

# Northern French coal companies performances in 1935-1945: A panel data analysis

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## 1. INTRODUCTION

In the first part of her book on European collieries from 1945 to 1958, R. Perron (1996) underlines the lack of quantitative data and difficulties in the obtaining of new data in the 1939-1945 sub-period<sup>1</sup>. In this analysis, we try to partially remedy to this problem through the use of an original statistical material on NPC collieries. An historical approach is associated to an economic approach in order to study the strategic behaviour of NPC coal companies from 1935 to 1945. More precisely, our approach aims to test the hypothesis of a change in the firms' behaviour associated with the change from a competitive economy to a state-controlled economy. Our analysis is based on panel data.

The historical approach permits us to present the main characteristics concerning the economic environment inside which companies operate during the period studied. By taking into account historical facts, we postulate a change in 1939, so that we consider two sub-periods. Next, an economic approach is undertaken in two main steps. First, we take into account several theoretical results derived from Industrial Organisations in order to construct our econometric model. Next, we estimate our model on the two sub-periods defined from the historical approach. This econometric approach permits us to test the hypothesis of a change in NPC coal firms' behaviour in 1939 and to evaluate the degree of relevance of the historical approach.

## 2. THE NPC COAL BASIN FROM 1935 TO 1945

Cartelised since 1922, NPC coal-basin tried to reinforce its cooperative organisation during the thirties. Heads of companies, convinced by the French public authorities, tried to adapt the collusive structure to the economic conjuncture. This strategy did not impede NPC companies to cheat on collusive agreements through several secret price cuts in order to preserve their sales as well as their market shares. Since 1931 NPC directors agreed to change collusive agreements in order to reinforce individual collusive behaviour. This explains that regional agreements were modified several times during the thirties. On the April, 9<sup>th</sup> 1935, a new agreement introduces quotas on the regional and national levels sustained by a punishment system in the event of cheating on collusive agreements.

During the second part of the thirties, government's control on NPC coal industry is reinforced. Law of August 18<sup>th</sup> and 19<sup>th</sup> 1936 introduce a public control on coal prices. The law of July 11<sup>th</sup> 1938 on war economy reinforced French public authorities control on the economy. Higher state's intervention on the French collieries - and in particular on the NPC coal-basin - can be explained by the fact that coal product is of a strategic importance for the national interest. Moreover, the strategic importance of the main French coal-basin (i.e. the NPC coal-basin) is due to the fact that France has never been self-sufficient in coal product (one-third of the French coal consumption must be imported from England, Netherlands, Belgium, Poland and Germany) and coal imports were decreasing during the second part of the thirties<sup>2</sup>, so that French government had to control the national coal activity according to the collective interest.

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<sup>1</sup> Cf. R. Perron, p.40

<sup>2</sup> Cf. M. Heaulme, p.415

Laws of August, 16<sup>th</sup> 1940 and September, 10<sup>th</sup> 1940 introduces a planned economic system. Law of September, 10<sup>th</sup> 1940 creates an organisation called OCRPI<sup>3</sup> that can enforce producers to sell their product to specific customers (conversely, a consumer can be constrained to buy to a specific producer). Through this law, the industrial products cannot freely be offered any more on the market. Aside by this, decree of November 9<sup>th</sup> 1940 create the COH<sup>4</sup> in order to control the production of coal, coke, briquettes and other products derived from coal. Moreover, the COH prepares price changes. A second decree of November 9<sup>th</sup> 1940 introduces another organisation in order to control the coal trade. By the law of September, 13<sup>th</sup> 1940, each French coal-basin must be organised inside a unique cartel that sell coal product according to the strategy of the French public authorities. This law leads to deep changes in the economic organisation of the NPC coal-basin (M. Heaulme, p.399) because coal companies are not allowed to sell themselves their product. This centralised organisation appears in the NPC coal-basin in October, 29<sup>th</sup> 1940. From this time, the commercial function and the production function are separated in two distinct parts. Coal companies can control the production activity but not the commercial activity, so that competition does not still exist inside the NPC coal-basin. By the law of October, 21<sup>th</sup> 1940, the minister of the economy is the sole one to be able to change prices (M. Heaulme, p.405). Nevertheless, according to M. Heaulme p.413, a decree of October, 4<sup>th</sup> 1939 conduced companies to loose their ability to sell themselves their product. Sales of coal product were then controlled by public authorities.

In sum, historical facts shows us that NPC coal companies have operated inside a competitive environment until October 1939<sup>5</sup>, after what they operated inside a state-controlled economy.

### 3. THE APPROACH IN INDUSTRIAL ORGANIZATION

In this section, we present expected effects from various variables introduced in the empirical analysis on the individual profit. Theoretical model considered here study the influence of a specific variable on the stability of a cooperative structure. The aim of a collusive structure is to make a profit as close as possible from the profit of a monopolist. If an industrial collusive structure is unstable, its members act non-cooperatively so that the market price decreases as well as firms' profit. In this context, a relationship can be established between the concept of collusive stability and the level of the individual profit of adherents to the cooperative structure<sup>6</sup>. It appears then that theoretical results on the impact of a given variable on the stability of a collusive structure can be used to analyse the impact of these variables on the profit obtained by firms on a market.

Industrial organisation's models disagree about the relationship between the economic conjuncture and the level of profits obtained by firms on a market<sup>7</sup>. E.J. Green and R.H. Porter (1984) consider that collusive firms operate on a market with imperfect information because they can observe the level of their individual demand but not the level of the global demand to the industry nor the demand obtained by others collusive firms. In this context, a firms that observes a reduction of its individual demand doesn't know if this is due to a reduction of the demand to the industry or to a defection by another firm from collusive agreements. In order to preserve the credibility of punishments, companies revert to a non-

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<sup>3</sup> *Office Central de Répartition des Produits Industriels.*

<sup>4</sup> *Comite d'organisation des houillères.*

<sup>5</sup> Nevertheless, the set up of a coal price control from August 1936 conduces us to mitigate the hypothesis of a competitive phase in 1935-1939.

<sup>6</sup> Nevertheless, this relationship must be considered with caution, because the unstability of a collusive structure increase with the collusive price and is the highest for a collusive price close to the price obtained with a monopolist. It appears then that a stable cartel does not imply that its members obtain a high profit. Aside by this, it appears that if a collusive structure is unstable, then individual profits decrease.

<sup>7</sup> This presentation is focused on classical models. We do not take into account here models that introduce forecasts on the level of demand.

cooperative behaviour (retaliatory phase)<sup>8</sup>. The reduction of industrial demand leads to an increasing of cartel instability. Alternatively, J.J. Rotemberg and G. Saloner (1986) consider a market situation inside which collusive firms face an increasing demand. Firms are aware of the fact that their future profits shall be lower than their present profits, whatever is their attitude towards cartel agreements<sup>9</sup>. If they cooperate, the return of the economic conjuncture to its usual levels will reduce their profits. Conversely, if they cheat on cartel agreements, they will have to face a retaliatory phase according to collusive agreements. Nevertheless, these cheaters will have obtained a high cheating profit. Firms are incited to maximize their short turn gain, so they cheat on collusive agreements and the collusive structure then becomes unstable.

Imports effect on individual profit of cartel’s members is analysed by R.M. Feinberg (1989). This author considers a market in which a domestic collusive structure operates in an imperfect information situation and faces an increase of imports. Two separate effects are highlighted. For a fixed level of demand, an increase of imports supply leads to a higher degree of competition on the domestic market. The first effect is a price reduction on the domestic market. Aside by this, following E.J. Green and R.H. Porter (1984), the increase of import supply forces firms to revert to a punishment phase in order to preserve the credibility of punishments. This explains that firms develop non-cooperative strategies which leads to a reduction of the domestic price, an instability of the domestic collusion and a reduction of individual profits. This second effect associated with the first one leads to a reduction of the domestic price higher than the price reduction due to the sole increase of imports. This theoretical approach shows that higher imports lead to a reduction of individual profits.

The effect of excess production capacities on firms’ profit is analysed by C. Davidson and R. Deneckere (1990). These authors establish the existence of a dual effect of excess production capacities on profits of a collusive structure’s members. For a fixed level of supply, a reduction of demand leads to a positive excess capacity of production. This direct effect incites firms to cheat on cartel agreements in order to preserve their sales. This direct effect leads to a negative effect on firms’ profits. Aside by this, an indirect effect is due to the fact that adherents to the cartel must preserve excess capacities in order to maintain the credibility of punishments in the event of cheating on cartel agreements. This strategic effect of excess capacities reinforces a cooperative behaviour, which permits the obtaining of higher profits. The empirical effect of excess capacities on individual profits depends on the relative importance of the two effects previously mentioned: the direct effect and the indirect effect. Previous theoretical results are summed up in the following table.

**TABLE 1. THEORETICAL EFFET OF VARIOUS VARIABLES ON THE PROFIT**

Variable	Model	Effect on individual profits
Economic conjuncture	E.J. Green et R.H. Porter	Profit reduction associated with lower demand
	J.J. Rotemberg et G. Saloner	Profit reduction associated with higher demand
Imports	R.M. Feinberg	Profit reduction associated with higher imports
Excess production capacities	C. Davidson et R. Deneckere	Profit reduction associated with higher excess capacities (direct effect)
		Higher profit associated with higher excess capacities (strategic or indirect effect)

**4. THE STATISTICAL MATERIAL**

<sup>8</sup> Firms revert to non-cooperative strategies by decreasing their price or by increasing their production offered on the market.  
<sup>9</sup> This is due to the fact that the level of global demand will return soon to its usual levels.

Numerical data are obtained from internal archives of NPC coal companies collected through personal searches performed at the Centre des Archives du Monde du Travail (CAMT, Roubaix) and at the Centre Historique Minier (CHM, Lewarde) between 1997 and 2000. This statistical material has been completed by other data obtained from February to July 2002 at the CAMT. Several chronicles are extracted from books edited by *la Statistique Générale de la France* and *Revue de l'Industrie Minérale*. Yearly data from 1935 to 1945 are used. Variables considered in the analysis appear in the following table:

**TABLE 2. DEFINITION OF THE VARIABLES INTRODUCED IN THE MODEL**

Variable	Definition
PROFIT	Annual real profit
IND	Annual French industrial production index
VIND	Rate of growth of the IND index
QHNPC	Annual NPC coal-basin's coal production
QHLORR	Annual Lorraine coal-basin's coal production
PE1	Annual imports index over-estimated
PE2	Annual imports index
RU	Annual English industrial production index
ALL	Annual German industrial production index
QHINDIV	Annual individual coal production of each NPC coal firm from 1935 to 1939
QHINDIV1	Annual individual coal production of each NPC coal firm from 1935 to 1945
CAPIND	Annual individual excess production capacity of each NPC coal company
CAPAH1	Annual excess capacity of coal production of the NPC coal-basin from 1920 to 1945
CAPAH2	Annual excess capacity of coal production of the NPC coal-basin from 1920 to 1950
PARTIND	Annual individual market share of each NPC coal company
FONTE	Annual index of melting production in France
VFONTE	Rate of growth of the FONTE index
SIZE1	Dummy variable (= 1 for NPC companies whose market share is higher than 8.5%)
SIZE2	Dummy variable (= 1 for NPC companies whose market share is higher than 5%)
OCCUP2	Dummy variable (= 1 from 1939 to 1944)
DUM3538	Dummy variable (= 1 from 1939 to 1945)
DUM3539	Dummy variable (=1 from 1940 to 1945)
DUMCA1	Dummy on change of composition of board of directors of NPC coal companies

#### **DATA ON PROFITS**

Data on yearly profits of companies are extracted from yearly companies' balance-sheet. These balance-sheets have been obtained just for some NPC coal companies. These documents must be considered with caution because of the lack of accounting normalization during the studied period (O. Hardy-Hémery, 1985, vol. 1, p.257). Data collected correspond to profit data obtained in balance-sheets. Moreover, data are available in limited quantity for several companies<sup>10</sup>. In order to measure the representativeness of the sample used in the analysis, we sum for each year the market share associated with companies for which the annual profit data is available. This approach permits us to find that the representativeness of our sample is equal to 69.3% from 1935 to 1945<sup>11</sup>.

From 1935 to 1945, the significance of our sample is systematically higher than 58%, except for 1945 when the figure is equal to 43.7%. Considering the fact that the mean significance of the sample is 70% from 1935 to 1945, the available sample is significant on the level of the NPC coal-basin. In order to take into account the inflation, annual profit data are divided by an index of price obtained from data published by *la Statistique Générale de la*

<sup>10</sup> For example, data concerning the Aniche company are available for only two years.

<sup>11</sup> Notice that since market shares data are not available from 1940 to 1945, we have considered the mean of market shares from 1935 to 1939. The representativeness of the sample in the 1935-1945 period is unchanged if we consider instead the mean of market shares following the rehabilitation of the NPC coal-basin (i.e. after 1924). This method is based on the postulate that relative sales, measured in tons, of NPC companies have not been modified since 1940. This hypothesis is based on the fact that the NPC coal-basin has not suffered severe destructions, instead of the first World War, so that its production capacity remained unchanged. Moreover, sales from 1940 to 1945 are controlled by the administration which imply some stability of individual coal sales.

France. Real profit data of the Anzin company are computed with those available from 1927 to 1936 in O. Hardy-Hémery (1985, p.2934) and in D. Barjot (1991, p.168). The correlation coefficient index between the chronicle of nominal price obtained from archives available at the CAMT and the profits chronicle obtained from mining activity is 0.935<sup>12</sup>. This high correlation between these two series signals the quality of profits data. The general model considered is given thereafter<sup>13</sup>:

$$\text{PROFIT} = f(\text{CAPA}, \text{PARTIND}, \text{QHINDIV}, \text{CONJ}, \text{QHLORR}, \text{TIME}, \text{PE}, \text{SIZE}, \text{DUMMIES})$$

## 5. RESULTS

The historical approach permits us to highlight the existence of a competitive period followed from October 1939 by a state-controlled period. In this section, an econometric analysis is performed in order to check if statistical facts do not contradict the historical approach. First, we consider the entire period. Next, two sub-periods are considered.

### ■ THE 1935-1945 PERIOD

Our aim here is to test the hypothesis of a change in 1939. This explains the relative simplicity of the model considered. In order to reach this objective, two dummies - namely DUM3538 and DUM3539 - are introduced in the model. These variables are respectively equal to 1 in 39-45 and 40-45<sup>14</sup>. The specific design of estimated forms is based on an analysis of the correlations matrix<sup>15</sup>. First order serial correlation is rejected at the 1% risk level (D. M. Drukker, 2003).

**TABLE 3. ESTIMATIONS IN 1935-1945 (endogenous variable: PROFIT)**

Exogenous variables	Eq. 1	Eq. 2	Eq. 3	Eq. 4	Eq. 5	Eq. 6
Intercept	3847.56 (0.45)	39200.05*** (6.49)	45884.15*** (7.09)	9000.42 (1.00)	9203.30 (1.07)	43761.76*** (8.23)
QHINDIV1	1459.70*** (4.84)			1261.49*** (4.10)	1262.72*** (4.14)	
CAPIND		-580.95 (-0.65)	-1306.45 (-1.44)	66.27 (0.08)		-671.02 (-0.84)
OCCUP2		-10624.11** (-2.18)				
DUM3538	-11807.19** (-2.52)		-16940.44*** (-3.36)			
DUM3539				-15467.54*** (-3.31)	-15516.05*** (-3.37)	-20705.53*** (-4.84)
Test Breusch-Pagan (P-Value)	0.075	0.02	0.01	0.11	0.11	0.01
Test Hausman (P-Value) <sup>16</sup>		0.05	0.03			0.04
Number of observations	87	87	87	87	87	87
Method	OLS	FGLS	FGLS	OLS	OLS	FGLS

\*\*\* Significant at 1% risk; \*\* Significant at 5% risk; \* Significant at 10% risk. Figures in brackets correspond to the T-Stat.

In each of the six forms estimated by ordinary least squares (OLS) or feasible generalized least squares (FGLS), dummies differ significantly from zero, even at a 1-percent

<sup>12</sup> The fact that the correlation coefficient index is different from 1 can be explained by the use of a different deflator. This hypothesis is sustained by the fact that the correlation coefficient between these two chronicles in nominal value is near one, with a value of 0.96.

<sup>13</sup> Subscripts for the period  $t$  and the firm  $i$  do not appear in this formulation. CAPA corresponds to excess capacities variables; CONJ corresponds to economic conjuncture variables expressed in level as well as in rate of growth. DUMMIES corresponds to binary variables introduced. The econometric methodology is based on B. Dormont (1989), P. Sevestre (2002) and J. M. Wooldridge (2002). Methodological details are available on request.

<sup>14</sup> The previous historical approach conducted us to postulate a change associated with the law of October 1939. The use of *yearly* data explains that we consider two dummies in order to define an ex ante period and an ex post one.

<sup>15</sup> The same methodology is used for each sub-period.

<sup>16</sup> The use of an error component model is based on the existence of a specific effect and no correlation between the stochastic individual effect and exogenous variables introduced in the model. Practically, the previous statement corresponds to P-value (Hausman test)  $> X > P$ -value (Breusch-Pagan test), where  $X$  is a probability lower or equal to 10-percents.

risk for a majority of cases. This shows that a change exists in 1938-1939 and does not contradict the result derived from the historical approach.

Coefficient associated with OCCUP2 differs significantly from zero, which supports the previous statement. Its negative sign indicates that coal companies' profits decreased during the Occupation. We must admit that in forms 2, 3 and 6, we reject the hypothesis of a correlation between the specific effect and explanatory variables even though the probability associated with the Hausman test statistic is not very higher than the probability associated with the Breusch-Pagan test statistic. Nevertheless, even with ordinary least squares, dummies differ significantly from zero.

Moreover estimated coefficient associated with QHINDIV1 differs systematically from zero. Its positive sign does not contradict the fact that France suffered from a lack of coalmining products. An increase of domestic coal production is consumed by domestic customers so that NPC coal companies' profits increase. CAPIND is always non significant. Estimates performed on the 1935-1945 period highlight a change in 1938-1939. In the following, we consider two sub-periods around 1938-1939.

#### ■ *THE 1935-1938 SUB PERIOD*

First order serial correlation is always rejected at the 1% risk level. Estimated coefficient associated with excess production capacity CAPIND is significant and positive in each of the four specifications presented in the Table 4 below. This shows that in the 1935-1938 sub period, NPC coal firms' excess capacities permitted them to increase their profits. Following C. Davidson and R. Deneckere (1990), we can interpret this result as the sign that the strategic effect associated with excess production capacities is more important than the direct effect associated with excess production capacities (i.e. indirect effects are higher than direct effects). In other words, during this sub period, NPC coal companies want to preserve an excess production capacity in order to maintain the credibility of punishments in the event of cheating on cartel agreements. Conjuncture variables (namely IND and FONTE) have estimated coefficients that differ significantly from zero; their negative sign indicates that any increase of domestic industrial activity or any increase of melting domestic production leads to a reduction of NPC firms' profits. Such a result indicates that members of the NPC coal cartel are incited to cheat on cartel agreements when demand is high. Cheating on cartel agreements when demand is high leads cartel's members to revert to a punishment phase, so that profits are decreasing (J. Rotemberg and G. Saloner (1986)). Estimated coefficients associated with import variables (PE1 and PE2) have a negative sign when they differ significantly from zero. For a given level of domestic demand, an increase of imports leads to a price reduction, so that NPC firms' profits are reduced (direct effect). Moreover, higher imports reduce the demand obtained by NPC coal firms, so that they initiate a retaliatory phase that leads to a price reduction and a reduction of firms' profits (R.M. Feinberg (1989)). The significant and negative estimated coefficient of Lorraine coal-basin's coal production (QHLORR index) means that an increase of Eastern coal-basin's coal production corresponds to an increase of the coal supply that, for a level of demand fixed, leads to a price reduction on the domestic market as well as a decrease of NPC coal-basin's profits. The negative coefficient of the trend variable (TIME) indicates that NPC coal-basin's profits are downward slopping. The positive and significant coefficient associated with coal firms' market shares does not contradict the theory. The same remark can be done for the dummy on the size of the firm (SIZE2). A firm that have a higher market share can experience a higher market power and can obtain higher profits. Estimated coefficients associated with German and English industrial production (ALL and RU) differ significantly from zero and have a negative sign. This shows that a higher foreign industrial activity leads to a reduction of NPC coal-basin's performances.

**TABLE 4. ESTIMATIONS IN 1935-1938 (Endogenous variable: PROFIT)**

Explanatory variables	Eq. 1	Eq. 2	Eq. 3	Eq. 4	Eq. 5	Eq. 6	Eq. 7	Eq. 8
Intercept	216953.60 ** (2.57)	70126.10 ** (2.27)	81753.35 *** (3.16)	226506.88 *** (4.77)	121930.09 *** (3.02)	264935.37 ** (3.33)	124036.34 ** (2.68)	209175.58 ** (4.49)
CAPIND	2742.98 ** (2.01)		5914.51 *** (3.53)		2595.35 * (1.88)		2853.23 * (1.88)	
IND	-1497.17 ** (-2.26)							
FONTE		-130.52 ** (-2.56)	-178.48 *** (-3.73)					
DUMCA1		13109.93 (1.10)	19868.94 *** (2.70)	3994.52 (0.36)				5409.75 (0.477)
SIZE2		38158.13 * (2.03)	23452.34 (1.77)					
SIZE1				-217.12 (-0.03)			-3107.42 (-0.439)	
TIME				-8198.08 *** (-2.97)				
QHLORR								-1446.19 ** (-2.22)
ALL					-650.29 ** (-2.26)		-642.48 ** (-2.21)	
RU						-1865.42 ** (-3.15)		
QHINDIV						542.81 (0.811)		
PE1							-13248.66 (-0.151)	-198367.21 ** (-2.56)
PE2				-276464.12 * (-2.02)	-21227.73 (-0.137)			
Test Breusch-Pagan (P-Value)	0.265	0.021	0.520	0.058	0.282	0.087	0.311	0.046
Test Hausman (P-Value)		0.854		0.916		0.670		0.768
Number of observations	33	15	15	15	33	33	33	15
Method	OLS	FGLS	OLS	FGLS	OLS	FGLS	OLS	FGLS

\*\*\* Significant at 1% risk; \*\* Significant at 5% risk; \* Significant at 10% risk. Figures in brackets correspond to the T-Stat.

### ■ THE 1939-1945 SUB PERIOD

First order serial correlation is always rejected at the 1% risk level. To interpret correctly the estimations, it is fundamental to consider the transformation in October, 1940 of the cartel NPC in a structure of centralized sale. This change is very important because the institution of a structure of centralized sale leads the companies to lose their capacity to sell by themselves their production. Particularly the companies of coal were not capable any more of reducing their prices. The system of centralized sale prevented the firms from cheating on collusive agreements. Therefore, the punishment mechanism was obsolete. In this context, estimates can not be interpreted in terms of stability or instability of the explicit collusive structure, because the cartel has been replaced by a central selling agency. We do not base our interpretation of excess capacity variable and of demand variable on theoretical models used previously.

Coefficient associated with excess capacity CAPIND is significant and negative in formulations 5 and 6. It appears then that during the period, individual excess production capacities lowered firm's profits. During the 1939-1945 sub-period, the excess capacities which could appear were not voluntary and resulted from an supply superior to the demand<sup>17</sup>. A similar interpretation can be done for the NPC coal-basin's excess capacity variable (CAPAH2). Estimated coefficients associated to conjuncture variables (IND and FONTE) differ significantly from zero and are positive so that a reduction of the domestic industrial activity as well as the domestic melting production leads to a reduction of coal companies' profits. Variables on change of economic conjuncture (VIND and VFONTE) are both significant and positive: a reduction of economic activity or melting production leads to a reduction of coal firms' gains. Imports variable (PE1<sup>18</sup>) has a positive sign. An imports increase leads, for a level of demand unchanged, to higher profits. This result is opposed to the one that we should obtain in a competitive regime and can be considered as the signal that NPC coal firms operate from 1939 to 1945 in another regime, namely in the state-controlled regime<sup>19</sup>.

The positive sign of the individual coal production index (QHINDIV1) is due to an important coal deficit. Due to the lack of coal product in France, an increase of coal production, for a given level of coal domestic demand, does not imply any price reduction on the domestic market<sup>20</sup>. Any coal supply increase meets demand, without price reduction, which increase coal firms' profits. Interpretation of estimated coefficients associated to QHLORR, ALL, RU, TIME and SIZE1 indexes is similar to the one developed in the previous sub period.

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<sup>17</sup> If we take into account the deficit of coal in 1939-1945, excess capacities could only be exceptional.

<sup>18</sup> By construction, PE1 and PE2 indexes are similar on the 1940-1945 sub period. Therefore, we do not have to distinguish PE1 from PE2.

<sup>19</sup> Besides, we have to keep in the spirit that for this sub period, the method used to construct the index is not based on a direct observation of imported products, but on an indirect approach, so that the accuracy of the measure is not exempt of critics. Notice that the mean of imports index during the Second World War corresponds to less than 15 percents of its level from 1935 to 1938. This tremendous reduction is due to the interruption of German and English coal exports towards France during the conflict.

The existence of a control on imports during the sub period considered explains that there could be no causal relationship between imports and firms' profits. In other words, there could be no causal relationship between these two variables even if they move in the same direction. Due to the lack of data, we are not able to perform Granger causality tests.

<sup>20</sup> This lack of correlation can also be explained by the fact that during this sub period, prices are not fixed through a competitive mechanism, but by the administrative way.

**TABLE 5. ESTIMATIONS IN 1939-1945 (Endogenous variable: PROFIT)**

Explanatory variables	Eq. 1	Eq. 2	Eq. 3	Eq. 4	Eq. 5	Eq. 6	Eq. 7	Eq. 8	Eq. 9
Intercept	21139.03 <sup>***</sup> (4.34)	35006.37 <sup>***</sup> (5.89)	-2582.50 (-0.31)	209659.97 <sup>***</sup> (7.50)	-28121.21 <sup>***</sup> (-2.76)	173178.96 <sup>***</sup> (4.46)	73779.99 <sup>***</sup> (2.62)	47759.84 (1.72)	208936.63 <sup>***</sup> (4.79)
QHINDIV1								1410.49 <sup>**</sup> (2.21)	
CAPIND	-513.02 (0.43)		-1309.40 (-1.49)		-1286.21 <sup>*</sup> (-1.63)	-1751.49 <sup>*</sup> (-1.78)			
CAPAH1									127.05 (1.21)
CAPAH2		-246.42 <sup>***</sup> (-3.10)						-486.70 <sup>*</sup> (-2.05)	
FONTE			84.72 <sup>***</sup> (5.02)				95.19 <sup>***</sup> (5.99)		
IND					594.22 <sup>***</sup> (6.48)				
VIND				33862.29 <sup>*</sup> (1.81)					
VFONTE									32366.29 <sup>***</sup> (4.51)
QHLORR								-874.14 <sup>**</sup> (-2.16)	
ALL							-482.12 <sup>***</sup> (-2.97)		-1020.86 <sup>***</sup> (-4.06)
RU						-984.53 <sup>***</sup> (-3.99)			
SIZE1						15767.95 <sup>***</sup> (2.76)			
TIME				-7980.82 <sup>***</sup> (-6.53)					
PE1	72883.28 <sup>***</sup> (-2.85)	36216.15 (1.41)							
Test Breusch-Pagan (P-Value)	0.159	0.122	0.037	0.063	0.029	0.483	0.041	0.932	0.063
Test Hausman (P-Value)			0.115	0.234	0.076		0.955		0.519
Number of observations	54	54	54	54	54	54	54	23	54
Method	OLS	OLS	FGLS	FGLS	FGLS	OLS	FGLS	OLS	FGLS

<sup>\*\*\*</sup> Significant at 1% risk; <sup>\*\*</sup> Significant at 5% risk; <sup>\*</sup> Significant at 10% risk. Figures in brackets correspond to the T-Stat.

## ■ COMPARAISON OF THE RESULTS

The main results of estimates are considered in the following table<sup>21</sup>:

**TABLE 6. COMPARAISON OF SIGNS OF THE ESTIMATED COEFFICIENTS**

VARIABLE	1935-1938	1939-1945
SIZE1	ns	+
SIZE2	+	
IND	-	+
FONTE	-	+
PE1	-	+
PE2	-	+
CAPIND	+	-
CAPAH2		-

An estimated coefficient that does not differ significantly from zero appears with “ns”.

The effect of the structural variable (SIZE) on NPC coal firms’ yearly profits is positive in both sub periods, which does not contradict the theory<sup>22</sup>. By taking into account conjuncture indexes (IND and FONTE), we can differentiate one sub period from the other one. In 1935-1938, a high coal demand, explained by a high industrial production, conduces NPC cartel’s members to cheat on collusive agreements, that leads to a reduction of the market price and a reduction of individual profits. Inverted signs in 1939-1945 can be explained by the fact that companies do not operate inside a cartel but a central selling agency. In the second sub period, firms do not control commercial activities; therefore they can’t cheat on cartel agreements when demand is high. For a lower industrial production, coal demand is reduced and coal companies’ profits are lowered.

Conjuncture variables highlight a change. More precisely, import indexes (PE1 and PE2) have negative signs in the first sub period which does not contradict the hypothesis that NPC firms operate inside a competitive regime. In the second sub period, signs are inverted and contradict the hypothesis of a competitive regime<sup>23</sup>. Moreover, individual excess capacity index (CAPIND) has a negative sign in the second sub period. The positive sign obtained in the first sub period signals the existence of a strategic effect, that permits firms to price over their marginal cost. The negative sign in the following period indicates a change in NPC coal-basin’ strategic behaviour<sup>24</sup>. As previously mentioned, NPC companies operate inside a central selling agency during the second sub period so that they have lost their ability to sell by themselves their product. In this context, the preservation of a positive excess capacity is useless. Excess capacities are involuntary and have a negative impact on individual profits.

## 6. CONCLUSION

Through this analysis, we have highlighted a change in NPC coal firms’ strategic behaviour, following the law on war-economy. The existence of a competitive regime until 1938 has been established, in spite of the set up of a control on coal prices by the laws of August 18<sup>th</sup> and 19<sup>th</sup> 1936<sup>25</sup>. Through the results presented here, this work underlines the

<sup>21</sup> We only consider the main variables. Nevertheless, we can notice that estimated coefficients associated to ALL, RU and QHLORR indexes, not introduced in this table, are systematically negative in both sub periods.

<sup>22</sup> Notice that from one sub period to the next one, the critical size (i.e. the size from which a firm has an impact on the profit) increases: in the first sub period, the significant index is SIZE2 which corresponds to a 5-percents market share whereas in the second sub period, the significant index is SIZE1 which corresponds to a 8.5-percents market share.

<sup>23</sup> In a competitive regime, higher imports imply a higher supply on the domestic market, which, for a given level of demand, leads to a reduction of the domestic price as well as a reduction of domestic firms’ profits.

<sup>24</sup> The negative sign obtained for the CAPIND index in the second sub period is not contradicted by the negative sign associated to the CAPAH2 index. The low correlation between NPC coal-basin’s excess production capacity (CAPAH1 and CAPAH2) and the explained variable (PROFIT) in the 1935-1938 sub period explains that we have not been able to introduce these variables in the econometric model.

<sup>25</sup> It appears then that the economic approach has permitted us to mitigate the historical one.

interest of the combination of a historic approach with an economic approach. We have analysed on which degree periods defined through historical facts could be sustained by an analysis of NPC companies' strategic behaviour. In other words, we tried to justify through our econometric approach periods defined ad hoc by the historical approach. The results presented here must be considered with caution for two main reasons: (i) our estimates have been performed with an unbalanced panel data sample and (ii) during the period studied, there were no precise standard concerning the balance-sheets. Besides, the estimated equations do not include lagged variables. This element must be mentioned given the importance of inertia in extractive industries such as the coal industry. In these industrial sectors, past variables have probably an effect on the current performances of firms<sup>26</sup>.

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<sup>26</sup> If the influence of a past variable is shorter than one year, then the non-introduction of lagged variables in the model should not modify the estimations because of the annual panel data set used. Conversely, if this influence is longer or equal to one year, then it should be important to introduce these lagged variables in the model. Nevertheless, such an approach seems technically difficult to perform, due to the fact that our panel data set is unbalanced.

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**ANNEX: CORRELATION MATRIX**

**TABLE 7. CORRELATION MATRIX IN 1935-1945**

	PROFIT	CAPIND	TIME	QHINDIV1	WAR	PE1	PE2	DUM3538	DUM3539	DUMCA1	RU	ALL	TIME	FONTE	IND	VIND
PROFIT	1.00															
CAPIND	0.12	1.00														
TIME	-0.76	-0.25	1.00													
QHINDIV1	0.47	0.01	-0.38	1.00												
WAR	-0.56	-0.33	0.81	-0.23	1.00											
PE1	0.63	0.16	-0.85	0.35	-0.82	1.00										
PE2	0.61	0.21	-0.84	0.33	-0.85	0.99	1.00									
DUM3538	-0.56	-0.33	0.81	-0.23	1.00	-0.82	-0.85	1.00								
DUM3539	-0.65	-0.11	0.86	-0.37	0.79	-0.99	-0.97	0.79	1.00							
DUMCA1	0.01	-0.26	-0.10	-0.08	-0.14	0.15	0.13	-0.14	-0.15	1.00						
RU	-0.73	-0.24	0.89	-0.29	0.79	-0.93	-0.92	0.79	0.93	0.00	1.00					
ALL	-0.62	-0.08	0.59	-0.14	0.72	-0.65	-0.68	0.72	0.63	0.05	0.78	1.00				
TIME	-0.76	-0.25	1.00	-0.38	0.81	-0.85	-0.84	0.81	0.86	-0.10	0.89	0.59	1.00			
FONTE	0.56	0.13	-0.80	0.42	-0.55	0.81	0.80	-0.55	-0.80	0.17	-0.71	-0.25	-0.80	1.00		
IND	0.68	0.11	-0.87	0.41	-0.61	0.87	0.85	-0.61	-0.88	0.02	-0.87	-0.47	-0.87	0.88	1.00	
VIND	0.37	-0.27	-0.30	0.22	-0.45	0.67	0.66	-0.45	-0.66	0.13	-0.57	-0.64	-0.30	0.41	0.43	1.00

**TABLE 8. CORRELATION MATRIX IN 1935-1938**

	PROFIT	IND	QHNPC	QHLORR	RDT1	RU	ALL	TIME	QHINDIV	CAPIND	PARTIND	PE1	PE2	VIND	SIZE1	SIZE2	VFONTE	FONTE	DUMCA1
PROFIT	1.00																		
IND	-0.66	1.00																	
QHNPC	0.52	-0.80	1.00																
QHLORR	-0.51	0.79	-0.32	1.00															
RDT1	0.54	-0.84	0.40	-1.00	1.00														
RU	-0.65	0.98	-0.68	0.82	-0.86	1.00													
ALL	-0.61	0.91	-0.50	0.89	-0.91	0.97	1.00												
TIME	-0.61	0.92	-0.51	0.91	-0.94	0.97	1.00	1.00											
QHINDIV	0.31	0.06	-0.08	0.03	-0.03	0.05	0.03	0.03	1.00										
CAPIND	0.42	0.07	-0.26	-0.09	0.07	0.00	-0.08	-0.07	0.46	1.00									
PARTIND	0.24	0.15	-0.22	0.05	-0.06	0.12	0.07	0.08	0.99	0.50	1.00								
PE1	-0.39	0.62	-0.96	0.13	-0.21	0.46	0.25	0.28	0.08	0.31	0.22	1.00							
PE2	-0.40	0.63	-0.96	0.15	-0.22	0.47	0.26	0.29	0.08	0.31	0.22	1.00	1.00						
VIND	-0.33	0.48	-0.84	-0.16	0.08	0.39	0.19	0.17	0.06	0.25	0.18	0.83	0.83	1.00					
SIZE1	-0.30	0.23	-0.26	0.07	-0.09	0.22	0.18	0.17	0.58	-0.12	0.60	0.22	0.22	0.27	1.00				
SIZE2	0.37	-0.19	-0.04	-0.33	0.32	-0.24	-0.30	-0.30	0.75	0.34	0.74	0.12	0.12	0.17	0.33	1.00			
VFONTE	0.06	-0.08	-0.53	-0.62	0.56	-0.23	-0.44	-0.44	0.05	0.31	0.14	0.69	0.68	0.77	0.13	0.34	1.00		
FONTE	-0.35	0.56	-0.94	0.05	-0.12	0.40	0.18	0.21	0.08	0.32	0.22	1.00	1.00	0.86	0.22	0.15	0.75	1.00	
DUMCA1	0.10	0.01	-0.08	-0.05	0.05	-0.02	-0.04	-0.04	-0.25	-0.38	-0.25	0.10	0.10	0.09	-0.29	-0.19	0.12	0.10	1.00

**TABLE 9. CORRELATION MATRIX IN 1939-1945**

	PROFIT	IND	QHNPC	QHLORR	CAPAH1	CAPAH2	RU	ALL	TIME	QHINDIV1	CAPIND	PE1	PE2	VIND	SIZE1	SIZE2	VFONTE	FONTE	DUMCA1
PROFIT	1.00																		
IND	0.95	1.00																	
QHNPC	0.94	0.99	1.00																
QHLORR	0.78	0.84	0.86	1.00															
CAPAH1	0.57	0.56	0.51	0.02	1.00														
CAPAH2	0.57	0.62	0.66	0.32	0.62	1.00													
RU	0.89	0.95	0.97	0.77	0.56	0.82	1.00												
ALL	0.93	0.99	0.99	0.80	0.59	0.74	0.99	1.00											
TIME	0.87	0.93	0.96	0.78	0.52	0.83	1.00	0.98	1.00										
QHINDIV1	0.96	0.95	0.95	0.83	0.48	0.61	0.92	0.94	0.91	1.00									
CAPIND	0.56	0.53	0.49	0.02	0.95	0.59	0.54	0.56	0.50	0.50	1.00								
PE1	0.75	0.80	0.79	0.94	0.05	0.07	0.63	0.71	0.61	0.76	0.05	1.00							
PE2	0.83	0.88	0.87	0.96	0.16	0.22	0.74	0.81	0.73	0.84	0.15	0.99	1.00						
VIND	-0.19	-0.15	-0.08	0.40	-0.89	-0.30	-0.13	-0.16	-0.08	-0.06	-0.85	0.28	0.21	1.00					
SIZE1	0.75	0.72	0.73	0.62	0.38	0.53	0.73	0.73	0.72	0.82	0.43	0.54	0.61	-0.05	1.00				
SIZE2	0.88	0.85	0.87	0.72	0.47	0.67	0.87	0.87	0.87	0.94	0.52	0.61	0.70	-0.09	0.84	1.00			
VFONTE	-0.31	-0.36	-0.44	-0.25	-0.25	-0.90	-0.63	-0.51	-0.67	-0.41	-0.24	0.08	-0.05	-0.05	-0.39	-0.50	1.00		
FONTE	0.93	0.97	0.95	0.83	0.54	0.43	0.85	0.92	0.82	0.91	0.51	0.86	0.92	-0.18	0.67	0.78	-0.13	1.00	
DUMCA1	0.47	0.59	0.61	0.72	0.00	0.20	0.53	0.56	0.53	0.53	0.00	0.68	0.69	0.29	0.38	0.47	-0.15	0.59	1.00