UKRAINIAN INDUSTRY IN TRANSITION: STEEL PRICE DETERMINATION MODEL

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Abstract

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Ukrainian steel industry is by far the most important field for the country. The research investigates factors that influence Ukrainian steel prices. The model is done with simultaneous equation model techniques which required by endogenous nature of the supply and demand equations. The obtained results show that Ukrainian steel pricing is consistent with that of developed countries. Thus, Ukrainian steel industry has passed its transition position and act as a fully-fledged market economy sector. Thus, Ukraine's joining WTO will not cause losses for Ukrainian producers.

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GLOSSARY

Crude steel – steel at its first stage of solidification, i.e. continiously cast semi-finished products.

Semi-finished products – products of solid cross section which have not been worked except by continuous casting or primary hot-rolling.

Iron ore – mineral mined from the earth that contains 50%-65% of iron. Used to produce prepared ore material – sinter and pellets, which are charge into blast furnace.

Coke – product obtained from heating coal at high temperatures – 1200-1300 C. Used to make sinter and pig iron.

Sinter – agglomerated (prepared) iron ore that is used to produce pig iron.

Pellets – prepared type of iron ore.

Scrap – metal waste of machines, equipments etc.

Chapter 1

INTRODUCTION

This research deals with the industrial issues and is in line with those devoted to the solution of the practical problems the economy of Ukraine facing nowadays. The primary aim of this study is to investigate the factors determining steel price formation in Ukraine and their influence on the Ukrainian steel export prices. The conclusion on the nature of the Ukrainian steel industry based on this ground may be used in the defense of Ukrainian producers in the antidumping cases and implications of Ukraine's integration into the WTO for the industry.

My interest of this topic stems from the fact that the steel industry is one of the most important in Ukraine's economy. Steel is Ukraine's premier export commodity that accounts for more than 30% of country's currency revenue. Ukraine has unique natural resources at its disposal- iron ore, coal and dolomites, and developed rail road facilities that ensure stable raw material supplies to the steel plants. Ukraine produces about 40 million tons of steel and is the seventh largest steel-producing country in the world. A lion's share of steel produced in Ukraine is exported (79.3 %), so Ukraine is an influential player on the world steel market. Stability of exports markets is important for Ukraine since the industry employs thousands of people, steel plants are town making enterprises and the industry itself is the base sector in the economy: the well-being of many other industries, such as mining, construction, pipe and auto-making depend on the good functioning of the steel sector.

Importance of the Ukrainian steel industry is manifested by the fact that it accounts around for 30% of foreign currency inflow and around 40% of

Ukrainian GDP. The Ukrainian steel industry depends on the external market and since the domestic market is underdeveloped it will continue to be export-oriented in the future. Therefore, the ability to forecast world steel price behavior and know the quantitative impact of other factors are important and desirable for the Ukrainian steel producers. Knowledge of how these factors influence steel prices and awareness of the direction of prices movement will help Ukrainian steel makers to make correct decision about their production plans. They also help government officials better predict the amount of the budget revenues and improve state's budget planning process through tax payment to the budget. Moreover, due to the importance of the steel sector to Ukraine's economy, ability to envision the direction of the world steel prices and their impact on their Ukrainian plants will help economists to forecast the future condition of the Ukrainian economy.

Similar researches were made by foreign and Ukrainian researchers. There are works that describe the influence of different determinants on the steel price level in the US, estimate the model of steel prices and examined the effect of different explanatory variables such as: industrial production, steel prices, scrap price, coal price, electricity production, wage, dollar exchange rate, production capacity. Ukrainian authors describe industry as a whole, also differences between the real state of the Ukrainian ferrous metal industry and the potential efficient state of the market. So, analysis of steel price determination has never been done before in Ukraine. The only company that does this research is a state enterprise "Ukrpromzovnishexpertise". Yet, this enterprise evaluates the future prices by expert's estimation without usage of econometric methods. Thus, my research will be the first to deal with steel prices by econometric methods.

Another motivation is to compare the pricing models both in Ukraine, which is deemed a developing country, and developed country to draw conclusions as to how closely Ukraine has approached market economy countries.

In the research simultaneous equation method is going to be used, since we estimate supply and demand equations that are linked through endogenous variable-price. The supply equation is the function of world price, world steel production, Ukraine's economic growth rate, and steel capacities of Ukraine, steel price of Ukraine. Instead of the demand equation I write the inverted function-steel price as a function of quantity of steel supplied in the world, steel supplied in Ukraine and cost indices.

The paper is structured in the following way. Chapter 2 provides the overview of the literature of the thesis. Chapter 3 provides overview of the industry and the exposition of the main model. Chapter 4 presents empirical results of the evaluation of the influence of those variables on steel price in Ukraine. The chapter also includes description of data and its sources. The diploma concludes with the comments on the results and compares those results with ones from the literature review.

Chapter 2

LITERATURE REVIEW

The goal of this paper is to define the factors that contribute to fluctuations in the price level of steel products and analyze their influence on Ukrainian steel prices in the future. This will include macroeconomic analysis - determining the demand and supply functions for the Ukrainian steel industry as well as econometric research for implementation of the model. That is why, to fulfill such plans one needs to review the papers of the researchers in analyzing steel industry or building steel price model by examining literature (split into international and local literature) that may relate to the subject of the research. The foreign sources are the following.

Mancke (1968) considers factors that influence steel price level in the USA. He views demand, supply and the market structure as the main determinants of the steel price. The problem the author argues about is difficulties with the determining of aggregate demand (the sum of small demands may lead to the misleading results) because of steel buyers peculiarity to compass the range of American industry. Mancke tests the determinants of steel prices with an ordinary least squares multivariate regression analysis. In his econometric analysis he represents the effect of capacity utilization by regressing prices on the demand level. Contrary to the logic obtained coefficients are not positive, but not significant as well. He also includes dummy variable for import ratio. Insignificant coefficients of the regression lead to the conclusion that the price stability was not caused by the level of import. The next regression the author builds contains dummy for capacity utilization which is significantly positive at 5% level indicating that there were structural changes in the demand-supply relations. The article relates to the research in the sense that the theory and empirical study may be applied there.

Richard D. Rippe (1970) devoted his research to steel price determination and estimated price equations. The author defines the change in the industry employment cost per man hour as a main factor that defines dependent variable (he uses the wholesale price index for steel instead of price). The author continues using this price equation for price-making process description. In this model he defines the index of employment cost per man –hour, price index of materials, used in the production of steel, the lagged wholesale price index for steel (which is responsible for small coefficients of first two variables obtained) and the lagged residuals from the estimated variables estimation (estimate of first-order autocorrelation) as variables that explain the wholesale price index for steel. Gallet (1997) determines the influence of the change in domestic demand on the oligopoly coordination level in the steel industry of the USA. He argues that the market demand is determined by the price of steel. Then he moves on by finding the domestic steel producers demand by deducting import supply from the market demand. The author estimates market and import quantity of steel regressions using three-stage least squares. These empirical results showed negative relationship between the degree of coordination of US steel producers and market demand, and positive relationship between the coordination and import supply.

Liebman (2005) describes the influence of safeguards and other determinants on the steel price level in the US. Empirical evidence shows that tariffs imposed by the President Bush on steel import in 2002 increased price level in the US by 3.3%. The author continues by estimating the model of steel prices to examine the effect of different explanatory variables such as: industrial production, oil price, scrap price, coal price, electricity production, wage, dollar exchange rate, production capacity, China's steel demand, antidumping duty, safeguards tariffs on steel prices. According to the article increase in Chine's demand influence US prices positively, even in spite of the abolition of safeguards, while increase in production capacity– negatively. Decrease in production capacity increases price level. Negative coefficient of dollar shows that as dollar exchange rate increases, steel prices fall. Positive coefficient of antidumping duty (AD) shows that AD affects prices positively.

So, foreign literature pays a lot of attention to the empirical analysis unlike Ukrainian literature which proves that the issue-steel price determination model for Ukraine is of current importance. The literature is provided in the chronological way.

The paper of Grygorenko (2001) presents an overview of the Ukrainian ferrous metal industry under transitional institutions where he compares the current state of the industry and the potential market efficient equilibrium. Using econometric analysis he showed that ferrous metal industry is not in equilibrium because of the low rate of capacity utilization which causes the inefficient level of output to be achieved. In his work Grygorenko estimates demand and supply functions for Ukrainian ferrous metal industry and thus is related to the subject of our research. The Institute for economic research and policy consulting in Ukraine provides several papers that describe the industry. One of them (Pavel, 2002) discusses the current support policy and the future development of the ferrous metal industry. In 1999 the law on "Conducting an economic experiment at ore-mining and metallurgical enterprises of Ukraine" started to work. The goal of the policy was to support production activity of the ferrous metal firms through reduction of tax rate from usual 30% to 9% in 1999 and 15% in 2000 in order to give firms possibilities to put free funds to their working capital. According to the report of the Ministry of the Economy and European Integration in 2000 comparing with

1999 tax payments increased and the deficit of working capital decreased. It is known that because of the Asian crises the demand for Ukrainian steel increased, prices rose so it is not completely clear due to which fact the industry experienced improvement. Then the paper proposed its own strategy. The first proposition is to create competitive environment on the market where efficient enterprises could work at minimal costs to increase efficiency and no effective firms should exit the market. The second proposition is to maintain social stability. To achieve competitiveness the liquidation of all tax privileges should be implemented, so that 30% tax rate exists for all the firms for all of them to have the same incentive to work. Also hard budget constraints should be provided, in other words, improvement of bankruptcy procedures and effectiveness of legal system. Next measure is speeding up of privatization since private property provides much better performance than public one, because of the more efficient management, possibility of new owners to invest in the production. To achieve social stability alternative employment should be designed through the support of small business, entrepreneurship, maybe elimination of tax payments for businesses who just start their business as it is provided in developed countries like USA and others.

The next paper (Vincentz, Legeida, 2002) discusses the issue of state support of ferrous metallurgy. At first, author focuses on the necessity of information for a government when it is going to provide the support. The problem is that (and it is true not only for metallurgical industries) that investors can not completely rely on the information enterprises propose. Balance sheets, income statements, list of wages do not always correspond to the reality since it is beneficial for producers to hide part of their income to reduce tax payments. That is why it is important before any support program is created to get the knowledge of all the subsidies firm obtains including cross-subsidies within producing firms which in fact is widespread in Ukraine because of the vertically integrated industry.

Also when support program is designed there is high possibility (maybe because of the old-way of thinking) that money, targeted at financing production activities, will be used inexpediently. That is why monitoring should be introduced. Also before the provision of specifics one should be aware of specifics of Ukrainian steel enterprises such as outmoded technologies (which increase average costs) overstaff of industry (which decreases labor productivity). After the monitoring of enterprises the main goal of state support should be determined. And here the next problem appears –many goals contradict to each other. For instance improvement of technologies leads to the reduction of labor force. That is why interaction of all the goals should be considered to choose the best composition of them.

Next thing that should be done is determination of measures to achieve theses goals. One of the propositions of institute is to change the mechanism of tax payment so that it was collected not into the centralized fund but through bank credits. The new mechanism makes it possible to monitor the allocation of funds, to prevent the probability of corruption.

Next topic, the authors write about, is assessment of ferrous metallurgy exports. The authors argue on the problematic sides of ferrous metal industry. At first the author shows that technology in Ukraine is still outdated, for instance open-heart furnace that were phased out of production in the developed countries twenty years ago, still continue to function in Ukraine. Next problem is low labor productivity in the Ukrainian steel industry. Thus one worker in Ukraine produces three times less than one in the European Union per year. The paper discusses external risks. One of them is loosing competitiveness because of the appearance of new competitors on the world steel market such as Russia, China and India. One of the factors that determine volumes of steel exported from Ukraine is import-restricting measures that occurred because of the

appearance of many newcomers in the industry. Thus, Ukrainian steel export to North America, fall by 80% because of quotas. Ukraine may export only1, 7% of the total steel export to the countries of EU.
To solve the problem, to reduce the risk of export shortfalls, Ukraine is recommended to increase the productivity by phasing out outmoded technologies. It will create funds for financing exit costs that appear because of the reduction in employment. Also it will enhance the technological level of steel industry as a result risk of shortfalls fall. One more recommendation for Ukraine is that it should cooperate with the international community to guard from anti-dumping measures against its exports.

Dubohryz (2003) overviews the Ukrainian ferrous metal industry the part of which is the steel industry. The author emphasizes the importance of the chosen subject and describes the whole structure and elements that composes ferrous metal industry- the information that is necessary for steel industry overview. The author estimates demand and supply functions which also relates to our research. Also he considers the effect of the Law "On conducting an Economic experiment at the enterprises in Mining and Metallurgical complex of Ukraine" adopted in 1999 (the goal of which was to free enterprises from tax obligations to improve profit results) and proved that the reform had real effect on profits and revenues (they increased as a result).

Mykhnenko (2004) in his research examines the Ukrainian ferrous metal industry, describes it within the USSR in 1986 and shows the percentage share of each kind if ferrous metals in Soviet Union's output emphasizing that it was great (from 35% to72%) comparing with Ukraine's territory (just 2.7% of total Soviet Union's size). Also he compares the industrial growth before the economy transition (1990), after it (1996) and in 2003 showing that market transition negatively influenced industry's output – volume index decreased from 100% to 45% in

1996 (in 2003). According to his evaluation Ukraine is the seventh largest steel producing country after the China, Japan, United States, Russia, South Korea, Germany (in 2002). The author moves on by analyzing efficiency, labor productivity, return on investment and profit and shows that at the time of transition efficiency deteriorated, productivity fell and other determinants deteriorated. And as a whole the economy is unstable during the period. Then analysis shows that in several years all the factors improved and the ferrous metal production grows.

Some valuable information was provided by the state enterprise "Ukrpromvneshexpertyza". One of the papers (2005) compares the technological process of steel production in Ukraine and in the world. At the end of the last century all the developed countries conducted restructuring and modernization of metallurgical production as a result of which all redundant and chronic production facilities were liquidated. Open-hearth production was replaced by basic oxygen process and by the production of electric steel. Also the technology of continuous overflow of steel was introduced. It increased labor productivity and decreased steel intensity and power intensity substantially. But Ukraine, the great producer of ferrous metals, continues to be the most outdated country in this sense. Open-hearth process is one of the main ways of steel smelting in Ukraine. The weight of open-hearth process for Ukraine is 47.7% in 2002 while for the world 3.6%. The weight of electric steel is 20.8 in 2002 while for the world 3.6%. The weight of electric steel is 20.8 in 2002 for Ukraine and 88% for the world. As it was found Ukrainian producers had no incentive for substitution open-hearth process by basic oxygen process and by the production of electric steel. Because under open-hearth process producers use higher quantity of scrap instead of cast iron to achieve necessary quantity of steel. And under the production of electric steel, producers increase usage of electricity and scrap of higher quality. As a result in Ukraine there is a higher level of labor, energy and power intensity than in the world. Thus the production of Ukrainian metallurgical production comparing with the level of developed countries has 5% higher material capacity and 25% higher energy capacity.

According to the Metal Bulletin (www.metalbulletin.com), the rate of growth scrap, coke and iron ore consumption outstrip steel production rate of growth in the world. The reason is structural changes in the smelting of electric steel in the world. During the last ten years total volume of steel smelting in the world increased by 30% while smelting of electric steel increased by 42% (from 225 to 332 mln. ton.) Increase in electric steel smelting during those years demanded 8 mln. t. increase in scrap each year. The demand for steel exceeds the supply that is the reason for permanent increase in scrap price. Ukraine consumes much less scrap less than developed countries , it is explained by the fact that the weight of electric steel smelting in Ukraine is low, at the same time, open-hearth production needs higher level of scrap counting on one ton of steel than under basic oxygen process. Under the open-hearth process steel production needs two times higher level of scrap than under the basic oxygen process. That is why in spite of the low level of electric steel production. Scrap plays strategic role for Ukraine.

"Perspectives of the development of internal market of ferrous metals in Ukraine up to 2005" (papers of Ukrpromvneshexpertiza) describes peculiarities of management in the industry.

Metallurgical sector functions in non-state regime. This fact affected the character of management. Most of the metallurgical enterprises endured the change of managers several times. There were several stages of management transformation on Ukrainian metallurgical enterprises. The first stage can be called "zero", because at this stage new owners did not penetrate into the activity of the firms and old management implemented contracts with new owners in the sphere of the sale of products under shady schemes. The second stage can be called "initial" because at this stage new owners started to control raw materials and electricity costs. The third stage is the most effective because here the replacement of the old management occurs and new specialists of new professional orientation appeared – marketing, sales, financial policy. But the most fundamental changes took place on metallurgical enterprises,

where strategic owners come to. Practically all the great enterprises have the Plan of restructuring and technical requirement.

According to the data of International Metalworks Federation wage of workers in metallurgical sector increased greatly during the last several years but continuous to be low if to compare with the wage of developed countries (www.infmetal.org). Thus in 2001 average wage of personnel was $96.9 in Ukraine, $335 in Turkey, < $460 in Russia, $750 in China, $3050 in Germany. The highest level of average monthly wage for Ukrainian metallurgist is on "Azovstal" and "Kryvorizhstal"- more than $188 .The low cost on wage is one of the reasons for low costs of steel production in Ukraine.

Another section of the firm's paper provides statistics on the prices in the industry. In 1994-2002 the dynamic of price changes on the world rolled metal characterized by the alternation of the periods of growth and recession every approximately half of the year. However since 2002 market development was defined by the stable tempts of growth of demand on the rolled metal, exceeding the supply that caused the growth of prices on rolled metal during 2002-2004. Especially sharply those the prices on metal increased in the first quarter of 2004 when due to the economic development in the most regions the demand increased, while because of the deficit of iron ore and coke the production growth was insufficient. As a result of the deficit of delivery under the condition of great demand, metal prices in 2004 increased by 50-60% comparing with 2003.

Index of metal prices by the end of 2004 increased to 152 against 100 in 2003.At that flat section prices grew more rapidly than flat one.

Additional factor of price growth on metal in dollar measurement was decrease in the dollar exchange rate against the main world exchange rates (European Euro, Japan yen) , just the change of dollar exchange rate provided for 20% price growth during 2003-2004. (Source:www.steelbb.com).

One of the papers of "Ukrpromvneshexpertiza" describes tendencies of ferrous metallurgy development in the world in 2000-2005, according to which the development of the world market is characterized by the increase in the growth rate of production and consumption That is caused by the high rates of the economic development of China under the condition of countries industrialization. As a result average annual growth rates of steel production in the world increased by 5.8% in 2001-2004 against 1% during 1990-2000.

In 2004 metallurgy developed significantly which was caused by the economical development of the USA, Japan, countries of EU, China. The production of steel in the world was 1054 mln.t., exceeding the level of previous year by 86,2 mln.t. or 8,9%. At that metallurgical production of China increased most rapidly (60% of the world steel growth or 51,3% mln.t.) The increase in steel production in 2004 in EU countries was 9,6 mln.t., in countries of North America-6,8% mln.t..
According to the data of International Institute of steel and cast iron (IISI) world production capacities on steel smelting during the 2003-2004 increased on 96 mln.t. and in 2004 was 1191 mln.t. . According to the predictions steel smelting capacities will achieve 1315 mln.t.
The volumes of production and consumption of rolled metal in 2004 was 965,9 mln. t.(production) and 946.9 mln. t .(consumption). Thus, growth rates of the production of rolled metal in 2004 comparing with the previous year was 7,5%

while increase in the metal consumption was 8,5%. Exceeding of the rates of growth of consumption comparing with the rates of growth of production was caused by the acceleration of the economic development and limited possibilities of production because of the raw materials deficit (iron ore, scrap, coke).Thus because of the deficit of rolled metal delivery in 2004 metal prices increased in most regional markets.

Another journal of the company describes the tendencies of the development of metallurgy in Ukraine in 2000-2004. Tables from it shows that due to the accelerated development of the internal market and favorable conjecture on the world steel markets in 2001-2004 average annual growth rates of metallurgical production in Ukraine keep up on 5.5% level. In 2004 in Ukraine was produced 31.06 mln. t. of cast iron, 38,74% mln. t. of steel, 33,38 mln. t. of rolled metals.
The development of metallurgical capacities in Ukraine in 2000-2004 was carried out at the expense of maintenance and technical modernization of existing domain production. Production capacities on steel smelting in Ukraine in 2004 were 43.5%.

Disposal of Ukrainian rolled metal on the internal and external markets in 2000-2004 was characterized by the stable increase in the weight of the internal market. The share of the rolled metal, realized on the internal market, in 2004 increased to 20,9% against 14,8% in 2002. In 2004 on the internal market 6.9% mln. t. of rolled metal was realized while the export of metal constituted 26.1 mln. t.
Structural changes in the export of ferrous metals from Ukraine in 2004 were related with the decrease in sales on the China's market reorientation of deliveries on the markets of Middle East and Turkey. As a result the share of China's market in the whole export of ferrous metals of Ukraine decreased from 13.5% in 2003 to 8,9% in 2004.

The largest region of sales of metals from Ukraine continues to be the market of South-Eastern Asia where in 2004 5.26 mln. t. was exported to or 20,8% of all the exported sales. The problem of Ukrainian metallurgy continuous to be the gap in technologies of Ukraine and other developed countries. The level of investments in the Ukrainian metallurgy is the lowest in the world – only 5-7$ for 1 t. of steel during the last few years.

Kramar (2004) writes that the rate of price growth on the world and home markets of countries, which have metallurgical production, including Ukraine, was so great that it started to blockade the development of metal consuming spheres. Because of this many assumptions of possible "steel" crises similar to oil ones in 1973, 1979 and 1990 appeared in the world. In fact, as any commodity market world market of steel is inclined to cyclical development. The growth of demand and prices generated considerable public excitement in 2003. But experts tend to think that the world steel market does not tend to experience crisis situation similar to one that took place on the oil market. The growth of demand and prices in the world market was substantially stimulated by the panic of systematic consumer large traders which bought up the metal in reserves because of regular price growth expectations. The decentralization on the steel market will lead to the quick normalization of price situation according to the author's predictions. The normalization of demand will cause the fall in prices on the world as well as home ferrous metal markets.

The behavior of the main players on steel markets in the USA, Japan, and the European Union is predictable because there exist clear rules of game. These countries intensively increased the ferrous metal production during the period of high rate of economic growth. That is why, the stability in the volumes of production and volumes of ferrous metal consumption in these regions is expected. The correspondence of demand and supply excludes abrupt changes in prices. Asia and the countries of the former Soviet Union belong to the unstable regional markets. Russia and Ukraine do not take part in the formation of the global demand on the ferrous metal. They satisfy their internal needs mainly due to the own production. Their existence on the world market determines the volume of the global ferrous metal supply. That is why the expected increase in the production of exporting products will promote the overcoming of the gap between supply and demand. The behavior of these countries will support the tendency towards the normalization of the world prices.

In my work I will investigate all the variables that influence the price of Ukrainian steel (in this sense the paper of Liebman (2005)is the most helpful), using not only the literature I overviewed but also my own understanding , since many of the facts described in literature changed since the it was written for instance China is now more export-oriented than ever before.

Chapter 3

INDUSTRY OVERVIEW

As a result of collapse of the USSR in 1991 and creation on its basis new independent states Ukraine inherited a powerful metallurgical complex. In production quantities it constituted more than 35% of the former All-Union metallurgical complex. Ukrainian metallurgical complex embraces stages of the whole technological circle – from production and processing of raw materials to production and processing of metals. Now it constitutes of 350-400 enterprises and organizations.

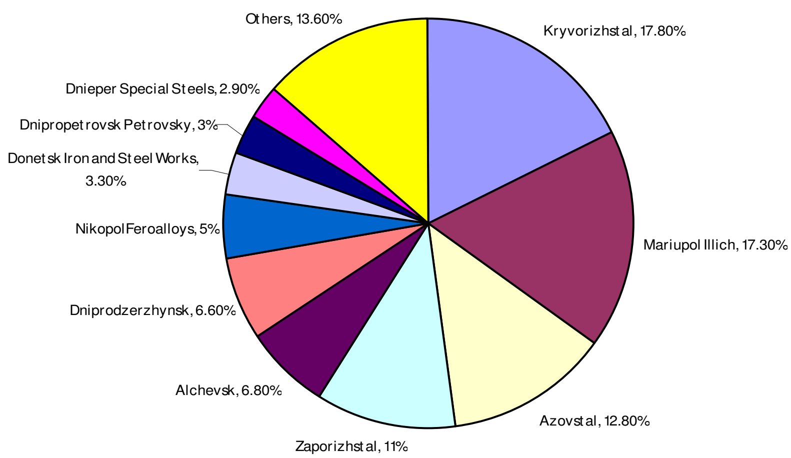
The sector of black metallurgy is represented with 12 large enterprises-metallurgical plants and industrial complexes. They produce more than 96% of the national production of steel. Industrial complexes and large plants are the enterprises with the total metallurgical circle which includes smelting of cast iron and steel and production of rolling metal. Some complexes consists of the enterprises that produce and process iron ore and coke. Historically industrial complexes were formed as the integration of industrial enterprises connected to each other with the common technological process and management. Great metallurgical plants mostly repeat the structure of complexes but they are in a larger scale.

According to Kramar (2004) the Ukrainian steel works of ferrous metallurgy are not only the largest enterprises in Ukraine but they are also highly ranked among the metallurgical companies of the world. International Iron and Steel Industry lists 80 greatest metallurgical companies of the world which includes five Ukrainian enterprises : ”Kryvorizhstal” (28 place) the Mariupol Illich Iron and

Steel Combine (31), the Azovstal Iron and Steel Combine (40), “Zaporizhstal” (55), the Alchevsk Iron and Steel Combine (67). The production of these five enterprises makes up 71,2% of Ukrainian steel production. Metallurgical production is concentrated mainly in four regions: Donetsk oblast (42.4% of the steel production), Dnipropetrovsk oblast (30.6%), Zaporizhzhia (12.5%), Lugansk (9.3%).

The following figure shows the importance of all steel companies for the industry.

Figure 1. Ukraine’s steel companies by average annual revenue share, 2000.

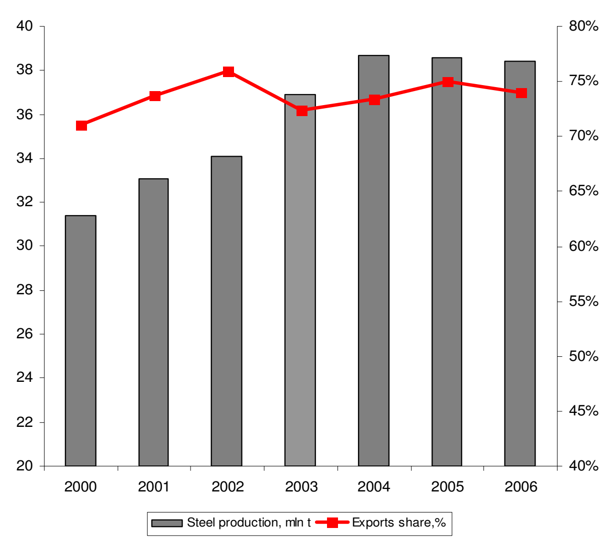


Source: V. Mykhnenko. ”Rusting Away? The Ukrainian Iron and Steel Industry in Transition ”

Today Ukraine is a great producer and exporter of ferrous metals. In 2003 its share in the worldwide production of the cast iron is 4.5% and steel-3.97%.

According to the volume production Ukraine ranks 7 place in the world after such countries as China, Japan, USA, Russia, South Korea and Germany. Being so export-oriented Ukraine has a profound effect on the world market. At the beginning of the nineties fast growth of exports of rolled metals by Ukraine and Russia shocked and destabilized the world market. The increase in the world export of rolled metals due to these two countries was 40.7% in 1993 in comparison with 1992, 60.1% in 1994 comparing with 1993. In that period Ukraine's share in the world export of rolled metals was 8.7%, scrap metals-6.8%. According to the net export indexes Ukraine ranks the third place in the world after Japan and Russia. Ukraine is has a favorable geopolitical location. It is located near one of the largest regional markets-European Union. European Union's share in the world production of steel is 33.9%. Russian is another important economic partner that Ukraine borders on. Russia's share in the world production of steel is 6.6%, world export-8.7%, import-0.7%. Russia is one of the largest importers of Ukrainian metallurgical production and is the main supplier of raw materials and energy supply that ensures stable functioning of the Ukrainian metallurgical production.

Figure 2. Ukrainian steel production and exports.



Ferrous metallurgy is the basic sector of Ukrainian national economy. The sector influences greatly the gross domestic product, foreign commerce and the inflow of the currency to the budget of Ukraine. In 2003 the ferrous metallurgies share in the gross domestic product of Ukraine was 2.4%. The share of ferrous metallurgy in export was 29.5%. Ferrous metallurgy is one of the largest sectors of Ukraine's industry. Its part in the industrial production was 17.4%. Production capacities of ferrous metallurgy are capable to provide the full-scale development of the national machine construction, growing needs of the building and to support volume export.

In the territorial structure of the state metallurgical enterprise is the center of regional systems – composes the basis of economy and provides the required support of social servicing of population of the territory. Since historically the enterprise of ferrous metallurgy were concentrated mainly in three regions – Dnipropetrovsk, Donetsk and Zaporizhzhya regions, on the territory of these regions metallurgical complexes were created near which the systems of machine-building enterprises, chemical production and the net of servicing enterprises appeared. Those enterprises are important for population employment and their stopping has negative consequences not only for the enterprise itself but also for economic and social systems of cities.

As the review of economical department of "Kryvorizhstal" states the sector of ferrous metallurgy belongs to the part of national economy where market relations developed very quickly. At the very first stages of market reforms conducted in the state, the sector attracted attention of the private sector by the opportunities of the wide export activity. Under deep economic conditions, vivid enough economic activity maintained in external economic sphere. The most active expansion into the sector of ferrous metallurgy was led by the gas traders which supplied the natural gas to regional enterprises.

Because they had power in the region, procurement traders started massively to use barter in their relationships with metallurgical enterprises: as a payment for gas they obtained metals which they sold on external markets where it was greatly demanded. In their relationships with enterprises traders used the mechanism of nonequivalent exchange- machines, equipments and raw materials were overpriced delivered while the purchase of theirs products were bought at the lower prices. Trading companies gradually captured the whole system of sale and delivery of enterprises. As a result the first private financial and industrial groups (FIG) started to form around the trader's companies. At that time FIG controlled metallurgical enterprises that produced more than 60% of steel in Ukraine. Existence of exports profits attracted to this sector banking capital also. It started to increase its control over the finances of enterprises. The main instrument of this initial capital was account payable. Although in contrast to traders, banks were unable to expand their influence so broadly. In that time they controlled metallurgical enterprise which produce only 6% of the whole Ukrainian steel.

Large FIG captured the control over the sector of ferrous metallurgy gradually. At first FIG strengthened their influence over enterprises with the help of shadow means including using of body-checks. Although with the normalization of law situation in Ukraine, Using shadow means by FIG started to be risky. Large investments into enterprises demanded more legal forms of control over actives. Thus, FIGs started to transform to corporations which became the active players of privatization in the sector of ferrous metallurgy.

Privatization that broke out in the closed sectors at first- coal and mining industry, set up the conditions for the redistribution of affected zones of private FIGs in these sphere. At that, under the influence of powerful metallurgical lobby privatization mechanisms stated to slave to their interests. The revised mechanism of privatization, stated by the law of Ukraine ”About the privatization of enterprises that included into the national stock company “Ukrrudprom”. The allotment of separate privatization mechanism for each enterprise opens up the possibility for participation in Fig's competitions, which have system-defined metallurgical business. Consequently, the privatization of coal mines and concentrating combines created the conditions for speeding up the appearance of vertically integrated structures, which includes enterprises of the whole metallurgical chain “extraction of the coke coal- production of coke-mining and processing of iron ore- smelting of cast iron - production of rolled metal”.

Chapter 4

DATA DESCRIPTION

The ferrous metallurgy industry of Ukraine is highly profitable. The enterprises of the sector were privatized by different foreign and Ukrainian companies. Thus the information about the prices of steel as well as some important determinants of the price is privately owned and is closed. That is why the research uses monthly data for the period 1999-2005 only (84 observations are available). It means that estimation will not be so precise as it could be if there were more observations.

Since we have a set of observations on the values that a variable takes at 84 months and only for one country it will be time series data. The data collected include: the quantity of steel produced in Ukraine (Qukr), Ukrainian steel price (P) and world price (Pch)-it is given by the price of China; price of iron ore (Pore), price of scrap (Pscrap), price of coke (Pcoke), price of wage in Ukraine (Pwage) as costs of steel production, Ukrainian steel producing capacity (cap), economic growth rate in Ukraine (gdp), idices of industrial production of steel consuming countries – China, USA, Turkey and EU. We take industrial production instead of GNP as in case with Ukraine since GNP of these countries provided only on monthly basis.

The quantity of steel produced in Ukraine is one of the main variables that determine the price. It influences negatively the price of steel in the demand equation since the more steel is produced the lower the price at which it can be sold. But the relationship between those two variables in the supply equation is positive- with the growth of supply producers are able to sell products at a lower price.

Since Ukraine is not very big country its economy is affected by the changes in the world. That is why we include the world price of steel, given by the price of China, and the world quantity of steel produced. The increase in the world price should increase the Ukrainian steel price. The world steel quantity produced (which is used as the proxy for the world consumption) affects positively the quantity of steel produced in Ukraine since the more world consume the more products it demands the higher the supply of steel.

The China's factor needs to be discussed more. According to Kumba annual report (www.kumbaresources.com) the input of China's activity into the world economic growth is great. Thus, in 2003 China's contribution to the world commodity demand was 16%. And China accounted for 27% of global demand for steel products, 27% for iron ore. The China's demand for imported raw materials was so great that it led to the increase of world dry bulk freight rates in the previous three years. In 2003 China increased investments in the industry because of the lower capital costs in this country comparing with the developed countries. In 2004 the government imposed administrative controls to restrict economy growth- the measure which influenced China's industrial policy, it became a net exporter of steel rather than importer. Thus in 2004-2005 steel China's consumption increased by 10.8% while China's growth rate was more than 20%. As a result China started to influence international commodity prices. If I do not include China's production the world's level of steel production will not change or even decrease by 1% (comparing last year with the year before). But, if we include China's steel production it will lead to the increase of the world's production by 7%. That is why this explanatory variable is important.

Iron ore, coke and scrap are the main raw materials that are used in steel production process. Thus their inclusion in the regression is motivated by technology.

To calculate iron ore price index I resort to the following transformation. This formula is to reflect the fact that there are four types of ore and their usage is technologically fixed and has own weights in steel production[1]:

Ore Price Index=BFI*0.1+F*0.1 +P*0.22 +C*0,43 +S*0.16

Where BFI – blast furnace iron price;

F-fines price;

P-pellets price;

C-concentrates price;

S-sinter price.

The relationship between the price of materials and the price of steel is positive. Ukrainian steel productive capacity is the determinant variable since the higher the capacity of the country the more products it is capable to produce. Capacity shows the maximum potential of steel producing sector that is how much steel the sector can produce. Capacity growth means that steel owners make investments and equipment work with the aim of increasing steel output that signifies that in the future supply will increase. Accordingly this means that there will be downward pressure on prices in the market. Capacity goes in the supply equation.

GDP of Ukraine and industrial production of steel consuming countries appear in the demand equation. They affect demand because GDP shows general health of the economy and it embraces many steel consuming industries: construction, machine-building, vessel-building, oil and gas sector (consume pipes). So if GDP grows then these underlying industries also grow and influence steel supply.

Since data series are given in nominal values we use the deflator to bring them to real value. This step is made to rule out the influence of inflation on the following

[1] The source is the state company *Ukrpromzovnishexpertyza*

variables: all prices data and GNP data. The cite of National Bank of Ukraine provides industrial price index for each year. We transform the index accordingly to make the year 1999 as the base year.

Data on Ukrainian steel production and China steel production for the period 1999-2005 were obtained from the web-site of the International Iron and Steel Industry (www.worldsteel.com). The monthly data on prices of Ukrainian and world steel were obtained on www.metalbulletin.com, data on Ukrainian production capacity is provided by the Ministry of Industrial Policy of Ukraine. The data on industrial production of steel consuming countries were obtained at the web-site of "Economist" (www.eco5.com) and Bloomberg. The data on average annual wages were obtained on the web-site of National Bank of Ukraine.

The descriptive statistics of some series (steel production of Ukraine, China and the world, Ukrainian steel producing capacities and the domestic price of ore) are given in appendix1.

Chapter 5

METHODOLOGY

Since there is simultaneity (price is dependent on quantity produced and quantity is dependent on the price, so they are both endogenous variables) I can not use OLS. Ordinary least-squares parameter estimators will be inconsistent and biased if there is simultaneity. So in my research I use simultaneous equation method, where supply and demand equations are linked through endogenous variables – price and quantity. The supply equation is the function of world price, world steel production, Ukrainian steel capacities, Ukrainian growth rate, price of Ukrainian steel. I write demand equation as an inverted function - steel price as a function quantity of steel supplied in Ukraine of quantity of steel supplied in the world, , costs of steel production (price of scrap and iron ore and average annual wage of Ukraine).

Mathematically, the tentative model looks as following (it was build due to the examples of simultaneous equation model from Wooldridge (p.502-514)):

$$P_{ukr} = \beta_{10} + \beta_{11}Q_{ukr} + \beta_{12}IP_{EU} + \beta_{13}IP_{US} + \beta_{14}IP_{ch} + \beta_{15}IP_{tu} + \beta_{16}GNP_{Ukr} + \varepsilon_1$$

$$Q_{ukr} = \beta_{20} + \beta_{21}P_{ukr} + \beta_{22}P_{ore} + \beta_{23}P_{coke} + \beta_{24}Cap + \varepsilon_2$$

Where explanatory variables are:

Pukr-Ukrainian steel price;

Qukr-steel production in Ukraine;

cap -steel producing capacities of Ukraine;

Pore - price of iron ore in Ukraine (cost of steel production);

Pcoke- price of coke in Ukraine

GNPukr – Ukrainian GNP

IPeu – index of industrial production of EU (US, China, Turkey)

The model should satisfy the order and rank conditions. The first supply equation satisfies the order condition since costs are excluded from it. When we define that the model is identified we can estimate it by several methods of simultaneous equation model: seemingly unrelated regression, two-stage least square estimation, weighted two-stage least squares, three-stage least squares, full information maximum likelihood. The choice of the model will depend on whether heteroskedasticity is present, whether regressors and residuals are correlated, and whether there is contemporaneous correlation in residual.

Two-stage least squares estimator consists of two steps. In the first step the reduced form should be estimated by OLS. In the second step, demand and supply equations are estimated by OLS (by substituting all the endogenous variables with their predicted values from the reduced form). The main condition for first equation to be identified is that second equation should contain at least one exogenous variable that is omitted from the first equation. Three-stage least squares method assumes the possibility of contemporaneous correlation between disturbances in different structural equations. Seemingly unrelated regression estimation means that equations are estimated by 2SLS at first and than the disturbance covariance matrix is estimated using resultant residuals and then all identified structural parameters are estimated jointly using the disturbance covariance matrix. If estimations repeat at the first step there should be full information maximum likelihood estimation. It is efficient if the system specification is correct because misspecification of any equation can damage the whole system.

Table 1. Strategy for choosing the method of estimation of SEM.

Strategy for choosing the method of estimation of SEM			
Statistical problem			
Method of estimation	Regressors and residuals are correlated	Contemporaneous correlation in residuals	Heteroscedastisity
2SLS	Yes	No	No
SUR	No	Yes	Yes
W2SLS	Yes	Yes	Yes
3SLS	Yes	No	No
FILM		Contemporaneous errors are distributed jointly normally	
GMM		Errors do not correlate with instrumental variable	

Source. T.Shulga Masters Thesis EERC.2003

Chapter 6

MODEL ESTIMATION.

6.1. Regression output.

Accordingly to the model described we use both 2sls and 3SLS method to solve the simultaneous equations system. The supply equation is the function of price of Ukrainian steel, Ukrainian steel capacities and prices of raw material inputs – iron ore and coke. The demand equation includes the price of Ukrainian steel and indices of industrial development of main steel consuming markets – Ukraine, EU, China, Turkey and USA.

Preliminary estimations showed that such variables scrap and electricity price had no influence on the price of steel so they are dropped from the supply equation. Likewise the variable of industrial growth of Russia proved insignificant in the demand equation. Both supply and demand equations are estimated in logs as this form allows seeing elasticity coefficients of supply and demand. As we mentioned before, the demand equation is specified as inverted function with price of Ukrainian steel being a dependent variable. Thus, Ukrainian steel production and price of steel are endogenous variables and we can estimate the system of supply and demand by 2SLS and 3SLS methods. Since both equations suffer from heteroskedasticity and serial correlation (see 6.2) we force the standard errors to be robust to guard from these problems. We report full output results in the

Appendices. Here we present coefficients and corresponding p-values of initial and robust estimation.

Table 2. 2SLS estimation output.

Variable	demand	sup	rdemand	rsup
lgQukr	-1.57462		-1.57462	
	0.0019		0.0064	
lggnp	-0.12285		-0.12285	
	0.0003		0.0006	
lgIPeu	6.709845		6.709845	
	0.0005		0	
lgIPch	0.952222		0.952222	
	0.0001		0.0001	
lgIPtu	0.706517		0.706517	
	0.0799		0.0653	
lgIPus	-3.73952		-3.73952	
	0.0177		0.0052	
lgP		0.623603		0.623603
		0.0004		0
lgcap		7.651019		7.651019
		0		0
lgPore		0.454778		0.454778
		0.0113		0.0245
lgPcoke		-0.48352		-0.48352
		0.0009		0.0018
_cons	-1.94558	-3.51901	-1.94558	-3.51901
	0.7574	0.0861	0.7341	0.0329

The three stage estimation brings very similar output results.

Table 3. 3SLS estimation output.

Variable	3SLS estimation
lgQukr	
lgP	0.620366
	0.0001
lgcap	7.659882
	0
lgPore	0.420838
	0.0129
lgPcoke	-0.45703

	0.0007
_cons	-3.53203
	0.072
lgP	
lggnp	-0.12417
	0.0019
lgIPeu	8.462358
	0.0003
lgIPch	1.518254
	0
lgIPtu	0.646073
	0.1902
lgIPus	-6.1128
	0.0019
lgQukr	-3.01608
	0
_cons	10.69326
	0.1915

6.2. Model testing.

Before we test the model for the possible problems we note that the requirements of the simultaneous equations - the rank and order conditions – are fulfilled. The order conditions demands that in the second equation (the supply equation in our case) must be at least one exogenous variable excluded from the first equation. We have several variables excluded from the first (demand) equation. Then, all of them have non-zero coefficients in the second equation, which means that the rank condition is also fulfilled. Fulfilment of the order and rank condition means that the first equation is identified. Likewise we see that the second equation is also identified for the first (demand) equation contains the variable Pore, excluded from the second equation, with non-zero coefficients. Thus, we claim that both equations are identified.

We proceed by checking for the following problems

1) serial correlation
2) heteroscedasticity
3) correct functional form
4) unit root
5) multicollinearity

We note that we do not check for simultaneity as the usage of 2SLS method implies that the equations include endogenous variables from the start.

The test outputs are listed in the Appendix 4.

Serial correlation

Testing for serial correlation we follow the next procedure:

1. Obtain 2SLS residuals, r.

2. Plug r(t-1) in the above equation and conduct t-test to the coefficient near r(t-1), p.

3. Ho: no serial correlation, if p=0, Ho is not rejected and we conclude that there is no serial correlation.

In both supply and demand equations p-value of the corresponding lagged residual is significant which means that residuals correlate with their past values. Thus, Ho is not rejected and we conclude that we face serial correlation problem. The simplest way according to Woodridge (1999) is to recomputed the model with robust standard errors.

Test for heteroscedasticity

To test for heteroscedasticity we apply an analog of the Breush-Pagan test to each equation estimated by 2SLS. We refer to the procedure proposed by Wooldridge.

1. Obtain 2SLS residuals, r.
2. Regress r-squared on the same regressors.
3. Form F-test to check for heteroscedasticity.
4. Check the null hypothesis: Ho: Var=$\sigma 2$, i.e. residuals are homoskedastic.

The decision rule is the following: if Fcalc>F(k-1,n-k) than reject Ho. Alternatively, we look at F-statistics and its p-value in the output. In other words, we conduct an F test of joint significance in a regression of squared residuals on the same regressors. We check if squared residuals are related to one or more explanatory variables. If the variables are jointly significant the null hypothesis of homoskedasticity is rejected.

From the output (Appendix 4) we see that F-statistics (demand equation)=5.3 and F-stat (supply equation)=5.9 and both are significant at 1%. We thus conclude that heteroskedasticity is present in both equations. The consequence of heteroskedasticity is that the statistics, like t and F, are no longer valid, although the estimators are still unbiased and consistent.

To correct for heteroskedasticity and serial correlation we force standard errors to be robust, which is the simplest way (Wooldridge, 1999). Therefore our final outputs are estimated with robust standard errors.

Multicollinearity

There is no perfect way to test for multicollinearity and researches use different rule of thumbs that may indicate its presence. The question of multicollinearity concerns its degree rather than presence. Therefore, multicollinearity is not tested for, but measured to determine degree of correlation between regressors. I use pair-wise correlation coefficients, listed in the Appendix 4.

Comparison suggests that there exist fairly mild multicollinearity between the regressors of both equations. In the demand equation most correlation coefficients are in the 0.7-0.50 limits and only one correlation coefficient above 0.8 (the one between industrial production of China and Turkey). In the supply equation, there is also one quite high coefficient (0.9) between the price of ore and coke. I leave both variables in the regression as these are the inputs in the steel production that technologically required.

Test of Correct functional form

To test for omitted variables we use the RESET test

1. Obtain estimated Yhat

2. Rerun the regression with an additional regressor Yhat

3. Calculate F-test and compare it with the F-statistic s from the table.

$$F = \frac{(R_{new}^2 - R_{old}^2)/(\#ofregressors)}{(1 - R_{new}^2)*(n - \#ofparamerinnew\bmod el)}$$

Ho: the equation is specified correctly

We obtain following F-statistics FD=0.0014<F(1, 75)=4 and FS=0.003<F(1, 75)=4 which means that an increase in R2 in the new models are not statistically significant and our models are correctly specified.

Unit root

Applying ADF test to each variable we conclude that each time series is nonstationary since the obtained τ-values are smaller in absolute value than MacKinnon statistics at any level. Yet we check if the series are cointegrated. To do this we conduct DF test to residuals of the demand and supply equations also known as Engle-Granger test. After estimating the residuals from regression we see that τ-values are higher MacKinnon statistics. So we conclude that the series are cointegrated and the relationship is stable in the long run both in the demand and supply equations.

6.3 Statistical and economic significance.

We tabulate the obtained coefficients from 2SLS and 3SLS estimation in the following from. Predicted sign column tells us which sign we should expect in theory. We see that estimation coefficients from different methods are quite close.

Table 4. Results from 2SLS and 3SLS estomations.

Expected sign	Variable	rdem	rsupply	3SLS
	lgP			
-	lgQukr	-1.57462		-3.01608
		0.0064		0
+	lggnp	-0.12285		-0.12417
		0.0006		0.0019
+	lgIPeu	6.709845		8.462358
		0		0.0003
+	lgChi	0.952222		1.518254
		0.0001		0

+	lgTur	0.706517		0.646073
		0.0653		0.1902
+	lgIus	-3.73952		-6.1128
		0.0052		0.0019
	lgQukr			
+	lgP		0.623603	0.620366
			0	0.0001
+	lgcap		7.651019	7.659882
			0	0
-	lgPore		0.454778	0.420838
			0.0245	0.0129
-	lgPcoke		-0.48352	-0.45703
			0.0018	0.0007
	_cons	-1.94558	-3.51901	
		0.7341	0.0329	

The results obtained are in line with the law of demand and supply – we have the corresponding negative sign near Ukrainian steel production in the demand equation and a positive sign near the price (lgP) in the supply equation. Both are significant at 1%. Yet we have some discrepancies in signs in the both equations.

In the supply equation we expect that the prices of inputs (ore, coke) should be negative since they signify cost. Sign on coke is negative yet on the iron ore is positive. The possible explanation is that the negative sign reflect the monopolization of the Ukrainian iron ore market that we saw in the Industry Review Chapter. As we mentioned three business groups control 48% of iron ore production in the country. Since they also control steel works, they supply ore to these works at the prices that do not reflect the real market prices.

In the supply equation we have all statistically significant coefficients at 1%. All the sign but the Price for Chinese steel coincides with a priory expectation. The negative sing near the price of Chinese steel is explained by the fact that the Chinese producers while increasing production reduce their prices to penetrate to the markets of Asia, Europe and the US. Thus the price of China does not reflect the world price.

Now we turn to discuss the economic significance for the obtained results. The estimation is done in log-log form which allows to directly obtain the elasticity coefficients. Since the demand equation is estimated as inverted demand function the elasticity coefficient is $E_D = \frac{1}{|-1.57|} = 0.64$. This indicates that 1% increase in the price of Ukrainian steel causes a 0.64 % decrease in quantity demanded, that is the demand for Ukrainian steel is inelastic with respect to price.

Supply of steel is inelastic with respect to price as supply changes by 0.62% when price changes by 1%. The highest effect on steel production has capacity – with 1% change in capacity steel output changes by 7.6%. We explain such a huge effect by low capacity utilization rates in the 1999-2000. That is, in those years Ukraine had huge idle steel capacities that were quickly utilized when the exports demand increased.

6.4. Results interpretation and economic recommendations.

Since Ukraine is a developing country a natural question arises – how the results compare with those of a developed country. The US was chosen as an example of a developed country, thanks to availability of research on the steel prices. A paper by Liebman (2005) "Safeguards, China and the price of Steel" is both relevant and up-to-date to make comparison. While the main motive for the construction of the price model was to research how safeguards tariffs imposed by the US Government in 2002 influenced the American prices the authors also considers points pertinent to our discussion. Thus, Liebman also considers many variables that enter our model. While different estimation techniques are used, signs of the variables and their significance are of interest to us.

Liebman has American steel price as a dependent variable while we have two equations and two dependent variables. To make comparison possible we insert supply equation into the demand one and after transformation obtain the following regression:

$$lgP=0.55–6lgcap–0.36lgPore+0.38Pcoke-0.06lggnp+3.35lgIPeu+0.47lgIPch+0.35lgIPtu-1.9lgIPus$$

The next table compares the variables that affect steel prices in the US and Ukraine. We are more concerned in the signs and actual influence of the variable on the price than its size.

Table 5. Comparison of US and Ukraine price models.

Variables	US	Ukraine
Industrial production/GNP	3.537	-0.06
Ore price	-0.577	-0.36
Coke price	0.761	+0.38
Scrap price	0.555	insignificant
Electricity price	0.510	insignificant
Wage price	-2.31 (insignificant)	insignificant
Capacity	-2.668	-6
China's ind production	0.033	0.47
EU ind production	Not included	3.35
Turkey's ind production	Not included	0.35
US ind production	-	-1.9
Dollar	-0.061	NA
Antidumping duty	0.019	NA
Safeguard tariffs	0.133	NA
Time	0.003	

The first obvious disparity is the difference in the importance of costs to the steel prices in both countries. While in the US such inputs as iron ore, coke, scrap, and electricity are all significant, in Ukraine scrap, wage and electricity proved to be insignificant and thus are excluded from the model. Yet a deeper look reveals more similarity than differences between the models. As we mentioned in the industry review chapter Ukrainian wages are very low (and this improves steel competitiveness) in comparison with other developed countries so insignificance of this variable in the steel price underlies this fact. In fact, in the US model wages are insignificant either. Then, in my model scrap and electricity variable are also insignificant. I explain this by the fact that Ukraine consumes relatively little of scrap and electricity. The share of electric steel in Ukraine is only 3% while in the world this number is 40%-50%. Steel production by electric arc furnace is a progressive mode that dominates in the countries like US. At the same time, this process requires only scrap as an input and a lot of electricity. Thus, in the US model these two variables are significant. As Ukrainian steel producers plan to increase the share of steel produced by electric furnaces instead of open hearth technology consumption of scrap and electricity will also increase. For other raw material inputs we see similar signs – the sign for iron ore is negative and for coke is positive. We would expect that the higher input price will increase the price of finished product - steel. Yet both model produce negative signs near to iron ore variable. The effect of iron ore in the Ukrainian model was surprisingly different from what we expected, yet as the comparison shows in the US iron ore also negatively affect steel price. The explanation is that both in the US and Ukraine iron ore mines are captive to the steel works and thus the price for iron ore may be pressed downwards.

Capacity in the US and Ukraine negatively influence the price, which is logical. Influence of the industrial production is different. In the US domestic industrial production has a positive influence, while Ukrainian GNP has a negative influence. We interpret this fact by low steel consumption on the domestic market.

As can be seen from the table, US's industrial production unlike that of Ukrainian positively affect its steel price. Ukrainian domestic market is underdeveloped and there is no GDP influence on the steel price. The influence of China is uniform in both markets – China's development has an upward potential on the price of steel as well as capacities. From the results it can be seen that industrial production of EU has the largest influence on the Ukrainian prices compared with Russia (insignificant) and Turkey. Since these three markets are located at the same distance from Ukraine and have approximately the same weight in Ukrainian exports this finding means high importance of the state of European economy for Ukrainian steel producers.

The obtained coefficients and their signs witness that steel prices formation (especially in terms of costs) in Ukraine and America is similar. This means that Ukrainian steel industry can no longer be considered industry in transition. Ukrainian steel industry is becoming more and more of a market economy industry. Indeed the current situation is a far cry from 1997-98 when the Government intervened into the steel market and indirectly subsidized the industry. Ukrainian steel industry is by far the only sector in Ukraine that is competitive on a global scale. Thus, this dependence on the world market means that this industry, more than any other in Ukraine, operates within market economy framework. Thus, the Ukrainian prices for inputs such as ore, coke, scrap as well as steel prices follow the prices on the world market. The conclusion of market nature of the Ukrainian steel industry is to be used as an argument in defense against the possible antidumping investigations. On the other hand, non-transitional status of Ukrainian steel industry guarantees steel producers that, after the country enters World Trade Organization, they will not suffer any losses. This is in opposite to the situation that other Ukrainian sectors will face upon joining WTO.

CONCLUSIONS.

- Oligopolistic nature of the steel market (by business groups) distorts raw material prices and has negative effect on the steel prices (iron ore case). Yet we saw that an analogous situation exists in the US.
- Demand for steel (from the world market) in inelastic with respect to prices and thus Ukrainian producers can increase their prices without losing the market.
- Ukrainian market which accounts roughly for 15% of steel consumption of total output has little if any influence on the steel prices in Ukraine.
- Industrial growth of the EU economy is the most important than that of any other market for Ukrainian steel prices.
- Ukrainian steel industry has the same pricing character as a developed county such as the US. Thus, it does not differ from the analogous sectors of the developed market economy countries and antidumping measures can not be applied here.
- Joining WTO does not pose a threat for the Ukrainian steel industry as it is integrated into the world steel industry.

APENDICES

Appendix 1. Structure of the Ukrainian Metallurgical industry.

Steel Plant	2005 steel output, mln t	Steel group/ control power	Other steel related assets	Strengths	Weaknesses
Makeevsky MK	1	Smart Group	Inguletsky GOK, 50% of Pivdenny GOK	100% iron ore supply	Huge liabilities
Enakievsky MK	2.3	SCM	Pivnichniy GOK, Tsentralny GOK, Dokuchaevsky Lime Plant, Novotroitsk Lime Plant, coke plants and coal mines	100% iron ore supply, 100% coke supply	Tensions with new Government about legality of privatization
Azovstal	5.9				
Donetsky MK	0.9	Energo	Mines, coke plants	100% supply of own coke	Lacks own iron ore resources
Istil	0.8	Istil USA	-/-	New equipment	Lack of scrap supply
Alchevsky MK	3.7	IUD	Alchevsky Coke Plant, coal mines, 50% in Duferco Trading International	100% coal and coke supply	Problem with iron ore supply
Dniprovsky MK n.a. Dzerzhinsky	3.2				
Mariupol MK n.a. Illich	7	Management	Komsomolsky Lime Pit,Ukrmechanobr GOK	High value added products, favorable geographical position	Problem with iron ore and coke supply
Zaporizhstal	4.4	Management	27% in Zaporizky GOK	The largest share in the domestic market, developed steel warehouse network	Problem with iron ore and coke supply

Dnipropertovsky MZ	1.2	Privat Bank	50% in Pivdenny GOK, Sukha Balka, Kryvyy Rih GOK	100% supply of iron ore	Lacks own coke supply
Mittal Steel Kryvyy Rih	7	Mittal Steel	Coke plant, Iron Ore Mine n.a. Kirova, and Novokrivorizky GOK	Controls 87% of own iron ore supply	Problems with coal supply
Dniprospetstal	0.5	Concern Metallurgia		Monopoly position on the market of stainless and alloy steel products	Problem with scrap

APPENDIX 2. Data description.

January 1999 - Dec 2005.

```
. sum Qukr P cap Pore Pcoke gnp IPeu IPus IPch IPtu
```

Variable	Obs	Mean	Std. Dev.	Min	Max
Qukr	84	2849.381	371.2401	1961	3524
P	84	99.14286	28.74785	61.69	166.97
cap	84	3.410714	.0484115	3.333333	3.491667
Pore	84	16.32726	4.08016	12.11	26.49
Pcoke	84	70.14214	29.68919	46.43	145.06
gnp	84	73647.67	46155.78	7953.37	177688.3
IPeu	84	101.3	2.0925	96.3	106.4
IPus	84	129.919	24.72367	107.1	182.4
IPch	84	38.56905	17.90161	15.5	83.2
IPtu	84	109.2095	14.5113	83.7	141.6

APPENDIX 3 Estimation outputs

Demand Equation

```
ivreg lgP  lggnp lgIPeu lgIPch lgIPtu lgIPus ( lgQukr = lgPore lgPscr lgPcoke
lgcap  ), robust

IV (2SLS) regression with robust standard errors       Number of obs =      84
                                                       F(  6,    77) =   21.43
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.4870
                                                       Root MSE      =  .20437

------------------------------------------------------------------------------
             |               Robust
        lgP  |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lgQukr |  -1.574623   .5615105    -2.80   0.006    -2.692733   -.4565124
       lggnp |  -.1228485   .0343455    -3.58   0.001    -.1912391   -.0544579
      lgIPeu |   6.709845   1.468748     4.57   0.000     3.785194    9.634497
      lgIPch |   .9522221   .2223514     4.28   0.000     .5094639     1.39498
      lgIPtu |   .7065173    .377793     1.87   0.065    -.0457646    1.458799
      lgIPus |  -3.739522   1.301471    -2.87   0.005    -6.331081   -1.147963
       _cons |  -1.945584   5.706465    -0.34   0.734    -13.30861    9.417439
------------------------------------------------------------------------------
Instrumented:  lgQukr
Instruments:   lggnp lgIPeu lgIPch lgIPtu lgIPus lgPore lgPscr lgPcoke lgcap
------------------------------------------------------------------------------
```

Supply Equation

```
ivreg lgQukr lgcap lgPore lgPcoke  (lgP = lggnp lgIPeu lgIPus lgIPch  lgIPtu),
robust

IV (2SLS) regression with robust standard errors       Number of obs =      84
                                                       F(  4,    79) =   32.83
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.4607
                                                       Root MSE      =  .10232

------------------------------------------------------------------------------
             |               Robust
      lgQukr |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        lgP  |   .6236025    .136365     4.57   0.000     .3521747    .8950304
       lgcap |   7.651019   1.148735     6.66   0.000      5.36452    9.937518
      lgPore |   .4547785   .1982965     2.29   0.024     .0600791    .8494778
     lgPcoke |  -.4835211   .1494961    -3.23   0.002    -.7810857   -.1859566
       _cons |  -3.519007   1.620328    -2.17   0.033    -6.744189   -.2938256
------------------------------------------------------------------------------
Instrumented:  lgP
Instruments:   lgcap lgPore lgPcoke lggnp lgIPeu lgIPus lgIPch lgIPtu
------------------------------------------------------------------------------
```

3SLS estimation

```
reg3 (lgQukr  lgP   lgcap  lgPore  lgPcoke   )  (lgP  lggnp  lgIPeu  lgIPch  lgIPtu
lgIPus  lgQukr)

Three-stage least squares regression
----------------------------------------------------------------------
Equation          Obs  Parms        RMSE    "R-sq"       chi2        P
----------------------------------------------------------------------
lgQukr             84      4    .0990741    0.4623      87.42   0.0000
lgP                84      6    .2514278    0.1529      74.37   0.0000
----------------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lgQukr       |
        lgP  |   .6203664   .1630244     3.81   0.000     .3008445    .9398884
       lgcap |   7.659882   1.391106     5.51   0.000     4.933364     10.3864
      lgPore |   .4208375   .1692305     2.49   0.013     .0891518    .7525232
     lgPcoke |  -.4570266   .1353708    -3.38   0.001    -.7223485   -.1917046
       _cons |  -3.532033   1.963266    -1.80   0.072    -7.379964    .3158976
-------------+----------------------------------------------------------------
lgP         |
       lggnp |  -.1241703   .0399196    -3.11   0.002    -.2024114   -.0459293
      lgIPeu |   8.462358   2.343654     3.61   0.000      3.86888    13.05584
      lgIPch |   1.518254   .3137546     4.84   0.000      .903306    2.133202
      lgIPtu |   .6460731   .4931557     1.31   0.190    -.3204943     1.61264
      lgIPus |  -6.112803    1.96571    -3.11   0.002    -9.965524   -2.260081
      lgQukr |  -3.016077   .7008413    -4.30   0.000    -4.389701   -1.642453
       _cons |   10.69326   8.186766     1.31   0.191    -5.352502    26.73903
------------------------------------------------------------------------------
Endogenous variables:  lgQukr lgP
Exogenous variables:   lgcap lgPore lgPcoke lggnp lgIPeu lgIPch lgIPtu lgIPus
------------------------------------------------------------------------------
```

APPENDIX 4 Tests outputs

Demand Equation

```
Estimation output for serial correlation

ivreg lgP   lggnp  lgIPeu  lgChi  lgTur  lgIus  (  lgQukr  =  lgPore  lgPscr  lgPcoke
lgcap  ) l.r

Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =      83
-------------+------------------------------           F(  7,    75) =   28.49
       Model |  4.31722829     7  .616746898           Prob > F      =  0.0000
    Residual |  1.93596721    75  .025812896           R-squared     =  0.6904
-------------+------------------------------           Adj R-squared =  0.6615
       Total |   6.2531955    82  .076258482           Root MSE      =  .16066

------------------------------------------------------------------------------
lgP          |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lgQukr       |  -1.900429   .4159169    -4.57   0.000    -2.728978    -1.07188
lggnp        |  -.1120057   .0264125    -4.24   0.000     -.164622   -.0593893
lgIPeu       |    5.35156   1.515486     3.53   0.001     2.332556    8.370563
lgChi        |   1.006397   .1958793     5.14   0.000     .6161857    1.396609
lgTur        |   .4417426   .3182323     1.39   0.169    -.1922086    1.075694
lgIus        |  -2.896124    1.27201    -2.28   0.026    -5.430098   -.3621494
r            |
          L1 |   .7042511   .0950784     7.41   0.000     .5148453    .8936569
_cons        |   3.941283   5.174809     0.76   0.449    -6.367466    14.25003
------------------------------------------------------------------------------
Instrumented:  lgQukr
Instruments:   lggnp lgIPeu lgChi lgTur lgIus L.r lgPore lgPscr lgPcoke lgcap
```

```
Estimation output for heteroskedasticty

ivreg R lggnp lgIPeu lgChi lgTur lgIus ( lgQukr = lgPore lgPscr lgPcoke lgcap)
Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =      84
-------------+------------------------------           F(  6,    77) =    5.30
       Model |  .087973074     6  .014662179           Prob > F      =  0.0001
    Residual |   .18448431    77    .0023959           R-squared     =  0.3229
-------------+------------------------------           Adj R-squared =  0.2701
       Total |  .272457385    83  .003282619           Root MSE      =  .04895

------------------------------------------------------------------------------
           R |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lgQukr |  -.0980511   .1170826    -0.84   0.405    -.3311923    .1350902
       lggnp |   -.014505   .0077107    -1.88   0.064     -.029859    .0008489
      lgIPeu |  -.1588467    .444265    -0.36   0.722    -1.043491     .725798
       lgChi |   .0796622    .055282     1.44   0.154    -.0304184    .1897428
       lgTur |  -.0688407   .0953464    -0.72   0.472    -.2586997    .1210182
       lgIus |   .5240494   .3694516     1.42   0.160    -.2116227    1.259721
       _cons |  -.6783269   1.503008    -0.45   0.653    -3.671198    2.314544
------------------------------------------------------------------------------
Instrumented:  lgQukr
Instruments:   lggnp lgIPeu lgChi lgTur lgIus lgPore lgPscr lgPcoke lgcap
------------------------------------------------------------------------------
```

Estimation output for multicollinearity

```
pwcorr  lggnp lgIPeu  lgIPch  lgIPtu lgIPus  lgQukr

             |    lggnp   lgIPeu   lgIPch   lgIPtu   lgIPus   lgQukr
-------------+------------------------------------------------------
       lggnp |   1.0000
      lgIPeu |  -0.0413   1.0000
      lgIPch |   0.4363  -0.0884   1.0000
      lgIPtu |   0.4777   0.1385   0.8698   1.0000
      lgIPus |   0.2191   0.4628   0.7135   0.7343   1.0000
      lgQukr |   0.3659  -0.0775   0.8513   0.7229   0.5373   1.0000
```

Estimation output for unit root

```
dfuller re

Dickey-Fuller test for unit root                   Number of obs   =        83

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -4.222            -3.534            -2.904            -2.587
------------------------------------------------------------------------------
* MacKinnon approximate p-value for Z(t) = 0.0006
```

Estimation output for correct functional form

```
ivreg lgP lggnp lgIPeu lgIPch lgIPtu lgIPus ( lgQukr = lgPore lgPscr lgPcoke
lgcap )  fv

Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =      84
-------------+------------------------------           F(  6,    77) =   16.84
       Model |  3.55765926     6  .592943209           Prob > F      =  0.0000
    Residual |  2.71093663    77  .035206969           R-squared     =  0.5675
-------------+------------------------------           Adj R-squared =  0.5338
       Total |  6.26859589    83  .075525252           Root MSE      =  .18764

------------------------------------------------------------------------------
         lgP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lgQukr |   .8046674   .4323582     1.86   0.067    -.0562678    1.665603
       lggnp |   -.019805   .0401525    -0.49   0.623     -.099759    .0601489
      lgIPeu |  (dropped)
      lgIPch |  -.2161303   .1798003    -1.20   0.233    -.5741583    .1418978
      lgIPtu |   .2360964   .4458306     0.53   0.598    -.6516656    1.123858
      lgIPus |   .6797108   .9192625     0.74   0.462    -1.150775    2.510196
          fv |   .7826767   .2459256     3.18   0.002     .2929762    1.272377
       _cons |  -8.672653   5.048377    -1.72   0.090    -18.72525    1.379949
------------------------------------------------------------------------------
Instrumented:  lgQukr
Instruments:   lggnp lgIPeu lgIPch lgIPtu lgIPus fv lgPore lgPscr lgPcoke lgcap
```

Supply Equation

```
Estimation output for serial correlation
ivreg lgQukr lgcap lgPore lgPcoke  (lgP = lggnp lgIPeu lgIPus lgIPch  lgIPtu)
l.rs

Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =      83
-------------+------------------------------           F(  5,    77) =   25.07
       Model |  .757152662     5  .151430532           Prob > F      =  0.0000
    Residual |  .660927811    77  .008583478           R-squared     =  0.5339
-------------+------------------------------           Adj R-squared =  0.5037
       Total |  1.41808047    82  .017293664           Root MSE      =  .09265

------------------------------------------------------------------------------
lgQukr       |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lgP          |   .8228823   .1457198     5.65   0.000     .5327172    1.113047
lgcap        |    8.90656   1.298848     6.86   0.000     6.320224     11.4929
lgPore       |   .3054629   .1605471     1.90   0.061    -.0142272    .6251531
lgPcoke      |  -.5106762   .1257468    -4.06   0.000      -.76107   -.2602824
rs           |
         L1  |   .7197834   .1137394     6.33   0.000     .4932993    .9462676
_cons        |  -5.439636    1.82476    -2.98   0.004    -9.073198   -1.806074
------------------------------------------------------------------------------
Instrumented:  lgP
Instruments:   lgcap lgPore lgPcoke L.rs lggnp lgIPeu lgIPus lgIPch lgIPtu
------------------------------------------------------------------------------

Estimation output for heteroskedasticity

ivreg  R2 lgcap lgPore lgPcoke  (lgP = lggnp lgIPeu lgIPus lgIPch  lgIPtu)

Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =      84
-------------+------------------------------           F(  4,    79) =    5.93
       Model |  .007356314     4  .001839078           Prob > F      =  0.0003
    Residual |  .011164745    79  .000141326           R-squared     =  0.3972
-------------+------------------------------           Adj R-squared =  0.3667
       Total |  .018521059    83  .000223145           Root MSE      =  .01189

------------------------------------------------------------------------------
          R2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        lgP  |   .0447011   .0195451     2.29   0.025     .0057975    .0836047
       lgcap |   .1451849   .1666819     0.87   0.386    -.1865871    .4769569
      lgPore |   .0597814   .0203719     2.93   0.004     .0192322    .1003306
     lgPcoke |  -.0703759   .0162782    -4.32   0.000    -.1027768    -.037975
       _cons |  -.2431088    .235243    -1.03   0.305    -.7113482    .2251306
------------------------------------------------------------------------------
Instrumented:  lgP
Instruments:   lgcap lgPore lgPcoke lggnp lgIPeu lgIPus lgIPch lgIPtu
```

```
Estimation output for multicollinearity

pwcorr lgcap lgPore lgPcoke  lgP

             |    lgcap   lgPore  lgPcoke     lgP
-------------+------------------------------------
       lgcap |   1.0000
      lgPore |   0.0675   1.0000
```

```
    lgPcoke |   0.0863   0.9567   1.0000
       lgP  |  -0.2989   0.7722   0.7864   1.0000
```

Estimation output for unit root

```
           Dickey-Fuller test for unit root                     Number of
           obs   =       83

                            Interpolated Dickey-Fuller
                             Test           1% Critical        5% Critical
           10% Critical
                          Statistic             Value               Value
           Value

            Z(t)
 Q         -2.627           -3.534           -2.904            -2.587
           Z(t)
 Pore      -0.711           -3.534           -2.904            -2.587
           Z(t)
 Pscr      -1.413           -3.534           -2.904            -2.587
           Z(t)
 Pcoke     -0.910           -3.534           -2.904            -2.587
```

```
. dfuller  rs

Dickey-Fuller test for unit root                   Number of obs   =        83

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -4.135            -3.534            -2.904            -2.587
------------------------------------------------------------------------------
```

- MacKinnon approximate p-value for Z(t) = 0.0008

Estimation output for correct functional form

```
ivreg lgQukr lgcap lgPore lgPcoke  (lgP = lggnp lgIPeu lgIPus lgIPch  lgIPtu)
FV

Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =      84
-------------+------------------------------           F(  4,    79) =   25.04
       Model |  .857325909     4  .214331477           Prob > F      =  0.0000
    Residual |  .676119493    79  .008558475           R-squared     =  0.5591
-------------+------------------------------           Adj R-squared =  0.5368
       Total |   1.5334454    83  .018475246           Root MSE      =  .09251

------------------------------------------------------------------------------
      lgQukr |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         lgP  |  -.1324266   .0665178    -1.99   0.050    -.2648269   -.0000264
       lgcap |  (dropped)
      lgPore |   .1974173   .1658128     1.19   0.237    -.1326248    .5274593
     lgPcoke |   .0206205     .10647     0.19   0.847    -.1913026    .2325437
          FV |    .708317   .1168144     6.06   0.000     .4758037    .9408304
       _cons |   2.289036   .7790525     2.94   0.004     .7383712    3.839702
------------------------------------------------------------------------------
```

```
Instrumented:  lgP
Instruments:   lgcap lgPore lgPcoke FV lggnp lgIPeu lgIPus lgIPch lgIPtu
------------------------------------------------------------------------------

F=0.003
```

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