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Araştırma Makalesi/Research Article

ANALYSIS OF THE SOCIAL SECURITY INSTITUTION'S HEALTH SPENDING: AN ARDL BOUNDS TEST APPROACH*

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Abstract

With the health transformation program, universal health insurance was introduced. Thus, it became the most significant health service purchaser social security institution. The services provided by hospitals began to occupy an important place in the expenditures of the social security institution. Thus, the study aims to predict and model the effect of functional characteristics of health facilities on Social Security Institution (SSI) health expenditures in Turkey. While collecting the data used in the study, the hospital's service levels as functional characteristics were considered, and the data between 01/2009 and 05/2020 were analyzed. Auto-Regressive Distributed Lag Model (ARDL) bounds test was used to analyze the presence of cointegration between variables in the short and long run. Long-run predictions show that while the secondary-level state hospitals reduce the health expenditure of the SSI, the tertiary-level state, university, and secondary-level private hospitals increase the SSI health expenditure. Measuring the services provided by hospitals and the benefits they provide to patients according to objective criteria will be the most significant indicator of the appropriateness of health expenditures.

Keywords: ARDL Bounds Test, Reimbursement, Health Spending, Health Insurance, Social Security Institution

Jel Codes: C32, G22, G28, H51, I13

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1. Introduction

After a series of economic crises, a health reform called the Health Transformation Program was implemented in Turkey in 2004 with the credit support of the World Bank and the consultancy support of the World Health Organization. The most crucial component of the reform has been universal health insurance. Institutions providing health and social insurance that used to be individual, disorganized institutions were combined under the same umbrella insurance institution called the Social Security Institution of the Republic of Turkey (SSI). An equitable, accessible, and sustainable health service delivery system has been established with universal health insurance, which was brought entirely into force in 2012. SSI, whose primary income is the premiums paid by workers, employers, and the Government, performs the functions of collecting revenue, pooling, and purchasing healthcare (SGK, 2006). SSI, which has become Turkey's largest health service purchaser, receives health services from public and private healthcare providers (HCPs). SSI, which has become Turkey's largest health service purchaser, receives health services from public and private HCPs, constituting a significant part of SSI's health spending. So, it was aimed to predict the health spending of the SSI, including the reimbursements it makes to HCPs using the method of Autoregressive Distributed Lag (ARDL) Bounds Test in the study.

Regarding universal health insurance, the World Health Organization is interested not only in the improvement of the health status of individuals and the scope of health care offered to individuals but also in how these services are funded and managed (WHO, 2014). So, appropriate healthcare funding is the most significant aspect of making these services sustainable. Health insurance systems are mainly funded from general taxes, compulsory premiums, or both to guarantee the access of individuals to healthcare. Independently on the socioeconomic statuses of individuals, health insurance provides everyone with financial security in accessing healthcare (Vaidya and Boes, 2021). In addition to reducing inequalities in access to healthcare, health insurance is also seen as a driving force for improving health (Costa-Font *et al.*, 2021).

Furthermore, it is known that health insurance leads to increased health spending because it makes access to healthcare easier, resulting in higher utilization of outpatient and inpatient medical care (Shami *et al.*, 2019). A previous study concluded that providing individuals with the security of health insurance before the age of 65 would compensate for only approximately 50% of public health spending (McWilliams *et al.*, 2009). Accordingly, creating health reform and health insurance plans causes policymakers serious difficulties.

Advances in science and technology have corresponded in health care. These developments have replaced contagious diseases with non-contagious diseases (WHO, 2018). This way, a change has occurred in the existing morbidity and mortality patterns, which has necessitated the restructuring of the current processes of allocation of resources in health systems (Krstic *et al.*, 2019). Thus, it was aimed to predict the health spending of the SSI, including the reimbursements it makes to the HCPs, using the method of ARDL bounds test in the study.

It is observed that, since the enaction of the Universal Health Insurance, the health expenditures of SSI are increasing day by day (SGK, 2020a). In Turkey, the number of individuals who resort to secondary-level state, tertiary-level state, university, and private hospitals has regularly increased each year. Compared to other HCPs, the number of visits to private HCPs has followed a constant pattern. It was seen that there was a substantial decrease in the number of visits only in 2020. The reason for this was the COVID-19 pandemic that affected the entire world. The reimbursements made by SSI were higher in university hospitals and private hospitals (SGK, 2020b). In this context, knowledge about the extent to which types of HCPs influence the increasing health expenditures of SSI will be crucial for planning the institution's funding.

2. Literature Review

In a study that examined usage and spending in private and public HCPs in low-income countries, it was concluded that the prices of private HCPs for outpatients were higher than those of public ones in 27 of these 39 countries. It was also reported in the same study in some countries (India, Pakistan, Bangladesh) that while outpatient treatment services were more inexpensive in private HCPs, inpatient treatment services were more inexpensive in public HCPs (Saksena *et al.*, 2012). In a study that investigated the effects of the prospective fee-for-service payment method for payments made to HCPs in Burkina, it was found that there was an increase in the medical spending of HCPs as a result of the transition in 2016 from fee-for-service paid retrospectively to fee-for-service paid prospectively (Meda *et al.*, 2020). Researchers who examined differences after universal health insurance in China determined that inpatient health spending and out-of-pocket expenses were lower in private HCPs at all levels, and those with social health insurance were less sensitive to costs (Wang *et al.*, 2018). A study on the uninsured and insured patients in Vietnam found that health insurance reduced out-of-pocket expenditures, and costs increased according to HCPs levels (Thanh *et al.*, 2019). In a study from Ghana on the provision of health care in HCPs after the transition to the National Health Insurance Scheme, it was reported that there was an increase in the health expenditures of all HCPs at different levels; in addition, health spending per patient increased four times in

hospitals, 15 times in clinics and three times in health centers (Aryeetey *et al.*, 2016). In a study conducted in Pakistan, the use of healthcare services and out-of-pocket expenses in private and public HCPs were examined, and it was found that the number of studies conducted in private HCPs were higher (Khalid *et al.*, 2021).

Some studies have compared the private and public HCPs in the setting of more specific cases regarding health spending in underdeveloped countries. A survey of the medical and non-medical costs of pneumonia and diarrhea cases in 35 HCPs in Ethiopia revealed that both conditions resulted in from 2.3 to 3.8 times higher medical costs in private HCPs (Memirie *et al.*, 2017). Another finding of the same study was that the type of health facility was the primary variable affecting medical spending. Moreover, in a study where the burden of severe pneumonia seen in children in the household was examined in Bangladesh, it was stated that the cost per episode of pneumonia was higher in private HCPs than costs in autonomous HCPs, district HCPs, and district health complexes (Sultana *et al.*, 2021). A study conducted in Tanzania determined that costs borne by participants in the care-seeking process for fever were 19% lower in public HCPs than in private HCPs. The researchers added that this cost difference originated mainly from medical costs, while non-medical costs were higher in private than public HCPs (Mikkelsen-Lopez *et al.*, 2013).

3. Method

The dependent variable and independent variables used in the study were obtained from the official statistics website of SSI and taken from financial (SGK, 2020a) and health statistics (SGK, 2020b), respectively. The period examined in the study was between 01/2009 and 05/2020, with no missing data. The following equation was formed for this study:

$$LSSIHE = \beta_0 + \beta_1 LSSH + \beta_2 LTSH + \beta_3 LUNH + \beta_4 LPRH + \mu_t \quad (1)$$

The definitions of the variables in the equation are presented below (Table 1).

Table 1
Description of Variables

Name	Description
LSSIHE	Social Security Instutions Health Expenditures
LSSH	Secondary-Level State Hospitals Invoice Amounts
LTSH	Tertiary-Level State Hospitals Invoice Amounts
LUNH	University Hospitals (Public and Private) Invoice Amounts
LPRH	Private Hospitals Invoice Amounts
β_0, β_1, β_2, β_3 ve β_4	Parameter Coefficients to Estimate
μ_t	Error Term

All series were transformed into logarithmic (log) form to reduce the series' heteroskedasticity, make generalizations for other periods regarding the series, and obtain meaningful results from the analyses.

Considering the study's purpose, model, and data, cointegration analysis based on the boundary test method was used in the study (Pesaran *et al.*, 2001). Cointegration tests determine if there is a long-term relationship between two variables found in a model (Narayan and Narayan, 2005). "The Autoregressive Distributed Lag (ARDL) model" gives more reliable results in small samples, so ARDL was preferred as the analysis method in the study, Narayan and Narayan (2005). It is compatible with the I(0) and I(1) series, and "the Error Correction Model (ECM) can be derived from ARDL model through a simple linear transformation, which integrates short-run adjustments with long-run equilibrium without losing long-run information" (Nkoro and Uko, 2016).

Before the ARDL bounds test, the seasonality in the log-transformed series was removed using the TRAMO/SEATS method. The series were made linear with the ARIMA model in this method and then decomposed into their components with SEATS (Gómez and Maravall, 1997). In the next step, the series was subjected to unit root tests to prevent spurious regression. The existence of a unit root in a series means that the series has a trend. "Augmented Dickey-Fuller (ADF) test" and "Phillips-Perron (PP) test" were used for unit root tests in the study (Dickey and Fuller, 1979; Phillips and Perron, 1988).

As variables included in ARDL must be at most first-order stationary, the ARDL bounds test was performed after the ADF and PP unit root tests were applied. The equations shown below for the short-run estimation (2) and for the long-run estimation (3) are used. In these equations, z is the vector of independent variables, δ and γ are the vectors of coefficients and β_0 the drift component (Karagöz, 2010).

$$\Delta LSSIHE_t = \beta_0 + \sum_{i=1}^{m} \beta_i \Delta LSSIHE_{t-i} + \sum_{i=1}^{m} \delta_i \Delta z_{t-j} + \gamma_0 LSSIHE_{t-1} + \gamma_i z_{t-1} + e_t \quad (2)$$

$$\Delta LSSIHE_t = \beta_0 + \sum_{i=1}^{m} \beta_i \Delta LSSIHE_{t-i} + \sum_{i=1}^{m} \delta_i \Delta z_{t-i} + \lambda ECM_{t-1} + \varepsilon_t \quad (3)$$

The lag lengths are determined according to the information criteria, and the error terms (e_t) of the model must have a normal distribution, homoskedasticity, and no autocorrelation. Additionally, the parameters must be stable, and the model must not have a specification error. If the model meets all assumptions, based on this, one can start the estimation of the conditional error correction (CEC) model. Pesaran *et al.* (2001) proposed five different CEC models, and the cointegration relationship between series can be studied on these models with the ARDL bounds test approach. In the study, the model without a constant and trend was used.

For the model formed in the study, the assumptions of homoskedasticity, no autocorrelation, no specification error, and normality of the error terms were tested using the following tests. The Breusch-Pagan-Godfrey, a systematic test, was used to test homoskedasticity. The Breusch-Godfrey test, which takes the residuals of the main model as the dependent variable and is based on the auxiliary regression model, was utilized to investigate the presence of autocorrelation. The Ramsey Reset test was used to test the presence of a specification error.

Finally, to test whether the error terms were normally distributed, the Jarque-Bera normality test, which is used for asymptotic or large distributions, was used. Next, the calculated Jarque-Bera test statistic and the χ^2 table value were compared. All tests for the method used in the study were conducted on the EViews10 package software.

4. Results

In the study, the descriptive statistics on the log-transformed series in relation to the independent and dependent variables are shown in Table 2, whereas the plots of the series were stationary at the level presented in Figure 1.

Table 2
Descriptive Statistics

Variables	***Mean ± Sd***	***Median (Max; Min)***
LSSIHE	22.26 ± 0.43	22.25 (23.24; 21.52)
LSSH	20.60 ± 0.38	20.73 (21.15; 19.78)
LTSH	20.21 ± 0.50	20.23 (21.05; 19.27)
LUNH	20.12 ± 0.43	20.17 (20.83; 19.21)
LPRH	20.23 ± 0.25	20.28 (20.61; 19.65)

Observations 137 (2009M01:2020M05)
See Table 1 for full names of study variables.

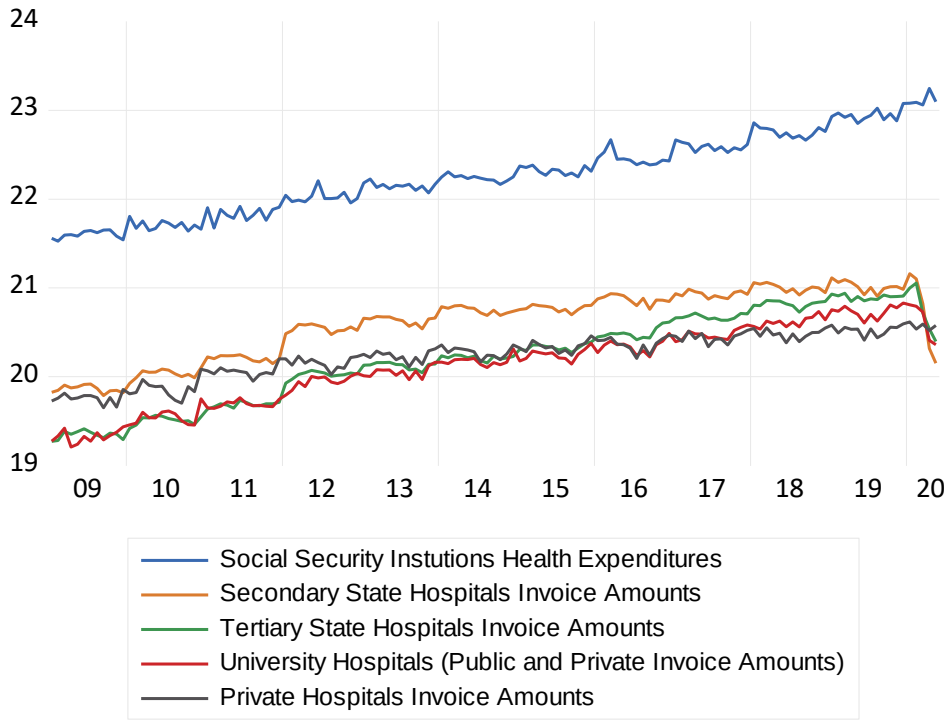

Figure 1

Level Data Plots (Logorithmic Transformation was Performed)

According to the descriptive statistics, the median and mean values of the series were close to each other (Table 2). The lower standard deviation value of the variable of private hospital invoice sums compared to other variables showed that this variable was more stable on the monthly level; that is, the sums of invoices issued by private hospitals were closer to each other monthly. As seen in the plots of the series that were stationary at the level given in Figure 1, it may be stated that all series had an increasing trend, regularly repeated volatilities, and, therefore, seasonality. While a break was observed in the year 2020 in the variables *LSSH*, *LTSH*, and *LUNH*, this was attributed to the COVID-19 pandemic experienced in Turkey and around the world.

The TRAMO/SEATS test filtered the seasonal volatilities under the seasonal effect for the same period each year. This way, seasonally adjusted series were obtained by removing the seasonal effect from the original series. Before the short and long-run prediction of the seasonally adjusted series, ADF and PP unit root tests were used to examine whether they contained unit root. It was determined that they had unit roots when I(0) in both the ADF and PP unit root tests. In this case, as the null hypothesis (H_0) was not rejected, to make the series stationary, their first differences were taken. The series whose first differences were taken were

subjected to stationarity testing again, and it was determined that all series were stationary at I (1) (Table 3).

Table 3
Unit Root Tests Results

Variables		**ADF**		**PP**	
		I(0)	**I(1)**	**I(0)**	**I(1)**
LSSIHE	*With Constant*	1.7040	-12.107***	1.162	-20.238***
	With Constant& Trend	-0.338	-10.243***	-2.690	-20.963***
	Without Constant& Trend	7.721	-1.786*	9.924	-13.895***
LSSH	*With Constant*	0.242	-6.896***	-1.837	-7.398***
	With Constant& Trend	1.033	-7.472***	2.171	-7.760***
	Without Constant& Trend	0.808	-6.863***	0.406	-7.470***
LTSH	*With Constant*	0.215	-5.155***	-2.046	-10.556***
	With Constant& Trend	2.066	-5.561***	1.971	-10.965***
	Without Constant& Trend	1.063	-5.055***	1.711	-10.476***
LUNH	*With Constant*	-2.322	-14.259***	-2.275	-14.219***
	With Constant& Trend	0.644	-14.732***	-0.909	-14.727***
	Without Constant& Trend	2.487	-13.754***	2.354	-13.557***
LPRH	*With Constant*	-2.177	-20.190***	-2.476	-22.393***
	With Constant& Trend	-1.947	-20.406***	-2.660	-28.257***
	Without Constant& Trend	3.627	-18.999***	3.466	-18.415***

****1%; **5% ;*10%; significance level*
See Table 1 for full names of study variables.

The most appropriate model obtained using the Akaike Information Criterion (AIC) was ARDL (4,4,0,0,0). The outlier that disrupted the distribution of the error terms for 2016M3 was corrected with the dummy variable (DUM) added to the equation. The models selected based on the AIC and others are given in Figure 2.

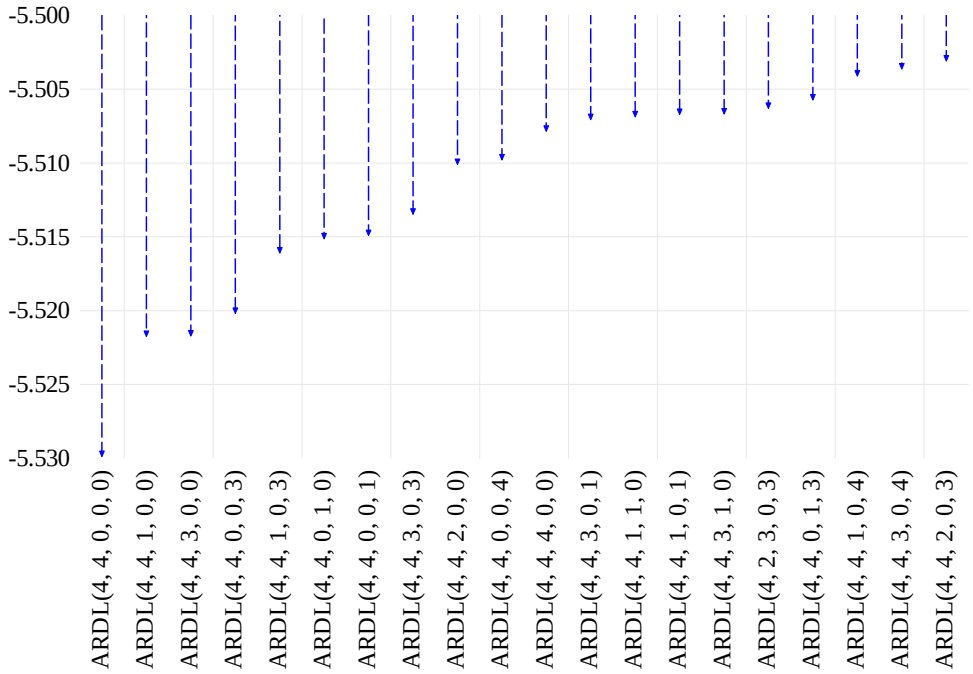

Figure 2

Top 20 Models

The composite hypothesis of the F- bounds test to be performed to test the existence of cointegration was in the form of H_0: $\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$. Following the result of the F-bounds test, the null hypothesis (H_0), stating that the coefficients were equal to zero, was rejected on all levels of significance as the upper critical value was exceeded by the test statistic (Table 4). Since the calculated T-statistic was less than the upper critical value, the found cointegration was valid (Table 4). That is, it was found that the series had a long-run equilibrium relationship. The long-run predictions for the variables are shown in Table 4.

According to the long-run results, all coefficients were statistically significant (Table 4). Likewise, based on the long-run coefficients, a 1% increase in the total invoices made out to SSI by secondary-level state hospitals reduced the health spending on SSI by 1.48%. Moreover, a 1% increase in the sums of the invoices from tertiary-level state hospitals increased health spending by 0.84%. Similarly, a 1% increase in the sums of the invoices from university hospitals increased health spending by 0.77%. 1% increase in the sums of the invoices from private hospitals increased health spending by 1%.

According to the diagnostic test results, the probability of the Breusch Pagan-Godfrey heteroskedasticity test and the probability of the Breusch-Godfrey LM test were greater than 0.05. Therefore, the null hypothesis stating the absence of heteroskedasticity and the null hypothesis stating the lack of autocorrelation was not rejected (Table 4). Since the probability of the Ramsey Reset test exceeded 0.05, the null hypothesis stating that there was no

specification error in the model was not rejected (Table 4). Since the probability of the Jarque-Bera test was greater than 0.05, it was accepted that residuals were normally distributed, and the null hypothesis was not rejected (Table 4).

Table 4
Results of Auto-Regressive Distributed Lag Model Tests

F and T Limit Test Results

	Value	*Significance Level (%)*	*Critical Bound*		*Lag Structure*
			Lower	*Upper*	
F-Statistic	29.625* k=4	***10***	1.9	3.01	4, 4, 0, 0, 0
		5	2.26	3.48	
		1	3.07	4.44	
T-Statistic	-4.322*	***10***	-1.62	-3.26	
		5	-1.95	-3.6	
		1	-2.58	-4.23	

Long Run Results

Variables	*Dependent Variable: LSSIHE ARDL (4, 4, 0, 0, 0) Coefficient*
LSSH	-1.481* (-5.358)
LTSH	0.849* (3.266)
LUNH	0.771* (2.840)
LPRH	1.001* (7.073)

Diagnostic Tests Results

Tests	*Prob.*
Breusch-Pagan-Godfrey Test	0.768 (0.745)
Breusch-Godfrey LM Test:	1.542 (0.218)
Jarque-Bera Normality	0.667 (0.716)
Ramsey Reset Test	0.478 (0.633)

ARDL Error Correction Regression Results

Variable	*Coefficient*	*t-Statistic*	*Prob.*
D(LSSIHE(-1))	-0.5242	-10.1792	0.0000
D(LSSIHE(-2))	-0.3425	-6.0642	0.0000
D(LSSIHE(-3))	-0.2084	-3.8092	0.0002
D(LSSH)	-0.1698	-6.4947	0.0000
D(LSSH (-1))	0.0941	3.0636	0.0027
D(LSSH (-2))	-0.0524	-1.2299	0.2211
D(LSSH (-3))	0.1559	3.1081	0.0024
DUM	0.1799	12.4464	0.0000
ECT(-1)	-0.1175	-12.3721	0.0000
		Critical Bound	
t-statistic= -12.365*		*Lower*	*Upper*
		-1.95	-3.6

**1 % significance level; T-statistic is shown in parenthesis.*
See Table 1 for full names of study variables.

The CUSUM and CUSUMSQ tests developed by Brown *et al.* (1975), which test the stability of the coefficients of variable, were used. A break in the significance level of 0.05 was observed for the late period in 2019 in CUSUM (Figure 3). Nevertheless, as all curves in the CUSUMSQ plot were within the critical limits, it was concluded that the coefficients were stable, and the model was congruent.

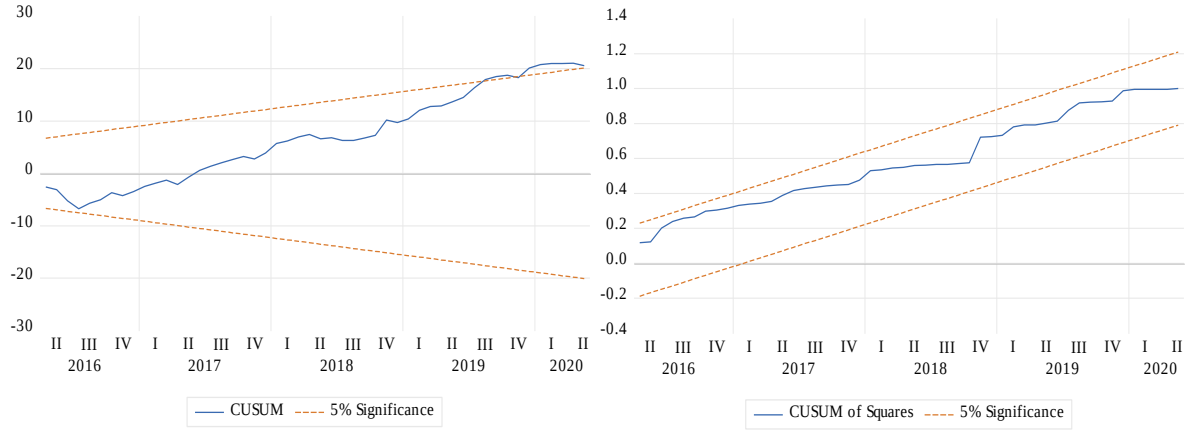

Figure 3
CUSUM and CUSUMQ Plots for Stability Tests

As the error correction term (ECT) was not compatible with Student's t distribution, it was found to be significant following the critical values calculated, Pesaran *et al.* (2001). When the health spending of SSI deviates from equilibrium, in the long run, 11.75% of SSI's health expenditures deviate from the equilibrium will disappear in the next period (Table 4). That is, deviation from the long-run equilibrium will correct itself after approximately 8.5 months.

5. Discussion

In the study, it was concluded that every 1% increase in the sums of the invoices made out to SSI as a result of the provision of healthcare by private hospitals, tertiary-level state hospitals, and university hospitals led to a rise in the health expenditure of SSI by 1% 0.84%, and 0.77% respectively. On the contrary, every 1% raise in the total invoices issued for SSI by secondary-level state hospitals led to a 1.48% reduction in health expenditure.

In their study on the costs of some instances in 35 HCPs in Ethiopia, Memirie *et al.* (2017) found that private HCPs provided services with higher costs than public HCPs. Likewise, studies conducted in Tanzania, Bangladesh, and Pakistan have concluded that treatment costs were higher in private HCPs than in public ones (Khalid *et al.*, 2021; Mikkelsen-Lopez *et al.*, 2013; Sultana *et al.*, 2021). Considering the studies mentioned earlier, the increase in the per invoice mean sum imposed upon SSI supported the finding in the survey that private HCPs were the variable that increased the health spending of SSI most. Khalid *et al.* (2021) stated that

the higher costs of private HCPs, especially doctor wages, consumables, durable medical products, inpatient reimbursements, operating room expenses, and non-medical costs, lead these facilities to provide services for higher sums. In a study that calculated health care costs in mid-level public hospitals in India, it was determined that annual hospital costs were generated by pharmaceuticals and human resources at a rate of 53% and 14%, respectively (Prinja *et al.*, 2017). Additionally, as a result of the sensitivity analysis in the same study, it was concluded that annual costs mainly originated from changes in the prices of medications and consumables, Prinja *et al.* (2017). In this context, it was considered that the finding in the study was that private HCPs provided services for higher sums and issued invoices to the reimbursement institution at higher sums; that is, they tended to increase the health spending of SSI further in comparison to public HCPs, may be explained by the fact that they bore all costs of hiring personnel, machines, equipment and consumables by their capital and revenues.

According to the Health Practice Communique of SSI determining the standards of reimbursement and issuing invoices, 10% additional points are added to the invoices issued by tertiary-level health institutions for some predetermined procedures. In their study that was carried out in Korea, the authors reported that cancer patients with an exceptionally high cost of treatment are increasingly resorting to tertiary HCPs, and this application is more elevated in low-income cancer patients (Kim and Kwon, 2014). Aytekin and Aytekin (2010) examined public healthcare funding in Turkey. They explained their finding of high invoice sums in tertiary HCPs as those patients requiring high-risk, complicated, and intensive care usually presented to these facilities. Shactman *et al.* (2003); investigated hospital utilization expenditures and projected that technology would bring cost-reducing innovations, while they determined that the latest technologies for reaching the desired level and the use of these technologies would continue to contribute to increasing costs for a long time. Tertiary-level state and university hospitals provide intensive care for patients in complicated and critical states using technology. It is believed that this situation leads to increased health care costs. The high total invoices issued by university hospitals and tertiary-level state hospitals determined in the findings of this study were compatible with the information in the literature.

In a study comparing Norway and Finland, Linna *et al.* (2006) reported that small and medium-sized local hospitals are below the average in Finland using the Diagnosis-Related Group (DRG) payment system were the most efficient hospitals. In the study they conducted in China, Wang *et al.* (2018) found that costs were higher in district hospitals than in district/public health centers, and the reason for this was the higher number of treatment items. The results of these studies agreed with the study result that secondary-level state hospitals included in the

scope of this study and could be considered medium-sized compared to the other hospital categories tended to reduce the health spending on SSI.

6. Conclusion

As a result of the study, it was concluded that there was cointegration between the variable of health spending by the SSI (dependent variable) and the variables of total invoices amount made out to SSI by HCPs (independent variables) and this cointegration was valid. It was determined that in the long run, while healthcare provided by private hospitals, university hospitals, and tertiary-level state hospitals would increase the health expenditure of SSI, healthcare provided by secondary-level state hospitals would reduce this spending. A previous study also reported that health insurance could increase health spending (Wagstaff and Lindelow, 2008).

Moreover, secondary-level state hospitals and private hospitals in this study's scope provide services to the same patient profile in terms of health conditions and diseases. However, while secondary-level state hospitals had a trend toward reducing the health spending on SSI, private hospitals had a trend towards increasing it. In addition, the sums of the invoices issued by private hospitals were higher than those given by state hospitals. Nevertheless, as opposed to the case of private hospitals, state hospitals do not have factors that create costs, such as investment and personnel-related expenditures. Sharing a part of the cost arising from the healthcare provided by private hospitals by those utilizing the services will reduce the financial burden on SSI.

It is believed that determining the value of the utility and contribution provided to patients by the services offered for the same conditions and diseases by HCPs at different levels will be the most significant indicator of the appropriateness of the health expenditures made.

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