



Impact of competition & economic policy uncertainty on payout policy of the Indian pharmaceutical industry

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Abstract: Extant literature shows that competition and Economic Policy Uncertainty (EPU) have a bearing on the economic growth, investments and payout policies. However, studies in this area have been limited in India. The objective of this paper is to examine the influence of competition and EPU on the Dividend Payments of Indian Pharmaceutical Industry and whether the dividend payment was affected by the Financial Crisis of 2008/09.

The study is conducted on 12-year data i.e. from 1.4.2007 to 31.3.2019. Herfindahl-Hirschman Index (HHI) is used to check the market concentration and EPU is measured by the newly developed Newspaper based EPU index. Profitability, leverage and firm size are used as control variables. Fixed Effects model in Panel regression is used. Chow test checks if there was any break in the dividend payment during the Financial Crisis.

The study establishes that dividend payment is inversely related to industry concentration - when there is more competition, there is more dividend payment in the industry. Dividend payment is positively related to EPU. Higher the uncertainty, higher the dividend. While leverage is inversely related to dividend payment, size of the firm does not play any role. Chow test confirms that Financial Crisis did not influence the dividend payout.

Keywords: *Competition; Policy; Uncertainty; Dividend; Pharmaceutical; Economic.*

JEL Classification: *G350, G380, M210, O400*

1. Introduction:

The study of factors affecting dividend payment has been one of the most sought-after subjects by researchers. Despite volumes of research, there is still no consensus about the most important determinant/s that will drive corporate houses to pay dividends. The search for determinants of dividend payment is overshadowed by the notion that dividend payment affects the shareholders' wealth. According to Modigliani & Miller (1961), the power of the firm's assets to earn and its investment policy are the determining factors of the value of the firm, while the wealth of the shareholders is not affected in any way by the payout policy or retention of profits. This point of view was argued by several researchers who opined that the condition of uncertainty was brushed aside by Modigliani & Miller (1961). However, there could be some factors under uncertainty that could affect the value of the firm. For example, some uncertainties like profitability of firms was believed to have been resolved by payment of dividends. Dividend payment is seen as a feat of sending out signals to shareholders (Bhattacharya, 1979). This contention had a basis on the fact that the existing available information in the financial statements was not enough in conveying to the shareholders the true disposition of a firm's profitability and as a result when dividends are paid over and above the previous period payouts, there is expected to be a favorable reaction of share prices to this occurrence.

Based on the theory of factors under uncertainty, the financial signaling influence of dividend payment was examined and supported by Alli et al. (1993). Many other researchers have examined other factors like earnings,

structure of ownership, leverage (Kumar, 2006; Rozeff, 1982; Myers & Frank, 2004) competition (Grullon & Michaely, 2008, Wen He, 2011; Booth & Zhou, 2009) and economic policy uncertainty (Attig et al, 2016; Bliss et al, 2015 and Huang et al, 2015) to name a few.

There have been numerous studies in the west about the role of competition on dividend payment. Further, the use of the newly introduced news based EPU index has been popular among researchers to find its impact on varied aspects. However, the use of these indicators in India has been limited. Focus of this paper is to study the impact of competition and EPU on the dividend payments in the Indian Pharmaceutical Industry.

Why the Pharmaceutical Industry?

India has a large role to play in the world Pharmaceutical stage. It is the largest supplier of world's requirement of generic drugs, has over 50% share of production of world's requirement of various vaccines and meets 40% of the volume of US generic drugs requirement and 25% of the entire medicine requirement in the UK. The pharma industry is poised to reach a turnover of US\$ 100 billion by 2025. Indian Pharmaceutical exports were valued at US\$ 20.7 billion in 2019-20 and US\$ 19.14 billion in 2018-19 (Source: www.ibef.org).

The Indian pharmaceutical industry attracted Foreign Direct investment of US\$ 16.50 billion between April, 2000 and March, 2020 (Source: Dept of Industrial Policy and Promotion-DIPP). The Government of India has allowed 100% FDI, subject to certain conditions, under the automatic route.

Competition & dividend payment:

Starting from Adam Smith who opined that monopoly is a big enemy of good management, Allen & Gale, 2000 who observed that Corporate governance is more effectively brought about by competition than by monitoring agencies or by market for corporate control, recent works suggest the notion that it is the competition that brings out better efficiency in managers and makes them more aligned to shareholders. Empirical research has established that competition is a sort of incentive to managers that pushes them to be more efficient and more proactive with shareholders.

Grullon & Michaely (2008) argued that product market competition could exert pressure on the management on payouts in two opposite ways. In one case, the managers shelve the plans of long term non-profitable investments that may bring business risks (like liquidation and lower long-term returns) and rather pay dividends. This is outcome model. In another case managers try to substitute dividends for factors that are external to establish better reputation in the market and thereby raise capital. This is substitution model. The researchers use Herfindahl – Hirschman Index (HHI) to prove that industries that are more concentrated are with lower ratio of payouts than firms in lesser concentrated industries.

Recent studies have established that good corporate governance is being substituted by dividends and dividends are also used as a tool to reduce agency costs. Higher incidence of dividends in industries that are more competitive assumes that competition seems to have nudged the managements to disburse more cash. These revelations point that payouts are a result of external factors and prove that competition can influence the payout policy.

Wen He (2011) examined the behavior of Japanese firms in payment of dividends in the face of competition. The author studied 2008 Japanese firms and established that firms from industries that are more competitive tend pay out higher amounts of dividend and are very likely to increase dividends. The study endorsed a relationship that is positive between payment of dividend and competition. This study also points to the fact that the effect of competition is less significant in recession than during boom.

A downward trend in the payment of dividends among firms in the US was noticed by Booth & Zhou (2009). The authors noticed that the structures of US firms had become more competitive within the earlier two decades. The researchers used HHI, import penetration index and Lerner index in the study. The finding of the study was that, on the basis that firms with more market power encountered less competition as compared to other firms that faced more competition, the firms with more market power were in a position to pay dividends.

Obembe & Adegboye (2014) examined in the Nigerian context the impact of competition on dividend payments. Their finding was that monopolistic firms paid more dividends and there exists a negative correlation between competition and dividend payments. Contrary to the findings of Grullon & Michaely (2008) the researchers observed that a positive impact was exerted by market share and market power on dividend payments. This finding is in tandem with that of Booth & Zhou (2009) who confirmed that in an environment of less competition, firms paid more dividend.

Economic Policy Uncertainty (EPU) & Dividend Payment:

There is an increasing concern around the world about the EPU, following the Global Financial Crisis, the Eurozone Crisis and the slow recovery thereafter. These events are believed to be the outcome of the uncertainty of fiscal policies in the United States and Europe. A lot of curiosity has been around to examine the financial decisions in the light of policy uncertainty, while researchers have used cumbersome and strenuous methods to calculate the policy uncertainty and evaluate its impact on various financial decisions (payouts and investments being quite popular).

EPU may be defined as “The probability of changes in the existing economic policies that determine the rules of the game for economic agents” (Baker et al., 2013). In 2016 a new index was published by Prof Scott R Baker, Prof. Nicholas Bloom and Prof Steven J Davis to measure the EPU. The unique feature of this index is that it is based on the newspaper articles that contain certain terms (Please refer www.policyuncertainty.com for methodology of construction of the EPU index) that depict the economy. Higher value of EPU index indicates higher degree of policy uncertainty. Baker, Bloom & Davis (henceforth BBD) developed this index not only for the United States but also for 26 other countries including Japan, EU, India and China. The EPU index has increasingly become popular with researchers who study the economic uncertainty and its impact on various facets of economy.

Baker et al (2016) show that policy uncertainty can damage to a large extent the economy and the economy recovery process as high level of uncertainty can nudge the proxies to slow down capital expenditure, employment growth and spending on the whole. Similar argument is also put forth by Bonaime et al (2018). Past research on the influence of uncertainty that is induced by policy and regulation, on corporate payouts is limited despite the survey of executives published by Brav et al (2005, 2008) which confirms that forecast future earnings which are naturally driven by economic policy uncertainty, are key to dividend payouts. Maybe, researchers were uncertain about the herculean task of measuring the economic policy uncertainty. However, since the introduction of newspaper based EPU index by BBD, this task becomes simpler and has led to a lot of research in recent years e.g. Broggaard & Detzen (2015), Gulen & Ion (2015) etc. Unlike firm level uncertainty, economic policy uncertainty largely stems from events that are out of the control of managers e.g.: political elections, financial turmoil, famines etc.

The negative association between EPU and Dividends is based on the precaution aimed at preserving the resources of the firm and strengthening the future higher earnings stability. Managers look to cut down on the spending, pay lesser dividends / avoid dividends altogether with a view to buffer temporary financing shocks and smoothen the future cash flow and earnings (Attig et al, 2016). This is also akin to the dividend smoothening theory of John Lintner (Lintner, 1956), where the researcher argues that managers tend to look at long term dividends and avoid increasing dividends unless they are able to sustain them.

An increased uncertainty may enhance investors’ preference for dividends to capital gains and may force the managers to disburse cash. In addition, at the time of high uncertainty, managers may pay dividends, thereby sending signal about the future profitability and cash flow of the firm (Bhattacharya, 1979; Miller & Rock, 1985).

There are contrasting findings about the impact of EPU on payouts. Bliss et al (2015) and Attig et al (2016) find that there was considerable reduction in dividend payouts as a result of 2008-09 financial crisis which was wrought with high level of policy uncertainty. In the meantime, studies conducted by Floyd et al (2015) demonstrate that US firms increased payouts to same level that prevailed before and after the crisis.

Huang et al (2013) studied 35 countries over twenty years to examine the influence the political uncertainty may have on dividend decisions. The study is based on the exogenous shocks triggered by international political crises and second, it studies the time series variation in dividend decisions (rather than cross sectional variation). The study reveals that (a) during the period of severe political crisis, firms that paid dividends in the past are unlikely to continue. Further, firms that did not pay dividends in the past are unlikely to initiate them (b) In countries with stable political system, decisions on dividends are unlikely to be swayed by political uncertainty (c) Under-valued firms and those with illiquid shares are unlikely to be influenced by political uncertainty as their dividend decisions are more driven by market demand for dividends during high political uncertainty.

Attig et al (2018) used BBD index to study the policy induced uncertainty on payout policy. Their main finding is that EPU is associated positively with dividend payouts. This is quite contrast to the executives survey conducted by Brav et al (2005) which indicates that EPU has an adverse bearing on managers’ perceived stability of future earnings, which would affect dividends negatively. Another interesting disclosure of this study is that country level creditor protection, disclosure and enforcement, governance quality and free cash flow of firms - affect the impact of EPU on dividend decisions.

2. Objective:

This paper seeks to find if competition and EPU have a bearing on dividend payment in the Indian Pharmaceutical industry. As backed by a plethora of research work, payment of dividend is influenced by factors like financial performance, size, leverage, investment opportunity, quality of management- to name a few. Hence, the study considers financial performance, size and leverage as control variables.

Following are examined:

- Whether Competition and EPU influence the dividend payout policy of the Indian Pharmaceutical Industry.
- Whether the EPU during the financial crisis period of 2008-09 had any impact on the dividend payments by the Indian Pharmaceutical Industry.

3. Approach / Methodology:

Method of Analysis: Descriptive statistics, Panel regression and Chow test.

To understand the effect of Competition & EPU on Dividend Payments, following tests have been used:

- Regression on Fixed Effect Model
- Chow test is used to understand whether the EPU had any significant impact on the dividend payment during the financial crisis period of 2008-09.

The statistical tests are done on STATA 14.0.

Data and Sample Construction:

Secondary data is used in this paper. The data is based on the pharmaceutical firms listed in the Bombay Stock Exchange (BSE) as on 1.4.2019.

As payment of dividend is the dependent variable, only those pharma companies that have paid dividends during all 12 years of study have been considered. The result is 31 such companies. Shortlisted firms are given in Annexure 1. Further, the market share of all firms in the industry is considered to find the representation of these companies. The selected companies had a market share of 81.9% as at 31.3.2019. Market share of each company is calculated using the following formula:

$$\text{Market Share} = \frac{\text{Total sales of the company}}{\text{Total sales of the listed companies}}$$

Financial data of all the listed companies is taken from www.screener.in. Financial years considered are 2007-08 up to 2018-19.

Variables

Dividend payout ratio:

Payment of dividend is measured by the actual cash dividend paid scaled by the net income (Dividend / Profit After Tax). This formula is also used by Wen He (2011).

Product Market Competition:

Studies by Grullon & Michaely (2012) & Mackay & Philips (2005) used HHI in measuring the product market competition. HHI is obtained by totaling the squares of the market share of individual companies. In this study also, HHI is used for the Indian Pharma Industry.

EPU Index (independent variable):

The EPU is measured with the index developed by BBD, who have constructed the newspaper-based index for 26 countries apart from the US. The detailed methodology of construction of this index is given in www.policyuncertainty.com. It is to be noted that the terms set for E, P, U are country specific and are chosen by consulting people who know the local language and economy very well and hence may vary from country to country. It is not necessary that the index correlates with all political events of lesser significance that will have little consequence on the economy. Given the concern that the newspaper-based index could have a political bias and hence may not be correct, BBD conduct various validations, including human audits of newspapers under close supervision and confirm the computer-generated index correlates with human generated index.

The BBD index is also used by data providers like Reuters, Bloomberg, Haver Analytics which only shows that BBD index is of relevance to all those who subscribe to their services.

The use of EPU index of BBD in this paper, follows that of Gulen & Ion (2015), Brogaard & Detzel, (2015) and Bonaime et al. (2018).

EPU is computed on a monthly basis. In this paper EPU is considered as a 12-month arithmetic average of the BBD index with the financial year end month i.e. March as the last month. This calculation fits with the data of companies which are following the financial year. The computation follows Gulen & Ion (2015), except that in their paper calendar year has been considered.

• Control Variables:

Profitability:

Literature points out that profitability of a firm plays a vital role in the dividend payment decisions. The argument that dividends are influenced by the current earning and previous year dividends was put forth by Lintner (1956) and Baker et al (1985). Hence, in this study Return on Assets (ROA) has been considered to represent profitability. The formula: Profit Before Tax / Total Assets.

Leverage:

That the total debt of the company influences the dividend payment decision, has been found by several studies including Jensen et al (1992) and many other researchers. It is argued that in order to meet their financial obligations, highly geared firms are prudent in managing their cash flow and are reluctant in paying dividends. However, the general pointer is lower dividend / no dividend is paid by highly geared firms. The formula: Total external debt / Total assets is used in this paper.

Firm Size:

Large firms are known to distribute large portions of their earnings as dividend (Fama & French (2000), Jensen et al (1992)). This is seen from two points. Payment of large dividends is seen as an attempt towards reducing that

asymmetric information between the large firms and shareholders. Further, dividend payments are an attempt towards reducing agency costs.

It is also argued that large firms pay higher dividends as they have easy access to capital market for cash requirements. The general notion is that bigger the firm, higher will be the cash dividend paid. As such, the size of the firm and dividend payments enjoy a positive relationship. In this study, total assets of a company (in '000 million) are used to measure the size of the firm.

4. Results and Discussion:

Summary Statistics:

Annexure 2 gives the details of Summary Statistics. By considering 31 companies for 12 years, 372 values are obtained. It is seen that the dividend ratio varies widely between 1.56 % to 246.84%. The EPU index varies between 47.76 (for 2006-07) and 182.78 (for 2011-12). EPU for the turbulent years of 2008-09 of financial crisis was 142.30. The ROA ranges widely between 0.69% and 92.51%. Among the 31 companies chosen, the highest market shares as at 31.3.2018 was of Sun Pharmaceuticals (16.70%) and the lowest was of Jenburkt Pharmaceuticals (0.05%). It is observed that the range in the data is wide. By observing the data it can be concluded that the data is positively skewed with majority of the data points lower than the mean. This results in a long right tail. However, the data is not so skewed in the case of leverage, as all firms resort to external borrowings and on an average, about 44% of the total assets are funded by external borrowings. High skewness in the data is an inherent part of the pharma industry in India.

Panel Regression:

Annexure 3 gives the results of the Fixed Effects panel regression. Following needs to be noted:

1. The effect of EPU has a positive impact on the Dividend Payment Pattern of Indian Pharmaceutical Industry. That means, when the policy uncertainty is higher, the dividend payment will be higher.
2. The effect of HHI has a negative impact on the dividend payment. More the concentration, lesser will be the dividend. In other words, when there is more competition, the industry tends to pay more dividends.
3. The effect of ROA has a significant negative impact on the dividend payment pattern of Indian Pharmaceutical Industry.
4. The effect of leverage has negative impact on dividend payment. The higher the leverage, lesser will be the dividend payment.
5. The effect of Total Assets and Market Share are found to be insignificant.

Chow Test:

Annexure 4 gives the results of Chow Test. In line with the mean EPU of each year, the mean of Dividend Ratios for each year from 2007-08 to 2018-19 is considered. The data is grouped into two sets i.e. From 2007-08 to 2010-11 in set 1. The rest of the observations in set 2.

$$\text{Chow test statistic } F = \frac{(ESS_c - (ESS_1 + ESS_2)) / k}{(ESS_1 + ESS_2) / (N_1 + N_2 - 2k)}$$

$$ESS_c = 90.4669; \quad k=2; \quad N_1=4; \quad N_2=8; \quad ESS_1=15.7369; \quad ESS_2=47.6305;$$

$$F = 1.7106; \quad \text{P value} = 0.2407.$$

H_0 = There is no structural break in the dividend payment

H_1 = There is structural break in the dividend payment

As the P value which is 0.2407 is greater than 0.05, we fail to reject the null hypothesis. Hence, there was no structural break in the dividend payment, and it can be concluded that the financial crisis (2008/09) had no impact on the dividend payouts of the Indian Pharmaceutical Industry.

5. Conclusion:

Extant literature shows that competition and Economic Policy Uncertainty (EPU) have a bearing on the economic growth, investments and payout policies. However, studies in this area have been limited in India. Following numerous studies abroad and in the light of the recently developed EPU index, this paper seeks to find the influence if any, of market competition and EPU on the dividend payment in the Indian Pharmaceutical Industry. The data considered for this study is 12 years, i.e. 2007-08 to 2018-19.

It is observed that EPU has a positive effect on the Dividend Payment Pattern of the Indian Pharmaceutical industry. In other words, when the EPU increases, firms tend to pay more dividends to the shareholders. This is quite contrary to the conservatism theory, where firms tend to safeguard their cash holdings, withhold dividend payments and investments and look forward to more favorable days. The results of this study are not in consonance with the findings by Baker et al (2013) and Bhagat & Obreja (2013) who concluded that EPU results in economic slowdown and unemployment. It is to be noted that these authors have not specifically looked at EPU effect on

dividend payments but at the macro level effect. The Chow Test confirms that there was no structural break in the payment of dividend during the Global Financial Crisis. Hence it can be concluded that the financial crisis did not have any effect on the dividend payment in the pharmaceutical industry in India.

The study also finds that HHI has a negative impact on the dividend payment. One-point increase in HHI will reduce the dividend payment by (0.03)%. This means that, higher the concentration, lesser will be the dividend OR, higher the competition, more will be the dividend. This finding is in line with the findings of Grullon & Michaely (2008) who observed that firms in competitive environment tend to pay more dividend than firms in less competitive environment. This observation is contrary to the findings of Booth & Zhou (2009).

The above result is obtained after controlling for variables like profitability (represented by ROA), Leverage and size (represented by total assets & market share). While it is found that the ROA is negatively related to dividend payments, the effect of total assets and market share are found to be insignificant with low p value. As expected, leverage is inversely related to dividend payment i.e. One percent increase in leverage ratio will decrease the dividend payment by (0.36) %. This is in conformity with many studies, specially Rajan & Zingales (1995), Ebaid (2009) and Almeida & Campello (2007).

Further scope:

This study considers the pharma industry as a whole. However, if the industry is analyzed segment wise i.e. Active pharmaceutical ingredients/bulk drugs, formulations, biotech etc. the study will be in a better position to appreciate the research problem and may find different readings / relationships between competition and dividend payments. Further, it would also be interesting to look into why there is negative relationship between ROA and dividend payments. This is left to future research.

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Annexure 1: List of companies selected for study

Sl	Name of the company	Sl	Name of the company
1	Lupin Laboratories Limited	16	Nectar Lifesciences Ltd
2	Cipla Limited	17	UniChem Laboratories Ltd
3	Dr. Reddy's Laboratories Ltd	18	Granules India Ltd
4	Aurobindo Pharma Ltd	19	JB Chemicals Ltd
5	Glenmark Pharma Ltd	20	Indoco Remedies Ltd
6	Sun Pharmaceutical Industries Ltd	21	Aarti Drugs Ltd
7	Torrent Pharmaceuticals Ltd	22	FDC Ltd
8	Divis Laboratories Ltd	23	Merck Ltd
9	Piramal Enterprises Ltd	24	Shilpa Medicare Ltd
10	Cadila Healthcare Ltd	25	Suven Life Sciences Ltd
11	Ipsa Laboratories Ltd	26	Lincoln Pharmaceuticals Ltd
12	GlaxoSmithKline Pharmaceuticals Ltd	27	Amrutanjan Health Care Ltd
13	Biocon Ltd	28	Anuh Pharma Ltd
14	NATCO Pharmaceuticals Ltd	29	Alembic Pharmaceuticals Ltd
15	Ajanta Pharma Ltd	30	Jagsonpal Pharmaceuticals Ltd
		31	Jenburkt Pharmaceuticals Ltd

Annexure 2: Summary Statistics

	HHI	EPU	ROA	SIZE	MARKET SHARE	LEVERAGE	DIVIDEND RATIO
Mean	475.12	104.00	10.81	3.83	2.31	44.27	23.33
Median	433.76	100.23	9.67	1.09	0.90	45.92	19.65
Std. Deviation	107.50	41.91	8.30	7.34	2.89	16.20	20.87
Range	338.22	135.02	91.81	61.89	16.65	65.72	245.28
Minimum	325.40	47.76	0.69	0.02	0.05	13.25	1.56
Maximum	663.62	182.78	92.51	61.91	16.70	78.97	246.84
Count	372	372	372	372	372	372	372

Annexure 3: (Result of Panel Regression) Summary of Fixed Effects Model

Variables	Coefficient	t	P value
Constant	58.071	6.222	0.000
HHI	(0.030)	(3.035)	0.002
Market Share	(1.689)	(1.464)	0.144
EPU	0.051	2.519	0.012
ROA	(0.622)	(4.764)	0.000
Size	0.275	1.077	0.282
Leverage	(0.360)	(3.244)	0.001

$R^2 = 0.4396$;
 $\rho = 0.077$;

Within $R^2 = 0.105$;
 Durbin Watson = 1.791

P value (F) = $3.20e - 25$;

Annexure 4 (Chow Test)

Group 1 : Year upto 2011

Group 2 : Year 2012-2019

. regress DIVIDENDRATIO EPU if group==1

Source	SS	df	MS	Number of obs	=	
Model	11.8301093	1	11.8301093	F(1, 2)	=	1.50
Residual	15.7369632	2	7.8684816	Prob > F	=	0.3449
Total	27.5670725	3	9.18902417	R-squared	=	0.4291
				Adj R-squared	=	0.1437
				Root MSE	=	2.8051

DIVIDENDRATIO	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
EPU	.0458639	.0374044	1.23	0.345	-.1150741 .2068019
_cons	19.9382	3.274143	6.09	0.026	5.850694 34.0257

. regress DIVIDENDRATIO EPU if group==2

Source	SS	df	MS	Number of obs	=	
Model	86.9184975	1	86.9184975	F(1, 6)	=	10.95
Residual	47.6305195	6	7.93841991	Prob > F	=	0.0162
Total	134.549017	7	19.2212881	R-squared	=	0.6460
				Adj R-squared	=	0.5870
				Root MSE	=	2.8175

DIVIDENDRATIO	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
EPU	.0862973	.02608	3.31	0.016	.0224818 .1501128
_cons	13.16331	3.1962	4.12	0.006	5.342492 20.98413

. regress DIVIDENDRATIO EPU

Source	SS	df	MS	Number of obs	=	
Model	71.9819295	1	71.9819295	F(1, 10)	=	7.96
Residual	90.4669402	10	9.04669402	Prob > F	=	0.0181
Total	162.44887	11	14.7680791	R-squared	=	0.4431
				Adj R-squared	=	0.3874
				Root MSE	=	3.0078

DIVIDENDRATIO	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
EPU	.0585243	.0207477	2.82	0.018	.0122956 .104753
_cons	17.24391	2.325865	7.41	0.000	12.06156 22.42626

$$\text{Chow test statistic } F = \frac{(ESS_c - (ESS_1 + ESS_2)) / k}{(ESS_1 + ESS_2) / (N_1 + N_2 - 2k)}$$

$$ESS_c = 90.4669 \quad k=2 \quad N_1=4 \quad N_2=8$$

$$ESS_1 = 15.7369 \quad ESS_2 = 47.6305 \quad F = 1.7106 \quad P \text{ value} = 0.2407$$