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PRICE DYNAMICS OF POLYPROPYLENE AND ITS FEEDSTOCKS IN ASIA AND NORTH WEST EUROPE

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OVERVIEW

Our study aims to discern the causal chain (or lead-lag relationship) between the prices of polypropylene (PP), propylene, naphtha and crude oil in North West Europe (NWE) and Asia. Crude oil derivatives are the economical choice due to the lack of natural gas resources compared to North America where 70% of the petrochemical feedstocks are come from refined natural gas products. The paper has been motivated by the growing debate that downstream polymer markets are being directly affected by changes in oil prices before experiencing shocks from closer feedstock prices of propylene. The petrochemical industry is part of the wider chemical industry and the plastics and polymer industry constitutes the most important sub-sector within the petrochemical industry in a broad sense. One of the polymers that is of extreme importance and is analyzed here is Polypropylene (PP). PP is manufactured from the monomer propylene; in fact on a global scale about 60% of the consumption of propylene is dominated by polypropylene and has been the fastest growing of major propylene derivatives. Propylene in turn is manufactured by steam cracking of liquid feedstocks like naphtha and from off-gases produced in fluid catalytic cracking (FCC) units in refineries. PP producers have the highest feedstock costs (coming from propylene) in the plastics producing world but are also sensitive to crude oil and naphtha prices. We investigate how the contribution of these upstream prices movements flows through to movements in PP prices. Our model also captures the degree of prices shocks coming from downstream PP industries.

METHODS

The plastics value chain is modeled using the well established cointegration technique through the application of vector error correction models, impulse responses and variance decomposition techniques. These methods have been mechanical in nature in testing the long run relationship and we extend this by using the 'long run structural modeling (LRSM) technique where over identifying restrictions are imposed based on theories and apriori information on which variables are likely to play a less or more important role (Pesaran and Shin, 2002). The exactly identifying and over-identifying restrictions are based on the debate as to what is driving the PP price and how the dynamics stand out in NWE and the Far East. The debate as to whether the polypropylene price is closely linked to its more immediate feedstock (propylene) price or shares a closer link to further upstream prices is tested. We test this by imposing an over-identifying restriction of zero on the crude oil price and if this is rejected then our recommendation to the policy makers is that the crude oil price should not be ignored in cointegrating vector when making risk management and hedging decisions in manufacturing polypropylene. The impact of crude oil price on feedstocks like naphtha and propylene will also be of extreme importance if certain regions show polypropylene prices to be cost driven rather than demand driven.

RESULTS

After going through the unit root test, Johansen cointegration test, testing the overidentifying restriction and generating the vector error correction model, we estimate the variance decomposition and impulse response functions. This interesting and valuable step gives us a better insight on how the variance of prices behaves when shocks are introduced to each variable in the cointegrating vector. The table below shows the variance decomposition for NWE. We find that PP prices are driven mainly by naphtha and crude oil prices. Propylene prices are also driven by upstream prices movements emphasizing a cost driven hierarchy.

Table 1. Generalised Variance Decomposition Analysis

Percentage of Forecast Variance Explained by Innovations in:					
		PP	**Propylene**	**Naphtha**	**Brent Crude**
Months	Δ Polypropylene				
1		65.00	8.37	16.18	10.45
3		48.22	8.40	25.52	17.86
5		44.15	6.55	28.81	20.50
10		41.97	4.11	31.43	22.49
	Δ Propylene				
1		7.85	59.67	19.01	13.48
3		6.86	41.99	29.23	21.93
5		5.64	32.91	34.95	26.50
10		4.18	23.56	40.98	31.28
	Δ Naphtha				
1		8.58	3.87	51.19	36.35
3		10.51	3.61	49.57	36.31
5		11.35	4.16	48.66	35.83
10		12.42	5.40	47.20	34.98
	Δ Brent Crude				
1		3.83	2.93	38.33	54.91
3		4.73	3.46	37.45	54.35
5		5.29	4.46	36.85	53.40
10		5.97	5.89	36.13	52.00

CONCLUSIONS

This study is an initial investigation into the price dynamics between PP and its feedstocks. We test if PP prices are input cost driven, i.e., via changes in propylene, naphtha and crude oil prices or if they are demand driven. Our novel and new approach using the LRSM methodology shows similarities and differences to the behaviour of PP prices in NWE and Asia. Our findings, based on the rigorous techniques and subject to the limitations of the study, tend to suggest that in NWE, PP prices are input cost driven while for Asia the prices tend to be demand driven. The out of sample analysis through the generalized variance decompositions however shows that naphtha and crude oil also play a leading role in driving propylene and PP prices.

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