Working Paper No. 910

Australian Government Bonds' Nominal Yields: An Empirical Analysis

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August 2018

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The data set is available for replication: The data set used in the empirical part of this paper is available upon request to bona fide researchers for the replication and verification of the results.

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ISSN 1547-366X

ABSTRACT

The short-term interest rate is the main driver of the Commonwealth of Australia government bonds' nominal yields. This paper empirically models the dynamics of government bonds' nominal yields using the autoregressive distributed lag (ARDL) approach. Keynes held that the central bank exerts decisive influence on government bond yields because the central bank's policy rate and other monetary policy actions determine the short-term interest rate, which in turn affects long-term government bonds' nominal yields. The models estimated here show that Keynes's conjecture applies in the case of Australian government bonds' nominal yields. Furthermore, the effect of the budget balance ratio on government bond yields is small but statistically significant. However, there is no statistically discernable effect of the debt ratio on government bond yields.

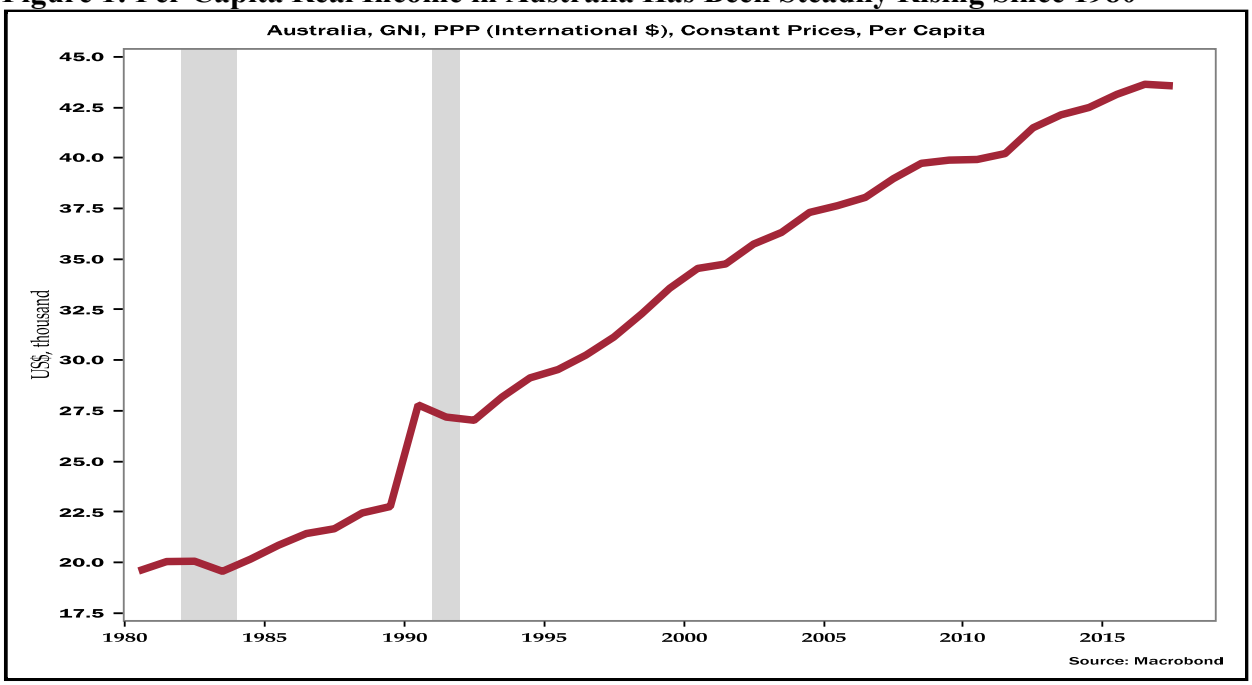
KEYWORDS: Government Bond Yields; Long-Term Interest Rate; Monetary Policy; Australian Government Bond Market; Commonwealth of Australia

JEL CLASSIFICATIONS: E43; E50; E60; G10; G12; O16

I. INTRODUCTION

Australia's economic performance for the past several decades has been stellar. Per capita real income has grown steadily, while the country has avoided a major slowdown in economic activity (figure 1). Even during the global financial crisis, the decline in output was modest and occurred only for a brief period. The country quickly returned to its growth path. Australia has benefited from favorable terms of trade since the turn of the century (figure 2) because of the strong demand for various resource and energy commodities from China and other emerging markets (Kelly 2014; McMahon 2018). Similar to other advanced countries, inflation has declined markedly since the early 1980s. The International Monetary Fund's (2018a, 2018b) latest Article IV report and studies of selected issues provide a useful background to Australia's recent economic developments and structural changes and challenges.

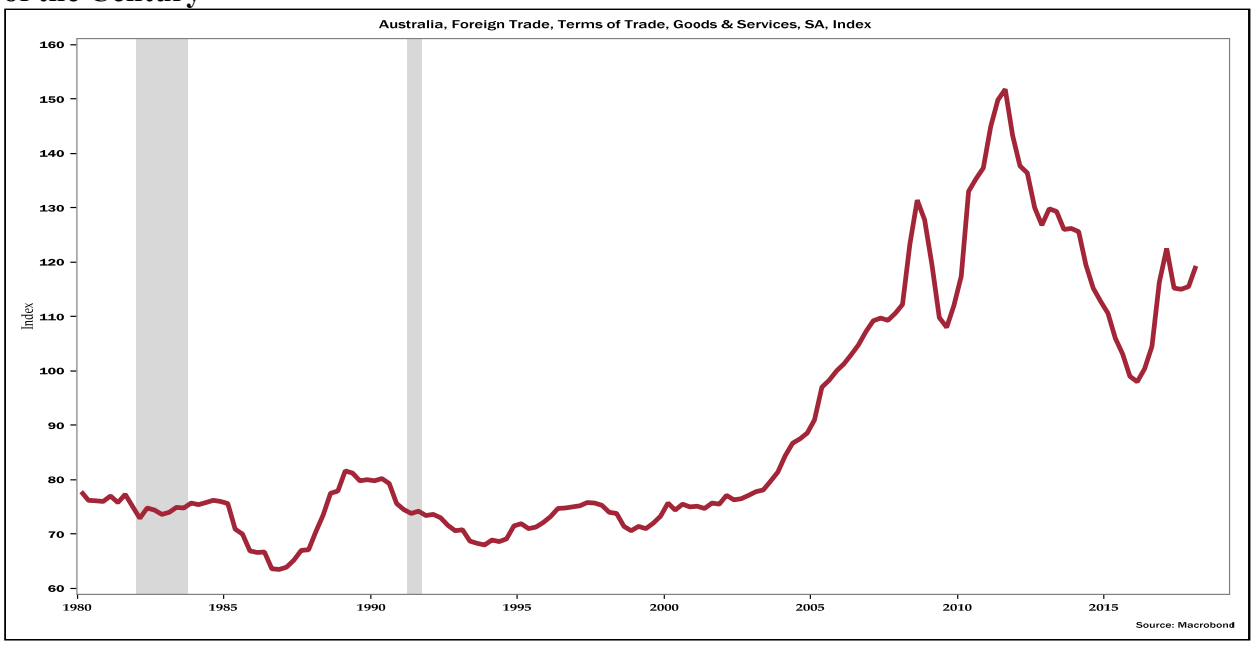
Figure 1: Per Capita Real Income in Australia Has Been Steadily Rising Since 1980



Along with steady growth and a decline in inflation, long-term interest rates on government bonds in Australia have steadily declined since the 1980s. Australia's government debt ratio is lower than most advanced economies, as the country tends to pursue conservative fiscal policies. It would be useful for policymakers and analysts to understand the determinants of the nominal

yields of the Commonwealth of Australia's[1] government bonds (AGBs), as this is an important issue for macroeconomists and finance theorists, public policymakers, and investors in Australia's government bonds and other fixed income assets.

Figure 2: Australia Benefited from the Improvement of its Terms of Trade Since the Turn of the Century



John Maynard Keynes (1930) proclaimed that the short-term interest rate is the key driver of the long-term interest rate. Keynes's contention was inspired by Riefler's (1930) pioneering investigation on the relationship between central bank operations and interest rates in general and the relationship between the short-term interest rate and the long-term interest rate in particular (Kregel 2011).

In the recent empirical literature on the determinants of government bond yields, there is a considerable debate about the relative importance of the short-term interest rate, the fiscal ratio, and other variables for long-term government bond yields. Akram (2014, 2016), Akram and Das (2014a, 2014b, 2015a, 2015b, 2017a, 2017b), Akram and Li (2016, 2017a, 2017b, 2018), and Kregel (2011) emphasize the paramount role of the short-term interest rate as a major driver of

[1] In this paper, AGBs denote bonds issued by the Commonwealth of Australia (that is, the country's central government) unless specified otherwise.

long-term bond yields. In contrast, Baldacci and Kumar (2010), Doi and Okimoto (2011), Gruber and Kamin (2012), Horioka, Nomoto, and Terada-Hagiwara (2014), Lam and Tokuoka (2011), Reinhart and Rogoff (2009), and Tokuoka (2012) espouse a view in which the fiscal ratio—such as the ratio of government debt of nominal GDP (nGDP) or fiscal balance to nGDP—have a decisive impact. The debate on the determinants is quite relevant for understanding the operational effects of the central bank's and the treasury's functions (Bindseil 2004; Fullwiler [2008] 2017), the fiscal theory of price (Sims 2013), and the theory of modern money (Wray 2012; Fullwiler 2016). However, this debate has not been empirically settled. Furthermore, research on the relationship between long-term bond yields, the short-term interest rate, and other macroeconomic variables is conspicuously absent for Australia.

The aim of this paper is to fill the lacunae in the literature by providing an empirical analysis of the AGBs' yields. This paper models the dynamics of government bond yields using the autoregressive distributed lag (ARDL) approach, and shows that the short-term interest rate is the main determinant of the long-term interest rate on government bonds.

This paper is organized as follows. Section II provides a narration of the evolution of government bond yields and fundamental macro variables in Australia. Section III gives the institutional background to the government debt market. Section IV describes the data and reviews the results from unit root tests. Section V explains the econometric approach used here. Section VI presents and interprets the results of the econometric modeling and the robustness tests. Section VII concludes with a summary of the findings, a discussion of policy implications, and a delineation of areas for further research. Appendix A presents additional unit root tests, and appendix B provides additional regression results that largely reinforce the findings of paper.

II. THE EVOLUTION OF NOMINAL BOND YIELDS AND MACROECONOMIC VARIABLES IN AUSTRALIA

Australia has witnessed steady and resilient economic growth for many years. This has resulted in a steady increase in per capita real gross national income (figure 1) and improvements in the material standard of living and the quality of life. Between 1980 and 2016, per capita real income more than doubled. Australia has benefited from extremely favorable terms of trade, particularly since the turn of the century (figure 2), due to the rapid growth of China (Wang 2012) and other emerging markets. The strong demand for commodities produced in Australia has raised the prices of these commodities. Even though the auspicious terms of trade have subsided somewhat since the beginning of 2010s, the terms of trade remain mostly in favor of Australia.

The evolution of AGBs' nominal yields (figure 3) has reflected key developments in the country's economy and has been influenced by monetary policy and inflation. Short-term interest rates have largely moved together with the Reserve Bank of Australia's (RBA) (the country's central bank) cash rate target (figure 4). The evolution of various measures of consumer price index (CPI) inflation shows that inflation has noticeably declined from over 12 percent in the early 1980s to around 2 percent as of 2018 (figure 5). A sharp decline in inflation occurred in the recession of the early 1980s, but inflation gathered steam immediately afterwards. The decline in inflation resumed with the start of the 1990s. Since then inflation has gradually stabilized, though with occasional spikes, such as those of early 2000s and just before the global financial crisis. Inflation has stayed within a fairly narrow range, close to the RBA's target range, since the global financial crisis. The decline in nominal bond yields has largely been on trend with the fall in inflation. The decline in inflation, however, preceded the decline in government bond yields (figure 6). With the decline in inflation, nominal yields on government bonds have also subsided.

Figure 3: The Evolution of Yields of Long-Term Australian Government Bonds

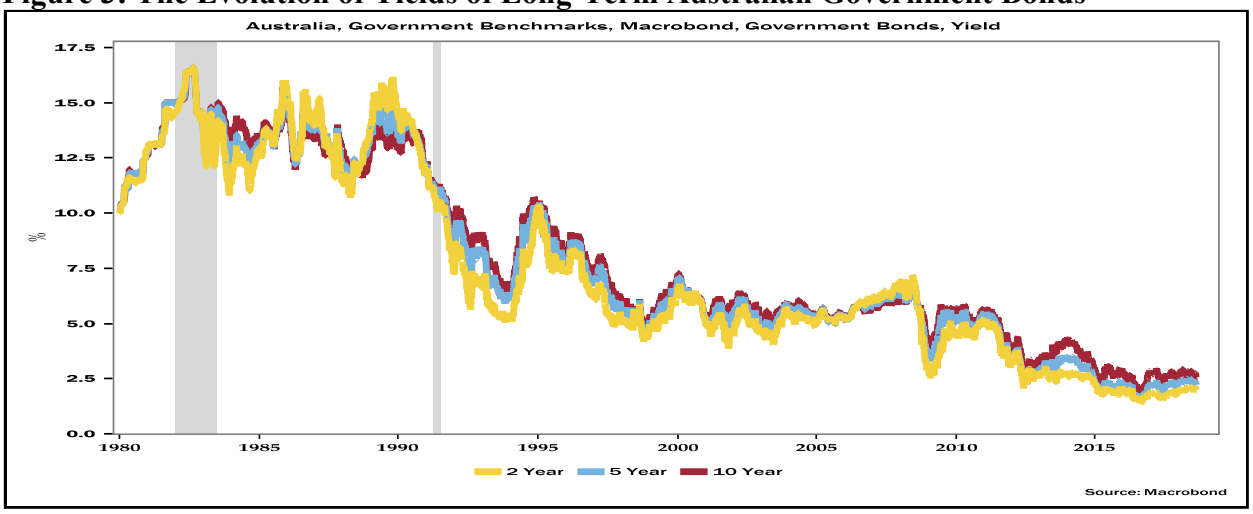


Figure 4: The Evolution of Policy Rates and Various Short-Term Interest Rates in Australia

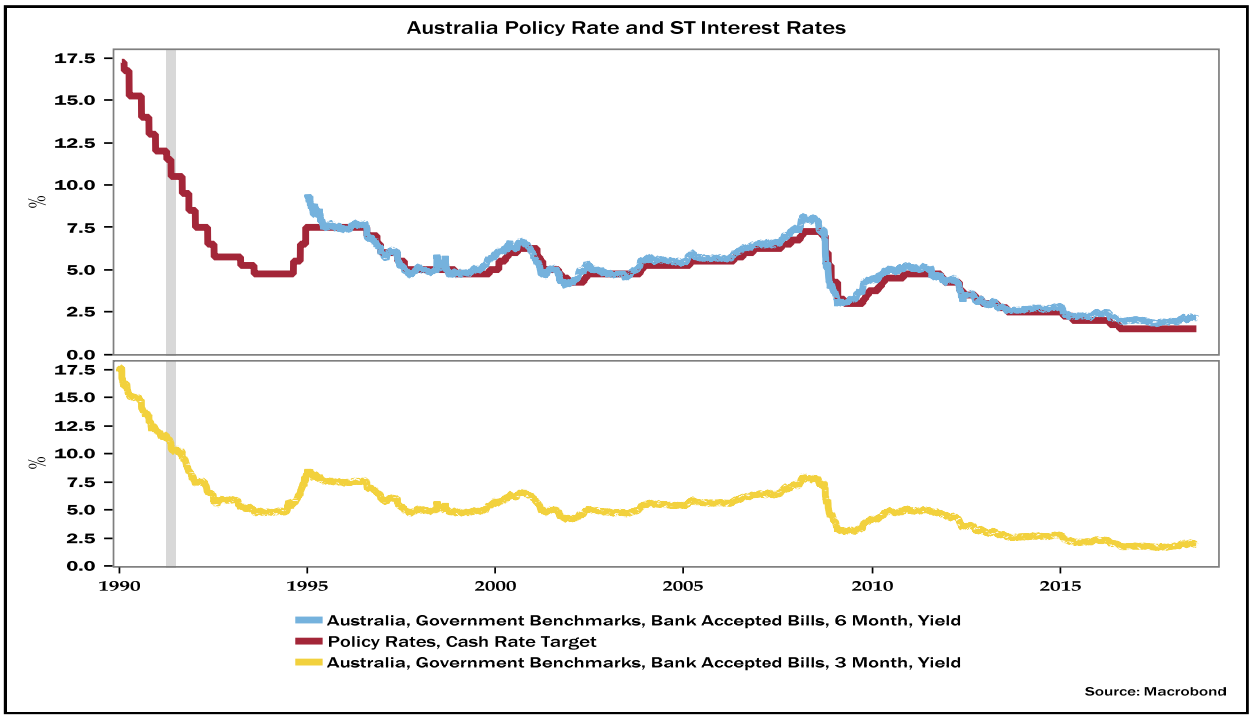


Figure 5: The Evolution of Various Measures of CPI Inflation, Year-over-Year

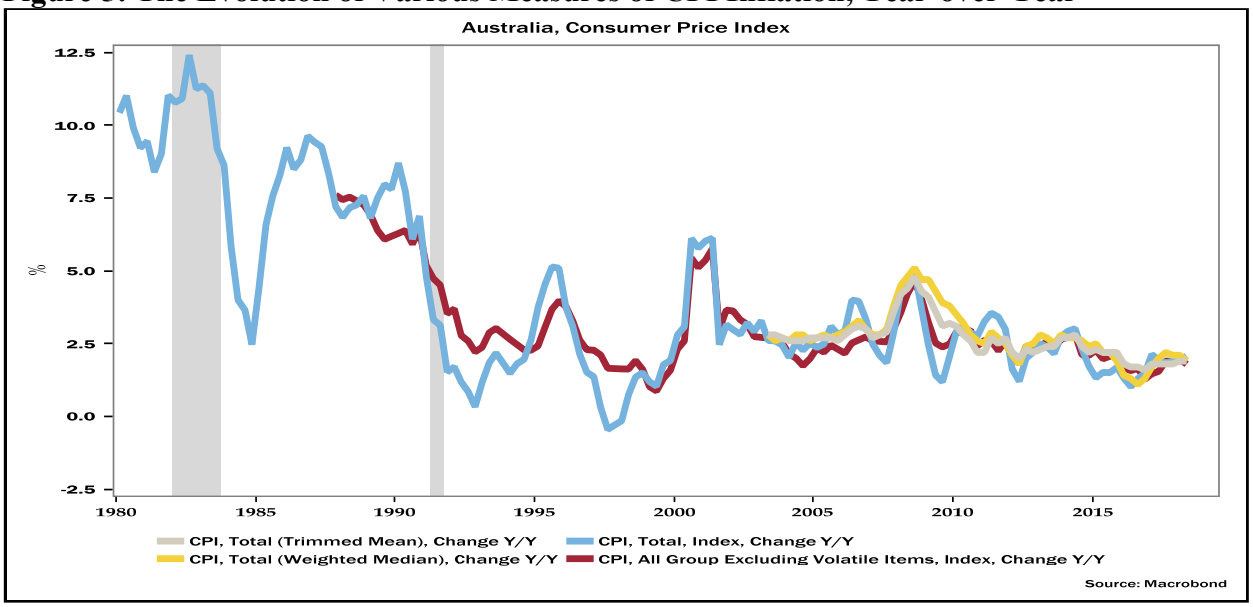
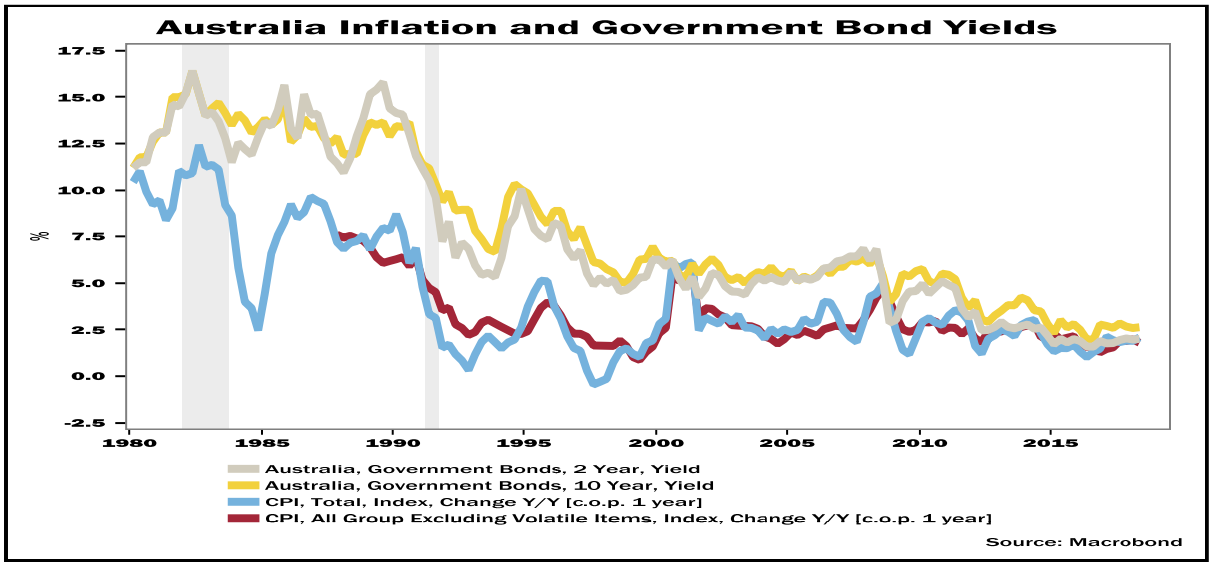
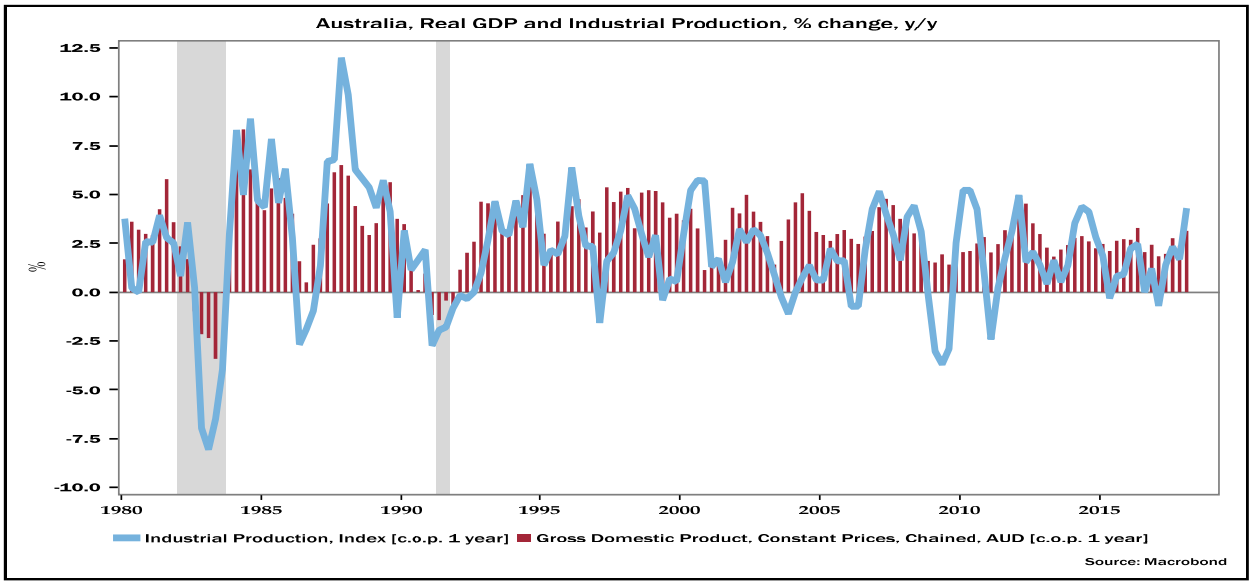


Figure 6: The Trend Decline in Government Bond Yields Has Followed the Trend Decline in Inflation in Australia



Fluctuation in industrial production is a useful indicator of economic activity in Australia. The growth (decline) of industrial production in Australia moves largely in unison with the growth (decline) of real gross domestic product (GDP) (figure 7). This is surprising since Australia is a service-oriented economy and the manufacturing sector is quite small.

Figure 7: The Evolution of Real GDP Growth and the Growth of Industrial Production in Australia



The amount of outstanding Australian government debt as a share of nGDP is quite moderate, as the country has pursued fairly conservative fiscal policies. Figure 8 shows this evolution of the debt ratios of the Commonwealth of Australia. Figure 9 presents the evolution of net borrowing/lending as a share of nGDP. Net borrowing as a share of nGDP widened during the early 1990s but narrowed in the mid-1990s. The Australian government was a net lender from the later 1990s to the mid-2000s. However, following the global financial crisis, the Australian government was forced to engage in net borrowing. The magnitude of net borrowing has subsided gradually as the fiscal stimulus was withdrawn and the Australian economy returned to its growth path. Despite occasional incidences of higher fiscal deficits, Australia's government debt as a share of nGDP is noticeably less than other advanced countries (figure 10).

Figure 8: The Evolution of Government Debt in Australia, Including Outstanding Commonwealth and State Government Securities Guaranteed by the Commonwealth of Australia

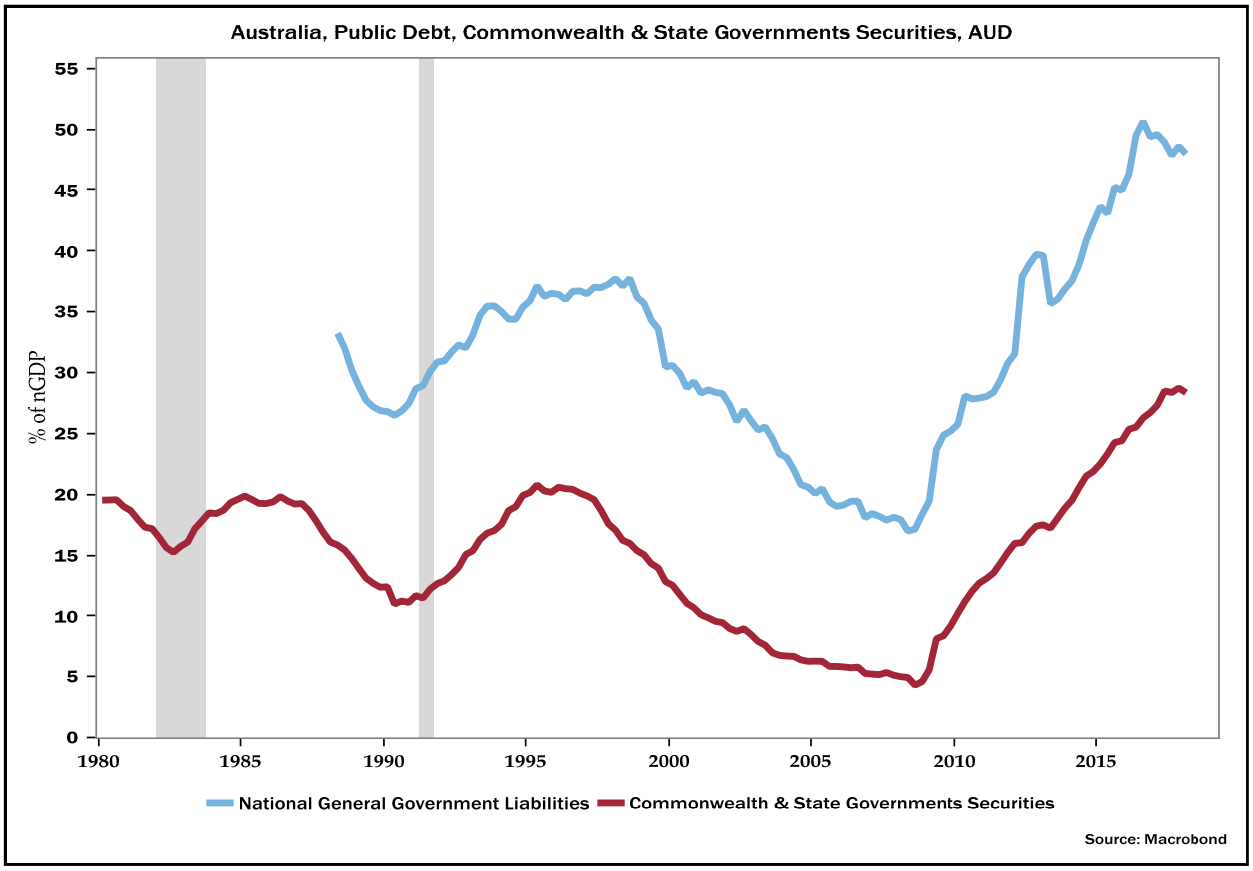


Figure 9: The Evolution of the Ratio of Government Net Borrowing/Lending to nGDP in Australia

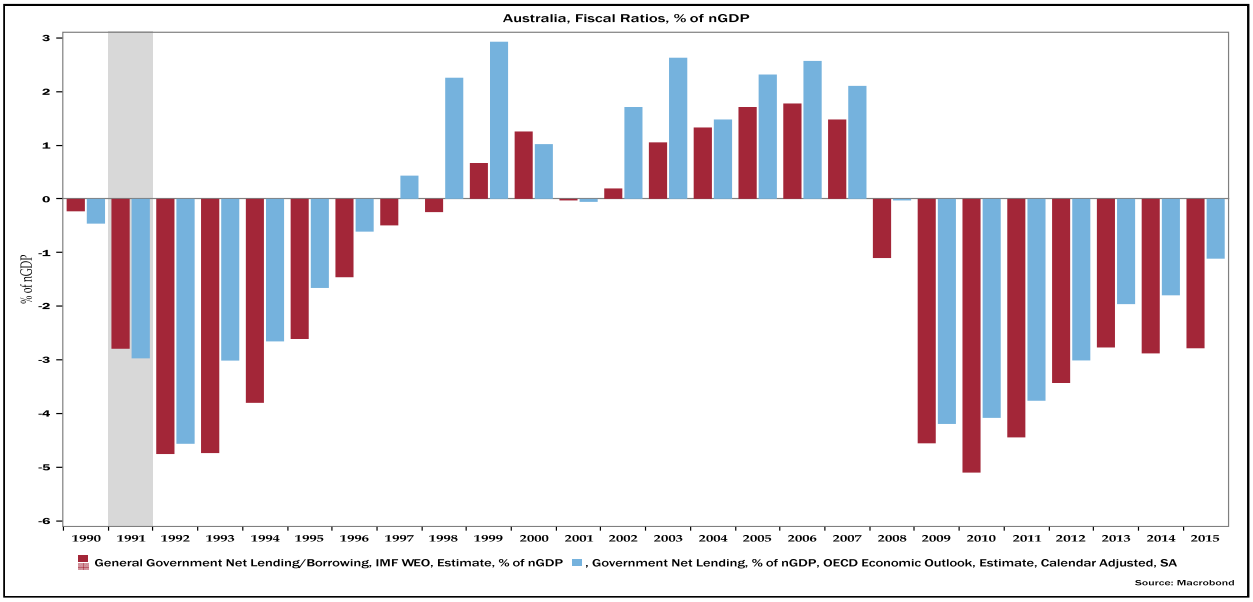
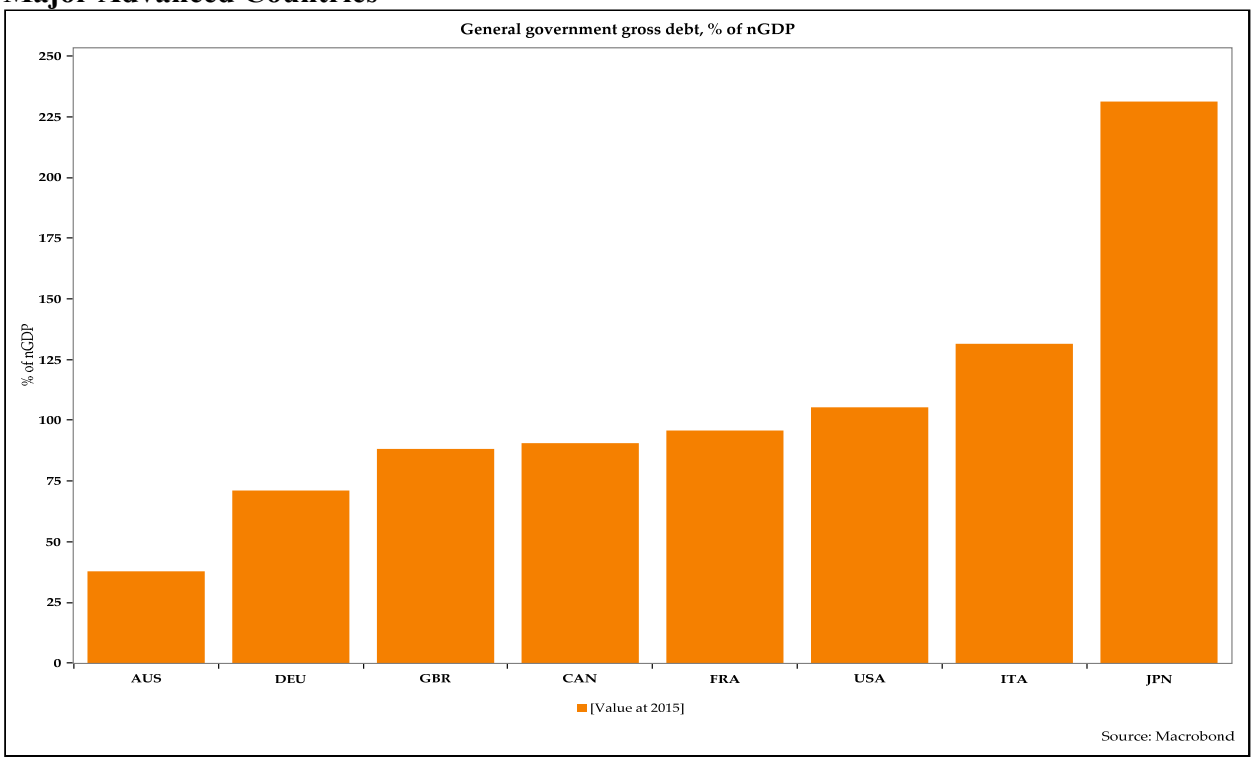


Figure 10: Australia's Ratio of Government Debt to nGDP is Much Lower than in Most Major Advanced Countries



The short-term and long-term interest rates on AGBs exhibit some clear relationships, as shown in the scatterplots below. Figure 11 displays the scatterplot of the short-term interest rate and the yield of AGBs of a 2-year tenor. Figure 12 shows the scatterplot of the year-over-year percentage point changes in the short-term interest rate and the year-over-year percentage point changes in the yields of AGBs of a 2-year tenor. Figure 13 presents the scatterplot of the short-term interest rate and the yields of AGBs of a 5-year tenor. Figure 14 shows the scatterplot of the year-over-year percentage point changes in the short-term interest rate and the year-over-year percentage point changes in the yields of AGBs of a 5-year tenor. Figure 15 displays the scatterplot of the short-term interest rate and the yields of AGBs of a 10-year tenor. Figure 16 shows the scatterplot of the year-over-year percentage point changes in the short-term interest rate and the year-over-year percentage point changes in the yield of AGBs of a 10-year tenor.

Figure 11: Scatterplot of the Yields of 2-Year AGBs and 3-Month Bank Accepted Bills

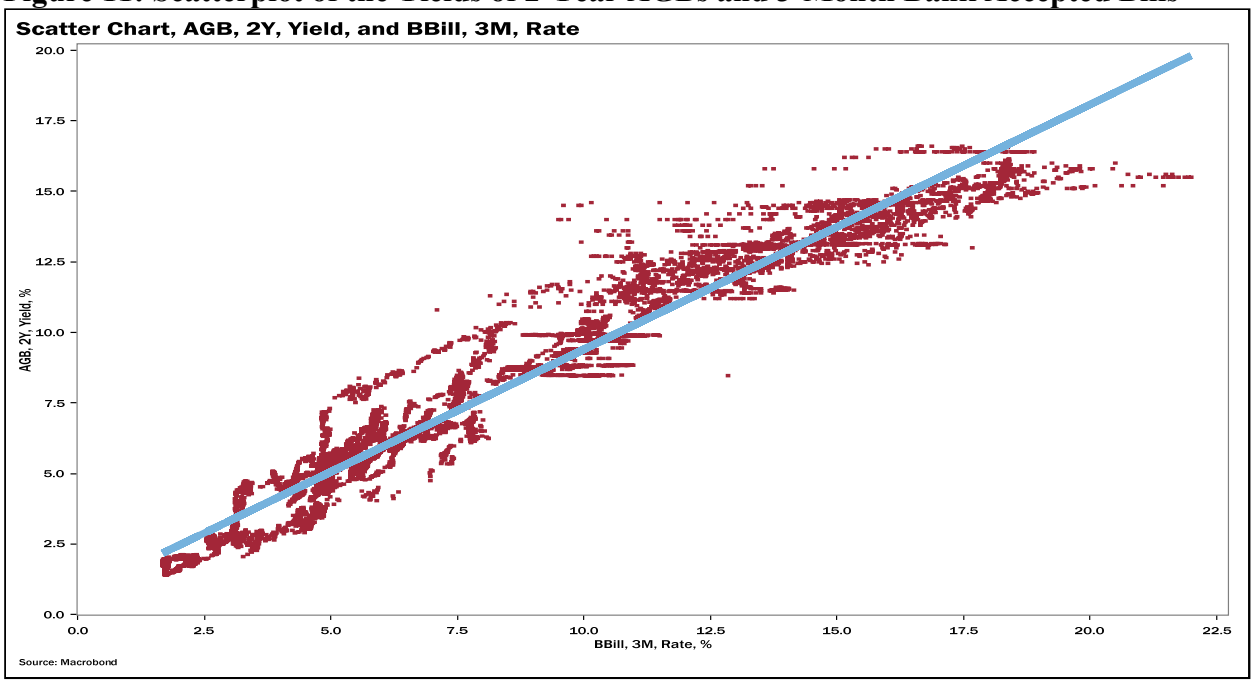


Figure 12: Scatterplot of Year-over-Year Percentage Point Changes in the Yields of 2-Year AGBs and 3-Month Bank Accepted Bills

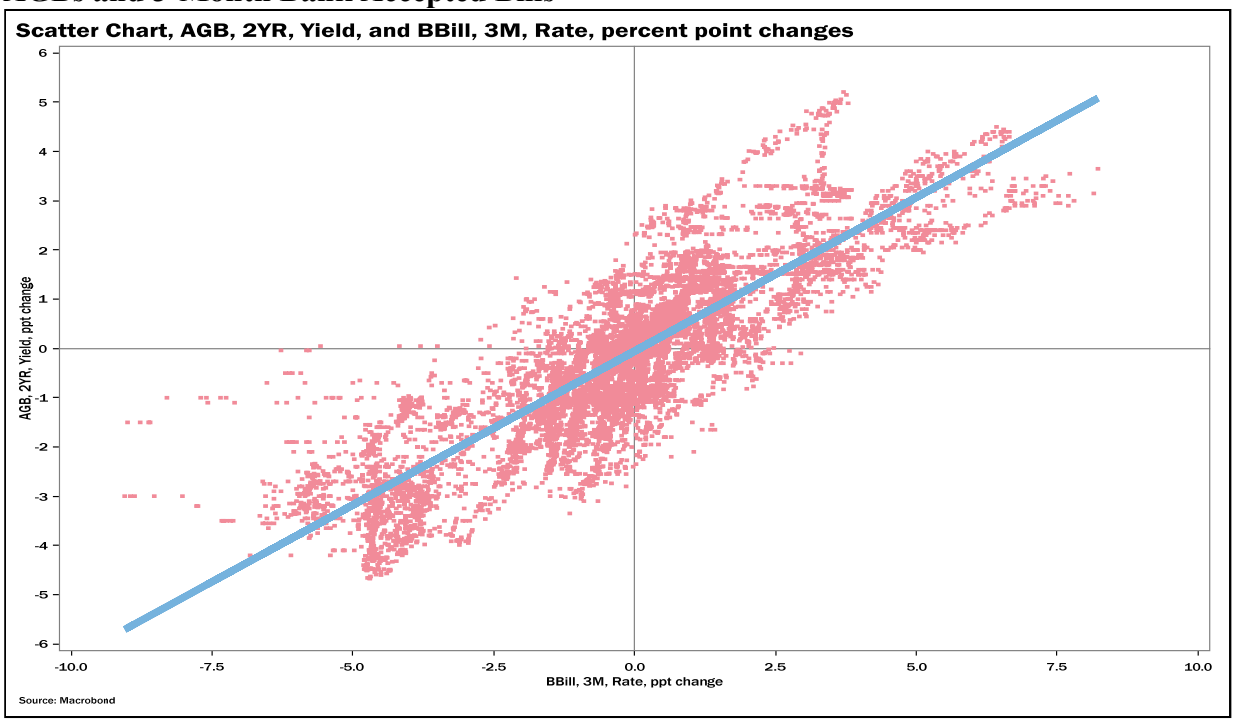


Figure 13: Scatterplot of the Yields of 5-Year AGBs and 3-Month Bank Accepted Bills

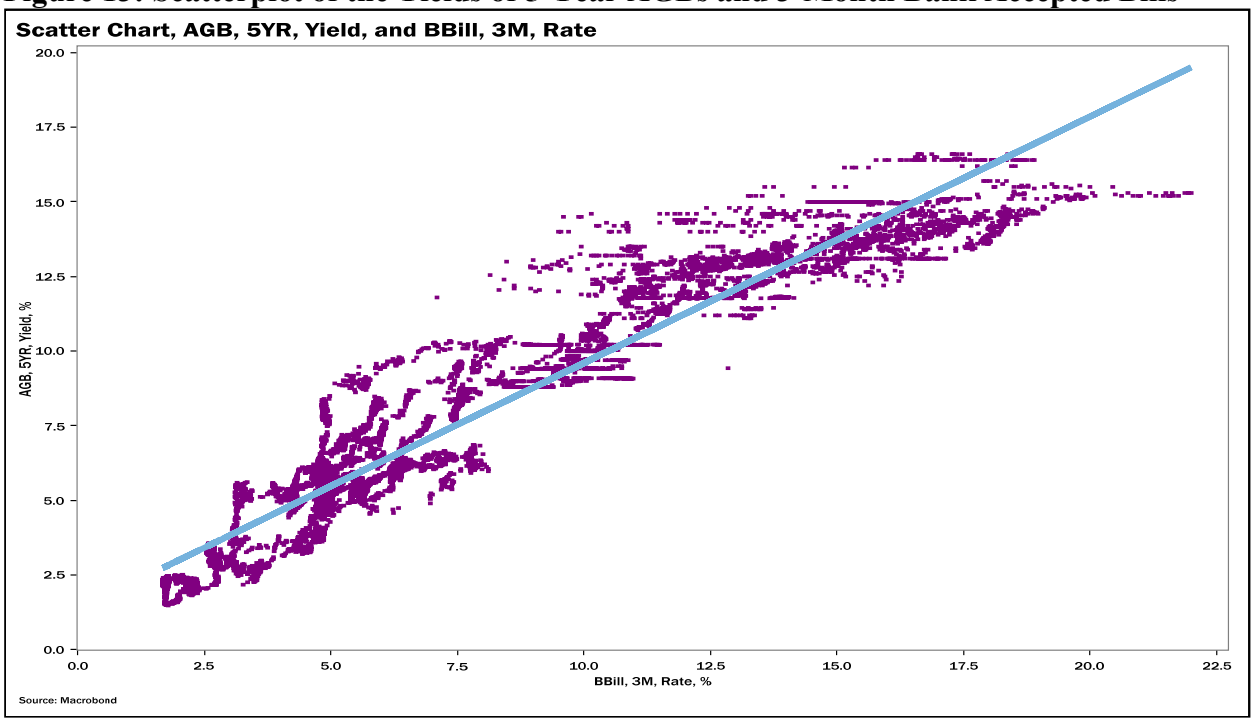


Figure 14: Scatterplot of Year-over-Year Percentage Point Changes in the Yields of 5-Year AGBs and 3-Month Bank Accepted Bills

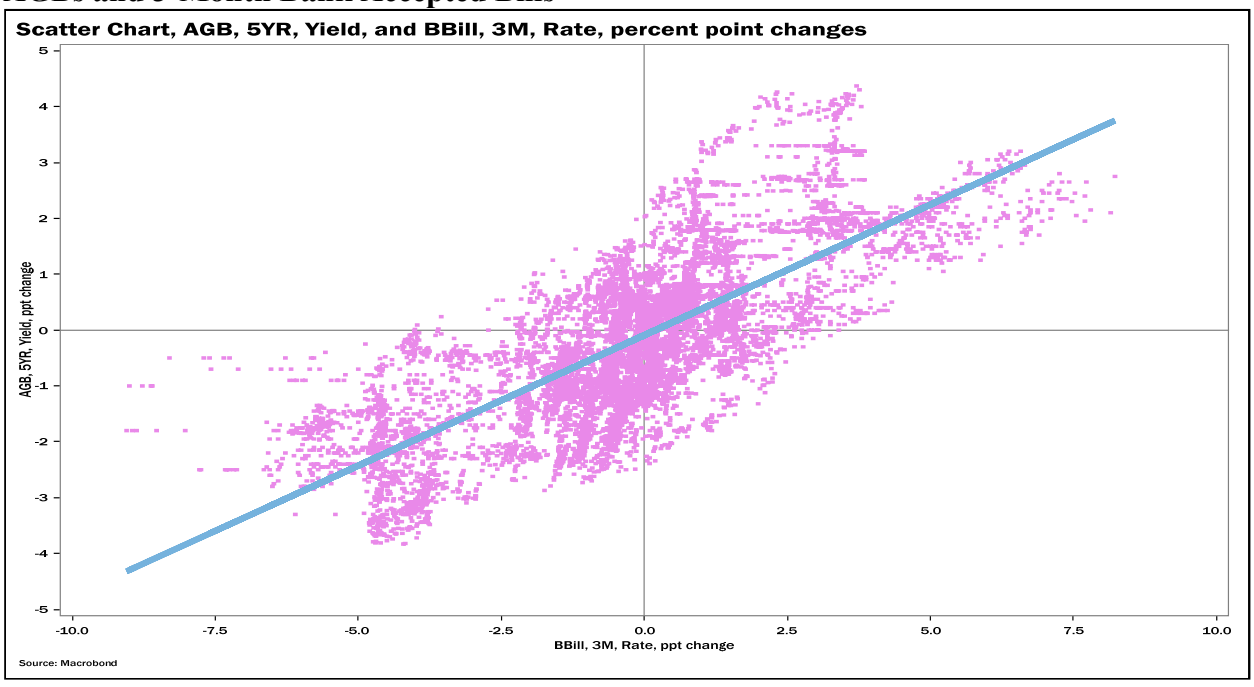


Figure 15: Scatterplot of the Yields of 10-Year AGBs and 3-Month Bank Accepted Bills

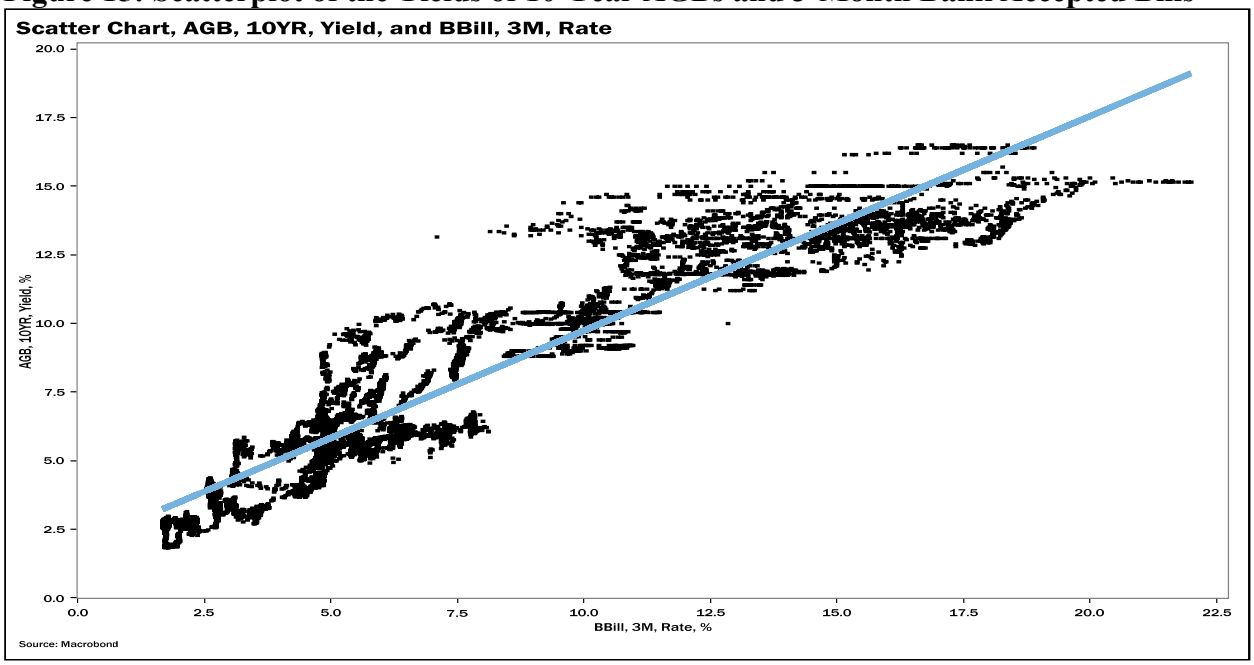
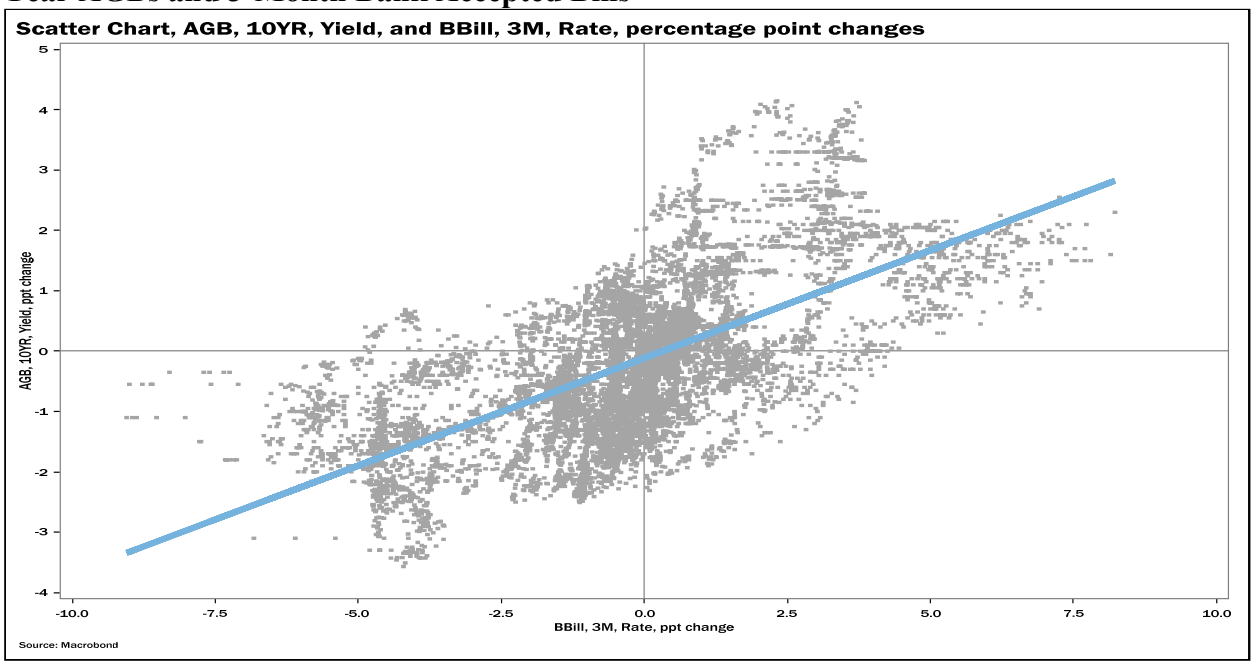


Figure 16: Scatterplot of Year-over-Year Percentage Point Changes in the Yields of 10-Year AGBs and 3-Month Bank Accepted Bills



The scatterplots reveal that there are strong correlations between the short-term and long-term interest rates on government bonds. Such correlations are stronger for government bonds of shorter tenors compared to government bonds of longer tenors. Furthermore, there are positive correlations between the year-over-year percentage point changes in the short-term interest rate and the year-over-year percentage point change in the long-term interest rate on government bonds. However, the strength of these positive correlations is less so for the year-over-year percentage point changes than the correlations for the levels of bond yields. Such correlations are higher for government bonds of shorter tenors compared to that of government bonds of longer tenors.

III. THE INSTITUTIONAL BACKGROUND TO THE GOVERNMENT BOND MARKET IN AUSTRALIA

The government bond market in Australia includes AGBs and semi-government bonds (SGBs). SGBs refer to bonds issued by various subnational authorities (states and federal territories), such as Queensland Treasury Corporation, New South Wales Treasury Corporation, Treasury Corporation of Victoria, and so forth. Macquaire Investment Management (2014) furnishes a useful summary of the overall government bond market in Australia, and Battellino and Chambers (2006) provide detailed background information about the corporate bond market in Australia. However, since this paper is concerned solely about the dynamics of the nominal yields of AGBs, this section only provides a concise summary of the institutional features and characteristics relevant for the analysis undertaken here.

The Reserve Bank of Australia (RBA), the country's central bank, is responsible for monetary policy, issuance of banknotes, creation of reserves, and overall financial stability. The RBA renders banking services for the Commonwealth of Australia and its agencies. It also manages the country's gold and foreign exchange reserves, and oversees the country's payment system. The RBA operates independently under the Reserve Bank Act 1959. The RBA is mandated to ensure (1) the stability of the Australian dollar, (2) the maintenance of full employment, and (3) the economic prosperity and welfare of the people of Australia. Since the early 1990s, however,

the RBA has interpreted its mandate as one that primarily focuses on controlling inflation. It has targeted to keep inflation within a range of 2 percent to 3 percent, on average, over the course of the business cycle. Australia has a flexible exchange rate regime. Hence, the Australian dollar floats against the US dollar and other major currencies.

The Commonwealth of Australia issues three types of government securities:

- **Treasury Notes**: Treasury notes are short-term discount securities, redeemable at face value on maturity. Their tenors are generally less than six months. The holder receives a single payment on maturity.
- **Treasury Indexed Bonds**: Treasury indexed bonds are medium- to long-term inflation-linked securities. The capital value of the security is adjusted for inflation as measured by in the CPI. Interest is paid quarterly, at a fixed rate, on the adjusted capital value. At maturity investors receive the adjusted capital value of the security.
- **Treasury Bonds**: Treasury bonds are medium- to long-term nominal debt securities that carry an annual rate of interest that is fixed over the life of the security, payable semiannually. At maturity investors receive the face value of the security.

The government-sector debt in Australia has grown notably since the global financial crisis. There are a variety of securities with different yields and durations available in decent volumes and liquidity. However, the bulk of the outstanding debt is in the form of treasury bonds.

The Australian Office of Financial Management (AOFM) is responsible for the efficient operation of financing and debt management on behalf of the Commonwealth of Australia. AGBs are issued by competitive tender and occasionally through syndicated offerings. There are both primary and secondary markets for these securities. Exchange-traded treasury bonds and exchange-traded treasury indexed bonds are quoted and traded in the Australian Securities Exchange. There are 18 major market makers in Commonwealth of Australia government bonds consisting of both international and domestic institutions, such as Goldman Sachs, Daiwa Capital Markets, National Australian Bank, Westpac, and others. There is a vibrant and liquid futures market in Australian treasury securities, with contracts on 3-year, 10-year, and 30-year futures.

In recent years the AOFM has made a conscious effort to progressively extend the yield curve from around 12 years in 2011 to 30 years as of 2018. The issuance of securities has been concentrated into relatively few lines to support liquidity in the government bond market. The authorities have issued securities across in the yield curve in response to investor demand and to facilitate futures contracts. The authorities have also issued long and ultra-long securities. Inflation-indexed securities and short-term securities remain a relatively small part of the outstanding debt. Offshore (foreign) ownership is an important component of AGBs, constituting over 60 percent as of 2018. However, in recent years, the share of domestic holdings has increased from less than 30 percent to nearly 40 percent in 2018.

Australia's monetary sovereignty, the dynamic and liquid market for government securities, and its fiscal position and resilient economic growth make the empirical investigation of the determinants of AGBs' yields an important and interesting question for macroeconomic and finance theory, public policy, and fixed income investment.

IV. DATA AND UNIT ROOT TESTS

Data

This study focuses its analysis on the determinants of long-term bond yields in Australia using quarterly time-series data. The dataset runs from the first quarter of 1980 to the second quarter of 2017. In the analysis the aim is to examine the relationships between long-term bond yields and other important variables including the short-term interest rate, inflation, economic activity, and fiscal ratios. Data on interest rates cover both short-term and long-term interest rates. Short-term interest rates include yields on treasury bills of a 3-month tenor and bank accepted bills of short-term tenors. Long-term interest rates include the nominal yields of long-term AGBs, including yields on AGBs of 2-year (AGB2YR), 5-year (AGB5YR), and 10-year maturities (AGB10YR). Economic activity is proxied by the industrial production index (IPI) in Australia. To examine the potential effects of the rate of inflation on long-term bond yields, we use different inflation data, including the CPI, the core consumer price index including volatile items (CPIEXV), the weighted median consumer price index (CPIWM), and the trimmed mean consumer price index

(CPITM). Due to space constraints, the results provided in the main body of the paper use the CPIEXV. Government finance ratios include the ratio of government debt to nGDP and the ratios of the central government's budget balance and the fiscal balance to nGDP. The ratios of the budget balance and the fiscal balance to nGDP take a positive sign in the case of a budget surplus and a negative sign for a budget deficit.[2]

Data on all variables are collected from Macrobond, which consolidates time-series data from different primary sources. Definitions and sources of all variables used in this paper are presented in table 1. Additional results using alternative inflation indices and other variables are given in the tables in appendix B.

[2] Data on the nominal yields on government bonds of a 3-year (AGB3YR) maturity are only available from 1996. Including this variable in the behavioral equation produces results that are significantly different from other results. Results on the determinants of AGB3YR are presented in table B4 in appendix B.

Table 1: Summary of the Data

Variables	Data description, data date range	Frequency	Source(s)
Short-term interest rates			
BB1M	Bank accepted bills, 1 month, yield, % 1995Q1–2017Q2	Daily; converted to quarterly	Macrobond Financial AB
BB3M	Bank accepted bills, 3 month, yield, % 1980Q1–2017Q2	Daily; converted to quarterly	Macrobond Financial AB
BB6M	Bank accepted bills, 6 month, yield, % 1995Q2–2017Q2	Daily; converted to quarterly	Macrobond Financial AB
TB3M	Treasury bill, 3 month, yield, % 1980Q1–2017Q2	Monthly; converted to quarterly	Building Wealth Through Shares; Macrobond
Long-term interest rates			
AGB2YR	AGBs, 2 year, yield, % 1980Q1–2017Q2	Daily; converted to quarterly	Macrobond Financial AB
AGB3YR	AGBs, 3 year, yield, % 1995Q1–2017Q2	Daily; converted to quarterly	Macrobond Financial AB
AGB5YR	AGBs, 5 year, yield, % 1980Q1–2017Q2	Daily; converted to quarterly	Macrobond Financial AB
AGB10YR	AGBs, 10 year, yield, % 1980Q1–2017Q2	Daily; converted to quarterly	Macrobond Financial AB
GB10YR	AGBs, 10 year, yield, % 1980Q1–2017Q2	Monthly; converted to quarterly	Building Wealth Through Shares; Macrobond
Inflation			
CPIEXV	CPI, all group excluding volatile items, index, % change, y/y 1980Q1–2017Q2	Quarterly	Australian Bureau of Statistics; Macrobond
CPI	CPI, total, index, % change, y/y 1980Q1–2017Q2	Quarterly	Australian Bureau of Statistics; Macrobond
CPIWM	CPI, total (weighted median), % change, y/y 2003Q2–2017Q2	Quarterly	Australian Bureau of Statistics; Macrobond
CPITM	CPI, total (trimmed mean), % change y/y 2003Q1–2017Q2	Quarterly	Australian Bureau of Statistics; Macrobond
Pace of economic activity			
GDP	GDP, total, constant prices, seasonally adjusted, chained, % change, y/y 1980Q1–2017Q2	Quarterly	Australian Bureau of Statistics; Macrobond
IPI	Industrial production index, % change, y/y 1980Q1–2017Q2	Quarterly	Australian Bureau of Statistics; Macrobond
Fiscal ratios			
DEBT	Ratio of outstanding commonwealth government securities, % of nGDP, seasonally adjusted 1980Q1–2017Q2	Quarterly	Australian Department of Finance, Australian Bureau of Statistics; Macrobond
BBALANCE	Australia, central government budget, balance, budget surplus/deficit, % of nGDP, seasonally adjusted 1980Q1–2017Q1	Quarterly	Australian Department of Finance, Australian Bureau of Statistics; Macrobond

Unit Root Tests

Unit root tests are conducted on the relevant variables at level and their first difference. To examine the level of integration, the standard unit root tests are used. The Augmented Dickey-Fuller (ADF) (Dickey and Fuller 1979, 1981) and Phillips-Perron (PP) (Phillips and Perron 1988) tests are used in this paper. The three versions (namely, without either constant or trend, only with constant but no trend, and with both constant and trend) of both tests are reported in table 2. As the results show, the interest rate variables (AGBs and TB3M) are mostly nonstationary at levels but stationary at first differences. Therefore, these variables are integrated of order one (i.e., they are mostly I(1)). CPIEXV is found to be I(0) by four out of six tests and I(1) by two tests. IPI is mostly stationary and hence I(0). Among the government finance variables, DEBT is mostly found to be I(1), while BBALANCE is mostly I(0). Unit root tests for additional variables are given in table A1 in appendix A.

Table 2: Results from Unit Root Tests

	Augmented Dickey-Fuller Test			Phillips-Perron Test		
Variable	**No Constant or Trend**	**With Constant**	**With Constant and Trend**	**No Constant or Trend**	**With Constant**	**With Constant and Trend**
AGB2YR	-1.29 (1980Q2–2017Q2)	-0.88 (1980Q2–2017Q2)	-2.93 (1980Q2–2017Q2)	-1.28 (1980Q2–2017Q2)	-0.94 (1980Q2–2017Q2)	-3.26* (1980Q2–2017Q2)
ΔAGB2YR	-11.46*** (1980Q3–2017Q2)	-11.50*** (1980Q3–2017Q2)	-11.47*** (1980Q3–2017Q2)	-11.46*** (1980Q3–2017Q2)	-11.50*** (1980Q3–2017Q2)	-11.47*** (1980Q3–2017Q2)
AGB5YR	-1.28 (1980Q2–2017Q2)	-0.73 (1980Q2–2017Q2)	-3.22* (1980Q2–2017Q2)	-1.28 (1980Q2–2017Q2)	-0.74 (1980Q2–2017Q2)	-3.40 (1980Q2–2017Q2)
ΔAGB5YR	-11.89*** (1980Q3–2017Q2)	-11.95*** (1980Q3–2017Q2)	-11.92*** (1980Q3–2017Q2)	-11.89*** (1980Q3–2017Q2)	-11.95*** (1980Q3–2017Q2)	-11.92*** (1980Q3–2017Q2)
AGB10YR	-1.29 (1980Q2–2017Q2)	-0.62 (1980Q2–2017Q2)	-3.35* (1980Q2–2017Q2)	-1.30 (1980Q2–2017Q2)	-0.64 (1980Q2–2017Q2)	-3.47** (1980Q2–2017Q2)
ΔAGB10YR	-11.77*** (1980Q3–2017Q2)	-11.85*** (1980Q3–2017Q2)	-11.82*** (1980Q3–2017Q2)	-11.77*** (1980Q3–2017Q2)	-11.84*** (1980Q3–2017Q2)	-11.81*** (1980Q3–2017Q2)
TB3M	-1.44 (1980Q2–2017Q2)	-1.70 (1980Q2–2017Q2)	-3.43* (1980Q2–2017Q2)	-1.40 (1980Q2–2017Q2)	-1.52 (1980Q2–2017Q2)	-3.53** (1980Q2–2017Q2)
ΔTB3M	-12.53*** (1980Q3–2017Q2)	-12.54*** (1980Q3–2017Q2)	-12.49*** (1980Q3–2017Q2)	-12.74*** (1980Q3–2017Q2)	-12.79*** (1980Q3–2017Q2)	-12.74*** (1980Q3–2017Q2)
CPIEXV	-2.36** (1989Q1–2017Q2)	-3.20** (1989Q1–2017Q2)	-3.11 (1989Q1–2017Q2)	-2.31** (1988Q1–2017Q2)	-2.85* (1988Q1–2017Q2)	-2.85 (1988Q1–2017Q2)
ΔCPIEXV	-6.68*** (1989Q1–2017Q2)	-6.80*** (1989Q1–2017Q2)	-6.89*** (1989Q1–2017Q2)	-10.51*** (1988Q2–2017Q2)	-10.57*** (1988Q2–2017Q2)	-10.63*** (1988Q2–2017Q2)
IPI	-1.86 (1982Q2–2017Q2)	-5.43*** (1981Q4–2017Q2)	-5.49*** (1981Q4–2017Q2)	-4.35*** (1980Q–22017Q2)	-3.87*** (1980Q2–2017Q2)	-3.77*** (1980Q2–2017Q2)
ΔIPI	-7.82*** (1982Q2–2017Q2)	-7.79*** (1982Q2–2017Q2)	-7.77*** (1982Q2–2017Q2)	-23.48*** (1980Q3–2017Q2)	-23.31*** (1980Q3–2017Q2)	-23.73*** (1980Q3–2017Q2)
DEBT	0.20 (1981Q2–2017Q2)	-1.39 (1981Q2–017Q2)	-1.00 (1981Q2–2017Q2)	0.27 (1980Q2–2017Q2)	-0.63 (1981Q2–2017Q2)	0.06 (1981Q2–2017Q2)
ΔDEBT	-2.13** (1981Q2–2017Q2)	-2.19 (1981Q2–2017Q2)	-2.57 (1981Q2–2017Q2)	-6.22*** (1980Q3–2017Q2)	-6.26*** (1980Q3–2017Q2)	-7.02*** (1980Q3–2017Q2)
BBALANCE	-2.70*** (1981Q3–2017Q1)	-3.36** (1981Q4–2017Q1)	-3.34*** (1981Q4–2017Q1)	-2.06** (1980Q2–2017Q1)	-2.17 (1980Q2–2017Q1)	-2.16 (1980Q2–2017Q1)
ΔBBALANCE	-4.67*** (1982Q2–2017Q1)	-4.65*** (1982Q2–2017Q1)	-4.64*** (1982Q2–2017Q1)	-8.42*** (1980Q3–2017Q1)	-8.39*** (1980Q3–2017Q1)	-8.38*** (1980Q3–2017Q1)

Notes: Δ represents quarter-to-quarter change. The null hypothesis of both the ADF and PP tests is that the series contains unit roots. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent level, respectively. Adjusted sample period is in parenthesis.

V. ECONOMETRIC METHODOLOGY

Method

To estimate the relationship between long-term bond yields and other relevant variables it is appropriate to rely on a method that is not constrained by the outcomes of the unit root tests. In this regard the autoregressive distributed lag (ARDL) approach, developed by Pesaran and Pesaran (1997), Pesaran and Shin (1999), and Pesaran, Shin, and Smith (2001), is an appropriate econometric method, since this econometric technique allows for a combination of purely I(0), purely I(1), or mutually cointegrated time-series variables.

The ARDL approach is not only well matched for the purpose of the estimations of the behavioral equations specified here, but for a number of reasons it is also a preferred technique over other cointegration methods, such as the Johansen cointegration technique (Johansen and Juselius 1990) or the Engle-Granger two-step method (Engle and Granger 1987). There are three distinct advantages of using the ARDL approach. First, unlike the Johansen test, which is based on a vector autoregressive (VAR) model, this approach uses a single ARDL equation and thereby reduces the number of parameters to be estimated. Second, different variables can take different optimal numbers of lags within the ARDL framework. This is not allowed in the standard cointegration approaches. The Akaike Information Criteria (AIC) is used to determine the lag length order of the estimated ARDL models. Third, the ARDL technique is suitable for a dataset with a shorter time period. Given that the adjusted sample in the dataset begins in 1988, the ARDL is the most appropriate technique for estimating the relationships between the long-run government bond yields and various independent variables.

Behavioral Equations

The behavioral equation to be estimated is as follows:

$$AGBY = c_1+c_2*STIR+c_3*INFL+c_4*GROWTH+c_5*FISCAL$$

Where variables are: AGBs yields, AGBY = {AGB2YR, AGB5YR, AGB10YR, GB10YR}; short-term interest rate, STIR = {BB1M, BB3M, BB6M, TB3M, SWAP1M}; inflation, INFL = {CPIEXV, CPI, CPIWM, CPITM}; the pace of growth, GROWTH = {IP}; and the fiscal ratio, FISCAL = {DEBT, BBALANCE}.

Short-term interest rates and general government finance are two important independent variables in the behavioral equation. Additional controls are inflation and economic growth. The above behavioral equation includes government bonds of different tenors as its dependent variable. It also incorporates different measures of short-term interest rates, inflation, the pace of growth, and fiscal ratios as its independent variables. The results provided below are given for a subset of the above specification. However, additional results are provided in appendix B.

VI. RESULTS AND DIAGNOSTIC TESTS

ARDL Results

Results from the application of the ARDL approach are presented in tables 3–5. For each government bond variable (AGBs of different tenors), two separate equations are estimated. The first equation (the second column in each table) includes DEBT as an independent variable, while the second equation (the third column in each table) includes BBALANCE as an independent variable. The estimated *F*-statistic is significant at least at the 5 percent level in all six equations; therefore, it can be argued that the variables in all six equations have a long-run relationship. The long-run coefficients are estimated in the second stage of the ARDL technique. The negative and significant error-correction term in all six equations shows the moderate speed of adjustment toward the long-run equilibrium. Approximately 50 to 60 percent of any deviation from the equilibrium is corrected within the first quarter. The trend variable—which captures the

underlying phenomenon of the general decline in AGBs' nominal yields, short-term interest rates, and inflation since the early 1980s—is always negative and significant at the 1 percent level. This means that the dependent variables (namely AGB2YR, AGB5YR, and AGB10YR) have declined over time, which is also evident in figure 1.

Table 3: Long-Run ARDL Results for AGB2YR

Variable	AGB2YR	
TB3M	0.77*** (0.04)	0.82*** (0.06)
CPIEXV	-0.12 (0.09)	-0.18 (0.12)
IPI	0.10* (0.05)	0.10 (0.08)
DEBT	-0.01 (0.01)	-
BBALANCE	-	-0.07* (0.04)
Trend	-0.02*** (0.00)	-0.02*** (0.00)
Constant	3.73*** (0.46)	3.10*** (0.49)
F-Statistic	**8.45**	**7.00**
Error-Correction	-0.59*** (0.10)	-0.51*** (0.09)
Selected Model	ARDL (3,1,3,3,3)	ARDL (3,4,4,3,2)
Time Period	1988Q1–2017Q2	1988Q4–2017Q1

Notes: *** implies statistical significance at the 1 percent level. The numeric value in bold represents a significant *F*-statistic value. The standard error is in parenthesis. The error-correction term is estimated from the short-run equation.

Not surprisingly, the short-term interest rate has the strongest influence on the long-term bond yield. TB3M is significant at the 1 percent level when AGB2YR is used as the dependent variable. The size of this coefficient is 0.77 and 0.82 when DEBT and BBALNCE, respectively, are used. This means that over the long run, approximately 77 to 82 percent of any movement in long-term bond yields can be explained by the short-term interest rates. CPIEXV does not seem to have any statistically significant impact on long-term bond yields. IPI is positive and significant at the 10 percent level when DEBT is included in the equation. This variable is insignificant when BBALANCE is used in the equation, although it displays the expected sign. Among the government finance variables, the debt ratio does not have any significant impact on long-term government bond yields. However, the central government's budget balance ratio is negatively associated with nominal yields on government bonds. This coefficient is significant at the 10 percent level with a magnitude of 0.07. Although marginal, this result suggests that in Australia the government bond yields rise (falls) when there is a fiscal deficit (surplus).

Table 4: Long-Run ARDL Results for AGB5YR

Variable	AGB5YR	
TB3M	0.59*** (0.04)	0.69*** (0.07)
CPIEXV	-0.04 (0.09)	-0.21 (0.16)
IPI	0.13* (0.06)	0.13 (0.09)
DEBT	-0.02 (0.01)	-
BBALANCE	-	-0.13*** (0.05)
Trend	-0.04*** (0.00)	-0.03*** (0.00)
Constant	6.09*** (0.49)	5.28*** (0.62)
F-Statistic	**9.71**	**6.38**
Error-Correction	-0.61*** (0.10)	-0.47*** (0.09)
Selected Model	ARDL (4,3,2,3,2)	ARDL (3,3,4,3,2)
Time Period	1988Q2–2017Q2	1988Q4–2017Q1

Notes: *** and * imply statistical significance at the 1 percent and 10 percent level, respectively. The numeric value in bold represents a significant *F*-statistic value. The standard error is in parenthesis. The error-correction term is estimated from the short-run equation.

Table 5: Long-Run ARDL Results for AGB10YR

Variable	AGB10YR	
TB3M	0.50*** (0.04)	0.51*** (0.05)
CPIEXV	0.05 (0.09)	0.02 (0.09)
IPI	-0.00 (0.04)	-0.03 (0.04)
DEBT	0.00 (0.01)	-
BBALANCE	-	-0.19*** (0.03)
Trend	-0.04*** (0.00)	-0.04*** (0.00)
Constant	7.24*** (0.28)	7.07*** (0.49)
F-Statistic	**9.16**	**7.16**
Error-Correction	-0.61*** (0.09)	-0.61*** (0.09)
Selected Model	ARDL (3,3,0,2,4)	ARDL (4,3,0,2,0)
Time Period	1987Q4–2017Q2	1987Q4–2017Q1

Notes: *** implies statistical significance at the 1 percent level. The numeric value in bold represents a significant *F*-statistic value. The standard error is in parenthesis. The error-correction term is estimated from the short-run equation.

The coefficients of TB3M become smaller as the maturity tenors of government bonds rise. However, irrespective of what tenor of government bond is used as the dependent variable, TB3M always has the strongest impact on long-term bond yields. CPIEXV is always insignificant and IPI is always positive when significant. DEBT does not have any significant relationship with long-term bond yields. BBALANCE is significant at the 1 percent level. The size of this coefficient is -0.13.

Inflation is not statistically significant in these estimates. However, there is a plausible explanation for this. The RBA adjusts its cash rate target in response to available information. If either observed inflation or the inflation expectation is higher (lower) than the targeted level of inflation, then the RBA changes its cash rate target. When either observed or expected inflation

is high (low), the RBA raises (lowers) the cash rate target. As the cash rate target rises (declines), the short-term interest rate rises (declines). Hence, the effect of inflation on long-term bond yields is mainly captured by changes in the short-term interest rate, such as TB3M, rather than directly though inflation.

Some simple econometric models are used to test the hypothesis that a driver of the short-term interest rate is inflation. First, ordinary least squared (OLS) regressions between changes in TB3M and CPIEXV are used. Results are presented in table B5 in appendix B. Both the quarter-over-quarter percentage change (denoted as "Δ") and the year-over-year percentage change (denoted as "Λ") of the aforementioned variables are used for the purpose of regressions. Second, an ARDL regression for TB3M as a function of CPIEXV is used. Results are presented in table B6 in appendix B. These results suggest that the effects of CPIEXV on TB3M in both the short run and long run are positive and statistically significant.

There is some evidence of the conventional view that the government deficit can have an adverse impact on long-term bond yields in Australia. These results somewhat reinforce arguments, put forward by Baldacci and Kumar (2010), Doi, Hoshi, and Okimoto (2011), Gruber and Kamin (2012), Horika, Nomoto, and Terada-Hagawara (2014), Lam and Tokuoka (2011), Poghosyan (2014), and Tokuoka (2012), that the deterioration of the fiscal balance generally raises government bonds' nominal yields, provided other things are held constant. However, it is worth noting that contrary to the conventional view, the models fail to find any evidence that the debt ratio has any effect on government bond yields.

What is definitely clear is that the strongest determinant of yields on sovereign debt in Australia is the short-term interest rate, as Keynes (1930) envisioned. Similar results supporting Keynes's conjecture are reported elsewhere by Akram and Das (2014a, 2014b) and Akram and Li (2018) for Japan, Akram and Das (2015a, 2015b, 2017a, forthcoming) for India, Akram and Das (2017b, 2017c) for the eurozone countries, and Akram and Li (2016, 2017a, 2017b) for the United States. The results provided here support Keynes's view that the short-term interest rate set by the central bank's policy action is the most important driver of the yields on long-term government bonds. Keynes's view is based on his perspective regarding ontological uncertainty

and the formation of investors' expectations (Davidson 2015; Kregel 2011; Akram and Das 2015a; Akram and Li 2017a). The findings of this paper are consistent with the Keynesian view of interest rates and financial markets (Keynes 2007 [1936]; Lavoie 2014; Wray 2012).

Robustness Tests

Diagnostic Tests

A battery of robustness tests, including a set of short-run diagnostic tests and the structural stability test, are conducted to confirm the validity of the models estimated in this paper. Table 6 presents the results for the Breusch-Godfrey serial correlation Lagrange-multiplier (LM) test and the Breusch-Godfrey heteroskedasticity test. The LM tests do not reject the null hypothesis of no serial correlation for any estimated equation. (For all but one equation, the white heteroskedasticity test results show that there is no presence of heteroskedasticity in the error-correction equations.)

Table 6: Tests for Serial Correlation and Heteroskedasticity

Equation	Breusch-Godfrey Serial Correlation LM Test	Breusch-Godfrey Heteroskedasticity Test
AGB2YR=f(TB3M, CPIEXV, IP, DEBT)	0.43	0.79
AGB2YR=f(TB3M, CPIEXV, IP, BBALANCE)	0.02	1.21
AGB5YR=f(TB3M, CPIEXV, IP, DEBT)	0.07	1.47
AGB5YR=f(TB3M, CPIEXV, IP, BBALANCE)	0.16	1.64
AGB10YR=f(TB3M, CPIEXV, IP, DEBT)	0.91	2.70**
AGB10YR=f(TB3M, CPIEXV, IP, BBALANCE)	0.71	1.72

Note: ** implies 5 percent level of statistical significance.

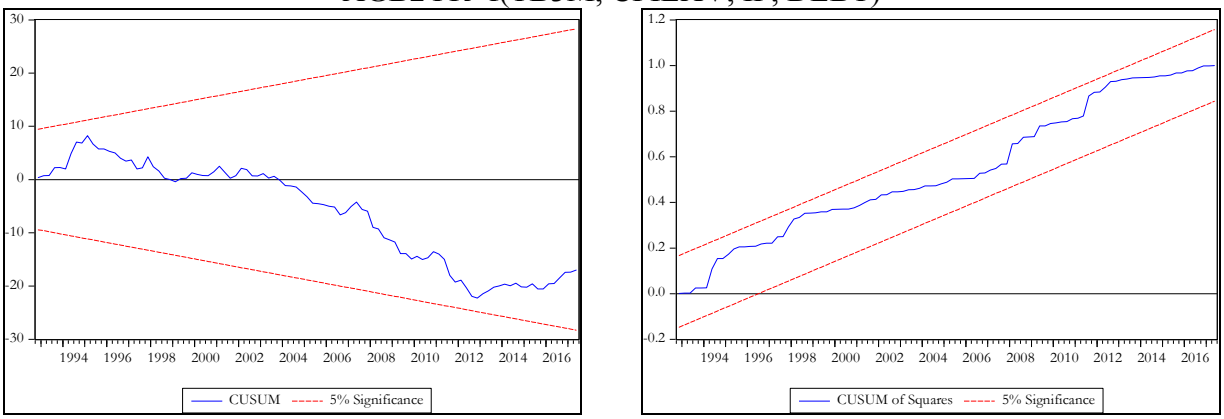
Tests for Structural Stability

Two simple tests for structural stability are performed to examine if the coefficients of the error-correction model are stable over the period under investigation. Plots of the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of the recursive residuals (CUSUMQ) can reveal whether the coefficients of the error-correction term exhibit any structural breaks, as well as for instability of the parameters. From the plots of CUSUM and CUSUMQ (figure 17), it is evident that all the coefficients of the estimated models are stable, as they fall within the critical 5 percent significance bounds. Hence, it can be argued that the relationships between variables are stable and predictable.

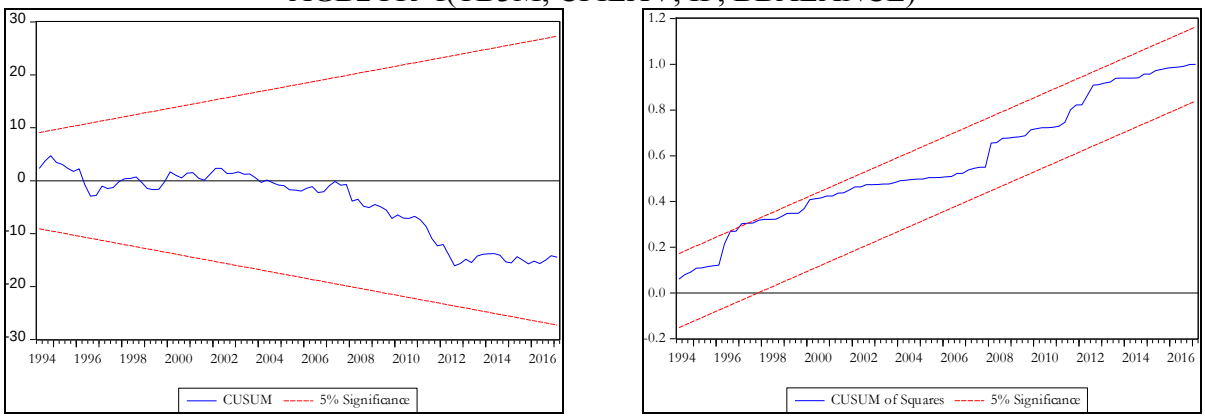
Figure 17: Tests for Stability

Cumulative Sum of Recursive Residuals (CUSUM)	Cumulative Sum of Squares of Recursive Residuals (CUSUMQ)

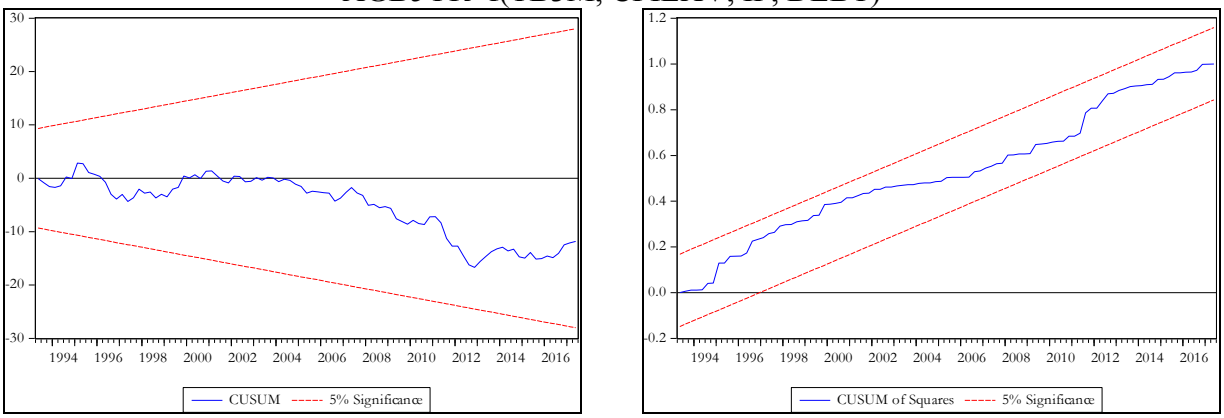
AGB2YR=f(TB3M, CPIEXV, IP, DEBT)



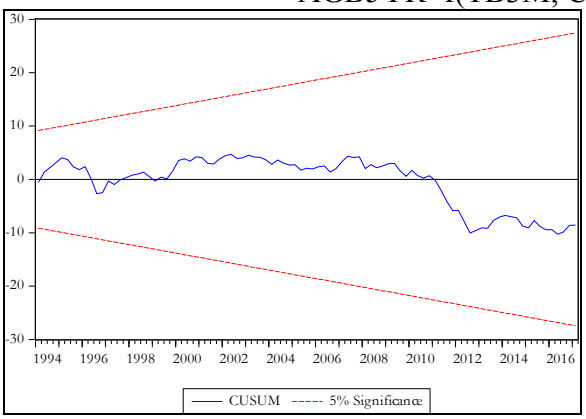
AGB2YR=f(TB3M, CPIEXV, IP, BBALANCE)

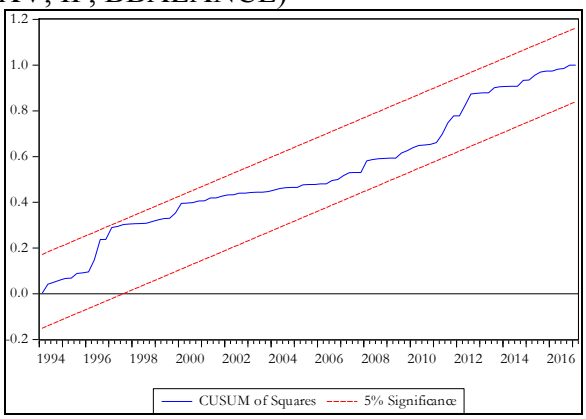


AGB5YR=f(TB3M, CPIEXV, IP, DEBT)

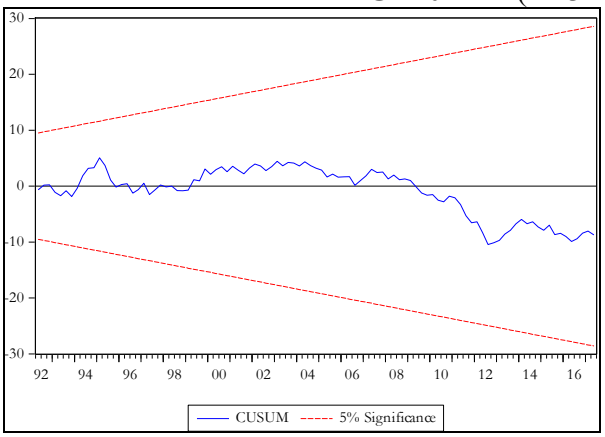


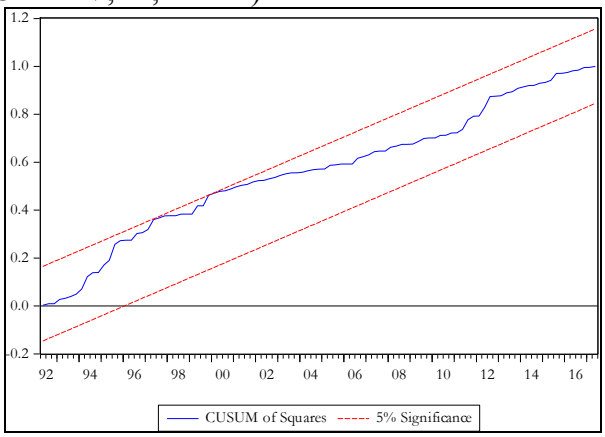
AGB5YR=f(TB3M, CPIEXV, IP, BBALANCE)



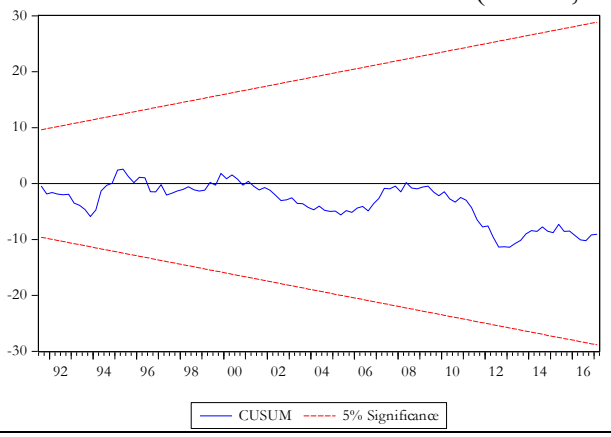


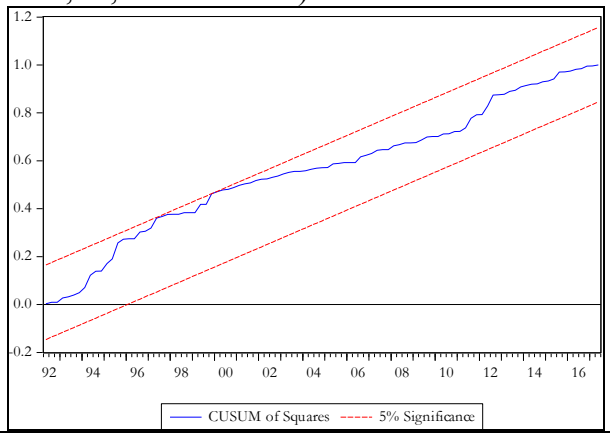
AGB10YR=f(TB3M, CPIEXV, IP, DEBT)





AGB10YR=f(TB3M, CPIEXV, IP, BBALANCE)





VII. CONCLUSION

This section concludes with a summary of the findings, a discussion of the policy implications, and a delineation of relevant topics for further research into the dynamics of government bond yields in the Commonwealth of Australia.

Summary of the Findings

The models estimated in this paper provide strong support for Keynes's (1930) view holding in Australia because the models reveal that the short-term interest rate is the main driver of long-term government bonds' nominal yields in Australia. The application of the ARDL approach shows that Keynes's conjecture holds for the long run in the Australian government bond market after controlling for several key fundamental variables, such as inflation, economic growth, and different measures of the fiscal ratio. However, the estimated models also reveal that there is some ambiguity about the effect of the fiscal ratio on government bond yields. While the ratio of the budget balance exerts a small but statistically significant effect, the debt ratio does not have any discernable effect. These findings contribute to the ongoing debate about the drivers of government bond yields by examining the case of Australia. These findings also contribute to providing some empirical perspectives that can illuminate issues related to controversies in macroeconomics regarding the fiscal theory of price, the theory of modern money, and the economic effect of fiscal stimulus and fiscal policy.

Policy Implications

The main policy implication of these findings is that the RBA's monetary policy action is the critical factor in determining government bond yields. If the authorities are willing to use monetary policy action then they can prevent a spike in government bond yields and the RBA's actions can keep yields largely in check. An understanding of the determinants of long-term government bond yields in Australia can be quite useful, particularly as the Commonwealth authorities may need to engage in changes in fiscal and monetary policy if the country were to face economic slowdown, encounter a financial shock, witness drastic change in its terms of trade, or experience increased exchange rate volatility.

Further Research

There is scope for further empirical research on the determinants of AGB yields. First, it would be useful to analyze the effects of additional variables, such as credit flows, global financial flows, nominal effective exchange rate, and volatility and risk aversion in global financial markets. Second, it might be fruitful to analyze whether AGB yields are correlated with government bond yields in other advanced countries, such as the United States, Japan, and the United Kingdom. Third, models that use higher-frequency data based on monthly and daily variables can provide valuable insights. The authors expect to extend the research on the determinants of AGB yields along these lines in the near future.

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APPENDIX A: ADDITIONAL UNIT ROOT TESTS

Table A1: Unit Root Tests Results for Additional Variables

	Augmented Dickey-Fuller Test			Phillips-Perron Test		
Variable	**No Constant or Trend**	**With Constant**	**With Constant and Trend**	**No Constant or Trend**	**With Constant**	**With Constant and Trend**
GB10YR	-1.32 (1980Q2–2017Q2)	-0.70 (1980Q2–2017Q2)	-3.41* (1980Q2–2017Q2)	-1.36 (1980Q2–2017Q2)	-0.61 (1980Q2–2017Q2)	-3.45** (1980Q2–2017Q2)
ΔGB10YR	-12.48*** (1980Q3–2017Q2)	-12.55*** (1980Q3–2017Q2)	-12.52*** (1980Q3–2017Q2)	-12.48*** (1980Q3–2017Q2)	-12.57*** (1980Q3–2017Q2)	-12.54*** (1980Q3–2017Q2)
BB1M	-1.45 (1995Q4–2017Q2)	-1.96 (1995Q4–2017Q2)	-3.04 (1995Q4–2017Q2)	-1.56 (1995Q3–2017Q2)	-1.54 (1995Q3–2017Q2)	-2.38 (1995Q3–2017Q2)
ΔBB1M	-5.83*** (1995Q4–2017Q2)	-5.89*** (1995Q4–2017Q2)	-5.86*** (1995Q4–2017Q2)	-5.85*** (1995Q4–2017Q2)	-5.75*** (1995Q4–2017Q2)	-5.72*** (1995Q4–2017Q2)
BB3M	-1.45 (1980Q2–2017Q2)	-1.70 (1980Q2–2017Q2)	-3.42* (1980Q2–2017Q2)	-1.41 (1980Q2–2017Q2)	-1.51 (1980Q2–2017Q2)	-3.52** (1980Q2–2017Q2)
ΔBB3M	-12.58*** (1980Q3–2017Q2)	-12.59*** (1980Q3–2017Q2)	-12.54*** (1980Q3–2017Q2)	-12.79*** (1980Q3–2017Q2)	-12.84*** (1980Q3–2017Q2)	-12.79*** (1980Q3–2017Q2)
BB6M	-1.42 (1995Q4–2017Q2)	-2.14 (1995Q4–2017Q2)	-3.17* (1995Q4–2017Q2)	-1.52 (1995Q3–2017Q2)	-1.45 (1995Q3–2017Q2)	-2.46 (1995Q3–2017Q2)
ΔBB6M	-6.38*** (1995Q4–2017Q2)	-6.42*** (1995Q4–2017Q2)	-6.38*** (1995Q4–2017Q2)	-6.20*** (1995Q4–2017Q2)	-6.22*** (1995Q4–2017Q2)	-6.18*** (1995Q4–2017Q2)
CPI	-1.89* (1981Q2–2017Q2)	-2.17 (1981Q2–2017Q2)	-2.86 (1981Q3–2017Q2)	-2.02** (1980Q2–2017Q2)	-2.54 (1980Q2–2017Q2)	-3.12 (1980Q2–2017Q2)
ΔCPI	-7.96*** (1981Q2–2017Q2)	-7.99*** (1981Q2–2017Q2)	-7.99*** (1981Q2–2017Q2)	-9.53*** (1980Q3–2017Q2)	-9.55*** (1980Q3–017Q2)	-9.56*** (1980Q3–2017Q2)
CPIWM	-0.63 (2003Q4–2017Q2)	-2.12 (2004Q4–2017Q2)	-2.83 (2004Q4–2017Q2)	-0.71 (2003Q3–2017Q2)	-1.40 (2003Q3–2017Q2)	-1.90 (2003Q3–2017Q2)
ΔCPIWM	-5.04*** (2003Q4–2017Q2)	-4.99*** (2003Q4–2017Q2)	-5.04*** (2003Q4–2017Q2)	-5.10*** (2003Q4–2017Q2)	-5.06*** (2003Q4–2017Q2)	-5.02*** (2003Q4–2017Q2)
CPITM	-0.68 (2004Q4–2017Q2)	-1.75 (2004Q4–2017Q2)	-2.61 (2004Q4–2017Q2)	-0.77 (2003Q3–2017Q2)	-1.53 (2003Q3–2017Q2)	-2.08 (2003Q3–2017Q2)
ΔCPITM	-2.60** (2004Q4–2017Q2)	-2.60* (2004Q4–2017Q2)	-2.67 (2004Q4–2017Q2)	-5.67*** (2003Q4–2017Q2)	-5.64*** (2003Q4–2017Q2)	-5.63*** (2003Q4–2017Q2)

Notes: Δ represents quarter-to-quarter change. The null hypothesis of both the ADF and PP tests is that the series contains unit roots. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent level, respectively. Adjusted sample period is in parenthesis.

APPENDIX B: ADDITIONAL REGRESSION RESULTS

Table B1: ARDL Results with Different Short-Term Interest Rates

Variable	AGB2YR		AGB5YR		AGB10YR			
BB1M	-	-	-	-	0.57***	0.58***	-	-
					(0.09)	(0.10)		
BB3M	-	-	0.60***	0.61***	-	-	0.49***	0.51***
			(0.04)	(0.05)			(0.04)	(0.05)
BB6M	0.81***	0.83***	-	-	-	-	-	-
	(0.05)	(0.05)						
CPIEXV	0.08	0.09	-0.02	0.02	0.18**	0.13	0.06	0.01
	(0.05)	(0.07)	(0.09)	(0.11)	(0.09)	(0.12)	(0.08)	(0.09)
IPI	-0.02	0.07	0.09	0.03	-0.08	-0.08	-0.01	-0.03
	(0.03)	(0.06)	(0.06)	(0.08)	(0.05)	(0.07)	(0.04)	(0.04)
DEBT	0.00	-	-0.01	-	0.02	-	0.00	-
	(0.01)		(0.01)		(0.01)		(0.01)	
BBALANCE	-	-0.06*	-	-0.13***	-	-0.15***	-	-0.19***
		(0.03)		(0.04)		(0.06)		(0.03)
Trend	-0.02***	-0.02***	-0.04***	-0.03***	-0.04***	-0.03***	-0.04***	-0.04***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)
Constant	2.96***	1.42***	3.84***	2.98***	4.10***	2,71***	4..83***	4.01***
	(0.58)	(0.31)	(0.73)	(0.51)	(0.70)	(0.57)	(0.66)	(0.62)
F-Statistic	**4.92**	3.37	**7.19**	**5.72**	**5.49**	**3.70**	**8.67**	**6.80**
Error-Correction	-0.72***	-0.57***	-0.63***	-0.55***	-0.64***	-0.48***	-0.66***	-0.57***
	(0.15)	(0.12)	(0.09)	(0.09)	(0.11)	(0.10)	(0.09)	(0.09)
Selected Model	ARDL (4,3,0,1,4)	ARDL (4,3,0,4,0)	ARDL (4,3,2,3,4)	ARDL (4,3,2,4,0)	ARDL (4,3,0,0,4)	ARDL (4,3,0,0,0)	ARDL (4,3,0,2,4)	ARDL (4,3,0,2,0)
Time Period	1996Q1–2017Q1	1996Q1–2017Q1	1988Q1–2017Q1	1988Q2–2017Q1	1996Q1–2017Q2	1996Q1–2017Q1	1987Q4–2017Q2	1987Q4–2017Q1

Notes: *** and ** imply statistical significance at the 1 percent and 5 percent level, respectively. The numeric value in bold represents a significant *F*-statistic value. The standard error is in parenthesis. The error-correction term is estimated from the short-run equation.

Table B2: ARDL Results with Different Inflation Rates

Variable	AGB2YR		AGB5YR		AGB10YR	
TB3M	0.25	0.76***	0.01	0.48***	0.38***	0.40***
	(0.16)	(0.13)	(0.25)	(0.15)	(0.06)	(0.06)
CPIWM	-0.44**	0.29	-	-	-	-
	(0.18)	(0.18)				
CPITM	-	-	-0.44	0.62***	-	-
			(0.49)	(0.21)		
CPI	-	-	-	-	0.15**	0.13
					(0.07)	(0.08)
IPI	-0.10**	-0.06	-0.22**	-0.12*	0.01	-0/05
	(0.04)	(0.10)	(-0.10)	(0.06)	(0.04)	(0.05)
DEBT	-0.27***	-	-0.36**	-	0.00	-
	(0.07)		(0.14)		(0.02)	
BBALANCE	-	0.05	-	0.08	-	-0.14**
		(0.06)		(0.08)		(0.06)
Trend	0.05**	-0.01	0.09*	-0.02	-0.05***	-0.04***
	(0.02)	0.01)	(0.05)	(0.02)	(0.00)	(0.01)
Constant	0.94***	0.73***	0.06	1.41***		2.61***
	(0.15)	(0.19)	(0.10)	(0.32)		(0.41)
F-Statistic	**7.00**	2.56	3.41	**4.85**		**7.08**
Error-	-0.62***	-0.71***	-0.30***	-0.42***		-0.35***
Correction	(0.09)	(0.17)	(0.09)	(0.10)		(0.35)
Selected Model	ARDL	ARDL	ARDL	ARDL	ARDL	ARDL
	(2,2,0,0,3)	(4,3,2,4,3)	(2,2,4,0,3)	(1,1,3,0,0)	(2,1,2,0,1)	(1,1,2,1,0)
Time Period	2003Q2–	2003Q4–	2004Q2–-	2004Q1–	1980Q3–	1980Q3–
	2017Q2	2017Q1	2017Q2	2017Q1	2017Q2	2017Q1

Notes: ***, **, and * imply statistical significance at the 1 percent, 5 percent, and 10 percent level, respectively. The numeric value in bold represents a significant *F*-statistic value. The standard error is in parenthesis. The error-correction term is estimated from the short-run equation.

Table B3: Long-Run ARDL Results for GB10YR

Variable	GB10YR	
TB3M	0.49*** (0.04)	0.51*** (0.05)
CPIEXV	0.07 (0.08)	0.01 (0.09)
IPI	-0.01 (0.03)	-0.02 (0.04)
DEBT	0.00 (0.01)	-
BBALANCE	-	-0.19*** (0.04)
Trend	-0.04*** (0.00)	-0.04*** (0.00)
Constant	7.33*** (0.45)	6.95*** (0.50)
F-Statistic	**11.15**	**8.70**
Error-Correction	-0.66*** (0.09)	-0.60*** (0.09)
Selected Model	ARDL (3,3,0,0,4)	ARDL (3,3,0,0,0)
Time Period	1987Q4–2017Q2	1987Q4–2017Q1

Notes: *** implies statistical significance at the 1 percent level. The numeric value in bold represents a significant *F*-statistic value. The standard error is in parenthesis. The error-correction term is estimated from the short-run equation.

Table B4: Long-Run ARDL Results for AGB3YR

Variable	AGB3YR	
TB3M	0.67*** (0.09)	0.75*** (0.09)
CPIEXV	0.05 (0.09)	-0.03 (0.11)
IPI	-0.02* (0.05)	-0.03 (0.06)
DEBT	-0.01 (0.02)	-
BBALANCE	-	-0.02 (0.06)
Trend	-0.03*** (0.01)	-0.02*** (0.01)
Constant	4.65*** (1.00)	3.41*** (0.84)
F-Statistic	**4.40**	3.65
Error-Correction	-0.57*** (0.14)	-0.47*** (0.15)
Selected Model	ARDL (4,3,0,1,2)	ARDL (4,3,0,1,2)
Time Period	1996Q2–2017Q2	1996Q2–2017Q2

Notes: *** and ** imply statistical significance at the 1 percent and 5 percent level, respectively. The numeric value in bold represents a significant *F*-statistic value. The standard error is in parenthesis. The error-correction term is estimated from the short-run equation.

Table B5: Short-Run Relationships between TB3M and CPIEXV

Variable	ΔTB3M	ΔTB3M
ΔCPIEXV	0.28**	-
	(0.12)	
ΔCPIEXV	-	0.45***
		(0.16)
Constant	-0.07	0.13

Notes: *** and ** imply statistical significance at the 1 percent and 5 percent level, respectively. Standard errors are in parenthesis.

Table B6: Long-Run Relationships between TB3M and CPIEXV

Variable	TB3M
CPIEXV	1.11*** (0.34)
Trend	-0.04*** (0.01)
Constant	6,46*** (2.05)
F-Statistic	**8.14**
Error-Correction	-0.14*** (0.04)
Selected Model	ARDL (4,3)
Time Period	1988Q3–2017Q2

Notes: *** implies statistical significance at the 1 percent level. The numeric value in bold represents a significant *F*-statistic value. The standard error is in parenthesis. The error-correction term is estimated from the short-run equation.