International Research Journal of Finance and Economics
ISSN 1450-2887 Issue 99 October, 2012

http://www.internationalresearchjournaloffinanceandeconomics.com

The Dynamics of Indonesian Coal Price Reference (HBA) and Its Determinants: An Econometric Analysis

Maydin Sipayung
Bogor Agricultural University and Coalindo Energy PT, Indonesia
E-mail: maydins@yahoo.com

Hermanto Siregar
Bogor Agricultural University, Indonesia
E-mail: hermansiregar@yahoo.com

Mangara Tambunan
Bogor Agricultural University, Indonesia
E-mail: mangaratambunan@yahoo.com

Roy Sembel
Bogor Agricultural University and Christian University of Indonesia
E-mail: rsembel@yahoo.com

Abstract

The role of coal as one of the main energy sources of the world is predicted to be still quite dominant and strategic. To optimize state revenues, since January 2009 the Ministry of Energy and Mineral Resources of the Republic Indonesia had determined the Indonesian Coal Price Reference (HBA) that constitutes the average total of four coal indexes namely: Indonesian Coal Index (ICI), Platts Index (PI), Global Coal Index (GC) and Newcastle Export Index (NEX) as the base of calculation for royalty and tax payments by coal mining companies to the State. This study tries to analyze the impact of macro factors to the dynamics of movement of HBA. The result of study founds that the macro factors influence the dynamics of movement of HBA. Among said factors, world coal price and world oil price provide a relatively dominant influence on the fluctuation of HBA. The study also founds that the formulation based on the HBA is not proportional to the fourth constituent index as set by the government so far.

Keywords: Coal price reference (HBA), macro factors, vector error correction model, impulse response, forecast error variance decomposition.

1. Introduction

During 1997-2007, world coal production and consumption had risen over 35%, with the highest increase in the Asia Pacific region. In the past two years, the utilization of coal had grown with a growth rate faster than other fuels, with almost 7% increase in 2007. The need in China was recorded up by 15%, in Russia 7%, Japan 5% and the USA 2.6%. The need for coal and its other vital roles in the world energy system will continue. The increase in the use of coal that happens mostly in Asian countries, China and India control about 68% of said increase. At this moment, coal supplies 39% of world electricity, this figure is estimated to slide down just one percent within the time span of the next decade. With the overflow of its availability, affordable and geographically distributed, coal will continue to play a vital and strategic role as the supplier of electricity source in the world (World Coal Institute, 2005).

In the context of Indonesia as the second world biggest producer and exporter of thermal coal, it does not only contribute in procuring coal in the global level but also in the national level. Coal is one of the alternative energy that has a rapid growth either from the point of production or consumption. This is what makes the coal industry increasingly popular, particularly after the uncontrolled rise in oil fuel prices in the past several years. With the lessening attractiveness of oil fuel due to its soaring price and limited availability, coal has great opportunity to replace oil fuel segment. The principal advantage of coal compared to other energy sources is its relatively abundant sources. Enormous coal resources and reserves as well as production capacity that keeps on rising at the moment, have made coal the most possible choice to replace oil fuel after the deregulation of energy prices. Development of natural gas will be limited due to the constraints of gas transmission and distribution infrastructures, while development of renewable energy (water, geothermic, solar, wind and biomass) can only be developed at a limited capacity.

The use of coal in Indonesia year by year undergoes increase with quite a high growth although the amount is much smaller than oil fuel. The segment of coal consumption in the early '90s was only 8% rose to 16.7% of the total commercial primary energy in 2002. Besides for domestic consumption, Indonesia's coal is also exported to a number of countries. The biggest portion of coal consumption at home is for fuel of power plants. The segment of coal consumption in the primary energy mix of power plants keeps on rising year by year. In 2003 the use of coal for power plants was 75% of the whole domestic coal consumption. Other uses which are quite large were for industry, comprising of cement, paper and metallurgy industries (Ministry of Energy and Mineral Resources , 2005).

The rapid development in Indonesia's coal industry was particularly witnessed in early 2000 when coal production was around 80 million tons; by the end of 2011 it had reached over 371 million tons. Likewise was the development in export, when in 2000 it was only 57 million tons but by the end of 2011 rose to 306 million tons and was of thermal coal (for power plants), the world biggest export defeating Australia and South Africa. Various factors that encourage it are the world's demand for coal that is increasingly vital, the increasingly favorable support of government policy and the sharp rise in world coal prices. If in 2006 the price of coal was in the range of US$40 per ton, toward the end of 2011 it was almost threefold to US$120 per ton.

Meanwhile, as of the budget year of 2009, coal became one of the state revenue sources in the draft state budget. In 2010, the realization of income from coal royalty was recorded at Rp15 trillion. Besides as a source of income, the state also had to bear the burden of buying coal for power plants managed by the State Electricity Company (PT. PLN), either for existing ones or new plants. In 2010, the need for coal was recorded at 40 million tons, by 2015 it is estimated to increase to 100 million tons and, by 2020 to 150 million tons. If the average price of coal is US$70/ton, the state will have to allocate a budget of roughly US$7.0 billion by 2015 and US$10.5 billion by 2010. In addition, the Ministry of EMR has issued a Circular Letter No.2637/32/DJB/2009 regarding the determining of HBA (coal price reference) by using the average prices of four coal indexes, namely ICI, PI, GC and NEX effective as of January 2009. Hopefully the HBA will have a positive impact on Indonesia either as a source of state revenue, in the form of royalty and tax, or as a source of funding reference for the purchase of coal for fuel of PT PLN power plants.

Based on the above explanation, understanding of factors that cause the fluctuation of HBA becomes very strategic, as it could provide important information either for the government or other stakeholders in particular in relation to state income in royalty and tax and for anticipating the allocation of budget for purchasing coal for PT PLN power plants. The purpose of this paper is to study the macro factors that affect the Index Components that Forms Indonesian Coal Price Reference (KIP HBA).

One of the studies about factors that affecting coal price was done by Zhihua (2010). In that study, a verification model of coal price (VEC) is established by using cointegration analysis method. In addition, an empirical study is carried on the corresponding statistics from the year 1985 to 2008. It shows that the main factors affecting coal prices are the output value of industry, GNP, retail price index, coal cost and coal supply. Considering the factors, the proposed verification model can predict the actual value of coal price with high forecast accuracy and explain the changes in coal prices, at the same time, the comprehensive short and long term relationship of these variables and coal prices is better than that of the long-term relationship. The model illustrates the factors' affection on the impact of coal price based on quantitative analysis, which will offer certain references for macro-control department and coal enterprises.[1]

Meanwhile, according to Mimuroto (2000) coal prices have a correlation with a number of factors, namely: (i) the impact of exchange rate; and (ii) oil price. Thus, the theoretical study on thermal coal in Australia and Indonesia shows that they are more or less of similar characteristics both in production and sales. In the world coal trading market transactions are generally made in US dollar. As such, this means that the income from sales of Australian coal producers will be affected by the exchange rate of the local currency, the Australian dollar, against the US$. If the Australian dollar strengthens the price of coal sold will drop in the local currency and that will give rise to mine shutdowns, resulting in negative impacts on Australia's coal industry.

The need for thermal coal in Japan reflects the position of price that comes closer to the price of energy during the two waves of oil crisis. The principle factor that urges the rising demand is the much cheaper price of coal compared to oil and on the other hand the soaring price of gas. Then, there is the difficulty in handling and the burden of environment, thereby damaging coal utilities unless the price is cheap. In short, the price of oil has a big influence in determining the ceiling price of coal.

The international coal industry has been marked by a fundamental change in the last decade. In 1960 the coal market was far from the international market, considering that production was almost exclusively geared toward national use (Warell, 2006). Trading between different parts of the world had yet to be developed. The oil crisis in 1973 and 1979 has compelled the market arrangement of this energy to change and as the pushing power of the rapid development of the international coal market as is observed today.

This has contributed to the great improvement in coal trading. Since 1970 the world demand for coal had risen over 60 percent and, even faster than the rise in world demand for oil. However, the most significant increase was felt in the world coal trading market, when it rose over 230 percent within the same period. Such development has happened in the past several years that caused analysts to consider the international coal market as an integrated global market.

Assessed the influence of prices and the use of other energy sources, environmental measures, energy efficiency and the influence of electricity market liberalization on coal price movements. Our estimation shows that, if the prices of other energy sources and electricity increase, the price of coal increases. If the use of other energy sources increases, and if the gross uses of industrial waste and renewable resources increase, the price of coal decreases. Environmental protection measures contribute to an increase in coal prices. A higher quotient of energy efficiency decelerates the price of coal. And the euro (to dollar) appreciation decelerates coal prices (Festic, 2010).

Future coal reserve consumption depends, and is conditional, on environmental requirements. The price of coal is influenced by the price of coal production and preparation technologies, i.e. transportation costs, environmental legislation, the price of coal burning technology, the price of gas purification, the price of CO2 permissions or emission coupons, the consumption and price of other energy sources (natural gas and oil) and liberalization of the electricity markets. Forecasted emissions of CO2 are increasing due to increased energy consumption until 2030 (Kucewitz, 2007).

1 Ding Zhihua (2010). Quantitative Analysis of Factors Affecting Coal Price. Management and Service Science (MASS), Sch. of Manage., China Univ. of Min. & Technol., Xuzhou. China.

These studies are conducted entirely developed countries. While in the context of developing countries like Indonesia, there have been no similar studies. In this regard, this study sought to examine the dynamics of the reference coal price in Indonesia in relation to the influence of macro factors that are expected to provide benefits in the form of the formulation of policies for the development of coal industry in Indonesia as well as enrich the literature pertaining to studies on world coal prices.

Hence, this paper is systematically made as follows: First, a theoretical framework containing explanations on theories as a literary foundation in the analysis. Second, suggest a methodology that reviews data and model including the procedure of analyzing. Third, this paper is to present analyzes and discussions and, concluded by policy implications.

2. Theoretical Framework

2.1. Price Discovery

Price discovery is one of the central functions of the financial market. In the financial market this issue has often been construed as a search for price balance i.e. accumulating and interpreting various informations as reflected by trade activities to the market price. This interpretation indicates that the discovery of dynamic prices and the process of discovering efficient prices is marked by the quick adjustment of market price from the previous to the new equilibrium in line with the development of information (Yan and Zivot, 2007).

In the context of several markets, the general price with random efficient reflects that prices can be observed in different markets for the same assets to co-integrate known as co-integration vector. In this regard, it is shown that the structure of co-integration model makes it possible to identify efficient price innovations with minimal limitation using modification of permanent decomposition. With structural co-integration and identified model, new price discovery measures are needed based on response of functional impulse to illustrate the dynamic process of discovering a market price.

2.2. Determining Coal Price Reference (HBA)

Formulation of Indonesia's coal standard price is used as a basis for calculating royalty and tax by coal companies to the state. Prior to the determining of HBA, the government has no reference for determining the price of coal for calculating royalty and tax. In determining the selling price, coal producers in Indonesia were using the benchmarking of Barlow Jonker Index FOB Newcastle, Australia, with calorie 6700/kcal/kg (ADB) or equal with 6322 kcal/kg (GAR).

Prior to the determining of HBA in January 2009, Indonesia coal price index had been launched in July 2006 initiated by the Indonesian Coal Mining Association (APBI-ICMA). The index was then called Indonesia Coal Index (ICI) publicized jointly by two companies i.e. Argus Media Limited London and PT Coalindo Energy Jakarta. Since the launching of ICI, almost 300 coal companies worldwide from 21 Asia Pacific countries, Europe and the USA were customers of ICI.

As time passes, the government observes that the calculation of revenues from royalty and tax based on ICI is satisfactory. As such, the government does not hesitate to determine ICI 6500 GAR FOB Kalimantan as one of the index components that forms the HBA (KIP HBA) for Indonesia's coal together with other indexes: Platts Index, Global Coal Index and Newcastle Export Index. Further on through the Ministry of EMR, the government determines the calculating formulation of KIP HBA. This formula was officially in effect as of January 2009 and strengthened with the implementation of Regulation of the Minister for Energy and Mineral Resources No.17 Year 2010 regarding the Procedure of Determining The Standard Selling Price of Minerals and Coal and observing the Regulation of the Director General of Minerals and Coal No.515.K/32/DJB/2011 regarding Formula for Determining the Standard Price of Coal. The HBA formula (in calorific value of 6322 kcal/kg (GAR) equivalent is:

HBA = 25% ICI-1+25% Platts-1+25% GC +25% NEX

where:

- HBA = Coal Price Reference (US$/ton)
- ICI-1 = Indonesia Coal Index (US$/ton)
- Platts-1 = Platts Index (US$/ton)
- GC = Global Coal Index (US$/ton)
- NEX = Newcastle Export Index (US$/ton)

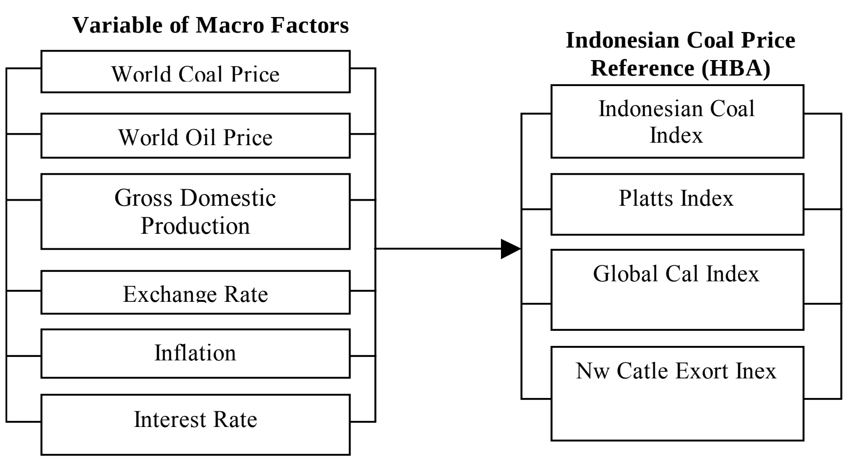
Platts has a head office in the USA and representative in Asia headquartered in Singapore. Its method of determining prices is by using the services of coal reporters, namely on a number of Indonesian coal sellers and buyers. The determining of prices is for Indonesian coal of 5900 kcal/kg calorie GAR (FOB Kalimantan). Global Coal Index has a head office in London, United Kingdom; they also open a representative office in Singapore just like Platts Index. The assessment they carried out is on Australian coal FOB Newcastle with calorie 6700 kcal/kg (ADB) or equal to 6322 kcal/kg (GAR.Then there is NEX, its method of determining prices is by making observations to several coal players both sellers and buyers in Australia. Determining of prices is done on Australian coal (FOB Newcastle) with caloric value of 6700 kcal/kg (ADB) or equal with 6322 Kcal/kg (GAR).

3. Data and Methodology

The data used in this research are secondary data obtained from various sources, such as: Pertamina, the Directorate General of Minerals and Coal , the Central Bureau of Statistics (BPS), Bank of Indonesia (BI), PT Coalindo Energy, Argus Media Limited, Indonesia Coal Index, Platts Index, Global Coal Index, Newcastle Export Index (NEX) within a time span from July 2006 to July 2011. The data used are data of real exchange rate USD/Rp, real GDP, HBA, ICI, PI, GC, NEX, interest rate (SBI), world coal price, world oil price, inflation, coal production, production cost and, wages of workforce in the coal mining sector. Data consideration was taken as of July 2006, because PT Coalindo Energy in cooperation with Argus Media Limited (London, UK) had just launched the ICI in that month.

The framework of the model above is based on figure below:

Figure 1: Framework of Implementation Research Thought



In order to examine macro-economic factors that have influences over KIP HBA, the approach of Vector Error Correction Model (VECM) will be employed. Variables used in said model are ICI, PI, GC, NEX, WCOAL, POIL, GDP, KURS, INF and R. In general, the VECM model used in this research refers to Verbeek (2000) expressed as follows:

$$\Delta Y_t = \sum_{i-1}^{k-1} \Gamma_t \Delta Y_{t-1} - \gamma\, \beta Y_{t-1} + \varepsilon_t$$

where:

Γ = short-term coefficient

β = long-term coefficient

γ = speed of adjustment
Y_t = vector of dependent variables that used in the model
(ICI, PI, GC, NEX, WCOAL, POIL, GDP, KURS, INF and R)
Data and data resources used in this writing are summed up in the following Table 1.

Table 1: Data and Data Resources (July 2006-July 2011)

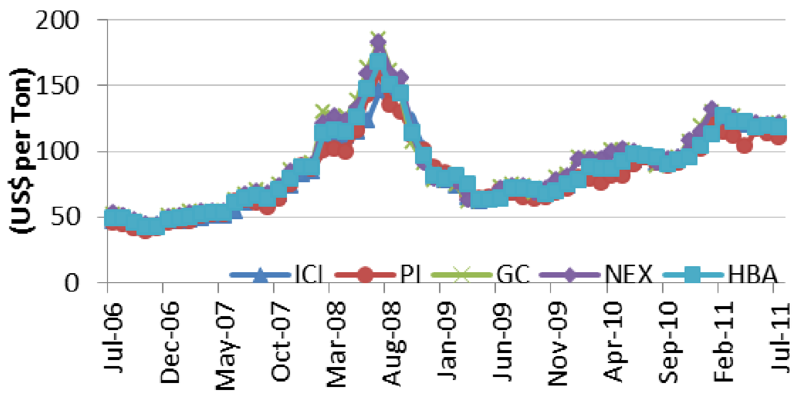
No	Variable		Unit	Source
1	PCOAL	HBA that reflects the price of Indonesian coal	US$/ton	Minister for Energy and Mineral Resources
2	WCOAL	World coal price	US$/ton	Argus Media Limited
3	POIL	World oil price	US$/barrel	Pertamina
4	GDP	Gross Domestic Product	Rp Trillion	The Central Bureau of Statistics
5	KURS	Exchange rate	US$/Rp	Bank of Indonesian
6	INF	Inflation	(%)	Ministry of Finance
7	R	Interest rate	(%)	Bank of Indonesia
8	ICI	ICI grade 6500 kcal, FOB Kalimantan	US$/ton	Minister for Energy and Mineral Resources
9	PI	PI, grade 5900 kcal, FOB Kalimantan	US$/ton	Minister for Energy and Mineral Resources
10	NEX	NEX grade 6322 kcal, FOB Newcastle	US$/ton	Minister for Energy and Mineral Resources
11	GC	GC , grade 6322 kcal, FOB Newcastle	US$/ton	Minister for Energy and Mineral Resources

4. Results and Discussion
4.1. The Dynamics of HBA and KIP HBA

Generally, the dynamics of the KIP HBA during the period of study tended to have similar movements with an upward trend. Figure 1 shows that in the course of July 2006 – July 2008, the four KIP HBA tended to undergo a quite significant rise, whose peak happened in July 2008 which on average reached a price of US$145-183 per ton. Said value on average rose more than 200 percent from July 2006 of around US$45-53 per ton. The increase of the four KIP HBA that also had an implication on the rise in HBA was indicated as caused by the global crisis that made the world price of crude oil to soar, which in turn jacked-up the rise in the world coal price. But, after July 2008, when the impact of the crisis gradually restored, the price of KIP HBA tended to decline until July 2011, although in general throughout the period of study the price of KIP HBA remained to undergo an increase.

Figure 2 show that throughout the period of study (July 2006 – July 2011), on average GC price (90.50) was the highest, followed by NEX (90.41), ICI (84.52) and PI (82.24) In Table 2 can also be seen the dynamic diversity of GC was the biggest compared to the other three KIP HBA.

Figure 2: The dynamics of the KIP HBA during July 2006-July2011



Source: Minister for Energy and Mineral Resources

This shows that in the course of the period of study the fluctuation of GC price was more dynamic compared to the other KIP HBA. During the period of crisis it was also recorded that among the rise in prices of the KIP HBA, the price of GC had the highest increase of 184.51, followed by NEX (182.60), PI (159.93) and ICI (145.67).

Table 2: Descriptive Statistics of HBA and KIP HBA

Descriptive Statistics	ICI	PI	GC	NEX	HBA
Mean	84.52	82.24	90.59	90.41	86.40
Median	80.58	79.80	89.01	88.88	81.50
Standard Deviation	28.79	27.59	32.47	32.22	29.78
Sample Variance	828.64	761.10	1054.57	1037.86	886.76
Minimum	44.02	39.11	42.36	43.41	42.69
Maximum	145.67	159.93	184.51	182.60	168.18

4.2. Econometric Analysis

In the VECM model, the first step is stationary testing of each variable. The result of stationary testing of each variable shows that the variable of KIP HBA on the whole is not stationer at the level. These are shown by the result of Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) testing which is wholly insignificant on a conventional significant level (5%). In other words, null hypothesis that states there is a unit root is accepted.

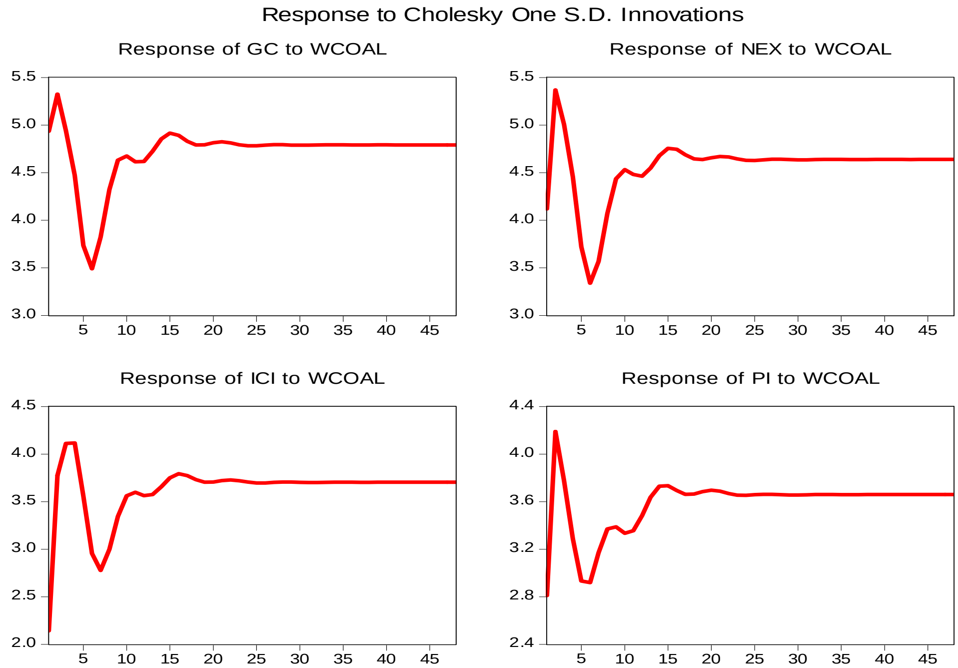
Subsequently, by re-testing the stationary condition of each variable in first differences by using ADF and PP testing, it was known that every KIP HBA variable has already been stationer. It can be seen from the p-value of the two tests which is smaller than the conventional significant level (5%).

Meanwhile, the result of stationary testing for the macro economic variables presumed to affect KIP HBA on the whole is not stationer at the level, except inflation. This was indicated by the result of ADF and PP test which is wholly not significant at the conventional significant level (5%). Further, by stationary re-testing of each variable in the first differences by using the ADF and PP test, it was believed that all macro economic variables have been stationary in nature. It can be observed from the p-value of the two tests which is smaller than the conventional significant level (5%).

Response of KIP HBA to WCOAL Shock

As explained in the methodology, IRF analysis on the VECM model is used to see the response from a variable against the shock of other variables. The innovations of WCOAL had caused ICI, PI, GC, and NEX to rise by US$2.142, US$2.810, US$4.935, and US$4.119 in the first period respectively, and then, it tend to fluctuate in the short time. Due to the shock of WCOAL, in the long term ICI, GC, NEX, and GC rose by US$3.70, US$3.65, US$4.792, and US$4.644 respectively, as of the 18^{th} -23^{rd} period. The response of ICI, PI, GC, and NEX which moved upward and reached its long-term balance in those periods in general was following the movement of WCOAL response due to WCOAL innovations (see Figure 3).

Figure 3: Response of KIP HBA to WCOAL



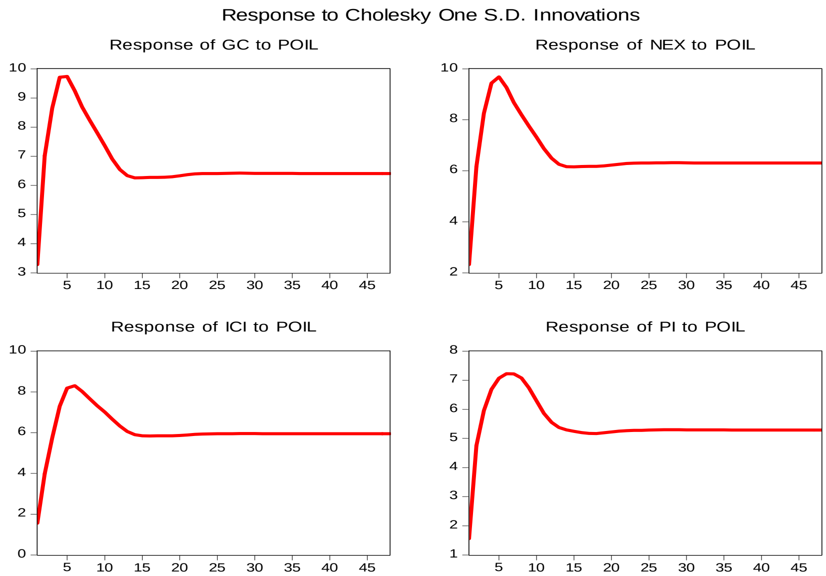
From the result above, the innovations of WCOAL had caused an increase of WCOAL which in turn increase the KIP HBA either in the short term as well as in the long term. The result is similar with Li (2000). According to Li study, it was found that the world coal price (FOB South Africa) was integrated with the Australian coal price (FOB Newcastle). As such, the shocks received by WCOAL will give a positive impact on Global Coal Index (GC) and Newcastle Export Index (NEX) where the two indexes are using FOB Australia. Likewise, the shocks of WCOAL toward Indonesia's coal (FOB Kalimantan) happened not directly, but in general the shocks of WCOAL had caused integration in general which means giving a positive impact on Indonesia's coal, i.e. ICI and Platts and the two indexes are using FOB Kalimantan.

Response of KIP HBA to POIL Shock

The innovations of POIL had caused WCOAL, ICI, PI, NEX, and GC to rise by US$42.428, US$1.556, US$1.560, US$3.279 and US$2.320 in the first period respectively, and then, it also tend to fluctuate in the short time. Due to the shock of POIL, in the long term WCOAL, ICI, PI GC, and NEX rose by US$6.836, US$5.913, US$5.280, US$6.407, and US$6.304 respectively, as of the 22th-24th period. The response of ICI, PI, GC, and NEX which moved upward and reached its long-term balance in those periods, in general was also following the movement of WCOAL and POIL response due to POIL shock (see Figure 4).

From the result above , IRF analysis the shock of POIL caused a rise to POIL which in turn increased WCOAL and the KIP HBA either in the initial periods (short term) or in the long term. The result is in accordance with the research of Mimuroto (2000). The price of petroleum constitutes a constraint toward the price of coal. The price of coal per unit of energy will always be lower than the price of petroleum in equal unit of energy. At the time the price of petroleum soared in 1980-1985 the price of coal followed with a not too high increase (about US$45 per ton). But at the time the price of petroleum dropped, the price of coal went down not as much as that of petroleum.

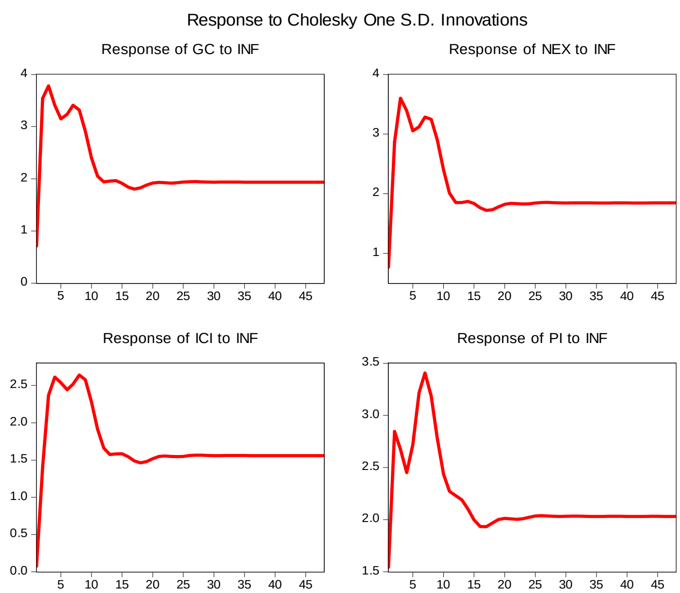
Figure 4: Response of WCOAL and KIP HBA to POIL



Response of KIP HBA to INF Shock

The innovations of INF had caused ICI, PI, NEX, and GC to rise by US$0.073, US$ 1.543, US$0.711, and US$0.768 in the first period respectively, and then, it also tend to fluctuate in the short time. Due to the shock of INF, in the long term ICI, PI GC, and NEX rose by US$1.582, US$ 2.012, US$ 1.920, and US$1.822 respectively, as of the 14th-20th period. The response of ICI, PI, GC, and NEX moved upward and reached its long-term balance in those periods (see Figure 5).

Figure 5: Response of KIP HBA to INF

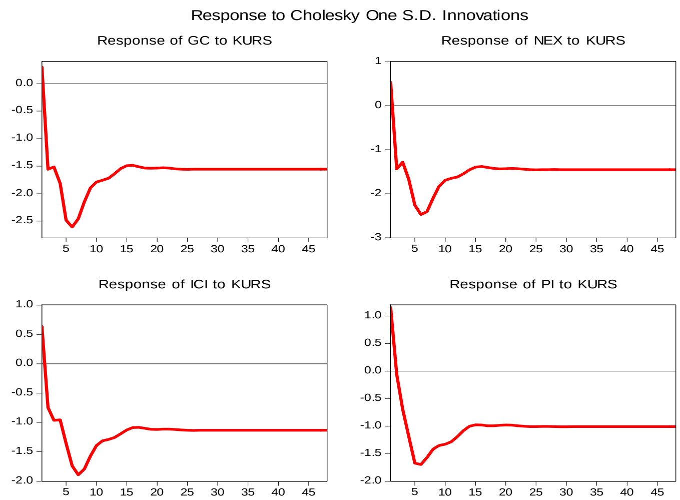


From the result above, the shock of INF had caused a rise to INF which in turn increased the KIP HBA either in the short term as well as in the long term. The result is similar with Ran and Qianggqian (2009) which found that inflation raises company cost and it's an impact on a higher production cost. In addition, it causes an adjustment on the micro factor, such as wages, and so on. But from the result of IRF it can be seen that the response of KIP HBA due to the shock of INF was not as big as that of WCOAL and POIL.

Response of KIP HBA to Exchange Rate (KURS) Shock

The innovations of KURS had caused ICI, PI, NEX, and GC to rise by US$0.636, US$1.155, US$0.302, and US$0.529 in the first period respectively, and then, it also tend to fluctuate in the short time. Due to the shock of KURS, in the long term ICI, PI GC, and NEX declined by US$1.134, US$1.004, US$1.558, and US$1.454 respectively, as of the 23rd-26th period. The response of ICI, PI, GC, and NEX moved upward and reached its long-term balance in those periods (see Figure 6).

Figure 6: Response of KIP HBA to INF



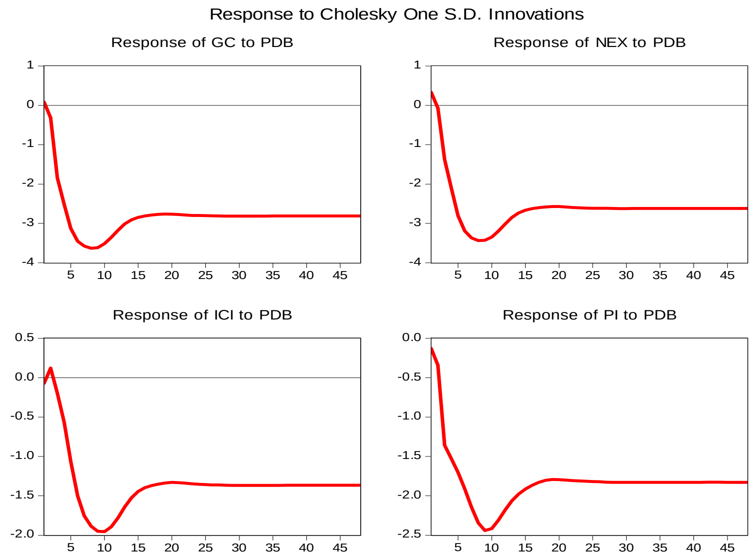
From the result above, the shock of KURS had caused a decline to KURS which in turn lowered the KIP HBA either in the short term as well as in the long term. The result is in accordance with the research by Mimuroto (2000) which found that the condition of exchange rate of Australian dollar against the US dollar has quite an influence toward the price of Australia's coal. This is because the cost of procuring Australia's coal was calculated in Australian dollar. Thus, if the Australian dollar weakens against the US dollar the export price of Australia's coal (sold in US dollar) will drop. In the other part, as explained earlier, the price of Australian coal has been integrated with the price of Indonesia's coal so that there is a similarity of type between Australia's thermal coal and Indonesia's, thereby the jolt of KURS will give a similar impact toward Indonesia's coal.

Response of KIP HBA to GDP Shock

The shock of GDP over KIP HBA could be transmitted by INF. The shock GDP did not cause INF to fluctuate in the first period. Only in the 8th period was its lowest decline of 0.569% happened and declined again in the next period although remained negative. Due to the shock of GDP, in the long term INF declined -0.033% as of the 16th period. The innovations of GDP had caused ICI and PI to decline by US$-0.071 and US$-0.127 as well as d GC and NEX rose by US$0.081 and US$0.329 in the first period respectively. And then, it also tends to fluctuate in the short time. Due to the shock of GDP, in the long term ICI, PI GC, and NEX declined by US$ 1.360, US$ 1.823, US$ 2.612, and US$ 2.812 respectively, as of the 25th-28th period. The response of ICI, PI, GC, and NEX moved upward and reached its long-term balance in those periods (see Figure 7).

From the above, the shock of GDP had caused a rise to GDP which in turn increased the KIP HBA either in the initial short term or in the long term. The result is in accordance with the research by Leiby (2001) which found that the rise in GDP also affect the price of industrial products including mining thus it has a positive influence on the affordability of consumers which also increased demand for company products and has a positive consequence on KIP HBA. A similar opinion was put forward by Wietze (2005) who states that there is a co-integrated connection between GDP and energy consumption in particular coal.

Figure 7: Response of INF and KIP HBA to GDP

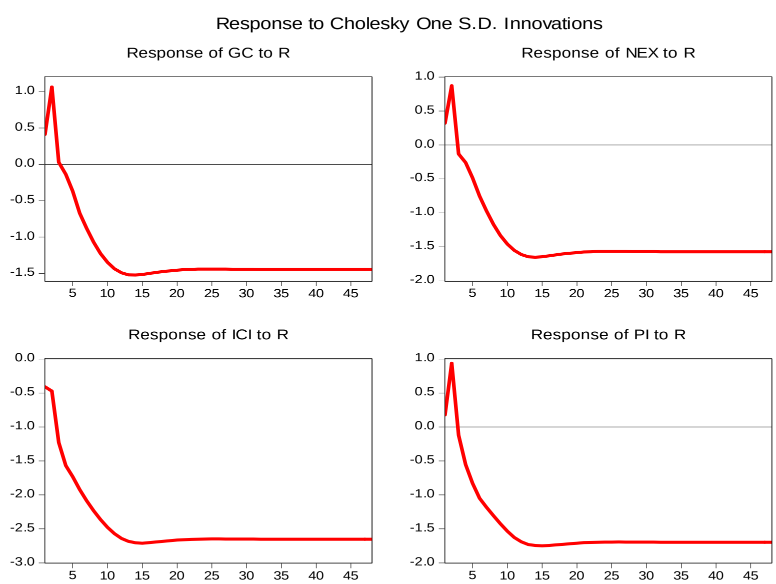


Response of KIP HBA to Interest Rate (R) Shock

The innovations of R had caused ICI to decline by US$-0.4077, but it gave rise to an increase of PI, GC, and NEX by US$0.1769, US$0.4100, and US$0.320 in the first period respectively. And then, it also tends to fluctuate in the short time. Due to the shock of R, in the long term ICI, PI GC, and NEX declined by US$ 2.6501, US$-1.6994 , US$-1.4403 , US$-0.0675 respectively, as of the 22nd-30th period. The response of ICI, PI, GC, and NEX moved upward and reached its long-term balance in those periods (see Figure 8).

From the result above, the shock of R had caused a rise to R which in turn lowered the KIP HBA either in the short term as well as in the long term. The result is in accordance with the research by Leiby (2001) which found that the rise in interest rate will cause a rise in interest rate required on investment of company shares or that the company is not interested to invest through the existing coal unit and switched to time deposit investment or to another country with low interest rate. Thus a high interest rate gave a negative sign toward KIP HBA.

Figure 8: Response of KIP HBA to R



Analysis of Forecast Error Variance Decomposition (FEVD)

The result of variance decomposition in predicting contribution (in percentage) of every KIP HBA variable within 48 time horizon is explained as follows. In the first period WCOAL variable provided the biggest contribution of 33.29 percent, followed by GC (20.13%) and POIL (17.58%) over ICI fluctuation. However, as time passed, in the long term, the contribution of WCOAL and GC tended to decline and moved relatively constant consecutively in the range of 15 percent and 9.5 percent. The opposite was shown by the contribution of POIL that tended to rise in the long term to 45 percent, which was the biggest contribution among other variables. Besides POIL, the variables that provided a relatively big contribution to the fluctuation of ICI in the long term were WCOAL (15.88%), NEX (11.10%), GC (9.45%), R (7.51%), INF (3.63%), ICI (2.87%) and GDP (2.33%). Meantime, the contribution of KURS and PI toward the fluctuation of ICI in the long term was relatively small, i.e. 1.71 %and 0.15% respectively (see Table 3).

Table 3: Variance Decomposition of ICI

Period	GC	NEX	ICI	PI	INF	KURS	GDP	POIL	R	WCOAL
1	20.13	8.16	16.62	0.00	0.04	2.94	0.04	17.58	1.21	33.29
3	7.58	4.62	4.38	1.19	6.35	1.58	0.05	42.79	1.59	29.87
6	12.43	9.32	2.08	0.70	5.57	1.59	0.78	49.86	2.29	15.36
12	12.97	10.63	2.47	0.43	5.10	1.94	2.16	48.05	3.99	12.25
24	10.68	10.93	2.75	0.25	4.15	1.80	2.31	46.22	6.30	14.62
48	9.45	11.10	2.87	0.15	3.63	1.71	2.33	45.37	7.51	15.88

Meanwhile, in the first period PI variable provided the biggest contribution of 30.75 percent, followed by WCOAL (28.78%) and GC (10.80%) over the fluctuation of PI. However, in the long term, the contribution of WCOAL and GC tended to decline and moved relatively constant consecutively in the range of 17.15% and 14.32%. The opposite was shown by the contribution of POIL that tended to rise in the long term to around 40%, which was the biggest contribution among other variables. Besides POIL, the variables that provided a relatively big contribution to the fluctuation of PI in the long term were WCOAL (17.03%), NEX (8.48), GC (14.36%), R (3.32%), Inflation (6.53%), PI (0.5%) and GDP (4.5%). Meantime, the contribution of KURS and PI toward the fluctuation of PI in the long term was relatively small, i.e. 1.56% and 0,52% respectively (see Table 4).

Table 4: Variance Decomposition of PI

Period	GC	NEX	ICI	PI	INF	KURS	GDP	POIL	R	WCOAL
1	10.80	7.06	0.02	30.75	8.68	4.87	0.06	8.88	0.11	28.78
3	7.00	5.45	0.61	10.16	11.04	1.14	1.24	37.91	0.58	24.87
6	18.62	6.81	1.88	3.52	8.44	1.82	2.22	42.29	0.62	13.80
12	17.65	8.18	2.37	1.63	8.02	1.85	3.95	42.41	1.48	12.46
24	15.45	8.38	2.79	0.95	7.06	1.67	4.39	41.13	2.69	15.50
48	14.32	8.50	3.02	0.52	6.51	1.56	4.55	40.52	3.34	17.15

In the first period WCOAL variable provided the biggest contribution of 47.51 percent, followed by GC (30.00%) and POIL (20.98%) over the fluctuation of GC. However, in the long term, the contribution of WCOAL and GC tended to decline and moved relatively constant consecutively in the range of 18.54% and 11.77%. The opposite was shown by the contribution of POIL that tended to rise in the long term to around 38%, which was the biggest contribution among other variables. Besides POIL, the variables that provided a relatively big contribution to the fluctuation of GC in the long term were WCOAL (18.54%), NEX (16.02), GC (11.77%), R (1.51%), INF (4.11%), PI (0.20%) and GDP (6.72%). Meantime, the contribution of KURS and ICI toward the fluctuation of PI in the long term was relatively small, i.e. 2.27% and 0.37% respectively (see Table 5).

Table 5: Variance Decomposition of GC

Period	GC	NEX	ICI	PI	INF	KURS	GDP	POIL	R	WCOAL
1	30.00	0.00	0.00	0.00	0.99	0.18	0.01	20.98	0.33	47.51
3	13.73	10.67	0.08	0.82	8.20	1.44	1.05	40.48	0.39	23.14
6	17.90	13.12	0.26	0.67	6.24	2.22	3.32	43.10	0.20	12.97
12	15.75	14.62	0.38	0.43	5.67	2.42	5.67	41.26	0.62	13.19
24	13.23	15.48	0.38	0.29	4.70	2.32	6.36	39.45	1.19	16.60
48	11.77	16.02	0.37	0.20	4.11	2.27	6.73	38.48	1.51	18.54

And then, in the first period WCOAL variable provided the biggest contribution of 49.95% followed by GC (24.93%) and POIL (15.85%) over the fluctuation of NEX. However, by the passing of time, in the long term, the contribution of WCOAL and GC tended to decline and moved relatively constant consecutively in the range of 18.42% and 11.44%.

The opposite was shown by the contribution of POIL that tended to rise in the long term to around 39 %, which was the biggest contribution among other variables. Besides POIL, the variables that provided a relatively big contribution to the fluctuation of NEX in the long term were WCOAL (18.42%), NEX (15.85), GC (11.44%), R (1.89%), INF (3.97%), ICI (0.46%) and GDP (6.20%). Meantime the contribution of Exchange rate and PI toward the fluctuation of NEX in the long term was relatively small, i.e. 2.12 percent and 0.21 percent respectively (see Table 6).

Table 6: Variance Decomposition of NEX

Period	GC	NEX	ICI	PI	INF	KURS	GDP	POIL	R	WCOAL
1	24.93	6.08	0.00	0.00	1.74	0.82	0.32	15.85	0.30	49.96
3	12.22	11.29	0.04	0.87	7.80	1.43	0.72	39.95	0.31	25.37
6	17.16	13.37	0.25	0.67	6.05	2.09	2.83	44.00	0.20	13.38
12	15.42	14.64	0.44	0.44	5.53	2.31	5.22	42.17	0.75	13.08
24	12.90	15.38	0.46	0.30	4.56	2.19	5.86	40.37	1.49	16.48
48	11.44	15.85	0.46	0.21	3.97	2.12	6.20	39.43	1.89	18.42

As is known, IRF could be used to observe the fluctuation or the variance of macro factors, while FEVD could be used to see the source of shocks of KIP HBA as the consequence of the shocks of macro indicators. HBA should be able to adjust dynamically to changes or shocks from external factors. From those analysis, thus we can determine the formulation of KIP HBA using the variance of fluctuations of the KIP HBA. The value of variance of the KIP HBA based on IRF and FEVD is presented in Table 7 and Table 8. Based on IRF (Table 7) it may be observed that on average NEX has the highest average fluctuation sensitivity, i.e. 0.421, followed by GC (0.379), ICI (0.301) and PI (0.248). Based on the result, it can be used to obtain the weighted HBA from its every component that formed it.

Table 7: The Variance of Fluctuation KIP HBA based on IRF

Shock	**KIP HBA**			
	GC	**NEX**	**ICI**	**PI**
WCOAL	0,09	0,10	0,10	0,06
POIL	1,11	1,25	0,98	0,69
INF	0,34	0,30	0,19	0,14
KURS	0,14	0,15	0,11	0,16
PDB	0,40	0,43	0,16	0,15
R	0,30	0,29	0,28	0,30
Average	0,40	0,42	0,30	0,25
Weighted	29,20	30,65	21,90	18,25

Notes: 1) *Shock* on GC, NEX, ICI, and PI not included
2) The given figures are average

Table 8: The Variance of Source of Fluctuation KIP HBA based on FEVD

Contribution	KIP HBA			
	ICI	**PI**	**GC**	**NEX**
WCOAL	24,26	12,41	29,15	35,20
POIL	21,65	25,25	9,82	16,07
PDB	0,50	1,30	3,04	2,69
KURS	0,05	0,23	0,14	0,07
INF	0,98	1,35	1,32	1,05
R	4,02	0,96	0,19	0,33
Average	8,57	6,92	7,28	9,23
Weighted	26,78	21,62	22,75	28,85

Notes: 1) Contribution from GC, NEX, ICI, and PI not included
2) The given figures are average

Meanwhile, based on FEVD (Table 8) on average NEX has the highest average fluctuation sensitivity, i.e. 9.23, followed by ICI (8.57), GC (7.28) and PI (6.92). In this case, index components that were more sensitive or more dynamic against shocks will be given higher weight compared to other index components. Based on IRF (Table 3) it can be observed that the highest weight for calculating HBA was for NEX (30.65%), followed by GC (29,20%), ICI (21,90%) and PI (18.25%), while based on FEVD (Table 4) the highest weight for calculating HBA was for NEX (28.85%), followed by ICI (26.78%), GC (22.75%) and PI (21,62%).

5. Conclusion and Policy Implications

5.1. Conclusions

The studies on macro factors reflected through variables of world oil price, world coal price, inflation rate, GDP, exchange rate and interest rate influenced the movement of KIP HBA. Among the factors, the world coal price and the world oil price provided a relatively dominant influence on the fluctuation of KIP HBA. The result from IRF analysis found that the shock of world coal price cause a rise in the world coal price, which in turn increased the KIP HBA either in the short term or in the long term. Whereas, it was known that HBA was used by the government for calculating royalty and tax for state revenue. On the other hand HBA was also used for calculating the heavy budget for the purchase of coal by PLN. Therefore, the government needs to adjust the calculation of revenue and expenditures from the coal sector based on the dynamic movement of said macro factors.

5.2. Policy Implications

At present, Indonesian Coal Price Reference mandated in the Ministerial Regulation No.34 of 2009 has been issued, namely the Regulation of the Minister No.17 Year 2010. The Ministerial Regulation determines that HBA is calculated proportionally from the four indexes that formed it. On the other hand, based on the result of calculation it can be seen that the weighted calculation of HBA (based on IRF and FEVD) varied of which the highest was NEX and the lowest was PI. The weighted result was un-proportional as the formulation determined by the government. By using the two formulations, the HBA obtained was higher than the actual HBA determined by the government and this will certainly affect state revenue (from royalty and tax) simultaneously the government's income for the purchase of coal for fuel of PLN power plants.

References

[1] Cullmann, A. 2009. *Globalization of Steam Coal Markets An Econometric Analysis* IAEE, 10th European Conference, Vienna.

[2] Captur, C., J. 2004. *Trends in US Domestic Coal Markets Are Higher Prices and Higher Price Volatility* PINCOCK Persfectives Issue No.58, September 2004, Colorado.

[3] Cattaneo, C., Manera M.,and Scarpa E. 2009. *Industrial Coal Demand in China: a Provincial Analysis*. Department of Statistics, University of Milan-Bicocca, Via Bicocca degli Arcimboldi 8, I-20126 Milano, Italy.

[4] Cortes M. 2007. *Examining Patterns of Bilateral Trade between Australia and Colombia by Using Cointegration Analysis and Error-Correction Models*, University of Wollongong, Australia.

[5] Dvornak, N., Marion K., and Gordon M. 2003. *Australia's Medium – Run Exchange Rate: A Macroeconomic Balance Approach.* Research Discussion Paper 2003-03. Economic Group Reserve Bank of Australia.

[6] Denne, T. et al. 2009. *Coal Price in New Zealand Market*, COVEC, Ministry of Economic Development, Final Report. Waikato Regional Council Private Bag 3038 Waikato Mail Centre HAMILTON 3240, New Zealand.

[7] Festic, M. 2010. Estimating Coal Price Dynamics with the Principal Components Method, *Romanian Journal Economic Forecasting-2/2010, 188-212.*

[8] Fan J. P. H. 2010, Price uncertainty and Vertical Integration: An Examination of Petrochemical firms, *Journal of Corporate Finance*, Vol. 6, pp. 354-376.

[9] Kavalov B. et.al. 2007. *The Future of Coal*, DG JRC Institute for Energy. Petten, The Netherlands.

[10] Leiby, at.al.2001. *Oil Price Shock and The Macroeconomy; What has been learned since 1996.* Environmental Sciences Division Oak Ridge National Laboratory.The Energy Journal, Oak Ridge. U.S.A.

[11] Li, R. 2008. *International Steam Coal Market Integration*, Department of Economics, Macquarie University, Australia.

[12] Lin, B., Dong B., and Li X. 2005. *Forecasting Long-run Coal Price in China*. Department of Economics, University of International Business and Economics, Beijing, China 100029.

[13] Li, Z. 2007. *Determinants of Trade Barriers within China: Evidence via Price Differentials*, the University of Hong Kong.

[14] Lisea, W. 2005. Energy Consumption and GDP In Turkey: Is There A Cointegration Relationship?", ECN *Policy Studies*, Energy Research Centre Of The Netherlands, Amsterdam Department Of Econometrics, Faculty Of Economics And Business Administration, Free University, Amsterdam.

[15] Ma, J. 2008. *Price Discovery and Information in an Emerging market: Evidence from China*, Tsinghua University.

[16] Mimuroto, Y. 2000. *An Analysis of Steaming Coal Price Trends – Factors behind Price Fluctuations and Outlook*, Coal Research Group, International Cooperation Department, Japan.

[17] Ran, J. 2010. *The Impact of the Global Crisis on China's Oil Industry*, School of Business Administration, China University of Petroleum, Beijing, China.

[18] Qiangqian, Z. 2011. The Impact of International Oil Price Fluctuation on China's Economy, *Energy Procedia* 5, 1360-1364.

[19] Ratti, A. Ronald. 2011. *Oil and Coal Price Shocks and Coal Industry Returns*. School of Business University of Notre Dame, Australia.

[20] Robert, A. and Amano. S. N. 1995. *Exchange Rates and Oil Prices*, Research Department International Department, Bank of Canada Bank of Canada.

[21] Rafiq, S. 2008. *Energy Consumption and Income in Six Asian Developing Countries: A Multivariate Cointegration Analysis*, School of Economics & Finance, Curtin Business School, Curtin University of Technology, Perth, Australia.

[22] Sipayung, M. 2007. *Estimated Economic Impact Analysis and Distribution of Household Income Up Development of Coal-Fired Power Plants 10,000 MW in Indonesia*, Graduate School of Economics, University of Indonesia

[23] Sueyoshi, T., Goto M., and Ueno T. 2010. Performance Analysis of US Coal-Fired Power Plants by Measuring Three DEA Efficiencies, *Energy Policy* 38, pp. 1675-1688

[24] Shi, X. 2005. *Energy Prices and Energy Intensity in China: A Structural Decomposition Analysis and Econometrics Study*, Massachusetts Institute of Technology, Cambridge, MA 02139, U.S.A.

[25] Uner, M. M. 2009. *Leading indicators of heating coal pricing in Turkey: A coal pricing model*, Department of Business Administration, Faculty of Economics and Administrative Sciences, Gazi University, Ankara, TURKEY.

[26] Truby, J. 2011. Market Structure Scenarios in International Steam Coal Trade, Institute of Energy Economics at the University of Cologne.

[27] Verbeek, M. 2000. *A Guide to Modern Econometrics*. John Wiley& Sons.Ltd. New York.USA

[28] Von, P. L. 2010. *The Coal Market Structure and Price Dynamics* – A Cointegration, Germany.

[29] Wårell, L. 2006. *Integration of International Coal Markets An Econometric Analysis*, Economics Unit Luleå University of Technology, Sweden.

[30] Yan, B. and Zivot E. 2007. The *Dynamics of Price Discovery*, Department of Economics, University of Washington, Seattle, USA.

[31] Zaklan, A. 2009. *The Globalization of Steam Coal Markets and the Role of Logistics: An Empirical Analysis*, Deutsches Institut für Wirtschaftsforschung, Berlin, Germany.

[32] Zhihua, D. (2010). *Quantitative Analysis of Factors Affecting Coal Price*. Management and Service Science (MASS), School of Management, China Univ. of Min. & Technol., Xuzhou. China.