DAFTAR PUSTAKA

Agusti,N. 2018. Aplikasi Metode VaR dalam Menganalisis Risiko Investasi Saham Menggunakan Pendekatan Model EGARCH (studi kasus:PT Pelat Timah Nusantara Tbk, PT Barito Pacific Tbk, dan PT Delta Dunia Makmur Tbk) . Skripsi, Universitas Islam Negeri Syarif Hidayatullah.

Angabini A, Wasiuzzaman S. 2011. GARCH models and the financial crisis- A study of the Malaysian stock market. *The International Journal of Applied Economics and Finance*, 5(3),226-236

Aritonang R. 2009. Peramalan Bisnis (Edisi Kedua). Penerbit Ghalia Indonesia, Bogor.

Best, P. 1998. Implementating Value at Risk. West Sussex: John Wiley and Sons,Ltd

Bollersev, T. 1986. Generalized Autoregressive Conditional Heteroscedasticity. *Journal of Econometrics*,31(3), 307-327.

Collins, C. N. 2020. Effect of COVID-19 Pandemic on Global Stock Market Values: A Differential Analysis. Acta Universitatis Danubius (Economica), 16(2), 255-299.

Cryer JD, Chan KS. 2008. Time Series Analysis with Applications in R. New York (USA): Spring Street.

Dwipa, N.M.S. 2016. Identifikasi Model I-Garch *(IntegratedGeneralized Autoregressive Conditionally Heterocedastic)* Untuk Peramalan *Value At Risk. Jurnal Devirat*,3(1), 25-38.

Enders, W.1995. Applied Econometrics Time Series. John Willey and Sons,Inc. United States of Statistics.

Engle, R.1982. *The Use of ARCH/GARCH Models in Applied Econometrics*. *Journal of Econometric Prespective*, 15(4), 157-168. DOI: 10.1257/jep.15.4.157

Francq, C., & Zakoïan, J. M. (2011). GARCH models: structure, statistical inference and financial applications. John Wiley & Sons.

Freedi A, Shamiri A, Isa .(2011) A Study on the behavior of volatility in Saudi Arabia stock market using symmetric and asymmetric GARCH models. Journal of Mathematics and statistics,8(1),98-106.

Ghozali, I. 2007. Manajemen Risiko Perbankan. Semarang: BPUNDIP.

Hull, J.C. 2012. Options, Futures, and Other Derivatives (Eight ed.). England:Pearson.

Jones, C. P. (2006). Investments: Analysis and Management; 10th edition. New York: John Wiley & Sons.

Junaedi, D. (2020). Dampak Pandemi Covid-19 terhadap Pasar Modal di Indonesia: Studi Kasus Indeks Harga Saham Komposit (ISHG).*Al-Kharaj:Jurnal Ekonomi, Keuangan & Bisnis Syariah*, 2(2), 109-131.

Kelikume I, Salami A. 2014.Time Series Modeling and Forecasting Inflation: Evidence from Nigeria. *The International Journal of Business and Finance Research*. Vol.8 Edition 2

Longerstaey, J. & More, L. (1995). Introduction to riskmetrics. New York, NY: Morgan Guaranty Trust Company

Maricar, M. A. (2019). Analisa perbandingan nilai akurasi moving average dan exponential smoothing untuk sistem peramalan pendapatan pada perusahaan xyz. *Jurnal Sistem dan Informatika* (JSI), 13(2),36-45.

Massey,FJ.1951. The Kolmogorov-Smirnov Test for Godness of Fit. *Journal of the American Statistical Association*, 46 (253), 68-77.

Mubarokah IS, Fitrianto A, Afendi FM. 2020. Perbandingan model GARCH simetris dan asimetris pada data kurs harian. Indonesian Journal of Statistics and its application, 4(4), 627,637.

Nelson, D.B.1991.Conditional Heteroskedasticity in Asset Returns: A New Approach Soource.Econometrica,(59),347-370.

Panjaitan H, Prahutama A, dan Sudarno. 2018. Peramalan Jumlah Penumpang Kereta Api Menggunakan Metode ARIMA, INTERVENSI dan ARFIMA (Studi Kasus: Penumpang Kereta Api Kelas Lokal Ekonomi DAOP IV Semarang). *Jurnal Gaussian*, 7(1), 96-109.

Qamruzzam A.C.M.A,M. (2015). Estimasing and forecasting volatility ofstock indices using asymmetric GARCH models and Student.-t-densities:

Evidence from Chittagong Stock Exchange. International Journal of Business and Finance Management Research, 3,19-34

Rosadi, D. 2011. Analisis Ekonometrika dan Runtun Waktu Terapan dengan R. Yogyakarta: ANDI

Ruppert D, Matteson DS. 2011. *Statistics and Data Analysis for Financial Engineering*. New York (US): Springer

Sukirno S, 2003."Pengantar Teori Mikro Ekonomi". Jakarta: PT. Salemba Empat.

Tagliafichi,R.A.2011. The Garch model and their application to the VaR. Washington:*Proceedings ASTIN 2001*.

Tendelilin,Eduardus .2001. Analisis Investasi dan Manajemen Portofolio, Edisi I, cet. I. Yogyakarta: BPFE

Tsay, R. S. 2005. *Analysis of Financial Time Series Second Edition*. New York : A John Wiley & Sons, Inc.

Tsay, R.S. 2002. Analysis of Financial Time Series. Canada: John Wiley and Sons, Inc.

Tsay, R. S. and Tiao, G. C. (1984). Consistent Estimates of Autoregressive Parameters and Extended Sample Autocorrelation Function for Stationary and Nonstationary ARMA Models. *J. Amer. Statist. Assoc*. 79(385), 84-96.

Untari N, Mattjik AA, Saefuddin A. 2009. Analisis deret waktu dengan ragam galat heterogen dan asimetrik: studi indeks harga saham gabungan (IHSG) periode 1999-2008. Forum Statistika dan Komputasi. 9:22-33.

Wei, W.W.S. 2006.*Time Series Analysis Univariate and Multivariate Methods Second Edition*. Pearson Education Inc., Canada.

Yahoo Finance. 2021. Jakarta composite index (JKSE): Historical data [internet]. [diakses 2022 Feb 8]. Tersedia dari: https://finance.yahoo. com/quote/%5EJKSE/history/.

Lampiran 1. Data *return* saham sebelum dan selama pandemi COVID-19

Periode Sebelum Pandemi	Harga Penutupan Saham	Return Saham
1/2/2019	6181.175	-0.0022
1/3/2019	6221.01	0.0064
1/4/2019	6274.54	0.0086
1/7/2019	6287.224	0.0020
1/8/2019	6262.847	-0.0039
1/9/2019	6272.238	0.0015
1/10/2019	6328.714	0.0090
1/11/2019	6361.465	0.0052
1/14/2019	6336.116	-0.0040
1/15/2019	6408.784	0.0115
⋮	⋮	⋮
⋮	⋮	⋮
⋮	⋮	⋮
12/9/2019	6193.791	0.0011
12/10/2019	6183.505	-0.0017
12/11/2019	6180.099	-0.0006
12/12/2019	6139.397	-0.0066
12/13/2019	6197.318	0.0094
12/16/2019	6211.592	0.0023
12/17/2019	6244.352	0.0053
12/19/2019	6249.93	0.0009
12/20/2019	6284.372	0.0055

Lampiran 1. (Lanjutan)

Periode Selama Pandemi	Harga Penutupan Saham	Return Saham
3-Mar-20	5518.6279	0.0294
4-Mar-20	5650.1362	0.0238
5-Mar-20	5638.1299	-0.0021
6-Mar-20	5498.5400	-0.0248
9-Mar-20	5136.8091	-0.0658
10-Mar-20	5220.8262	0.0164
11-Mar-20	5154.1050	-0.0128
12-Mar-20	4895.7480	-0.0501
13-Mar-20	4907.5708	0.0024
16-Mar-20	4690.6572	-0.0442
⋮	⋮	⋮
⋮	⋮	⋮
⋮	⋮	⋮
19-Feb-21	6231.9321	0.0051
22-Feb-21	6255.3120	0.0038
23-Feb-21	6272.8071	0.0028
24-Feb-21	6251.0542	-0.0035
25-Feb-21	6289.6460	0.0062
26-Feb-21	6241.7959	-0.0076
1-Mar-21	6338.5132	0.0155
2-Mar-21	6359.2051	0.0033
3-Mar-21	6376.7568	0.0028

Lampiran 2. Uji Diagnostik Model ARIMA

- Sebelum Pandemi

```
> Box.test(sebelum_101$residuals, lag = 10, type = "Ljung")

        Box-Ljung test

data:  sebelum_101$residuals
X-squared = 12.073, df = 10, p-value = 0.2802

> arch.test(sebelum_101, output = TRUE)
Lagrange-Multiplier test:

     order    LM  p.value
[1,]     4 67.62 1.38e-14
[2,]     8 30.59 7.40e-05
[3,]    12 18.59 6.90e-02

> ks.test(sebelum_101$residuals,"pnorm")

        Asymptotic one-sample Kolmogorov-Smirnov test

data:  sebelum_101$residuals
D = 0.49305, p-value < 2.2e-16
```

- Selama Pandemi

```
> Box.test(selama_202$residuals, lag = 10, type = "Ljung")

        Box-Ljung test

data:  selama_202$residuals
X-squared = 11.902, df = 10, p-value = 0.2917

> arch.test(selama_202, output = TRUE)
ARCH heteroscedasticity test for residuals
Lagrange-Multiplier test:

     order     LM p.value
[1,]     4 104.15 0.00000
[2,]     8  27.69 0.00025
```

Lampiran 3. Identifikasi model GARCH

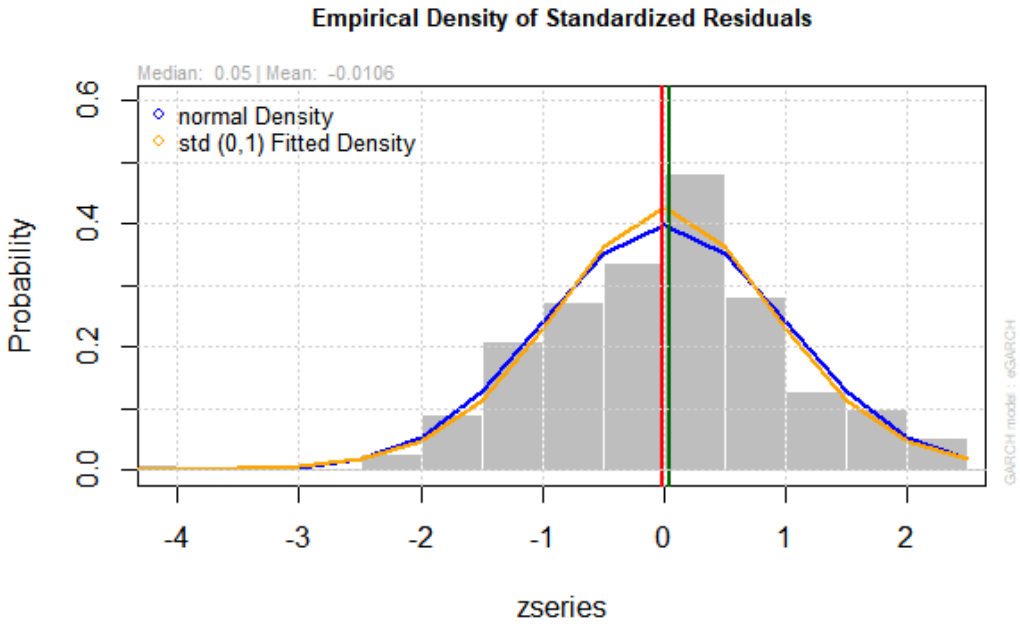
Model Sebelum Pandemi	Parameter	Koefisien	Prob.	AIC
ARIMA(1,0,1) GARCH (1,1)	μ ϕ_1 θ_1 α_0 α_1 β_1 v	0.0005 -0.9455 0.9918 0.000007 0.0361 0.9629 13.5816	0.2929 0.0000 0.0000 0.0000 0.0000 0.0000 0.1469	-6.8728
ARIMA(1,0,1) GARCH (1,2)	μ ϕ_1 θ_1 α_0 α_1 β_1 β_2 v	0.0004 -0.9405 0.9923 0.0000 0.0000 0.0702 0.8099 22.5826	0.4439 0.0000 0.0000 0.9181 0.9999 0.0003 0.0000 0.3021	-6.8479
ARIMA(1,0,1) GARCH (2,1)	μ ϕ_1 θ_1 α_0 α_1 α_2 β_1 v	0.0005 -0.9455 0.9917 0.000007 0.0739 0.0000 0.8047 13.8195	0.2970 0.0000 0.0000 0.0000 0.3929 1.0000 0.0000 0.1716	-6.8653
ARIMA(1,0,1) GARCH (2,2)	μ ϕ_1 θ_1 α_0 α_1 α_2 β_1 β_2 v	0.0006 -0.9455 0.9915 0.000012 0.0930 0.0292 0.0934 0.5686 13.2660	0.2733 0.0000 0.0000 0.0000 0.2046 0.6548 0.8516 0.2471 0.1606	-6.8566

Lampiran 3. (Lanjutan)

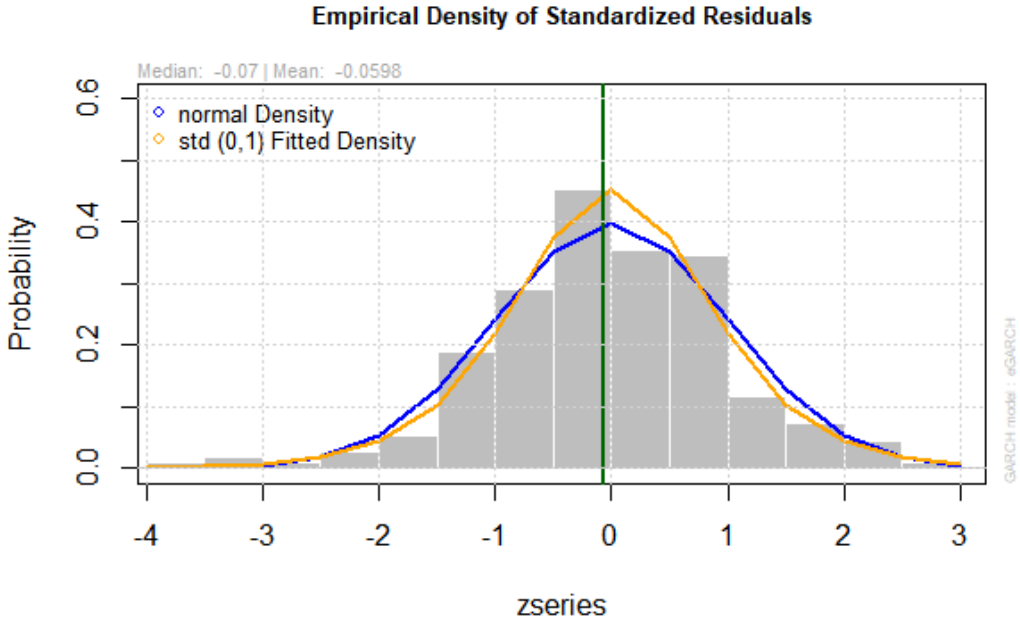
Model Selama Pandemi	Parameter	Koefisien	Probabilitas	AIC
ARIMA(2,1,2) GARCH (1,1)	μ ϕ_1 ϕ_2 θ_1 θ_2 α_0 α_1 β_1 v	0.0021 -0.6462 -5.4927 0.5518 0.3977 0.00002 0.2153 0.7249 5.8125	0.0022 0.0239 0.0000 0.0000 0.0000 0.0235 0.0144 0.0000 0.0089	-5.6264
ARIMA(2,1,2) GARCH (1,2)	μ ϕ_1 ϕ_2 θ_1 θ_2 α_0 α_1 β_1 β_2 v	0.0021 -0.7948 -0.5529 0.7542 0.4152 0.000027 0.3140 0.4548 0.0000 5.8125	0.0022 0.0239 0.0545 0.0834 0.2115 0.0236 0.0517 0.2073 1.0000 0.0092	-5.6173
ARIMA(2,1,2) GARCH (2,1)	μ ϕ_1 ϕ_2 θ_1 θ_2 α_0 α_1 α_2 β_1 v	0.0020 -1.5135 -0.8959 1.5959 0.9323 0.000024 0.2843 0.0000 0.6289 5.7191	0.0026 0.0258 0.0491 0.0858 0.1986 0.0967 0.1624 0.6196 0.0000 0.0059	-5.6185
ARIMA(2,1,2) GARCH (2,2)	μ ϕ_1 ϕ_2 θ_1 θ_2 α_0 α_1 α_2 β_1 β_2 v	0.0021 -0.6486 -0.5535 0.5555 0.4025 0.00002 0.1718 0.0679 0.6927 0.0000 5.7176	0.0041 0.0318 0.0692 0.1049 0.2221 0.8513 0.7933 0.9293 0.9262 1.0000 0..0378	-5.6094

Lampiran 4. Plot hasil uji normalitas sisaan EGARCH

- Sebelum pandemi



- Selama pandemi



Lampiran 5. Peramalan mean dan variansi model IGACRH dan EGARCH

Sebelum Pandemi	EGARCH		IGARCH	
	Return	Sigma	Return	Sigma
22-Nov-19	0.0035	0.0075	0.0034	0.0072
25-Nov-19	-0.0028	0.0074	-0.0027	0.0072
26-Nov-19	-0.0080	0.0079	-0.0075	0.0072
27-Nov-19	0.0038	0.0083	0.0033	0.0072
28-Nov-19	0.0034	0.0081	0.0032	0.0072
29-Nov-19	0.0010	0.0081	0.0009	0.0072
2-Dec-19	0.0159	0.0084	0.0138	0.0072
3-Dec-19	0.0038	0.0067	0.0043	0.0072
4-Dec-19	-0.0031	0.0066	-0.0034	0.0072
5-Dec-19	-0.0116	0.0070	-0.0120	0.0072
6-Dec-19	0.0054	0.0074	0.0052	0.0072
9-Dec-19	0.0090	0.0069	0.0099	0.0072
10-Dec-19	0.0046	0.0061	0.0057	0.0072
11-Dec-19	0.0020	0.0058	0.0026	0.0072
12-Dec-19	0.0071	0.0060	0.0084	0.0072
13-Dec-19	-0.0040	0.0052	-0.0057	0.0072
16-Dec-19	0.0019	0.0056	0.0024	0.0072
17-Dec-19	0.0026	0.0056	0.0036	0.0072
19-Dec-19	0.0000	0.0057	0.0000	0.0072
20-Dec-19	0.0124	0.0060	0.0148	0.0072

Lampiran 5.(Lanjutan)

Selama Pandemi	EGARCH		IGARCH	
	Return	Sigma	Return	Sigma
4-Feb-21	0.0068	0.0109	0.0042	0.0185
5-Feb-21	-0.0021	0.0108	0.0001	0.0189
8-Feb-21	-0.0087	0.0108	-0.0032	0.0193
9-Feb-21	0.0093	0.0127	0.0064	0.0196
10-Feb-21	0.0062	0.0101	0.0042	0.0200
11-Feb-21	0.0010	0.0109	0.0019	0.0203
15-Feb-21	0.0190	0.0092	0.0150	0.0207
16-Feb-21	0.0066	0.0100	0.0053	0.0210
17-Feb-21	-0.0044	0.0086	-0.0029	0.0214
18-Feb-21	-0.0133	0.0099	-0.0108	0.0217
19-Feb-21	0.0145	0.0131	0.0134	0.0220
22-Feb-21	0.0126	0.0096	0.0123	0.0223
23-Feb-21	0.0072	0.0113	0.0072	0.0227
24-Feb-21	0.0040	0.0091	0.0049	0.0230
25-Feb-21	0.0160	0.0098	0.0185	0.0233
26-Feb-21	-0.0066	0.0087	-0.0104	0.0236
1-Mar-21	0.0058	0.0112	0.0077	0.0239
2-Mar-21	0.0067	0.0084	0.0077	0.0242
3-Mar-21	0.0017	0.0097	0.0010	0.0245
4-Mar-21	-0.0180	0.0079	-0.0249	0.0248

Lampiran 6. Perbandingan data aktual dan peramalan harga penutupan saham

Sebelum Pandemi			Selama Pandemi		
Aktual	IGARCH	EGARCH	Aktual	IGARCH	EGARCH
6100	6122	6138	6107	6104	6110
6071	6105	6122	6152	6104	6106
6026	6056	6076	6209	6085	6073
6023	6079	6096	6182	6124	6110
5953	6100	6116	6202	6150	6161
6012	6106	6121	6223	6161	6154
6130	6204	6207	6270	6254	6272
6134	6228	6233	6292	6288	6314
6113	6209	6212	6228	6269	6286
6152	6137	6138	6200	6202	6203
6187	6170	6170	6232	6286	6294
6194	6226	6231	6255	6363	6374
6184	6255	6267	6273	6409	6419
6180	6268	6283	6251	6441	6445
6139	6313	6336	6290	6561	6549
6197	6288	6300	6242	6493	6506
6212	6300	6316	6339	6544	6543
6244	6316	6338	6359	6594	6587
6250	6316	6338	6377	6601	6598
6284	6395	6433	6291	6430	6350
MAPE	1.4248%	1.1992%	MAPE	1.7724%	1.7572%
RMSEP	98.5128	84.2424	RMSEP	141.9190	140.7383