.8436**	**0.8360**	**0.8284**
g(t) & CCI	**0.8446**	0.8450	0.8447	0.8415
g(t) & Output Gap & CPI	0.9537	0.9376	0.9335	0.9346
g(t) & Output Gap & CCI	**0.8757**	**0.8720**	**0.8720**	**0.8723**
g(t) & Output Gap & PPI	0.9773	0.9729	0.9795	0.9907

	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
AR (4)	0.2163	0.2333	0.2477	0.2605	0.2724
g(t) (Exposure Ratio)	0.9089	**0.8972**	**0.8847**	**0.8719**	**0.8598**
Output Gap	1.0185	1.0217	1.0257	1.0305	1.0362
CUR (Capacity Util. Rate)	1.0088	1.0040	0.9983	0.9920	0.9854
RSCI (Real Sec. Conf. Ind.)	0.9507	0.9461	0.9411	0.9362	0.9317
IP (Ind. Production Growth)	0.9204	0.9200	0.9199	0.9204	0.9218
CPI	0.9760	0.9797	0.9828	0.9847	0.9850
CCI (Cons. Conf. Ind.)	**0.9029**	0.8975	0.8913	0.8851	0.8795
PPI	1.0019	1.0125	1.0220	1.0301	1.0363
g(t) & Output Gap	0.9159	0.9126	0.9103	0.9095	0.9106
g(t) & IP	**0.8205**	**0.8126**	**0.8054**	**0.7994**	**0.7952**
g(t) & CCI	0.8359	0.8290	0.8217	0.8150	0.8096
g(t) & Output Gap & CPI	0.9378	0.9417	0.9453	0.9481	0.9496
g(t) & Output Gap & CCI	**0.8727**	**0.8736**	**0.8757**	**0.8794**	**0.8852**
g(t) & Output Gap & PPI	1.0039	1.0177	1.0314	1.0444	1.0560

From the discussion in this chapter, it is obvious that exposure ratio is a good estimator of bond excess returns both in in-sample and out-of-sample forecasts. The assumptions of the theoretical framework hold and exposure ratio (in other words, gap analysis) increases the quality of studies in the examination of bond risk premia in Turkish government bond markets.

Now, this study will be finished by the concluding remarks.

CHAPTER 5

CONCLUDING REMARKS

Banks could be considered as marginal and sophisticated investors of the financial markets. This is evident by examination of government bond excess returns in United States, based on the Haddad and Sraer [30]. This study extends this analysis to Turkish government bond markets, constituting almost 89% of the bond market in Turkey. Income gap, rate-sensitive assets minus rate-sensitive liabilities normalized by total assets, is a strong forecasting power over government bond risk premia, shown by Haddad and Sraer [30]. However, this is not the case for Turkish government bond market since FX-denominated bank assets have a significant portion on bank assets. Instead, exposure ratio, rate-sensitive assets minus rate-sensitive liabilities normalized by total equity, is a better forecasting variable for Turkish government bond market as the FX-denominated equity in Turkish banks is negligible. Therefore, this study follows exposure ratio as the main forecasting variable over bond excess returns.

After the introduction, this study started with the related literature of bond excess returns, the effect on financial intermediaries on excess returns and income gap. Bond excess returns have been explained by three main dimensions – outlook of the yield curve, changes in several macroeconomic indicators and supply conditions of Treasury market. The effect on financial intermediaries on risk premia has been mainly observed on the equity markets, thus it lacks the bond market. Income gap has a relatively newer topic in research and has been examined by a few studies.

Upon literature review, this study presented the basics of banking financial statement components and the calculations of yield curve and bond excess returns.

Nelson-Siegel framework has been utilized to calculate the government bond yields. After that, theoretical framework is presented by relating the interest rate risk of banks to the market price of the risk. This theoretical framework is based on the studies Greenwood and Vayanos [29] and Haddad and Sraer [30].

This study then presented the findings of the model and regression results. It should be noted that all the assumptions of the theoretical framework hold. Also, this study runs regressions of one-year excess returns on government bonds on the income gap, exposure ratio, several macroeconomic variables and their combinations. The sample period is from the second quarter of 2006 and first quarter of 2021, mainly due to the data availability.

According to the forecasting results, exposure ratio provides explanatory power over bond excess returns, especially for longer maturities. On the other hand, output gap and industrial growth present strong in-sample forecasting power for shorter-term maturities. The inclusion of macroeconomic variables into the regression along with exposure ratio increases the predictive power of the regressions for the explanation of bond excess returns. Output gap is the most contributive in-sample forecasting macro variable in terms of the explanation of bond excess returns. Together with output gap and exposure ratio, the inclusion of consumer price index (CPI), producer price index (PPI) or consumer confidence index improves the statistical and economic significance of in-sample regression results.

For out-of sample forecasting, exposure ratio (for longer maturities) and consumer confidence index (for shorter maturities) provide better results for single variable regressions. For two-variable regressions, exposure ratio and industrial growth provide better forecasting and for three-variable regressions, exposure ratio, output gap and consumer confidence index provide better forecasting results.

This study showed the significance of banking system in Turkey in the government bond markets. It should be noted that Haddad and Sraer [30] conducted an enlightening study by observing the banks as marginal investors which could have strong effects on bond markets. Further studies could be developed for financial markets in Turkey with that respect. For example, the effect of banks and/or other financial intermediaries could be examined for excess returns of stock markets. Moreover, by having a glance at the fluctuations of Turkish Lira (Figure 8), researchers could also focus on the effects of banks on FX excess returns in Turkey, considering the fact that banks regularly report their FX-denominated assets position on their balance sheets. The theoretical framework presented in this study could be instructive to study those effects.

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APPENDIX

Table A.1: Income Gap and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on income gap of banks in Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Income gap corresponds to the asset-weighted income gap of banks, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-value of the income gap, number of observations, adjusted R-squared, standard errors of the constant and income gap are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.01	-0.03	-0.05	-0.07	-0.09	-0.11*	-0.13*	-0.15*	-0.17**
	(0.023)	(0.033)	(0.042)	(0.049)	(0.056)	(0.062)	(0.068)	(0.074)	(0.081)
Income Gap	-0.47*	-0.81**	-1.15**	-1.48**	-1.81***	-2.14***	-2.46***	-2.77***	-3.08***
	(0.2517)	(0.3717)	(0.4756)	(0.5703)	(0.6595)	(0.7458)	(0.8312)	(0.9167)	(1.0034)
p-value (Income gap)	0.0651	0.0329	0.019	0.0118	0.0079	0.0057	0.0045	0.0037	0.0032
p-value (F-statistic)	0.1055	0.0589	0.0374	0.0253	0.0179	0.0134	0.0105	0.0086	0.0075
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.0438	0.0592	0.0713	0.0820	0.0913	0.0993	0.1059	0.1112	0.1152
Adjusted R-squared	0.0276	0.0432	0.0556	0.0664	0.0759	0.0840	0.0908	0.0961	0.1002
Akaike info criterion	-2.0550	-1.2913	-0.7998	-0.4395	-0.1546	0.0834	0.2906	0.4769	0.6482
Schwarz criterion	-1.9858	-1.2221	-0.7306	-0.3703	-0.0853	0.1526	0.3598	0.5461	0.7174
Hannan-Quinn criter.	-2.0279	-1.2642	-0.7727	-0.4124	-0.1274	0.1105	0.3177	0.5040	0.6754
Durbin-Watson stat	0.5218	0.5345	0.5470	0.5628	0.5843	0.6135	0.6513	0.6971	0.7496

Table A.2: Exposure Ratio and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, exposure ratio, p-value of the exposure ratio, number of observations, adjusted R-squared, standard errors of the constant and exposure ratio are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.11**	-0.18**	-0.25***	-0.32***	-0.38***	-0.45***	-0.51***	-0.57***	-0.64***
	(0.049)	(0.071)	(0.090)	(0.106)	(0.121)	(0.135)	(0.150)	(0.164)	(0.178)
Exposure Ratio	0.08**	0.12**	0.16***	0.21***	0.25***	0.29***	0.33***	0.37***	0.41***
	(0.032)	(0.047)	(0.059)	(0.070)	(0.081)	(0.091)	(0.101)	(0.112)	(0.122)
p-value (Exposure ratio)	0.0224	0.012	0.0072	0.0047	0.0033	0.0025	0.002	0.0017	0.0015
p-value (F-statistic)	0.0118	0.0062	0.0037	0.0024	0.0016	0.0011	0.0009	0.0007	0.0006
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.1028	0.1204	0.1340	0.1460	0.1566	0.1656	0.1729	0.1785	0.1825
Adjusted R-squared	0.0876	0.1055	0.1193	0.1315	0.1423	0.1515	0.1589	0.1646	0.1686
Akaike info criterion	-2.1187	-1.3586	-0.8696	-0.5118	-0.2291	0.0070	0.2127	0.3981	0.5692
Schwarz criterion	-2.0495	-1.2894	-0.8004	-0.4426	-0.1599	0.0762	0.2819	0.4673	0.6384
Hannan-Quinn criter.	-2.0916	-1.3314	-0.8425	-0.4846	-0.2020	0.0341	0.2398	0.4252	0.5963
Durbin-Watson stat	0.5537	0.5713	0.5855	0.6014	0.6224	0.6510	0.6882	0.7338	0.7864

Table A.3: Output Gap and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on output gap of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Output gap corresponds to difference between actual GDP and potential GDP, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-value of the output gap, number of observations, adjusted R-squared, standard errors of the constant and output gap are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Data are obtained from Bloomberg terminal.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	0.01	0.01	0.00	0.00	-0.00	-0.00	-0.01	-0.01	-0.01
	(0.015)	(0.021)	(0.027)	(0.033)	(0.038)	(0.043)	(0.048)	(0.913)	(0.058)
Output Gap	-1.00***	-1.47***	-1.89***	-2.25***	-2.58***	-2.86***	-3.10***	-3.31***	-3.50***
	(0.284)	(0.415)	(0.530)	(0.633)	(0.730)	(0.823)	(0.913)	(1.003)	(1.094)
p-value	0.0009	0.0008	0.0007	0.0007	0.0008	0.001	0.0012	0.0016	0.0022
p-value (F-statistic)	0.0002	0.0002	0.0002	0.0002	0.0003	0.0004	0.0006	0.0009	0.0013
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.2114	0.2126	0.2108	0.2069	0.2009	0.1931	0.1837	0.1732	0.1621
Adjusted R-squared	0.1980	0.1992	0.1975	0.1935	0.1874	0.1794	0.1698	0.1592	0.1479
Akaike info criterion	-2.2476	-1.4693	-0.9626	-0.5858	-0.2831	-0.0265	0.1996	0.4045	0.5937
Schwarz criterion	-2.1784	-1.4001	-0.8934	-0.5166	-0.2139	0.0427	0.2689	0.4737	0.6629

Table A.4: Change in Capacity Utilization Rate and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on change in capacity utilization rate of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Capacity utilization rate corresponds to the realized portion of a country's potential output, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, change in capacity utilization rate, p-value of the change in capacity utilization rate, number of observations, adjusted R-squared, standard errors of the constant and change in capacity utilization rate are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Data are obtained from Bloomberg terminal.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	(0.018)	(0.026)	(0.034)	(0.041)	(0.047)	(0.054)	(0.060)	(0.066)	(0.072)
Cap. Util. Rate	-0.48	-0.64	-0.74	-0.82	-0.88	-0.93	-0.98	-1.02	-1.05
	(0.389)	(0.584)	(0.767)	(0.943)	(1.112)	(1.274)	(1.430)	(1.582)	(1.729)
p-value	0.2216	0.2792	0.3369	0.3883	0.4317	0.4678	0.498	0.5235	0.5454
p-value (F-statistic)	0.0846	0.1195	0.1584	0.1967	0.2321	0.2645	0.2943	0.3220	0.3480
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.0541	0.0443	0.0365	0.0307	0.0263	0.0230	0.0203	0.0182	0.0163
Adjusted R-squared	0.0366	0.0266	0.0187	0.0127	0.0083	0.0049	0.0022	0.0000	-0.0019
Akaike info criterion	-2.0934	-1.3190	-0.8116	-0.4352	-0.1352	0.1161	0.3348	0.5305	0.7095
Schwarz criterion	-2.0210	-1.2466	-0.7393	-0.3628	-0.0629	0.1885	0.4071	0.6029	0.7818

Table A.5: Change in Real Sector Confidence Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on change in real sector confidence index of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Real sector confidence index corresponds to the tendencies in the manufacturing industry based on the expectations of senior managers regarding their expectations for the industry, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, change in real sector confidence index, p-value of the change in real sector confidence index, number of observations, adjusted R-squared, standard errors of the constant and change in real sector confidence index are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Data are obtained from Bloomberg terminal.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	0.01	0.01	0.01	0.00	0.00	-0.00	-0.00	-0.01	-0.01
	(0.017)	(0.025)	(0.032)	(0.039)	(0.045)	(0.051)	(0.057)	(0.063)	(0.068)
Real Sec. Conf. Ind.	-0.17	-0.23	-0.28	-0.33	-0.36	-0.40	-0.42	-0.44	-0.46
	(0.141)	(0.214)	(0.279)	(0.339)	(0.394)	(0.447)	(0.497)	(0.545)	(0.592)
p-value	0.2407	0.2856	0.3154	0.3388	0.3598	0.3798	0.3993	0.4184	0.4373
p-value (F-statistic)	0.0163	0.0256	0.0341	0.0423	0.0512	0.0613	0.0732	0.0871	0.1029
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.0939	0.0816	0.0739	0.0681	0.0629	0.0581	0.0534	0.0488	0.0444
Adjusted R-squared	0.0785	0.0660	0.0582	0.0523	0.0471	0.0421	0.0373	0.0327	0.0282
Akaike info criterion	-2.1088	-1.3154	-0.8025	-0.4244	-0.1238	0.1282	0.3477	0.5447	0.7252
Schwarz criterion	-2.0396	-1.2462	-0.7333	-0.3552	-0.0546	0.1974	0.4169	0.6139	0.7944

Table A.6: Industrial Production Growth and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on industrial production growth of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Industrial production growth measures the changes in price-adjusted output of the manufacturing industry, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, industrial production growth, p-value of the industrial production growth, number of observations, adjusted R-squared, standard errors of the constant and industrial production growth are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Data are obtained from Bloomberg terminal.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	0.03*	0.04*	0.05	0.05	0.06	0.06	0.06	0.06	0.06
	(0.017)	(0.024)	(0.031)	(0.038)	(0.045)	(0.052)	(0.059)	(0.066)	(0.073)
IP Growth	-0.44***	-0.63***	-0.80***	-0.93***	-1.05**	-1.15**	-1.23**	-1.30**	-1.35**
	(0.136)	(0.209)	(0.275)	(0.338)	(0.398)	(0.456)	(0.512)	(0.568)	(0.623)
p-value	0.0022	0.0036	0.0053	0.0076	0.0107	0.0147	0.0198	0.0261	0.0337
p-value (F-statistic)	0.0002	0.0002	0.0003	0.0005	0.0008	0.0012	0.0020	0.0031	0.0047
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.2134	0.2058	0.1964	0.1860	0.1749	0.1631	0.1511	0.1391	0.1275
Adjusted R-squared	0.2001	0.1924	0.1828	0.1722	0.1609	0.1489	0.1367	0.1245	0.1127
Akaike info criterion	-2.2503	-1.4608	-0.9444	-0.5598	-0.2510	0.0099	0.2388	0.4449	0.6343
Schwarz criterion	-2.1811	-1.3916	-0.8752	-0.4906	-0.1818	0.0791	0.3080	0.5142	0.7035

Table A.7: Consumer Price Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on changes in consumer price index (CPI), with heteroskedasticity and autocorrelation consistent Newey-West estimator. CPI is a price index based on the prices of a weighted average basket of consumer goods and services, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, changes in CPI, p-value of the changes in CPI, number of observations, adjusted R-squared, standard errors of the constant and changes in CPI are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Data are obtained from Bloomberg terminal.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.05*	-0.08*	-0.10*	-0.11	-0.12	-0.13	-0.12	-0.11	-0.10
	(0.028)	(0.043)	(0.057)	(0.070)	(0.083)	(0.094)	(0.105)	(0.115)	(0.125)
CPI	0.67**	0.94**	1.11**	1.22*	1.26*	1.25	1.19	1.09	0.96
	(0.294)	(0.431)	(0.550)	(0.656)	(0.750)	(0.837)	(0.917)	(0.993)	(1.066)
p-value	0.0253	0.0336	0.0474	0.0682	0.0985	0.1415	0.2002	0.2766	0.3713
p-value (F-statistic)	0.0335	0.0458	0.0657	0.0957	0.1383	0.1957	0.2690	0.3575	0.4585
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.0743	0.0659	0.0562	0.0463	0.0369	0.0282	0.0207	0.0144	0.0093
Adjusted R-squared	0.0586	0.0501	0.0402	0.0302	0.0205	0.0117	0.0041	-0.0023	-0.0074
Akaike info criterion	-2.0874	-1.2985	-0.7837	-0.4014	-0.0963	0.1594	0.3817	0.5802	0.7612
Schwarz criterion	-2.0182	-1.2293	-0.7145	-0.3322	-0.0271	0.2286	0.4509	0.6495	0.8304

Table A.8: Change in Consumer Confidence Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on changes in consumer confidence index, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Consumer confidence index is an indicator for future developments of households' consumption and saving, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, changes in consumer confidence index, p-value of the changes in consumer confidence index, number of observations, adjusted R-squared, standard errors of the constant and changes in consumer confidence index are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Data are obtained from Bloomberg terminal.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	0.00	-0.00	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03	-0.03
	(0.016)	(0.024)	(0.031)	(0.038)	(0.044)	(0.050)	(0.056)	(0.062)	(0.067)
Cons. Conf. Ind.	-0.33**	-0.45*	-0.53*	-0.61	-0.67	-0.72	-0.76	-0.80	-0.83
	(0.153)	(0.231)	(0.304)	(0.372)	(0.437)	(0.501)	(0.563)	(0.625)	(0.686)
p-value	0.0351	0.0591	0.0836	0.1081	0.1327	0.1573	0.1818	0.2062	0.2305
p-value (F-statistic)	0.0010	0.0027	0.0055	0.0091	0.0137	0.0193	0.0261	0.0344	0.0441
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.1697	0.1421	0.1235	0.1098	0.0987	0.0894	0.0811	0.0737	0.0669
Adjusted R-squared	0.1556	0.1276	0.1087	0.0947	0.0835	0.0739	0.0655	0.0579	0.0511
Akaike info criterion	-2.1961	-1.3836	-0.8577	-0.4703	-0.1627	0.0944	0.3180	0.5182	0.7014
Schwarz criterion	-2.1269	-1.3144	-0.7885	-0.4010	-0.0935	0.1636	0.3872	0.5874	0.7706

Table A.9: Producer Price Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on changes in producer price index (PPI), with heteroskedasticity and autocorrelation consistent Newey-West estimator. PPI is a price index based on the prices of a weighted average basket of producer goods and services, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, changes in PPI, p-value of the changes in PPI, number of observations, adjusted R-squared, standard errors of the constant and changes in PPI are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Data are obtained from Bloomberg terminal.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.02	-0.03	-0.04	-0.05	-0.06	-0.06	-0.06	-0.06	-0.06
	(0.019)	(0.030)	(0.040)	(0.050)	(0.060)	(0.069)	(0.078)	(0.086)	(0.095)
PPI	0.28*	0.40*	0.48	0.54	0.57	0.58	0.57	0.54	0.51
	(0.157)	(0.230)	(0.293)	(0.350)	(0.402)	(0.452)	(0.500)	(0.547)	(0.594)
p-value	0.0787	0.0878	0.1041	0.1281	0.1612	0.2046	0.2589	0.3238	0.398
p-value (F-statistic)	0.0418	0.0507	0.0661	0.0892	0.1218	0.1657	0.2218	0.2901	0.3691
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.0684	0.0632	0.0561	0.0482	0.0401	0.0323	0.0252	0.0189	0.0137
Adjusted R-squared	0.0526	0.0473	0.0401	0.0321	0.0238	0.0159	0.0087	0.0023	-0.0030
Akaike info criterion	-2.0810	-1.2956	-0.7835	-0.4034	-0.0997	0.1552	0.3771	0.5756	0.7568
Schwarz criterion	-2.0118	-1.2264	-0.7143	-0.3341	-0.0305	0.2244	0.4463	0.6448	0.8260

Table A.10: Exposure Ratio, Output Gap and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey and output gap of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, output gap is the difference between actual GDP and potential GDP, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-values of the exposure ratio and output gap, number of observations, adjusted R-squared, standard errors of the constant, exposure ratio and output gap are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Exposure ratio data is obtained from the website of "The Banks Association of Turkey" and remaining data are obtained from Bloomberg terminal.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.10**	-0.17***	-0.24***	-0.30***	-0.37***	-0.43***	-0.50***	-0.56***	-0.62***
	(0.043)	(0.061)	(0.075)	(0.088)	(0.100)	(0.111)	(0.123)	(0.135)	(0.147)
Exposure Ratio	0.07**	0.12***	0.16***	0.20***	0.24***	0.28***	0.32***	0.36***	0.39***
	(0.028)	(0.039)	(0.049)	(0.058)	(0.066)	(0.075)	(0.083)	(0.091)	(0.100)
Output Gap	-0.98***	-1.44***	-1.85***	-2.20***	-2.51***	-2.78***	-3.02***	-3.22***	-3.40***
	(0.240)	(0.335)	(0.412)	(0.477)	(0.536)	(0.593)	(0.650)	(0.711)	(0.776)
p-value (Exposure ratio)	0.0107	0.0045	0.0021	0.0011	0.0006	0.0004	0.0003	0.0002	0.0002
p-value (Output gap)	0.0001	0.0001	0.0002	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	61	61	61	61	61	61	61	61	61
Adjusted R-squared	0.2819	0.3006	0.3124	0.3204	0.3250	0.3261	0.3239	0.3190	0.3119
Akaike info criterion	-2.3425	-1.5890	-1.1014	-0.7414	-0.4529	-0.2078	0.0100	0.2093	0.3956
Schwarz criterion	-2.2387	-1.4852	-0.9976	-0.6376	-0.3491	-0.1039	0.1138	0.3132	0.4994

Table A.11: Exposure Ratio, Industrial Production Growth and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey and industrial production growth of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, industrial production growth measures the changes in price-adjusted output of the manufacturing industry, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-values of the exposure ratio and industrial production growth, number of observations, adjusted R-squared, standard errors of the constant, exposure ratio and industrial production growth are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Exposure ratio data is obtained from the website of "The Banks Association of Turkey" and remaining data are obtained from Bloomberg terminal.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.08*	-0.13**	-0.19**	-0.25***	-0.31***	-0.37***	-0.43***	-0.48***	-0.54***
	(0.043)	(0.060)	(0.074)	(0.085)	(0.096)	(0.107)	(0.118)	(0.130)	(0.143)
Exposure Ratio	0.07**	0.11***	0.15***	0.19***	0.23***	0.27***	0.31***	0.35***	0.39***
	(0.027)	(0.038)	(0.047)	(0.055)	(0.062)	(0.070)	(0.078)	(0.085)	(0.094)
IP Growth	-0.42***	-0.61***	-0.76***	-0.89***	-1.00***	-1.09***	-1.16***	-1.22**	-1.27**
	(0.120)	(0.18)	(0.230)	(0.278)	(0.325)	(0.370)	(0.415)	(0.460)	(0.506)
p-value (Exposure ratio)	0.0115	0.0042	0.0017	0.0008	0.0004	0.0002	0.0002	0.0001	0.0001
p-value (IP Growth)	0.0009	0.0012	0.0016	0.0022	0.0032	0.0048	0.0071	0.0104	0.0148
p-value (F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.3011	0.3101	0.3137	0.3151	0.3145	0.3118	0.3074	0.3014	0.2943
Adjusted R-squared	0.2770	0.2863	0.2900	0.2915	0.2908	0.2881	0.2835	0.2773	0.2699
Akaike info criterion	-2.3356	-1.5687	-1.0694	-0.6996	-0.4035	-0.1529	0.0681	0.2688	0.4549
Schwarz criterion	-2.2318	-1.4649	-0.9656	-0.5958	-0.2997	-0.0491	0.1719	0.3726	0.5587

Table A.12: Exposure Ratio, Changes in Consumer Confidence Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey and changes in consumer confidence index of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, consumer confidence index is an indicator for future developments of households' consumption and saving, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-values of the exposure ratio and changes in consumer confidence index, number of observations, adjusted R-squared, standard errors of the constant, exposure ratio and changes in consumer confidence index are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Exposure ratio data is obtained from the website of "The Banks Association of Turkey" and remaining data are obtained from Bloomberg terminal.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.11**	-0.18**	-0.25***	-0.32***	-0.38***	-0.45***	-0.51***	-0.57***	-0.64***
	(0.047)	(0.070)	(0.090)	(0.107)	(0.124)	(0.140)	(0.155)	(0.171)	(0.187)
Exposure Ratio	0.07**	0.11***	0.16***	0.20***	0.24***	0.28***	0.32***	0.36***	0.39***
	(0.027)	(0.040)	(0.052)	(0.062)	(0.072)	(0.082)	(0.091)	(0.101)	(0.110)
Cons. Conf. Ind.	-0.32**	-0.42*	-0.51*	-0.57	-0.62	-0.67	-0.70	-0.73	-0.76
	(0.146)	(0.220)	(0.287)	(0.350)	(0.409)	(0.467)	(0.523)	(0.578)	(0.632)
p-value (Exposure ratio)	0.0120	0.0063	0.0037	0.0023	0.0016	0.0012	0.0010	0.0008	0.0007
p-value (CCI)	0.0347	0.0589	0.0836	0.1084	0.1333	0.1584	0.1837	0.2092	0.2348
p-value (F-statistic)	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0004
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.2590	0.2491	0.2443	0.2428	0.2426	0.2425	0.2419	0.2405	0.2381
Adjusted R-squared	0.2334	0.2232	0.2183	0.2167	0.2165	0.2164	0.2158	0.2143	0.2119
Akaike info criterion	-2.2771	-1.4840	-0.9732	-0.5993	-0.3039	-0.0570	0.1584	0.3524	0.5314
Schwarz criterion	-2.1733	-1.3802	-0.8694	-0.4955	-0.2001	0.0468	0.2622	0.4562	0.6352

Table A.13: Exposure Ratio, Output Gap, Consumer Price Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey, output gap of Turkey and changes in consumer price index (CPI) of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, output gap is the difference between actual GDP and potential GDP, CPI is a price index based on the prices of a weighted average basket of consumer goods, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-values of the exposure ratio, output gap and changes in CPI, number of observations, adjusted R-squared, standard errors of the constant, exposure ratio, output gap and changes in CPI are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Exposure ratio data is obtained from the website of "The Banks Association of Turkey" and remaining data are obtained from Bloomberg terminal.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.17***	-0.27***	-0.36***	-0.43***	-0.50***	-0.56***	-0.62***	-0.67***	-0.72***
	(0.045)	(0.067)	(0.086)	(0.103)	(0.121)	(0.138)	(0.156)	(0.174)	(0.193)
Exposure Ratio	0.08***	0.13***	0.17***	0.21***	0.25***	0.29***	0.33***	0.37***	0.40***
	(0.028)	(0.040)	(0.050)	(0.059)	(0.067)	(0.075)	(0.084)	(0.092)	(0.101)
Output Gap	-0.90***	-1.34***	-1.72***	-2.07***	-2.37***	-2.64***	-2.88***	-3.10***	-3.29***
	(0.247)	(0.358)	(0.455)	(0.540)	(0.616)	(0.687)	(0.755)	(0.822)	(0.889)
CPI	0.63***	0.88***	1.05***	1.15**	1.19**	1.18**	1.13*	1.04	0.92
	(0.198)	(0.290)	(0.372)	(0.447)	(0.518)	(0.588)	(0.659)	(0.733)	(0.811)
p-value (Exposure ratio)	0.0057	0.0024	0.0012	0.0006	0.0004	0.0003	0.0002	0.0002	0.0002
p-value (Output gap)	0.0005	0.0004	0.0004	0.0003	0.0003	0.0003	0.0003	0.0004	0.0005
p-value (CPI)	0.0024	0.0036	0.0066	0.0128	0.0254	0.0495	0.0925	0.1614	0.2597
p-value (F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.3686	0.3802	0.3836	0.3830	0.3794	0.3731	0.3646	0.3545	0.3433
Adjusted R-squared	0.3354	0.3476	0.3511	0.3506	0.3467	0.3401	0.3312	0.3205	0.3087
Akaike info criterion	-2.4045	-1.6431	-1.1440	-0.7713	-0.4703	-0.2134	0.0146	0.2226	0.4157
Schwarz criterion	-2.2661	-1.5047	-1.0056	-0.6329	-0.3319	-0.0750	0.1531	0.3610	0.5541

Table A.14: Exposure Ratio, Output Gap, Changes in Consumer Confidence Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey, output gap of Turkey and changes in consumer confidence index of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, output gap is the difference between actual GDP and potential GDP, consumer confidence index is an indicator for future developments of households' consumption and saving, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-values of the exposure ratio, output gap and changes in consumer confidence index, number of observations, adjusted R-squared, standard errors of the constant, exposure ratio, output gap and changes in consumer confidence index are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Exposure ratio data is obtained from the website of "The Banks Association of Turkey" and remaining data are obtained from Bloomberg terminal.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.10**	-0.17***	-0.24***	-0.31***	-0.37***	-0.44***	-0.50***	-0.56***	-0.62***
	(0.0424)	(0.0618)	(0.0780)	(0.0922)	(0.1055)	(0.1184)	(0.1314)	(0.1448)	(0.1587)
Exposure Ratio	0.07**	0.11***	0.15***	0.20***	0.23***	0.27***	0.31***	0.35***	0.39***
	(0.0264)	(0.0384)	(0.0484)	(0.0572)	(0.0655)	(0.0735)	(0.0814)	(0.0895)	(0.098)
Output Gap	-0.80***	-1.22***	-1.59***	-1.92***	-2.21***	-2.47***	-2.70***	-2.89***	-3.06***
	(0.2399)	(0.3446)	(0.4308)	(0.5051)	(0.5739)	(0.6424)	(0.7138)	(0.7903)	(0.873)
Cons. Conf. Ind.	-0.23*	-0.30	-0.34	-0.37	-0.40	-0.41	-0.43	-0.44	-0.44
	(0.1293)	(0.1958)	(0.2564)	(0.3135)	(0.3685)	(0.4227)	(0.4766)	(0.5310)	(0.586)
p-value (Exposure ratio)	0.0109	0.0049	0.0024	0.0012	0.0008	0.0005	0.0004	0.0003	0.0002
p-value (Output gap)	0.0015	0.0008	0.0005	0.0004	0.0007	0.0004	0.0003	0.0002	0.0005
p-value (CCI)	0.0754	0.1323	0.1873	0.2391	0.2877	0.3331	0.3755	0.4150	0.2597
p-value (F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.2590	0.2491	0.2443	0.2428	0.2426	0.2425	0.2419	0.2405	0.2381
Adjusted R-squared	0.2334	0.2232	0.2183	0.2167	0.2165	0.2164	0.2158	0.2143	0.2119
Akaike info criterion	-2.2771	-1.4840	-0.9732	-0.5993	-0.3039	-0.0570	0.1584	0.3524	0.5314
Schwarz criterion	-2.1733	-1.3802	-0.8694	-0.4955	-0.2001	0.0468	0.2622	0.4562	0.6352

Table A.15: Exposure Ratio, Output Gap, Producer Price Index and Bond Excess Returns. This table shows the regression results of Turkish government bond excess returns on exposure ratio of banks in Turkey, output gap of Turkey and changes in producer price index (PPI) of Turkey, with heteroskedasticity and autocorrelation consistent Newey-West estimator. Exposure ratio corresponds to the asset-weighted exposure ratio of banks, output gap is the difference between actual GDP and potential GDP, PPI is a price index based on the prices of a weighted average basket of producer goods, $rx^{(n)}$ denotes the one-year bond excess return of zero-coupon government bonds with n-year maturities. Constant, income gap, p-values of the exposure ratio, output gap and changes in PPI, number of observations, adjusted R-squared, standard errors of the constant, exposure ratio, output gap and changes in PPI are presented in this table. *, ** and *** refer values statistically different from 0 at the 10%, 5% and 1% level of significance, respectively. Exposure ratio data is obtained from the website of "The Banks Association of Turkey" and remaining data are obtained from Bloomberg terminal.

	$rx^{(2)}$	$rx^{(3)}$	$rx^{(4)}$	$rx^{(5)}$	$rx^{(6)}$	$rx^{(7)}$	$rx^{(8)}$	$rx^{(9)}$	$rx^{(10)}$
Constant	-0.14***	-0.22***	-0.30***	-0.37***	-0.44***	-0.51***	-0.57***	-0.63***	-0.69***
	(0.042)	(0.062)	(0.078)	(0.093)	(0.108)	(0.123)	(0.138)	(0.153)	(0.170)
Exposure Ratio	0.07***	0.12***	0.16***	0.20***	0.24***	0.28***	0.32***	0.36***	0.40***
	(0.027)	(0.039)	(0.048)	(0.057)	(0.065)	(0.073)	(0.081)	(0.090)	(0.099)
Output Gap	-1.01***	-1.50***	-1.91***	-2.28***	-2.59***	-2.86***	-3.10***	-3.30***	-3.47***
	(0.224)	(0.327)	(0.418)	(0.500)	(0.575)	(0.647)	(0.717)	(0.786)	(0.856)
PPI	0.3197***	0.4572***	0.5593***	0.6311***	0.6761**	0.6977**	0.6993*	0.6840	0.6545
	(0.0965)	(0.1416)	(0.1865)	(0.2326)	(0.2801)	(0.3293)	(0.3802)	(0.4325)	(0.4863)
p-value (Exposure ratio)	0.0082	0.0033	0.0015	0.0008	0.0004	0.0003	0.0002	0.0002	0.0002
p-value (Output gap)	0	0	0	0	0	0	0.0001	0.0001	0.0002
p-value (PPI)	0.0016	0.0021	0.004	0.0088	0.019	0.0385	0.0711	0.1193	0.1837
p-value (F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	61	61	61	61	61	61	61	61	61
R-squared	0.3939	0.4065	0.4099	0.4086	0.4035	0.3951	0.3842	0.3715	0.3578
Adjusted R-squared	0.3620	0.3753	0.3789	0.3775	0.3721	0.3633	0.3518	0.3385	0.3240
Akaike info criterion	-2.4454	-1.6865	-1.1877	-0.8137	-0.5098	-0.2492	-0.0168	0.1958	0.3934
Schwarz criterion	-2.3070	-1.5481	-1.0493	-0.6752	-0.3714	-0.1107	0.1217	0.3342	0.5318