INDUSTRY PERFORMANCE UNDER TRANSITIONAL INSTITUTIONS: THE CASE OF UKRAINIAN FERROUS METAL INDUSTRY

By

Yegor Grygorenko

A thesis submitted in partial
fulfillment of the requirements for the
degree of

Master of Arts in Economics

Economic Education and Research
Consortium

2001

Approved by _____
Chairperson of Supervisory Committee

_____

_____

_____

Program Authorized
to Offer Degree _____

Date _____

Economic Education and Research
Consortium

Abstract

INDUSTRY PERFORMANCE UNDER TRANSITIONAL INSTITUTIONS: THE CASE OF UKRAINIAN FERROUS METAL INDUSTRY

by Yegor Grygorenko

Chairperson of the Supervisory Committee: Professor _____

The importance of the ferrous metal industry to the Ukrainian economy as a whole may hardly be overstated: the sector produces almost 20% of the nation's gross domestic product, employs more than 500 thousand workers, and accounts for nearly half of all hard currency revenues in the economy. At the same time, the industry is far from being on its equilibrium growth path. The opening part of the following paper is devoted to a fairly concise description of the present state of the Ukrainian ferrous metal industry and a demonstration of several disparities between the current situation and a potential market-ruled efficient equilibrium.

In particular, empirical evidence suggests that the industry is characterized by extremely low capacity utilization rates. The paper then employs econometric analysis to show that the ferrous metal industry fails, in general, to achieve efficient levels of output, which implies that capacity underutilization is not the first-best solution in the given circumstances.

A natural question, then, is what are the causes for such a disequilibrium situation. The paper seeks for an explanation within the framework of the property rights approach, developed by Grossman, Hart and Moore (GHM). The problem of excessive capacities is regarded as a consequence of underinvestment. Versions of the GHM model are presented then to analyze

what could be the causes and effects of such underinvestment. A solution to the problem is then proposed via introduction of the third party into a specific relationship between primary producing firms. The paper proceeds then with econometric evaluation of the validity of the suggested hypothesis. Finally, an attempt is made to summarize the findings of the analytical research described above and to develop some policy suggestions.

TABLE OF CONTENTS

ACKNOWLEDGMENTS

The author would like to express sincere gratitude to Prof. Charles Steele. His insightful lectures on institutional economics inspired, to some extent, the very topic of the present work, while his advice was invaluable help in writing it. I would also like to thank Prof. Fedir Kushnirsky and Prof. Roy Gardner for their helpful comments. I am very grateful to corporate bank employees of Citibank (Ukraine) — working with them helped me in developing the idea of this thesis. Special thanks go to Yuri Gorodnichenko, the best economist among my best friends. Finally, I reserve my warmest words for my wife.

Chapter 1

INTRODUCTION

The Ukrainian ferrous metal industry represents a huge and mature complex that comprises iron and manganese ore mining and dressing; coke, pipes, steel and ferroalloy manufacturing; and metal scrap conversion. The contribution of this sector to the national gross domestic product is as large as 19%, and its share in total industrial output is equal to 23.9%. The industry employs 540 thousand workers (6.5% of the total employed labor force)[1]. Furthermore, ferrous metal industry is also the largest exporter in the economy — almost half of the nation's hard currency revenues (47%)[2] originate from this sector.

Clearly, one may see from these figures that the ferrous metal industry is of exceptional importance to the overall performance of the Ukrainian economy. A standard structure-conduct-performance (SCP) research could then reveal some general trends in the industry, unveil basic structural links within it, and possibly uncover channels through which it influences other sectors of the economy. Potential practical implications of such an analysis are quite obvious. This alone could suffice our interest in this field.

However, this is by far not the only motive behind the present work. In fact, this research is not intended to be conducted in the standard SCP framework. What seems more analytically interesting is that the Ukrainian ferrous metal industry provides a rich and challenging field for *theoretical* research. The reasons for that are quite simple: the industry is functioning in a very special transitional environment and is characterized by a specific set of institutional arrangements, not typical for Western economies. This different institutional

[1] The figures given are from the official reports by the State Committee of Statistics.

[2] October, 2000; estimate of the National Bank of Ukraine (cited in *Ukrainian News* issues).

setup results all too often in outcomes that do not seem quite compliant with predictions of the standard microeconomic theory. A more detailed description of the industry will clarify the point.

The core of the Ukrainian ferrous metal industry is the steel industry that is a major source of the nation's hard currency revenues. Key companies of the segment are[3]:

Kryvorizhstal — the player with the greatest market power in the market, holding almost quarter of it;

Mariupol Metal Works (20%), *Azovstal* (16%), *Zaporizhstal* (12%), *Alchevsk* Metal Works (10%), and *Dniprovskyi* Metal Works (8%) — dominant players in the market;

Donetsk Metal Plant, *Yenakiyeve* Metal Plant, and *Dnipropetrovskyi* Metal Plant — small players that still derive considerable revenues and are among the top hundred enterprises of Ukraine ranked by revenues.

The leader in electric steel manufacturing and production of stainless steel is *Dniprospetsstal* that holds 77.5% and 40.3% respectively in these special markets.

This segment of manufacturing has a long history in Ukraine, rooted back in the dawn of Soviet era. The "industrial revolution" of early 1930s, initiated by Stalin and aimed at creation of an impressive military potential as soon as possible, brought to life giant metallurgical integrated plants. Though successors of Stalin were persons of a much smaller scale and never attempted to realize his Napoleonic plans for conquering the world, they still cherished the steel industry as a cradle of the Soviet military power.

With the collapse of the USSR and break-up of the centralized economy, Ukrainian steel working enterprises found themselves in a strange situation. For almost 60 years they had been the hen laying golden eggs every day and

[3] Figures in parentheses indicate market shares. They are calculated on the basis of *Investgazeta Top'100* Rating (June 2000), State Property Fund of Ukraine reports, and data from the *Ukrainian News* issues.

enjoying the kind attitude of the grateful master. But one morning it suddenly became clear that the master would never come again to take the eggs and feed his precious pet, the eggs themselves were not golden anymore, and the hen is not so special at all — there is a large market out there, where dozens of hens compete for customers.

What was a blessing before, became a curse then: the Ukrainian steel industry has enormous installed capacities that rank 5th in the world after Japan, US, China, and Russia, but cannot find sufficient demand for its products. The structure of capacities is given below (maximum per annum output)[4]:

- pig iron — 45 million ton (51%);
- steel — 45 million ton (60%);
- rolled products — 34 million ton (56%);
- tubes — 7.3 million ton (17%).

Figures in parentheses indicate respective capacity utilization rates (as of July 2000). It should be intuitively clear that the overall rate of capacity utilization for the industry is well below normal cost-minimizing levels (empirical evidence for this will be presented in the second chapter of this paper). Furthermore, technology employed in the production process is largely outmoded, and capacities are in most cases antiquated and overly aged. This drives the average cost of production even higher.

Generally, the situation described above is a good example of the inefficient resource allocation: capital, labor, and technology are utilized in proportions incompatible with profit-maximization. Modern microeconomic theory suggests that such an allocation cannot be self-sustaining in the long run

[4] Figures are calculated on the basis of reports of the State Property Fund of Ukraine (available on-line at www.spfu.gov.ua).

under normal market conditions[5]. The "long run" need not be really long here: evidence from industrialized Western economies (Germany, Japan, US, South-East Asian countries) suggests that 3-7 years is quite enough for the steel industry to adjust to technology shocks or adverse changes in market demand patterns[6]. Yet, Ukrainian integrated steel plants still operate with huge excessive capacities and some minor signs of fundamental changes have appeared only in the late 1999 (capacity restructuring programs or shutdown of some major plants).

What could possibly preserve such an inefficient "equilibrium"? A mix of factors, we think, all of them being more or less related to the specific Ukrainian institutional setup. This "specificity" in no way should be attributed to special mental or cultural background of Ukrainian entrepreneurs that makes them "irrational" agents — a usual excuse of many government officials and a common trick of some policy makers to hide their incompetence or poor education — Ukrainian businesses are no less rational than their counterparts in any other part of the world. However, the environment they work in places certain binding constraints on their ability to implement first-best rational decisions and changes their incentives.

The main hypothesis of the paper is that these constraints are related to the existing property rights distribution. Through the assignment of residual control rights, such distribution creates a certain pattern of investment incentives that may be different from the first best optimality conditions. The idea, as well as the formal model, derives from the works of Grossman, Hart,

---

[5] By "normal market conditions" we do not mean here free competition or any other particular market structure. In our view, the only necessary and sufficient conditions for self-liquidation of the mentioned misallocation are:

a) rational profit-maximizing agents (firms, in our case);

b) absence of external deterrents that forcibly prevent firms from implementing their profit-maximizing decisions.

[6] Supporting evidence may be found in Hatch Beddows (2000).

and Moore (Grossman and Hart (1986), Hart and Moore (1990), Hart (1995)).

The structure of the thesis is as follows. In chapter 2 the econometric evaluation of the industry performance is conducted. This analysis suggests that over the 1990s the Ukrainian ferrous metal industry demonstrated systematic deviations from the first best long run equilibrium. Chapter 3 presents the standard GHM framework and develops a hypothesis about optimal ownership structure that might move the industry to the first best equilibrium. A brief discussion of main practical implications is also provided there. Chapter 4 contains an attempt at testing the hypothesis formulated in Chapter 3. The paper concludes with some general comments and deductions from the research conducted.

To sum up, the main message of the paper is that institutional arrangements of the transitional Ukrainian economy place serious binding constraints on the ability of agents to choose first best decisions and implement them. Consequently, these constraints have a substantial impact on operating performance of the Ukrainian steel industry and largely determine its long-run growth path.

The purpose of the work then is to:

– document these discrepancies between an actual stance of the industry and theoretical projections — at least some of them, as any attempt at completeness would require volumes;

– provide some theoretically plausible explanations for observed phenomena and try to develop a more or less formal model on the basis of these potential explanations;

– finally, attempt to test the validity of the constructed model.

Though simple it may sound at first, the research outlined above seems to the author to be quite a challenging task. Several potential difficulties that one may envision at the moment are:

– absence of a uniform methodological approach to incorporating institutional factors in the formal microeconomic models;

– complete deficiency of similar research in Ukraine — presently, local economists and international experts mostly limit themselves in this area to descriptive industry studies (at best, with some elements of econometric analysis) or entirely verbal opuses of a normative nature;

– limited availability and poor reliability of the necessary data at the micro level.

Overcoming these difficulties may appear to be a challenging task, but, in opinion of the author, such challenge itself is the best possible motivation: *laetius est, quoties magno sibi constat honestum.*

Chapter 2

PERFORMANCE ANALYSIS

Our research will begin with the performance evaluation of the Ukrainian ferrous metal industry. This will be mostly an exercise in econometrics aimed at demonstrating that the problem of excessive capacities has indeed been present in this segment of manufacturing. A hypothesized explanation for the problem and potential solutions to it will be offered in the next chapters.

We have chosen mark-up (Lerner index)[7] as the measure of performance in this work. Calculating mark-up is quite a challenging task, but it may provide us with valuable information about efficiency of the firms' operating behavior. This section is devoted exactly to such evaluation. As intermediate tools, we use our estimations of the industry cost function, and market supply and demand functions. Then we proceed immediately with mark-up analysis.

2.1. Cost function for the ferrous metal industry

The cost function is a very valuable tool for analysis of an industry since it provides us with explicit estimates of cost curves, in particular, average total cost (*ATC*). Having estimated the average cost function, we are able to calculate a few key characteristics of an industry, e.g. minimum efficiency scale. From the ATC function we can derive the marginal cost (MC) function necessary for estimation of a mark-up and efficient output level. However, estimation of the ATC function is cumbersome because statistical data at the enterprise level are difficult to find. Moreover, estimation of a cost function

[7] Here, as usual, mark-up is defined as $(p - MC)/p$, where p stands for price and MC — for marginal cost. This index has been introduced as a measure of monopoly power in Lerner (1934). Starting from the works of Bain (1951, 1956), this index has received a wider interpretation. In particular, Carlton and Perloff (2000) explicitly define it as a measure of performance, i.e. of "the success of a market in producing benefits for consumers".

on the basis of a single firm could be inappropriate since we would obtain not the industry specific cost function but a firm specific cost function.

Fortunately, we have panel data that enables us to combine industry and firm specifics[8]. We have output of 10 steel producing integrated plants, major players in the industry. In the time dimension we have observations for 1998 and 1999. In addition to output data, we have data on total costs of enterprises calculated as total revenues less net profit[9]. Dividing total cost by output we get average total cost. Thus, we have average total costs and output for 10 enterprise for 1998 and 1999.

To eliminate price level effects, we divide prices of 1999 by an index of steel prices. As a result we measure all costs in 1998 prices. To take into account possible difference in the economic environment, we introduce a dummy variable for 1998.

Having discussed data, let us turn to the specification issues. The panel data estimation has some advantages for estimation of cost functions. In particular, we can eliminate potential bias in estimates by taking into account effects of time invariant omitted (unobserved) variables such as quality of management and technology peculiarities. We assume a cubic total cost function[10] and estimate the corresponding average cost function. The specification is then

$$AC_{it} = \alpha_i + \beta_1 Q_{it}^{-1} + \beta_2 Q_{it} + \beta_3 Q_{it}^2 + \lambda Dummy98 + \varepsilon_{it},$$

where

---

8 This data set has been published in *Investgazeta Top'100* Rating (June 2000). It originates from the State Property Fund of Ukraine and State Stock Market and Securities Commission.

9 Available from the same source.

10 This assumption is easy to justify. Polynomial functional form provides a sufficiently good approximation for *any* continuous and continuously differentiable function (Taylor series expansion). Terms of order higher than three appeared to be statistically insignificant. Hence cubic total cost. It is worth noting that cubic total cost may provide us with concave marginal cost function, which is highly desirable — such a functional form would capture the variation in scale effect for different volumes of production. So, we have another pro for cubic total cost.

i indexes firms and *t* indexes time periods, and variables are defined as follows:
AC — average cost,
Q — annual output volume,
Dummy98 — dummy that takes value "1" for year 1998, "0" otherwise (supposed to capture the effect of exogenous macroshocks).

Applying random effects panel data estimation (the Hausman test fails to reject the null hypothesis of inconsistency of the random effect estimator), we obtained the results shown in Table 2.1.

As one may see, the regression explains variation in average total cost quite well. About 85% of variation is described by variation in the level of output. For sufficiently high output level we observe declining average cost. Up to 3.5 million MT, average cost declines. After this point it starts rising. Thus, we may conclude that minimum efficiency scale is somewhere around this

TABLE 2.1[11]

AVERAGE COST FUNCTION ESTIMATION

VARIABLE	COEFFICIENT	T-STATISTIC
Constant term	0.815	(6.01)
Q_{it}^{-1}	-171792.3	(-2.52)
Q_{it}	$-1.99 \cdot 10^{-7}$	(-2.94)
Q_{it}^{2}	$2.53 \cdot 10^{-14}$	(2.87)
Dummy98	0.1294	(7.38)

$R^2 = 0.852$

F – statistic = 18.772

[11] In this regression, as well as throughout the rest of the text, *Q* is measured in millions of metric tons (MT).

volume. It is worth noting that according to estimates made in McKinsey Report (1999) minimum efficiency scale in the Russian ferrous metal industry is approximately 3 million MT — an inspiring fact, given that Russian integrated steel plants are quite close in technology and scale to their Ukrainian counterparts.

From the above formula, we can derive the marginal cost function. To be specific we should multiply ATC by output and take the derivative from the product with respect to quantity:

$$MC_{it} = 0.815 - 3.98 \cdot 10^{-7} Q_{it} + 7.59 \cdot 10^{-14} Q_{it}^2 .$$

The marginal cost function is a simple quadratic function. Marginal cost declines until roughly 2.62 million MT and then it increases. Average output of Ukrainian metal works is approximately 3.043 million MT per year. Therefore, we can infer that Ukrainian firms are operating at the increasing marginal cost segment of the cost function, but still below minimum efficiency scale — that is, on the declining portion of the average cost function.

2.2. Estimation of demand and supply functions

2.2.1. Demand function

Demand for output of the Ukrainian ferrous metal industry is of interest to us since its own price elasticity is required to evaluate mark-up indirectly (see below for details). We also estimate supply function, but only as a part of the general simultaneous equations model[12]. It has no *per se* value for the present research. However, the results of the estimation are presented below in order to provide additional empirical evidence in favor of the whole model.

[12] The list of instruments along with the test of their quality is presented in APPENDIX 1. Hausman specification test, contained therewith, suggests that the simultaneous equation model is weakly preferable to the OLS estimator.

Let us now turn to the demand function. From the available statistics we know that major consumers of Ukrainian steel are foreign customers in the US, European Union and Asia. Less than 10% of steel is consumed in Ukraine. Consequently, we should concentrate our analysis on demand from abroad. Unfortunately, aggregated time series on global steel price is not available. We should find a proxy which correlates highly with the global steel price, and at the same time is readily available and reliably measured. The US steel price appears to be a perfect candidate for such a proxy since the US market is highly integrated into the world economy and quarterly statistics are reliable and can be easily obtained. Hence, we will apply US steel prices for our econometric analysis. Other factors that can affect demand are prices of substitutes and level of economic activity. *Ceteris paribus*, a higher price of substitutes for steel will induce higher consumption of steel. Although there are no perfect substitutes for steel, we can suggest that plastics and non-ferrous metals can to some extent be considered as such. Because plastics are not widely traded, we apply only non-ferrous metals' price[13]. Since Ukrainian exporters are concerned with the real effective price in UAH we pre-multiply US steel price by the official exchange rate and divide by the GDP deflator. The same approach is applied to the price of non-ferrous metals.

Changes in economic activity may be approximated by real GDP of European Union or the USA (we take the former variable). Apparently, this measure of economic activity in a global scope is not ideal. However, we believe that the suggested proxy consistently captures the dynamics of the world economy. To completely characterize specifics of the demand we use real output of the Ukrainian machine building industry as a proxy for internal demand for steel.

[13] Quarterly time series for the US steel price and the US prices for non-ferrous metals are aggregated multiproduct series taken at www.economagic.com.

From the technical point of view we should also use tools that allow for partial adjustment of demand to changes in exogenous factors. Therefore, we introduce lagged demand into the regression.

Obviously we should use a two-stage least squares method to eliminate the endogeneity problem. Instruments should correlate with endogenous variable and at the same time should be uncorrelated with the error term. We believe that average wage in Ukraine, UAH/$ exchange rate, real GDP of foreign countries, Ukraine's manufacturing output and some other factors listed in the regression output are appropriate instruments[14].

Summing up, we present the specification below.

$$\log(Q_t) = \alpha_0 + \alpha_1 \log(Q_{(t-1)}) + \alpha_2 \log(Q_{(t-2)}) + \alpha_3 \log(MBOUT_t) +$$
$$+ \alpha_4 \log(\frac{P_t \cdot ER_t}{GDPDEF_t}) + \alpha_5 \log(\frac{P_t^{NF} \cdot ER_t}{GDPDEF_t}) + \alpha_6 \log(EURGDP_t) + \varepsilon_t,$$

where

i indexes firms and *t* indexes time periods, and variables are the following:
Q — quarterly output volume,
MBOUT — Ukrainian machine building output (quarterly),
P — the US price of steel products (product group weighted average),
P^{NF} — the US price of non-ferrous metals (product group weighted average),
ER — UAH/$ exchange rate,
GDPDEF — GDP deflator,
EURGDP — real GDP of the European Union.

Results of the statistical estimation are presented in Table 2.2. Generally, obtained estimates are consistent with *a priori* expectations. The cross-price elasticity with respect to non-ferrous metals has correct sign and plausible magnitude. It is statistically significantly different from zero. In particular, a 1% increase in non-ferrous metals price results in a 1.8% increase in steel consumption. This seems realistic enough, since steel is believed to be a highly procyclical product. Elasticity of demand with respect to the EU real GDP seems to be insignificantly different from zero. Partial adjustment

[14] Again, all these series are quarterly.

appears to explain variation in demand. Coefficients of lagged demand are not simultaneously equal to zero at any reasonable level of significance. Estimated own price elasticity, which is of the greatest importance to us, is roughly equal to -2.

In terms of econometrics the regression seems to be correctly specified and estimated. In particular, the Breusch-Godfrey LM test does not reject the null hypothesis of no autocorrelation. The RESET test suggests that specification of the model is correct (*p*-value of the RESET far exceeds critical 10%).

The White heteroscedasticity test does not reject the null hypothesis of homoscedasticity of the error term. Consequently, in terms of econometrics the regression is adequate.

TABLE 2.2

DEMAND FUNCTION ESTIMATION

(dependent variable is log (Q_t))

VARIABLE	COEFFICIENT	T-STATISTIC
Constant term	-5.144	(-1.430)
log (Q_{t-1})	0.220	(0.661)
log (Q_{t-2})	0.673	(4.469)
log ($MBOUT_i$)	-0.133	(-1.399)
log $\left(\frac{P_t \cdot ER_t}{GDPDEF_t}\right)$	-2.124	(-3.710)
log $\left(\frac{P_t^{NF} \cdot ER_t}{GDPDEF_t}\right)$	1.781	(4.053)
log ($EURGDP_i$)	0.627	(1.299)
R^2 = 0.771		
F – statistic = 5.28		
P(*Breusch-Godfrey*)= 0.31		
P (*RESET*) = 0.74		

In conclusion, the obtained results are congruent with economic theory and observed facts. However, we realize limitations of the analysis. Applied proxies are not perfect. Thus, we should regard these results with a great deal of caution.

2.2.2. Supply function

In analysis of the supply function we should consider factors that affect costs of producing steel. From this point of view it appears to be instructive to introduce prices of major inputs such as coal, oil, gas, and electricity. Inter-enterprise arrears and wage arrears indirectly affect the costs. Interest rate influences financial expenditures (e.g. interest payment on loans). As in the demand function, in the supply function we use a partial adjustment mechanism to capture gradual adaptation of production to market demand. At the same time, lagged output reflects seasonality.

The resulting specification is then:

$$\log(Q_t) = \beta_0 + + \beta_1 RI_t + \beta_2 [d \log(\frac{PAY_t}{GDPDEF_t})] + \beta_3 \log(\frac{P_t \cdot ER_t}{GDPDEF_t}) +$$
$$+ \beta_4 [d \log(\frac{WARR_t}{GDPDEF_t})] + \beta_5 \log(\frac{EP_t \cdot CP_t \cdot GP_t}{GDPDEF_t^3}) + \beta_6 \log(Q_{(t-4)}) + \varepsilon_t,$$

where

i indexes firms and *t* indexes time periods, and variables are the following:
RI — real interest rate,
PAY — inter-enterprise payables,
P — the US price of steel products (product group weighted average),
ER — UAH/$ exchange rate,
WARR — wage arrears,
EP — electricity price (quarterly),
CP — coal price (quarterly),
GP — natural gas price (quarterly),
GDPDEF — GDP deflator,
Q — quarterly output volume.

Econometric estimation of the suggested functional form provided us with the estimates demonstrated in Table 2.3. Obtained estimate of elasticity of

supply with respect to price is equal to 0.1. This is the short-run elasticity of supply. The long-run elasticity is equal to 0.133 according to a partial adjustment technique.

Wage arrears and inter-enterprises arrears negatively affect the production of steel. Holding everything else constant, growth in arrears reduces steel output. Increase in prices of electricity, gas, and coal raises costs, consequently shifting supply curve upwards. *Ceteris paribus*, it leads to the decrease in output.

The interest rate, which approximates financial costs, has an unexpected sign. Growth of interest rates increases output. This contradictory result could be explained in the following way. Poor monitoring possibilities and excessively

TABLE 2.3

SUPPLY FUNCTION ESTIMATION

(dependent variable is log (Q_t))

VARIABLE	COEFFICIENT	T-STATISTIC
Constant term	-3.11	(-5.86)
RI_t	0.054	(3.09)
$d \log(\frac{PAY_t}{GDPDEF_t})$	-0.567	(-3.79)
$\log(\frac{P_t \cdot ER_t}{GDPDEF_t})$	0.1	(1.68)
$d \log(\frac{WARR_t}{GDPDEF_t})$	-0.293	(-3.27)
$\log(\frac{EP_t \cdot CP_t \cdot GP_t}{GDPDEF_t^3})$	-0.24	(-12.29)
$\log(Q_{t-4})$	0.27	(2.06)

$R^2 = 0.82$

F – statistic = 6.52
P (*Breusch-Godfrey*) = 0.79
P (*RESET*) = 0.77

risky environment create incentives for banks to ration their credits, especially when mid-term and long-term lending is concerned. The market for credit does not clear then. Under such circumstances, a moderate increase in the interest rate may actually stimulate additional lending to enterprises and create a basis for output growth.

Concerning technical aspects, we see that statistical tests imply correct specification of the behavioral equation and consistency of estimates. The RESET test does not reject correct specification of the regression. The White heteroscedasticity test suggests homoscedasticity of residuals. A Breusch-Godfrey LM test indicates that there is no autocorrelation of the error term. High R^2 demonstrates high explanatory power of the regression.

2.3. Estimation of the mark-up

To estimate performance we may apply a variety of tools. However, the Lerner index appears to be economically justified, straightforward and self-explanatory. We can derive the Lerner index $\left(\frac{P-MC}{P}\right)$ applying different approaches.

The first of them is based on cost functions. This is the most simple one, because all that we need is price of a good and marginal cost. The second one exploits the market structure and elasticity of market demand. The market structure is captured by the Herfindahl-Hirschman index

$$\sum_i s_i \frac{P-MC}{P} = -\frac{\sum_i s_i^2}{\varepsilon} = -\frac{HHI}{\varepsilon},$$

where s_i stands for the market share of the enterprise i and ε for the market demand elasticity.

It is instructive to apply all approaches to verify consistency in estimates of the mark-up.

On the basis of the cost function we can find marginal cost that depends on output, *Q*. We use indicative prices set up by the Ministry of Economy. This price is the lowest bound of price for exported steel. Since marginal cost varies with output we apply the average output of Ukrainian metal works: 3.049 million MT. At this level of output marginal cost will be equal to UAH 314 per MT. This is significantly lower than the price of steel in the international market. Plugging in marginal cost and price, we find that the mark-up is equal to 76.5%. We might explain such a surprising result by the specifics of Ukrainian metal industries. In particular, the technology of most Ukrainian metal works implies relatively low variable cost and huge fixed cost. Efficient output then is far above the average of 3 million MT. As a result, the average cost curve lies well above the marginal cost curve. Apparently this is not economically optimal. Ukrainian plants should have expanded output up to efficient scale or switch to more modern technologies with lower fixed costs. Nevertheless, Ukrainian steel export is considerably constrained by foreign governments. Anti-dumping investigations and quota restrictions are the most widely used practices of protecting domestic markets. This argument might explain why the plants cannot realize economies of scale and earn higher profits. As for investment in new technology, the issue will be considered in the next chapter.

Now we check mark-up calculation by applying the second approach. On the basis of available output data, we estimated the Herfindahl-Hirschman index as 1,601. Econometric estimation of the demand function showed that elasticity of demand is approximately –2. Therefore, we can calculate mark-up, which will be equal to 8%. This result clearly contradicts the estimate derived from the first methodology. We may suggest that the problem is not in estimations of *MC* and *P*, but rather in methodology itself. The way of derivation of these estimates assumes that market is in equilibrium, and, in particular, that $MR=MC$ for each firm in the industry. The difference in mark-up estimates may serve as an additional evidence of distortion in steel

market. Since the first approach directly reckons on marginal cost, we believe that it is more reliable than the second one.

The third way of estimation will allow us to test adequacy of the first approach. It is based on the following formula derived by us (derivation is presented in APPENDIX 2):

$$MU = RR\left(-\frac{1}{\varepsilon \cdot RR} + \frac{1}{\varepsilon} + 1 \right),$$

where

MU — mark-up value,
RR — net margin,
— elasticity of net margin with respect to output,
ε — own price elasticity of market demand.

The derivation does not depend on assumption $MR = MC$. Hence, it should be robust to market distortions, for instance government interventions.

Obviously, to calculate the mark-up using this framework we have to estimate price elasticity of demand, average net margin, and the parameter γ. The average net margin can be easily obtained from income statements of enterprises. Price elasticity of demand can be derived from the econometric estimate of the market demand function. Parameter γ, which measures the elasticity of net margin with respect to quantity, should be estimated statistically. In the previous regressions we assume a cubic cost function. In this case we also assume that net profits are explained by a third order polynomial of output[15]. The specification proposed for the net margin is then the following:

$$RR_{it} = \alpha_i + \beta_1 Q_{it} + \beta_2 Q_{it}^2 + \beta_3 Q_{it}^3 + \varepsilon_{it},$$

where

[15] See footnote 10

i indexes firms and *t* indexes time periods, and variables are defined as follows:
RR — net margin,
Q — annual output volume.

We have pooled data on net margins and output of enterprises. Applying panel data estimator we have found a consistent estimate of parameter γ. The results of this estimation are presented in Table 2.4. These figures may be used to calculate that at *q* equal to 3.043 million MT (industry average output) parameter γ is 13.1, and mark-up reaches the level of 72%. This result is comparable to the estimates derived by the first approach. We can conclude that mark-up is likely to be somewhere around 75%.

The main implication of this result, in combination with low capacity utilization rates, is that the industry is operating inefficiently: an average firm is not able to reach its minimum efficiency scale due to market constraints and bears a huge amount of unproductive fixed costs. Why have then excessive capacities not been removed or restructured? The next chapter is

TABLE 2.4

MARK-UP ESTIMATION:ALTERNATIVE APPROACH
(dependent variable RR_{it})

VARIABLE	COEFFICIENT	T-STATISTIC
Constant term	-0.016	(-0.21)
Q_{it}	$-1.48 \cdot 10^{-7}$	(-1.323)
Q_{it}^2	$8.44 \cdot 10^{-14}$	(2.11)
Q_{it}^3	$-1.06 \cdot 10^{-20}$	(-2.51)

$R^2 = 0.82$

F – statistic = 21.7

concerned with answering this question.

Chapter 3

THEORY AND MODEL

3.1. The problem reconsidered

A starting point for the analysis of the present situation in the Ukrainian ferrous metals may be the following observation: existence of excess capacities in the middle or long run is a result of inadequate investment strategy employed by an enterprise. Stated in other words, the presence of idle capacities is evidence of either overinvestment in capital construction or underinvestment in technology. This point deserves to be discussed in a somewhat greater detail.

Varying installed capacity is clearly not a short-run decision, since installation period in vast majority of cases exceeds one year. Therefore, such capacity adjustment necessarily involves intertemporal decisions and requires certain investments to be made. The size of these investments is, of course, determined *ex ante*, before their gains or state of nature is realized.

At first sight, excessive plant and machinery should be a consequence of *overinvestment — ex ante* investment plants of producers appeared to overstate future demand and idle capacities emerged. However, this seems not to be the case with the Ukrainian ferrous metal industry for several reasons.

Firstly, presence of excessive machinery and plant of this type is not likely to be persistent over time. Two or three years is quite sufficient to remove (or restructure) idle capacities. If the total volume of installed fixed assets appears to systematically exceed demand, rational agents would not continue to operate them beyond the short-run. Secondly, the situation in the Ukrainian ferrous metals is not really a result of companies' investment plans — rather it

is a legacy of Soviet times and centralized planning. Excess capacities were not painful for the enterprises in presence of regular huge military purchases and soft budget constraints (see Kornai (1991) for discussion of soft budget constraints) — firms were effectively maximizing output, not profits. However, things changed dramatically in the early 1990s when the winds of liberalizations wiped out governmental paternalism. Thirdly, most of these excessive capacities are aged and highly depreciated. Their productivity is well below modern Western standards. So, taking into account all said above, one may conclude that decentralization of the Ukrainian economy should have invoked an immediate trend among the industry players towards restructuring and removal of plant and machinery.

This is not what happened in reality, however. Existence of idle capacities (above the world's industry norm) had been systematic over the period of 1992-1998. The situation began to normalize by the end of 1999 only. Such a systematic pattern suggests that the Ukrainian case is an example of the *underinvestment* problem, rather than the overinvestment one.

Apparently, removal and restructuring of plant and machinery requires considerable investment — often larger than that in the installation of new capacities[16]. Furthermore, if fixed assets under consideration are outmoded and highly depreciated removal plans are usually intimately connected to investments in new technology. That is, investment program should include in such case not only a schedule for deinstallation of capacities, but also a plan for replacement of them with new more productive ones. Fig. 3.1 would clarify the point.

In the graph, one may see an initial inefficient point where the industry operates with excessive capacities (point *A*). Underinvestment in new technology and machinery replacement prevents a typical industry firm from

[16] Good evidence in favor of this is that American plants are almost never removed after shut down — at best they are used as Hollywood shooting areas (anyone who has seen the film *Terminator* may confirm that).

moving to the first-best point *B*, where minimum efficiency scale is achieved. The firm gets stuck then in point *A*, where its mark-up is positive but there are still some unexploited profit opportunities. Investments may lower fixed costs born by the firm[17], and the average cost curve would move downwards (from level AC_1 to level AC_2). If this investment trend turned out to be industry wide (on a global scale), market price would fall also (from P_{old} to P_{new}), so that both average and marginal cost would be equal to it. However, we cannot regard Ukraine as a large country in international trade flows. Consequently, the global price would not change in this instance and the mark-up would still remain positive. Anyway, the industry would settle at the long-run equilibrium point *C* consistent with profit-maximizing. Noteworthy,

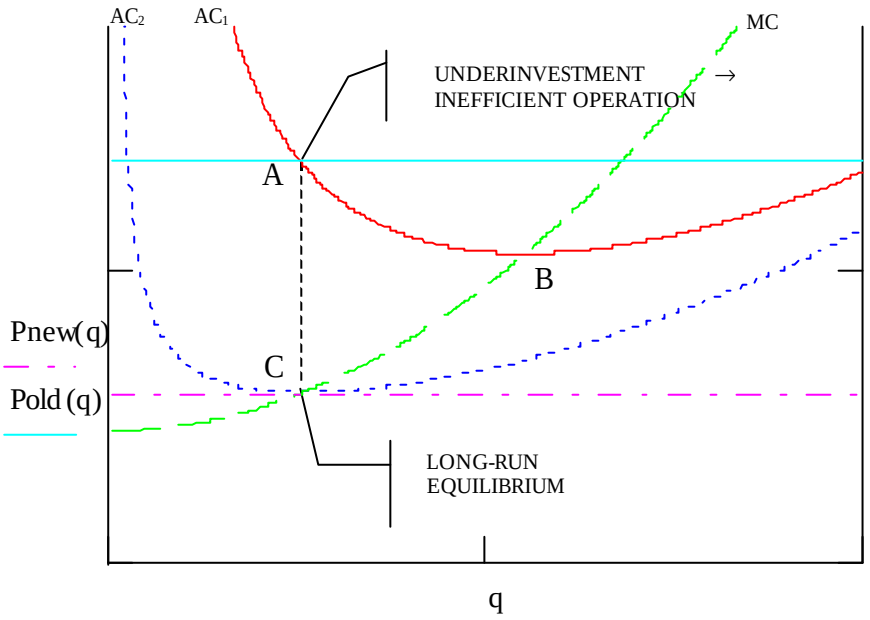

FIGURE 3.1.

[17] This example may be easy generalized to the case where investment affects both fixed and variable costs of production. To do this, just note that *any* cost-reducing investment should necessarily lower $\partial AC(q)/\partial q, \forall q \geq 0$.

the total volume of capacities installed did not change in the example considered, but due to increased cost efficiency (i.e., implementation of technology) misbalances have been removed.

Based on the above considerations, our assumption is that persistence of excessive capacities and inadequate performance of the Ukrainian ferrous metal industry in 1990 have their roots in underinvestment in new technology and fixed assets restructuring. This statement is crucially important to us, since it allows us to anchor further research within the framework of the famous Grossman-Hart-Moore model (GHM). The following three sections are dedicated to a brief description of the GHM model (as it is stated in Hart (1995)) and some of its modifications (Hart and Moore, 1990; de Meza and Lockwood, 1998).

3.2. Investment incentives and property rights: GHM approach

The fundamental idea behind the GHM is that in the world of incomplete contracts, distribution of property rights over the set of physical assets has an impact on production and investment incentives of the agents that work with those assets.

A firm in the view of this approach is nothing more than a collection of the assets that it owns (Grossman and Hart, 1986). Ownership itself is determined as "possession of residual control rights over the asset: the right to decide all usages of the asset in any way not inconsistent with a prior contract, custom, or law" (Hart, 1995). This definition is somewhat different from the conventional "residual income rights" approach. However, Hart (1995) and Hart and Moore (1990) demonstrate that residual income rights in many cases are not separable from the residual control rights. Moreover, in instances when these rights are separable, residual income claims are also almost always *ex ante* contractible. Therefore, the "residual income rights"

definition of ownership would not resolve the problem of incomplete contracts[18].

Intuitively, possession of the residual control rights over some asset should have a positive influence on an agent's propensity to invest into the human or physical capital related to this asset. This is so because appropriation of the investment benefits not specified in *ex ante* contract (in the form of direct income or improved opportunities) is a privilege of the asset owner.

Suppose now that there are two firms engaging in a vertical production relationship. The surplus generated by the relationship is realized *ex post* but depends on some investments made by the parties *ex ante.* Consider the case when one of the firms (say, party U) acquires the other firm (party D). It is logical to anticipate, based on the ownership definition stated above, that integration of this type would likely increase firm U's incentives to invest, since it would concentrate all of the residual control rights over the assets involved in the relationship with this particular party. Improved investment incentives would increase the value of the relationship then. This benefit of vertical integration has been pointed out long ago by Klein, Crawford, and Alchian (1978).

Hart (1995), however, emphasizes that integration is likely to involve some costs as well. In particular, it is obvious that transfer of residual control rights from party D to party U would most likely lower the former firm's incentives to invest in the specific relationship (since it does not longer possess residual rights of control over the assets it operates with). The net balance of the mentioned costs and benefits determines the size of the firm and the scope of integration. Let us now proceed with a more formal model of the described ideas[19].

---

[18] A comprehensive analysis of different aspects of ownership from the economic perspective may be found in Furubotn and Richter (1997).

[19] This exposition basically follows Hart (1995)

Consider a pair of firms engaging in a vertical production relationship: we will continue to denote them U (upstream) and D (downstream). The firm U *operates* some set of assets a_U, similarly its counterparty *operates*[20] asset group a_D. We assume that both a_U and a_D are utilized in the production process. The party U manufactures some input required by the party D and sells it at the price negotiated *ex ante*. Production and sale takes place some time after the deal is arranged, that is, *ex post*. However, investments necessary for *ex post* trading are made *ex ante*, meaning that the parties do not know for sure whether they will co-operate in the production process when they make their investment decisions. So, the model will implicitly involve two periods.

Generally, firms possess symmetric information about each other. However, there is one element of uncertainty in their relationship: *ex ante* none of them is able to specify precisely all the parameters of the input traded *ex post* and contingencies of the external environment. This assumption is sufficient to make complete contracts non-feasible — any attempt to specify in advance optimal investment scheme in the contract would be prohibitively costly (Williamson (1985)). Therefore, each party has to determine the size of investment related to the assets it operates on its own and *ex ante*.

Investments are assumed to be relationship-specific. This assumption allows us, however, to include the widest range of investment decisions in the analysis. For instance, suppose that one of the parties (let it be party U) defaults on the date of contract maturity and does not deliver the input. Even if specifications of the input were quite conventional, party D will have to sign a new spot market contract for a similar input. The cost of writing such a contract may be viewed as negligible only for the most liquid commodities (grains, crude oil, precious metals). Unfortunately, most of the real-world inputs do not belong to this group. Hence party D will face a positive contracting cost, which will probably include costs of search, due diligence

[20] Note the distinction between 'operating' and 'owning' an asset.

and writing a comprehensive legally compliant contract. The implication is straightforward then: once the parties have locked in the particular relationship, virtually *any* investment may be viewed as relationship-specific. Put in other words, specificity of investment is rather a matter of degree than an existence problem[21].

Further, investments are assumed to have effects on both physical and human capital. This is a reasonable assumption since investing in new technology requires not only installation of new capacities and removal of the old ones, but also appropriate training of workers and development of new skills among the managers of the firm. At the same time, this assumption is critical, since investments that result only in the increasing value of physical assets may lead to indeterminacy concerning optimal ownership structure (see Hart (1995), de Meza and Lockwood (1998)).

Finally, investments are assumed to be observable, but not verifiable. The difference between these two notions may be understood on such examples as quality of intellectual products, effort, etc — they may be observed by outsiders easily, but there is no single objective standard for due verification (see Hart (1995) for a clear distinction between the concepts of observability and verifiability).

If firms agree to co-operate, party U produces input at cost $C(e)$ and sells it to party D at a pre-arranged price p^*. Party D then utilizes this input and sells a finished product in the open market, which brings revenue $R(i)$ to it. Here i stands for the revenue-increasing investment by firm D, and e for the cost-enhancing investment by party U. If the parties do not reach an agreement, they may exploit their alternative spot market options:

---

[21] Johnson, McMillan and Woodruff (1999a) provide an interesting empirical study of investment specificity and production chain rigidity in transition economies. In particular, they find out that "the average duration of relationships as a ratio of the age of the firm is … highest in Russia and Ukraine". They also report that 90% of Ukrainian firms would not break up with their traditional suppliers, even in presence of better outside options.

$(r(i; A_D) - \underline{p})$ — for party D,

$(\underline{p} - c(e; A_U))$ — for party U,

where A_D, A_U — are assets owned by the respective firm, and $\underline{p}$ is the spot market price for input. Functions $r(i; A_D)$ and $c(e; A_U)$ that enter these payoffs represent revenue of party D and cost of party U in case of no trade. They are assumed to be different from functions $R(i)$ and $C(e)$[22]. Clearly, the sum of these no-trade payoffs is assumed to be less than the total surplus in case of co-operation[23]. That is,

$$(R(i) - p^*) + (p^* - C(e)) \geq (r(i; A_D) - \underline{p}) + (\underline{p} - c(e; A_U)). \tag{3.1}$$

Further, some common assumptions concerning the nature of functions R, C, r, c should be made. These are standard and aim mainly at the preserving "well-behaved" payoff functions that may be easily compared via first order conditions:

$$\begin{aligned}
&R(i) \in C^2, \frac{\partial R}{\partial i} > 0, \frac{\partial^2 R}{\partial i^2} < 0;\\
&C(e) \in C^2, \frac{\partial C}{\partial e} < 0, \frac{\partial^2 C}{\partial e^2} > 0;\\
&r(i) \in C^2, \frac{\partial r}{\partial i} \geq 0, \frac{\partial^2 r}{\partial i^2} \leq 0;\\
&c(e) \in C^2, \frac{\partial c}{\partial e} \leq 0, \frac{\partial^2 c}{\partial e^2} \geq 0.
\end{aligned} \tag{3.2}$$

Finally, a set of assumptions regarding relative productivity of investments should be made:

$$\frac{\partial R}{\partial i} > \frac{\partial r(i; a_U, a_D)}{\partial i} \geq \frac{\partial r(i; a_D)}{\partial i} \geq 0; \tag{3.3}$$

---

[22] Intuitively, there are two reasons behind this difference: 1) spot market may require a commodity to have slightly different specifications than in case of co-operations, which implies variations in value, price and, consequently, in revenues and costs; 2) different investment schedules under co-operation and non-cooperation precipitate variations in cost efficiency.

[23] This assumption is vital, since otherwise co-operation would never occur. It seems appealing: in case of non-cooperation each party has no access to physical and human capital of its counteragent, and its gains from production and trade should be weakly less.

$$\frac{\partial C}{\partial e} < \frac{\partial c(e; a_U, a_D)}{\partial e} \leq \frac{\partial c(e; a_U)}{\partial e} \leq 0. \qquad (3.4)$$

These assumptions postulate that investment is more productive in the co-operative use of assets than in the no-trade options. This seems intuitively appealing since investment is specific in nature to the trade relationship between the parties. Furthermore, in a no-trade option an agent's revenue is an increasing function in the number of assets assigned to this particular agent. This is quite compliant with the hypothesis about investment incentives and property rights distribution described above.

Let us consider now investment incentives under different ownership structures. First of all, we should define the first-best level of investments. It is quite easy to do by formulating first order conditions, given our assumptions. Total surplus from trade net of investment costs in case of co-operation is:

$$(R(i) - p^*) + (p^* - C(e)) - i - e = R(i) - C(e) - i - e.$$

Taking derivatives and regrouping we get:

$$\frac{\partial R(i)}{\partial i} = 1; \qquad (3.5)$$

$$\frac{\partial C(e)}{\partial e} = -1. \qquad (3.6)$$

Having obtained conditions that define first best levels of investment we may compare to them the results generated by a different ownership structures. Under any of the possible ownership structures, each party's payoffs net of investments are given by:

for D

$$_D = R(i) - p^* = (r(i; A_D) - \underline{p}) + \Theta((R(i) - C(e)) - (r(i; A_D) - c(e; A_U))) - i, \qquad (3.7)$$

for U

$$_{U} = C(e) - p^{*} = (\underline{p} - c(e; A_U)) + (1-\Theta)((R(i) - C(e)) - (r(i; A_D) - c(e; A_U))) - e. \tag{3.8}$$

Parameter $\Theta \in [0;1]$ denotes here the share of the total trade surplus that goes to party D. It reflects the relative bargaining power of party D.

After regrouping, (3.7) and (3.8) yield the following first order conditions:

$$\Theta \frac{\partial R(i)}{\partial i} + (1-\Theta)\frac{\partial r(i; A_D)}{\partial i} = 1, \tag{3.9}$$

$$(1-\Theta)\frac{\partial C(e)}{\partial e} + \Theta \frac{\partial c(e; A_U)}{\partial e} = -1. \tag{3.10}$$

In a two parties instance there are three ownership structures possible[24]:

1) NON-INTEGRATION. U owns a_U and D owns a_D.

2) UPSTREAM INTEGRATION. U owns both a_U and a_D.

3) DOWNSTREAM INTEGRATION. D owns both a_U and a_D.

First order conditions (3.9) and (3.10) then take the form:

$$\left.\begin{aligned} \Theta \frac{\partial R(i)}{\partial i} + (1-\Theta)\frac{\partial r(i; a_D)}{\partial i} &= 1, \\ (1-\Theta)\frac{\partial C(e)}{\partial e} + \Theta \frac{\partial c(e; a_U)}{\partial e} &= -1; \end{aligned}\right\} \text{for the non - integration case}$$

$$\left.\begin{aligned} \Theta \frac{\partial R(i)}{\partial i} + (1-\Theta)\frac{\partial r(i; \varnothing)}{\partial i} &= 1, \\ (1-\Theta)\frac{\partial C(e)}{\partial e} + \Theta \frac{\partial c(e; a_U, a_D)}{\partial e} &= -1; \end{aligned}\right\} \text{for upstream integration}$$

$$\left.\begin{aligned} \Theta \frac{\partial R(i)}{\partial i} + (1-\Theta)\frac{\partial r(i; a_U, a_D)}{\partial i} &= 1, \\ (1-\Theta)\frac{\partial C(e)}{\partial e} + \Theta \frac{\partial c(e; \varnothing)}{\partial e} &= -1. \end{aligned}\right\} \text{for downstream integration}$$

Clearly then, if assumptions (3.3) and (3.4) hold then for any value of Θ and independently of the ownership structure conditions (3.9) and (3.10) generate

[24] The fourth type, reverse non-integration (U owns a_D and D owns a_U), may be ruled out as weakly inefficient compared to simple integration.

maximizers $\underline{i}$ and $\underline{e}$ that are different from the first-best investment levels i^* and e^* resulting from the first order conditions (3.5) and (3.6). Verbal interpretation of this proposition is quite simple: *any* distribution of property rights among the two parties leads to *underinvestment* in the specific relationship. This basic result, along with extensive discussion of its implications, is contained in Hart (1995). Naturally, different ownership structures would lead to a smaller or larger extent of underinvestment in different circumstances. Hart (1995) carries out a thorough analysis of the pros and cons of particular property rights distributions and formulates some hypotheses concerning which structures are most likely to be observed under various states of the world. This analysis is, however, beyond the scope of the present work. So, we will take the basic result of the GHM model and proceed with it in our own way.

3.3. "Third party" solution

We are now ready to formulate the main hypothesis of the present paper.

PROPOSITION. An introduction of the third party into the trade relationship among firms U and D in the GHM model is sufficient to generate first best levels of investment and maximize total trade surplus.

The rest of the section is dedicated to demonstrating that it is truly so in the GHM model. Suppose that there appears some third party O in the model of section 3.2. This agent O is endowed with residual rights of control over some of the assets being in operating use of both firms U and firm D. We assume that party O's endowment in each of the firms is equally valuable to him. Moreover, the rights granted to O are large enough to provide him with a power of control over the firms as a whole.

Total trade surplus of the relationship depends on *ex ante* investments and on *ex post* production decisions. As for investments, we have stated first best conditions for optimality with respect to them in the previous section (see

(3.5, 3.6)). Clearly, conditions (3.9) and (3.10) are identical to the latter in only one case:

$$\frac{\partial R(i)}{\partial i} = \frac{\partial r(i; A_D)}{\partial i} = 1, \tag{3.11}$$

$$\frac{\partial C(e)}{\partial e} = \frac{\partial c(e; A_U)}{\partial e} = -1. \tag{3.12}$$

A third party may preserve (3.11) and (3.12) by implementing a scheme of redistribution payments among the parties U, D and itself. The basic principle would be as follows: if a party effects too low an investment compared to some benchmark (lower than first best) it pays a fine to O, and trade does not occur and parties take alternative options; if it overshoots the benchmark level it gets a bonus and trade takes place. Bonuses and fines are supposed to be proportional to the amount of investment. Since functions $r(i; A_D)$ and $c(e; A_U)$ are monotonic it is quite easy to construct on their basis some functions $r^*(i; A_D)$ and $c^*(e; A_U)$ satisfying conditions (3.11) and (3.12) in the manner suggested. Practically, this would be possible if investments are observable (their verifiability is not required).

As for production incentives, they will not be affected by the introduction of the third party. There two cases possible: the model with outside alternative options and the model with inside alternative options. If options are inside, the optimal value of parameter θ that maximizes total trade surplus is ½ (see Nash (1950), Osborne and Rubinstein (1990)). A third party O may easily achieve it by setting a kind of lump-sum fee on total trade surplus in case of co-operation and dividing what is left equally among firms U and D. As long as this fee does not exceed the difference between the total trade surplus and the value of inside options, firms will act efficiently.

If options are outside, matters become more complicated at first glance. As de Meza and Lockwood (1998) show, with binding outside options distribution of surplus between producers is no longer equal. Their analysis is based on the "split-the-difference" setup that has gained convincing empirical support in the work of Binmore, Shaked, and Sutton (1989). This implies that $\theta = ½$ will not be achieved in general in two-party contracts. However, introduction of the third party resolves the issue perfectly: by alienating direct access to the external market for inputs from the upstream firm and to the external market for outputs from the downstream firm, party O may always make outside options non-binding. There is, however, the potential problem of overinvestment arising then but we may ignore it in the present work.

For all the reasons stated above, we may conclude that proposition established in the beginning of the section holds in theory. Does it find then any empirical support?

3.4. Discussion

The hypothesis of the previous section, along with a GHM framework, allows us to construct a quite consistent story of the development of Ukrainian ferrous metals in 1990s.

In the Soviet era, the state was the sole owner of residual control rights in integrated metal plants, ore processing plants, mines and other enterprises of the sector. The needs of final consumers (military sector enterprises, oil/gas extractors, etc) were regarded as primary and corresponding vertical organization was implemented (with downstream firms having some bargaining power over upstream ones). This resulted in overinvestment in physical capital [25].

[25] Analysis of inefficiencies and anomalies pertaining to planned economies may be found in Kornai (1992) or in more recent work by Gaidar (1997) with some Soviet colority. See AISI (2000) for brief description of past and present situation with capacities and technology in Ukrainian ferrous metals.

Upon the break-up of the USSR, the state lost much of its power and *de facto* residual rights of control were appropriated by the management of respective firms. This corresponds to the non-integration ownership structure of section 3.2. Forecast result, underinvestment, did indeed occur and total value of specific relationships within the industry, as well as its output, have declined considerably. So far this story is quite congruent with the disorganization story of Blanchard and Kremer (1997).

There is a striking difference, nonetheless, in the proposed explanations for such industry movement and in the prediction implied. Blanchard and Kremer suggest that private potential uses of resources outweigh conventional state uses and divert inputs from the public sector of the economy. This generates downturn in output. In the course of time, private uses improve and total output rise.

There are two problems with this explanation. The first one is that it is not clear, why private uses should outweigh the state ones. Blanchard and Kremer argue that for a sufficiently long production chain value of the state use becomes so small that alternative private use could easily exceed it. But, private use, most likely is also a link in some production chain, and there's no any obvious reason for this second chain to be shorter or more efficient than the state one.

Some may argue that the private chain is "shorter" in some sense due to lower transaction costs. This is what Blanchard and Kremer do in fact by assuming that bargaining between firms suddenly becomes inefficient in transition. However, transaction costs are too wide a concept. What are the *initial sources* of intersectoral variation in transaction costs — this is a cornerstone question.

See also Grossman and Hart (1986) and de Meza and Lockwood (1998) for theoretical discussion of overinvestment.

Secondly, it is also dubious that private uses should improve over time while state ones should not. Again, some may refer to an inherent inability of governments to calculate and plan perfectly, stated theoretically for the first time by the Austrian school economists in the beginning of the last century. Apart from the fact that such inability has never been proven "in stone", we accept this hypothesis. However, it is not relevant for the present study: our interest lies in the area of mixed economies, where both government planning and market coordination are present. Under such circumstances, the government *competes* with private rivals for the right of contracting with a given firm. And if it has a truly better (i.e., more efficient, profitable, etc) final use for resources of a firm, it will always be able to offer more favorable conditions and win the contract — this is what competition is about.

For example, Ukrainian ferrous metals have gained a free access to export markets in 1994-1995 already. Evidently, the options available in those highly developed and competitive markets may be considered efficient. Based on the work by Blanchard and Kremer, we would expect rapid improvements in performance of Ukrainian ferrous metals enterprises. This seems not to be the fact, however: output did, in fact, rise, but productivity, profitability and investment patterns did not improve (in many instances they fell even). Changes for the better showed their early signs much later — in 1999, along with accelerating change in property rights distribution in the industry.

To summarize, Blanchard and Kremer deliver quite a plausible picture of the economy development in transition, but they do not go far enough to uncover the particular mechanisms that precipitate the collapse of output and determine its time path.

A number of papers emerged in the last four years to fill in this gap and develop a brilliant idea of Blanchard and Kremer into a "stonewalled" formal theory. The most interesting among these works is, probably the one by Roland and Verdier (1999). These authors devise a model where firms of two

types, "low productivity" and "high productivity", engage in vertical productive relationships. Under central planning relatively productive firms are locked in inefficient chains with less productive partners. With the beginning of transition, costs of abandoning such an inefficient chain sharply fall. There are several reasons for this: removal of administrative barriers, higher uncertainty associated with increased discount rate, and price liberalization (see Roland (2000) for a careful formal analysis). Regardless, marginal benefits of searching for a new productive partner become relatively larger and old production chains are disrupted. This disorganization results in output fall. As search process converges to an equilibrium where all the high productivity firms have found best matches for themselves, output starts recovering.

What is unclear in this model is the fate of low productivity firms. Their very existence after liberalization seems impossible in the long-run. Indeed, all the low productivity enterprises should either improve their efficiency or shut down — this severe requirement is imposed by competition in the markets for final goods. This simple observation may be a starting point for more elaborate critique of the Roland-Verdier model. However, this is not our goal here. Quite contrary, we would like to emphasize an apparent merit of the Roland-Verdier theory: their analysis does not depend on doubtful assumption of "inefficient bargaining"[26].

Recanatini and Ryterman (2000) concentrate on the legal contract enforceability in transition economies and apply the Blanchard-Kremer framework to empirical analysis of the role of institutions in the production co-ordination process. In particular, they argue that business or trade associations are an important means of eliminating uncertainty in transition economies and their development leads to better contract enforceability and output recovery. Their analysis finds a strong theoretical and empirical

[26] For more details about Roland-Verdier model we refer the reader to Roland and Verdier (1999) and Roland (2000).

support in the works of Johnson, McMillan, and Woodruff (1999a, 1999b). At the same time, "because trade associations provide information about potential trading partners' reliability and help arbitrate disputes, membership in a trade association … makes a firm more ready to switch to a new supplier" (Johnson, McMillan, and Woodruff, 1999a) — note the resemblance to the Roland-Verdier disorganization model.

Marin and Schnitzer (2000) relate disorganization to the collapse of financial system and development of trade credit. Their formal analysis develops ideas of Johnson, McMillan, and Woodruff (1999a) in the Blanchard-Kremer framework.

However interesting and insightful are all these works, they all seem to ignore largely the role of *property rights* arrangements in explaining disorganization and output path in transition. In attempt to eliminate this void we claim in this paper that property rights structure and changes in it are those factors behind the U-shaped movement of industries in transition. The explanation suggested is based on the GHM model and the proposition of the Section 3.3.

Applied to the Ukrainian ferrous metal industry, the field of the present research, this would mean that certain property rights arrangements would promote efficiency in investment and production, while others would not. In particular, if there appeared some third parties (conventionally labeled "oligarchs") in the industry who attempted to create closed groups of vertically integrated enterprises, our proposition suggests that investment volumes in the industry would be likely to rise and performance to improve. Fortunately, the last two to three years provide us with evidence of similar integration trends in Ukrainian ferrous metals. Hence the next chapter of the present work will be dedicated to empirical tests of the hypothesis stated in this chapter.

Chapter 4

HYPOTHESIS TESTING AND RESULTS

4.1. Ukrainian context

Before presenting the econometric model devised for testing the main hypothesis of the present work and estimation results, we would like to provide a fairly concise description of the Ukrainian ferrous metal industry in the light of topic of the present research — in other words, put the problem in context.

The ferrous metal industry is essentially a multistage production cycle (see APPENDIX 3). It includes a variety of subindustries that co-operate closely and engage in vertical production chains in the process of creating final value added for the economy. Such co-operation is mutually beneficial and essential for successful operation of the whole industry. It may, however, be substituted to some extent by free market transactions (i.e., relying on ad hoc purchase of inputs and sale of output in open markets, mostly international). There are obviously some potential benefits for enterprises from both engaging in long-run vertical relationships (either through mergers or through long-term contracts) and reckoning on the market — the firms choose one of the options in accordance with their perception of cost-benefit balance.

The production process begins at the very upstream (coal and ore mining) and finishes at the very downstream (hi-tech manufacture of electric and other special steel brands, pipe rolling, etc). Enterprises within the subindustries are not homogenous with respect to their technology, endowments and capacity, which has a significant impact on their potential gains from co-operating with each other. For instance, ore extracting plants differ in quality of their produce (concentration, content of usable oreing

downs, etc) and location. The same may be said about coking plants. This makes their output more or less desirable for steel mills, depending on the brand mix of the latter. Finally, pipe rolling enterprises also have strict preferences over steel brands used for production of tubes. Consequently, there is an inherent specificity of assets and investments observed in the industry.

This seems to fit perfectly into the basic GHM framework. Furthermore, asset specificity concerns human capital as well as physical, since peculiarities of installed machinery and natural resource endowments inevitably lead to differences in labor training, production techniques and even management organization. Consequently, the GHM model may, in principle, be applied to the Ukrainian ferrous metal industry.

Is it then possible to test the predictions of that model on the basis of the empirical evidence supplied by the industry? In particular, can one test the hypothesis presented in this paper? The answer seems to be positive.

Enterprises of the industry are characterized by very different property rights arrangements. We observe a great portion of firms that remain under the state control (*Kryvorizhstal, Mariupol'/Illich* Metal Works, numerous GOKs[27], etc), as well as numerous privatized ones (*Zaporizhstal, Donetsk* Metal Plant, *Poltava* GOK, several coke plants, *Nyzhnyodniprovskyi* Tube Plant, and others). Some of the enterprises are completely vertically integrated (*Kryvorizhstal* — upstream integration), others engage in long-term specific vertical relationships, while some of them rely mostly on the open market.

There are also instances of what we called above "third party" integration — closed vertical chains controlled by financial and industrial groups that do not engage in production process directly. We have encountered three such conglomerates: *Interpipe*, *Industrial Union of Donbass*, and *Midland Holdings*. There

[27] GOK is a Russian abbreviation for *gorno-obogatitelnyi kombinat* (ore enrichment plant).

are also some other similar groupings ("Surkis group"; a group controlled by *Privatbank*), but their positions in the ferrous metals are relatively weak — their influence is stronger in other industries and they have failed to create more or less closed vertical chains for now — therefore, we do not consider these agents as third parties.

Obviously, cross-sectional studies of property rights impact on performance are possible in the Ukrainian ferrous metal industry, given such a variety of ownership arrangements. What is also important, status of many enterprises in this respect has been changing over the last years. Consequently, one may try to examine temporal variations in performance and investment patterns of enterprises in connection with their property rights status. However, time series available are too short. A panel data study seems to be the most adequate under such circumstances.

The data set used for these purposes is comprised of enterprise balance sheets, income statements, and several other standard forms describing ownership, employment and economic activity. This data set has been compiled from several sources. The main one is the State Securities and Stock Market Commission — it provides a standard bunch of annual reports for most incorporated entities. For those firms that remain under 100% state control or are not publicly incorporated[28], data in a similar format have been obtained from private sources.

In the time dimension the data are available for years 1997 through 2000. The total number of firms included is 34. These are all the major players in the industry that account for more than 97% of its total produce, and may be viewed as representative of it. However, certain sample deficiencies should be noted also.

[28] These entities are not obliged to reveal any financial or operating information publicly.

Some of the reports contain gaps, so the sample is not perfectly balanced — but still operational. Also, Ukrainian enterprises have switched to new accounting principles during the period considered, and sample construction required some demonstration of accounting skills and inventiveness. Finally, a certain amount of inevitable difference in accounting practices among firms may result in excessive variation of estimates or even a measurement error — certain judgmental reconciliation was applied to fight this vice.

To sum up, one may not absolutely rely on the quality of data in this case, but this is a common evil in transition and developing economies. In our opinion, this fact should never be allowed to halt a research completely, but must be taken into account somehow. The best available option is then to preserve a reasonable amount of caution in interpreting obtained results and making policy implications.

Let us now turn to the econometric model itself and empirical results. We will begin with methodological issues.

4.2. Methodology

In the world of imperfect information it is always difficult to find ideal measures for economic reality. This issue is especially acute in microeconomic studies when heterogeneous agents with bounded rationality interact with each other. The analysis of vertical integration is one of such cases. Agents with asymmetric information can make mistakes and be unaware of opportunities. This, at least in part, explains why econometric studies apply in the analysis such crude proxies for relevant economic variables. For instance, transaction costs are sometimes approximated by the length of production chain; sunk investment of a firm — by its actual investment in fixed assets, though these investments could be as good as cash; bargaining power – by a sort of Herfindahl-Hirschman index.

In our case, the challenge is even tougher. We should somehow estimate potential gains from a property rights structure. Obviously, no Ukrainian firm publishes assessment of gains associated with mergers, demergers, privatizations, etc. In addition, the problem of estimating the partial effect of these gains on an incentive to pursue a particular property rights arrangement and then raise investment and production is complicated by ubiquitous endogeneity of the variables. For instance, it is a well-known fact that the ownership and performance (in some of its aspects) are simultaneously determined. To put it differently, ownership determines the performance, while performance determines the ownership. To make things even worse, Ukrainian data, especially at the micro level, are subject to deserved critique. The methodology and conduct of the measurement are weak. Reporting is distorted by the threat that corrupted statistic-collecting agencies can release business sensitive information about a firm. Finally, many of important variables are not measurable or observable. For example, there are hardly any consistent reliable measures of the quality of management or, more generally, human capital possessed by a firm.

The above suggestions indicate, in particular, a few important econometric implications. Firstly, we should bear in mind potential endogeneity of key variables: ownership, performance (profits, productivity, payments/arrears, etc.), etc. Secondly, these variables are likely to be measured with a considerable error (e.g. purposefully distorted by firms). Thirdly, we have to apply econometric techniques capable of attenuating the inherent bias of omitting relevant (and presumable non-measurable/non-observable) variables. Fourthly, the use of proxies is virtually inevitable. We cannot estimate the gains from a certain property rights arrangement. Only very tentative and imprecise indicators are available.

These considerations lead us to employing a kind of panel data estimators. Panel estimators allow eliminating the omission bias by the assumption of time invariance of these variables. Thus, using fixed/random effects we can

effectively solve this part of the problem. Furthermore, as Frydman et al. (1999) suggest, panel data specification with individual specific intercept (i.e., fixed or random effects) is capable of attenuating endogeneity stemming from selection bias. Indeed, if a third party investor enters a firm non-randomly but picks up the best player first, endogeneity is likely to occur — but firm specific intercept should absorb that initial difference in firm performance. This is true, however, only under certain strong assumptions: factors influencing the investor's decision to enter a firm are related solely to firm performance (i.e., dependent variable) and do not change over the period concerned.

Ideally, a kind of instrumental variables technique should be used to get rid of endogeneity. The appropriate set of instruments could be:

- costs structure (share of capital expenses, labor outlays, fuel, etc.);
- past performance and ownership (it is the past and may not be affected by the present decisions. Though perfect foresight may lead to endogeneity);
- geographic proximity to borders and other membersof the merger;
- access to foreign markets;
- initial technological conditions (for instance, some technologies require specific inputs. In Soviet times, when co-operation was legally enforced, it could be not a problem but in market economies the threat of opportunism is quite realistic. Substitution of such inputs could be costly. This suggests modeling a dummy for prolonged trade flows between firms);
- change in the top management;

- dummy for enterprises that participate in the experiment in the ferrous metal industry[29];
- exogenous shocks (currency crisis, etc.);
- a set of time invariant variables captured by fixed or random effects (geographic proximity could be dropped).
- size (employment, assets, etc. May require instrumentation);
- past performance, ownership, etc;
- dummies for the industry branch: mines, ore enriching plants (*GOK*s), coke plants (chemical plants that produce coke required for some steel technologies), metallurgical plants, pipe-producing plants, etc.

Moreover, what we observe is that some firms integrate while others do not. If we consider in econometric analysis only those firms that have integrated[30] and then spread our conclusion made with respect to this limited sample on the population, we may get inconsistent results. Therefore, we would like to apply a method that takes into account that some firms may have integrated but did not. In brief, we should further elaborate our econometric endeavors with probit/tobit features. In other words, we should devise such a specification that takes into account the decisions not to integrate (stay out of the sample of 'merged' firms). This would mean "instrumenting" an

[29] Recognizing that the ferrous metal industry serves as a primary source of Ukraine's hard currency revenues, the Ukrainian parliament has adopted the Law "On conducting an economic experiment at the enterprises of metal and mining companies". The main idea is to provide the industry players with tax benefits in order to assist them in increasing their working capital, uploading their present capacities and upgrading their production facilities. The privileges granted include the following: beneficial corporate income tax rate equal to 9% (standard rate is 30%) and 50% reduction on innovation tax. All tax indebtedness prior to July 1, 1999 is cancelled. Other arrears accruals in favor of the state budget have been restructured. The program will be effective until January 2002 (three years long). In order to qualify for these benefits, a company's reported overall financial results and amount of taxes paid should be less than those prior to introduction of the Law.

[30] It is worth noting that we know about integration post factum.

ownership dummy by a certain probabilistic variable limited within a [0;1] range.

Unfortunately, data constraints do not allow us to implement an instrumental variable estimator more or less consistently. Therefore, we have to rely on individual specific intercepts in tackling endogeneity problem. This approach, hopefully, would be helpful in getting consistent results of hypothesis testing.

4.3. Model specification and results

The purpose of this study is to estimate the effect of presence of the third party investor on the performance of enterprises. The proposition of Section 3.3 may be translated into three falsifiable predictions:

- presence of the third party investor improves profitability of the *whole* production chain (group) controlled by him;
- presence of the third party investor improves performance (productivity) of *each* enterprise entering the group;
- presence of the third party investor stimulates investment of *each* enterprise entering the group.

Unfortunately, we are not able to test the first of the three statements formulated above. Size of the industrial groups being under consideration may be enormous — up to 650 enterprises. Consolidated public reporting is not carried out usually. Furthermore, such groups usually include a number of trading houses and offshore companies for profit stripping and tax planning purposes. Therefore, profitability of a typical group is impossible to estimate. Hence we concentrate on the latter two statements only.

According to the GHM argument, presence of the third party investor leads to in improvement of firm performance. Thus, the null hypothesis is: '***presence (entry) of the third party investor improves enterprise performance***'. The alternative hypothesis is, apparently, '***presence of the third party investor does not lead to the improvement in performance.***

Third party investor is irrelevant for firm performance.' It is worth noting that third parties invest not only in physical capital but also in human capital. However, both types of investment should be reflected on the labor productivity — another argument in favor of this indicator.

Total factor productivity is believed to be the best measure of enterprise performance. Unfortunately, in reality it is extremely difficult to collect information that adequately reflects capital employed in production. In Ukraine, data on capital is highly distorted (Estrin and Rosevear, 1999); thus, we cannot use total factor productivity as a measure of enterprise performance. In such a situation, we should employ proxies for enterprise performance, e.g. real net sales over labor input[31] (i.e. labor productivity). The strong advocates of labor productivity as a measure of performance are Bevan, Estrin, and Schaffer (1999). They show formally that labor productivity should in general tightly correlate with total factor productivity under transitional institutions (unlike capital productivity or some other performance indicators). Then they review a number of studies where labor productivity has been successfully applied as a measure of enterprise performance and consider potential distortions in this indicator. Their analysis concludes with an observation that "labor productivity may be regarded as the indicator least likely to be subject to bias".

One can show the presence of a third party investor in a firm with a dichotomous dummy variable. It equals one when the third part investor has a stake in the firm and zero otherwise. Unfortunately, there is no clear cut whether the third party investor enters the firm or not. Usually, the third party investor penetrates into the firm ownership through own subsidiaries registered abroad. The author uses all available information to determine whether say *'XYZ Trading, Ltd*' is a branch of an investing group such as

[31] Normally, a wide set of performance indicators (proxies) (see e.g. Estrin and Rosevear, 1999) is used to multidimensionally capture the true performance of enterprises.

'*Industrial Union of Donbass*' or other powerful clans[32]. From this perspective, the introduced definition of this variable is somewhat judgmental but this is the best what one can do in the nontransparent business environment of Ukraine.

As we see from the theoretical model, another important explanatory variable that is likely to be endogenous is investment. It is very reasonable to assume that the amount of investment and the third party investor's decision to enter the firm are made simultaneously. Thus, we should also apply individual effects model to get consistent estimates.

Precise measures of how much firms invest are not available; thus, we have to use proxies to estimate the direction and magnitude of changes brought by third party investors. Such a proxy could be the change in production assets plus depreciation. From accounting, we know that

$$NPPE_t = NPPE_{t-1} + INVEST_t - DEP_t$$

where
$NPPE$ – net property plant and equipment,
$INVEST$ – investment,
DEP – depreciation.

From this formula we can easily derive the imputed investments made by a firm:

$$INVEST_t = D(NPPE_t) + DEP_t$$

[32] The procedure for constructing *TPI* (third party investor) dummy was as follows. List of official shareholders is publicly available for all enterprises in the sample, but it typically includes numerous offshore entities. Industrial groups ("third parties") in some cases disclose information about their participation in offshore companies to primary financial intermediaries (banks, custodians, etc). From private sources, we had access to this type of information, and, thereby, we were able to determine whether a certain offshore company belongs to particular Ukrainian industrial group or not. This information cannot be revealed, since we have to abide confidentiality agreement. If in some particular period an enterprise in the sample turned out to be at least 25% controlled by an industrial group (either through offshores or through Ukrainian companies already being in the group), we set *TPI* to equal 1. Otherwise, this variable was set to 0.

This measure is, however, often criticized because flaws in initial periods are going to be transferred to other periods. However, other measures for investment are even less reliable. To reduce the inherent heterogeneity, we weight investment by income before taxes.

It is also preferable to control for the soft budget of some firms. There is no perfect measure of how soft the budget constraint is. Some authors use a quite large set of variables (more than 20) compressed into synthetic indices by principal components techniques (Carlin, Fries, Shaffer, and Seabright, 2001). The author does not possess such extensive description of firm characteristics. However, one can use, for instance, the share of payables to budget in total liabilities and equity as a proxy for the softness of the budget constraint[33]. *Ceteris paribus*, a higher share indicates a paternalistic approach to the firm, i.e. a softer budget constraint. Given paternalistic approach to the firm from the government, we can expect that firms are less concerned with their performance than in the case of hard budget constraints. Consequently, we expect that the soft budget constraint leads to a fall in the firm performance.

From the analysis of industry performance we see that the capacity is largely underutilized. It means, in particular, that the average product of labor could be increasing. Thus, larger employment, ceteris paribus, could lead to a higher productivity of labor given mentioned economies of scale. To take into account this effect, we include employment as a measure of economies of scale. The expected sign is positive indicating that the firm size has a positive effect on labor productivity.

The state has a stake in most enterprises in the industry. Although the effect of state ownership is somewhat mixed, it is argued that state presence may

[33] Shaffer (1997) indicates that "the main route by which budget constraints are softened in the rapidly transforming transition economies, and one of the main routes by which they are softened in the slower reformers, is via tax arrears". Taking into account that Schaffer supports his claim with empirical evidence, we may regard budget payables as a reliable proxy for soft budget constraints.

indicate soft budget constraint. Given the suggested arguments, this may result in lower performance. In addition, the state is generally a poor owner since the incentives to care about profits and enterprises performance are quite muted and distanced. In brief, we expect that the coefficient sign of the state share in ownership is negative. It is worth noting that sometimes the presence of the state among equity holders may serve as a guarantee that the state is interested in the normal functioning of an enterprise. This implicit guarantee may extend planning horizons, increase investment in both physical and human capital and, consequently, raise performance. On balance, the author believes that in this particular instance higher government share in the property would lead to poorer firm performance. The state share includes explicit government bodies (e.g. State Property Fund) as well as state companies (e.g. State Joint Stock Company "Ukrainian Polymetals").

Another important factor is the dispersion of ownership. It is reasonable to anticipate that the more parties participate in the bargaining, the more difficult it becomes to reach agreement. Therefore, the dispersion of ownership reduces the possibility for principal owners to effectively control management. In addition, when there are many owners, surplus per owner is quite small, and owners, consequently, have relatively small incentive to care about the firm performance. They would rather sell (exit) when things go wrong than actively 'fight' for better performance. In sum, we expect that the higher concentration of ownership results in better enterprise performance, ceteris paribus.

To estimate the ownership concentration we use the Herfindahl-Hirschman index (HHI). The HHI is calculated as the sum of squares of equity holder shares. The author takes into account only those owners whose stake exceeds 5% level because enterprise reports do not reveal more details about the ownership structure. This issue, nevertheless, does not seem to play any significant role. Even if all 'unrevealed' shares are slightly below the threshold five percent, the HHI does not change much in the vast majority of cases.

It is worth noting, however, that we should be careful in using the HHI. The state quite often has a significant share in the firm's capital. As a result, a high HHI may indicate not the efficiency enhancing concentration of ownership but the efficiency diminishing state ownership. To tackle this problem it is worth using the HHI net of the squared state share. This measure of ownership concentration should be a more consistent estimate for ownership concentration. In a sense, suggested indicator is the concentration of private ownership.

The model specification is summarized in the following equation:

$$\frac{NS_{it}}{CPI_t \cdot Empl_{it}} = \beta_{0i} + \beta_1 \cdot \frac{D(BP_{it})}{TA_{it}} + \beta_2 \cdot \frac{INVEST_{it}}{TA_{it}} + \beta_3 \cdot TPI_{it} + \beta_4 \cdot SS_{it} +$$

$$+ \beta_5 \cdot (HHI_{it} - SS_{it}^2) + \beta_6 \cdot Empl_{it} + \varepsilon_{it},$$

where

i — index for an enterprise,
t — index for time period,
NS — net sales, thousand UAH,
CPI — consumer price index, 1997=1,
$Empl$ — number of employed by an enterprise, persons,
BP — payables to budget, thousand UAH,
TA — total assets, thousand UAH,
$INVEST$ — investment of an enterprise, equal to change in the net value of property plant and equipment plus accrued depreciation, thousand UAH,
TPI — dummy variable for the presence of third party investor (presence =1),
SS — state share in enterprises equity, %,
HHI – Herfindahl-Hirschman index for the shares of equity holders.

The null hypothesis is $H_0 : \beta_3 > 0$. The alternative hypothesis is $H_1 : \beta_3 \le 0$.

A few important features deserve special attention and care.

Many, if not most, characteristics of agents are unobservable or immeasurable. For instance, we can barely measure the quality of management or firm's endowment with intangible human capital. If we cannot somehow take into account the effect of these variables, we will end up with biased and inconsistent estimates for other parameters. The panel data estimator can help to attenuate this problem of omission bias. We assume that these unobservable or immeasurable characteristics are time invariant, and we use firm-specific coefficients that absorb the influence of all these effects. Thus, the use of firm-specific coefficients β_{0i} (either random or fixed effects) diminishes the problems caused by unobserved heterogeneity.

One should also be aware that many variables that appear on the right hand side of the 'main' equation are potentially endogenous. When the regressand and some regressors are determined simultaneously, we obtain biased and inconsistent estimates for the coefficients. Though individual specific intercepts are supposed to resolve this problem, their adequacy for this task in the present case is not obvious. Thus, the results presented below should be taken with a grain of salt.

The results of random effects panel estimation are presented in the Table 4.1.

TABLE 4.1

ENTERPRISE PERFORMANCE

(dependent variable is $NS_{it}/[CPI \cdot Empl_{it}]$)

VARIABLE	COEFFICIENT	T-STATISTIC
Constant term	24.9183	(4.113)
$D(BP_{it})/TA_{it}$	-14.0125	-0.524
$INVEST_{it}/TA_{t}$	3.0807	0.486
TPI_{it}	7.9315	2.855
SS_{it}	-0.1101	-1.642
$(HHI_{it} - SS_{it}^2)$	0.0023	2.523
$Empl_{it}$	0.0013	2.533
R^2 = 0.989 (cross-section weights)		

The 'main' coefficient of the regression is that of TPI_{it}. It is positive and significant. The estimated parameter indicates that presence of a third party investor results in enhancing enterprise performance. *Ceteris paribus*, presence of the third party investor raises the real net sales per worker by 7.93 thousand UAH (roughly 25% increase). It is worth noting that the sign and significance is very robust to changes in model specification. The estimate may suffer from endogeneity but its robustness indicates persistence of third party investor effect on the firm performance. Nevertheless, it is worth noting that the endogeneity may not be an issue here since labor productivity and the decision to invest are related only indirectly. In other words, returns on capital and profitability matter for outside investors rather than labor productivity.

As it was expected in the preliminary discussion of the model specification, presence of the state reduces the performance indicators of enterprises. The soft budget constraint approximated by change in payables to budget over total assets has the same direction.

Dispersion of private ownership ($HHI_{it} - SS_{it}^2$) appears to adversely affect the enterprise performance. The coefficient is positive and significant. Thus, high concentration of ownership in private 'hands' increases the firm efficiency. This result is in conformity with other studies of firm performance in transition countries.

The firm size measured by employment also seems to play a role in explaining variation of the real net sales per employed. Holding other things constant, one additional employee raises the output per worker by 1.3 UAH.

Let us now consider the effects of the third party presence on the investment activity of the enterprises. We take the ratio of investment (as it was defined above) to earnings before taxes as a dependent variable here. Such a regressand is supposed to reflect an enterprise willingness to devote its free profits to improving total factor productivity — in other words, "average propensity to invest".

The main regressor is again the dummy for third party presence. Apparently, the null hypothesis is: '***presence (entry) of the third party investor stimulates investment***'. The alternative hypothesis is, '***Third party investor is irrelevant for firm investment activity***.'

The list of control variables includes:

- state share in the ownership, supposed to capture difference in investment incentives between private and state-owned firms (the coefficient sign is not clear — on the one hand, privately run enterprises are expected to have longer term planning horizons and higher investments, but on the other, state bureaucrats may overinvest in order to maximize their budgets and political significance);
- leverage (net worth to total assets), with anticipated positive coefficient sign (moderately leveraged enterprises might have better internal cash generation and more sound financial stance, which results in longer planning horizons);
- earnings before taxes (current and lagged one period), expected coefficient sign is positive;
- investment of the previous period (anticipated sign is unclear — on the one hand, higher past investments may indicate that an enterprise has a long run investment project and is likely to invest more in the following periods; on the other hand, high investments in the recent past reduce the necessity for new investments in future).

The resulting specification is then:

$$\frac{INVEST_{it}}{EBT_{it}} = \beta_{0i} + \beta_1 \cdot \frac{NW_{it-1}}{TA_{it-1}} + \beta_2 \cdot \frac{INVEST_{it-1}}{EBT_{it-1}} + \beta_3 \cdot TPI_{it} + \beta_4 \cdot SS_{it} + \\ + \beta_5 \cdot EBT_{it} + \beta_6 \cdot EBT_{it-1} + \varepsilon_{it},$$

where

i — index for an enterprise,
t — index for time period,

TABLE 4.2

ENTERPRISE INVESTMENT

(dependent variable is $\frac{INVEST_{it}}{EBT_{it}}$)

VARIABLE	COEFFICIENT	T-STATISTIC
Constant term	-4.163	(-3.975)
$\frac{NW_{it-1}}{TA_{it-1}}$	7.580	(3.961)
$\frac{INVEST_{it-1}}{EBT_{it-1}}$	-0.109	(-2.683)
TPI_{it}	2.096	(1.960)
SS_{it}	$6.99 \cdot 10^{-5}$	(0.015)
EBT_{it}	$2.19 \cdot 10^{-6}$	(2.969)
EBT_{it-1}	$-7.36 \cdot 10^{-6}$	(-1.590)

R^2 = 0.776 (cross-section-weights)

$INVEST$ — investment of an enterprise, equal to change in the net value of property plant and equipment plus accrued depreciation, thousand UAH,
EBT — earnings before taxes, thousand UAH,
NW — net worth of an enterprise (book value), thousand UAH,
TA — total assets, thousand UAH,
TPI — dummy variable for the presence of third party investor (presence =1),
SS — state share in enterprises equity, %.

The results of the estimation are presented in Table 4.2.

The main coefficient of the regression, that of *TPI*, is positive and marginally significant (*p*-value is 8.6%). However, we must confess that robustness of the obtained estimate to specification changes was far from satisfactory. Generally speaking, the positive impact of third party presence on the investment is not so obvious from the empirical evidence available. Mentioned sample deficiencies and potential endogeneity may have played the role here.

However, when considering both regressions, one may say that the formulated hypotheses do indeed find support in the empirical evidence. Though this support is not overwhelmingly strong, the author finds it possible to claim that third party presence stimulates investment of

enterprises and improves firm performance in terms of productivity, as it was predicted by the GHM model.

Chapter 5

CONCLUDING REMARKS

The main empirical result of the present research is quite clear: a "third party" does indeed seem to have a positive influence on enterprise performance. Though evidence provided is not decisive, it is undoubtedly supportive. High absolute value, significance and, above all, robustness of the obtained estimate to changes in specification validate such a conclusion. However, the impact on investment is much less clear. In sum, an elaborate empirical study based on a more reliable data set is required in order to make the positive conclusions of the present research sufficiently strong. The guidelines for such a research are quite clear and may be easily deduced from the previous chapter.

Policy implications of the obtained results are not so straightforward, however. On the one hand, if "third party" integration appears to promote productive efficiency, it should be desirable to create favorable conditions for integration of this type. They might include taxation privileges, arrangement of privatization tenders (in contrast to privatization for money), abolition of insider buy-outs for state owned firms, export promoting policies, etc.

On the other hand, the phenomenon under consideration also has some other consequences apart from promoting productive efficiency, and they may be not so attractive. In particular, it would inevitably lead to concentration of the industry. "Third parties", strong financial and industrial groups, could gain some monopolistic power in this case and exploit it to their own benefit, causing thereby losses to the society.

Growing importance of these groups would also concentrate enormous lobbying power in their hands and endanger political stability in the society, and thereby hamper overall economic growth. Certain normative issues (as distributional ones, for instance) should also be considered.

In general, a detailed cost-benefit analysis is required to make a final judgment concerning desirability of wide scale "third party" integration for the whole economy. Intuitively, one may expect that costs are likely to outweigh benefits in the long run — given the examples of "oligarch" societies like Russia or Indonesia. Nonetheless, existence of integrating groups is typical for all the developed economies as well — their ultimate utility seems to be a matter of effectiveness of the public control.

However, this study did not intend to go deeply to normative issues of this sort. The main message of the present research lies in the area of positive economics and does not depend on any potential policy implications. What this paper is supposed to demonstrate is that property rights arrangements do matter for incentives of the firms and have a crucial impact on their performance. Different property rights allocations lead to different outcomes in terms of relative efficiency, and they place binding constraints on the behavior of agents in the economy. Effects of this difference can be (and probably should be) measured quantitatively and taken into account by both economic academicians in their research and policy makers in their programs. If the reader has come at this point to the same conclusion, this work is probably not a failure then.

WORKS CITED

American Iron and Steel Institute. 2000. *Global Steel Trade. Structural Problems and Future Solutions. Report to the President of the US*. International Trade Administration, US Department of Commerce. Available on-line at http://www.ita.doc.gov/media/steelreport726.htm

Bain, Joe S. 1951. *Relation of Profit Rate to Industry Concentration: American Manufacturing, 1936-1940*. "Quarterly Journal of Economics", Vol. 65

____, ___. 1956. *Barriers to New Competition: The Character and Consequences in Manufacturing Industries.* Cambridge: Harvard University Press

Bevan, Alan A., Saul Estrin, and Mark E. Schaffer. 1999. *Determinants of Enterprise Performance during Transition.* CERT Discussion Paper No. 99/03

Binmore, Ken, Avner Shaked and John Sutton. 1989. *An Outside Option Experiment.* "Quarterly Journal of Economics", Vol. 104 (4)

Blanchard, Oliver and Michael Kremer.1997. *Disorganization.* "Quarterly Journal of Economics", Vol. 112 (4)

Carlin, Wendy, Steven Fries, Mark Schaffer, and Paul Seabright. 2001. *Competition and Enterprise Performance in Transition Economies. Evidence from a Cross-Country Survey.* Presented at the IZA-EERC Workshop in Kyiv, on April 9, 2001

Carlton, Dennis W., and Jeffrey M. Perloff. 2000. *Modern Industrial Organization.* Addison-Wesley-Longman

Estrin, Saul and Adam Rosevear. 1999. *Enterprise Performance and Ownership: The Case of Ukraine*. "European Economic Review", Vol. 43

Frydman, Roman, Cheryl Gray, Marek Hessel, and Andrzej Rapaczynski. 1999. *When DoesPrivatization Work? The Impact of Private Ownership on Corporate Performance in Transition Economies.* Proceedings of the 5th Nobel Symposium in Economics, "Economics of Transition"

Furubotn, Eirik G. and Rudolf Richter. 1997. *Institutions and Economic Theory. The Contribution of the New Institutional Economics.* The University of Michigan Press

Gaidar, Yegor. 1997. *Anomalies of the Socialist Growth.* Moscow [in Russian]

Grossman, Sanford G. and Oliver D. Hart. 1986. *The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration.* "The Journal of Political Economy", Vol. 94 (4)

Hart, Oliver D. 1995. *Firms, Contracts, and Financial Structure.* Clarendon Press, Oxford

Hart, Oliver D., and John Moore. 1990. *Property Rights and the Nature of the Firm.* "The Journal of Political Economy", Vol. 98(6)

Hatch Beddows Group. 2000. *Steel in the 21st Century: Growth in a Gloom Industry*. London-Toronto-Pittsburgh-New York

InvestGazeta. 2000. *Top 100 Rating of Ukrainian Enterprises*, June 2000

Johnson, Simon, John McMillan, and Christopher Woodruff. 1999. *Contract Enforcement in Transition.* CESifo Working Paper No.211

Johnson, Simon, John McMillan, and Christopher Woodruff. 1999. *Property Rights, Finance, and Entrepreneurship*. CESifo Working Paper No.212

Klein B., R. Crawford, and A. Alchian. 1978. *Vertical Integration, Appropriable Rents, and the Competitive Contracting Process.* "Journal of Law and Economics" Vol. 28

Kornai, Janos. 1991, *Deficit.* Moscow: Nauka [in Russian]

_____, _____. 1992. *The Socialist System. The Political Economy of Communism.* Oxford Univ. Press

Lerner, Abba P. 1934. *The Concept of Monopoly and the Measurement of Monopoly Power.* "Review of Economic Studies", Vol. 1

Marin, Dalia, and Monika Schnitzer. 2000. *Disorganization and Financial Collapse.* CESifo Working Paper No. 339

McKinsey Report. 1999. *Steel*

de Meza, David and Ben Lockwood.1998. *Does Asset Ownership Always Motivate Managers? Outside Options and the Property Rights Theory of the Firm*. "Quarterly Journal of Economics". Vol. 113 (3)

Nash, John. 1950. *The Bargaining Problem.* "Econometrica" 18.

Osborne, Martin J. and Ariel Rubinstein 1990. *Bargaining and Markets.* Academic Press

Recanatini, Francesca, and Randi Ryterman. 2000. *Disorganisation or Self-Organization.* World Bank. FEEM Working Paper No.26.00

Roland, Gerard. 2000. *Transition and Economics*. The MIT Press, Cambridge, Massachusetts

Roland, Gerard, and T. Verdier. 1999. *Transition and the Output Fall*. "Economics of Transition", Vol. 7(1)

Schaffer, Mark E. 1997. *Do Firms in Transition Have Soft Budget Constraints? A Reconsideration of Concepts and Evidence*. CERT Discussion Paper

Williamson, Oliver E. 1985. *The Economic Institutions of Capitalism.* Free Press, New York

APPENDIX 1.

THE FERROUS METAL DEMAND FUNCTION: TESTING FOR VALIDITY OF INSTRUMENTS

List of exogenous variables:
INDEXINDOUT — industrial output index,
AWAGE — average wage, UAH,
GDPDEF — GDP deflator,
RGDP — real GDP, billion UAH,
OILGAS — liquid fuels consumption index,
RI — real interest rate,
ER — UAH/$ exchange rate,
GP — natural gas price (quarterly),
EP — electricity price (quarterly).

The overidentifying restrictions test:

TABLE A1.1

OVERIDENTIFYING RESTRICTIONS TEST
(dependent variable is residual of regression in Table 2.2)

VARIABLE	COEFFICIENT	T-STATISTIC
log(*INDEXINDOUT*)	-0.346	(0.367)
$\log\left(\frac{AWAGE}{GDPDEF}\right)$	-0.078	(0.234)
log (*GDPDEF*)	-0.012	(0.127)
log (*RGDP*)	0.172	(0.176)
log (*OILGAS*)	-0.048	(0.132)
RI	0.001	(0.011)
$\log\left(\frac{ER}{GDPDEF}\right)$	-0.067	(0.114)
$\log\left(\frac{GP}{GDPDEF}\right)$	-0.053	(0.086)
$\log\left(\frac{EP}{GDPDEF}\right)$	0.100	(0.237)

$R^2 = 0.203838$

$R^2 \times N \approx 3.05 \sim \chi^2_9$

Critical value of χ^2_9 at α = 1% is 21.7, which implies that instruments are adequate.

Hausman specification test for demand function:

$$b\_iv := \begin{bmatrix} -5.688163 \\ -0.127450 \\ 0.201672 \\ 0.745751 \\ -2.136593 \\ 1.803616 \\ 0.636679 \end{bmatrix} \qquad b\_ols := \begin{bmatrix} -5.046371 \\ -0.123734 \\ 0.211799 \\ 0.619460 \\ -1.869957 \\ 1.556705 \\ 0.587901 \end{bmatrix}$$

$$cov\_iv := \begin{bmatrix} 7.85179358217 & -0.06705432919 & 0.611809322217 & 0.0684799374731 & 1.05019807212 & -0.647371662575 & -1.04741757862 \\ -0.06705432919 & 0.0108670233906 & -0.00838644020474 & -0.00780319190148 & 0.00994422689158 & -0.010492360405 & 0.0115594101807 \\ 0.611809322217 & -0.00838644020474 & 0.0932108177039 & 0.0177329233875 & 0.0465120009663 & -0.0131820284351 & -0.0965537556877 \\ 0.0684799374731 & -0.00780319190148 & 0.0177329233875 & 0.0640923092209 & -0.0684039635074 & 0.0751254363295 & -0.0269785435318 \\ 1.05019807212 & 0.00994422689158 & 0.0465120009663 & -0.0684039635074 & 0.336963464206 & -0.285508383925 & -0.113341175701 \\ -0.647371662575 & -0.010492360405 & -0.0131820284351 & 0.0751254363295 & -0.285508383925 & 0.258930439567 & 0.0613734582672 \\ -1.04741757862 & 0.0115594101807 & -0.0965537556877 & -0.0269785435318 & -0.113341175701 & 0.0613734582672 & 0.150910504407 \end{bmatrix}$$

$$cov\_ols := \begin{bmatrix} 7.05688855059 & -0.0522387004576 & 0.577225617347 & 0.0900091386598 & 0.896128359532 & -0.525397939162 & -0.952710950901 \\ -0.0522387004576 & 0.00892930256911 & -0.0071821154196 & -0.00630932091225 & 0.00775434830618 & -0.00807312844097 & 0.00922032464993 \\ 0.577225617347 & -0.0071821154196 & 0.0852073770583 & 0.0202752069663 & 0.045079891543 & -0.0133701323876 & -0.0913132750824 \\ 0.0900091386598 & -0.00630932091225 & 0.0202752069663 & 0.0472459801083 & -0.0487290506375 & 0.0557806162264 & -0.0262054020449 \\ 0.896128359532 & 0.00775434830618 & 0.045079891543 & -0.0487290506375 & 0.274236335301 & -0.228890384279 & -0.0996503721239 \\ -0.525397939162 & -0.00807312844097 & -0.0133701323876 & 0.0557806162264 & -0.228890384279 & 0.206788794791 & 0.0515220436031 \\ -0.952710950901 & 0.00922032464993 & -0.0913132750824 & -0.0262054020449 & -0.0996503721239 & 0.0515220436031 & 0.138449261488 \end{bmatrix}$$

$$st := (b\_iv - b\_ols)^{T} \cdot (cov\_iv - cov\_ols)^{-1} \cdot (b\_iv - b\_ols)$$

$$st = (1.395)$$

$$pp := pchisq(st, 7)$$

$$pp = (0.014)$$

The test does not reject consistency of OLS at any α >1.4%.

Hausman specification test for supply function:

$$b\_iv := \begin{bmatrix} -3.114298 \\ 0.054554 \\ -0.566625 \\ 0.100955 \\ -0.293473 \\ -0.235178 \\ 0.266803 \end{bmatrix} \qquad b\_ols := \begin{bmatrix} -3.167620 \\ 0.047722 \\ -0.364711 \\ 0.105718 \\ -0.303751 \\ -0.235599 \\ 0.313298 \end{bmatrix}$$

$$cov\_iv := \begin{bmatrix} 0.282504191252 & -0.00152680410587 & 0.0248349209357 & 0.0101559630736 & 0.0127799694927 & 0.00879593476478 & -0.0151635196911 \\ -0.00152680410587 & 0.000310629617895 & -0.00196586509587 & -0.00067242735214 & -0.00152775521163 & 4.13894471567 \cdot 10^{-5} & -0.00141524282926 \\ 0.0248349209357 & -0.00196586509587 & 0.022274394191 & 0.00732951222128 & 0.0107929603543 & 7.38696295272 \cdot 10^{-5} & 0.0147340080992 \\ 0.0101559630736 & -0.00067242735214 & 0.00732951222128 & 0.00361540099644 & 0.0041050015218 & -0.000156393454712 & 0.00588603820832 \\ 0.0127799694927 & -0.00152775521163 & 0.0107929603543 & 0.0041050015218 & 0.0080418746991 & -8.41992578591 \cdot 10^{-5} & 0.00816896216982 \\ 0.00879593476478 & 4.13894471567 \cdot 10^{-5} & 7.38696295272 \cdot 10^{-5} & -0.000156393454712 & -\left(8.41992578591 \cdot 10^{-5}\right) & 0.000366155237265 & -0.0011488226083 \\ -0.0151635196911 & -0.00141524282926 & 0.0147340080992 & 0.00588603820832 & 0.00816896216982 & -0.0011488226083 & 0.0167600425699 \end{bmatrix}$$

$$cov\_ols := \begin{bmatrix} 0.95829568935 & 0.00134337302487 & 0.0127988099883 & -0.012258193244 & 0.00540905531952 & 0.0422669466339 & -0.0744068621336 \\ 0.00134337302487 & 0.000219450593718 & -0.0016158956958 & -\left(7.88198079762 \cdot 10^{-5}\right) & -0.00078093252873 & 7.14758293161 \cdot 10^{-5} & -0.000484276772064 \\ 0.0127988099883 & -0.0016158956958 & 0.0386711992016 & 0.000736320792219 & 0.000900506131997 & 0.000616201732068 & 0.00438599319149 \\ -0.012258193244 & -\left(7.88198079762 \cdot 10^{-5}\right) & 0.000736320792219 & 0.00433497678681 & 0.00101916692701 & -0.00173755802316 & 0.00167331262595 \\ 0.00540905531952 & -0.00078093252873 & 0.000900506131997 & 0.00101916692701 & 0.00607761405729 & -\left(7.0335866591 \cdot 10^{-5}\right) & 0.000947833688597 \\ 0.0422669466339 & 7.14758293161 \cdot 10^{-5} & 0.000616201732068 & -0.00173755802316 & -\left(7.0335866591 \cdot 10^{-5}\right) & 0.00227296398525 & -0.00273299555326 \\ -0.0744068621336 & -0.000484276772064 & 0.00438599319149 & 0.00167331262595 & 0.000947833688597 & -0.00273299555326 & 0.0150378434762 \end{bmatrix}$$

$$st := (b\_iv - b\_ols)^{T} \cdot (cov\_ols - cov\_iv)^{-1} \cdot (b\_iv - b\_ols)$$

$$st = (3.466)$$

$$pp := pchisq(st, 7)$$

$$pp = (0.161)$$

The test rejects consistency of OLS at any α <16%.

We may conclude that the demand function may be estimated by OLS in principle. However, the whole demand-supply system may be consistently estimated by 2SLS only. Hence simultaneous equations model seems weakly preferable in this case.

APPENDIX 2.
DERIVATION OF ALTERNATIVE MARK-UP DEFINITION

Let *RR* denote the net margin, total cost equal *TC=TC(q),* and total revenue equal *TR=TR(q)=p(q)*q.*

Then, apparently,

$$RR = \frac{TR - TC}{TR} = 1 - \frac{TC}{TR}.$$

Differentiating with respect to quantity, we then obtain:

$$\frac{\partial RR}{\partial q} = -\frac{MC \cdot TR - TC \cdot \frac{\partial TR}{\partial q}}{TR^2} = -\frac{MC \cdot p \cdot q - TC\left(p + \frac{\partial P}{\partial q} q\right)}{(pq)^2} == -\frac{MC}{pq} + TC\left(\frac{1}{pq^2} + \frac{\partial P/\partial q}{p^2 q}\right)$$

.

Let us denote $\frac{\partial q}{\partial p}\frac{p}{q} = \varepsilon$ (price elasticity of demand). Multiplying both sides by *q*, we then get:

$$\frac{\partial RR}{\partial q} q = -\frac{MC}{p} + TC\left(\frac{1}{pq} + \frac{\partial p \diagup \partial q \cdot q \diagup p}{pq}\right) = -\frac{MC}{p} + TC\left(\frac{1}{pq} + \frac{1}{pq\varepsilon}\right).$$

Let us denote mark-up as $MU = \frac{P - MC}{P} = 1 - \frac{MC}{P}$. If we add 1 to both sides of the above equation, we then obtain:

$$1 + \frac{\partial RR}{\partial q} q = MU + \frac{TC}{pq} + \frac{TC}{pq\varepsilon} = MU + \frac{TC}{TR} + \frac{TC}{pq\varepsilon} = MU + 1 - RR + \frac{TC}{pq\varepsilon},$$

$$\frac{\partial RR}{\partial q} q = MU - RR + \frac{TC}{pq\varepsilon}.$$

Let $\frac{\partial RR}{\partial q}\frac{q}{RR} =$ denote the elasticity of the net margin with respect to quantity.

$$= \frac{MU}{RR} + \frac{TC}{p \cdot q \cdot \varepsilon \cdot RR} - 1 = \frac{MU}{RR} + \frac{1}{RR \cdot \varepsilon}(1 - RR) - 1.$$

Finally,

$$MU = RR\left(-\frac{1}{\varepsilon \cdot RR} + \frac{1}{\varepsilon} + 1 \right).$$

This analysis does not depend on assumption *MR = MC*. Hence, it should be robust to market distortions, for instance government interventions.

APPENDIX 3.

INDUSTRY CYCLE