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Sovereign Asset and Liability Management (SALM) and Efficient Debt Management: An Empirical Study for Jordan

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ABSTRACT. This research is about the effect of Sovereign Asset and Liability Management (SALM) on efficient debt management in Jordan using quarterly data from 2005 to 2023. The paper applies time series analysis methods, such as the Autoregressive Distributed Lag (ARDL) and Nonlinear Autoregressive Distributed Lag (NARDL) models to study the links between SALM components (cash reserves, foreign reserves, equity in state-owned enterprises, future revenues, government debt, fiscal expenditures and contingent liabilities) and Jordan's debt-to-GDP ratio. The results show that these variables have a significant impact on the short-term and long-term efficiency of debt management. Besides, the NARDL model shows that there are asymmetric impacts of equity in SOEs, future revenues and fiscal expenditures which means that these variables have different effects when they increase or decrease. The policy recommendations are to keep the debt levels sustainable, to accumulate foreign reserves, to manage contingent liabilities effectively and promote coordination among the relevant institutions for fiscal sustainability and economic growth.

1. Introduction

Sovereign debt management is now a major issue for governments all over the world, especially in developing countries like Jordan where they are trying to achieve fiscal sustainability and promote economic growth [8]. The inefficient debt management can cause the unsustainable burden of debts, economic instability and limitations on the government's ability to finance essential public services and investments [12]. In this case,

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Sovereign Asset and Liability Management (SALM) has been the framework for governments to manage their assets and liabilities strategically.

SALM is the process of finding, counting and management of a government's assets and liabilities which include financial ones (e. g., cash reserves, foreign reserves, sovereign wealth funds) and non-financial assets (e. g., equity in state-owned enterprises, infrastructure investments), and the liabilities (e. g., government debt, and contingent liabilities [17].

Jordan is facing a problem with the management of its public debt due to political instability, resource constraints and external shocks which have resulted in the increase of debt over time. The Jordanian government has come to the recognition of the importance of efficient debt management and therefore, it has adopted various strategies such as MTDS (the Medium-Term Debt Management Strategy) which is a latest development in this field. However, the outcome of SALM on the efficient debt management in Jordan has not been fully studied. This research aims to fill this vacuum by the method of practically examining the connection between SALM components and Jordan's debt-to-GDP ratio, which is a commonly used indicator for measuring the efficiency in managing debt.

2. Literature Review

The literature on SALM and its effects on the debt management has been evolving over the last few decades. The first studies were on the asset and liability management (ALM) practices in the banking sector which emphasized that it is very necessary to match assets with liabilities so as to manage risks and get maximum returns. ([10], [18]) The authorities began to realize that they have to handle all kinds of risks, and so SALM became a well-known term.

The theoretical foundation of SALM was studied by the researchers like ([2], [4], [13]). who stated that there is a connection between sovereign assets and liabilities, their effect on fiscal policy and debt sustainability. The recent studies have been concentrating on the implementation of SALM frameworks and their influence on debt management

([7], [3]). The main message of these studies was the government institutions' need for coordination and strong risk management practices.

The empirical study of the relationship between SALM and debt management according to the literature has given different results. [1] found out that an asset-liability management method could be the way to decrease the risk-adjusted returns of sovereign investments and borrowing costs. However, [6] .mentioned that the full application of SALM frameworks is still not so popular and they attributed this to the institutional and governance problems as possible obstacles.

In the case of Jordan, many studies have been done on public debt management and its macroeconomic effects ([8], [9]). Nevertheless, there is a dearth of the empirical research that studies in detail the effect of SALM on efficient debt management in Jordan.

3. Methodology

The study is of a quantitative nature and it uses time series analysis to examine the link between SALM components and efficient debt management in Jordan. The information is collected from the Ministry of Finance and the Central Bank of Jordan, it covers the time period from 2005 to 2023 on a quarterly basis. The dependent variable is the debt-to-GDP ratio, which represents efficient debt management. The independent variables are the various SALM elements, for instance: cash reserves (CRES), foreign reserves (FORR), equity in state-owned enterprises (SOES), future revenues (FUR), government debt (GDEBT), fiscal expenditures (FEXP) and contingent liabilities (CL) variables are described and measured as in Table 1.

To take into account the possibility of non-stationarity in the time series data, unit root tests (Augmented Dickey-Fuller and Phillips-Perron) are carried out. The cointegration tests (Johansen's test) are conducted to check if the variables have long-run relationships. The research applies the Autoregressive Distributed Lag (ARDL) model to investigate the short-run and long-run relations between SALM components and the debt-to-GDP ratio [14]. The ARDL method is suitable for the variables of different orders of integration and can be used even in small sample sizes. Moreover, to be able to take

into account the possible asymmetric effects of SALM components on debt management efficiency, the Nonlinear Autoregressive Distributed Lag (NARDL) model is used [16]. The NARDL model decomposes the explanatory variables into positive and negative partial sums, hence it becomes possible to study the asymmetric short-run and long-run effects. The diagnostic tests, which are the normality test, multicollinearity test, autocorrelation test and model specification tests are carried out to ensure that the estimated models are sound and valid.

Table 1: Descriptions and Measurements of Variables.

Variable	Description	Measurement
DEBTEX	Debt-to-GDP ratio, used as a proxy for efficient debt management	Total public debt outstanding divided by GDP
CRES	Cash reserves held by the government	Debt service divided by cash reserves
FORR	Foreign/international reserves held by the central bank	Debt service divided by foreign reserves
SOES	Equity in state-owned enterprises	Net worth of state-owned enterprises divided by debt service
FUR	Future revenues expected to be generated by the government	Debt service divided by projected future revenues
GDEBT	Total government debt outstanding	Sum of domestic and external debt owed by the government
FEXP	Fiscal expenditures incurred by the government	Total government expenditures in a given period
CL	Contingent liabilities of the government	Estimated present value or expected cost of contingent liabilities

Sources: Adapted from ([17], [7], [9]).

The debt-to-GDP ratio (DEBTEX) is the dependent variable, which stands for the effectiveness of debt management. The independent variables represent different aspects

of SALM, such as cash reserves (CRES), foreign reserves (FORR), equity in state-owned enterprises (SOES), future revenues (FUR), government debt (GDEBT) fiscal expenditures (FEXP) and contingent liabilities (CL).

4. Results

Unit Root Tests

The unit root test results, which are presented in Table 2, indicate that most of the variables are I(1) integrated and therefore cointegration analysis is justified. The Johansen cointegration test (Table 3) is the proof that there are long-run relationships among the variables, therefore it can be concluded that ARDL and NARDL models can be used.

Table 2: Unit root test results

Variable	ADF Test			PP Test		
	t-Statistic	Prob.	Order	t-Statistic	Prob.	Order
DEBTEX	-4.8536	0.0000	I(1)	-3.5500	0.0092	I(0)
LNCRES	-12.7566	0.0000	I(1)	-17.1166	0.0000	I(1)
LNFORR	-7.5548	0.0000	I(1)	-7.5559	0.0000	I(1)
LNSOES	-5.4716	0.0000	I(0)	-5.4389	0.0000	I(0)
LNFUR	-3.0660	0.0341	I(1)	-8.8326	0.0000	I(0)
LNGDEBT	-2.8000	0.0637	I(0)	-13.1874	0.0000	I(1)
LNFEXP	-2.2690	0.0235	I(1)	-8.9205	0.0000	I(0)
LNCL	-3.1647	0.0262	I(0)	-3.0966	0.0311	I(0)

Notes: ADF = Augmented Dickey-Fuller test, PP = Phillips-Perron test. The null hypothesis is that the variable has a unit root (non-stationary). The tests are conducted with individual intercept. The order of integration, I(0) or I(1), is determined based on the test statistics and corresponding p-values at the 5% significance level.

The unit root test results show that most variables are integrated of order one, I(1), except for LNSOES, LNGDEBT and LNCL which are stationary at level, I(0) according to at least one of the tests. The mixed order of integration is the reason why this research

use ARDL and NARDL models, where that are able to deal with variables having different orders of integration.

Table 3: Johansen cointegration test results

Unrestricted Cointegration Rank Test (Trace)				
Hpothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.9004	302.3151	159.5297	0.0000
At most 1 *	0.4372	136.2222	125.6154	0.0096
At most 2	0.3427	94.8322	95.7537	0.0578
Trace test indicates 2 cointegrating equation(s) at the 0.05 level				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.9004	166.0929	52.3626	0.0000
At most 1	0.4372	41.3900	46.2314	0.1509
At most 2	0.3427	30.2127	40.0776	0.4100
Max-eigenvalue test indicates 1 cointegrating equation(s) at the 0.05 level				
Notes: * denotes rejection of the hypothesis at the 0.05 level. ** MacKinnon-Haug-Michelis (1999) p-values.				

The Johansen cointegration test results reveal that the variables are co-integrated, where both trace and maximum eigenvalue tests show at least one co-integrating equation at the 5% significance level. To be more precise, the trace test shows two cointegrating equations and the maximum eigenvalue test indicates one cointegrating equation, thus proving that there are long-run relationships among the variables.

ARDL Model

The ARDL model results reveal significant short-run and long-run effects of SALM components on Jordan's debt-to-GDP ratio. Table 4 presents the short-run coefficients, which show that changes in cash reserves (CRES), foreign reserves (FORR), equity in

SOEs (SOES), government debt (GDEBT), fiscal expenditures (FEXP), and contingent liabilities (CL) have immediate impacts on the debt-to-GDP ratio in the short run.

Table 4: ARDL short-run coefficients

Dependent Variable: DEBTEX				
Method: ARDL				
Sample: 2006Q2 2023Q3				
Included observations: 70				
Dependent lags: 5 (Automatic)				
Automatic-lag linear regressors (5 max. lags): LNCRES LNFORR LNSOES LNFUR LNGDEBT LNFEXP LNCL				
Deterministics: Restricted constant and no trend (Case 2)				
Model selection method: Akaike info criterion (AIC)				
Number of models evaluated: 1399680				
Selected model: ARDL(4,5,1,5,0,0,4,5)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
DEBTEX(-1)	0.2955	0.1185	2.4937	0.0171
DEBTEX(-2)	-0.2788	0.1324	-2.1058	0.0419
DEBTEX(-3)	0.1457	0.1416	1.0292	0.3099
DEBTEX(-4)	0.3612	0.1139	3.1719	0.0030
LNCRES	-0.0223	0.0388	-0.5747	0.5689
LNCRES(-1)	0.0292	0.0405	0.7208	0.4755
LNCRES(-2)	0.1160	0.0417	2.7831	0.0083
LNCRES(-3)	0.0413	0.0376	1.0975	0.2793
LNCRES(-4)	-0.0101	0.0321	-0.3148	0.7546
LNCRES(-5)	0.0836	0.0307	2.7186	0.0098
LNFORR	0.0467	0.0797	0.5857	0.5616
LNFORR(-1)	-0.2093	0.0830	-2.5222	0.0160
LNSOES	0.0489	0.0230	2.1266	0.0400

LNSOES(-1)	0.0158	0.0232	0.6826	0.4990
LNSOES(-2)	0.0631	0.0227	2.7809	0.0084
LNSOES(-3)	-0.0489	0.0234	-2.0891	0.0434
LNSOES(-4)	0.0141	0.0240	0.5871	0.5606
LNSOES(-5)	-0.0340	0.0232	-1.4678	0.1504
LNFUR	-0.0532	0.0720	-0.7392	0.4643
LNGDEBT	0.2587	0.0753	3.4361	0.0014
LNFEXP	-0.2521	0.0884	-2.8506	0.0070
LNFEXP(-1)	0.0195	0.0314	0.6212	0.5382
LNFEXP(-2)	-0.0037	0.0316	-0.1183	0.9064
LNFEXP(-3)	0.0199	0.0314	0.6354	0.5290
LNFEXP(-4)	0.2916	0.0681	4.2846	0.0001
LNCL	-0.0704	0.0741	-0.9500	0.3481
LNCL(-1)	-0.2110	0.0779	-2.7073	0.0101
LNCL(-2)	0.0036	0.0784	0.0456	0.9639
LNCL(-3)	-0.1082	0.0711	-1.5223	0.1362
LNCL(-4)	-0.0201	0.0738	-0.2721	0.7870
LNCL(-5)	-0.2481	0.0643	-3.8592	0.0004
C	3.0526	0.6870	4.4436	0.0001
R-squared	0.9416	Mean dependent var	0.7729	
Adjusted R-squared	0.8940	S.D. dependent var	0.1380	
S.E. of regression	0.0449	Akaike info criterion	-3.0649	
Sum squared resid	0.0766	Schwarz criterion	-2.0370	
Log likelihood	139.2698	Hannan-Quinn criter.	-2.6566	
F-statistic	19.7773	Durbin-Watson stat	2.0025	
Prob(F-statistic)	0.0000			
*Note: p-values and any subsequent test results do not account for model selection.				

The error correction term (ECT) in Table 5 is negative and significant, confirming the existence of a long-run relationship among the variables. The coefficient value of -0.4764 implies a relatively rapid adjustment process, with approximately 47.64% of the deviation from the long-run equilibrium being corrected each quarter.

Table 5: ARDL error correction term

Dependent Variable: D(DEBTEX)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
COINTEQ*	-0.4764	0.0609	-7.8216	0.0000
R-squared: 0.8528				
Adjusted R-squared: 0.7793				

Notes: COINTEQ* is the error correction term which is the lagged residual of cointegrating equation. The coefficient indicates the rate of adjustment to the long-run equilibrium. A negative and significant coefficient is the proof that there is a long-run relationship among the variables.

The error correction term (COINTEQ*) in the ARDL model has a coefficient of -0. 4764, which is negative and statistically significant at the 1% level means that the adjustment process is quite fast. Specifically, approximately 47. 64% of the deviation from the long-run equilibrium is corrected each quarter. Thus, if the debt-to-GDP ratio is not at its long-run equilibrium level, it will return to this level with a speed of 47. 64% per quarter. The negative and significant error correction term, together with the relatively high speed of adjustment shows that the ARDL model has successfully caught the long-run dynamics between SALM components and Jordan's debt management efficiency.

Table 6 presents the long-run coefficients, revealing significant relationships between cash reserves (CRES), foreign reserves (FORR), government debt (GDEBT), and contingent liabilities (CL) with the debt-to-GDP ratio in the long run. The positive coefficient for CRES is unexpected, as higher cash reserves would typically reduce the need for debt financing. However, this result could be specific to Jordan's economic conditions and borrowing practices.

Table 6: ARDL long-run coefficients

Deterministic: Rest. constant (Case 2)				
CE = DEBTEX(-1) - (0.498909*LNCRES(-1) - 0.341423*LNFORR(-1) + 0.123835*LNSOES(-1) - 0.111675*LNFUR + 0.543030*LNGDEBT + 0.158012*LNFEXP(-1) - 1.373165*LNCL(-1) + 6.407920)				
Variable *	Coefficient	Std. Error	t-Statistic	Prob.
LNCRES(-1)	0.4989	0.1878	2.6560	0.0100
LNFORR(-1)	-0.3414	0.1400	-2.4379	0.0177
LNSOES(-1)	0.1238	0.1318	0.9393	0.3512
LNFUR	-0.1117	0.1739	-0.6423	0.5230
LNGDEBT	0.5430	0.1478	3.6743	0.0005
LNFEXP(-1)	0.1580	0.2733	0.5782	0.5652
LNCL(-1)	-1.3732	0.5553	-2.4728	0.0162
C	6.4079	2.3396	2.7389	0.0080
Note: * Coefficients derived from the CEC regression.				

Notes: The table shows the long-run coefficients from the ARDL model estimation, where these coefficients give us the long-run effects of SALM components on debt-to-GDP ratio (DEBTEX). The p-values of the coefficients are less than 0. 05 are significantly different from the 5% level.

The long-term ARDL results reveal that cash reserves (LNCRES), foreign reserves (LNFORR), government debt (LNGDEBT) and contingent liabilities (LNCL) are the main factors of Jordan's debt-to-GDP ratio.

In particular, a higher level of cash reserves (LNCRES) is linked to the increase of debt-to-GDP ratio in the long run which is an unexpected result because normally higher cash reserves would reduce the need for debt financing. This result could be the unique case of Jordan's economic situation and borrowing habits. On the contrary, higher foreign reserves (LNFORR) and lower contingent liabilities (LNCL) are related to a lower debt-to-GDP ratio in the long term. These findings are in line with the hypothesis that foreign

reserves serve as a cushion against external shocks and thus, decrease the dependence on external borrowing. At the same time, efficient management of contingent liabilities can help to overcome fiscal risks and hence, reduce debt burdens. Besides, the higher government debt (LNGDEBT) is linked to a higher debt-to-GDP ratio in the long run which confirms theoretical predictions and underlines the significance of wise management of debts.

NARDL Model

The NARDL model uncovers asymmetric effects of certain SALM components on debt management efficiency. Table 7 shows the short-run coefficients of the positive and negative partial sums of the explanatory variables. The results indicate asymmetric short-run impacts of equity in SOEs (SOES), future revenues (FUR), and fiscal expenditures (FEXP) on the debt-to-GDP ratio, with different coefficient magnitudes for increases and decreases in these variables.

Table 7: NARDL short-run coefficients

Dependent Variable: D(DEBTEX)				
Method: ARDL				
Sample: 2006Q2 2023Q3				
Included observations: 70				
Dependent lags: 5 (Automatic)				
Automatic-lag linear regressors (5 max. lags): LNCRES LNFORR LNGDEBT LNCL				
Automatic-lag dual non-linear regressors (4 max. lags): LNSOES LNFUR LNFEXP				
Deterministics: Restricted constant and no trend (Case 2)				
Model selection method: Akaike info criterion (AIC)				
Number of models evaluated: 312500				
Selected model: NARDL(4,4,4,0,2,3,1,4)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
DEBTEX(-1)	-1.3540	0.3308	-4.0931	0.0003
LNCRES(-1)	-0.1329	0.0959	-1.3857	0.1764

LNFORR(-1)	-0.0945	0.1275	-0.7409	0.4647
LNGDEBT	1.0452	0.2867	3.6458	0.0010
LNCL(-1)	-0.1529	0.1617	-0.9454	0.3523
@CUMDP(LNSOES(-1))	0.3758	0.1644	2.2857	0.0298
@CUMDN(LNSOES(-1))	0.3914	0.1500	2.6086	0.0142
@CUMDP(LNFUR(-1))	0.2305	0.1502	1.5347	0.1357
@CUMDN(LNFUR(-1))	0.3895	0.1815	2.1465	0.0403
@CUMDP(LNFEXP(-1))	-0.7918	0.2906	-2.7251	0.0108
@CUMDN(LNFEXP(-1))	-0.9203	0.2973	-3.0952	0.0043
C	-5.1789	1.9852	-2.6088	0.0142
D(DEBTEX(-1))	0.3340	0.2691	1.2411	0.2245
D(DEBTEX(-2))	-0.0961	0.1872	-0.5132	0.6117
D(DEBTEX(-3))	-0.5015	0.1416	-3.5408	0.0014
D(LNCRES)	-0.1490	0.0455	-3.2768	0.0027
D(LNCRES(-1))	-0.1218	0.0649	-1.8759	0.0708
D(LNCRES(-2))	-0.0990	0.0562	-1.7611	0.0888
D(LNCRES(-3))	0.0484	0.0393	1.2306	0.2284
D(LNFORR)	0.0592	0.1150	0.5151	0.6104
D(LNFORR(-1))	0.0011	0.0965	0.0117	0.9908
D(LNFORR(-2))	0.1288	0.0992	1.2994	0.2040
D(LNFORR(-3))	-0.2087	0.0953	-2.1915	0.0366
D(LNCL)	0.0812	0.0906	0.8969	0.3772
D(LNCL(-1))	0.1081	0.0948	1.1406	0.2634
@DCUMDP(LNSOES)	0.1687	0.1411	1.1956	0.2415
@DCUMDN(LNSOES)	0.0410	0.0256	1.6047	0.1194
@DCUMDP(LNSOES(-1))	-0.2275	0.1427	-1.5942	0.1217
@DCUMDN(LNSOES(-1))	-0.2048	0.1619	-1.2651	0.2159
@DCUMDP(LNSOES(-2))	0.0592	0.0277	2.1413	0.0408

@DCUMDN(LNSOES(-2))	-0.1701	0.1365	-1.2457	0.2228
@DCUMDP(LNFUR)	0.5673	0.2053	2.7634	0.0098
@DCUMDN(LNFUR)	0.0817	0.1438	0.5679	0.5745
@DCUMDP(LNFEXP)	-0.5165	0.2308	-2.2380	0.0331
@DCUMDN(LNFEXP)	-0.5103	0.1749	-2.9180	0.0067
@DCUMDP(LNFEXP(-1))	0.3909	0.3243	1.2053	0.2378
@DCUMDN(LNFEXP(-1))	0.1425	0.1540	0.9252	0.3625
@DCUMDP(LNFEXP(-2))	-0.2529	0.2608	-0.9697	0.3402
@DCUMDN(LNFEXP(-2))	0.1510	0.1301	1.1611	0.2551
@DCUMDP(LNFEXP(-3))	-0.3068	0.2114	-1.4513	0.1574
@DCUMDN(LNFEXP(-3))	-0.1824	0.1165	-1.5655	0.1283
R-squared	0.8941	Mean dependent var		0.0023
Adjusted R-squared	0.7479	S.D. dependent var		0.0869
S.E. of regression	0.0436	Akaike info criterion		-3.1363
Sum squared resid	0.0552	Schwarz criterion		-1.8193
Log likelihood	150.7704	Hannan-Quinn criter.		-2.6132
F-statistic	6.1181	Durbin-Watson stat		1.8445
Prob(F-statistic)	0.0000			
*Note: p-values and any subsequent test results do not account for model selection.				

Notes: The table shows the short-run coefficients from the NARDL model estimation, where the dependent variable is D(DEBTEX) and the independent variables are lags of D(DEBTEX), first differences of LNCRES and LNFORR, and positive/negative partial sum decompositions of LNSOES, LNFUR, and LNFEXP. Coefficients with p-values less than05 are statistically significant at the 5% level.

The results reveal that the short-term effects of LNSOES, LNFUR and LNFEXP on DEBTEX are asymmetric with different coefficients' values and significance levels for positive and negative partial sums, which means that the changes in equity in SOEs, future revenues and fiscal expenditures have different short-run effects on Jordan's debt-

to-GDP ratio, the positive partial sum of LNFUR (@DCUMDP(LNFUR)) has a significant positive coefficient while the negative one (@DCUMDN(LNFUR)) is insignificant which implies that the future revenues increase has a more immediate effect on the debt-to-GDP ratio than the decrease, the asymmetry of the short-run dynamics which is captured by the NARDL model, gives an idea about the non-linear relationships between SALM components and debt management efficiency in Jordan.

The error correction term in Table 8 is negative and significant, confirming the long-run relationship among the variables, even in the presence of asymmetric effects. The coefficient value of -1.3540 implies a relatively fast adjustment process, with approximately 135.40% of the deviation from the long-run equilibrium being corrected each quarter.

Table 8: NARDL error correction term

Dependent Variable: D(DEBTEX)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
COINTEQ*	-1.3540	0.1720	-7.8716	0.0000
R-squared: 0.8941				
Adjusted R-squared: 0.8172				

Notes: COINTEQ* is the error correction term which is the lagged residual of cointegrating equation. The coefficient indicates the rate of adjustment to the long-run equilibrium. A negative and significant coefficient is the proof that there is a long-run relationship among the variables.

The error correction term (COINTEQ*) in the NARDL model has a coefficient of -1.3540, which is negative and statistically significant at the 1% level means that the adjustment process is quite fast even with asymmetric effects. Specifically, approximately 135.4% of the deviation from the long-run equilibrium is corrected each quarter. Thus, if the debt-to-GDP ratio is not at its long-run equilibrium level, it will return to this level with a speed of 135.4% per quarter when accounting for asymmetric effects. The negative and significant error correction term, together with the relatively high speed of adjustment shows that the NARDL model has successfully caught the long-run dynamics

between SALM components and Jordan's debt management efficiency while accounting for asymmetric effects.

Table 9 presents the long-run coefficients, revealing asymmetric long-run impacts of equity in SOEs (SOES), future revenues (FUR), and fiscal expenditures (FEXP) on the debt-to-GDP ratio. Both increases and decreases in these variables are associated with changes in the debt burden, but the magnitudes of the effects differ.

Table 9: NARDL long-run coefficients

Deterministics: Rest. constant (Case 2)				
CE = DEBTEX(-1) - (-0.098162*LNCRES(-1) - 0.069762*LNFORR(-1) + 0.771980*LNGDEBT - 0.112929*LNCL(-1) + 0.277527 *@CUMDP(LNSOES(-1),"2005Q3") + 0.289057*@CUMDN(LNSOES(*@CUMDP(LNSOES(-1),"2005Q3") + 0.289057*@CUMDN(LNSOES(-1),"2005Q3") + 0.170252*@CUMDP(LNFUR(-1),"2006Q1") + 0.287668 *@CUMDN(LNFUR(-1),"2006Q1") - 0.584817*@CUMDP(LNFEXP(-1),"2005Q2") - 0.679675*@CUMDN(LNFEXP(-1),"2005Q2") -3.824959)				
Variable *	Coefficient	Std. Error	t-Statistic	Prob.
LNCRES(-1)	-0.0982	0.0727	-1.3495	0.1823
LNFORR(-1)	-0.0698	0.0866	-0.8053	0.4239
LNGDEBT	0.7720	0.1203	6.4191	0.0000
LNCL(-1)	-0.1129	0.1144	-0.9875	0.3274
@CUMDP(LNSOES(-1))	0.2775	0.1029	2.6971	0.0091
@CUMDN(LNSOES(-1))	0.2891	0.0953	3.0330	0.0036
@CUMDP(LNFUR(-1))	0.1703	0.0828	2.0564	0.0442
@CUMDN(LNFUR(-1))	0.2877	0.0914	3.1482	0.0026
@CUMDP(LNFEXP(-1))	-0.5848	0.1425	-4.1026	0.0001
@CUMDN(LNFEXP(-1))	-0.6797	0.1374	-4.9462	0.0000
C	-3.8250	1.3864	-2.7588	0.0077
Note: * Coefficients derived from the CEC regression.				

Notes: The table shows the long-run coefficients of the NARDL model estimation, where these coefficients are used to measure the long-run effects of SALM components on DEBTEX which is debt-to-GDP ratio and at the same time they take into account potential asymmetric impacts. The variables @CUMDP and @CUMDN are the positive and negative partial sums of the respective SALM components and coefficients with p-values less than 0. 05 are statistically significant at the 5% level.

The long-term results show that the positive and negative partial amounts of LNSOES (equity in state-owned enterprises), LNFUR (future revenues) and, LNFEXP (financial expenditures) have a large, asymmetric effect on the debt-to-GDP ratio in Jordan. The sums of LNSOES both positive and negative, have the coefficients that are significant and positive which means that increases as well as decreases in equity in SOEs is related to higher debt-to-GDP ratios, this result might be connected with possible financial risks and contingent liabilities about state-owned companies. The positive and negative partial sums of LNFUR also reveal the coefficients which are significant, this means that both increases and decreases in future revenues will lead to a higher debt-to-GDP ratio in the long run, which mean that the future revenues are used for debt sustainability which can lead to increased debt levels no matter what is the direction of changes in revenues. On the other hand, the positive and negative partial sums of LNFEXP have a significant coefficient which is negative, meaning that increases in fiscal expenditures are associated with lower debt-to-GDP ratios in the long run. As for, a growth in the government debt (LNGDEBT) is connected with an increase of the debt-to-GDP ratio in the long run that matches perfectly to what has been obtained from the ARDL model.

5. Discussion

The results of this research are significant for the debt management strategies of Jordan in terms of policy. To begin with, the significant short-term and long-term effects of SALM components show that a comprehensive approach to debt management is necessary because these elements are interdependent. Policymakers should take into

account the cross-effects of changes in cash reserves, foreign reserves, equity in SOEs, government debt and fiscal expenditures when they are making decisions on how to manage the debts.

Besides, the asymmetric effects shown by the NARDL model indicate that the direction and size of changes in equity in SOEs, future revenues, and fiscal expenditures can have different effects on debt management efficiency. This implies a need for the policymakers to adopt a balanced way of dealing with this issue, taking into account the possible different responses of the debt-to-GDP ratio to changes in these variables. To illustrate, the case of borrowing against future revenues is a good example, as it may be risky since in the event that actual revenues fall short of expectation, this will only increase the debt burden.

Besides, the positive long-run effect of government debt on the debt-to-GDP ratio proves that it is necessary to have a sound management and to stick to fiscal sustainability goals. The fiscal consolidation measures, the efficient public spending and the revenue mobilization efforts should be given priority to make sure that there are sustainable debt levels and create a space for productive investments and social spending [11].

Besides, the long-term adverse effects of foreign reserves and contingent liabilities on the debt-to-GDP ratio show that it is crucial to have enough reserve buffers and effective management of contingent liabilities. The accumulation of foreign reserves can act as a protection against the external shocks and at the same time, it will reduce the dependence on external borrowing [5]. On top of that, through active monitoring and evaluation of contingent liabilities you can diminish fiscal risks [15].

The research makes a contribution to the knowledge of the connection between SALM and effective debt management in Jordan by giving empirical evidence of the important short-term and long-term effects of SALM components on the debt-to-GDP ratio. The results show the necessity of a comprehensive strategy in debt management and at the same time they expose the asymmetrical dynamics, which require specific policy measures.

6. Conclusion

This empirical research is focused on the investigation of the impact of Sovereign Asset and Liability Management (SALM) on efficient debt management in Jordan, using time series analysis techniques like ARDL and NARDL models. The findings are an additional piece of information on the SALM components and Jordan's debt-to-GDP ratio which is a commonly used measure of debt management efficiency.

The results indicate that the cash reserves, foreign reserves, equity in state-owned enterprises, government debt, fiscal expenditures and contingent liabilities have a big short-term and long-term effect on the debt-to-GDP ratio. Besides, the NARDL model shows that there are asymmetric effects of equity in SOEs, future revenues and fiscal expenditures. It means that these variables will have different impacts on the economy depending on whether they increase or decrease. The research is a good source of information for the policy makers in Jordan and other developing countries who are fighting with the debt management problems. The main policy suggestions are to keep the debt at a sustainable level, to build up foreign reserves, to manage contingent liabilities effectively and finally, to coordinate between relevant institutions. The governments can achieve the fiscal sustainability, risk mitigation and economic growth by applying a well-defined SALM framework and implementing the prudent debt management strategies. Further research could be conducted on the factors that affect SALM and debt management in different countries such as institutional, political, and economic ones. Besides, the inclusion of other possible factors like institutional quality, political stability and financial market development could give more information about the public debt management dynamics.

Conflicts of Interest: The authors declare that there are no conflicts of interest regarding the publication of this paper.

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