Dean&Francis

ISSN 2959-6130

Effects of some of the macroeconomics factors on the stock price of Hengrui Pharmaceutical Company

Haolan Cheng

International College Beijing

China Agricultural University, Beijing, 100083, P. R. China

Abstract:

This paper introduced and explored the background of Hengrui Pharmaceutical Company, then use PEST, Potter's Five Forces Model and SWOT to analysis how Hengrui Pharmaceutical Company is doing in the macroeconomic environments, industrial environments and the competing advantages and disadvantages of itself. Then this paper use VECM model to see how and to what extend that exchange rate, unemployment rate, which is the main focus of this paper, inflation rate and 1 year deposit interest rate is affecting close price of Hengrui Pharmaceutical Company. Results are exchange rate is negatively related with close price in short run, and exchange rate USD/RMB, unemployment, core inflation and interest rate have negative influences on stock price in medium run.

Keywords: VECM, Hengrui Pharmaceutical Company

1 Introduction

Hengrui Pharmaceutical, full name Jiangsu Hengrui Pharmaceutical Co., Ltd., is a leading innovative pharmaceutical company in China. Since its inception, Hengrui Pharmaceutical has been committed to the research, development, production, and sales of innovative and high-quality drugs to meet the needs of patients both domestically and internationally. The company boasts a high-caliber research and development team and advanced facilities, achieving significant breakthroughs in various fields such as anti-tumor drugs, anesthesia analgesics, contrast agents, etc., providing safer and more effective treatment options for global patients. Hengrui Pharmaceutical adheres to the mission of "Science and Technology as the Foundation, Serving Human Health" and upholds the core values of "Innovation, Excellence, Integrity, and Win-Win Cooperation". It continuously promotes technological and management innovations to create value for patients and society.

This article will start by using PEST, Potter's Five Forces Model and SWOT model to analysis how macroeconomic environments, industry environments affects the company's development and how advantages and disadvantages of this company affect its development and the company's competing power. Then this article will be focusing on quantitative analysis of how macroeconomic factors such as core inflation, unemployment rate, exchange rate, one year deposit interest rate and to what extent these factors affect the stock price of Hengrui Pharmaceutical Company using VECM model, which is also the main focus of this article.

In this study, we realized that a successful car-sharing company needs to have a beneficial public rela-

tionship, a mature resource allocation system, stable and sticky customers, and excellent service. By analyzing their shortcomings and advantages and combining with the background of China's sharing economy and car sharing, this paper provides some suggestions for the future development of car sharing enterprises in China.

Macroeconomic factors affect the stock price is widely accepted by now. Economists and financial expects are always interested in what macroeconomic factors affect the stock price of company and to what extent these factors affect stock price. The most popular model being used by now to see how and to what extent macroeconomic factors affect stock price is Arbitrage Pricing Theory Model also known as APT developed in 1976 by Ross [3].

The development of cointegration analysis provides an alternative method to study the relationship between economic variables and the stock market. Granger (1986) verify a long-run equilibrium between stock prices and macroeconomic variables, through cointegration analysis. A set of time series variables is said to be cointegrated if they are integrated with the same order and their linear combinations are stationary [1]. This linear combination would indicate a long-term relationship between the variables (Johansen & Juselius, 1990) [2].

One of the advantages of cointegration analysis is that by building an error correction model (ECM), it is possible to check the dynamic linkage between variables and the adjustment process towards long-term equilibrium.

2 Methodology

2.1 PEST

P: The reform of the medical and health system

Patent protection and innovation encouragement

A policy that is called about the reducing cost of manufacturing the innovative drug which is released in May, 2023 《医药工业高质量发展行动计划 (2023-2025 年)》

Many policies are released to support the whole chain of pharmaceutical drugs, like the policy released in August 2023 《医疗装备产业高质量发展行动计划 (2023-2025 年)》

E: China's economy is in a period of rapid growth and Increase in health care consumption.

S: China's aging trend. After the age of 65 years of medical needs accounted for half of the total demand and Decreasing consumption on tumor drugs.

T: developments of gene editing.

2.2 Potter's Five Forces

Threat of new entry: low. Because this is a capital-intensive and technology-intensive industry and the industry is strictly regulated and controlled by the government, so market entry barrier is high.

Buyers power: high

the main buyers are medical institutions, drug retailers and drug wholesale enterprises and The government will control the price of medicine.

Supplier power: low

The supplier is the raw material of medicine and chemical industry, don't have pricing power.

Substitution power is high for genic drug not for innovative drug.

Competition in the pharmaceutical industry: high because China's existing more than 300 listed medical and health companies and there are serious product homogenization.

2.3 SWOT

S:Scale advantage (well-known) and High domestic market share and High standard production base,Rich experience on generic drugs, 26 types and Abundant innovative drug pipeline, more than 80.

W: The proportion of generic drugs is still a little high (54% of revenue)

O: Policy encouragement to increasing enthusiasm and Reducing pressure of centralized procurement of drugs and Aging trend.

T: Centralized procurement of drugs and Competitive industry.

2.4 Johansen's Vector error correction model (VECM)

VECM model is as follow. VECM comes from VAR model with cointegration fixing,

$$\Delta Y_t = \sum_{j=1}^{p-1} \Gamma_j \Delta Y_{t-j} + \alpha\beta' Y_{t-p} + \mu_t + \varepsilon_t$$

$\sum_{j=1}^{p-1} \Gamma_j \Delta Y_{t-j}$ and ΠY_{t-p} comes from VAR model, first differences and error-correction components. ΔY_t is a k × 1 vector of variables and is integrated of order one. μ_t is a k × 1 vector of constants. p is a lag structure, ϵ_t is a k × 1 vector of white noise error terms. Γ_j is a k × k matrix that represents short-term adjustments among variables across k equations at the jth lag. β' is a k × r matrix of cointegrating vectors, and Δ denotes first differences. α is a k × r matrix of speed of adjustment parameters representing the speed of error correction mechanism, r is the number of cointegration vector. A larger α suggests a faster convergence toward long-run equilibrium in cases of short-run deviations from this equilibrium.

3 Data collection

3.1 Variables

Variables	Definition
CLO_t	Closing price of Hengrui pharmaceutical Company since it is listed on 2000-10-18, this data comes from Tonghuashun APP
EXC_t	Exchange rate of RMB to Dollar since 2006-01-04, this data is from China Public Bank
UNE_t	Quarterly unemployment from 2002-09-01 to 2017-12-01, monthly data since 2018-01-01, this data is from Trade Economic
CIN_t	Core inflation rate, the inflation rate that without fluctuation of food price and energy price, this data is from Trade Economic
DIR_t	1 year deposit interest rate, this data is from China Public Bank

Then because these variables are not stationary, they are all stationary after the first differences, so below are the variables after transformations (first differences).

Variables	Transformation
$\Delta CLO_t = CLO_t - CLO_{t-1}$	First difference of closing price of Hengrui pharmaceutical Company since it is listed on 2000-10-18, this data comes from Tonghuashun APP
$\Delta EXC_t = EXC_t - EXC_{t-1}$	First difference of exchange rate of RMB to Dollar since 2006-01-04, this data is from China Public Bank
$\Delta UNE_t = UNE_t - UNE_{t-1}$	First difference of quarterly unemployment from 2002-09-01 to 2017-12-01, monthly data since 2018-01-01, this data is from Trade Economic
$\Delta CIN_t = CIN_t - CIN_{t-1}$	First difference of core inflation rate, the inflation rate that without fluctuation of food price and energy price, this data is from Trade Economic
$\Delta DIC_t = DIR_t - DIR_{t-1}$	First difference of 1 year deposit interest rate, this data is from China Public Bank

This article assume that exchange rate, unemployment rate, core inflation rate and 1 year deposit interest rate will have negative influences on close price, because when USD/RMB goes up people may want to invest in dollar instead of stock, when unemployment rate and core inflation rate increase then people may cut off their money in stock market to keep same living standard, and when 1 year deposit interest rate increase then the cost to hold cash increases, people may want to invest in deposits because it's safer and profitable. However, existing literature review says otherwise on exchange rate and unemployment [5,6,7], same on core inflation rate and interest rate [4,6,8].

Variables	Mean	standard error
CLO_t	40	22
EXC_t	6.75	0.48
UNE_t	0.04	0.08
CIN_t	0.009	0.002
DIR_t	2.21	0.74

Variables	Mean	standard error
ΔCLO_t	0.17	8.88
ΔEXC_t	0.004	0.04

ΔUNE_t	0.0002 0.0025
ΔCIN_t	1.45e-05 0.0033
ΔDIC_t	-0.04 0.24

4 Analysis

4.1 Unit root test

	p	T	1% T	5% T	10% T
CLO_t	0.2952115901147897	1.9804471611886638	3.528889992207215	2.9044395987933362	2.589655654274312
EXC_t	0.15789703808936761	2.344894283375846	3.530398990560757	2.9050874099328317	2.5900010121107266
UNE_t	0.63269583911801	1.2922820660583876	3.53692771987915	2.907887369384766	2.591493291015625
CIN_t	2.5964467368828462e-17	9.945482126298726	3.528889992207215	2.9044395987933362	2.589655654274312
DIR_t	0.2072198124630944	2.1973193608709116	3.5386953618719676	2.9086446751210775	2.591896782564878

	p	T
$\Delta CLO_t = CLO_t - CLO_{t-1}$	5.876841653375643e-15	9.018057289519614
$\Delta EXC_t = EXC_t - EXC_{t-1}$	5.06281264261516e-09	6.653091835034573
$\Delta UNE_t = UNE_t - UNE_{t-1}$	0.0042365780845431055	3.6913433796790103
$\Delta CIN_t = CIN_t - CIN_{t-1}$	9.490118488327962e-08	6.107830357779635
$\Delta DIC_t = DIR_t - DIR_{t-1}$	0.0005988453821884999	4.224449885079065

1% T	5% T	10% T
3.530398990560757	2.9050874099328317	2.5900010121107266
3.530398990560757	2.9050874099328317	2.5900010121107266
3.53692771987915	2.907887369384766	2.591493291015625
3.528889992207215	2.907887369384766	2.589655654274312
3.5386953618719676	2.9086446751210775	2.591896782564878

4.2 Johansen Test for Cointegration

Johansen cointegration test using trace test statistic with 5% significance level			
r_0	r_1	test statistic	critical value
0	5	270.1	69.82
1	5	149.8	47.85
2	5	91.92	29.8
3	5	34.32	15.49
4	5	0.7029	3.841

The first column in the table shows the rank of the VECM that has been tested or, in other words, the number of cointegrating relationships for the set of interest rates, while the second reports the number of equations in to-

tal. The first row of the table tests the null hypothesis of at most one cointegrating vector, against the alternative hypothesis that the number of cointegrating equations is strictly larger than the number assumed under the null hypothesis, i.e., larger than one. The test statistic of 270.1 considerably exceeds the critical value (69.82) and so the null of at most one cointegrating vector is rejected. If we then move to the next row, the test statistic (149.8) again exceeds the critical value so that the null of at most two cointegrating vectors is also rejected. This continues, and we also reject the null of at most three cointegrating vectors, but we stop at the next row, where we do not reject the null hypothesis of at most four cointegrating vectors at the 5% level. Then there is 4 cointegration relationships in this model, cointegration rank r will be 4.

4.3 VECM model

Det. terms outside the coint. relation & lagged endog. parameters for equation 收盘价						
	coef	std err	z	P>|z|	[0.025	0.975
const	0.1190	1.083	0.110	0.913	-2.003	2.241

Loading coefficients (alpha) for equation 收盘价						
	coef	std err	z	P>|z|	[0.025	0.975
ec1	-1.1006	0.122	-9.041	0.000	-1.339	-0.862
ec2	1.3019	1.839	0.708	0.479	-2.302	4.906
ec3	-438.6627	423.910	-1.035	0.301	-1269.512	392.187
ec4	-23.6821	349.521	-0.068	0.946	-708.731	661.366

The short run effects can be seen from above. Since this VECM has lag of 0 because of AIC shows that VAR has lag of 1, the VECM has no lag term.

$$\Delta CLO_t = 0.1190 - 1.11006ec_{1t} + 1.3019ec_{2t} - 438.6627ec_{3t} - 23.6821ec_{4t}$$

From the tables and equations above, it can be seen that the first error correction term contributes significantly to the VECM model, the second, third, and fourth error correction term are not significant to VECM model. So VECM verify this paper's assumption that unemployment rate is negatively related to stock price, when unemployment rate goes up by 1%, stock price decrease by 0.011.

Cointegration relations for loading-coefficients-column 1						
	coef	std err	z	P>|z|	[0.025	0.975
beta.1	1.0000	0	0	0.000	1.000	1.000
beta.2	-4.852e-16	0	0	0.000	-4.85e-16	-4.85e-16
beta.3	2.652e-14	0	0	0.000	2.65e-14	2.65e-14
beta.4	-3.056e-14	0	0	0.000	-3.06e-14	-3.06e-14
beta.5	5.4562	3.901	1.399	0.162	-2.190	13.102

Cointegration relations for loading-coefficients-column 2						
	coef	std err	z	P>|z|	[0.025	0.975
beta.1	-4.516e-18	0	0	0.000	-4.52e-18	-4.52e-18
beta.2	1.0000	0	0	0.000	1.000	1.000
beta.3	8.725e-15	0	0	0.000	8.73e-15	8.73e-15
beta.4	4.392e-15	0	0	0.000	4.39e-15	4.39e-15
beta.5	2.6476	0.236	11.227	0.000	2.185	3.110

Cointegration relations for loading-coefficients-column 3						
	coef	std err	z	P>|z|	[0.025	0.975
beta.1	-2.123e-20	0	0	0.000	-2.12e-20	-2.12e-20
beta.2	-6.962e-19	0	0	0.000	-6.96e-19	-6.96e-19
beta.3	1.0000	0	0	0.000	1.000	1.000

beta.4	-7.903e-17	0	0	0.000	-7.9e-17	-7.9e-17
beta.5	0.0013	0.001	1.140	0.254	-0.001	0.003

Cointegration relations for loading-coefficients-column 4						
	coef	std err	z	P>|z|	[0.025	0.975
beta.1	2.356e-20	0	0	0.000	2.36e-20	2.36e-20
beta.2	6.628e-19	0	0	0.000	6.63e-19	6.63e-19
beta.3	-5.148e-17	0	0	0.000	-5.15e-17	-5.15e-17
beta.4	1.0000	0	0	0.000	1.000	1.000
beta.5	0.0031	0.001	3.863	0.000	0.002	0.005

There exists four cointegration relationships in this VECM model. From the tables above, it can be seen that ΔCLO_t have strong cointegration with itself, ΔEXC_t, ΔUNE_t, ΔCIN_t are statistically significant cointegrated with ΔCLO_t, but they are not strongly cointegrated on magnitude, ΔDIC_t are strongly cointegrated with ΔCLO_t on magnitude, but not statistically significant.

4.4 IRF Analysis

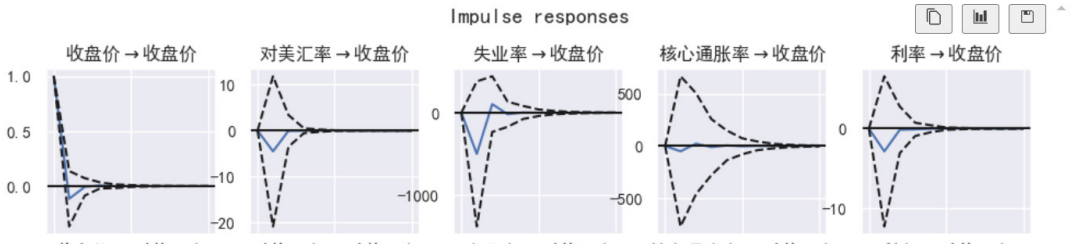

Fig.1 Impulse Responses for CLO

From the impulse response figures, it can be seen that at first ΔCLO_t is giving positive impulse on itself and its, statistically significant, then it's giving itself negative influences but it's not statistically significant, then go back to equilibrium afterwards. Then ΔEXC_t is giving ΔCLO_t negative influences but it's not statistically significant, then go back to equilibrium afterwards. ΔUNE_t is giving ΔCLO_t negative influences first then a little positive influences but it's not statistically significant, then go back to equilibrium afterwards. ΔCIN_t is giving ΔCLO_t negative influences but it's not statistically significant, then go back to equilibrium afterwards. ΔDIR_t is giving ΔCLO_t negative influences but it's not statistically significant, then go back to equilibrium afterwards. Overall, exchange rate USD/RMB, unemployment, core inflation and interest rate have negative influences on stock price in medium run but they are not statistically significant.

4.5 FEVD Analysis

FEVD for 收盘价					
	收盘价	对美汇率	失业率	核心通胀率	利率
0	1.000000	0.000000	0.000000	0.000000	0.000000
1	0.977173	0.001087	0.020128	0.000200	0.001412
2	0.976237	0.001129	0.020986	0.000233	0.001414
3	0.976195	0.001130	0.021018	0.000241	0.001416
4	0.976192	0.001130	0.021019	0.000243	0.001416
5	0.976191	0.001130	0.021019	0.000244	0.001416
6	0.976191	0.001130	0.021019	0.000244	0.001416

7	0.976191	0.001130	0.021019	0.000244	0.001416
8	0.976191	0.001130	0.021019	0.000244	0.001416
9	0.976191	0.001130	0.021019	0.000244	0.001416

The impact of the closing price itself: As can be seen from the first line, the closing price contributes 100% to its own prediction error variance. But over time (from lines 1 to 9), this contribution gradually declines to about 97.6%. The contribution to the variance of forecast error of US exchange rate on closing price is very small, but gradually increases. Increased from 0.1087% in line 1 to 0.1130% in line 9. This suggests that although the exchange rate against the United States has some effect on the closing price, the effect is very small. The contribution of the unemployment rate to the variance of the forecast error of the closing price gradually increases from 2.0128% in line 1 to 2.1019% in line 9. This indicates that the unemployment rate is a more important factor affecting the closing price. Core inflation contributes very little to the variance of forecast error for closing prices and increases slightly over time, from 0.02% in line 1 to 0.0244% in line 9. The contribution of interest rates to the variance of forecast error for closing prices is also very small, but increases slightly over time, from 0.1412% in line 1 to 0.1416% in line 9. Overall, unemployment rate is crucial for predicting stock price.

5 Conclusion

This paper introduced and explored the background of Hengrui Pharmaceutical Company, then use PEST, Potter's Five Forces Model and SWOT to analysis how Hengrui Pharmaceutical Company is doing in the macroeconomic environments, industrial environments and the competing advantages and disadvantages of itself. Then this paper use VECM model to see how and to what extend that exchange rate, unemployment rate, inflation rate and 1 year deposit interest rate is affecting close price of Hengrui Pharmaceutical Company. Results are the error fixing term of first differences of exchange rate is statistically and economically significant, it has positive influences on first differences of close price. Others (ΔUNE_t , $\Delta CIN_t, \Delta DIR_t$) are economically significant but not statistically significant for ΔCLO_t in the short run. In the long run, ΔCLO_t and ΔUNE_t contributes significantly to close price of Hengrui Pharmaceutical Company according to FEVD, and all macroeconomic factors contributes significantly to close price of Hengrui Pharmaceutical Company economically but not statistically according to IRF. Overall, in short run, exchange rate is negatively related with close price and exchange rate USD/RMB, unemployment, core inflation and interest rate have negative influences on stock price in medium run.

6 Limitations

The results may be affected by small data size and mixed frequency caused by different updating time of these macroeconomic variables.

7 References

[1] Granger, C.W.J.. Developments in the study of cointegrated economic variables. *Oxford Bulletin of Economics & Statistics,*1986, *48*(3).

[2] Johansen S, Juselius K. Maximum likelihood estimation and inference on cointegration--with applications to the demand for money. Oxford Bulletin of Economics and statistics. 1990;52(2):169-210.

[3] Dybvig PH, Ross SA. Yes, the APT is testable. The Journal of Finance. 1985 Sep;40(4):1173-88.

[4] N.F. Chen, R. Roll, S. &. Ross. Economic forces and the stock market. Journal of Business,1986, 59 (3), pp. 383-403

[5] Zhao H. Dynamic relationship between exchange rate and stock price: Evidence from China. Research in International Business and Finance. 2010 Jun 1;24(2):103-12.

[6] Ali M. Inflation, Interest and Exchange Rate Effect of the Stock Market Prices. Journal of Business and Economic Options. 2018 Jun 30;1(2):38-43.

[7] Gonzalo J, Taamouti A. The reaction of stock market returns to unemployment. Studies in Nonlinear Dynamics & Econometrics. 2017 Sep 26;21(4):20150078.

[8] Amarasinghe AA. Dynamic relationship between interest rate and stock price: Empirical evidence from colombo stock exchange. International Journal of Business and Social Science. 2015 Apr 1;6(4).