South African Reserve Bank Working Paper Series WP/22/10

Can National Treasury do contractionary monetary policy?

Luchelle Soobyah and Nicola Viegi

Authorised for distribution by Konstantin Makrelov

10 August 2022

South African Reserve Bank

South African Reserve Bank Working Papers are written by staff members of the South African Reserve Bank and, on occasion, by consultants under the auspices of the South African Reserve Bank. The papers deal with topical issues and describe preliminary research findings, and develop new analytical or empirical approaches in their analyses. They are solely intended to elicit comments and stimulate debate.

South African Reserve Bank Working Papers are externally refereed.

Information on South African Reserve Bank Working Papers can be found at
https://www.resbank.co.za/en/home/publications/Papers/working-papers

Enquiries relating to the Working Paper Series can be addressed to:

Head: Economic Research Department
South African Reserve Bank
P O Box 427
Pretoria 0001

Tel. +27 12 313 3911

Can National Treasury do contractionary monetary policy?

Luchelle Soobyah*and Nicola Viegi†

August 2022

Abstract

The long end of the South African yield curve has remained sticky and high for quite some time now, despite a low interest rate environment. In this paper we analyse the role of fiscal policy and its debt maturity structure which is producing this "monetary contraction" through its effect on the long end of the yield curve. We consider National Treasury's government bond switch auction programme and its impact on bond yields and the economy. We show that these switch auction announcements have resulted in increased yields and shocks to bond prices via increased modified duration or price sensitivity. Using these shocks to bond prices as an instrument for debt, we find that the switches have also resulted in a contractionary effect on output and monetary policy.

JEL classification: E50, E60, E62, H63

Keywords: Fiscal policy, government debt maturity structure, bond switch auctions, instrumental BVAR

*South African Reserve Bank, PO Box 427, Pretoria, South Africa, 0001. Email: Luchelle.Soobyah@resbank.co.za. The views expressed are those of the author(s) and do not necessarily represent those of the South African Reserve Bank or Bank policy. While every precaution is taken to ensure the accuracy of information, the South African Reserve Bank shall not be liable to any person for inaccurate information or opinions contained herein.

†University of Pretoria. Email: Nicola.Viegi@up.ac.za

1. Introduction[1]

The generalised increase of public debt around the world in response to two global crises has brought to the fore of the research and policy agenda the interaction between monetary and fiscal policy (Gopinath 2021). The focus of the debate is how unsustainable fiscal policy puts pressure on monetary policy to monetise public debt accumulation, thereby undermining central bank credibility and stable macroeconomic outcomes.

Less studied is the way debt management influences the economy and monetary policy through its effect on the yield curve and expectations of future inflation. This paper studies this interaction in the case of South Africa, where public debt has increased rapidly in the last 10 years. In addition, National Treasury (NT) has consistently followed a policy of lengthening the government debt maturity structure to minimise default risk.

One of the measures undertaken by NT to achieve this has been the institution of a government bond switch auction programme that involves repurchasing or switching of a bond before it matures in exchange for bonds of a longer maturity.[2] These programmes are common practice among public debt management officials and can be used for a number of reasons, such as to manage rollover risk and liquidity risks and optimise the borrowing cost for the government.[3] The NT switch auction programme has evolved over the years, with its goals changing from debt consolidation and building of benchmark bonds, to managing government refinancing risk.[4]

Standard theory (Modigliani-Miller and Ricardian equivalence) suggests that, in principle, a change in the maturity structure should have no macroeconomic effect. However, findings show that lengthening the maturity structure of public bonds increases the inflation risk of holding bonds in domestic currency, which is compensated for with a higher term premium. The balance between the reduction in default risk and the increase in inflation risk determines the effect of the change in the debt maturity structure on the yield curve and ultimately on the economy (Arellano and Ramanarayanan 2012). This is particularly relevant for monetary policy as the size and structure of public debt directly affects private sector expectations of future inflation and the credibility of the anti-inflation stance of central banks (Cochrane 2001).

In this paper we first consider how the South African National Treasury bond switch auction programme works and its contribution to lengthening the government debt maturity structure,

[1] We thank Thembi Mda and Mulalo Mamburu for their excellent discussion and contribution to understanding the National Treasury's switch auctions and their assistance with data and analysis of this. We also thank Henk Janse van Vuuren and Musa Khandela for their valuable discussions and comments.

[2] A bond buyback allows the issuer to pay off an outstanding debt before its maturity date with a cash payment. The bond switch (sometimes referred to as bond exchange) is similar but, instead of a cash payment, there is an issuance of new debt.

[3] Refinancing/rollover risk is the risk that debt will have to be rolled over at unusually high cost or cannot be rolled over at all. Liquidity risk is the risk that the issuer or buyer will be unable to easily and quickly sell or purchase a bond at a fair price in the market.

[4] Benchmark bonds are the most liquid bonds and are used as a standard against which other bonds' performance is measured. These bonds are typically 10-year bonds or are of longer maturity, such as the R108 bond which was a benchmark bond for South African government bonds.

as well as its impact on the yield curve. In general, a public debt manager (such as NT) would wish to optimise the debt maturity structure, taking into account many factors such as interest payments on the debt and refinancing risks which increase or decrease depending on the maturity structure.

We show the impact of these switch auctions on the NT debt maturity profile and evaluate the contribution of the length of the maturity profile to the steepness of the sovereign yield curve during the period of rapid debt accumulation.

Finally, we estimate the exogenous effects of fiscal policy on economic activity and monetary policy using the switch auctions as an external instrument in a Bayesian vector autoregression (BVAR) model. We estimate this model for the South African economy, following the methodology in Gertler and Karadi (2015) and Miranda-Agrippino and Ricco (2019). Our method deals with both the challenge of fiscal foresight (Ramey 2011) and the problem of omitted variable bias from small structural VAR models.

In particular, the instrument we use is the rand per point (also known as the dollar value per basis point) or price sensitivity of bonds calculated on the days of the switch auctions since 2011.[5] Our results suggest that fiscal debt and its maturity structure have a direct effect on the efficiency of the monetary transmission mechanism in two important ways: first, the lengthening of the debt maturity structure in times of fiscal uncertainty weakens the link between the monetary policy rate and long-term rates; second, a fiscal expansion financed by long-term debt induces a contraction equivalent to a monetary policy contraction by increasing expected inflation and expected future policy rates. These results suggest that South Africa shows initial signs of a fiscal dominant regime (Leeper 1991; Bassetto and Sargent 2020) and that fiscal policy and government maturity structure, at high levels of debt, have a direct effect on the monetary policy space.

The paper provides three main contributions. First, it analyses for the first time the contribution of the debt maturity structure to the slope of the yield curve, which in South Africa is particularly steep (Soobyah and Steenkamp 2020). Second, we directly connect the steepness of the yield curve, which plays an important role in determining the effects of the maturity structure, with expectations of future monetary policy (Corhay et al. (2014) and Corhay et al. (2016)). Third, we identify the effect of a debt shock to the economy by using switch auctions as an instrument for debt shocks. We show that, in the period considered, fiscal policy had a clear contractionary effect on the economy due to its effect on inflation and default risks, which outweighed any positive demand effect.

This paper is related to the literature on debt maturity structure and its effect on the economy and on the credibility of the government's anti-inflation stance (Dornbusch and Draghi 1990). For Organisation for Economic Co-operation and Development (OECD) countries, Missale and Blanchard (1991) find an inverse relation between the level of debt and its maturity when debt

[5] Rand per point or dollar value of a basis point is a measure of price sensitivity of a bond or market instrument to interest rate changes.

is high. They argue that at high levels of debt, and steeper yield curves (as a result of high term premia), as is the case in South Africa, governments face high debt-service costs. To minimise these costs, new debt issued by the government should be short-dated so as to shorten the maturity of debt. On the other hand, Lorenzoni and Werning (2019) find that a country's vulnerability to a debt crisis is affected by the maturity of debt (together with the level of debt and fiscal policy regime). They find that a longer debt maturity structure plays a role in preventing a debt crisis. In this paper we indirectly test these theories as well as the fiscal theory of the price level, which describes fiscal and monetary policy rules such that the price level is determined by government debt and fiscal policy alone, with monetary policy playing at best an indirect role. There is evidence of fiscal dominance if an increase in the debt maturity structure increases future inflation expectations and hence expected future short rates.

The paper is organised as follows: in the next section we outline the maturity structure of South African government debt and describe in detail the switch auction programme of the South African National Treasury. In section 3, we analyse the effect of the switch auction on the government yield curve. In section 4, we describe our measure of an exogenous fiscal shock, constructed from the switch announcement, and use this as an instrument for debt in a BVAR model to show the monetary effect of fiscal policy. Section 5 concludes.

2. Debt accumulation and debt maturity structure in South Africa

2.1 Consistently high long-term issuance

It is usually assumed that emerging markets have a short-term structure in their debt maturity profile. However, in contrast, South Africa has been able to issue long-term loans for quite some time. Table 1 below shows the average maturity of government debt for several countries. Strikingly, South Africa has one of the longest debt maturity profiles among its emerging market peers and this has increased at a rapid pace. Unlike many countries, South Africa has been privileged with access to markets that allow for a longer-term debt maturity profile than other countries. The Bank for International Settlements (BIS) reports that the average maturity of remaining government debt in South Africa by the end of 2020 was 14.8 years compared to the emerging market average of eight years.

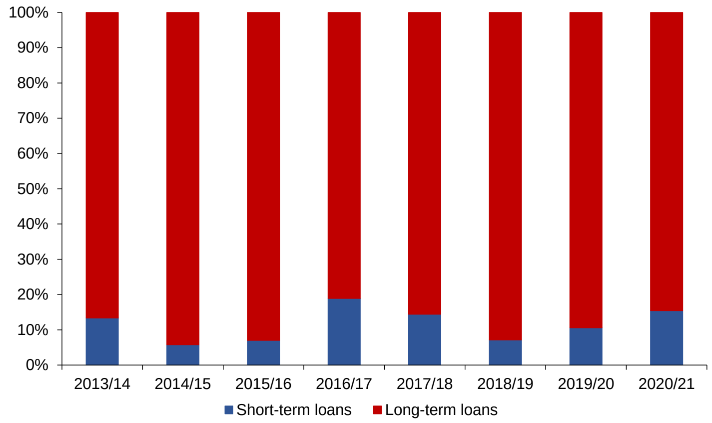
Table 1: Average maturity of government debt (years)

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Argentina	12.4	12.2	12.0	11.9	12.1	11.8	10.9	9.8	8.2	7.0	6.4	4.7	5.0	6.7
Brazil	3.0	3.3	3.4	3.4	3.5	3.8	4.1	4.3	4.4	4.4	4.1	4.0	3.8	3.4
Colombia	4.1	4.4	5.1	5.1	5.2	5.4	5.6	5.9	6.3	6.5	6.5	6.8	7.0	7.8
Hungary	4.0	3.8	2.7	2.9	3.6	3.2	3.1	3.6	3.6	3.4	3.3	3.3	3.9	5.4
India	10.6	10.5	9.8	9.8	9.6	9.7	10.0	10.2	10.5	10.7	10.6	10.4	10.7	11.3
Indonesia	8.2	8.2	7.9	8.6	9.2	9.9	10.0	9.7	9.3	9.1	8.0	8.0	8.0	8.0
Malaysia	5.4	5.3	5.3	4.5	5.1	5.5	5.8	6.2	5.4	5.1	6.7	6.9	7.5	8.0
Mexico	5.6	6.4	6.3	7.1	7.5	7.9	7.8	8.0	7.8	7.9	8.0	8.0	7.8	7.8
Peru	11.7	12.6	13.3	14.0	13.4	13.2	13.6	13.5	12.9	12.8	12.5	11.4	11.8	10.9
South Africa	8.5	10.0	10.6	10.6	11.6	12.3	13.3	14.2	15.7	16.0	16.6	16.6	16.1	14.8
Thailand	5.8	5.8	5.8	6.0	6.6	7.7	8.3	9.8	10.6	10.9	15.2	12.1	13.0	12.0
Turkey	1.1	1.9	1.9	2.5	2.5	2.7	2.3	4.5	4.5	4.3	4.1	3.8	3.0	2.8

Source: BIS, Debt security statistics

In addition, the issuance of new government debt has been consistently concentrated in long-term debt — see Figure 1. Around 10% of the funding requirement is financed by issuance of short-term loans, whereas long-term loan issuance accounts for almost 90% of total domestic loans.

Figure 1: Composition of government debt



Source: National Treasury

The accumulation of debt since 2007 has reached a point of possibly becoming unsustainable. High debt levels can increase refinancing risk, with large amounts of debt maturing in the near term, leaving government vulnerable to changes in market conditions. One way in which the growing debt problem and refinancing risk is managed by NT is through bond buybacks (i.e. repurchasing a bond before maturity to reduce the outstanding amount) and bond switches (i.e. exchanging short-dated debt for longer-dated bonds, referred to as source and destination bonds respectively).

2.2 The NT switch auction programme

The programme has evolved over the years, with its goal changing from debt consolidation and building of benchmark bonds to managing government refinancing risk. We consider the two most recent programmes, from 2011 to 2013 and 2015 to 2019.

Following South Africa's recession in 2009, the 2010/11 national budget made provision for government to manage refinancing risk resulting from lower tax revenue by switching out bonds maturing in 2012 to 2014. A total of R55 billion was switched from 2010/11 to 2012/13. Table 2 shows the average maturities of the bonds and amounts switched. The switch auctions were conducted according to a set calendar and fixed amount on offer. The source and destination bonds were announced a week in advance, with only one source and one destination bond in the auction. Each auction was conducted on a competitive basis, with the switch auction allocated to the best bids.

Table 2: Details of the bond switch auction programme, 2011 to 2013

	Average maturity of source bond (years)	Average maturity of destination bond (years)	Amount of source bonds switched (R'm)	Amount of destination bonds switched (R'm)
2011	0.99	21.15	12 425	14 995
2012	2.36	16.95	35 645	32 775
2013	1.50	13.00	10 480	9 424

Source: National Treasury

Following from the global financial crisis, NT primarily issued bonds of three- to 10-year maturities, given risk aversion and demand for shorter-dated debt. This resulted in high redemptions from 2017/18 to 2020/21. The switch programme was therefore reintroduced in 2015 to deal with the resultant refinancing risk. Table 3 shows the average maturities of the bonds and amounts switched. The auction calendar was eliminated and switches were conducted on an ad hoc basis, with an announcement made 24 hours before the auction. Multiple potential source and destination bonds were announced, with the actual bonds on auction announced 15 minutes before the auction began. Multiple source and destination bonds could be switched in the same auction. Auctions were also conducted on a non-competitive basis with yields for the source and destination bonds set at the market rate – bids outside the set rates were not accepted. The amount per switch auction was not fixed, but rather based on market demand, with some auctions switching as little as R1 billion while some switched as much as R23 billion. The programme continued on an ad hoc basis until 2019 and then was discontinued. This was because it created a lot of market volatility due to the uncertainty around the timing and size of the switch auctions. There was also a dramatic decline in the R207 and R208 bond yields due to price distortion along the yield curve, whereby market participants would anticipate the switch auction and potential switch bonds. Participants would then try to make a profit buying source bonds and causing their yields to fall and selling destination bonds, driving their price down (and yields up). A revised switch programme with an auction calendar was released in NT's 2020 *Medium Term Budget Policy Statement*. To date, there have not been many switches from this new released calendar. Some of the switch auctions planned in the

2020/21 calendar were cancelled last minute (25 March 2021), causing market volatility. The new switch programme also outlines the amount to be switched in each auction.

Table 3: Details of the bond switch auction programme, 2015 to 2019

	Average maturity of source bond (years)	Average maturity of destination bond (years)	Amount of source bonds switched (R'm)	Amount of destination bonds switched (R'm)
2015	4.86	17.64	103 180	98 793
2016	2.38	19.83	32 270	24 143
2017	1.54	19.10	52 730	56 481
2018	1.18	21.08	36 335	38 248
2019	0.72	15.93	12 795	14 152

Source: National Treasury

The result of this switch auction programme was a shift in the composition of debt skewed towards the ultra-long end of the yield curve. Table 4 shows that the share of bonds outstanding with short-term maturity has decreased from around 10% to 7%, whereas the share of ultra long-term bonds have increased from 49% to 59% between 2015 and 2019. The NT's bond switch programme has contributed toward this shift in the debt maturity structure, with shorter-term bonds being switched for much longer-term bonds (15 to 30 years).

Table 4: Composition of government bonds

Bond maturity	As at 31 Mar 2015 (R'bn)	As at 31 Mar 2019 (R'bn)
Short term (1-3 yrs)	133.97 (10.4%)	142.87 (7.37%)
Medium term (3-7 yrs)	260.4 (20.29%)	358.05 (18.48%)
Long term (7-12 yrs)	265.96 (20.73%)	292.26 (15.08%)
Ultra long term (12 yrs +)	622.93 (48.5%)	1144.76 (59.07%)

Source: National Treasury

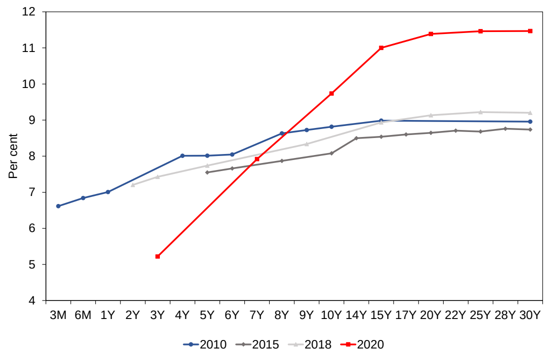
As a result of elevated debt, NT lengthened the maturity structure of debt as much as possible to reduce the risk of refinancing (or liquidity risk). In both bond switch auction programmes, source bonds with short maturities were exchanged for mostly long- and ultra long-dated maturities. Across the two programmes, the average maturity of the source bonds was two years, while the average maturity of destination bonds was between 15 to 20 years. This therefore increased government's long-dated issuance and therefore lengthened the debt maturity structure. However, it also comes with a cost and we test the effect of the lengthened maturity structure due to the exogenous policy change by using the event of the switch auctions.

3. Maturity structure impact on the yield curve

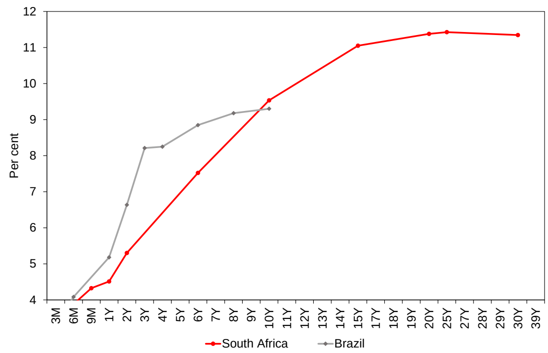
The South African yield curve has steepened over the years. Figure 2 shows the sovereign yield curve evolution over the last 10 years and it is clear that there has been an upward shift and steepening of the curve. Yields at the short end of the curve have fallen from around 7% to 5% over the last decade, whereas the long end has increased by around 250 basis points. What's even more striking is the comparison to a peer country such as Brazil with similar fiscal dynamics to South Africa. While both have seen very steep yield curves in recent times, the length of the maturity structure for South Africa is extremely long and this is quite unique. The longest-dated bond for Brazil is 10 years, whereas South Africa issues 30-year government bonds. The policy intention of NT would be to optimise the maturity structure but what is the external effect of this longer maturity structure? In this paper we analyse the effect of the switch auction in lengthening the maturity profile and assess the macroeconomic effects, using the event of the switches, to identify the impact of the longer maturity debt structure.

Figure 2: Sovereign yield curves

Evolution of the South African sovereign yield curve



Comparison of South Africa's and Brazil's yield curve (as at 04/05/2021)



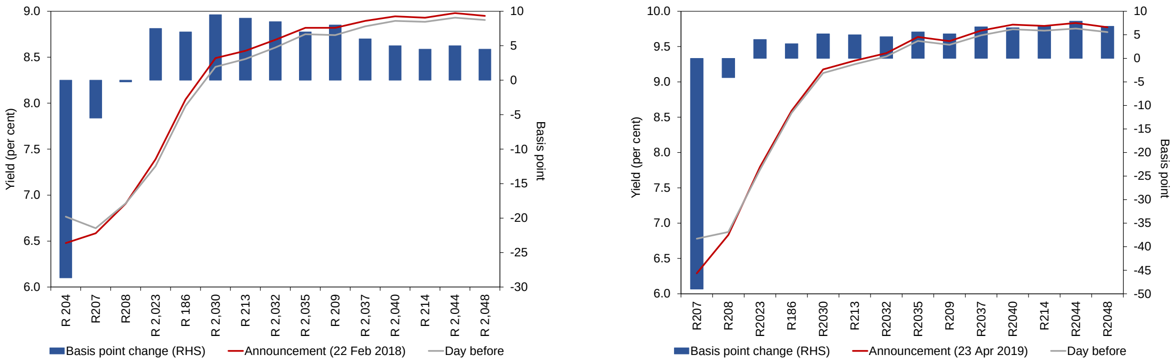
Source: Bloomberg

While the long maturity profile of government debt has the benefit of reducing near-term refinancing risk, it also comes with potential costs. Long-dated bonds tend to have higher yields since they embed higher term premia. As discussed, extending the debt maturity profile through switches has the same effect as outright issuance of long-term debt, increasing debt-service costs for NT. Another drawback of bond switches is potential price distortions along the yield curve. Source bond yields tend to decline over time as the market buys these bonds (thus pushing up their price) in anticipation of a switch. This could create an "unnatural" demand for such bonds, reducing the yield and increasing the price of the bond.[6] A further possible price distortion occurs in the market following the announcement of a switch auction. On announcement, the market may immediately start to push the prices of the source bonds higher so it can exchange such bonds for higher amounts of the destination bonds. Figure 3 shows the yield movements following the announcement of two switches (one in 2018 and another in 2019). On both of these switch announcements, there was an upward shift at the long end of the curve and slight downward shift at the short end – resulting in a steeper sovereign yield curve. While there are many factors that could have caused the yield curve to shift on these specific days, it is plausible that these shifts were primarily due to the switch auction announcement, as it resulted in more long-dated bonds being issued and thus potentially higher yields at the long end of the curve.

Another drawback, specific to the second switch programme between 2015 and 2019, is the volatility caused by uncertainty around the timing and size of the long-dated supply for the

[6] There is no real demand for these bonds at the time. Instead it is market participants pushing up the price to take advantage of the switch and to profit from the anticipated switch.

Figure 3: Steepening of yield curve on day of announcement of switch auction



Source: Bloomberg, author

switch. Some switches have been as large as R23 billion, injecting significant debt issuance into the market in one day, over and above the R4.5 billion issued in the weekly fixed-rate bond auction. This could cause rates on long-end bonds to increase and remain elevated for some time following the auction, leading to an even steeper yield curve and higher debt-service costs.

It appears from above that there is movement in bond yields at the time of the switch auction announcement. We therefore estimate some simple ordinary least squares (OLS) regressions to determine the impact of the switch announcements on yields of bonds at different maturities. We follow Nakamura and Steinsson (2018) in their high frequency identification approach of identifying a “policy news shock” and estimating the effect of policy surprises on nominal yields, real yields and inflation expectations. However, in our case this policy shock is the announcement of the switch auction and instead of a 30-minute window around the announcement time, we use a one-day change.[7] The policy shock is estimated by the first principle component of the change in forward rate agreements (FRAs) at different horizons on the day of the announcement from the day before.[8] We run individual OLS regressions on the following specification for each instrument we’re interested in at different maturities:

$$\Delta i_t = \beta + \gamma(\Delta shock_t) + \varepsilon_t \quad (1)$$

[7] It would have been ideal to use a tighter window since, as Nakamura and Steinsson (2018) point out, a smaller window size addresses the endogeneity problem and prevents spurious variation in the shock and any contagion effect from other information incorporated in financial markets. In this instance it is unlikely that shocks unrelated to the announcement would occur at the same time. We did not have intraday data available and therefore used daily changes, which potentially incorporate additional information impacting the financial markets on the day and we therefore interpret these results with some caution.

[8] While the FRAs represent monetary policy expectations, we believe that they capture this monetary effect from the fiscal action. So they capture the effect of the fiscal shock on interest rates. We have, however, also estimated this using a swap curve, using credit default swaps (CDS) instead of the FRAs to capture the effect of the fiscal shock or announcement on market instruments. We found that the results are robust and suggest that the switch announcement has resulted in an increase in yields and expectations. These estimates are given in the Appendix.

In this equation i_t represents the instrument we're interested in (i.e. nominal yields, real yields or inflation expectations from breakeven inflation rates); $shock_t$ is the policy shock; ε_t is the error term; and the Δ represents the change in these variables on the day of the switch announcement from the previous day. The results are given in Table 5 below. The first and second columns reflect changes in the nominal yields and real yields respectively, whereas the third column reflects changes to the breakeven inflation rates or (market-implied) inflation expectations. The effect on the nominal yields is significant across the maturity spectrum of the nominal yield curve and suggests that a 1 basis point change in the policy shock results in approximately a 2.5 basis point increase in nominal bond yields on average. The effect on real yields is smaller, at around 0.5 basis points, and on breakevens it is largest at the five-year horizon at 2.05 basis points. It is important to note that breakeven rates, which represent market expectations of inflation, are composed of an inflation expectations component as well as an inflation risk premium. The results thus suggest that the switch auction is increasing expectations of higher inflation and/or increasing the inflation risk premium, as well as increasing expectations of future short rates and/or increasing the term premium.[9] This implies that the effect of the switch auction on the increase in yields is through an expectations component.

Table 5: Response of interest rates and breakeven inflation rates to the policy shock

	Nominal	Real	Inflation
1yr bond yield	2.34***		0.40
	(0.28)		(0.27)
2yr bond yield	2.69***		
	(0.39)		
5yr bond yield	2.40***	0.43	2.06***
	(0.31)	(0.28)	(0.53)
10yr bond yield	2.32***	0.62*	1.89**
	(0.35)	(0.33)	(0.58)
15yr bond yield	2.35***	0.51**	1.94**
	(0.35)	(0.25)	(0.62)
20yr bond yield	2.30***	0.77**	1.64***
	(0.36)	(0.35)	(0.43)
25yr bond yield	3.56***	0.51	
	(0.92)	(0.34)	
30yr bond yield	2.57***	0.49	
	(0.46)	(0.35)	

The independent variable in each regression is the policy shock which is estimated by the first principle component of the change in FRAs at different horizons on the day of the announcement from the day before.
Regressions are run individually for each nominal and real yield, and breakeven rate at each maturity shown in column one. Therefore each entry in the table represents the change in the nominal yield, real yield or breakeven rate at each maturity (in column one) for a 1 basis point change in the policy shock.
All variables are differenced/one day changes and stationary.
Missing values are because there are no bonds or rates at the specified maturity/tenor given in coloumn one.
*, ** and *** indicate 10%, 5% and 1% level of significance. Standard errors in parentheses.

This indicates that, around the time of the switch announcement, there is movement of the yield curve with yields at all maturities increasing. We also show this graphically in the Appendix

[9] Since the nominal yields comprise a term premium and expectations of a future short rate or the policy rate, and the difference between the nominal and real yield is the breakeven rate or the sum of inflation expectations and a risk premium.

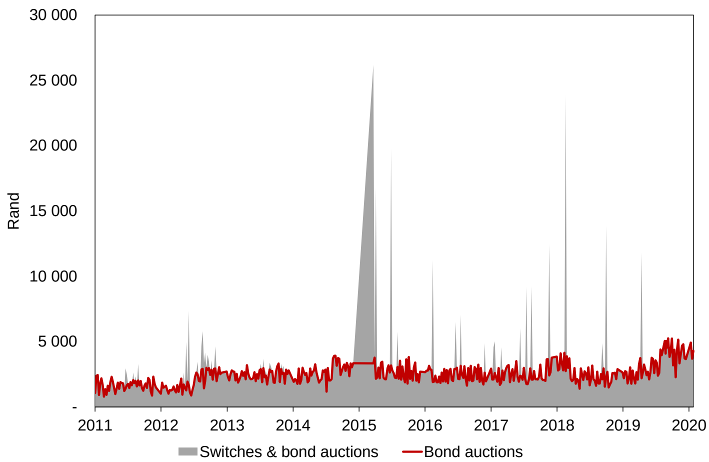
with the charts depicting changes in yields of government bonds at different maturities on the day of the switch announcement. But what is the cost of these switches in increasing yields? We next examine the external effect on the economy. We assess the implications of this debt shock to the yield curve on the monetary policy transmission mechanism.

4. The macroeconomic effect of the NT switch auction announcement

4.1 A proxy measure of fiscal shocks

NT lengthens the maturity of the debt structure as a way to respond to fiscal risk, but what is the cost of this? We calculate the potential costs or risks associated with the switches by using rand per point (reported by Bloomberg as DV01), which is also known as price value of a basis point (PVBP) or dollar value of a basis point. This indicator measures how a basis point change in the yield affects the price of a bond.[10] The estimated PVBP is used to calculate the total estimated cost of each switch auction and each bond auction (per week per bond) by multiplying the values of total bonds auctioned at each weekly auction and at each switch auction by the rand per point of each bond auctioned at that time. We do this for all auctions conducted in each year between 2011 and 2020.[11] We then add the PVBP calculated per switch auction in each year. Figure 4 shows the estimated PVBP of the weekly bond auctions (red line), which is the price sensitivity or change in market value for a given 1 basis point change in yields. The estimated potential cost to holders of these bonds is within the region of R1 400 to R5 200 (on aggregate) for every 1 basis point change in the yield curve. However, when switches are introduced into the bond market (the grey line shows the potential price changes created by the switches), this adds an additional shock from as a low as R2 300 to as high as R25 000. This implies that, for a 1 basis point change in yields, bond prices could fluctuate by as much as R25 000 on aggregate).[12]

Figure 4: Switch auction shocks

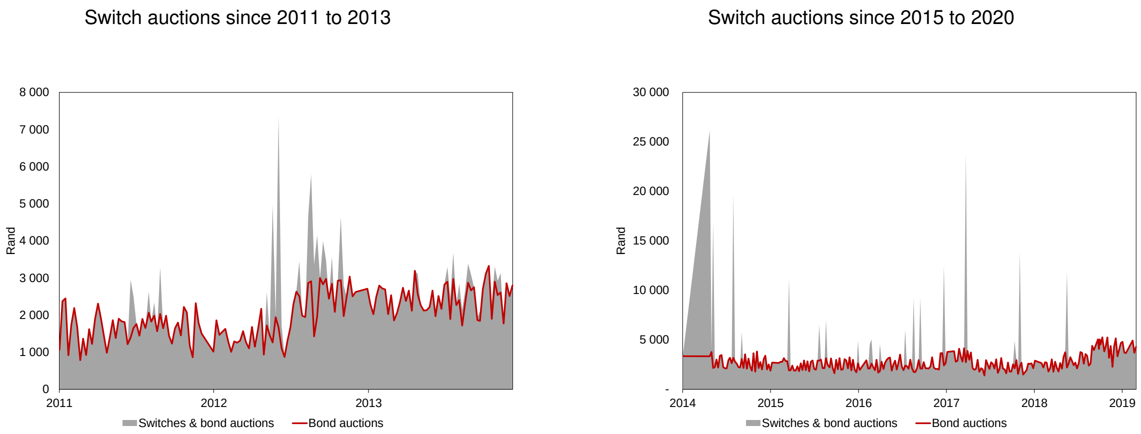


[10] The concept of duration has become an important tool for portfolio managers to understand the sensitivity of bonds (and other market instruments) to changes in the level of the yield curve (Longstaff and Schwartz 1992).

[11] We calculate a total of 60 switch auctions and 431 ordinary bond auctions over this period.

[12] The big spike in 2015 was a result of the introduction of the switch programme in that year and a large quantity of bonds being switched. This also caused some fluctuations in the bond market and yields, resulting in a big PVBP jump.

Figure 5: Switch auction shocks of the two programmes



Source: Bloomberg, SARB, authors calculations

Figure 5 shows the same results split between the two programmes (for when there was a calendar and when it was on an ad hoc basis). There were more switches conducted between 2011 and 2013 (36) than from 2015 to 2019 (19), but the size of the shocks were smaller during the former period. This could be related to the fact that the switches were conducted on a calendar basis from 2011 to 2013 which resulted in less volatility and uncertainty.

4.2 A Bayesian VAR with an instrumental variable

The technical characteristics of the NT switch auctions allow us to investigate the macroeconomic effects of these shocks as a proxy for debt shocks. To identify the impact of policy shocks, we need to observe an exogenous variation in the policy that is not anticipated by the economic agents (Ramey 2011). This identification condition is particularly difficult to satisfy regarding fiscal policy shocks, as most fiscal actions have a long lag from announcement to implementation. Recent literature has overcome this limitation of standard analysis by focusing on natural experiments (McLaren et al. 2014), that is a specific policy decision that can be easily classified as unanticipated, or using narrative approaches (Romer and Romer 2010; Ramey and Shapiro 1998). These approaches can be used to identify policy shocks by analysing the historical record of the policy decisions or by controlling for variables capturing the expectations of economic agents which should include any anticipated policy shocks (Ricco 2015).

The shocks in bond prices from the switch auction are a suitable instrument for debt shocks because they capture the surprise element of the switch announcement. These announcements have been on an ad hoc basis since 2015 and thus are not anticipated by the market. The source and destination bonds are also only known at the announcement and therefore the information is made available to the market at short notice prior to the actual auction. The timing of the switches is based on revenue shocks or fiscal pressures/funding needs by NT, which would assess market conditions to time the switch optimally to mitigate refinancing risk. The combination of unknown (by the market) current NT funding needs and variation in market conditions makes the timing of the switch difficult to predict, which makes it a good proxy for an exogenous policy shock.

We follow Gertler and Karadi (2015) and Miranda-Agrippino and Ricco (2019) and use the shocks to bond prices as an instrument for debt in a BVAR framework to identify the effect of fiscal policy shocks. The BVAR with instrumental variable (IV) framework is convenient because our sample size is relatively small, which precludes the use of a proxy structural vector autoregression as in Gertler and Karadi (2015). Also, the BVAR addresses the challenges of dimensionality and stationarity. Furthermore, it allows the inclusion of a relatively large number of variables and hence we can assess the impact on a number of economic and financial indicators. Since we identified the fiscal shock (or debt variable) with an instrumental variable (from the event of the switch), it is also perfectly identified.[13]

We convert the high-frequency measure of our shock to a monthly frequency by summing the shocks within a month, following Miranda-Agrippino and Ricco (2019). In our case this turns out to be of little importance, as we usually have not more that one shock per month.[14] Using monthly data from 2000 to 2020, we include the following variables in the simple BVAR: debt stock, industrial production, headline inflation, 3-month Johannesburg Interbank Average Rate, long-term bond yield (i.e. the yield on a 10-year government bond), term premium, real effective exchange rate (REER) and the Johannesburg Stock Exchange (JSE) All-Share Index (ALSI). We use the switch announcement as a proxy for the interest rate shock caused by fiscal policy.

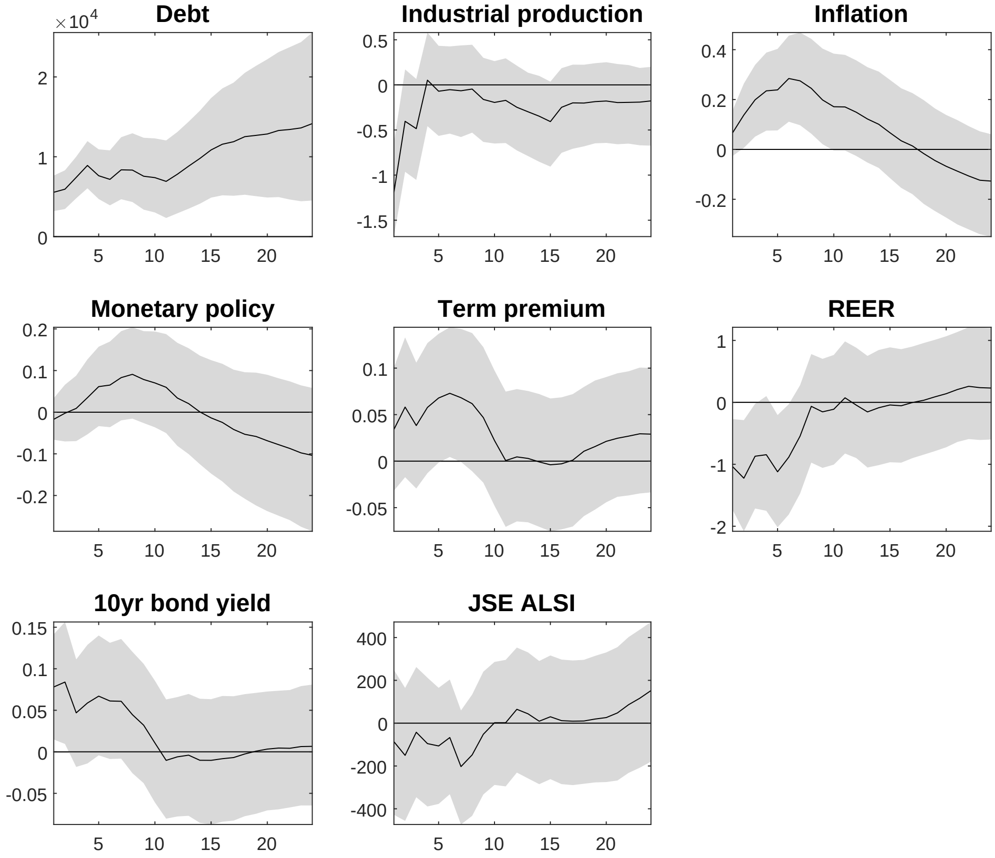
The impulse response functions (IRFs) from the BVAR with eight variables and a shock to the debt variable is shown in Figure 6.[15]

[13] We have estimated a small proxy structural vector autoregression as well and the results are robust.

[14] We also used the method by Gertler and Karadi (2015) who accumulate the shocks over the last 31 days prior to the shock and then average these across each day of the month. Our results are similar using this method.

[15] Different identification schemes and variables have been used in the BVAR and the results are robust with the direction being the same. These are shown in the Appendix.

Figure 6: IRFs from a shock to fiscal policy



A shock to debt, or fiscal policy, results in a fall in industrial production and this lasts over several months. There is a contraction in monetary policy in response to the rise in inflation. There is a rise in bond yields, the term premium and a real depreciation of the currency, as one would expect given that fiscal dynamics are deteriorating with an increase in debt. There is also a decline in the JSE All-Share Index price indicating a heightened perceived risk due to the increase in debt. The changes to industrial production and inflation are small and this makes sense given that they respond more to trends. The size of the shock is small and therefore changes resulting from this would be small, nonetheless the direction of the change suggests a steepening of the yield curve (with long bonds increasing by around 10 basis points), resulting from the fiscal shock.

The BVAR with IV was estimated over the entire sample (i.e. 2000 to 2020) which includes both programmes — for when the switches were conducted on a set calendar (2011-2013) and when they were on an ad hoc basis (2015-2019). We also estimate the BVAR with IV for the period 2000 to 2013, so that it just captures the effects from the switches that were conducted as per a set calendar, and then for the sub-sample 2015-2019. The results are different when we exclude the second programme whereby switches were conducted on an ad hoc basis.[16] This suggests that conducting switches on an ad hoc basis resulted in this potential "monetary policy contraction" scenario that we observe over the full sample. This programme created market volatility and distortions along the yield curve and was potentially costly for NT. As a

[16] IRFs over these sub-samples are included in the Appendix.

result, the programme was discontinued and, when it was reintroduced in 2020, NT reverted to a calendar-based switch auction programme to minimise associated uncertainty and market volatility.

5. Conclusion

The increase in South African government debt in the last decade has been accompanied by a shift in government debt issuance, from short- and medium-dated bonds to more long- and ultra-long-dated bonds. This has lengthened the maturity structure of government debt, thus reducing the refinancing risk associated with short-dated debt. In addition, NT has managed the remaining refinancing risk via its bond switch auction programme, which contributed to lengthening the debt maturity structure.

The increase in public debt and its maturity has been accompanied by a steepening of the yield curve and certain stickiness of long-term rates, even when monetary policy was aggressively expansionary in 2020, at the beginning of the global COVID-19 pandemic. This paper analysed the effect of the maturity of government debt on the yield curve and the macroeconomy, using the switch auction as a natural experiment of an unanticipated debt shock.

While standard theory suggests that the maturity structure of government debt should have no macroeconomic effect, our results suggest that the effect is significant. We show that the cost of this maturity structure and switch auctions is a steepening of the sovereign yield curve and increase in price sensitivity of bonds. At the macroeconomic level, an increase in debt puts pressure on inflation and monetary policy, in ways reminiscent of the fiscal theory of the price level in the presence of long-term bonds (Cochrane 2001; Corhay et al. 2016).

An increase in debt has a stagflationary effect with higher inflation, an increase in long-term rates and the term premium, and a contraction in real activity. The effect is a fiscally driven monetary contraction through its effect on the long end of the yield curve.

Therefore, while a long maturity structure of critically large government debt reduces the risk of default, it affects the monetary transmission mechanism by de-coupling long-term rates from the policy rate and by directly affecting inflation and inflation expectations, thus reducing the space for independent monetary policy. In this respect, as we suggest in the title of this paper, NT has a direct effect on the monetary policy domain, which requires better coordination of fiscal and monetary policy.

References

Arellano, C and Ramanarayanan, A. 2012. ‘Default and the maturity structure in sovereign bonds’. *Journal of Political Economy* 120: 187–232.

Bassetto, M and Sargent, T J. 2020. ‘Shotgun wedding: fiscal and monetary policy’. *Annual Review of Economics* 12: 659–690.

Cochrane, J H. 2001. ‘Long-term debt and optimal policy in the fiscal theory of the price level’. *Econometrica* 69: 69–116.

Corhay, A, Kung, H and Morales, G. 2014. ‘Government maturity structure shocks’ .
URL https://carlsonschool.umn.edu/sites/carlsonschool.umn.edu/files/inline-files/paper_-_howard_kung.pdf

Corhay, A, Kung, H and Morales, G. 2016. ‘Government maturity structure twists’ .
URL https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2766020

Dornbusch, R and Draghi, M. 1990. *Public debt management: theory and history*, Cambridge University Press.

Gertler, M and Karadi, P. 2015. ‘Monetary policy surprises, credit costs, and economic activity’. *American Economic Journal: Macroeconomics* 7: 44–76.

Gopinath, G. 2021. ‘The interaction of fiscal and monetary policy’. *International Monetary Fund* Jackson Hole Symposium.

Leeper, E M. 1991. ‘Equilibria under “active” and “passive” monetary and fiscal policies’. *Journal of Monetary Economics* 27: 129–147.

Longstaff, F A and Schwartz, E S. 1992. ‘Interest rate volatility and the term structure: a two-factor general equilibrium model’. *The Journal of Finance* 47: 1259–1282.

Lorenzoni, G and Werning, I. 2019. ‘Slow moving debt crises’. *American Economic Review* 109: 3229–63.

McLaren, N, Banerjee, R N and Latto, D. 2014. ‘Using changes in auction maturity sectors to help identify the impact of QE on gilt yields’. *The Economic Journal* 124: 453–479.

Miranda-Agrippino, S and Ricco, G. 2019. ‘Identification with external instruments in structural VARs under partial invertibility’ .

Missale, A and Blanchard, O J. 1991. ‘The debt burden and debt maturity’, *Working Paper 3944*, National Bureau of Economic Research.

Nakamura, E and Steinsson, J. 2018. ‘High-frequency identification of monetary non-neutrality: the information effect’. *The Quarterly Journal of Economics* 133: 1283–1330.

Ramey, V A. 2011. ‘Identifying government spending shocks: it’s all in the timing’. *The Quarterly Journal of Economics* 126: 1–50.

Ramey, V A and Shapiro, M D. 1998. ‘Costly capital reallocation and the effects of government spending’, in *Carnegie-Rochester conference series on public policy*, Elsevier, volume 48, 145–194.

Ricco, G. 2015. ‘A new identification of fiscal shocks based on the information flow’ . ECB Working Paper 1813.

Romer, C D and Romer, D H. 2010. ‘The macroeconomic effects of tax changes: estimates based on a new measure of fiscal shocks’. *American Economic Review* 100: 763–801.

Soobyah, L and Steenkamp, D. 2020. ‘Term premium and rate expectation estimates from the south african yield curve’ . SARB Working Paper 20/03.

A Appendix

A1 Movements in yields at time of switch announcement

Figure 7: Changes in yields across the curve since 2011 – change on day of announcement of switch auction from day before

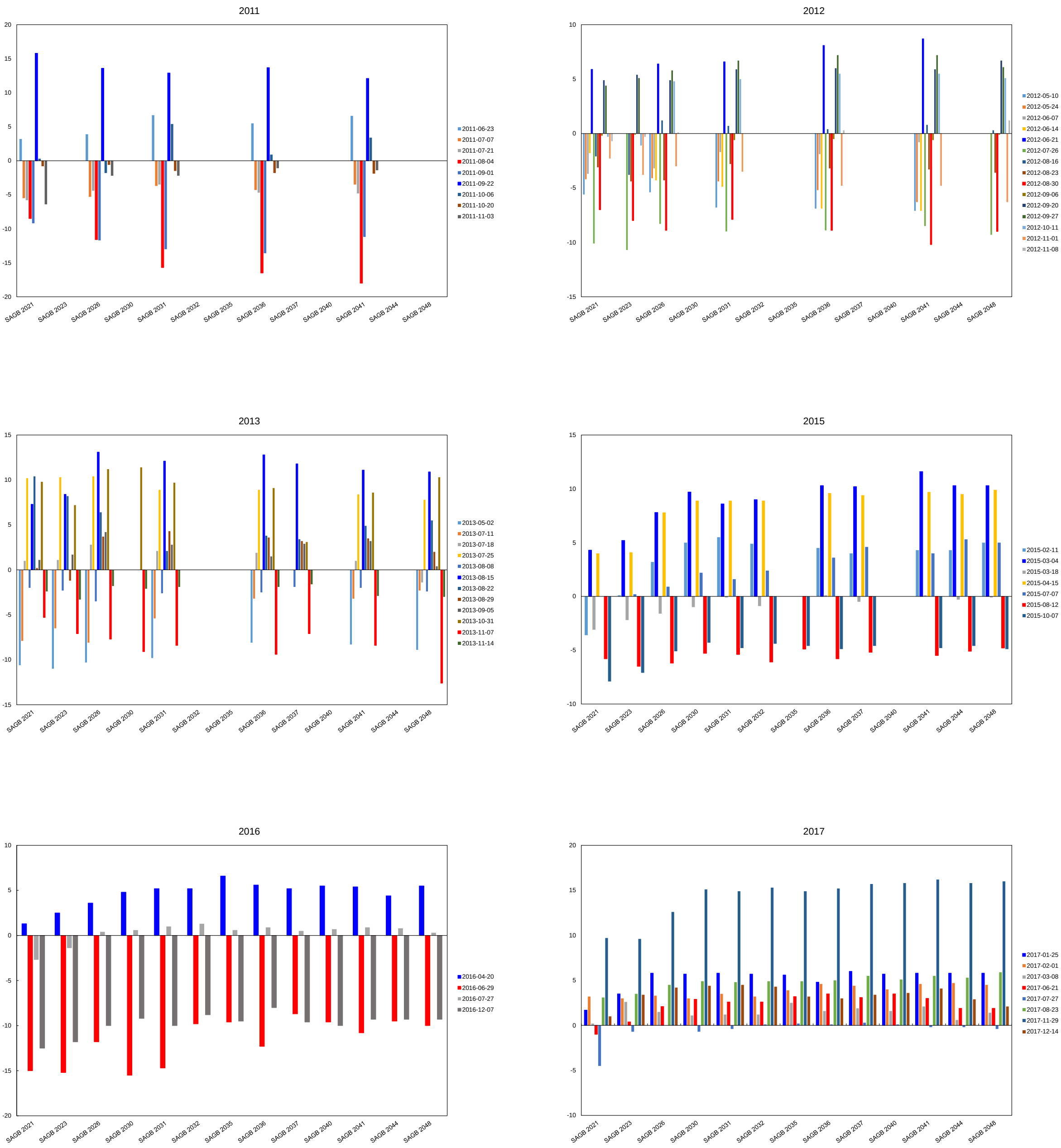
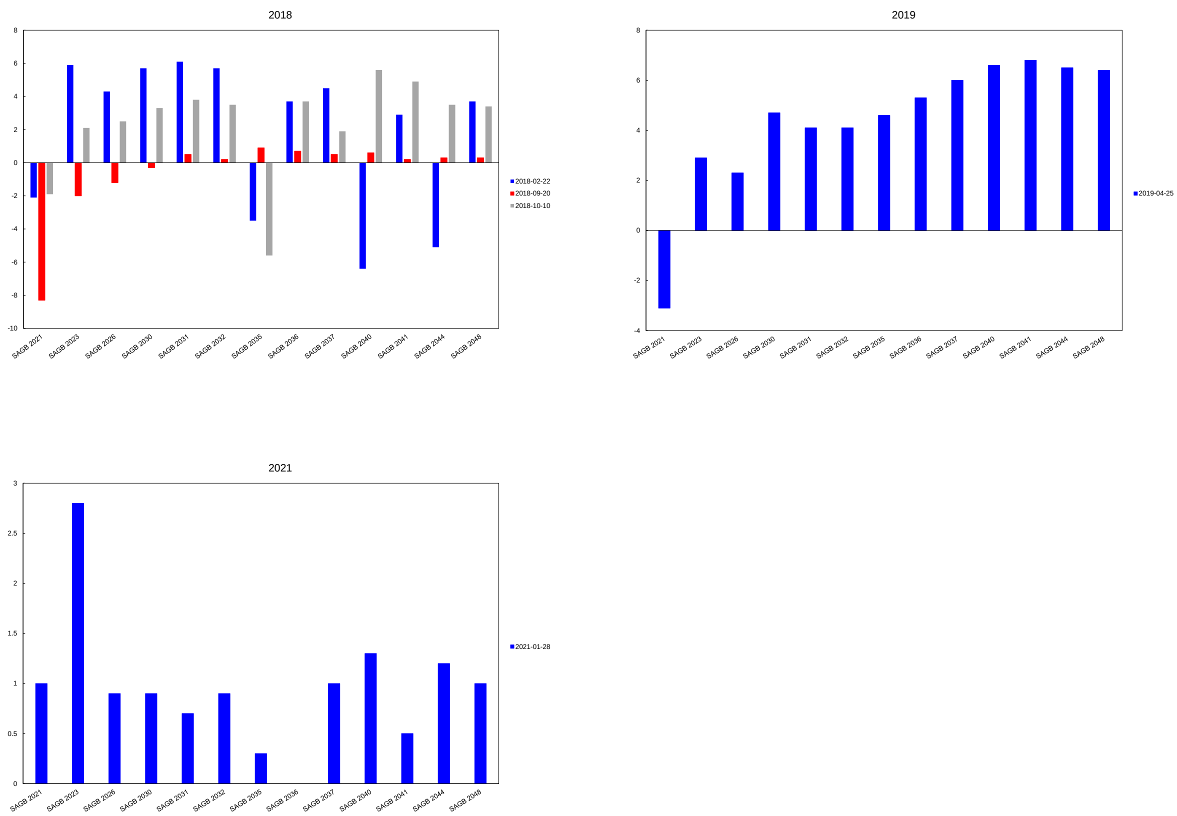


Figure 8: Changes in yields across the curve since 2011 – change on day of announcement of switch auction from day before



A2 High-frequency OLS results

Table 6: Response of interest rates and breakeven inflation rates from the policy shock using CDS spreads

	Nominal	Real	Inflation
1yr bond yield	1.16***		0.23
	(0.28)		(0.24)
2yr bond yield	1.56***		
	(0.42)		
5yr bond yield	1.15***	-0.19	1.98***
	(0.30)	(0.25)	(0.45)
10yr bond yield	1.07***	0.31	1.46*
	(0.32)	(0.30)	(0.52)
15yr bond yield	1.14***	0.17	1.75**
	(0.32)	(0.23)	(0.53)
20yr bond yield	1.03**	0.56*	1.07*
	(0.33)	(0.31)	(0.40)
25yr bond yield	2.08**	0.27	
	(0.55)	(0.31)	
30yr bond yield	1.69***	0.13	
	(0.45)	(0.31)	

*, ** and *** indicate 10, 5 and 1 percent level of significance. Standard errors in parentheses. The columns represent nominal bond yields, real yields or inflation-linked bond yields, and breakeven inflation rates at different maturities, respectively. The dependent variable is the fiscal shock from the switch announcement using CDS spreads.

Table 7: Response of interest rates and breakeven inflation rates from the policy shock

	Swap curve	Nominal	Real	Inflation
3-month	-0.03			
	(0.04)			
6-month	0.74***			
	(0.09)			
1yr bond yield	1.41***	2.34***		0.40
	(0.07)	(0.28)		(0.27)
2yr bond yield	2.38***	2.69***		
	(0.12)	(0.39)		
5yr bond yield	2.91***	2.40***	0.43	2.06***
	(0.23)	(0.31)	(0.28)	(0.53)
10yr bond yield	2.98***	2.32***	0.62*	1.89**
	(0.30)	(0.35)	(0.33)	(0.58)
15yr bond yield	2.77***	2.35***	0.51**	1.94**
	(0.29)	(0.35)	(0.25)	(0.62)
20yr bond yield	2.71***	2.30***	0.77**	1.64***
	(0.29)	(0.36)	(0.35)	(0.43)
25yr bond yield	2.64***	3.56***	0.51	
	(0.30)	(0.92)	(0.34)	
30yr bond yield	2.65***	2.57***	0.49	
	(0.32)	(0.46)	(0.35)	

*, ** and *** indicate 10, 5 and 1 percent level of significance. Standard errors in parentheses. The swap curve represents the foreign exchange swap rates at different tenors; whereas the nominal, real and inflation columns represent nominal bond yields, real yields or inflation-linked bond yields, and breakeven inflation rates at different tenors, respectively.

A3 Impulse response functions

Below we show some more IRFs from the BVAR with IV. We have added some more variables such as the Emerging Market Bond Index (EMBI) spread to capture domestic risk. The country risk rises (i.e. an increase in the EMBI spread) in response to the increase in debt as fiscal dynamics deteriorate. We have also tried different identification schemes and priors as robustness checks and the results are very similar.

Figure 9: IRFs from a shock to fiscal policy

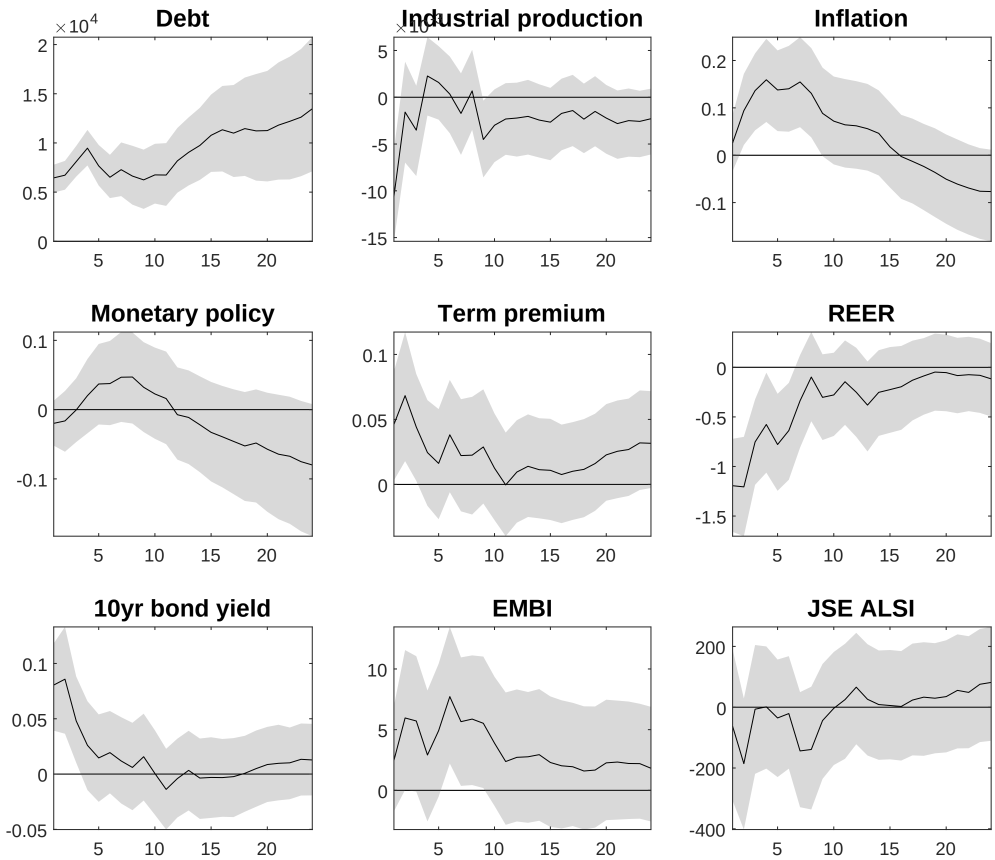
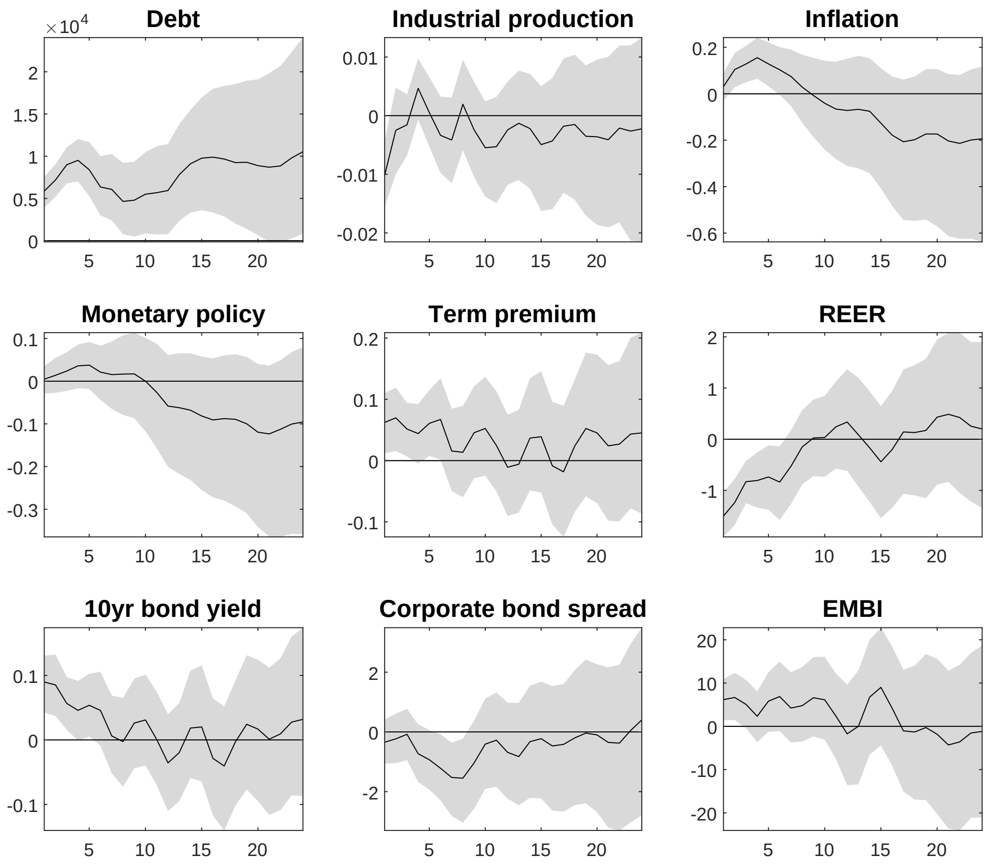


Figure 10: Impulse response functions from a shock to fiscal policy



A4 IRFs: sub-samples

Below we show some more IRFs from the BVAR with IV. We have split the sample between the two programmes (i.e. between 2011 and 2013 and then 2015 to 2019). The IRFs are not significant and this could be due to the small sample size (limited number of shocks over the sub-samples). However, we note that the IRFs over the period 2015 to 2019 reflect a similar trend to that observed over the full sample.

Figure 11: IRFs from a shock to fiscal policy – 2000-2013

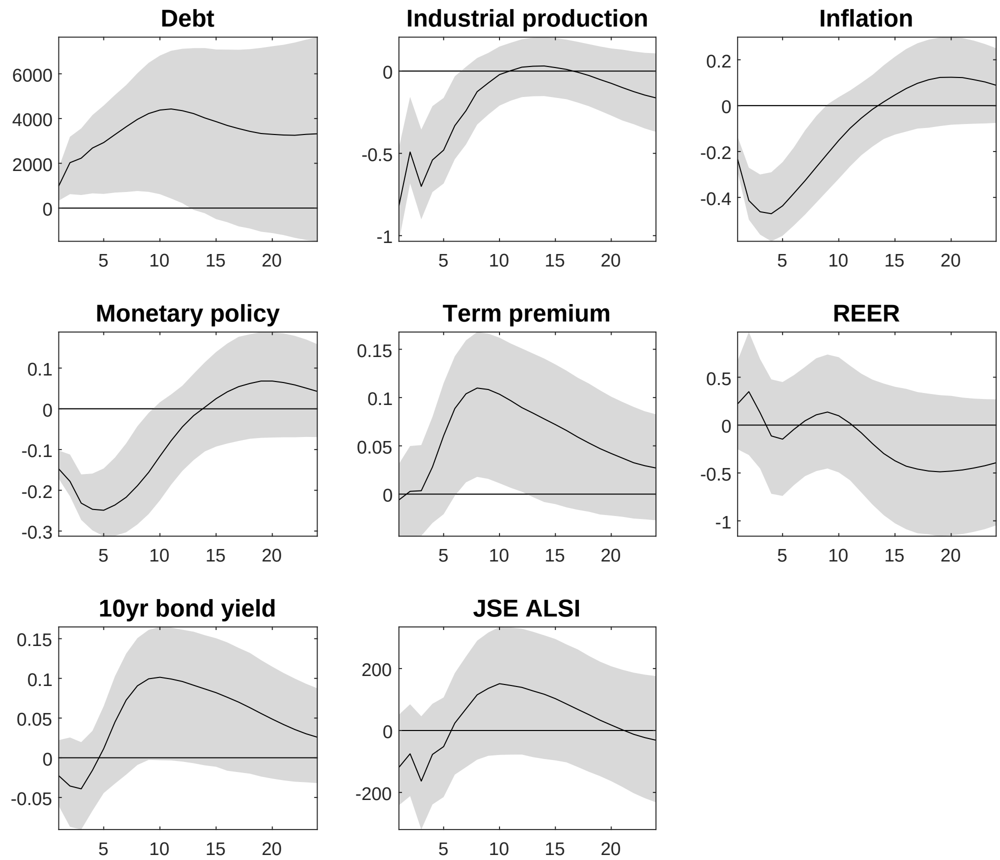


Figure 12: IRFs from a shock to fiscal policy – 2015-2019