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Probabilistic Approach to the Future Course of Fiscal Stability in Turkey: 1958 – 2025

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A B S T R A C T

This study gauges the fiscal stability in Turkey with a forward-looking approach using the fan-chart as a tool. Succinctly speaking, this tool portrays the probability distribution of each public debt realization in the forecast horizon. We construct this chart by simulating the debt/GDP ratio one thousand times using the bootstrapped error terms within a five-year forecast horizon. Our findings indicate that the AR(1) coefficient in the data generating process has a value less than unity which implies overall fiscal stability via an implosive debt pattern. Also, the simulation results indicate that the baseline scenario is around 25 % for the debt/GDP ratio over the forecast horizon and even in the worst-case scenario, the debt/GDP ratio is not likely to exceed 40 % level with a probability of 90 %.

1. Introduction

Borrowing is inevitable for any society since the public needs are mostly beyond the budgetary capacity of modern economies. Besides, most public investments entail intertemporal financing methods since the full benefit of those investments are generally reaped by future generations. Thus, borrowing impedes the widening of the intergenerational income gap and allows for large investments to be implemented. However, despite its beneficial aspects, borrowing is harmful in some cases, especially when used abusively. Relying heavily on new borrowing for budgeting culminates in unsustainable debt positions since in this case debt reaches unrepayable levels which increase the fiscal risks confronted by the country. Hence, the proper screening of the debt profile and the direction it is heading is key when appraising the fiscal position of the country. Otherwise, departures from the stable position are quite likely since, in the absence of a functional surveillance mechanism, no early warning signals are available to the government to take prudency measures promptly. Thus, it is essential to implement a forward-looking analysis of fiscal sustainability to preserve the stability of fiscal balances.

At this point, the fan-chart appears to be a practical tool for implementing a forward-looking analysis of sustainability in the literature. Briefly, this tool portrays the simulations of the potential debt trajectories across the forecast horizon. The chart is partitioned into quartiles representing the probability distribution of the contingent debt realizations. The likelihood of any scenario is visible through this tool which allows the fiscal policy to be altered before the certain distress position occurs. Bearing the functionality of this method in mind, in this study, we construct

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a fan-chart to envisage the possible trajectory of public indebtedness in the near future for Turkey. We set up AR(1) model as a data generating process using the data retrieved from the IMF databases. Based on one thousand simulations of the future debt trajectories with bootstrapped errors, we strive to calculate the likelihood of the baseline and the worst-case scenario regarding the debt/GDP indicator which is commonly used in the literature.

For accomplishing this objective, the rest of the paper is designed as follows. The first section is devoted to the theoretical consideration regarding the subject and the method of the study. The second section introduces the selected contributions to the literature to reconcile our study with the existing literature. The third section deals with empirics. The estimation results are discussed from a fiscal sustainability standpoint in this section. The final part concludes.

2. Literature Review

Since the fan-chart is a practical tool for analysing the stability of the fiscal posture, there are several contributions to the literature. In this section, we summarize selected studies to reconcile our work with the existing vast literature.

- [5], is a seminal contribution to the forward-looking analysis of fiscal stability via fan-chart approach. In this study, they propose a probabilistic approach to the fiscal sustainability analysis. They use fan-chart as a contingency mapping for the potential future trajectory of the public indebtedness. They build the fan-charts based on the past behaviour of the variable and the endogenous responses of the fiscal policy. Their coverage includes Argentina, Brazil, Mexico, South Africa and Turkey.

- [3] constructs a fan-chart for the South African economy. They use an augmented version of the construction procedure which involves a fiscal reaction function as a data generating process. In principle, their analysis is based on [5]'s approach regarding the technique used for the construction of the fan-charts. They attempt to the likelihood of achieving fiscal stability goals via probabilistic simulations of debt/GDP ratio in a forward-looking manner. Using the fiscal reaction function as a basis, they run stochastic simulations on the debt/GDP ratio to build up an 80 % confidence band for the future trajectory of the variable. According to their findings, the debt/GDP ratio is likely to stay below 50 % with a 90 % likelihood.

- [12] also employs an approach based on [5]. They run the estimation procedure for the countries that benefited from the HIPC/MDRI debt relief initiative. Similar to the other contributions, their aim is also to envisage the future values of the debt/GDP ratio to appraise the debt dynamics. Their analysis suffers from data limitations since they focus on multiple countries. They overcome this problem by pooling the data to estimate a panel VAR. Their findings from the fan-chart approach emit alarming signals for Guyana and Nicaragua.

- [1] claim that the debt projections are powerful tools to project the future dynamics of the public debt. The author applies this technique to 24 EU countries for the 2013-2017 period. The findings in this study imply that in Italy the debt/GDP ratio will be in a downward trend in an out-of-sample framework, whereas for Spain the estimation results indicate an increasing trend for debt/GDP ratio.

- [9] applies the fan-chart approach to the case of Pakistan between 2019 and 2025. Their findings reveal alarming results for the debt/GDP since throughout the projection horizon the debt/GDP ratio exhibits an increasing trend and reaches levels as high as 175 % which is by no means sustainable in comparison to any sustainability indicators. The authors propose austerity measures for spending and reduction in fiscal deficits.

- [14] uses the probabilistic approach to medium term debt simulations for a set of emerging market economies. Based on their debt sustainability analysis they offer three policy recommendations. i) Lower exposure to currency risk should be considered only in extreme case scenarios, ii) greater fiscal response enhances the fiscal sustainability more substantially, iii) countries lacking strong responsiveness take caveats about counter cyclical fiscal policies to circumvent unsustainable debt trajectories.

- [4] implements a similar debt risk assessment for Costa Rica. Their results show that fiscal behaviour has been unsustainable for several periods in the country and fiscal stability occurred only temporarily in the short run.

- [13] utilizes the fan-chart as a tool for debt sustainability analysis for Iran. They run one thousand simulations for the fiscal data to construct the fan-chart. According to their findings, the public debt is not sustainable in Iran in the long-run.

3. Theoretical Considerations

3.1. Economic implications of fiscal stability

The financial needs of modern societies mostly do not equally measure up against the budgetary capacity of the governments which inevitably results in public borrowing and no country is an exception in the modern public financial environment. Besides, oftentimes, the large infrastructure investments are financed through borrowing since it allows the cost of financing to be borne by future generations who will to a large extent reap the benefits of these investments. Hence, it is clear that borrowing is unavoidable and to a certain extent is beneficial for society. Nevertheless, despite its positive aspects, borrowing turns out to be hazardous and detrimental provided that it is not scrutinised properly. In this case, it can reach unrepayable levels due to abusive use by the budget authorities which has impairing effects on the economy once it persistently remains in the danger zone for prolonged periods. In such a scenario, fiscal stability becomes a pronounced concern for the economy since the impairing effects of compounding public debt get harsher in every round. Thus, to preserve fiscal stability, the fiscal authorities must monitor the existing profile and the future course of fiscal posture with positive rather than normative judgements.

However, in practice, implementation of such a surveillance mechanism is rather challenging since fiscal stability is a rather vague concept and the in the literature, despite several attempts by several authors, no cut and dried operational definition thereof exists. The plethora of alternative approaches impedes the standardization of the fiscal stability analysis which poses a challenge for the real-world analysis. Thus, embodying the fiscal stability concept is essential for carrying out empirical analysis on the pathway of fiscal posture. Proper scrutiny and the analysis of fiscal stability plays a key role in fiscal management since malfunctioning fiscal policies bring about severe consequences on the economy. Persistently unstable fiscal stance leads to a potential vulnerability to the sudden stops of the halts in the influx of foreign financial flows. The developing countries, in particular, suffer mostly from this type of fiscal fragility since due to the lack of sufficient domestic savings they are predominantly caught off-guarded by such abrupt stops of foreign financial flows.

For modern economies, the credibility of the fiscal policies is crucial for the continuum of the inflows of foreign finance to rollover the existing budgetary needs. Prolonged fiscal instability might give rise to a deterioration in the market perception regarding the country which in turn result in reduced credibility along with an outflow of existing foreign capital [8]. This situation can have permeative impairing effects on the economy involving cuts in expenditures, currency crisis, recession and eventually default. Also, due to shrinking credibility ratings of the sovereign, borrowing gets tougher which causes the interest rates to go up and consequently, the debt accumulation accelerates which impedes the fiscal stability even further. In addition, the fiscal space contracts restricting the fiscal manoeuvrability of the budget which is a hindrance for the promotion of social welfare especially for developing economies. Besides, the private investment is also crowded out and flexibility in budgeting is usually reduced. The end result of this process is a debt overhang which generates a disincentive for the new investors to lend to the government since the existing public debt is so high that the sole benefiter of the potential new funding will be the existing lenders. In this case, the new investors are unwilling to invest in the country since they believe that the defrayal of their lending is very unlikely [16]. Thus, eventually, a vicious circle of insufficient funding, lower growth, lower taxes, higher borrowing needs, higher debt and a potential default is established [11].

Hence, in order to sidestep this chain of unpleasant events, it is key to monitor the ongoing trends in fiscal fragility with a forward-looking approach in mind to promptly take measures for reversing the alarming trends in the fiscal balances. According to IMF, *"Debt is sustainable if the country (or its government) does not, in the future, need to default or renegotiate or restructure its debt or make implausibly large policy adjustments"* [7]. This definition emphasizes the notion of forward-looking approach to debt sustainability by stressing the importance of the future course of the fiscal policies. Also, according to [2], for a fiscal policy to be stable, the Debt/GDP ratio needs to be mean-reverting. In other words, in a fiscally stable environment, the Debt/GDP ratio eventually converges to its normal level. Also, they state that *"the assessment of the sustainability of fiscal policy must not be static, but forward-looking.* Thus, it is possible to infer that a proper fiscal stability analysis involves a forward-looking approach taking the Debt/GDP ratio as an indicator. Taking the Blanchard and IMF approaches as the basis, the fiscal stability analysis in this study is based on the Debt/GDP ratio with a forward-looking approach in mind.

3.2. The debt/GDP ratio as an indicator of fiscal stability

Now that we have outlined our philosophy for the analysis of fiscal stability which is borrowed from [2], it is essential to introduce the Debt/GDP ratio as an indicator of fiscal stability and touch upon its strengths and weaknesses in serving this purpose.

Literally, for every country, public debt is persistent but in fact, the real problem for modern economies is not the existence of public debt but its position against the capacity to pay. In other words, the monetary value of the public debt is not a direct measure when appraising the level of fiscal riskiness of the country. Focusing solely on the level of accumulated public debt, it is challenging to set a threshold level for evaluating the level of fiscal risk exposure for the economy. Also, cross-country comparisons become insensible since the size of every economy is different from one another. Thus, the same amount of accumulated public debt will be less burdensome for a country with a higher level of GDP since the higher the GDP the more it is assumed that the government has the ability to collect taxes for defraying public debt obligations.

Especially for emerging economies, the continuum of the influx of foreign financial funds is crucial to rollover their existing fiscal posture. For this reason, the debt to GDP ratio is a good performance indicator monitored by foreign investors when making purchase decisions regarding the bonds of those countries. The pattern of this indicator is considered as an early-warning indicator for investors and alarms about a looming debt crisis. Hence, it is crucial to determine a threshold level to assess the level of riskiness in the country. In the literature, there are several proposals for the threshold level which is required for appraising the likelihood of upcoming fiscal distress. According to [15], the debt to GDP ratio beyond 90 % impairs the economic performance and thereby leads to surging riskiness for the country. According to [10], however, the tipping point for this ratio is 77 % and each additional percentage point increase in the ratio brings about a 0,017-percentage point decline in economic growth which, as we mentioned earlier, jeopardizes the fiscal stability since reduced growth results in higher borrowing in the next periods. Nevertheless, the only official fiscal rule for the debt/GDP ratio is set by the Maastricht Criteria which is 60 %. The abundance of the proposed threshold levels indicates that the only drawback of the debt/GDP ratio is the absence of a cut-and-dried threshold level to be used as a decision rule. One of the reasons why there is no universal threshold level is that the capacity to pay is represented solely by the GDP level in this setting. In fact, there are several other determinants of capacity to pay but for practical reasons, in the fiscal stability literature, the GDP is used for indicating the capacity to pay despite the fact that it slightly reduces the scope of the analysis. Interestingly, there are some countries in the world whose payment capacity is far beyond it is explicit capacity. Japan, for instance, has a debt-to-GDP ratio of 240 % but its overall capacity to pay is way higher than its GDP level thanks to its international assets. Thus, despite possessing a remarkably high debt/GDP ratio, Japan is considered a fiscally stable country thanks to its enormous capacity to pay which is higher than its GDP level. Nevertheless, despite exceptional cases of this sort, debt/GDP is a practical and insightful indicator for analysing the trajectory of fiscal stability.

3.3. Basics of univariate forecasting and fan-chart for the forward-looking analysis

Dynamic forecasting basically stands for the out-of-sample forecasting procedure which implies that based on a data generating process, we envisage the values the indicator will get at a certain point in time. In the univariate case, the data generating process is represented with the parsimonious model below:

$$d_t = \beta_0 + \beta_1 d_{t-1} + \epsilon_t \;\; \epsilon_t \sim N(\sigma^2, 0) \tag{1}$$

where d_t denotes the debt/GDP ratio.

Suppose we want to forecast d_{t+1}, then;

$$d_{t+1} = \beta_0 + \beta_1 d_t + \epsilon_{t+1}$$

Taking the expectations of both sides we get;

$$Td_{t+1}^e = \beta_0 + \beta_1 d_t$$

Moving further in time;

$$d_{t+2} = \beta_0 + \beta_1 d_{t+1} + \epsilon_{t+2}$$

Once again taking the expectations we get;

$$Td_{t+2}^e = \beta_0 + \beta_1 Td_{t+1}^e$$

Plugging $Td_{t+1}^e = \beta_0 + \beta_1 d_t$ into this equation we get;

$$Td_{t+2}^e = \beta_0 + \beta_1(\beta_0 + \beta_1 d_t) = \beta_0 + \beta_1\beta_0 + \beta_1^2 d_t$$

Iterating this recursive procedure, we get a general forecasting function;

$$Td_{t+h}^e = \beta_0\left(1 + \beta_1 + \beta_1^2 + \cdots + \beta_1^{h-1}\right) + \beta_1^h d_t \tag{2}$$

where h denotes the forecast horizon.

As it is clear from the articulation above that, the forecasted value of the debt/GDP ratio in h periods ahead is determined by the estimated coefficient vector which is random variables. Since β_i coefficients are not deterministic, there is a forecast uncertainty associated with the forecasted value Td_{t+h}^{e}. In an autoregressive dynamic forecast setting, we use the forecasted values of the variable to run the forecast for the further periods in a recursive manner which allows the forecast errors to accumulate on themselves. However, since by definition the future values of the lagged values of the variable do not exist in the sample, we are impelled to run dynamic forecasting taking these compounded forecast errors into account. Hence, there are two sources of uncertainty in the forecasting procedure i.e., the coefficient uncertainty and error term of the model itself. In order to augment the precision of the forecasting model, both sources of uncertainty should be incorporated into the model. However, the future is uncertain and estimating a point forecast for a variable is very unlikely to match the true value the variable will get in the future. In other words, deterministic estimation of a forecast value will almost certainly not be equal to the value the variable will get when we reach the end of the forecast horizon in real-time. Thus, the stochastic approach performs better in terms of forecast generation since in this case numerous forecast values can be estimated at once. In this case, the error term of the data generating process is added to the deterministic forecast value in each round to obtain a simulation of the forecasted variable at the end of the forecast horizon.

The drawn error term can come from an assumed distribution, a hypothetical set or can ideally be bootstrapped from the vector of the error terms of the data generating process which puts out more realistic outcomes since the drawn error terms are taken from the real data generating process. The stochastic simulations can by definition be repeated so many times, say 1000, to construct a distribution of the potential values the variable will get at the end of the forecast horizon. Hence, in the stochastic simulation case, we do not have a point forecast value but instead a vector of potential values. Moreover, these values can be presented within varying confidence intervals so as to construct a fan-chart. Proposed initially by the Bank of England to portray the probability distribution of the forecasted inflation rates, the fan-chart is a simple yet practical tool to appraise the future course of the forecasted variable. In this chart, the projected values of the variable are plotted within the confidence intervals (30 %, 60 %, 90 % etc.) and the likelihood of the variable taking a certain value is interpreted based on these confidence intervals. The distance between the upper and the lower bounds of the interval corresponds to the highest and lowest values the variable can take in the forecast period and these bounds get closer to each other if we get closer to the current point in the forecast horizon. In this regard, the fan-charts are quite useful tools since they allow the interpretation of the best and the worst-case scenarios for the forecasted variable. Obviously, the longer the forecast horizon is, the larger the interval will be since forecasting will become less precise as we attempt to foresee further in time or vice versa.

Formally, the AR (1) model for the debt/GDP ratio was;
$d_t = \beta_0 + \beta_1 d_{t-1} + \epsilon_t \;\; \epsilon_t \sim i.i.d.(\sigma^2, 0)$.

Then, one period ahead forecast will be the conditional mean of this equation, namely,

$\hat{d}_{t+1} = \beta_0 + \beta_1 d_t$

Since our best guess for the error term is zero. In this case, the forecast error will be

$FE_1 = \hat{d}_{t+1} - d_{t+1} = \epsilon_{t+1}$ and $VAR(FE_1) = \sigma^2$.

Under the assumption of normal error terms, the 95 % confidence interval will be $\beta_0 + \beta_1 d_t \pm 1{,}96\sigma^2$.

If we move two periods ahead in time, the point forecast will be;

$\hat{d}_{t+2} = \beta_0 + \beta_1(\beta_0 + \beta_1 d_t)$ and the forecast error will be;

$FE_2 = \hat{d}_{t+2} - d_{t+2} = \beta_1(\hat{d}_{t+1} - d_{t+1}) + \epsilon_{t+2} = \beta_1\epsilon_{t+1} + \epsilon_{t+2}$

Thus, the variance of the forecast error:

$VAR(FE_2) = (1 + \beta_1^2)\sigma^2$ is greater than $VAR(FE_1) = \sigma^2$.

Consequently, the 95 % confidence interval will cover a larger area namely,

$\hat{d}_{t+2} = \beta_0 + \beta_1(\beta_0 + \beta_1 d_t) \pm 1{,}96\sigma\sqrt{1+\beta_1^2}$ is larger than $\beta_0 + \beta_1 d_t \pm 1{,}96\sigma$.

4. Empirics

Now that we have introduced the basics of AR (1) forecasting along with the brief outline of the fan-chart as a tool for fiscal stability appraisal, in this section, we set out the empirical analysis of the fiscal stability in Turkey within this framework. The next subsection presents the data and its salient features and shows its plot on a diagram while the second subsection deals with the empirics of the subject carried out using this data set.

4.1. Data and its salient features

In this study, we run a forecasting experiment using a univariate set up therefore our analysis is based on the debt/GDP ratio series retrieved from the public finances in modern history database and the fiscal monitor of IMF. The range of the series covers the 1958-2020 period.

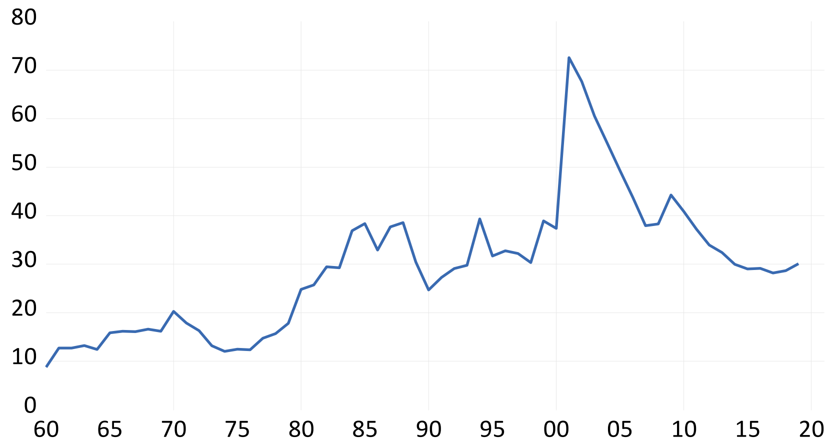
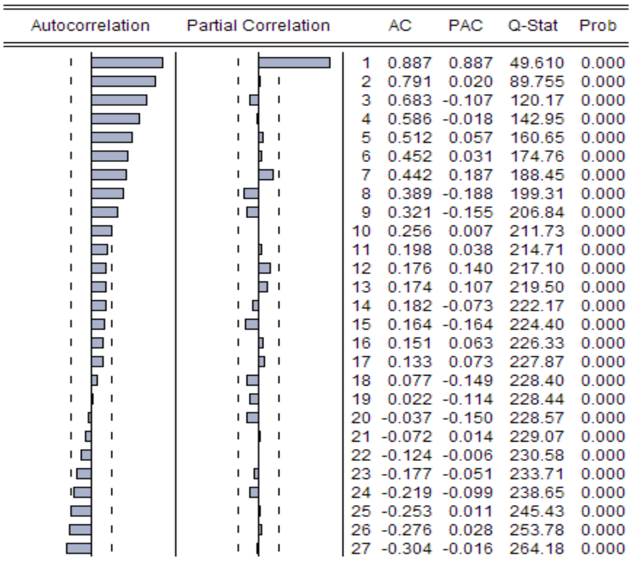


Figure 1. Data Plot (Source: IMF fiscal monitor and public finances in modern history databases.)

Figure one above displays the values of the debt/GDP ratio for the sample period. Except for the obvious summit of the 2001 economic crisis, the debt/GDP ratio oscillates within 10 % and 40 % band which is a clear sign for stability. However, an upward trend is also visible on the graph as a visual inspection. It appears that after hitting the record-high levels in the early 2000s, due to strong adherence to the implemented recovery programs, the debt/GDP ratio gradually and steadily stabilised throughout the entire 2000s. There is an upward movement during the 2009 global crisis but it is not permanent. The table below summarizes the statistics of the stationarity test results alongside several significance levels. According to the test results below, all three tests indicate that the data series is an AR (1) process. Additionally, the ACF and PACF graphs also support the AR (1) notion since ACF exhibits a gradual decay over time while PACF shows an abrupt fall in the first lagged value. The AR (1) feature of the data series is a good sign for the overall stability of the public debt in the country since it implies non-explosiveness for the debt trajectory which is essential for the long-run sustainability of public debt.

Table 1. Formal stationarity test results

	(Level)		
	ADF	PP	KPSS
	–2.027	–2.019	0.627
1%	–3.54	–3.54	0.73
5%	–2.91	–2.91	0.46
10%	–2.59	–2.59	0.34
	(First Difference)		
	ADF	PP	KPSS
	–8.04	–8.04	0.105
1%	–3.54	–3.54	0.73
5%	–2.91	–2.91	0.46
10%	–2.59	–2.59	0.34



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.887	0.887	49.610	0.000
		2	0.791	0.020	89.755	0.000
		3	0.683	-0.107	120.17	0.000
		4	0.586	-0.018	142.95	0.000
		5	0.512	0.057	160.65	0.000
		6	0.452	0.031	174.76	0.000
		7	0.442	0.187	188.45	0.000
		8	0.389	-0.188	199.31	0.000
		9	0.321	-0.155	206.84	0.000
		10	0.256	0.007	211.73	0.000
		11	0.198	0.038	214.71	0.000
		12	0.176	0.140	217.10	0.000
		13	0.174	0.107	219.50	0.000
		14	0.182	-0.073	222.17	0.000
		15	0.164	-0.164	224.40	0.000
		16	0.151	0.063	226.33	0.000
		17	0.133	0.073	227.87	0.000
		18	0.077	-0.149	228.40	0.000
		19	0.022	-0.114	228.44	0.000
		20	-0.037	-0.150	228.57	0.000
		21	-0.072	0.014	229.07	0.000
		22	-0.124	-0.006	230.58	0.000
		23	-0.177	-0.051	233.71	0.000
		24	-0.219	-0.099	238.65	0.000
		25	-0.253	0.011	245.43	0.000
		26	-0.276	0.028	253.78	0.000
		27	-0.304	-0.016	264.18	0.000

Figure 2. ACF and PACF (Source: Own calculations)

4.2. Estimation results and discussion

After inspecting the salient features of the data series, finally, we cover the estimation results and interpret the empirical findings from the fiscal stability standpoint. In the preceding section, we figured out that the Debt/GDP series follows an AR (1) process. The lag selection criteria also point to the same conclusion indicated by the values tabulated below.

Table 2. Lag selection criteria

AR / MA	0.000000	1.000000	2.000000
0.000000	8.106397	7.369179	6.948838
1.000000	6.499847	6.533122	6.553008
2.000000	6.533108	6.565809	6.586053

According to the lag selection criteria above, AR (1) procedure has the lowest information criterion value which supports the idea that our series follows an AR (1) process. Now that we have determined the lag level through the data inspection and lag selection criteria processes, we estimate the AR (1) model to be used as a data generating process for the simulations required for the construction of the fan-chart.

Table 3. AR (1) estimation results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	25.51477	8.374707	3.046647	0.0035
D2001	20.14734	1.009593	19.95590	0.0000
AR(1)	0.937830	0.051938	18.05655	0.0000
SIGMASQ	20.88854	3.367152	6.203622	0.0000
R-squared	0.892902	Mean dependent var		28.66170
Adjusted R-squared	0.887362	S.D. dependent var		14.07971
S.E. of regression	4.725370	Akaike info criterion		6.040244
Sum squared resid.	1295.089	Schwarz criterion		6.177478
Log likelihood	-183.2476	Hannan-Quinn criter.		6.094126
F-statistic	161.1864	Durbin-Watson stat		1.651745
Prob(F-statistic)	0.000000			
Inverted AR Roots	0.94			

Table 3 above tabulates the estimation results for the AR (1) model. In order to account for the historic summit of 2001, we included a dummy variable (D2001) in the model to improve the precision of the estimators by avoiding omitted variable bias. The SIGMASQ refers to the variance of the residuals which is an estimated variable within the ML procedure. The AR (1) variable has a statistically significant coefficient which is equal to 0,93 which is less than unity. This coefficient implies an implosive debt pattern for Turkey which is a good sign for fiscal stability. A coefficient value greater than one would translate into an explosive debt pattern which is by definition not sustainable. Besides, the table below displays the inverse roots of the AR (1) model. As it is clearly visible in the figure, the inverse root of the model lies within the unit circle which indicates that the AR (1) model is stable. Besides we conducted a Ljung-Box test for serial correlation whose results are tabulated in table four below. This test is based on the calculation of Q statistic which is defined as: $Q_{LB} = T(T+2)\sum_{j=1}^{k}\left(\frac{\tau_j^2}{T-J}\right)$ where τ_j is the j-th autocorrelation and T is the number of observations. According to the Q-stat results of this test which are displayed on table four no serial correlation is detected.

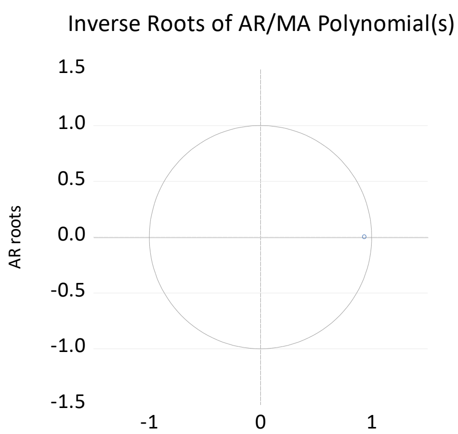


Figure 3. AR inverse roots (Source: Own calculations)

Table 4. Ljung-Box Q-stat test for serial correlation

	AC	PAC	Q-Stat	Prob*
1	0.144	0.144	1.3429	
2	-0.029	-0.050	1.3970	0.237
3	0.053	0.066	1.5872	0.452
4	-0.223	-0.249	4.9774	0.173
5	-0.104	-0.025	5.7261	0.221
6	-0.183	-0.209	8.0980	0.151
7	0.158	0.282	9.8890	0.129
8	0.128	-0.031	11.096	0.134
9	-0.064	-0.037	11.402	0.180
10	-0.003	-0.150	11.403	0.249
11	-0.195	-0.138	14.359	0.157
12	-0.196	-0.151	17.420	0.096

Now that we have analysed the AR (1) estimation which is the baseline data generating process for our forecasting exercise, we construct our fan-chart to judge the stability of public debt in Turkey. For this purpose, we ran one thousand simulations of the potential future paths of the public debt series in Turkey. We used bootstrapped error terms for this simulation and included coefficient and residual uncertainties to enhance the quality of the simulations[2].

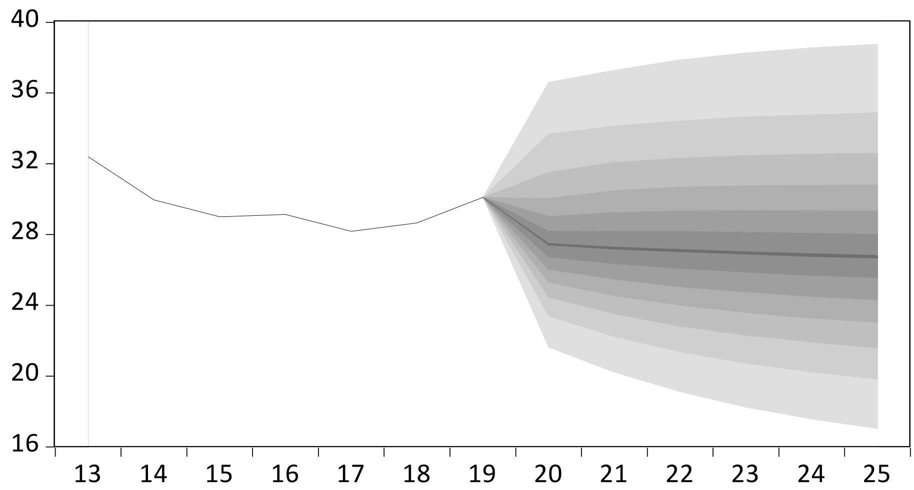


Figure 4. Fan-chart (Source: Own calculations)

The figure above plots the fan-chart constructed using the bootstrapped simulations based on the AR (1) model. The entire "fan" corresponds to a 90 % confidence interval and is partitioned into six quantiles and therefore each shade of grey represents a 15 % confidence interval. As we mentioned earlier, moving ahead in time the fan gets wider indicating less precise forecasting. The solid line in the middle represents the baseline forecast which exhibits a stable pattern throughout the forecast horizon around 25 %.

The most interesting point to note on the fan-chart is that the debt/GDP ratio is likely to be below 40 % in the next five years with a 90 % probability which is a clear sign for stability. Earlier in the text, we named the proposals for the strategic threshold level of public debt and no matter which proposed threshold is considered, the projected debt/GDP ratio is expected to be in the stable territory. From fiscal stability standpoint, what matters is not the level of the ratio but the direction in which it is heading for the upcoming periods. Thus, taking this argument into consideration, our findings indicate that the simulated projections of the debt/GDP ratio in our exercise do not imply a looming incipient fiscal distress or a departure from stability in the near future.

[2] The computer program for developing fan-chart simulations is available in Appendix

5. Conclusion

Fiscal stability is a common thread for all economies since it brings about severe adverse consequences such as impeding economic growth, reducing fiscal space and manoeuvrability, increasing borrowing requirements and reduced sovereign credibility and a potential default just to name a few. Hence, proper scrutiny of the recent trends in the fiscal indicators is key for preserving stability. Despite the fact that the current position of the fiscal posture gives quite a hint about the course of fiscal stability, what really matters is the direction it is expected to be heading in the near future. Thus, forward-looking analysis of fiscal stability reveals crucial insights about the likelihood of looming fiscal distress which allows for timely implementation of precautionary measures. In this sense, the fan-chart appears to be a practical yet functional tool to foresee the potential fiscal bottlenecks. It basically displays the confidence intervals of the potential positions of the indicator within the forecast horizon. In this study, we constructed a fan-chart based on the AR (1) data generating process of the debt/GDP ratio which is a commonly used indicator of fiscal stability in the literature. For this purpose, we estimated the AR (1) model and based on this model we ran one thousand simulations with bootstrapped error terms to construct the fan-chart. According to our findings, the AR (1) coefficient is smaller than one which implies an implosive debt pattern overall that is a good sign for fiscal stability Also, the baseline scenario for the debt/GDP ratio is around 25 % until 2025 which appears to be seemingly stable. Considering the extremities, we figured out that, even in the worst-case scenario, the debt/GDP ratio is likely to be below 40 % with a probability of 90 % which translates into a stable position compared to proposed threshold levels for this indicator in the literature. All in all, the fan-chart approach to fiscal stability in Turkey produces results that are in line with fiscal stability in the near future.

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Appendix

Program for constructing fan-chart (Eviews)

```
%esmpl="1958 2019"
%fsmpl="1958 2025"
!boot=1
!coefu=1
!numb=6
%modname="mod"
%varname="debt"
equation eq2.ls(OPTMETHOD=OPG) {%varname} c ar(1) d2001
eq2.makemodel({%modname})
%quant_array="90 "
!quant_step=90/!numb
!k=90-!quant_step
while !k>5
%quant_array=%quant_array+@str(@round(!k))+" "
!k=!k-!quant_step
wend
%quant_array=%quant_array+"1"
delete(noerr) g2
group g2
for %quant {%quant_array}
   !alfa={%quant}
   smpl {%fsmpl}
   !alfa_ratio=!alfa/100
   !num_simul=1000
  if @abs(!boot-1)<0.0001 then
      if @abs(!coefu-1)<0.0001 then
         {%modname}.stochastic(i=b, b=!alfa_ratio,c=t,r=!num_simul)
      else
         {%modname}.stochastic(i=b, b=!alfa_ratio,r=!num_simul)
      endif
   else
      if @abs(!coefu-1)<0.0001 then
         {%modname}.stochastic(i=n, b=!alfa_ratio,c=t,r=!num_simul)
      else
         {%modname}.stochastic(i=n, b=!alfa_ratio,r=!num_simul)
      endif
   endif
   {%modname}.solveopt(s=b,d=d)
   {%modname}.solve

   %first_elem_fsmpl=@wleft(%fsmpl,1)
   %second_elem_fsmpl=@wright(%fsmpl,1)

   smpl {%first_elem_fsmpl} {%first_elem_fsmpl}
   {%varname}_0h={%varname}
   {%varname}_0l={%varname}

   smpl {%first_elem_fsmpl}-6 {%second_elem_fsmpl}
   if !alfa<3 then
      %quant="0"
   endif
   series {%varname}_{%quant}h_={%varname}_0h
   series {%varname}_{%quant}l_={%varname}_0l
   g2.add {%varname}_{%quant}l_ {%varname}_{%quant}h_
next
series p1={%varname}
g2.add {%varname} p1
freeze(fanchart, mode=overwrite) g2.band(o="modern")

fanchart.legend -display
for !i=1 to !numb+1
   !r=@round(0.2*255)
   !b=0
   !g=@round((1-0.175*@sqrt(!i) )*255)
   fanchart.setelem(!i) fcolor(@rgb(!r,!g,!b))
next
!numline=!numb+2
fanchart.setelem(!numline) fcolor(blue) lwidth(10)

fanchart.draw(shade,b, gray) {%fsmpl}
show fanchart
smpl @all
```