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The Interactions between Covid-19 Cases in Turkey, the VIX Index and Major Sector Indexes

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Abstract

The COVID-19 pandemic, which started in China in December 2019, caused the great economic recession for about ten years, threatening health, devastating economic activity, and hurting well-being and jobs. The COVID-19 crisis is one the largest globally public health and economic crisis. The COVID-19 pandemic has affected economic activities across various sectors, including tourism, supply of medical equipment, global supply chains, electronic and financial markets, energy, and food services, while also significantly impacting social activities.

This paper investigates the impact of S&P 500 Volatility Index (VIX) on returns of the six sector indexes, informatics index, food index, real estate investment trust index, textile index, tourism index and Bank index from 11 March 2020 to 28 May 2021 in Turkey. Using the VAR analysis method, the results of the empirical study showed that the responses of the other indexes except for Bank index to VIX index are negative at the first. Contrary to these reactions, Bank index return reacts positively to the VIX index.

Keywords: *the Covid-19 fear; volatility index; VAR analysis; Turkey*.

JEL Classification: *G15; I15; O53.*

Introduction

The COVID-19 pandemic is one the great public health crisis and economic crisis worldwide. The Covid-19 shock caused the recession in most part of the world and slowed down the annual global growth rate below 2.5%. Markets became volatile, unpredictable, and characterized by uncertainty due to economic losses, causing the downgrade market (Reis and Pinho 2020). The volatility of global stock markets is mostly interrupted due to widespread of the coronavirus pandemic (COVID-19).

In the financial market, institutions and individuals can adjust with the uncertainty and changing conditions. The COVID-19 crisis increased uncertainty to extreme level than other various risks (Sadiq et al. 2021).

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Given low global interest rates, the probability of inducing an increase in the supply and demand through monetary policy decreases. thus restricting the range of effective policy tools to alleviate the pandemic's negative economic effects.

This study examines the effects of the S&P 500 Volatility Index and the COVID-19 outbreak fear index during the development of the COVID-19 pandemic. Especially, this study investigates the impact of S&P 500 Volatility Index (VIX) on returns of the six sector indexes, informatics index, food index, real estate investment trust index, textile index, tourism index and Bank index from 11 March 2020 to 28 May 2021 in Turkey.

Literature Review

Most studies carried out by authors, such as Haacker (2004), Lee and McKibbin (2004), Loh (2006), Kauffman and Weerapana (2006), McKibbin and Fernando (2020), Fernandes (2020), Albulescu (2020a), Albulescu (2020b), Ramelli and Wagner (2020b), Zeren and HIZARCI (2020), on pandemics and their effect on the economies and financial markets relate mainly to HIV/AIDS and SARS. However, there is a small but growing literature emerging on the impact of COVID-19 on the stock markets (Grima et al. 2021).

For example, Fernandes (2020) suggests that this pandemic (COVID-19) differs from other global crises since it is a global pandemic, which does not focus only on the low-to-middle-income countries, the interest rates are at historical lows, the world is much more integrated than before and there are spillover effects throughout the supply chains that disrupt the demand and supply (Grima et al. 2021).

Papadamou et al. (2020) created a Google trend index concerning coronavirus and investigated the COVID-19 pandemic on the time-varying correlation stock and bond returns for ten countries, covering Europe, Asia, US and Australia regions. They concluded that Google-based anxiety about the impacts of the Coronavirus enhances the risk-aversion of the investors in stock markets.

M. Al-Awadhi et al.(2020) investigated the effects of total cases and deaths caused by COVID-19 on stock returns in the Chinese stock market. They showed that increase in total cases and deaths caused by COVID-19 have significant negative effects on stock returns.

Onali (2020) investigated the relationship of COVID-19 crisis and the U.S. stock market from April 8, 2019 to April 9, 2020. Using a GARCH (1,1) model, the study concluded that the COVID-19 crisis did not have an impact on the U.S. stock market returns.

Zeren and Hizarci (2020) focused on the impacts of Covid-19 daily total death and Covid-19 daily total case on stock markets in China, South Korea, Italy, France, Germany and Spain. Using the Maki (2012) cointegration test, the study showed that all stock markets examined with total death act together in the long run.

Gunay (2020) examines the correlations across different stock markets before and after the pandemic and concludes that Chinese and Turkish stock markets weaken during the period 2005-2019, but display a 20% rise following the outbreak (Reis and Pinho, 2020).

In their study, Grima et al. (2021) used the co-integration analysis for the relationship among COVID-19 cases, deaths and the VIX index in the United States. Using data for the period of 27 January 2020 to 29 May 2020, the authors concluded that there was a statistically significant and long-run positive relation between the cases and the VIX index. On the other hand, there was a statistically significant and long-run negative relationship between the deaths and the VIX index.

Li et al. (2021) tested the impacts of COVID-19 fear on stock market volatility. Using the AR(1)-GARCH(1.1) model, the findings of the study showed that the performance of the stock market and GDP growth significantly decreased because of COVID-19 pandemic. In addition, the findings showed that the COVID-19 cases and deaths caused a significant decline in market liquidity and stability.

Yılmazkuday (2021) examined the effects of the COVID-19 on the S&P 500 index in the U.S. The empirical results suggest that the COVID-19 pandemic has negative effect on the S&P 500 index.

Econometric Methodology

This study examines the impact of VIX index on returns of the six sector indexes (XBLSM, XGIDA, XGMYO, XTEKS, XTRZM, XBANK). These sector indexes are selected from BIST and their explanations are given in Table 1.

Table 1. Explanations of sector indexes

Index code	Description
XBLSM	Informatics index
XGIDA	Food index
XGMYO	Real estate investment trust index
XTEKS	Textile index
XTRZM	Tourism index
XBANK	Bank index

The sample period for this study extends from 11 March 2020 to 28 May 2021. The daily closing data of indexes are obtained from investing database. In this study, index daily returns are calculated with the following formula:

$$index\ return = ln(P_t) - ln(P_{t-1})$$

where P_t denotes index daily closing value at time t, P_{t-1} denotes index daily closing value at time t-1.

To determine the impact of VIX index on returns of the six sector indexes, we use impulse response functions generated from the VAR model. The VAR modelling approach is proposed by Sims (1980) is expressed as follows:

$$Z(t) = C + \sum_{s=1}^{m} A(s)Z(t-m) + \varepsilon(t)$$

where Z(t) is a column vector of variables under consideration, C is the deterministic component of a constant, A(s) is a matrix of coefficients, m is the lag length and $\varepsilon(t)$ is a vector of random error terms.

An impulse response functions show the response of VIX index to 1 time unit shock in the six sector index returns. Impulse response is statistically limited to the upper and lower confidence bands at the 95% confidence level.

In order to VAR modelling analysis, the series must be stationary. For this reason, the first step to be applied before starting the analysis is to perform a unit root test. Augmented Dickey Fuller (ADF) and Phillips Perron (PP) unit root tests are applied to the variables in this study.

The ADF unit root test proposed by Dickey Fuller (1981) is developed by extending the DF test proposed by Dickey Fuller (1979). ADF unit root test equations are as follows:

$$\Delta Y_t = \delta Y_{t-1} + \sum_{j=1}^{p} \delta_i \Delta Y_{t-j} + \varepsilon_t \quad (1)$$

$$\Delta Y_t = \mu + \delta Y_{t-1} + \sum_{j=1}^{p} \delta_i \Delta Y_{t-j} + \varepsilon_t \quad (2)$$

$$\Delta Y_t = \mu + \beta t + \delta Y_{t-1} + \sum_{j=1}^{p} \delta_i \Delta Y_{t-j} + \varepsilon_t \quad (3)$$

Dickey and Fuller (1979) τ table values are used for the above models. In this study we use ıntercept model equation 2 and trend and intercept model equation 3.

ADF assumes that there is no autocorrelation between random errors. Phillips and Perron (1998) has made a new assumption by improving the assumption of the ADF unit root test. The Phillips-Perron (PP) unit root test is a non-parametric test. The PP test is expressed by the following equations:

$$Y_t = \mu + \alpha Y_{t-1} + \varepsilon_t$$

$$Y_t = \mu + \beta\left(1 - \frac{1}{2}\lambda\right) + \alpha Y_{t-1} + \varepsilon_t$$

The basic hypothesis for both unit root tests is the existence of a unit root.

Empirical Results

The analysis is started by applying unit root test to VIX index and six sector index returns. Table 2 reports the results of unit root tests using ADF test and PP test. ADF and PP unit root tests suggest that VIX index and the six sector index returns series used in this study are stationary.

Table 2. Results of ADF and PP Unit Root Tests

	ADF		**PP**	
	Trend and Intercept	**Intercept**	**Trend and Intercept**	**Intercept**
VIX	-3.8552**	-3.8452*	-3.3200***	-2.5594
XBLSM	-16.2293*	-16.0894*	-16.6515*	-16.2056*
XGIDA	-16.6293*	-16.5673*	-16.6292*	-16.5690*
XGMYO	-18.9435*	-18.6811*	-18.9003*	-18.6169*
XTEKS	-19.2481*	-19.1128*	-19.1809*	-19.1128*
XTRZM	-16.7023	-16.6107*	-16.6996*	-16.6188*
XBANK	-17.6892*	-17.7194*	-17.6737*	-17.7027*

Note: *, ** and *** denote rejection of the null hypothesis of unit roots of ADF and PP tests at the %1, %5 and %10 significance levels.

Source: Authors' own and all the calculations are carried out by E-views 9.0

The results of the estimated VAR model is in the Appendix A. The VAR model is tested by roots of characteristic polynomial to check the stability condition. The stationarity condition in the VAR model depends on the each eigenvalues are strictly less than 1. Evidence from Figure 1 shows that no unit roots outside the unit circle. In this context, the estimated var model satisfies the stationarity condition.

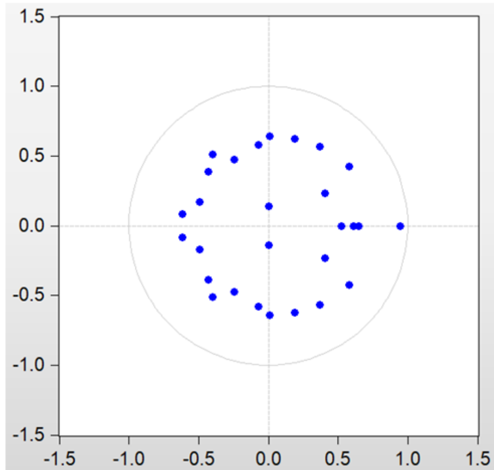

Fig. 1. Inverse Roots of Characteristic Polynomial

Source: Authors' own and all the calculations are carried out by E-views 9.0

If adjacent residuals are correlated, problem of autocorrelation occurs. This correlation means that the independent variables are not adequately explained. Evidence from Table 3 shows that the VAR model exhibits no serial correlation at lag 4.

Table 3. Serial correlation LM Test

Lag	LRE*stat	Prob.
4	63.5175	0.0795

Source: Authors' own and all the calculations are carried out by E-views 9.0

The generalized impulse-response functions derived from the VAR model are used to examine the effects of unexpected movements in VIX index on the six sector index returns. The six figures below show the response of the six sector index returns to a 1-standard deviation shock that occured in VIX index.

Figure 2 shows response of XBLSM index return to a 1-standard deviation increase in VIX index. The effect of VIX index is negative in the two period and the effect turns positive in the third period. The figure also show a significant increase in returns in the fourth period. The reason for this increase in the fourth period may be to recompense for the losses in the first two periods. The effect will disappear from the seventh period by the end of the analyzed period.

Figure 3 shows response of XGIDA index return to a 1-standard deviation increase in VIX index. The effect of VIX index is negative in the two period and the effect turns positive in the third period. In the fourth period, the previous losses are recompense and the XGIDA index return gives maximum response. The effect will disappear from the fifth period by the end of the analyzed period.

Figure 4 shows response of XGMYO index return to a 1-standard deviation increase in VIX index. A 1-standard deviation increase in VIX index affects negatively the return until the middle of the second period. The response of XGMYO index return turns positive in the second period and reaches maximum in the fourth period. The effect will disappear from the fifth period by the end of the analyzed period. The effect will disappear from the eighth period by the end of the analyzed period.

Figure 5 and Figure 6 show response of XTEKS and XTRZM index returns to a 1-standard deviation increase in VIX index respectively. The responses of index returns are similar to those in Figure 3 and Figure 4. The effect will disappear from the eighth period by the end of the analyzed period.

Figure 7 shows response of XBANK index return to a 1-standard deviation increase in VIX index. The effect of VIX index is positive in the first period and the effect turns negative at the end of first period. The XBANK index return reacts differently to the VIX index when compared to the other five index returns. The effect will disappear from the eighth period by the end of the analyzed period.

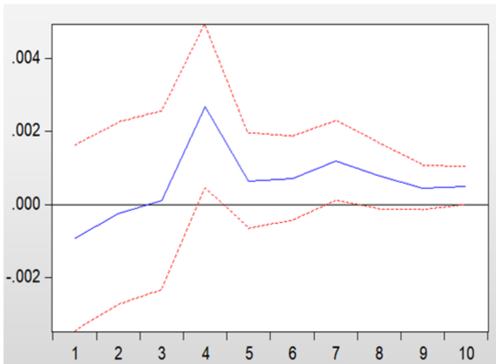

Fig. 2. Response of XBLSM to VIX

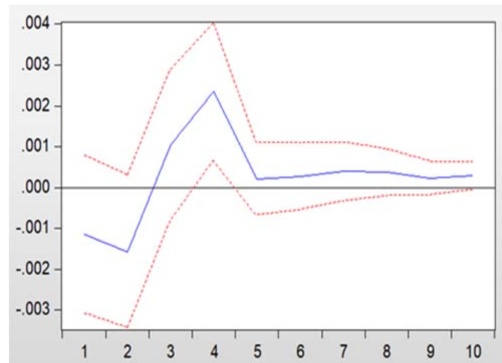

Fig. 3. Response of XGIDA to VIX

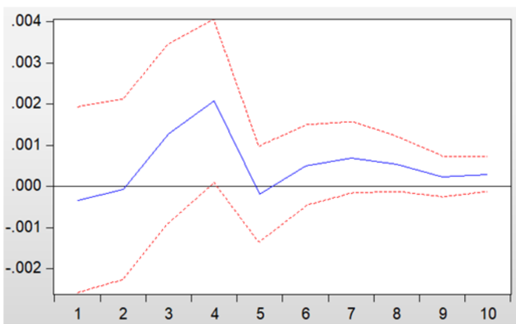

Fig. 4. Response of XGMYO to VIX

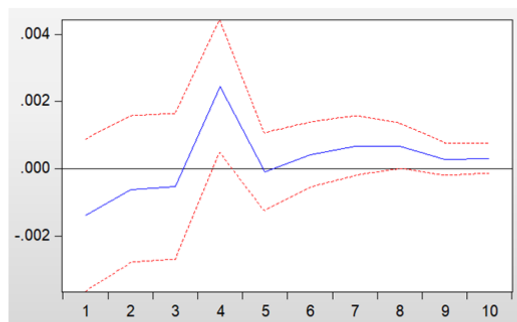

Fig.5. Response of XTEKS to VIX

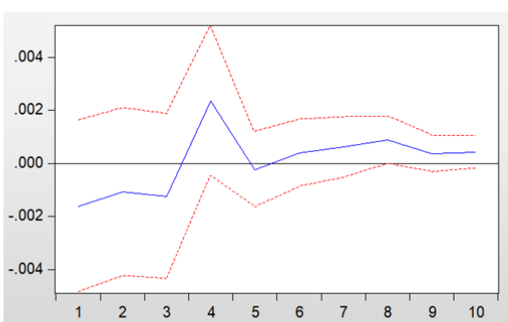

Fig. 6. Response of XTRZM to VIX

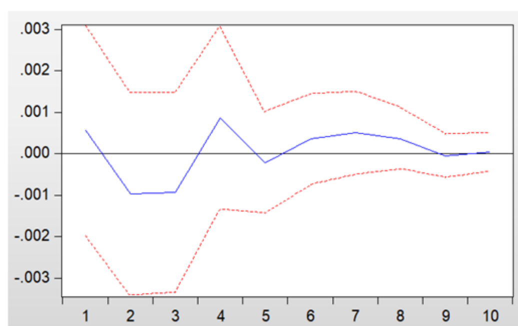

Fig. 7. Response of XBANK to VIX

Source: Authors' own and all the calculations are carried out by E-views 9.0

Conclusion

In December 2019, the coronavirus disease 2019 (COVID-19) outbreak began in the city of Wuhan, Hubei region, China. As of 20 March 2020, the virus had already affected more than 500,000 people in more than 60 countries, with around 16% deaths due to this virus. Around 5% of the infected patients were in a critical or serious condition, while there seemed to be a recovery rate of 85% (Worldometer 2020). On 3 February 2020, the Shanghai stock market plunged 8% following the general distress over COVID-19 in China. This shocking disruption rapidly spread to international financial markets (Grima et al. 2021).

Williams (2009) and Bird and Yeung (2010) noted that both changes in the VIX and the level of VIX are a proxy for uncertainty and explain how the market responds to earnings information. They found evidence that at times when there is high uncertainty, the market sentiment plays a role in counteracting the resultant pessimism of that uncertainty (Grima et al. 2021).

This study examines the impact of VIX index on returns of the six sector indexes (XBLSM, XGIDA, XGMYO, XTEKS, XTRZM, XBANK) selected from BİST. Our results highlighted that the responses of XBLSM, XGIDA, XGMYO, XTEKS and XTRZM index returns to VIX index are negative at the first. Contrary to these reactions, XBANK index return reacts positively to the VIX index. The findings are of special importance to portfolio and fund managers, as well as risk managers, underwriters and actuaries.

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Appendix A. VAR Estimates

	VIX	XBANK	XBLSM	XGIDA	XGMYO	XTEKS	XTRZM
VIX(-1)	0.7775*	-0.0005	1.36E-05	-0.0005	2.05E-05	-0.0002	-0.0003
	(0.0562)	(0.0005)	(0.0005)	(0.0004)	(0.0004)	(0.0004)	(0.0007)
VIX(-2)	0.1398**	0.0001	9.02E-05	0.0009***	0.0005	-5.43E-05	-0.0001
	(0.0682)	(0.0006)	(0.0006)	(0.0005)	(0.0005)	(0.0005)	(0.0008)
VIX(-3)	-0.0182	0.0008	0.0012**	0.0007	0.0005	0.0015*	0.0015**
	(0.0605)	(0.0005)	(0.0005)	(0.0004)	(0.0005)	(0.0005)	(0.0007)
VIX(-4)	0.0384	-0.0004	-0.0008***	-0.0008**	-0.0008**	-0.0010**	-0.0006
	(0.0511)	(0.0005)	(0.0005)	(0.0003)	(0.0004)	(0.0004)	(0.0006)
XBANK(-1)	-2.7764	0.1100	-0.1618**	-0.111***	-0.1004	-0.0979	-0.1083
	(7.9021)	(0.0767)	(0.0768)	(0.0584)	(0.0681)	(0.0681)	(0.0982)
XBANK(-2)	-1.4813	0.0473	0.0448	0.111***	0.0869	0.1190***	0.0434
	(7.9916)	(0.0776)	(0.0777)	(0.0591)	(0.0689)	(0.0688)	(0.0993)
XBANK(-3)	-5.1004	-0.2280*	-0.1567**	-0.0652	-0.0904	-0.1320***	-0.0566
	(8.0129)	(0.0778)	(0.0779)	(0.0592)	(0.0691)	(0.0690)	(0.0996)
XBANK(-4)	-1.0976	0.0941	0.0335	0.0685	-0.0600	-0.0634	-0.0826
	(7.8293)	(0.0760)	(0.0761)	(0.0579)	(0.0675)	(0.0674)	(0.0973)
XBLSM(-1)	-10.3558	0.0519	0.1888**	0.0302	0.0005	0.1163	-0.0395
	(9.0071)	(0.0874)	(0.0875)	(0.0666)	(0.0777)	(0.0776)	(0.1120)
XBLSM(-2)	16.30***	-0.0750	-0.0460	-0.0071	-0.1398***	-0.0866	-0.0432
	(9.1555)	(0.0889)	(0.0890)	(0.0677)	(0.0789)	(0.0789)	(0.1138)
XBLSM(-3)	-8.2994	0.0532	0.0728	0.0473	0.0549	0.1157	0.1129
	(9.0613)	(0.0880)	(0.0881)	(0.0670)	(0.0781)	(0.0780)	(0.1126)
XBLSM(-4)	-7.3181	-0.0321	-0.2553*	-0.1391**	-0.0571	-0.0876	-0.0613
	(8.8842)	(0.0862)	(0.0863)	(0.0657)	(0.0766)	(0.0765)	(0.1104)
XGIDA(-1)	-11.4371	0.1137	0.0919	0.1213	0.0300	-0.0158	0.1214
	(11.9465)	(0.1160)	(0.1161)	(0.0883)	(0.1030)	(0.1029)	(0.1485)
XGIDA(-2)	-23.56***	0.1454	0.1810	0.0133	0.1838***	0.2537**	0.0622
	(12.1216)	(0.1177)	(0.1178)	(0.0896)	(0.1045)	(0.1044)	(0.1507)
XGIDA(-3)	-6.7022	0.1255	0.0343	0.0201	0.1151	-0.0013	0.1008
	(11.9985)	(0.1165)	(0.1166)	(0.0887)	(0.1035)	(0.1034)	(0.1492)
XGIDA(-4)	29.815**	0.2371**	0.4683*	0.1941**	0.3188*	0.3280*	0.1791
	(12.0098)	(0.1166)	(0.1167)	(0.0888)	(0.1036)	(0.1035)	(0.1493)
XGMYO(-1)	-7.4742	-0.0161	-0.1180	0.0058	0.0267	0.0299	-0.0284
	(12.7758)	(0.1240)	(0.1242)	(0.0945)	(0.1102)	(0.1101)	(0.1588)
XGMYO(-2)	4.4899	-0.1044	-0.1121	-0.1189	-0.1412	-0.1379	-0.2108
	(12.6832)	(0.1231)	(0.1233)	(0.0938)	(0.1094)	(0.1093)	(0.1577)
XGMYO(-3)	-2.7863	0.0697	0.0957	0.1143	0.1329	0.0426	-0.0090
	(12.5650)	(0.1220)	(0.1221)	(0.0929)	(0.1084)	(0.1082)	(0.1562)
XGMYO(-4)	-14.5544	-0.0099	-0.0107	-0.0592	-0.0114	-0.0663	-0.0439
	(12.5118)	(0.1215)	(0.1216)	(0.0925)	(0.1079)	(0.1078)	(0.1556)

Appendix A (cont.)

XTEKS(-1)	-4.8018	-0.194***	-0.1258	-0.0622	-0.1583	-0.1516	-0.2313
	(12.1889)	(0.1183)	(0.1185)	(0.0901)	(0.1051)	(0.1050)	(0.1515)
XTEKS(-2)	-8.0645	-0.0260	-0.0833	-0.0246	0.0124	-0.0667***	0.0364
	(12.1023)	(0.1175)	(0.1176)	(0.0895)	(0.1044)	(0.1043)	(0.1505)
XTEKS(-3)	11.9869	0.0471	-0.1113	-0.0869	-0.1180	-0.0242	-0.2195
	(11.9488)	(0.1160)	(0.1161)	(0.0884)	(0.1030)	(0.1029)	(0.1486)
XTEKS(-4)	-6.3837	-0.1845	-0.1451	-0.0077	-0.1478	-0.0783	0.0179
	(11.9489)	(0.1160)	(0.1161)	(0.0884)	(0.1030)	(0.1029)	(0.1486)
XTRZM(-1)	7.0877	-0.0245	0.0786	0.0679	0.1467**	0.1092***	0.2439*
	(7.0372)	(0.0683)	(0.0684)	(0.0520)	(0.0607)	(0.0606)	(0.0875)
XTRZM(-2)	12.89***	0.0593	0.0524	0.0159	0.0342	0.0421	0.0164
	(7.2103)	(0.0700)	(0.0701)	(0.0533)	(0.0622)	(0.0621)	(0.0896)
XTRZM(-3)	-3.8381	-0.0873	0.0166	-0.0231	-0.0828	-0.0406	0.0369
	(7.1394)	(0.0693)	(0.0694)	(0.0528)	(0.0616)	(0.0615)	(0.0887)
XTRZM(-4)	5.4887	0.0694	0.0290	0.0305	0.0606	0.0675	0.1214
	(7.1708)	(0.0696)	(0.0697)	(0.0530)	(0.0618)	(0.0618)	(0.0891)
C	1.4825*	-0.0002	-0.0103*	-0.0054*	-0.0068**	-0.0034	-0.0057
	(0.4006)	(0.0038)	(0.0039)	(0.0029)	(0.0034)	(0.0034)	(0.0049)
R-squared	0.9534	0.1165	0.2075	0.1353	0.1518	0.1628	0.1090
Adj. R-squared	0.9485	0.0239	0.1243	0.0446	0.0629	0.0750	0.0156
Sum sq. resids	1351.922	0.1275	0.1278	0.0740	0.1006	0.1004	0.2091
S.E. equation	2.2501	0.0218	0.0218	0.0166	0.0194	0.0193	0.0279
F-statistic	195.2516	1.2584	2.4967	1.4925	1.7072	1.8552	1.1673
Log likelihood	-644.8065	726.9447	726.6063	807.5037	762.0152	762.3482	653.7706
Akaike AIC	4.5527	-4.7158	-4.7135	-5.2601	-4.9528	-4.9550	-4.2214
Schwarz SC	4.9143	-4.3542	-4.3520	-4.8986	-4.5912	-4.5935	-3.8598
Mean dep.	27.4015	-4.19E-05	0.0036	0.0019	0.0022	0.0037	0.0056
S.D. dependent	9.9206	0.0221	0.0233	0.0170	0.0200	0.0201	0.0282