Measurement on First-moment Exchange Rate Exposure and Second-moment Sector Index Exposure (Evidences from JSE)

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Abstrak

Tulisan ini mempelajari tingkat pentingnya momen-pertama eksposure nilai tukar dan momen-kedua eksposure indeks sektoral terhadap 9 *return* indeks sektoral di Bursa Efek Jakarta selama periode 2000-2004. Model GARCH (1.1) digunakan untuk mengukur momen-kedua eksposure indeks sektoral (yaitu *variance*) yang mempengaruhi *return* indeks sektoral. Momen-pertama eksposure nilai tukar (yaitu *mean*) dalam *return* indeks sektoral diukur melalui signifikansi koefisien *return* nilai tukar dalam Model Regresi Linear. Disamping itu, model regresi linear mengukur respon asimetris terhadap depresiasi dan apresiasi nilai tukar. Berdasarkan model yang ada, ditemukan momen-pertama eksposure nilai tukar yang signifikan dalam semua sampel dan semuanya bersifat asimetris. Momen-kedua eksposure indeks sektoral yang signifikan hanya ada dalam dua sektor yaitu sektor keuangan dan pertambangan. Hasil-hasil tersebut sesuai dengan beberapa studi sebelumnya yang mempelajari eksposure nilai tukar terhadap *return* saham.

***Keywords*: sector index return, exchange rate exposure, sector index exposure**

Besides money market, capital market is one of the financing source alternatives for a company. Capital market is useful especially for public companies. The companies will gain several advantageous through capital market, such as liquidity, speedy funds acquiring, large financing sources, and broad access to various types of investors. On the other hand, current or potential investors who have long-term investment horizon should include capital market instruments in their investment portfolio. Diversification is one important consideration to invest in various capital market instruments. Additionally, the investors could get additional source of income from the portfolio in terms of capital gain (i.e. the difference between stock market value / selling price and nominal value / buying price) and dividend (i.e. the allocation of companies' income to shareholders). Borderless financial transactions between countries make capital market in each country more important as a source of funds. Nonetheless, the condition comes along with obstacles. Besides market index return as a common factor influencing stock return, sensitivity of stock return to exchange rate and volatility of stock return itself are two other factors that investors should consider, in constructing their securities portfolio.

Return volatility as well as exchange rate return affects cash flows or stock return to the investors. Exchange rate exposure in stock return is result from cross-countries financial transactions. Whilst, return volatility representing risk, should not be overlooked due to logical relationship between risk and return. Therefore, we argue that second-moment sector index exposure or return volatility (not only first-moment exchange rate exposure or exchange rate return) affects sector index return. Related to first-moment exchange rate exposure, we argue that asymmetric responses present in the first-moment exchange rate exposure as well. It implies that there are different reactions between reactions to currency depreciations and appreciations.

This paper has three objectives. First objective is to report the extent of exchange rate exposure and sector index exposure in nine sector index returns over the 2000-2004 periods. Secondly, the paper explains the reason why certain sector index return is affected by volatility of its own return. Final objective is to spread new information about stock return behavior and its influencing factors at Jakarta Stock Exchange (JSX), particularly information on exchange rate exposure and sector index exposure.

This paper empirically tested the significance of first-moment exchange rate

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exposure and second-moment sector index exposure in sector index return at JSX. Firstly, the paper reviews related literature, followed by research methodology used in the analysis. Next section presents data analysis and discussion. Fourth section will present conclusion and finally the paper depicts limitation and suggestion.

RELATED LITERATURE

Besides market price index, first-moment exchange rate exposure is another important factor affecting sector index return. Asymmetric responses to appreciations and depreciations also accompany the exposure. Studies or empirical tests have been extensively conducting on those subjects. Priestley and Odegaard (2005) empirically tested exchange rate return exposure in twenty eight manufacturing US industries for period 1979-1997. They find that industries with broad international trade are significantly affected by exchange rates. Dominguez and Tesar (2004) analyze exchange rate exposure in eight countries (Chile, France, Germany, Italy, Japan, the Netherlands, Thailand, and the United Kingdom) to firm and industry-level stock returns, and show that the exposure is significant over the 1980-1999 periods. Non-financial Brazilian companies are influenced by exchange rate changes according to Rossi (2004) over the 1996-2002 periods.

Koutmos and Martin (2003) investigate first-moment exchange rate exposure (five different exchange rates) on nine US sector returns from 1992-1998. They find significant exposure in 17.8% of the cases and 25% of the significant exposures are asymmetric. Utami and Rahayu (2003) show that profitability, interest rate, inflation, and exchange rate exposure are significantly affect stock price at JSX during Indonesian financial crisis. Bodnar and Marston (2000) study 103 US firms in 1998 Survey of Risk Management and find that exchange rate exposure is relatively low for most of firms in the sample. Allayannis and Ihrig (2000) suggest that 22.22% of US manufacturing industries during 1979-1995 are significantly affected by exchange rate exposure.

The preceding researches or studies give mixed results of exchange rate exposure in stock return. However, most of them generally find that exchange rate exposure has relatively significant influence on stock return. Based on our argument and the related literature, the hypothesis in this paper is:

H0: First-moment exchange rate exposure and second-moment sector index exposure significantly affect sector index return.

H1: First-moment exchange rate exposure and second-moment sector index exposure not significantly affect sector index return.

RESEARCH METHODOLGY

Data used in this paper are daily data of sector index, Composite Stock Price Index (CSPI), and USD/IDR exchange rate at JSX for period 2000-2004. The sectors are "Agriculture", "Basic Industry and Commodity", "Construction, Property, and Real Estate", "Consumer Goods", "Finance", "Infrastructure and Utility", "Mining", Miscellaneous Industry", and "Trade and Service". The model used is as follows:

$$R_t = \alpha_0 + \alpha_M R_{M,t} + \alpha_X X_t + \alpha_D D_t X_t + \alpha_{\sigma^2}\sigma_t^2 + \varepsilon_t$$

$$\sigma_t^2 = \beta_0 + \beta_1 u_{t-1}^2 + \beta_2 \sigma_{t-1}^2$$

where

R_t = sector index return on day t

$R_{M,t}$ = market index return on day t represented by CSPI

X_t = exchange rate return on day t

D_t = 1 if $X_t < 0$ and 0 otherwise

σ_t^2 = time-varying sector index volatility

ε_t = sector error term on day t

All independent variables in the model are in terms of return calculated based on natural log (Bodie et al. 2002). First-moment exposure (i.e. mean) is measured by the significance of α_X and α_D statistically. Response of R_t is equal to α_X if $X_t > 0$ and $\alpha_X + \alpha_D$ if $X_t < 0$. The significance of statistically is used as indicator of whether or not there is asymmetric response.

Second-moment exposure (i.e. conditional variance) is measured by whether or not is statistically significant. We use GARCH (1,1) process (Gujarati 2003) to include conditional variance of the sector index return assuming return is related to risk. The model incorporates volatility risk of the sector index return represented by conditional variance. It is a function of short-run effects (short-term reaction) and long-run effects (long-term persistence) of sector index variance in sector index return.

DATA ANALYSIS AND DISCUSSION

Daily sector index, CSPI, and USD/IDR exchange rate, must be transformed to daily return of those variables. Correlogram of all independent variables show that there is no autocorrelation in the return series. Hence, those returns can be used in the regression model to provide relatively reliable result and analysis. The returns are used in the regression model using GARCH (1,1) model and lead us to make analysis on first-moment exchange rate exposure and second-moment sector index exposure.

Agriculture Sector

Table 1 shows that CSPI return is significant at 5% level. Hence, it is an important explanatory variable influencing the movement of sector index return. Exchange rate return is significant at 1% level and asymmetric response is significant for this sector. Sector index volatility is not significant in the model with t-statistic probability 41%. Variation in CSPI return, exchange rate return, sector index volatility, and dummy variable explain less than 3.5% variation in return of Agriculture sector index return. Nonetheless, F-statistic informs that all independent variables together are significant at 1% level in explaining sector index return movement.

Basic Industry and Commodity Sector

Return of CSPI and sector index volatility are not significant in the model (table 2), with t-statistic probability 16% and 30% respectively. It means that the movement of sector index return is not affected by market index return and its own volatility risk. On the other hand, exchange rate return is an important explanatory variable for sector index return at 1% level Response of this sector index return to

exchange rate depreciation is more volatile than to exchange rate appreciation. Despite the result that all independent variables together are significant at 1% level, less than 6% variation in sector index return is explained by variation in independent variables.

Construction, Property, and Real Estate Sector

The GARCH (1,1) model in this sector informs the similar result as the model in Basic Industry and Commodity sector. Exchange rate return is significant at 1% level in explaining sector index return. Market index return and sector index volatility are not significant in the model (table 3), with t-statistic probability less than 50% each. Less than 4% variation in sector index return is explained by variation in independent variables, though all independent variables together significantly explain sector index movement. Asymmetric responses present in the model as well.

Consumer Goods Sector

Table 4 reports that CSPI return is not significant with t-statistic probability 11%, while sector index volatility is not significant with t-statistic probability almost 90%. Market index return is not an important explanatory variable for explaining sector index return movement. Consumer Goods sector has characteristic of non-cyclical industry. It justifies that sector index volatility is not significant explanatory variable in this sector index return model. In contrast, exchange rate return is significant at 1% level and it is asymmetric. The model explains 5% movement in sector index return of Consumer Goods.

Finance Sector

Composite Stock Price Index return is not significant for this sector, meaning market index return is not an important variable to explain sector index return movement. Looking at the GARCH (1,1) component, sector index volatility representing volatility risk, is an important explanatory variable and significant at 1% level (table 5). Exchange rate return affects movement in Finance sector returns as well and the response is asymmetric. In addition, F-statistic informs that all independent variables together are significant at 1% level in explaining index return movement for Finance sector.

From variance equation, we imply that both impact of shocks with short-run effects (short-term reaction) and long-run effects (long-term persistence) are significant. Hence, volatility of Finance sector return is an important explanatory variable in the model. Characteristic of Finance sector activities is a main source of the result above. Core business of Finance sector uses monetary or financial assets more than real assets. Mainly, companies in this sector trade financial assets and not real assets. It implies that volatility of its returns has a persistent probability to affect the returns in every financial transaction.

Infrastructure and Utility Sector

The model shows that sector index volatility is not significant with t-statistic probability almost 75%. On the other hand, market index return is significant at 5% level. Exchange rate return has persistent effects on sector index return. Asymmetric response related to exchange rate exposure presents in this sector as well. In spite of all independent variables together are significant at 1% level in explaining sector index return movement, the model explains 3.5% variation in sector index return of Infrastructure and Utility (table 6).

Mining Sector

In Mining sector, sector index volatility has the same effect as in Finance sector. The volatility is significant at 5% level, meaning sector index return in this sector is affected by sector index variance. Mining sector transaction in capital market could not stay far from exchange rate exposure and asymmetric responses to exchange rate appreciations and depreciations. Conversely, market index return is not significant with t-statistic probability almost 29% (table 7). The model shows that 4% variation in Mining sector index return is explained by variation in independent variables. All independent variables together are significant at 1% level in explaining sector index return movement.

From variance equation, we imply that short-term reaction and long-term persistence of sector index volatility are significant at 1% level. It means that the effect of variance in return remains in long-term period, not only in current period.

Miscellaneous Industry Sector

It shows that CSPI return is significant at 5% level, whilst sector index volatility is not significant with t-statistic probability 56% (table 8). Hence, sector index variance is not an important explanatory variable for sector index return in Miscellaneous Industry. Nevertheless, exchange rate return is significant at 1% level and there is asymmetric response to currency movement. Only 6.1% variation in sector index return is explained by the model, though all independent variables together significantly explain sector index movement.

Trade and Service Sector

Table 9 reports that CSPI return as well as sector index volatility is not significant in the model, with t-statistic probability 65% and 60% respectively. Asymmetric responses to currency appreciations and depreciations present in the model accompanied by exchange rate exposure. Almost 61% variation in the sector index return of Trade and Service is explained by the model and all independent variables together are significant at 1% level in explaining sector index return.

For all sectors, each GARCH (1,1) model shows the same result as follows:

- Exchange rate return is significant at 1% level. Hence, it is important explanatory variable affecting movement in sector index return. It is in line with assumption of the borderless financial transactions between countries. Nowadays, capital market transactions could not circumvent exchange rate exposure.
- Dummy variable in related to exchange rate return, is significant at 1% level. It implies there are asymmetric responses to appreciations and depreciations in exchange rates. The responses to currency depreciations (i.e. IDR) are greater than to currency appreciations. Hence, for sector index return, the currency depreciations result in bigger volatility than currency appreciations.

- F-statistic informs that all independent variables together are significant at 1% level in explaining sector index return movement.
- The finding of significant level of first-moment exchange rate exposure on sector index return agrees with the studies as mentioned earlier.

In summary, the result is as follows:

Related to second-moment exposure, only 22.22% of the cases (two sectors) are significant over the sample period. Our finding on significant effect of sector returns volatility in Finance sector return is in line with its core business, which extensively uses financial assets. Hence, its sector index return is influenced by the sector index volatility. Different impacts of sector index volatility in each sector emerge due to different characteristic and core business of the sector.

Overall, all independent variables together used in the model are significant in explaining sector index return variation over the sample period. The significance of first-moment exchange rate exposure uncovered in this paper agrees with other studies analyzing the exposure.

Sector	CSPI	Exchange Rate Return	Dummy (Asymmetric Response)	Sector Return Volatility
Agriculture	S (5%)	S (1%)	S (1%)	N
Basic Industry and Commodity	N	S (1%)	S (1%)	N
Construction, Property, and RE	N	S (1%)	S (1%)	N
Consumer Goods	N	S (1%)	S (1%)	N
Finance	N	S (1%)	S (1%)	S (1%)
Infrastructure and Utility	S (5%)	S (1%)	S (1%)	N
Mining	N	S (1%)	S (1%)	S (5%)
Miscellaneous Industry	S (5%)	S (1%)	S (1%)	N
Trade and Service	N	S (1%)	S (1%)	N

S = Significant (with its level in parentheses)
N = Not Significant

CONCLUSION

This paper measures significant level of first-moment exchange rate exposure and second-moment sector index exposure in nine sector index returns at JSX. Regarding first-moment exposure, we identify significant exposure in all sectors (100%) and all of them are asymmetric. It means that all sector index returns at JSX are affected by USD/IDR exchange rate returns over the sample period. Furthermore, responses to currency appreciations and depreciations are different or asymmetric. Sector index return behavior is more volatile in currency depreciations than in currency appreciations.

LIMITATION AND SUGGESTION

Data range is one of the limitations in this paper. For next research, it will be more useful should we extend data period. It will provide more comprehensive analysis explaining the movement of sector index return and its controlling factors. Another limitation is in term of types of JSX index data used in the paper. Individual index at JSX should be used to find complete description about individual stock behavior. It will provide a comprehensive guideline for current and potential investors in Indonesian Capital Market. It will be more valuable should the data used is clustered into several relevant sub period, related to the various important circumstances over the selected period. Other regression model could be used to provide more representative model regarding exchange rate exposure and sector index exposure. U

Table 1
GARCH (1,1) Model for Agriculture Sector

	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	-1.941152	2.368326	-0.819630	0.4124
C	0.003246	0.001544	2.102370	0.0355
R_COMPOSITE	0.008855	0.004507	1.964595	0.0495
R_FOREX	-0.746288	0.117427	-6.355356	0.0000
DUMMY*R_FOREX	0.678154	0.195151	3.475027	0.0005
	Variance Equation			
C	1.36E-05	3.14E-06	4.321245	0.0000
ARCH(1)	0.079300	0.009684	8.188824	0.0000
GARCH(1)	0.903508	0.011659	77.49729	0.0000
R-squared	0.034643	Mean dependent var		7.40E-05
Adjusted R-squared	0.029031	S.D. dependent var		0.026565
S.E. of regression	0.026177	Akaike info criterion		-4.560492
Sum squared resid	0.825009	Schwarz criterion		-4.526828
Log likelihood	2771.658	F-statistic		6.172512
Durbin-Watson stat	2.026263	Prob(F-statistic)		0.000000

Table 2
GARCH (1,1) Model for Basic Industry and Commodity Sector

	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	5.545977	5.380561	1.030743	0.3027
C	0.000136	0.001247	0.109259	0.9130
R_COMPOSITE	0.003255	0.002293	1.419574	0.1557
R_FOREX	-0.553095	0.051962	-10.64414	0.0000
DUMMY*R_FOREX	0.511801	0.095817	5.341443	0.0000
	Variance Equation			
C	7.74E-05	1.38E-05	5.592533	0.0000
ARCH(1)	0.225928	0.040293	5.607078	0.0000
GARCH(1)	0.466476	0.079004	5.904474	0.0000
R-squared	0.052670	Mean dependent var		-0.000223
Adjusted R-squared	0.047364	S.D. dependent var		0.016127
S.E. of regression	0.015740	Akaike info criterion		-5.534041
Sum squared resid	0.298306	Schwarz criterion		-5.500377
Log likelihood	3361.629	F-statistic		9.601336
Durbin-Watson stat	1.810198	Prob(F-statistic)		0.000000

Table 3
GARCH (1,1) Model-Construction, Property, and Real Estate Sector

	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	1.673518	2.208974	0.757600	0.4487
C	0.000200	0.000625	0.320888	0.7483
R_COMPOSITE	0.000861	0.001226	0.702307	0.4825
R_FOREX	-0.402551	0.049847	-8.075808	0.0000
DUMMY*R_FOREX	0.358059	0.088501	4.045806	0.0001
	Variance Equation			
C	7.36E-06	1.46E-06	5.039109	0.0000
ARCH(1)	0.154871	0.016311	9.494998	0.0000
GARCH(1)	0.832353	0.014831	56.12317	0.0000
R-squared	0.034819	Mean dependent var		0.000166
Adjusted R-squared	0.029207	S.D. dependent var		0.018310
S.E. of regression	0.018040	Akaike info criterion		-5.485750
Sum squared resid	0.391648	Schwarz criterion		-5.452086
Log likelihood	3332.364	F-statistic		6.204827
Durbin-Watson stat	1.819644	Prob(F-statistic)		0.000000

Table 4
GARCH (1,1) Model for Consumer Goods Sector

	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	-0.925128	5.410698	-0.170981	0.8642
C	0.001732	0.001167	1.483590	0.1379
R_COMPOSITE	0.002532	0.001569	1.614418	0.1064
R_FOREX	-0.484490	0.040718	-11.89880	0.0000
DUMMY*R_FOREX	0.407296	0.084271	4.833167	0.0000
Variance Equation				
C	5.03E-05	9.69E-06	5.189731	0.0000
ARCH(1)	0.200046	0.026224	7.628459	0.0000
GARCH(1)	0.586550	0.053666	10.92959	0.0000

R-squared	0.052739	Mean dependent var	0.000120
Adjusted R-squared	0.047232	S.D. dependent var	0.015317
S.E. of regression	0.014951	Akaike info criterion	-5.622698
Sum squared resid	0.269132	Schwarz criterion	-5.589035
Log likelihood	3415.355	F-statistic	9.576122
Durbin-Watson stat	1.753298	Prob(F-statistic)	0.000000

Table 5
GARCH (1,1) Model for Finance Sector

	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	-8.998786	2.788206	-3.227447	0.0012
C	0.005350	0.001077	4.969544	0.0000
R_COMPOSITE	0.002914	0.002704	1.077722	0.2812
R_FOREX	-0.571725	0.088246	-6.478726	0.0000
DUMMY*R_FOREX	0.496937	0.148914	3.337065	0.0008
Variance Equation				
C	0.000155	2.68E-05	5.793828	0.0000
ARCH(1)	0.152647	0.032066	4.760353	0.0000
GARCH(1)	0.384045	0.103809	3.699543	0.0002

R-squared	-0.006322	Mean dependent var	0.000689
Adjusted R-squared	-0.012172	S.D. dependent var	0.020399
S.E. of regression	0.020523	Akaike info criterion	-5.217993
Sum squared resid	0.507107	Schwarz criterion	-5.184329
Log likelihood	3170.104	Durbin-Watson stat	2.062126

Table 6
GARCH (1,1) Model for Infrastructure and Utility Sector

	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	-1.413304	4.374355	-0.323088	0.7466
C	0.003520	0.002282	1.542326	0.1230
R_COMPOSITE	0.004090	0.001679	2.436008	0.0149
R_FOREX	-0.713621	0.094646	-7.539924	0.0000
DUMMY*R_FOREX	0.737783	0.156836	4.704174	0.0000
Variance Equation				
C	0.000300	4.80E-05	6.244640	0.0000
ARCH(1)	0.195348	0.027302	7.155202	0.0000
GARCH(1)	0.246374	0.103570	2.378819	0.0174

R-squared	0.034694	Mean dependent var	0.000645
Adjusted R-squared	0.029082	S.D. dependent var	0.023704
S.E. of regression	0.023357	Akaike info criterion	-4.730084
Sum squared resid	0.656825	Schwarz criterion	-4.696420
Log likelihood	2874.431	F-statistic	6.181797
Durbin-Watson stat	2.014780	Prob(F-statistic)	0.000000

Table 7
GARCH (1,1) Model for Mining Sector

	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	9.499055	4.447746	2.135701	0.0327
C	-0.002130	0.002090	-1.019213	0.3081
R_COMPOSITE	0.002881	0.002710	1.063303	0.2876
R_FOREX	-0.640433	0.097946	-6.538651	0.0000
DUMMY*R_FOREX	0.494248	0.146927	3.363903	0.0008
Variance Equation				
C	0.000204	3.75E-05	5.440598	0.0000
ARCH(1)	0.189527	0.034248	5.533907	0.0000
GARCH(1)	0.381357	0.099725	3.824094	0.0001

R-squared	0.040168	Mean dependent var	0.000818
Adjusted R-squared	0.034588	S.D. dependent var	0.022133
S.E. of regression	0.021747	Akaike info criterion	-4.862601
Sum squared resid	0.569423	Schwarz criterion	-4.828938
Log likelihood	2954.736	F-statistic	7.198043
Durbin-Watson stat	1.867661	Prob(F-statistic)	0.000000

Table 8
GARCH (1,1) Model for Miscellaneous Industry Sector

	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	2.992399	5.178952	0.577800	0.5634
C	0.000823	0.001113	0.738846	0.4600
R_COMPOSITE	0.003235	0.001343	2.408729	0.0160
R_FOREX	-0.569689	0.059776	-9.530409	0.0000
DUMMY*R_FOREX	0.373883	0.105260	3.551995	0.0004
Variance Equation				
C	3.70E-05	5.67E-06	6.528694	0.0000
ARCH(1)	0.166910	0.028672	5.821449	0.0000
GARCH(1)	0.672050	0.040807	16.46883	0.0000

R-squared	0.061146	Mean dependent var	0.000291
Adjusted R-squared	0.055687	S.D. dependent var	0.015351
S.E. of regression	0.014917	Akaike info criterion	-5.639218
Sum squared resid	0.267913	Schwarz criterion	-5.605554
Log likelihood	3425.366	F-statistic	11.20205
Durbin-Watson stat	1.927605	Prob(F-statistic)	0.000000

Table 9
GARCH (1,1) Model for Trade and Service Sector

	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	-2.181692	4.202492	-0.519142	0.6037
C	0.002571	0.001079	2.382024	0.0172
R_COMPOSITE	0.001174	0.002565	0.457816	0.6471
R_FOREX	-0.677872	0.054953	-12.33553	0.0000
DUMMY*R_FOREX	0.577998	0.112404	5.142144	0.0000
Variance Equation				
C	5.97E-05	9.19E-06	6.493002	0.0000
ARCH(1)	0.164468	0.020922	7.861034	0.0000
GARCH(1)	0.601597	0.050659	11.87552	0.0000

R-squared	0.060421	Mean dependent var	-0.000139
Adjusted R-squared	0.054958	S.D. dependent var	0.017214
S.E. of regression	0.016734	Akaike info criterion	-5.524552
Sum squared resid	0.337154	Schwarz criterion	-5.490889
Log likelihood	3355.879	F-statistic	11.06069
Durbin-Watson stat	2.050834	Prob(F-statistic)	0.000000

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