THE INFLUENCE OF WTO ACCESSION ON THE IRON AND STEEL INDUSTRY. THE CASE OF UKRAINE. PARTIAL EQUILIBRIUM ANALYSIS.

by

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Abstract

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The Ukrainian steel sector is highly involved in international trade and WTO membership is a necessary step for the further development of Ukrainian trade policy. This means, however, significant tariff regime changes and the abolition of export subsidies, which according to trade theory have a significant adverse influence on the welfare of competing producers. The thesis explores trade policy measures for the steel sector that may be appropriate in the lead up to WTO accession.

The paper adopts the partial equilibrium analysis for evaluation of the effect of eliminating of production subsidies under "small" and "large" country scenarios. A free trade regime or the introduction of an export tax are provided as better alternatives to production subsidies.

The empirical part provides the required import and domestic demand and domestic supply elasticities. On the basis of the estimated price elasticities a quantative evaluation is conducted on the welfare effects on steel producers, consumers, the government and the country as a whole. The econometric results support the "large" country case. The study demonstrates that subsidies are not desirable for national welfare, free trade or a small export tariff are sound alternatives.

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GLOSSARY

2SLS	Two Stage Least Squares
3SLS	Three Stage Least Squares
CIS	Commonwealth of Independent State
CPI	Consumer Price Index
EL	Efficiency Loss
EU	European Union
FDI	Foreign Direct Investment
FILM	Full Information Maximum Likelihood
FSU	Former Soviet Union
GATT	General Agreement on Tariff and Trade
GDP	Gross Domestic Product
GHM	Grossman, Hart and Moore
GMM	Generalized Method of Moments
IISI	International Iron and Steel Institute
MFN	Most-Favored-Nation
MR	Marginal Revenue
NBU	National Bank of Ukraine
OECD	Organization of Economic Cooperation and Development
OLS	Ordinary Least Squares

ROW	Rest of the World
SEM	Simultaneous Equation Modeling
SUR	Seemingly Unrelated Regression
TOT	Terms of Trade
UAH	Ukrainian Hryvna
W2SLS	Weighted Two Stage Least Squares
WTO	World Trade Organization

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Chapter1

INTRODUCTION

Ukraine remains one of the typical representatives of former soviet "over-industrialized" countries. More than ten years have already passed since Ukraine gained independence and the country has at least tentatively embarked on economic reforms. Ukraine is the seventh largest steel producer[1]and the fourth biggest steel exporter[2] in the world after Japan, Russia and Germany. A significant share of Ukrainian exports is composed of metallurgical products. In 2002 the steel export volume accounted for about 70 per cent of domestic ferrous metal output and constituted a 30% share in the total value of Ukrainian exports. In addition to being an export intensive sector, the metallurgical industry is a significant contributor to Ukraine GDP.

From the time of independence the Ukrainian Metallurgical sector due to its strategic importance has appeared among the sectors which were intensively subsidized by the government. The main motives for such state policy were the radical changes in the industrial structure in the countries of the Former Soviet Union, the destruction of trade links between enterprises, the trade liberalization aspect, and as a consequence the inability of large enterprises to be profitable on the basis of their own.

WTO members account for about 90% of the World trade flows and Ukrainian accession to WTO appears to be a necessary step in the elaborating its trade policy. Debates on the Ukrainian accession to this organization are nowadays in the lens of political attention. Obviously, different political and industrial groups will subject to various shocks from this step. First of all it concerns the sectors of the economy, which are highly involved in international trade because WTO membership means significant tariff regime changes and the abolishment of export subsidies,

[1] See Table 1.1 (Appendix 1)
[2] See Table 1.2 (Appendix 1)

which according to trade theory have a significant adverse influence on the welfare of competing producers. While WTO entrance appears to be significant overall for Ukraine, the evaluation of the changes in trade policy regime in such export intensive sectors as metallurgical sector appear to be highly relevant.

The main hypothesis that we are going to test in the paper is whether the elimination of implicit production subsidies in the Ukrainian steel sector will have positive effect on the Ukrainian welfare. Such trade liberalization will be compared with the introduction of an export tax, which is set optimally.

The welfare effects evaluation is conducted on the basis of partial equilibrium analysis. This allows the analysis to focus on distortion in sector of the economy, which is of interest.

The paper consists of the following parts:

Chapter 2 provides a literature review.

In Chapter 3 we outline the main features of Ukrainian steel industry. General economic tendencies are identified and the economic performance of the sector is assessed. Then brief industry overview revises the main players of the sector. Finally, we specify the peculiarities of subsidizing the steel producers and its potential contradiction with the GATT/WTO rules, which limits and in some cases prohibits trade policies that can have an adverse effect on other members.

In Chapter 4 we adopt the partial equilibrium analysis for our study. Assuming competitive market structure along with constant demand and supply elasticities on the domestic market as well as constant import demand elasticity on the foreign market, we conduct an evaluation of the effect from eliminating of subsidies under "small" and "large" country assumptions. The introduction of export tariffs is also considered.

Chapter 5 provides the empirical results of the analysis. At the first stage of the analysis we estimate the required elasticities. Then, on the basis of the

estimated elasticities we obtain the quantative evaluation of the welfare effects on steel producers, consumers, the government and the country as a whole.

The econometric results support "large" country case and we conduct the analysis in this particular framework. We find that subsidies are desirable for Ukrainian producers and consumers and, therefore, eliminating of subsidies has negative effect on them. But eliminating subsidies has total positive effect on national welfare because government collects substantial amount of revenues. The elimination of subsidies leads to a free trade regime in our analysis.

The introduction of the export tariff is proposed as an alternative trade policy measure after cancellation of production subsidy. It allows to collect additional benefits for the country compared to those that are obtained from transforming from subsidies to free trade. National welfare is positively affected with this trade policy.

The last part of the paper concludes the conducted analysis.

Chapter 2

LITERATURE REVIEW

Trade liberalization along with issues of joining WTO has attracted much attention and appeared to be in the spectrum of analysis in recent years. The issue of WTO membership concerns not only the resolution of disputes arising between countries while conducting their trade policies, but also the elimination or decrease of trade tariff and non-tariff barriers in countries-members.

Different theoretical and empirical studies on tariff regimes changes have been conducted in order to distinguish the main consequences in the form of welfare gains and losses of the elimination of trade barriers and the establishment of free trade.

2.1. Closely related market studies on trade policy under perfect competition.

Partial equilibrium analysis is a feasible tool in analyzing the welfare effect from the trade policy changes under perfectly competitive market structure. Although it does not reflect the spillover effect on other sectors of the economy, it, nevertheless, allows to focus on the sector of the economy that is of particular interest.

Shulha (2003) apply partial equilibrium modeling for estimation the welfare losses from the export tax policy in Ukrainian sunflower seed industry. She finds that optimal export tax that is estimated as an inverse to the absolute value of the import demand elasticity for Ukrainian export of seeds brings substantial benefits for the country. She considers "large" and "small" country cases that indicate different market power of Ukrainian producers on the world market and shows that "small" country case eliminates any possibility of welfare benefits by its construction. Since her econometric

results support "large" country case, Ukraine benefits from the optimal tax policy.

Legeida (2002) evaluates the economic consequences of government support of Ukrainian Steel Sector with the employment partial equilibrium technique. Along with results of Ukrainian export supply elasticity estimation obtained by Grygorenko (2001) she also uses the results obtained by Irwin (2001) and also the results independently obtained by Mount Union College (USA) for American steel export, and evaluates the welfare effects in "large" and "small" country cases. She finds that for all values of export supply elasticities, production subsidies are harmful for the national welfare under both "large" and "small" country assumptions.

Freenstra (1995) evaluates in terms of welfare losses of foreign countries the effects of US import protectionist measures for main export intensive industries among which is Steel sector. In spite of the rules established by General Agreement on Tariff and Trade and establishment of regional free trade areas, The United States perceive highly discriminatory trade policy, especially toward countries of Former Soviet Union. The author comes to a conclusion of a preference of a multilateral trade agreement instead of bilateral one.

In order to investigate the effect from the policy changes on the entire economy, computable general equilibrium appear to be a feasible alternative. Tarr (2002) investigates the impact of the WTO accession applying the computable general equilibrium model of the Russian economy that assumes the tariff reduction on the imported/exported goods and services along with FDI barriers elimination. Two scenarios are proposed in the study, one of which is based on the total tariff reduction up to 50% together with FDI of services barriers elimination, while the second one assumes only a 50% reduction in the ad valorem equivalent for FDI barriers, other assumptions being the same as in the first scenario. The medium and long run welfare gains are estimated with the help of CGE model and a Dixit-Stiglitz framework is employed in order to distinguish the productivity

effects in goods and services markets. Using the obtained results the author supports the idea that export intensive sectors among which the leading positions in Russia are occupied by ferrous, non-ferrous metals, chemicals, timber, wood, pulp and paper products will gain mostly under WTO accession.

2.2. Theoretical models on trade policy under imperfect competition.

The question of tariff and quotas arises in the early theoretical studies of trade liberalization. While the assumption of perfectly competitive market structure are predominantly involved with the purpose of maximum simplification of estimation and clarity of policy implications, the imperfect competition cases give more deep theoretical insights into the problem under which the exercising of the market power becomes feasible. This feature relates to the models based primary on the oligopolistic market structure.

Brander and Spencer (1982a) introduce two firms (the domestic and foreign) into the model, which produce perfect goods-substitutes competing in the third-country market. Assuming non-convexity of the demand (or at least not very convex demand), the authors give rationale to the government's ex ante trade policy determination on the basis of Cournot-Nash equilibrium and conclude that under the proposed conditions export subsidy is the most optimal trade policy issue.

Significant contribution into imperfect competition modeling is done further by Dixit (1984). He makes a brief trade policy literature review starting from the results of Brander and Spencer and extends their framework by introducing more firms in the model but not up to the perfectly competitive amount. This assumption along with Cournot oligopoly market structure practically preserves the previous models' background for the rent seeking behavior in the form of non-zero profits under imperfect competition. The results of the extended Dixit theoretical

framework are similar to those of Brander and Spencer because they prove export subsidy to be optimal under given assumptions.

The optimal trade and industrial policy under oligopoly is worked out by Eaton and Grosman (1986). They start the model development from the simple case of Cournot duopoly in the presence of oligopolistic competition among firms producing imperfect substitutes and prove the efficiency of export subsidy thus providing a slight generalization of Brander and Spencer (1982a) argument. In the further model expansion they find that export tax is optimal in the Bertrand duopoly case and conclude that in the presence of non-zero domestic consumption the introduction either imports or production tariffs or subsidies depends on the peculiarities of the market conditions. Given model brings us to the important conclusion that optimal trade policy should take into account *all* various market influences. Therefore, in order to implement any previously developed trade policy regime all possible country specific factors must be taken into account.

Dixit and Kyle (1985) apply the model of a Cournot duopoly with one incumbent and one potential entrant to competition between Boeing and Airbus. They find that in such case the domestic producer appears to be the potential beneficiary from the aggressive trade policy. They support their claim with the argument that as far as there is only one firm on the market, either Boeing or Airbus, it makes no problem for it to sell its production without any sunk costs; but if the other firm enters the market, suppose Boeing is a potential entrant, aggressive trade policy measures on behalf of the European government, which now starts to subsidize Airbus, not only obstructs the market entry for Boeing but also helps to capture larger market share. In this case income of the "promoting" country increases at the expense of the other country. In spite of the fact that such strategy is beneficial for one of the countries, these protection measures are harmful for the rest of the world.

The majority of theoretical developments (Spencer and Brander (1982a), Eaton and Grossman (1986), Dixit and Kyle (1985)) are conducted in the

form of duopolistic case under different market structure assumptions and various functional forms (demand, supply, cost structure). Nevertheless, the optimal strategic solutions appear to be not universal if basic assumptions of the model are altered. The changes in the entry conditions, functional form of cost function due to innovation, shifts in the strategic interactions between firms in the industry may bring the model development to substantially different results.

Markusen and Venables (1988) investigate different strategic trade policy issues of exporting industries under the basic assumptions of homogeneous products in Cournot competitive markets, linear nature of demand, and constant marginal costs. They also assume existence of domestic consumption and openness of the economy towards imports what initiates competition. Introducing industries with both free and restricted entry into the model, they revise the trade policy patterns under the market segmentation case and also when the countries are fully integrated.

Klette (1994) develops a more general strategic trade policy for exporting industries in the oligopolistic case. He develops the direction of the strategic trade policy under the only assumption about the nature of firms' profit function. He assumes the symmetric equilibria case for given number of firms. Considering the rule of thumb, the author derives the results from the impact of scale economies and product differentiation on the strategic trade policy. He comes to the important conclusion that while in the case of scale economies export subsidy is the optimal solution, export tax is the best strategic trade policy issue under product differentiation assumption. The subsidy to home producer is efficient if domestic consumption exists.

In the further theoretical developments of subsidy versus taxes aspect, Chang and Chen (1994) and Ishikawa and Spencer (1996) claims in favor of taxes instead of subsidies. Making specific assumption on the share of the imported intermediate good in the final output (the situation is quite similar to that in the Ukrainian steel sector when one-third of production costs consists energy imported from Russia (Mazur, Ivanov (2001)), they argue

that in such case foreign suppliers appear to be ultimate recipients of a subsidy paid to the final sector output. Therefore, under such circumstances export tax is the most appropriate solution.

Santis and Stahler (2001) revise the case of free entry for the exporting industries and estimate the optimal export tax and home production subsidies. Their main theoretical finding claims that when export price in a monopoly price and domestic price is a competitive price, domestic welfare in not maximized unless the market structure is taken into account. They also provide the theoretical justification for the fact that under the linearity assumption of domestic and foreign demands, the optimal oligopolistic tax/ subsidy is the same as those for perfect competition case.

Thus we can see that theoretical consideration for optimal trade policy is rather deep and diversified. The main conclusion that can be done from the above discussion is that we cannot establish one particular pattern for optimal trade strategy. The specific features of the country together with international environment in a certain period of time determine the direction of the trade strategy for the country.

2.3. Other studies devoted to the trade liberalization.

Along with the issue on tariff and subsidies changes and the evaluation of the effects of such policy shifts in terms of national welfare gains and losses under different market structures, there exist other studies on the WTO that concern other aspects and employ alternative methods of analysis.

The optimal open-trade strategic policy is worked out by Bagwell and Staiger (2001). They develop the model, which helps to outline the shifting in the comparative advantage from accession in the WTO under most-favored-nation (MFN) principle. The model assumes bilateral and sequential structure of bargaining environment what appears to be the main cause of backward-stealing and forward-manipulation problems. The main interpretation of the first problem lies in the fact that, ceteris paribus (i.e.

without tariff changes), the government of country A can 'bribe' the government of country B in order to liberalize the trade relation thus gaining beneficial improvement in its terms of trade for the cost of country C. The essence of the second problem provides us with the issue that a bilateral negotiation product between countries A and B in terms of trade relation improvement appears to be a "free lunch" for country C that did not make the contribution to the negotiating process. The authors resolve both problems with the introduction of the WTO negotiating rules based on renegotiation provision and reciprocity norms and conclude that provided strategy helps to achieve multilateral efficient trade agreements.

Rose (2002) claims the common belief that WTO membership encourages trade is really not valid. With the help of the logarithmic form of the standard gravity model of bilateral trade he supports his idea on the effectiveness of the preferential trade relatively to the trade liberalization agreement. In addition to the gravity model the author also involves the fixed effects regression analysis with the help of which about 70 percent of variation in the trade is explained by non-trade liberalization parameters. Therefore, he comes to a conclusion that trade liberalization does not have a significant effect on trade, while preferential trade regime appear to be more effective.

Patrick (2003) contradicts Rose arguments with the sequence of practical examples on the effectiveness of WTO membership. Although he does not involve any complex empirical techniques in his paper, on the basis of real cases he says that WTO membership is rather gainful but the effectiveness of it is biased towards rich countries. This mainly concerns the resolution of disputes when poor countries do not have sufficient financial support in conducting and winning negotiations. Nevertheless, Patrick advocates in favor of the regional trading blocks enlargement since, in his opinion, it decreases substantially the transaction cost and encourages cooperation. Moreover, trade liberalization helps to work out trading norms for

coordinating behavior, and creates favorable investment climate in poor countries and countries with transition economies.

Eremenko, Mankovska, and Dean (2003) develop the study mainly based on the gravity model that makes the main hypothesis about the positive effect of the WTO entrance for Ukrainian exporters but, unfortunately, the empirical part of the study based predominantly on the gravity model evaluative approach by Timbergen (1962) and Poyhonen (1963) appears to be of poor support to this idea. The model also releases the significant trade surplus of Ukraine with its partners, which actually exceeds the estimated potential within 6 times. This fact does not come into the justification of the initial hypothesis as well.

Michalopoulos (1999a and 1999b) in his study devoted to the integration of transition economies into the World Trading System discusses the current trade policies predominantly of the countries of the former Soviet Union (FSU) and puts into the picture the main difficulties which can arise in further negotiations. He alleges that the progress towards WTO accession varies significantly across FSU countries. For example, Baltics countries have already gained the WTO membership thus appear to be the exception in the complexity of the negotiation process compared to the rest of FSU countries. According to the paper the main obstacle for the FSU countries lies in the institutional and political inconsistency along with the influence of trade-related factors, tariff and customs regimes.

Since the question of the Russian pricing policy on the natural gas had raised under the WTO entrance negotiations, Tarr and Thomson (2003) discuss the merits of dual pricing of Russian natural gas under the WTO entrance. The model, which assumes the monopolistic power of the major Russian gas producer, works out the optimal two part tariff, and gives us the estimates of profits shifts supporting the idea of monetary gains from the policy but involving the possibility of the long-term risk of loss of the market share.

2.4. Studies devoted to the Ukrainian Steel Sector.

The case of Ukrainian Ferrous Metal Industry is revised under the transition period. Dubohryz (2003) evaluates the role of Ukrainian government in the industrial performance of Steel sector. The particular case of "The Economic Experiment in Metallurgy and Mining Industries" in the year 1999 is examined. The OLS regression analysis suggests that although the Experiment gives no substantial increase in overall Steel sector output, it has positive impact on enterprise profits, revenues and technologies, providing the argument in favor of effectiveness of industrial policy in the overall industry growth.

The economic performance of Ukrainian Iron and Steel Industry under Post-Communism period is evaluated by Mykhnenko (2003). He makes general overview of the steel industry and determines the main trend in the economic performance. The period is basically characterized by extremely unstable situation with deteriorating trend. It results in lower labor productivity, declining efficiency, negligible rate of return on investments, and as a result sharp output decline. The year 1998 is determined as a start of recovery. The recovery trend has non-linear nature. While the leading positions in the recovery are occupied by a limited number of enterprises, "the majority of the ferrous metal companies are clearly lagging far behind" Mykhnenko (2003). The author gives several possible explanations to this phenomenon. Along with insufficient recourses base hypothesis, he also provides industry environment hypothesis, but none of them can sufficiently characterize the declining character of the steel sector performance under transition.

Grygorenko (2001) revises the problem of disequilibria situation in the Ukrainian Steel industry and low capacity rates in the industry. According to the econometric findings the author suggests that the efficient level of output is not possible to obtain under the underutilization circumstances. With employing the property rights methodology by Grossman, Hart and

Moore (GHM) he tend to prove underinvestment to be the main cause of disequilibria. The further theoretical development of the model introduces the "third party" (that represents the role of intermediary) into the relationship between primary producing firms, with the help of which the author explains the underinvestment problem. The empirics confirm the assumption that the third party positively influences the enterprise performance. Nevertheless, the role of the "third party" on the level of investment remains ambiguous. The author concludes that despite the fact that the role of the third party in promoting production efficiency is substantial, it can hurt competition in the industry by creating high concentration in the industry and exploiting monopoly power.

Thus we can observe rather deep and diversified set of theoretical and empirical literature on the optimal trade regimes and trade liberalization issue. While the assumption of perfectly competitive market structure are predominantly involved with the purpose of maximum simplification of estimation and clarity of policy implications, the imperfect competition cases give more deep theoretical insights into the problem. The optimal trade policy is highly dependent on the specific features of the economy of the particular country. The empirical literature is mainly directed at the evaluation the welfare effects of the trade policy regimes within one country, either subsidies or export/import tariffs; and also WTO accession gravity models for different countries. The empirical literature for the Ukrainian Steel Sector is rather narrow and the trade related issues for the sector are investigated rather weakly.

Chapter 3

UKRAINIAN STEEL INDUSTRY

3.1 General Overview of the World Tendencies and their influence on the Ukrainian Industrial development

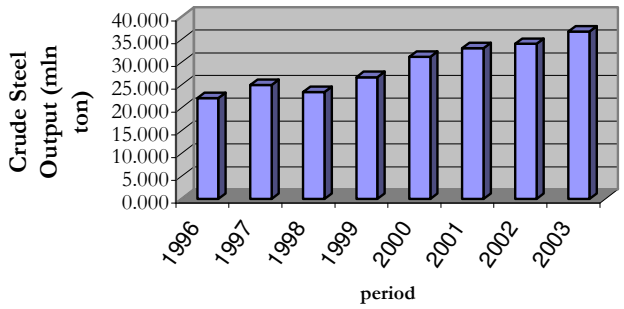
The financial crisis during 1997-1998 in Asian and Pacific Ocean regions has influenced almost all countries all over the World and has resulted in the significant macroeconomic determinants deterioration. Nevertheless the deepness and terms of this global crisis was varying through the countries. These tendencies in the world economy development have influenced the core industries of different countries. Poor and developing countries suffered much more than developed countries in which the decrease in the speed of GDP growth was observed.

Industrial countries among which is Ukraine were also influenced by this global crisis. The structure of Ukrainian GDP is different from that in the developed countries. While on average the GDP structure is composed of 20 and 61%[3] of goods and services shares respectively, Ukraine, in its turn has 58% share of goods and only 30% of services in GDP structure. The Iron Ore and Steel Industry occupy a 40% share in the total industrial output, what constitutes a 20% from GDP[4]. This big share of Steel Industrial output is not involved in the subsequent stages of goods and services production, thus, making the Steel Sector predominantly export oriented. In this aspect it becomes natural that Iron Ore and Steel sector is highly subjected to the World economic tendencies.

According to the International Iron and Steel Institute (IISI) statistics the Ukrainian Steel output was low in the 1997-1998 crisis years with the following rise in the subsequent years (Diagram 1).

[3] According to the World Bank statistics (1998) the GDP structure consists of 20% goods and 61% of services. Due to this classification the rest part refers to "others".
[4] According to the World Bank statistics (1998)

Diagram 1.Annual Ukrainian Steel output in 1996-2003



Source: IISI (2004)

The growing tendency of the steel output can be explained by two main groups of factors: internal and external. To the internal factors can be related such factors like improvements in political and economic environment, industrial productivity improvements[5], banking sector reforms, and also reforms in the energy sector. To the external factors we relate, first of all, improvements in terms of international trade environment, and also, as it has been mentioned above the world macroeconomic tendencies.

What can we say about the main tendencies that played the significant role in Ukrainian economic development? This is the post-crisis revival of the world economy that can be predominantly characterized by a booming development of the Asian and Pacific Ocean Countries and United States. These regions are the leaders in the speed of restoration of their economies. They appear to be the main consumers of steel on the world steel market. According to "Ukrpromvneshexpertiza" analysis Asian and Pacific Ocean Countries consumed 35% of Ukrainian steel export in 1999 post-crisis year, with a subsequent tendency in the year 2000 to 28%.

[5] We do not talk about some deep industrial restructuring tendencies in the Steel Sector, but the increase in the output can be explained by reforms (Economic Experiment) due to which, while still operating below the production possibility frontier, enterprises has obtained the possibility to overcome the dramatic Post Soviet Union economic recession

Global specialization has become one of the core tendencies in the Steel Industry during last years. Economic development of Asian and Pacific Ocean countries began in the circumstances of development of steel consuming industries: machinery building, construction, electrical engineering, which created outrunning demand for the steel products. Naturally, increasing imports mainly from the FSU countries with excess productive capacity satisfied the excess demand in this region. The development of advanced technologies of steel production in the region was targeted at the production of finished rolled steel, while the structure of import demand was directed on the consumption of semi-finished melted steel products from the CIS, Brazil, Australia, and China.
Significant improvements in the quality of steel production contributed to the intense competition in the industry. China has intensively reconstructed the industry and implemented the full production cycle. Therefore, China is expected to become the major steel supplier in the industry by the year 2005.

Thus, we can see that in the following years the increase in the quality of steel products along with generally rising demand for steel will be among the main tendencies in global steel production. And in such circumstances Ukraine will have to face more and more complicated competitive environment. Moreover global trade liberalization and GATT WTO rules establish significant barriers for trade until Ukraine is not a member of this organization.

3.2. Overview of Ukrainian Steel Sector.

The history of Ukrainian Steel Sector goes back to the XIX century. For more than 130 it has grown into a strategically important manufacturing sector. During Soviet times, Ukraine was among the main steel producers in

the country and supplied the dominant share of the industrial output to other Soviet Republics.

Steel enterprises are located in the southeastern part of Ukraine. Dnipropetrovsk, Zaporizhzhia, Donetsk, and Luhansk are the core industrial territories within the country. The industry has the high level of concentration. Steel enterprises with the yearly output of more than 1 million tons account for 97% share in the industry. The biggest steel work Kryvorizhstal in the year 2002 produced 6.9 million tons[6].

The main producers of steel account for 85% of total steel output. The main players are:

- Kryvorizhstal State Iron and Steel Combine (Krivyi Rih);
- Mariupol Ilych Iron and Steel Combine (Mariupol);
- Azovstal Metal Plant (Mariupol);
- Zaporizhstal Iron and Steel Combine (Zaporizhzhia);
- Alchevsk Iron and Steel Combine (Alchevsk);
- Dniprospetsstal Electric Steel Works (Zaporizhzhia);
- Dniprovsky Dzarzhinsky Iron and Steel Combine (Dniprodzerzhynsk);
- Dniepropetrovsk Petrovsky Iron and Steel Works (Dnipropetrovsk);
- Nikopol Ferroalloys Works (Nikopol);
- Donetsk Iron and Steel Works;
- Yenakiyevskiy Metal Plant (Yenakiyevo);
- Libnehta Metal Plant (Libnehta);

By the share of average revenue the five biggest steel enterprises account for approximately 60% in the total revenue volume: Kryvorizhstal – 17,8%, Mariupol Ilych – 17,3%, Azovstal – 12,8%, Zaporizhstal – 11,0%, Alchevsk – 6,8% for the years 1999-2002[7].

[6] State Statistics Committee

[7] source: Mykhnenko (2003) "The Ukrainian Iron and Steel Industry: Economic Performance Under Post-Communism"

Since the Ukrainian ferrous metal industry includes several production stages concentrated in the south-eastern region of the country, the description of the industry should also mention that the steel production cycle is connected with upstream coal and coke mining, iron-ore enriching, dressing and processing plants, and downstream pipe-making plants. In total the number of multi-stages steel production cycle is composed of more than 300 enterprises. Along with 14 big steel enterprises there exist 9 big pipe-making works, 11 coke works, 5 ore-enrichment plants, and 3 ferroalloys plants.

The Ukrainian Steel Sector is characterized by its high labor intensity. The total number of workers employed in the sector equals 500000, which is twice as big as the number of workers employed in the United States steel sector, which is more technologically developed. Therefore, in spite of the fact that Ukrainian Steel Sector is of great importance for Ukrainian economy, the labor intensity within the sector reflects poor technological development. While the general tendency in the world is directed towards the development of electric steel, Ukrainian metallurgy still produces nearly 60% of output by outdated and highly labor and electricity consuming open-hearth furnace technology. The high labor intensity within the sector determines the regional character of labor allocation. Big steel enterprises very often appear to be the only potential employer for people.

3.3. Government support of Ukrainian steel producers

From the time of independence, the Ukrainian metallurgical sector, due to its strategic importance, has been among the sectors, which were intensively subsidized by the government. The main motives for such a government policy were the radical changes in the industrial structure in the countries of the Former Soviet Union, the destruction of the trade links between enterprises, the trade liberalization aspect, and as a consequence the inability

of large enterprises to support the profitability with the help of its internal resources.

In order to investigate the peculiarities of the Ukrainian industrial subsidization, the definition of "subsidy" should be provided. Initially, following the System of National Accounts classification (OECD, 1997), "subsidies on production are grants which state and private enterprises receive from the government and which represent additions to the receipts of producers of goods and services over and above what they receive from the state". Particularly, export subsidies are directed at the intensification of the export activity of the sector, and, therefore are given to producers who operate on the foreign market. Two options appear within this framework. On the one hand subsidies can act as an export promotional instrument in order to provide the particular industry with enough power to gain the foreign market share, but, on the other hand, it can be provided for balance of payment reasons when on the basis of the price differences an incentive for exports is created (Krugman, Obstfeld, 1996). In either case subsidies appear to be harmful on both micro and macro levels. While at the micro level, a subsidy can bias the efficiency of income redistribution and stimulate unequal development of different sectors within the economy, at a macro level a subsidy stimulates the lobbying and rent seeking behavior of particular political groups and also prevents the development of free trade relationships with the rest of the world and leads to welfare losses for the entire economy. Moreover, subsidizing is in contradiction with GATT/WTO requirements, specifically with the point 1.1 (ii) "Subsidies and compensation" of the Article I and point 1.2 on "National regime of domestic taxation" of the Article II.

While at the beginning of 1990's the subsidizing of the domestic enterprises had the form of direct monetary transfers, later they transformed into the indirect support has been given in the form of tax exemptions, payables (trade credits) between enterprises, non-monetary transactions, banking

subsidies in the form of privileged credits, trade subsidies, and other implicit subsidies granted on behalf of the state.

Among the programs directed at the support of domestic enterprises is the Law "On Conducting an "Economic Experiment at Ore-mining and Metallurgical Enterprises of Ukraine" dated back to the year 1999. It was the reaction of the Ukrainian authorities to the booming development of the world steel market mainly due to the increasing demand for metallurgical products from China and Middle East. The idea was to provide the steel enterprises with profit tax reduction benefits.

Specifically, the metallurgical enterprises were to obtain the following privileges:

- The participating enterprises were allowed to reduce the amount of the profit tax by 30% from the initial amount, which constituted the 9% (the initial amount of tax was 30%). Such tax exemptions were directed at the *investment in the working capital*. Later, in the year 2001, the tax reduction was partially reversed but still equaled 15%;
- The innovation fund fee was reduced by 50%;
- The fee for the environmental pollution that was a significant cost for metallurgy was reduced by 70%. The amount of money saved by the enterprises was directed at the enterprise own environmental protection measures;
- The road fund fee was eliminated;
- The enterprises also were able to write-off debts and fines prior to the starting date of the experiment in July 1999. The fines for non-payments under the economic experiment period were reduced to 50%.

Certainly the reduction of the tax burden was the most significant instrument of production subsidization under the experiment. The Economic Experiment was in act until January 2002 when the Cabinet of Ministers adopted the project "On further development in the mining and smelting industry" for the period 2002-2010. Due to the program,

modernization of the sector is to be conducted and therefore the tax privileges are to be continued.

Therefore, we can see that such significant tax privileges increase the volume of available cash flows and decrease the effective costs of production of one unit by *s* for Ukrainian enterprises and can be interpreted as *ad-valorem* production subsidy. Since the dominant part of the steel products (up to 80%) is exported abroad, such protective measures from the side of the government can result in WTO-consistent antidumping and countervailing duties from trade parties because of its adverse effect on their producers[8].

The trend towards increasing exports by the Ukrainian steel sector together with unsuccessful trade policy and non-membership in WTO resulted in 58 antidumping investigations with 46 findings against Ukrainian producers during 1996-2000. Out of the total number of cases 15 were initiated on by the USA and 14 by the EU. As a result countries of EU, Latin America, Asia, and USA has established taxes and quotas or restricted import of steel products from Ukraine. Such retaliatory measures have brought Ukrainian producers direct losses of approximately $ 1,5 billion.[9] Therefore, we see that the set of measures intended to speed up the restructuring process and increase the volumes of export of Ukrainian Steel Industry come into contradiction with the rules of GATT/WTO and lead to inefficient welfare redistribution measures in terms of preventive measures from the side of importers of Ukrainian products.

Since Ukraine is actually pursuing accession to the WTO, it must develop alternative trade regime that is compliant with WTO rules and gives total welfare improvements for the country. Under such circumstances, indirect production subsidies should be eliminated. After cancellation of subsidies either a free trade or a small export tax should be introduced. The rationale for such trade policy has several practical dimensions. An export tax policy regime is not in direct contradiction with WTO rules and does not have an

[8] See Table 1.4 (Appendix 1)
[9] Source: "Ukrpromvneshexpertiza".

adverse effect on producers in other member countries. Moreover, such an export tax avoids the possibility of antidumping and countervailing duties against Ukraine that appear to be a serious problem for producers. In spite of the fact that introduction of export tariff for steel products will lead to producers' losses due to the reduction in the domestic price, it will help produces to avoid losses arising from countervailing duties, and it will also bring substantial benefits for the government budget.

Chapter 4

THEORETICAL CONSIDERATION: PARTIAL EQUILIBRIUM MODEL

The main hypothesis we are going to test within the framework of our research is ***whether subsidies are harmful or efficient for the Ukrainian Steel Industry and if not what trade policy might we choose to make international trade for Ukraine optimal? What will be the effect of introduction of small export tax instead of subsidy?***

4.1. Methodology

Partial Equilibrium Analysis appears to be the most attractive tool in the trade effects evaluation on producers, consumers and total welfare. The theoretical consideration of partial equilibrium analysis in the thesis is predominantly based on the classical technique of estimation tariff and quotas effects as those in the papers of Gaisford and Kerr (1998) on the impact of European Union accession on the agri-food sector of Poland, Gaisford and Kerr (2001) on the impact of WTO on agriculture, Porter (1997) on subsidizing the natural resources sector and its impact on trade, Rosenberg, Ruocco and Wiegard (1999) on the impact of subsidies on Uzbekistan trade.

For our analysis we make the following assumptions:

- COMPETITIVE market structure. (In order to provide the empirical support for this assumption we have conducted the endogeneity test for the price on the enterprise level. We have found that all except two enterprises appear to be price takers (Appendix 2). This allows to assume approximately competitive market structure)

Two main markets are involved in the analysis. Domestic Ukrainian market with equilibrium point at which domestic demand is well satisfied with domestic supply. Foreign market equilibrium is established in its turn when export supply enriches the foreign demand. Hence force, the total amount of exported products equals the difference between the amount supplied by Ukrainian producers and amount demanded by Ukrainian consumers. Thus we can observe that

Ukrainian export of steel=*Amount of steel supplied by Ukrainian producers-amount of steel demanded by Ukrainian consumers*

- CONSTANT demand and supply elasticities on the **domestic** market and CONSTANT **import** demand elasticity (These estimates are necessary in the evaluation of welfare effects);
- LOGARITHMIC form of demand and supply functions in order to facilitate empirical analysis (linearity in logarithms);
- Welfare evaluation will be conducted under "SMALL" and "LARGE" country assumptions;

In the "small" country case subsidy elimination does not affect the rest of the world trade policy (it does not effect the world price on the market); "large" country case assumes that Ukrainian trade policy has the impact on the world price. Such assumptions are made on the background of the trade policy and market structure theory proposed by Helpman and Krugman (1989) and also by Suranovic (2000)[10]. Full export subsidy elimination with no export tariff is equal to the trade liberalization case that refers to the first scenario of trade policy development, while the introduction of small export tariff refers to the second scenario.

- We assume the HOMOGENEOUS goods market structure;

Import and domestic markets are specified in the following way[11]

[10] Suranovic (2000) names those cases as "small" and "large" country cases.
[11] Francois, Hall (1997) "Partial Equilibrium Modeling" in Francois Rombout "Applied methods for Trade Policy Analysis", Cambridge University Press

Domestic demand: $Q^D_{DOM} = Q^D_{DOM}(P) = A \times P^{\varepsilon^d_{dom}}$

Domestic supply: $Q^S_{DOM} = Q^S_{DOM}(P(1+s)) = B \times [P \times (1+s)]^{\varepsilon^S_{dom}}$

Foreign import demand: $Q^D_{IMP} = Q^D_{IMP}(P^*) = C \times (P^*)^{\varepsilon^D_{IMP}}$

Export supply:

$$Q^S_{EXP} = Q^S_{DOM} - Q^D_{DOM} = B \times [P \times (1+s)]^{\varepsilon^S_{dom}} - A \times P^{\varepsilon^d_{dom}}$$

Where ε^d_{dom} and ε^d_{imp} are domestic and foreign import demand elasticities; and ε^s_{dom} is domestic supply elasticity. A, B, and C are functional constants; s is the amount of subsidy that Ukrainian producers obtain in indirect form. P and P* are the domestic and world steel prices respectively. In case of production subsidy under domestic and foreign consumers face the same price P, while P* becomes higher after elimination of subsidies in the "large" country case. As we have already noted the export supply of steel equals the difference between the amount of steel supplied and demanded on the domestic market.

4.2. Subsidies in the "small" country.

The first case that we are going to revise in the framework of the thesis is the effect of the production subsidy to Ukrainian steel producers when the price of Ukrainian steel industry has no effect on the world prices. We mean that the share of Ukrainian Ferrous metal sector in the total volume of production is very low. Consequently, the domestic prices are not changed and the consumption also remains unaffected.

In order to specify our analysis we make the following assumptions:

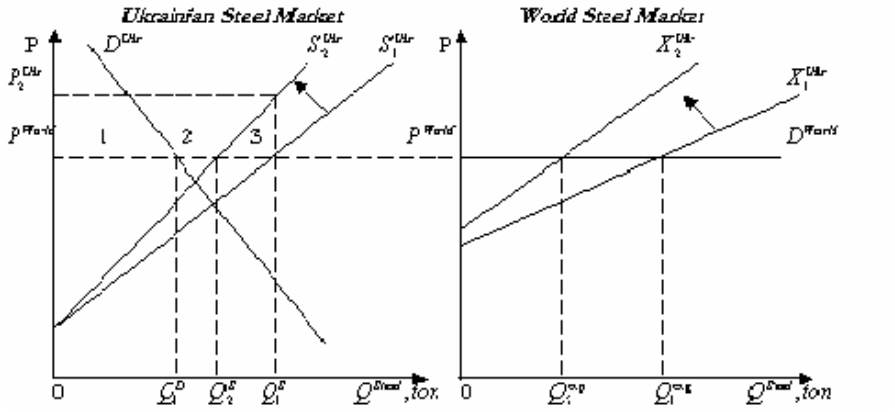
- FOREIGN MARKET represents by itself the aggregated world steel market that includes all the consumers of Ukrainian steel; graphic representation is proposed in the right-hand side Graph 1;
- Markets have perfectly competitive structure;

- The DOMESTIC SUPPLY curve is upward sloping (as that supported by the elasticity of supply estimate $\varepsilon^{s}_{dom} > 0$);
- The DOMESTIC DEMAND is downward sloping (econometric results goes into correspondence with the assumption $\varepsilon^{d}_{dom} < 0$);
- The IMPORT DEMAND is perfectly elastic with respect to the level of the world price

  $\frac{\partial P^{World}(Q)}{\partial Q} = 0$, where $P^{World}(Q)$ is the inverse import demand function;
- Transaction costs are zero;
- Ad-valorem amount of subsidy to Ukrainian producers equals *s*

The graphical representation is proposed on Graph 1[12].

Graph 1 The effect of subsidies elimination when Ukrainian market forces have no influence on the world economy.



According to Graph 1 we can conduct the following reasoning.

Curve S_1^{Ukr} represents the initial supply of steel on the domestic market under the subsidizing regime, and curve D^{Ukr} is the domestic demand for steel.

Initially, when Ukrainian steel producers are provided with the subsidies they obtain the opportunity to supply more steel on the domestic market as

[12] Graph 1 is represented in details in Appendix 3A.

well as on the world market. Their initial supply on the domestic market equals Q_1^S at the low price P^{World}. The domestic demand at this price equals respectively Q_1^D. The amount exported when subsidies exist for Ukrainian producers equals the amount of the excess supply on the domestic market. Thus,

$$Q_1^{\exp} = Q_1^S - Q_1^D$$

Now consider the situation when due to the WTO excess negotiation process Ukrainian government gives the obligation to abandon enterprise subsidizing and decides to cancel it.

The elimination of subsidies leads to the decrease in output for Ukrainian producers: the supply curve shifts leftwards but also pivots from S_1^{Ukr} to S_2^{Ukr}. Given the demand on the Ukrainian market D^{Ukr} unchanged, the new volume of steel on the domestic market equals Q_2^S. The amount of ad-valorem subsidy s equals respectively

$$s = P_2^{Ukr} - P^{World}$$

Since now the elimination of subsidy leads Ukrainian steel producers to an increase in effective cost per unit of good, the exporting activity of Ukrainian steel producers also contracts and the export curve shifts from X_1^{Ukr} to X_2^{Ukr}.

The decrease in the volume of Ukraine exports equals:

$$\Delta \exp orts = Q_1^{\exp} - Q_2^{\exp} = Q_1^S - Q_2^S$$

These changes result in a producer surplus deterioration by the amount ΔPS = -(1+2).

Given the inverse demand domestic supply function $P(Q) = \left[\frac{Q_{DOM}^S}{B}\right]^{\alpha}$,

where $\alpha = 1/\varepsilon_{dom}^s$, mathematically producer surplus is calculated with the following formula (Derivations see Appendix 3D):

$$\Delta PS = Q_2^S P^{World} - P_2^{Ukr} Q_1^S + \frac{(Q_1^S / B)^{\alpha+1} - (Q_2^S / B)^{\alpha+1}}{\alpha+1}$$

In this situation consumers do not have any losses since the price is not affected under our assumption (market forces have no influence on the world economy), but the government collects the revenue in the amount $\Delta GR = 1 + 2 + 3$.

Mathematically it looks

$$\Delta GR = Q_1^S (P_2^{Ukr} - P^W)$$

Collecting the above estimated results, the total gain of the country is positive and equals $\Delta TS = \Delta PS + \Delta CS + \Delta GR = 3$

$$\Delta TS = -P^{World}(Q_1^S - Q_2^S) + \frac{(Q_1^S / B)^{\alpha+1} - (Q_2^S / B)^{\alpha+1}}{\alpha+1}$$

Table 1 summarizes the obtained results.

Table 1. Welfare effects from elimination of subsidy under "small" country assumption

Producer Surplus	ΔPS =-(1+2)
Consumer Surplus	$\Delta CS = 0$
Government Revenue	$\Delta GR = 1 + 2 + 3$
Social Welfare	$\Delta TS = 3$

4.3. Subsidies in "large" country.

The next step is devoted to the situation when the share of Ukrainian steel sector in the global volume of steel producers is significant enough to influence the world prices as well as the domestic consumption and domestic prices after the subsidies elimination.

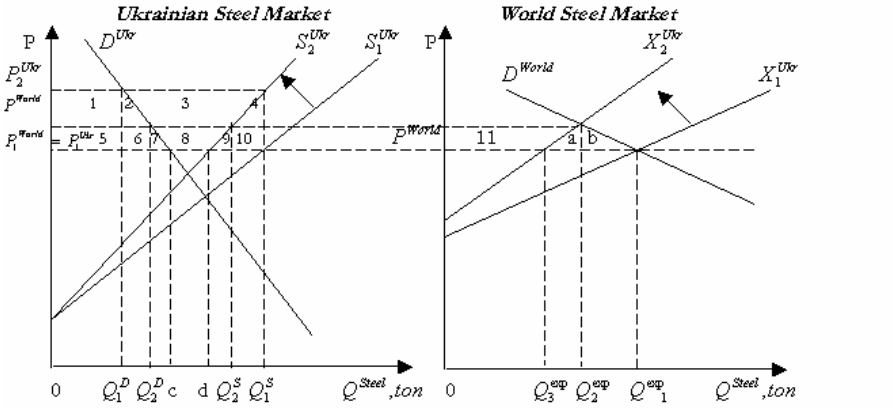
The set of assumptions in this case are similar to those as in the "small" country case except one referring to the character of the import demand curve. Now we assume that

- The IMPORT DEMAND is less than perfectly elastic with respect to the level of the world price and therefore it is downward sloping;

$\frac{\partial P^{World}(Q)}{\partial Q} < 0$, where $P^{World}(Q)$ is the inverse import demand function;

Graph 2 represents this situation[13].

Graph 2. *The effect of subsidies elimination when Ukrainian market forces have influence on the world economy.*



Suppose again that Ukrainian producers obtain ad-valorem export subsidy *s*. According to the general theory (Helpman, Krugman (1989)) under the subsidy Ukrainian and the ROW consumers face lower prices $P_1^{World} = P_1^{Ukr}$, while Ukrainian steel producers actually face the higher price P_2^{Ukr}.

The subsidy rate is equals

$s = P_2^{Ukr} - P_1^{Ukr} = P_2^{Ukr} - P_1^{World}$

As the theory claims the amount of subsidy always bigger than the amount of gain (Helpman, Krugman (1989)).

Suppose that the government decides to cancel it. Analogous to the "small" country case, in case when the share of Ukrainian export is significant canceling the subsidy also results in both pivot and shift of the supply curve from S_1^{Ukr} to S_2^{Ukr}. Since there is no more government support, now producers loose the opportunity to get the price P_2^{Ukr} for their products.

[13] Graph 2 is represented in details in Appendix 3B

They have the increase of the effective production costs and cannot provide the goods on the market at a price P_1^{Ukr}, which is lower than the costs. Therefore, producers are forced to raise the price to the level P^{World} ($P_1^{World} < P^{World} < P_2^{Ukr}$) and loose ΔPS = -(1+2+3).

$$\Delta PS = Q_2^S P^{World} - P_2^{Ukr} Q_1^S + \frac{(Q_1^S / B)^{\alpha+1} - (Q_2^S / B)^{\alpha+1}}{\alpha+1}$$

(Derivations see Appendix 3D)

Unfortunately, domestic and foreign consumers are also subject to losses since they face the new price P^{World}, which is higher than the initial level P_1^{Ukr}. Ukrainian consumers loose

ΔCS = -(5+6+7).

Specifying the form of inverse domestic demand function as $P(Q) = \left[\frac{Q_{DOM}^D}{A}\right]^{\beta}$ with $\beta = 1/\varepsilon_{dom}^d$, consumer surplus is evaluated with the following technique (Derivations are in Appendix 3D)

$$\Delta CS = -[Q_2^D P^{World} - P_1^{Ukr} c + \frac{(c/A)^{\beta+1} - (Q_2^D / A)^{\beta+1}}{\beta+1}]$$

The government collects the revenue in the amount of cancelled subsidy

$$\Delta GR = 1+2+3+4+5+6+7+8+9+10.$$

$$\Delta GR = Q_1^S (P_2^{Ukr} - P_1^{Ukr})$$

The sum of figures 4, 8, 9, and 10 is the change in Ukrainian Social Welfare. Part 8 represents a gain from more favorable terms of trade due to the welfare redistribution process (ΔTOT). This is the result of higher steel price for foreign consumers under the subsidy elimination issue. The sum of parts 4, 9, and 10 is the efficiency gain (ΔEG) due to the lower distortion.

$$\Delta EG = 4+9+10$$

Mathematically, the efficiency gain can be computed in the following way:

$$\Delta EG = \frac{(Q_1^S / B)^{\alpha+1} - (d/B)^{\alpha+1}}{\alpha+1} - P_1^{Ukr}(Q_1^S - Q_2^S)$$

(Derivations see Appendix 3D)

Terms of trade effect is as follows:

$$\Delta TOT = 8$$

$$\Delta TOT = \Delta TS - \Delta EG = \Delta GR + \Delta CS + \Delta PS - \Delta EG$$

It is calculated with the following formula[14]:

$$\Delta TOT = P^{World}(Q_2^S - Q_2^D) + P_1^{Ukr}(c - Q_2^S) - \frac{(c/A)^{\beta+1} - (Q_2^D / A)^{\beta+1}}{\beta+1}$$

$$+ \frac{(d/B)^{\alpha+1} - (Q_2^S / B)^{\alpha+1}}{\alpha+1}$$

The total surplus is the sum of consumer, producer, and government revenue surpluses. It equals

$$\Delta TS = \Delta PS + \Delta CS + \Delta GR = 4 + 8 + 9 + 10.$$

$$\Delta TS = P^{World}(Q_2^S - Q_2^D) + P_1^{Ukr}(c - Q_1^S) - \frac{(c/A)^{\beta+1} - (Q_2^D / A)^{\beta+1}}{\beta+1} +$$

$$\frac{(Q_1^S / B)^{\alpha+1} - (Q_2^S / B)^{\alpha+1}}{\alpha+1}$$

(Derivations see in Appendix 3D)

Foreign consumers are also subject to the losses due to the price level increase. Their welfare loss constitutes the amount $\Delta WL^{ROW} = -(11 + a + b)$

Since inverse export demand is $P(Q) = \left[\frac{Q_{IMP}^D}{C}\right]^{\varepsilon}$ where $\varepsilon = 1/\varepsilon_{imp}^d$

$$\Delta WL^{ROW} = -[Q_2^{\exp} P^{World} - P_1^{World} Q_1^{\exp} + \frac{(Q_1^{\exp}/C)^{\varepsilon+1} - (Q_2^{\exp}/C)^{\varepsilon+1}}{\varepsilon+1}]$$

(The derivations are shown in Appendix 3D)

The obtained results are summarized in Table 2.

[14] Derivations see Appendix 3D

Table 2. Welfare effects from elimination of subsidy under "large" country assumption	
Producer Surplus	ΔPS =-(1+2+3)
Consumer Surplus	$\Delta CS = -(5+6+7)$
Government Revenue	$\Delta GR = 1+2+3+4+5+6+7+8+9+10$
Efficiency Gain	$\Delta EG = 4+9+10$
Terms of Trade Gain	$\Delta TOT = \Delta GR + \Delta CS + \Delta PS - \Delta EG = 8$
Social Welfare	$\Delta TS = 4+8+9+10$
ROW Welfare	$\Delta WL^{ROW} = -(11+a+b)$

4.4. Introduction of the export tax.

Final step of our analysis id devoted to the alternative trade policy choice. In this framework we assume that simple subsidies elimination outcome is equal to the free trade case – no export tax is imposed. The second situation is referred to the case of the small export tax. There are two main types of export taxes:

- **Ad-valorem** – when the tax is imposed as fixed percentage from the value of exported goods;
- **Fixed per unit** – when the government redeems a fixed proportion from each separate exported item of good;
- The government can also apply a combination of these two taxes in its trade policy[15].

Imposition of the export tax as well as the export subsidy can be revised under "large" and "small" country cases. Therefore, in further development we are going to set the following set of assumptions:

- We consider COMPETITIVE markets;
- The IMPORT DEMAND is less than perfectly elastic with respect to the level of the world price and therefore it is downward sloping;

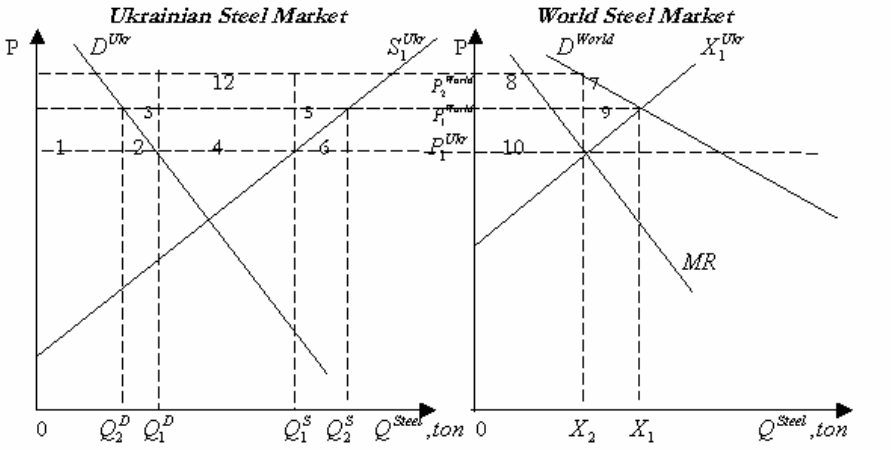
[15]Francois, Rombout "Applied methods for Trade Policy Analysis", Cambridge University Press, 1997

$\frac{\partial P^{World}(Q)}{\partial Q} < 0$; Where $P^{World}(Q)$ is the inverse import demand function;

- AD VALOREM export tax.

Graph 3[16] illustrates the situation of imposing a small ad-valorem export tax, which according to the general economic consideration (Helpman, Krugman (1989)), might be the optimal trade policy. The left-hand side of the Graph 3 represents the Ukrainian market, on which Ukrainian producers supply is represented by S_1^{Ukr} supply schedule, and Ukrainian consumers are represented by D^{Ukr} demand schedule. Right-hand side of the figure considers the situation on the World steel market.

Graph 3. The effect of introduction the export tax under "big" country assumption.



The level of optimal export tax must be set at the level where the gain from improved terms of trade successfully compensates the tax levying. In order to maximize the welfare the exporting country sets the marginal social costs of good equal to its marginal social value in all uses $X_1^{Ukr} = MR$ (Helpman, Krugman (1989)). Suppose initially under the free trade case the price on the world steel market holds on the level P_1^{World} and Ukrainian producers supply

[16] Graph 3 is Represented in details in Appendix 3C

at this price equals Q_2^S while consumers demand the amount Q_2^D. The excess supply in the free trade case equals

$\Delta ES^{Ukr} = exp.free.trade = Q_2^S - Q_2^D = X_1$

Now the government decides to impose the export tax *t* due to the defense of domestic consumers and also due to the tax revenue collection reasons. The amount of export tax equals

$t = (P_2^{World} - P_1^{Ukr}) / P_1^{Ukr}$ [17].

The price of the steel exported on the world market is now higher $P_2^{World} > P_1^{World}$, while the price for domestic consumers falls below the initial free trade level $P_1^{Ukr} < P_1^{World}$. At the price P_1^{Ukr} producers supply smaller amount on the market – we observe the steel supply contraction from Q_2^S to Q_1^S; but domestic consumers now demand more: $Q_1^D > Q_2^D$. The export volume is equal:

$\Delta ES.1^{Ukr} = exports.export.tax = Q_1^S - Q_1^D = X_2,\ X_2 < X_1$

Producer's loss in this circumstance is ΔPS = -(1+2+3+4+5),

$$\Delta PS = -Q_2^S P_1^{World} + P_1^{Ukr} Q_1^S + \frac{(Q_2^S / B)^{\alpha+1} - (Q_1^S / B)^{\alpha+1}}{\alpha+1}$$

(Derivations see Appendix 3D)

Consumers in Ukraine obtain the gain ΔCS =1+2,

$$\Delta CS = Q_2^D P_1^{World} - P_1^{Ukr} Q_1^D + \frac{(Q_1^D / A)^{\beta+1} - (Q_2^D / A)^{\beta+1}}{\beta+1}$$

(Derivations see Appendix 3D)

Government collects the revenue in the amount of export tax $\Delta GR = 8 + 10$ =4+12.

$\Delta GR = (P_2^{World} - P_1^{Ukr}) X_2$

And the improvement of the total welfare becomes

$\Delta TS = 12 - 3 - 5 = 8 - 9 = (8 + 7) - (7 + 9)$.

[17] We divide by P_1^{Ukr} in order to obtain absolute tax rate; multiplication by 100% gives us the percentage tax rate.

The (8+7) area is a terms of trade (TOT) gain and (7+9) is the efficiency loss (EL).

Mathematically it is estimated as:

$$\Delta TS = P_1^{World}(Q_2^D - Q_2^S) - P_1^{Ukr}(Q_1^D - Q_1^S) + \frac{(Q_2^S / B)^{\alpha+1} - (Q_1^S / B)^{\alpha+1}}{\alpha+1}$$

$$+ \frac{(Q_1^D / A)^{\beta+1} - (Q_2^D / A)^{\beta+1}}{\beta+1} + X_2(P_2^{World} - P_1^{Ukr})$$

Obviously, the country will gain in the case when 12>(3+5). This inequality means that in order to reach the total gain for the country from the introduction of export tax the increase in the government revenues and consumer inflows must cover the decrease in the producer losses. Or, if interpreted alternatively, deadweight losses initiated by the tax must be offset by the increase in the government revenues due to the exporting price rise.

Table 3 summarizes the obtained results

Table 3. Welfare effects from the imposition of the export tax

Producer Surplus	ΔPS = -(1+2+3+4+5)
Consumer Surplus	ΔCS =1+2
Government Revenue	$\Delta GR = 8+10 = 4+12$
Social Welfare	$\Delta TS = 12-3-5$ =8-9=(8+7)-(7+9)
Terms of trade gain	$\Delta TOT = 8+7$
Efficiency loss	$\Delta EL = -(7+9)$

4.5. Optimal export tax estimation.

Mathematically the optimal level of *export tax* can be computed employing the methodology proposed by Helpman and Krugman (1989). Suppose that p=p(X) is the inverse demand function for the Ukrainian exports that refers to D^{World} schedule in the right-hand side of the Graph 3. The Ukrainian export supply curve X_1^{Ukr} represents by itself the marginal cost of the

additional unit of exports, while *MR* curve determines the marginal social return from each additional unit.

In order to derive *MR* curve let us, first, compute total revenue from the exporting activity that will be $TR = X * P^{imp}(X)$. Second we take the first differential with respect to X. Hence force, the $MR = P^{imp}(X)(1-\frac{1}{\varepsilon})$, where ε is the elasticity of foreign demand for Ukrainian exports[18]. Point $[X_2; P_1^{Ukr}]$ on the graph determines the optimal trade position, in which the amount exported at the price P_1^{Ukr} equals the amount demanded on the foreign market at the price P_2^{World}

Than $MR^* = P_2^{World}(1-\frac{1}{\varepsilon})$

In order to obtain the optimal export tax we should equilibrate the new export price *p1* with the marginal revenue.

If $t = (P_2^{World} - P_1^{Ukr}) / P_1^{Ukr}$ and $p1 = P_1^{Ukr}$ than

$p1 = \frac{P_2^{World}}{1+t}$,

Setting *MR*=*p1*

We have $\frac{P_2^{World}}{1+t} = P_2^{World}(1-\frac{1}{\varepsilon}) \Rightarrow t^* = \frac{1}{\varepsilon - 1}$.

[18] Note: the absolute value of foreign demand elasticity assumes that it should be greater than 1 in order to obtain positive sign of optimal export tax for the exporting country

Chapter 5

EMPIRICAL ANALYSIS.

5.1. The data

In order to obtain the elasticities of demand and supply we use monthly data for the period 1997-2003. Therefore, on the basis of available time series we can estimate reliable elasticities demand and supply elasticities.

The main sources of the data are:

1) *The State Statistic Committee*;

From this source we obtain the prices for the main inputs: coal, iron ore, electricity, wages for workers in the steel sector, and also the price for steel on the domestic market.

2) *The International Iron and Steel Institute*;

This source gives the volumes of steel produced in Ukraine and in the United States.

3) *www.prometal.com.ua*

4) www.ukranews.org

Partial Equilibrium Analysis requires the estimation of the demand and supply elasticities in order to evaluate the effect of tariff on the total welfare. The 11 biggest steel enterprises are incorporated into the model, which is estimated by simultaneous equations technique (SEM). The output of the following enterprises is used: **Krivorozhstal, Ilyich Metal Plant, Azovstal, Zaporozhstal, Alchevsk Metal Plant, Dzerzhinskogo Metal Plant, Petrovskogo Metal Plant, Yenakiyevskiy Metal Plant, Donetskiy Metal Plant, Dneprspetsstal, Libnehta Metal Plant.** The last two sources provide this data.

5.2. The supply and demand elasticities calculation

The proposed technique is different from those applied in the previous work on the Ukrainian steel sector issue. Grygorenko (2001) estimates the demand for the steel products of Ukraine with the employment of the quarterly time series data for the total steel output using a two-stage least squares technique. Dubohryz (2003) acknowledges that simultaneity of the demand and supply equations appears to be a serious issue and ordinary least squares method would result in biased and inconsistent estimates. The two stage least squares approach, however, is less efficient in case of the absence of simultaneity as noted by Kennedy (1998). Using Hausman specification test for simultaneity he proves his data to be successfully free from this problem. For this reason the OLS procedure appears to be the most appropriate for his case and gives satisfactory results.

The techniques for this study cannot be predetermined because we are going to use a monthly time series that incorporates micro data[19]. Therefore our technique assumes simultaneous equation approach and the system includes 14 equations. Twelve equations of the system represent the supply side on micro level while the domestic and import demand equations are estimated at the aggregate level. The log-log systems of simultaneous equations allow one to obtain directly the supply elasticity, the domestic demand elasticity and import demand elasticity. We estimate the system by Seemingly Unrelated Regression approach (SUR) due to the presence of both cross-section heteroskedasticity and contemporaneous correlation of the residual terms that can be tested with the White heteroskedasticity test and the residual correlation matrix respectively. According to White (1980), the consistency of covariance matrix estimator can be used for detecting the cross-section heteroskedasticity. While the determinant residual covariance estimator is approximately of the same order for different model approaches

[19] To be more specific we employ the 11 biggest Ukrainian Steel enterprises data; the 12th "residual" enterprise (fringe enterprise) accounts for the rest of output. Therefore, our model specification fully reflects the supply side within the country.

(See Table 4 below), the consistency of chosen SUR approach in our analysis is supported by the residual correlation matrix (Appendix 5).

We specify the **system** in the following way:

Ukrainian Supply

$$log(totalmetals\_j) = c(6...17) + c(1) * log(price) + c(2) * log(price\_coal)c(3) * log(price\_electr) + \\ + c(18) * log(price\_ore) + c(4) * log(wage\_metal) + c(5) * log(totdem(-12)) + \varepsilon_{tj}$$

Ukrainian Demand

$$log(totdem\_dom) = c(19) + c(20) * log(price\_1) + c(21) * log(ukr\_gdpr) \\ + c(22) * log^2(ukr\_gdpr) + c(24) * log(exch\_rate) + c(25) * log(chi\_metal) + \\ + c(23) * log(totsupply(-6)) + \varepsilon_t$$

Foreign Import Demand

$$log(totdem\_imp) = c(26) + c(27) * log(us\_pricemet) + c(28) * log(us\_price\_nf\_1) \\ + c(29) * log(us\_gdpr) + c(31) * log(exch\_rate) + c(33) * log(totsupply(-6)) + \varepsilon_t$$

Where

totdem_dom – aggregate monthly quantity of steel sold by consumers on the domestic market; (in ton of crude steel);
totsupply – aggregate monthly supply of steel by all Ukrainian enterprises (in ton of crude steel);
totdem – aggregate monthly demand of steel on the domestic and foreign market (in ton of crude steel);
price_1 – price of steel products produced in Ukraine (weighted average for different product groups);
exch_rate – real UAH/$ exchange rate (NBU rate);
ukr_gdpr – Ukrainian real gross domestic product as an indicator of domestic economic growth;
us_price_nf_1 - the price for non-ferrous products in USA as a proxy for product-substitutes for steel (weighted average for different product groups)[20];
totdem_imp – aggregate monthly quantity of steel exported to the foreign market; it is calculated as a difference between the total supply of steel minus the amount of steel sold on the domestic market; (in ton of crude steel);
us_pricemet – price of steel produced by the USA as an indicator of world price (weighted average for different product groups);

[20] We have decided to include *price_us_nf* in estimation the domestic demand equation as a proxy for goods substitutes for steel products. The price of the US non-ferrous is assumed to influence the dynamics of internal price for goods-substitutes due to its high integration into the economic relationships with the rest of the world.

us_gdpr - USA real GDP economy as an indicator of foreign economic activity;
chi_metal – monthly Chinese steel output;
totalmetals_j, *j=1…12* – aggregate monthly quantity of steel produced by each Ukrainian steel enterprise involved into the analysis; *j* is the index for each enterprise; The 12th term stands for the residual fringe enterprise; (in ton of crude steel);
price – price of steel products that producers actually face because of the production subsidy[21];
price_electr – the price for the electricity for Ukrainian steel producers (in UAH weighed by CPI, base 2003);
price_coal – the price for the coal for Ukrainian steel producers (in UAH weighed by CPI, base 2003);
price_ore – the price for the iron ore for Ukrainian steel producers (in UAH weighed by CPI, base 2003);
wage_metal – wage of Ukrainian workers involved into the production in the Steel Sector (in UAH weighed by CPI, base 2003);

Domestic and Import Demand Equation. The First point that should be noted is the export-oriented character of the industry. Among the main foreign consumers are first of all China and countries of Middle East, South Asia, the USA and the European Union. Therefore in order to estimate the foreign demand elasticity for the Ukrainian Steel Products we should find a proxy for the world price available from the statistics. While Dubohryz (2003) proposes to construct the weighted average Ukrainian Steel sale price established by enterprises or their intermediaries in different periods, we are going to follow the reasoning given by Grygorenko (2001) and introduce US steel price into our analysis due to the high integration of the United States market into the world economy and its significant level of influence. For the estimation the domestic demand elasticity for steel we introduce the Ukrainian Steel price available from the State Statistics Committee. The expected signs of the import and domestic demand elasticities should be negative. The increase in price for the steel products leads to the demand deterioration and increasing consumption of the products-substitutes, which we also decide to include into the demand equation. Following the logic of our discussion US non-ferrous prices can be a good proxy for the

[21]Details for implicit production subsidy calculation see in Appendix 4

alternative to the steel in the import demand equation. Accordingly, the increase in price for steel substitute should positively influence the demand for the metal products; therefore, the coefficient must have positive sign. The exporting feature of Ukrainian Steel Sector necessitates the inclusion of the foreign economic activity exogenous variable. As it has already been noted, US economic activity is of high level of influence to the development of the world market. Consequently, the level of US real GDP is one of the best to reflect this fact. The domestic demand for steel also depends on the level of domestic economic activity that can be reflected with the employment of Ukrainian real GDP. We include the Chinese steel output in the domestic demand equation as an indicator of world steel production intensity. The inclusion of the exchange rate in the domestic and import demand equations can be explained in a way that depreciation of the domestic currency leads to the increase in the exporting activity of the country because it makes the products relatively cheaper and thus affects the demand. Since the steel demand has the tendency to partial adjustment to the previous period aggregate level of supply due to the long-term contracts reason, the introduction of the lagged exogenous factor allows capturing this adjustment, 6-month lag appears to be optimal.

Supply Equation. In the supply equation we should include the variables that have either direct or indirect impact on the costs of steel production. Due to the specificity of metal production the supply function depends on the prices on the domestic market for the steel products and also on the prices of the main inputs, namely, electricity, coal, iron ore, and also wage for workers involved into the sector. The elasticity of supply is expected to have positive sign. For the same reasoning provided in the demand, the steel supply of each enterprise also has the tendency to partial adjustment to the previous period aggregate demand level and the introduction of the 12-month lagged factor allows capturing this adjustment. We assume that the reaction of supply to the lagged exogenous factor is slower than that for the

demand due to technological reasons. Therefore, the supply equation has the 12-month lag.

Specification 1 of the supply equation. In order to obtain a coefficient which is common across all enterprises in the supply equation we impose a common price elasticity coefficient, C(1), for all 12 supply equations within the system. This restriction assumes a low degree of heterogeneity across firms.

Specification 2 of the supply equation. We provide this method for the additional justification of robustness the supply elasticity obtained in Specification 1. In this case we attribute different price elasticity coefficients (C(32)…C(43)) in the 12 supply equations. While all the enterprises are faced with the same price on the market, this method gives us the possibility to estimate the enterprise specific elasticities for each of 11 enterprises and the fringe enterprise and find weighted average elasticity with the following formula:

$$\bar{\varepsilon} = \sum_{i=1}^{12} \varepsilon_i s_i \ ,$$

Where

$\bar{\varepsilon}$ - the weighted average enterprise specific elasticity;

ε_i - the enterprise specific elasticity for each of 11 enterprise and fringe enterprise;

s_i - the share of each enterprise output in the total volume of Ukrainian Steel Sector output;

In order to estimate the obtained SEM appropriately we will follow the logic proposed by Shulha (2003). She proposes the cumulative table for choosing the optimum estimation technique for different SEM.

Table 4.[22]. Choosing of the Method of Estimation of the Simultaneous Equation Model.

Statistical Issue/Possible Testing Technique			
The Right-Hand Side Variables are Correlated with the Error Terms	Heteroskedasticity	Contemporaneous Correlation in Residuals	Estimation Method
Hausmann Test	White	Residual Correlation	

[22] Source: adopted from T. Shulha, Measuring the Cost of Protection in Ukrainian Sunflower Seed Industry, 2003, p.44

	Heteroskedasticity Test	Matrix	
Yes	No	No	2SLS
No	Yes	Yes	SUR
Yes	Yes	No	W2SLS
Yes	No	No	3SLS
		Joint normal distribution	FILM
		Disturbances are Uncorrelated with a Set of Instrumental Variables	GMM

5.3. The estimated results of Ukrainian demand and supply elasticities and import demand elasticity.

In proceeding to the next stage of the analysis on which the welfare effect will be evaluated we should first interpret the results of estimation demand and supply functions.

Table 5.2 in Appendix 5 gives us the results of the estimation the Specification 1 of the system. We present the part on this table in the main text.

Table 5. The results of estimation the demand and supply system of simultaneous equation by seemingly unrelated regressions approach (Specification 1)

	Coefficient	Std. Error	t-Statistic	Prob.
C(6)	10.18910	2.136647	4.768731	0.0000
C(7)	10.10360	2.136645	4.728723	0.0000
C(8)	9.833629	2.136648	4.602362	0.0000
C(9)	9.784754	2.136649	4.579486	0.0000
C(10)	9.463611	2.136669	4.429143	0.0000
C(11)	9.298452	2.136664	4.351854	0.0000
C(12)	8.294007	2.136645	3.881790	0.0001
C(13)	9.137919	2.136652	4.276746	0.0000
C(14)	8.593639	2.136697	4.021927	0.0001
C(15)	7.683506	2.136647	3.596059	0.0003
C(16)	7.867111	2.136644	3.681994	0.0002
C(17)	8.477384	2.138608	3.963973	0.0001
Log(price)	**0.445313**	**0.038386**	**11.60081**	**0.0000**
Log(price_coal)	-0.670938	0.423487	-1.584317	0.1134
Log(price_electr)	-0.572867	0.148679	-3.853045	0.0001
Log(wage_metal)	-0.065602	0.052966	-1.238564	0.2158
Log(totdem(-12))	0.179579	0.063166	2.842995	0.0046
Log(price_ore)	-0.352025	0.075132	-4.685386	0.0000

C(19)	14.52897	0.966735	15.02891	0.0000
Log(price_1)	**-0.851242**	**0.127348**	**-6.684380**	**0.0000**
Log(ukr_gdpr)	1.913219	0.621934	3.076240	0.0022
Log^2(ukr_gdpr)	-0.481813	0.161187	-2.989157	0.0029
Log(totsupply(-6))	-0.025516	0.085765	-0.297510	0.7661
Log(exch_rate)	0.164288	0.050924	3.226125	0.0013
Log(chi_metal)	-0.597765	0.100823	-5.928838	0.0000
C(26)	-14.97358	14.44453	-1.036626	0.3002
Log(us_pricemet)	**-7.591715**	**2.234494**	**-3.397509**	**0.0007**
Log(us_price_nf_1)	1.491075	0.418881	3.559665	0.0004
Log(us_gdpr)	6.843254	0.671355	10.19320	0.0000
Log(totsupply(-6))	-0.447348	0.130137	-3.437522	0.0006
Log(exch_rate)	-0.487297	0.085383	-5.707199	0.0000
Determinant residual covariance 3.40E-49				

All estimated elasticities have the expected signs. Due to our initial prediction domestic demand elasticity should be of negative sign that means that increase in price for the steel products decreases the amount demanded and consumers start seeking for the possible alternatives. This is what we exactly observe at Ukrainian market where the demand elasticity has the negative value and less than unity in absolute value ($\varepsilon_{DOM}^{D} = -0.851$). An increase in price for Ukrainian consumers by 1 percentage point leads to the decrease in consumption the Ukrainian Steel by 0.851 percentage points. We can see that import demand for steel is elastic $\varepsilon_{IMP}^{D} = -7.59$ and an increase in the world price by 1 percentage point leads to a decrease in the volume of steel demanded by 7.59 percentage points. The elasticity of steel supply equals $\varepsilon_{DOM}^{S} = 0.445$ that informs about the inelastic supply of steel products (less than unity).

The results of Specification 2 are presented in Table 5.3 of Appendix 5. The enterprise specific supply elasticities vary across enterprises and the estimated weighted average enterprise specific elasticity is 0.377. Since it is broadly similar to that obtained in Specification 1, we have confirmation of the robustness of the results of Specification 1, which we are going to involve on the next stages of our analysis.

5.4. Calibration

The estimated value of import demand elasticity is less than infinity (-7.59) and, therefore, drives us to the "large" country case.

In order to evaluate the welfare evaluation and consider the alternative export tax introduction we need to obtain the changes in quantities supplied and demanded under different price regimes.

The technique is as follows: given the initial prices and quantities we will obtain the values of parameters of supply and demand functions through which we will be able to predict the trade distortions. The analysis is conducted in two steps. On the first stage we eliminate subsidies in "large" country; this policy issue characterizes a move to free trade case where there are no subsidies or taxes; than we proceed to the situation of the export tax.

The estimated value of the import demand elasticity provides us with the 15% optimal export tax. Along with evaluation of the welfare gain for the optimum tax rate, we also evaluate the welfare gain under 5, 10, 17, and 20 percentage tax levels. This calculation appear to be appropriate since under the WTO negotiation process the level of the tax rate for the sector can be established on the level different from the estimated optimum.[23]

5.4.1. Elimination of subsidies in "large" country.

Referring to Graph 2, we can see that welfare effect evaluation requires the estimation of domestic demand and supply constants. Referring to the theoretical part of the paper, the domestic demand function is given with the following relationship:

[23] The rational for such reasoning can be provided from experience of other countries. For example, in Argentina export taxes on grains, oilseeds, vegetable oils and vegetable meals were reduced in 2003 because of high dissatisfaction of tariff policy by different farmers groups. They claim that such exorbitant trade policies disrupt local trade (http://www.cornandsoybeandigest.com/news/soybean_argentina_promises_export/)

$Q^D_{DOM} = Q^D_{DOM}(P) = A \times P^{\varepsilon^d_{dom}}$. This curve passes through the point $(c; P_1^{World})$, which corresponds to values *c=totdem_dom* and $P_1^{World} = price\_1$ in our empirical part.

Hence, constant term *A* can be computed as follows

$$A = \frac{Q_1^D}{P^{\varepsilon^d_{dom}}} = \frac{totdem\_dom}{(price\_1)^{\varepsilon^d_{dom}}}$$

The domestic supply curve before the elimination of subsidies is

$$Q^S_{DOM} = Q^S_{DOM}(P \times (1+s)) = B \times [P \times (1+s)]^{\varepsilon^S_{dom}}$$

This curve passes through the point $(Q_1^S; P_2^{Ukr})$, which corresponds to the values $Q_1^S = tot\sup ply$ and $P_2^{Ukr} = price$ in the data set. As we can see Ukrainian producers face higher actual price for their products under the subsidizing regime. Formally, *price=price_1*(1+s),* where *s* is the amount of ad-valorem implicit subsidy to producers which is not included into the observed price *price_1*. Available data provides only the observed price rate that faces Ukrainian consumers.

Parameter B equals:

$$B = \frac{Q_1^S}{P^{\varepsilon^s_{dom}}} = \frac{totsupply}{(price)^{e^S_{dom}}}$$

The foreign import demand equation is assumed to be of the following linear-logarithmic form

$$Q^D_{IMP} = Q^D_{IMP}(P^*) = C \times (P^*)^{\varepsilon^D_{imp}}$$

Since initially foreign consumers face the same price as Ukrainian P*=P on this step.

Using Graph 2 we can see that import demand curve passes through the point $(Q_1^{\exp}; P_1^{World})$ that corresponds to the following numerical parameters of the data:

$$Q_1^{\exp} = Q_1^S - c = totsupply - totdem\_dom$$

$$P_1^{World} = price\_1$$

Constant parameter *C* is given by

$$C = \frac{Q_{IMP}^D}{P^{\varepsilon_{imp}^d}} = \frac{totsupply - totdem\_dom}{price\_1^{\varepsilon_{imp}^d}}$$

Finally, export supply curve Q_{EXP}^S of Ukrainian producers is estimated as the difference between domestic supply and domestic demand

$$Q_{EXP}^S = B \times [P \times (1+s)]^{\varepsilon_{dom}^s} - A \times P^{\varepsilon_{dom}^d} = B(price)^{\varepsilon_{dom}^s} - A(price\_1)^{\varepsilon_{dom}^d}$$

Elimination of subsidies rise the world price up to the level P^{World} (we denote it as p*) and corresponds to the free trade regime, where *s=0*. Given the form of import demand equation, we set it to be equal to export supply at new price p* and find the new equilibrium world price with now subsidies solving the nonlinear equation with respect to p* :

$$Q_{EXP}^S(p^*) = Q_{IMP}^D(p^*) \Leftrightarrow$$

$$C \times (p^*)^{\varepsilon_{imp}^D} = B(p^*)^{\varepsilon_{dom}^s} - A(p^*)^{\varepsilon_{dom}^d} \Rightarrow p^*$$

Table 6 summarizes the obtained results

Table 6. Parameters of the curves estimated coefficients

Curve	Functional relation	Point	Constant parameter
Domestic demand	$Q_{DOM}^D = A \times P^{\varepsilon_{dom}^d}$	*(totdem_dom; price_1)*	$A = \frac{totdem\_dom}{(price\_1)^{\varepsilon_{dom}^d}}$
Domestic supply	$Q_{DOM}^S = B \times [P \times (1+s)]^{\varepsilon_{dom}^s}$	*(totsupply; price)*	$B = \frac{totsupply}{(price)^{\varepsilon_{dom}^s}}$
Foreign Import demand	$Q_{IMP}^D = C \times (P)^{\varepsilon_{imp}^D}$	*(totsupply-totdem_dom; price_1)*	$C = \frac{totsupply - totdem\_dom}{price\_1^{\varepsilon_{imp}^d}}$
Export supply	$Q_{EXP}^S = B \times [P \times (1+s)]^{\varepsilon_{dom}^s} - A \times P^{\varepsilon_{dom}^d} = B(price)^{\varepsilon_{dom}^s} - A(price\_1)^{\varepsilon_{dom}^d}$		
Free trade price (p*)	$Q_{EXP}^S(p^*) = Q_{IMP}^D(p^*) \Leftrightarrow C \times (p^*)^{\varepsilon_{imp}^D} = B(p^*)^{\varepsilon_{dom}^s} - A(p^*)^{\varepsilon_{dom}^d} \Rightarrow p^*$		

5.4.2. Introduction of the export tax

Suppose that government eliminated the production subsidy and the new equilibrium on the foreign market were established at the point where new export supply curve X_2^{Ukr} intersects with foreign demand curve D^{World}. The new equilibrium point is $(Q_2^{\exp}; P^{World})$ on the Graph 2. Graph 3 reflects this market situation as $(X_1; P_1^{World})$. This equilibrium represents the market situation, where no export taxes or subsidies are imposed.

Suppose now that the government introduces an ad-valorem export tax *t*, which, according to our analytical framework, is assumed to decrease the price for domestic consumers to the level P_1^{Ukr} and raise the price for the rest of the world market to the level P_2^{World}. The amount of the optimum export tax is computed as the inverse to the import demand elasticity $t^* = \frac{1}{\varepsilon - 1}$ and according to our previous computation equals 15%.

The export tax does not decrease the price for domestic consumers to the same extend as the amount of the tax and we need to estimate point P_1^{Ukr}.

Tax distortion leads us to the position where $P_2^{World} = (1+t) \times P_1^{Ukr}$. In order to estimate new Ukrainian price P_1^{Ukr}, we use the same approach as that in case of subsidies.[24] The new equilibrium on the foreign market drives us at the following non-linear equation:

$$B \times (P_1^{Ukr})^{\varepsilon_{dom}^s} - A \times (P_1^{Ukr})^{\varepsilon_{Dom}^d} = C \times ((1+t) \times P_1^{Ukr})^{\varepsilon_{imp}^d}$$

Solving the obtained equation with respect to P_1^{Ukr}, we obtain the new price on Ukrainian market under the export tax regime $\tilde{P}_1^{Ukr}$. Hence, $\tilde{P}_2^{World} = (1+t) \times \tilde{P}_1^{Ukr}$.

[24] we construct the equation in terms of quantity exported with the new trade regime on the foreign market. At the point X_2 the amount of steel demanded by foreign consumers at the price $P_2^{World} = (1+t) \times P_1^{Ukr}$ equals the amount supplied by Ukrainian producers at the price P_1^{Ukr}

Chapter 6

WELFARE ESTIMATION RESULTS

We conduct monthly analysis for the period 2003 and January and February of 2004 due to the availability of necessary data[25] supposing that Ukrainian government altered its trade policy in this period. With the employment of the initial data we estimate the necessary calibrated coefficients in order to get the policy changes. MathCAD gives us the possibility to obtain the non-linear equation solutions.

We estimate the distortionary amount of the production subsidy of 7.6% from the tax exemption[26] (see details in Appendix 4).

The other source of indirect subsidization is taken from the government support of iron ore enterprises (this is an intermediate producing sector for the steel industry) in terms of lower internal price for iron ore products than foreign prices. Such government policy has an impact on the cost function for steel producers who face lower input price.

For 2003 period the aggregated price for iron ore derivatives was on average 8.62% below the world price (see Appendix 4). But this is not the exact amount of the steel sector production subsidy. In order to estimate the value of subsidy for steel producers we should clarify the structure of the cost function for steel producers. The price per ton for iron ore input constitutes on average 36.7% from that per ton of steel. (see Appendix 4 for details); iron ore is used in the proportion of 1.28 ton of iron ore for production of 1 ton of steel output. Therefore, the amount of the production subsidy to the steel producers due to the lower input price is estimated at the level 4.05% (8.62*0.367*1.28).

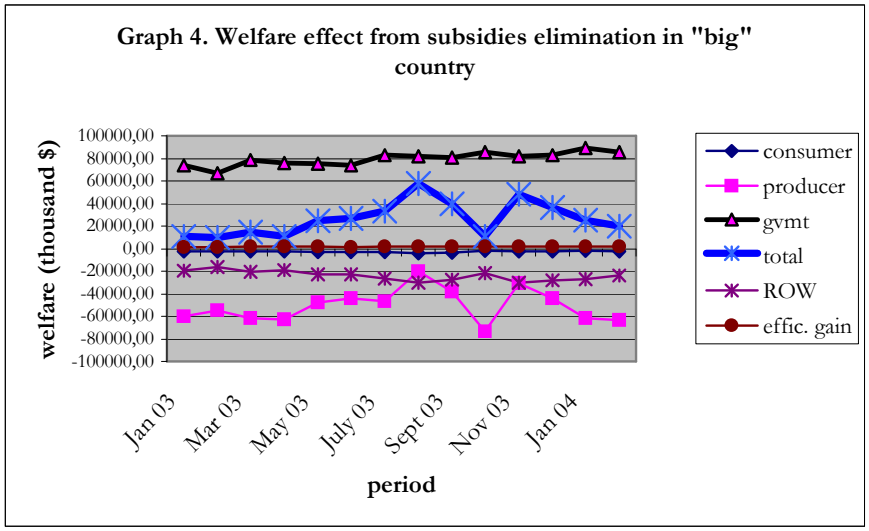
[25] Monthly data is taken from International Iron and Steel Institute (IISI) in terms of production the crude steel in thousand of metric ton

[26] Details see in Appendix 4

Summarizing the obtained results the total amount of the indirect production subsidy is estimated at the level 11.65% for the period 2003 and January and February of 2004.

Table 5.2 (Appendix 6) proposes welfare effect of eliminating the indirect production subsidy in the "large" country case. We observe producer and consumer welfare deterioration as was predicted by our theoretical analysis. On average produces bear monthly losses in the amount $ -50.614 mln. and consumers lose on average $ -2.596 mln per month. The decline in the consumer and producers gains is counterbalanced with positive government revenues in terms of revenues sacrifices from the cancellation of inefficient subsidizing policy for the industry. In monetary terms government collects $ 79.641 mln per month. Therefore, there is a positive effect from the elimination of production subsidies on the national welfare that brings the country an average monthly welfare benefit in the amount $26.430 mln. The pure efficiency gain from elimination of the distortion is estimated at $ 23.810 mln in total for the investigated period what constitutes $ 1.7 mln per month.

While Ukraine's total gain from the elimination of subsidies is positive, the rest of the world experiences welfare deterioration due to the rise in the world price. Thus foreign consumers are subject to losses at amount $ 334.75 mln in total or $ 23.91 mln for each month. The obtained results are generalized on the Graph 4.



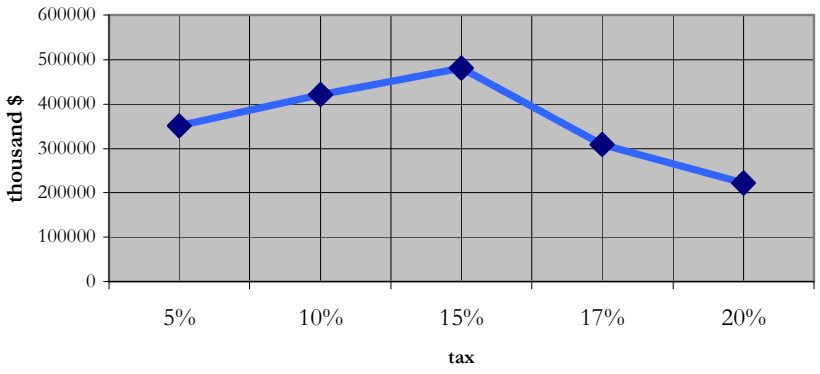
As we can see from Graph 4 the highest possible gain from elimination of subsidies equals $ 57.87 mln and occur in August 2003. November (2003) brings the lowest revenues across the investigated period. We also observe that government collects substantially constant share of benefits that is enough to counterbalance the consumer and producer negative gains.

Appendix 7 provides us with the results of the introduction of different export tax regimes for the sector. The introduction of export tax brings the expected results. Recall that theoretical analysis implies that an export tax in "large" country should improve national welfare. This means that despite the fact of producer and consumer surpluses deterioration due to the price increase, government tax revenues must successfully compensate the welfare gap.

Given the import demand elasticity the optimal export tax for Ukrainian steel producers is estimated on the 15% level and according to our calculations brings the country $ 481.238 mln total amount of gains for the investigated 14-month period. Graph 5 generalizes the obtained results and shows that 15% tax appears to be the real maximum welfare benefit level. The maximum is unique due to the estimated shape of demand and supply

functions that are negatively and positively sloped respectively and thus have one optimum.

Graph 5. Total welfare at different export tax regimes



Due to the possibility of renegotiating the amount of the export tax under the WTO accession process, we have also estimated 5, 10, 15, 17, and 20 per cent export tax introduction for comparison reasons. As Graph 5 visualizes any of the five proposed tax regime brings positive benefits for the country. It comes into additional support for our initial hypothesis that introduction of export tax in this range is beneficial overall.

Even with an export tax of 20% the welfare effect remains positive. Eventually, further increases in the tax will reduce welfare because the adverse distortionary effect will outweigh the favorable terms of trade effect. Therefore, we can see that while elimination of the export subsidy appears to be effective choice, introduction of the export tax of moderate magnitude is also desirable for the economy and such a policy brings the economy substantial social benefits.

Chapter 7

CONCLUSIONS

The WTO accession issue has created a lot of debate. While some parties are strongly against the accession especially in the short and medium run because they may subject to losses, other parties are waiting to obtain benefits. The interests of all parties under negotiation process should be taken into account.

Nevertheless, about 90% of global trade flows in the world are under the jurisdiction of this organization and WTO accession appears to be a necessary step in the elaborating trade policy for Ukraine. Membership in this organization can have different effects on different sectors of economy. Naturally, the sectors, which are of primary importance for the country, should receive priority consideration. The Ukrainian Ferrous and Steel sector is such a key sector. This is, first of all, due to its strategic importance. Exporting activity of the sector brings a large share of export revenues to the country. A problem that arises is that the sector receives substantial implicit subsidization. But such trade policies are potentially inconsistent with GATT/WTO rules on subsidization. Such subsidies are likely to be questioned in accession negotiations and even if they remain after accession, other WTO members can be expected to impose countervailing duties.

Thus one of the core trade policy changes are connected with subsidies elimination issue and introducing the alternative trade policy either in the form of trade liberalization or possibly in the form of introducing export tariffs. Partial equilibrium technique allows us to estimate the effect that such trade policy changes will have on the producers, consumers and national welfare.

Partial equilibrium method considers "small" and "large" country cases, which differ in a way that the former assumes an infinitely elastic foreign import demand elasticity, while the latter assumes it to be less than perfectly

elastic. Since out econometric results support "large" country case, we conduct the analysis in this particular framework. We have found that subsidies are desirable for Ukrainian producers and consumers, but eliminating subsidies has positive effect on national welfare. The numerical results support our theoretical discussion. The elimination of subsidies leads to a free trade regime in our analysis.

The introduction of the export tariff is proposed as an alternative trade policy measure after cancellation of production subsidy. It can be implemented as a way of collecting additional benefits for the country compared to those that are obtained from transforming from subsidies to free trade. National welfare is positively affected with this trade policy. This is predominantly due to the fact that the amount of government revenues in terms of tariff collection and gain in consumer surplus more than offset the producer losses arising from a lower Ukrainian price. We have estimated the optimal export tariff on the basis of calculated import demand elasticity. Since export tax introduction can dissatisfy producers because of higher prices we have also considered the possibility of alternative tax regimes for the sector. Although the 15% optimal export tax brings the highest benefits for the country, 5, 10, 17, and 20 per cent tariff levels appear to be beneficial in terms of national welfare.

Therefore, according to the paper analysis we can conclude that WTO accession has positive effect on the development of the steel sector. The elimination of subsidies has a positive effect on national welfare and introduction of an export tariff regime brings additional gains.

Chapter 8

PROPOSITIONS FOR FURTHER RESEARCH

Although the paper provides us with rather consistent econometric results and policy implications that quite successfully interpret current situation in the Steel Sector, it is restricted with certain type of limitation due to which some propositions for further research appear to be expedient.

The model gives us the results for the perfect competition assumption within a partial equilibrium framework. This is a simple and effective tool in evaluating the welfare effects from the trade policy changes within the sector. Nevertheless, it does not capture the effects of eliminating the subsidy and introducing the export tariff on other sectors. Therefore, the spillover effects that can be calculated with the employment of general equilibrium technique (CGE) appear to be reasonable complement to the foregoing analysis. Although CGE analysis may provide biased results due to the underlying aggregated data, it allows consideration of the overall effect for the entire economy.

The log-linear functional forms of demand and supply and constant supply elasticity, which are involved with the purpose to more precisely reflect the market structure in investigated period, although leaves out the possibility to capture the changing behavior of market participant across more significant time period. Although we found empirical support for the assumption that the market structure is approximately competitive, in the last year privatization powerful industrial groups have dominated the process. This suggests the desirability of reconsidering the steel sector in the context of imperfectly competitive market structures.

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APPENDIX 1

Table 1.1. **The Major Steel Producing Countries in 2001-2000 (million metric ton crude steel production)**

Country	2001		2000	
	Rank	Tonnage	Rank	Tonnage
China	1	148.9	1	127.2
Japan	2	102.9	2	106.4
United States	3	90.1	3	101.8
Russia	4	59.0	4	59.1
FR Germany	5	44.8	5	46.4
South Korea	6	43.9	6	43.1
Ukraine	**7**	**33.1**	**7**	**31.8**
India	8	27.3	9	26.9
Brazil	9	26.7	8	27.9
Italy	10	26.7	10	26.8
France	11	19.3	11	21.0
Taiwan, China	12	17.2	12	16.8
Spain	13	16.5	14	15.9
Canada	14	15.3	13	16.6
Turkey	15	15.0	17	14.3
United Kingdom	16	13.7	16	15.2
Mexico	17	13.3	15	15.6
Belgium	18	10.8	18	11.6
South Africa	19	8.8	20	8.5
Poland	20	8.8	19	10.5
Australia	21	7.0	21	7.1
Iran	22	6.9	22	6.6
Czech Republic	23	6.3	23	6.2
Netherlands	24	6.0	25	5.7
Austria	25	5.9	24	5.7
Sweden	26	5.5	26	5.2
Romania	27	4.9	27	4.8
Kazakhstan	28	4.7	28	4.8
Argentina	29	4.1	29	4.5
Slovakia	30	4.0	32	3.7
Finland	31	3.9	30	4.1
Venezuela	32	3.8	31	3.8
Egypt	33	3.8	36	2.8
Saudi Arabia	34	3.4	34	3.0
Indonesia (E)	35	3.0	35	2.8
Luxemburg	36	2.7	37	2.6
Others		28.8		30.8
World		847.0		847.6

Source: IISI (Steel Sector Report for 2002)

Table 1.2. **The Major Importers and Exporters of Steel in 2001**

Rank		Total Exports	Rank		Total Imports
1	*Japan*	28.5	1	*United States*	34.8
2	**Russia**	27.5	2	**China**	20.8
3	**Germany**	24.6	3	**Germany**	20.4
4	**Ukraine**	**22.3**	4	**France**	17.1
5	**Belgium-Luxemburg**	21.8	5	**Italy**	16.7
6	**France**	17.5	6	**Taiwan, China**	13.0
7	**South Korea**	13.9	7	**Belgium-Luxemburg**	12.9
8	**Italy**	11.8	8	**South Korea**	11.4
9	**China**	10.8	9	**Spain**	9.4
10	**Brazil**	9.6	10	**Canada**	8.8
11	**Taiwan, China**	8.3	11	**Hong Kong**	8.1
12	**United Kingdom**	7.8	12	**United Kingdom**	7.7
13	**Turkey**	7.5	13	**Turkey**	7.2
14	**Netherlands**	6.4	14	**Thailand**	5.9
15	**United States**	6.2	15	**Netherlands**	5.9
16	**Spain**	6.2	16	**Japan**	5.1
17	**Canada**	5.1	17	**Malaysia**	4.2
18	**Mexico**	4.8	18	**Mexico**	4.0
19	**Australia**	4.5	19	**Iran**	3.9
20	**South Africa**	4.1	20	**Sweden**	3.3

Rank		Net Exports (exports-imports)	Rank		Net Imports (imports-exports)
1	*Russia*	24.6	1	*United States*	28.6
2	**Japan**	23.4	2	**China**	9.9
3	**Ukraine**	22.0	3	**Hong Kong**	8.1
4	**Belgium-Luxembourg**	8.9	4	**Thailand**	5.9
5	**Brazil**	8.7	5	**Italy**	4.9
6	**Germany**	4.1	6	**Taiwan, China**	4.7
7	**South Africa**	3.8	7	**Canada**	3.8
8	**Kazakhstan**	3.6	8	**Iran**	3.4
9	**South Korea**	2.4	9	**Spain**	3.2
10	**Slovak Republic**	2.4	10	**Singapore**	3.1
11	**Romania**	2.0	11	**Indonesia**	2.9
12	**Australia**	2.0	12	**Egypt**	2.4
13	**Poland**	2.0	13	**Greece**	2.3
14	**Czech Republic**	1.4	14	**Portugal**	2.0
15	**Finland**	0.9	15	**Philippines**	2.0

Source: IISI (Steel Sector Report for 2002)

Table 1.3. **World Trade in Steel 1975-2000 (million metric ton finished steel)**

Year	**Exports**	**Production**	**Exports %**
1975	114.7	506.9	22.6
1976	126.1	533.7	23.6
1977	127.9	536.5	23.8
1978	138.6	571.7	24.2
1979	143.1	598.7	23.9
1980	140.6	578.7	24.3
1981	142.8	574.3	24.9
1982	135.5	528.7	25.6
1983	145.3	546.5	26.6
1984	158.8	588.4	27.0
1985	171.0	599.0	28.5
1986	161.7	597.4	27.1
1987	162.3	615.5	26.4
1988	171.1	656.8	26.1
1989	171.2	664.4	25.8
1990	171.0	654.0	26.2
1991	177.1	626.4	28.3
1992	196.1	616.8	31.8
1993	222.5	627.4	35.5
1994	238.6	628.7	37.9
1995	246.7	578.7	42.6
1996	237.8	656.3	36.2
1997	268.7	701.4	38.3
1998	271.6	685.0	39.7
1999	280.8	696.3	40.3
2000	302.7	747.9	40.5

Source: IISI (Steel Sector Report for 2002)

Diagram 1.1. **Export and Production of Finished Steel in the World in 1975-2000**

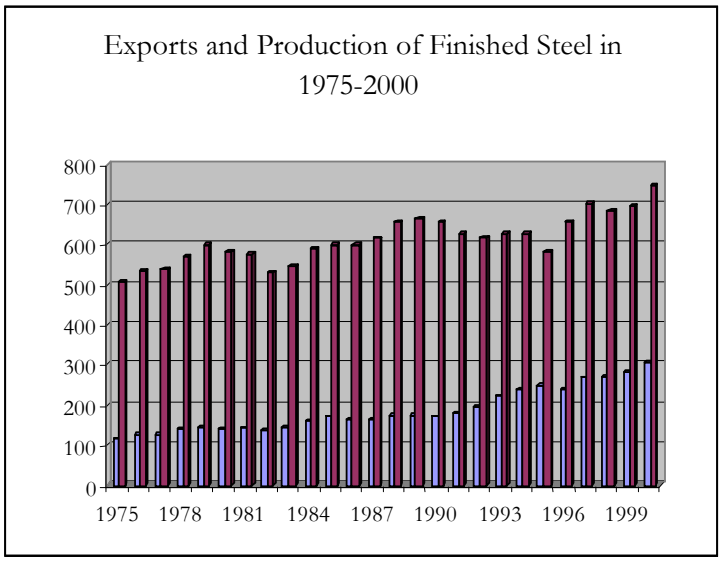


Table 1.4. **Examples of Antidumping investigations against Ukrainian Steel Sector (1996-2002)**

Period	Country-Importer	Size of Tax	Size of Quota	Type of Product
1996	Mexico***	7208.51.01-62% 7208.51.01-68% (antidumping duty)		Hot-rolled steel
1996	USA***	"Azovstal" 81% "Illich" –155% other 238% (antidumping margin)		Hot-rolled steel
1997	Egypt***	19.3%-21.9%		Armature
1997	Hungary***		7213.10.20-440 ton 7213.91-220 ton 7214-220 ton	Steel Products
1997	Egypt***	40%		Hot-rolled steel
1997	Brazil***	80.50%		Semi-processed steel
1998	Mexico***	46.66%		Hot-rolled steel
1998	Venezuela***	80.50%		Hot-rolled steel
1998	Venezuela***	52.90%		Hot-rolled steel
1999	Canada***	57.6% (antidumping duty)		Hot-rolled steel
1999	Poland**			
1999	USA***	10% for 2000 (import tariff)		Armature
1999	Columbia***	$ 65/ton (import margin)		Semi-processed steel
1999	Mexico***	30.50%		Armature
1999	Peru***	$ 50/ton (import margin)		Semi-processed steel
1999	Peru***	24.10%-31.49% (antidumping duty)		Hot and cold-rolled steel
2000	Canada***	15.7% (antidumping duty)		Armature
2000	Russia***		413.33 ton	Tubes
2000	USA***	89.49% (antidumping margin)		Hot-rolled steel
2000	USA***	90.33% (antidumping margin)		Hot-rolled steel
2000	Turkey*** (under review)	$ 17/ton		Semi-processed steel
2000	Egypt**			Semi-processed and ferrous- alloy steel
2001	Canada***	96% (antidumping duty)		Hot-rolled steel
2001	Russia**	(compensating)		Armature
2001	EU**			Tubes
2001	Argentina**			Cold-rolled steel
2001	USA**			Semi-processed steel
2001	USA**			Hot-rolled steel
2001	USA**			Metal products
2002	USA***	"Krivorozhstal"-116.37%		Steel wire

2002	USA***(preliminary decision)	others-166.37% (antidumping margin) 1.97%-153.6% (preliminary tariff)	Cold-rolled steel
2002	USA***(preliminary decision)	369% (preliminary antidumping margin)	Carbon steel wire rod

***-Positive solution, Ukraine takes duties;
**-Investigation is in process;
*-Negative solution, no duties taken by Ukraine.

Source:

1) *The Modern Tendencies in the Ferrous Metals Development in Ukraine and in the World*, The State Committee of Industrial Policy in Ukraine "UkrPromVneshexpertiza", Kiev-Dnipropetrovsk, 2001;

2) http://www.steelnews.com/companies/

3) http://www.business.kiev.ua/state/i450/a7202

APPENDIX 2

Table 2.1. **The Endogeneity Test for Steel Price for Ukrainian Enterprises.**

Enterprise	**Endogeneity test (prob)**	**Ownership structure**[27]
Krivirozhstal	**0.2388**	100% state owned
Illich Metal Plant	**0.3070**	Till March, 1997 – state share 100%; March, 1997-November, 2000 – state share 50%; From November, 2000 – state share 0% 87% owned by Illichstal, an employee-owned company headed by general director Vladimir Boiko; 6% portfolio investors; 4-5% free float
Azovstal	**0.1071**	2002 – 25% owned directly by Donbass Industrial Union
Zaporozhstal	**0.1129**	Till October 2001 – state share 25%; After October 2001 – 0% 2002 – Controlled indirectly by Midland Resources of Canada
Alchevsk Metal Plant	**0.0039**	2001 – 18% owned directly by Donbass Industrial Union (Socrat-info news agency reports ownership of 32.5% by Donbass Industrial Union, 32.5% by Interpipe, 25%+one share by Lughansk regional administration, 10% others)
Dzerzhinskogo Metal Plant	**0.0928**	1998-June, 2003 – (State controlled) 98,86% was hold by Ukrsibbank; from March, 2003 – controlled by Donbass Industrial Union
Petrovskogo Metal Plant	**0.1177**	Till October, 2000 – state share 60,28%; October, 2000-December, 2003 – state share 42,26%; From January, 2004 – state share 0% De facto controlled by Privat Bank group, according to TASIS and press reports
Yenakievskiy Metal Plant	**0.4960**	From 1996 – official state share 0% (controlled by Danko and System Capital Management); But unofficial government control still exist
Donetskiy Metal Plant	**0.1151**	Till summer, 1996 – state share is 100%; Till November, 1997 – state share is 60%; 2001 – 62% stake owned by Kontsern Energo
Dneprospetstal	**0.0125**	2001 – Controlling stake owned by Metallurgia group
Libnehta Metal Plant	**0.4933**	No information available
Fringe enterprise	**0.0048**	
Total	**0.1566**	**(Not the column sum but the aggregate level test for the whole industry)**

We conduct the endogeneity test in order to determine whether the steel price of the supply for each enterprise is endogenously determined. Due to the endogeneity test the low value of probability at the price means that the variable is exogenously determined. The exogenous character of steel price for the enterprise means that the enterprise is a price taker thus giving us an additional support to the perfect competition assumption.

There are only two enterprises (Alchevsk Metal Plant and Dneprospetstal) with 5% significance level for the residual coefficient in the first stage of Durbin-Watson test for endogeneity. Although there can exist the variety of reasons for explaining the behavior of producers as not price takers, we have attempted to give the reasoning from the point of

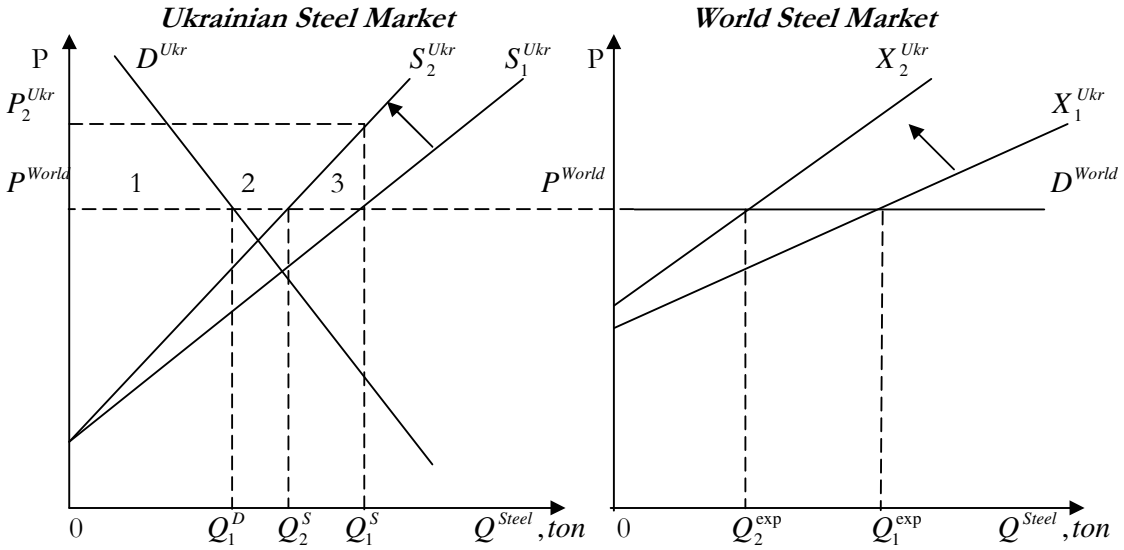
[27] The information is taken from: www.smida.gov.ua; www.corporation.com.ua; www.istock.com; www.google.com, Metal Bulletin

ownership structure. As we can observe the ownership structure at Alchevsk Metal Plant remains ambiguous (due to mismatch of information available from different sources); the non-price taking behavior of Dneprospetsal can be explained by the factor that it produces expensive type of steel products (like stainless steel) that is valuable and therefore competitive on the market.

Nevertheless, the general tendency for enterprises to behave as price takers becomes undoubtful. The endogeneity test on the aggregate level for the whole industry (represented by "**Total"** in the table) provides us with the results that in general the industry behaves as the price taker on the market and therefore we can assume approximately competitive market structure in our main analysis.

APPENDIX 3A

Graph 1. **The effect of subsidies elimination when Ukrainian market forces have no influence on the world economy – "SMALL" country case.**



Source: based on Helpman and Krugman "Trade policy and market structure" (1989)

Where

Q_1^S - the volume of Ukrainian steel supplied on the Ukrainian market with subsidy

Q_2^S - the volume of Ukrainian steel supplied on the Ukrainian market without subsidy

Q_1^D - the volume of steel demanded on Ukrainian market with subsidy

P_2^{Ukr} - the Ukrainian internal price for producers with subsidy

P^{World} - the world steel price

S_1^{Ukr} - the supply of Ukrainian steel on the domestic market with subsidy

S_2^{Ukr} - the supply of Ukrainian steel on the domestic market without subsidy

D^{World} - the world demand for steel

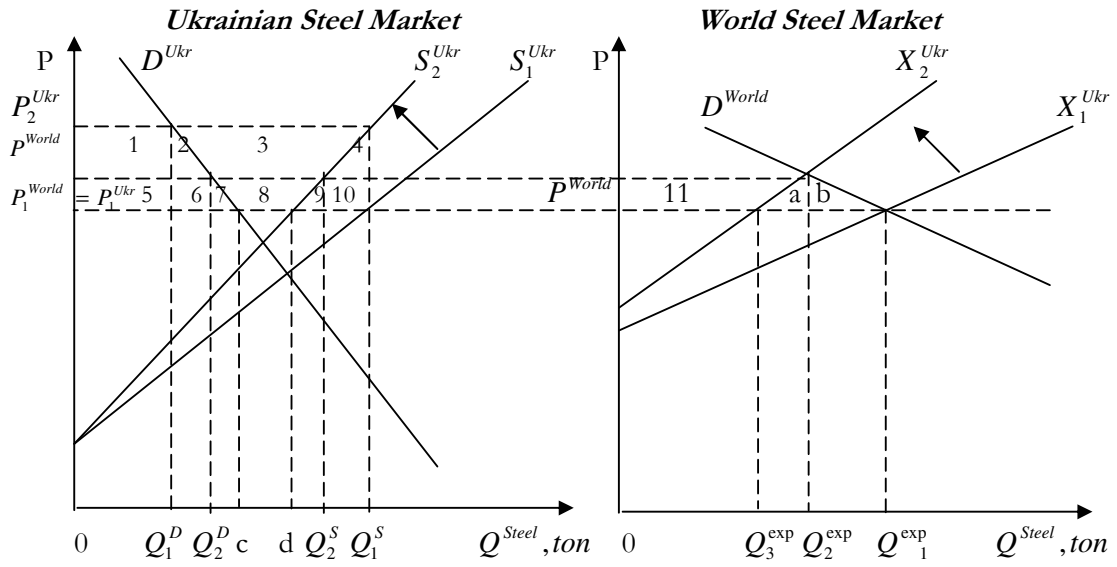
D^{Ukr} - domestic demand for steel

X_1^{Ukr} - the export supply of Ukrainian steel with subsidy

X_2^{Ukr} - the supply export of Ukrainian steel without subsidy

APPENDIX 3B

Graph 2. **The effect of subsidies elimination when Ukrainian market forces have influence on the world economy – "LARGE" country case.**



Source: based on Helpman and Krugman "Trade policy and market structure" (1989)

Where

Q_1^S - the volume of Ukrainian steel supplied on the Ukrainian market with subsidy

Q_2^S - the volume of Ukrainian steel supplied on the Ukrainian market without subsidy

Q_1^D - the volume of steel demanded on Ukrainian market at the price P_2^{Ukr}

Q_2^D - the volume of steel demanded on Ukrainian market without subsidy

c – the volume of steel demanded by Ukrainian consumers with subsidy

d – the volume of steel supplied to domestic market at low price P_1^{Ukr}

P_1^{Ukr}, P_1^{World} - the Ukrainian and World prices domestic and foreign consumers face under the subsidy regime

P_2^{Ukr} - the Ukrainian internal price for producers with subsidy

P^{World} - the world steel price after subsidy elimination for Ukrainian producers

S_1^{Ukr} - the supply of Ukrainian steel on the domestic market with subsidy

S_2^{Ukr} - the supply of Ukrainian steel on the domestic market without subsidy

D^{World} - the world demand for steel

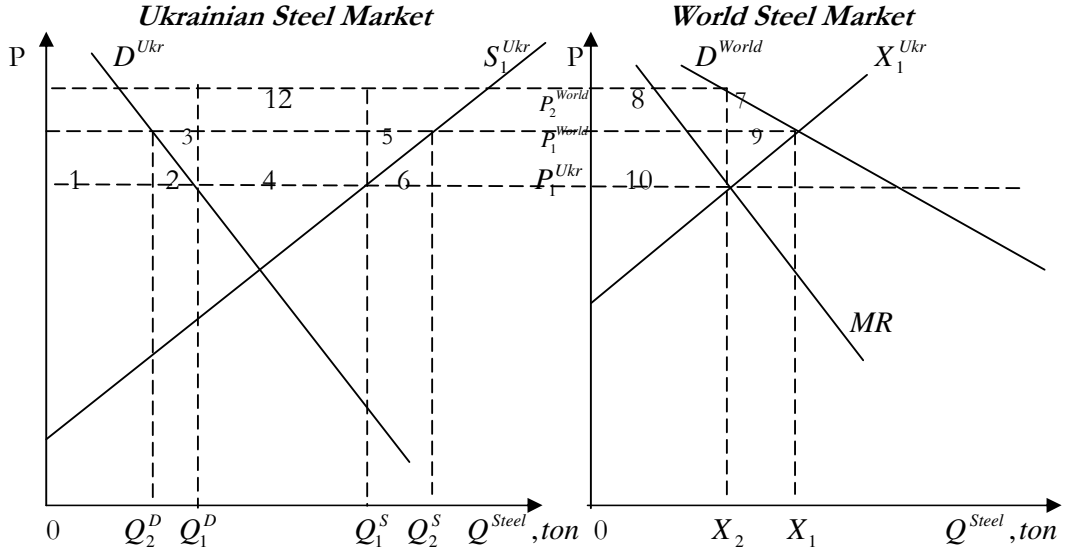
D^{Ukr} - domestic demand for steel

X_1^{Ukr} - the export supply of Ukrainian steel before subsidy

X_2^{Ukr} - the export supply of Ukrainian steel without subsidy

APPENDIX 3C

Graph 3. **The effect of introduction the export tax under "LARGE" country assumption.**



Source: based on Helpman and Krugman "Trade policy and market structure" (1989)

Where

Q_1^S - the volume of Ukrainian steel supplied on the Ukrainian market with the subsidy

Q_2^S - the volume of Ukrainian steel supplied on the Ukrainian market without the subsidy

Q_1^D - the world price on the Steel market

P_2^{Ukr} - the Ukrainian internal price for the steel with the subsidy

P^{World} - the world steel price

S_1^{Ukr} - the supply of Ukrainian steel on the domestic market before the subsidy elimination

S_2^{Ukr} - the supply of Ukrainian steel on the domestic market without the subsidy

D^{World} - the world demand for steel

X_1^{Ukr} - the export of Ukrainian steel before the subsidy elimination

X_2^{Ukr} - the export of Ukrainian steel without subsidy

APPENDIX 3D

Mathematical Estimation of Welfare Effect from Elimination Production Subsidies in "SMALL" country case

$$\Delta PS = -Q_2^S (P_2^{Ukr} - P^{World}) - P_2^{Ukr} (Q_1^S - Q_2^S) + \int_{Q_2^S}^{Q_1^S} f(q)dq =$$

$$= -Q_2^S (P_2^{Ukr} - P^{World}) - P_2^{Ukr} (Q_1^S - Q_2^S) + \int_{Q_2^S}^{Q_1^S} (Q/B)^{\alpha} dq =$$

$$= -Q_2^S (P_2^{Ukr} - P^{World}) - P_2^{Ukr} (Q_1^S - Q_2^S) + \frac{(Q/B)^{\alpha+1}}{\alpha+1}\Bigg|_{Q_2^S}^{Q_1^S} =$$

$$= Q_2^S P^{World} - P_2^{Ukr} Q_1^S + \frac{(Q_1^S/B)^{\alpha+1} - (Q_2^S/B)^{\alpha+1}}{\alpha+1},\ \alpha = 1/\varepsilon_{dom}^s$$

$$\Delta GR = Q_1^S (P_2^{Ukr} - P^W)$$

$$\Delta TS = -P^{World} (Q_1^S - Q_2^S) + \frac{(Q_1^S/B)^{\alpha+1} - (Q_2^S/B)^{\alpha+1}}{\alpha+1}, \alpha = 1/\varepsilon_{dom}^s$$

Mathematical Estimation of Welfare Effect from Elimination Production Subsidies in "LARGE" country case

$$\Delta PS = -Q_2^S (P_2^{Ukr} - P^{World}) - P_2^{Ukr} (Q_1^S - Q_2^S) + \int_{Q_2^S}^{Q_1^S} f(q)dq =$$

$$= -Q_2^S (P_2^{Ukr} - P^{World}) - P_2^{Ukr} (Q_1^S - Q_2^S) + \int_{Q_2^S}^{Q_1^S} (Q/B)^{\alpha} dq =$$

$$= Q_2^S P^{World} - P_2^{Ukr} Q_1^S + \frac{(Q_1^S/B)^{\alpha+1} - (Q_2^S/B)^{\alpha+1}}{\alpha+1}, \alpha = 1/\varepsilon_{dom}^s$$

$$\Delta CS = -[Q_2^D (P^{World} - P_1^{Ukr}) - P_1^{Ukr} (c - Q_2^D) + \int_{Q_2^D}^{c} f(q)dq] =$$

$$= -[Q_2^D (P^{World} - P_1^{Ukr}) - P_1^{Ukr} (c - Q_2^D) + \int_{Q_2^D}^{c} (Q/A)^{\beta} dq] =$$

$$= -[Q_2^D P^{World} - P_1^{Ukr} c + \frac{(c/A)^{\beta+1} - (Q_2^D/A)^{\beta+1}}{\beta+1}], \beta = 1/\varepsilon_{dom}^d$$

$$\Delta GR = Q_1^S (P_2^{Ukr} - P_1^{Ukr})$$

$$\Delta EG = \int_d^{Q_1^S} f(q)dq - P_1^{Ukr} (Q_1^S - Q_2^S) = \int_d^{Q_1^S} (Q/B)^{\alpha} dq - P_1^{Ukr} (Q_1^S - Q_2^S) =$$

$$= \frac{(Q/B)^{\alpha+1}}{\alpha+1}\Bigg|_d^{Q_1^S} - P_1^{Ukr} (Q_1^S - Q_2^S) = = \frac{(Q_1^S/B)^{\alpha+1} - (d/B)^{\alpha+1}}{\alpha+1} - P_1^{Ukr} (Q_1^S - Q_2^S)$$

$$\Delta TOT = Q_1^S (P_2^{Ukr} - P_1^{Ukr}) - Q_2^D P^{World} + P_1^{Ukr} c - \frac{(c/A)^{\beta+1} - (Q_2^D / A)^{\beta+1}}{\beta+1} + Q_2^S P^{World} - P_2^{Ukr} Q_1^S$$

$$+ \frac{(Q_1^S / B)^{\alpha+1} - (Q_2^S / B)^{\alpha+1}}{\alpha+1} - \frac{(Q_1^S / B)^{\alpha+1} - (d/B)^{\alpha+1}}{\alpha+1} =$$

$$= P^{World} (Q_2^S - Q_2^D) + P_1^{Ukr} (c - Q_2^S) - \frac{(c/A)^{\beta+1} - (Q_2^D / A)^{\beta+1}}{\beta+1} + \frac{(d/B)^{\alpha+1} - (Q_2^S / B)^{\alpha+1}}{\alpha+1}$$

$$\alpha = 1/\varepsilon_{dom}^s, \beta = 1/\varepsilon_{dom}^d$$

$$\Delta TS = P^{World} (Q_2^S - Q_2^D) + P_1^{Ukr} (c - Q_2^S) - \frac{(c/A)^{\beta+1} - (Q_2^D / A)^{\beta+1}}{\beta+1} + \frac{(d/B)^{\alpha+1} - (Q_2^S / B)^{\alpha+1}}{\alpha+1}$$

$$+ \frac{(Q_1^S / B)^{\alpha+1} - (d/B)^{\alpha+1}}{\alpha+1} - P_1^{Ukr} (Q_1^S - Q_2^{S)}) =$$

$$= P^{World} (Q_2^S - Q_2^D) + P_1^{Ukr} (c - Q_1^S) - \frac{(c/A)^{\beta+1} - (Q_2^D / A)^{\beta+1}}{\beta+1} + \frac{(Q_1^S / B)^{\alpha+1} - (Q_2^S / B)^{\alpha+1}}{\alpha+1}$$

$$\alpha = 1/\varepsilon_{dom}^s, \beta = 1/\varepsilon_{dom}^d$$

$$\Delta WL^{ROW} = -[Q_2^{\exp} (P^{World} - P_1^{World}) + \int_{Q_2^{\exp}}^{Q_1^{\exp}} f(q)dq - P_1^{World} (Q_1^{\exp} - Q_2^{\exp})] =$$

$$= -[Q_2^{\exp} (P^{World} - P_1^{World}) + \int_{Q_2^{\exp}}^{Q_1^{\exp}} (Q/C)^{\varepsilon} dq - P_1^{World} (Q_1^{\exp} - Q_2^{\exp})] =$$

$$= -[Q_2^{\exp} P^{World} - P_1^{World} Q_1^{\exp} + \frac{(Q_1^{\exp} / C)^{\varepsilon+1} - (Q_2^{\exp} / C)^{\varepsilon+1}}{\varepsilon+1}], \ \varepsilon = 1/\varepsilon_{imp}^d$$

Mathematical Estimation of Welfare Effect from Introduction Export Tax in "LARGE" country case

$$\Delta PS = -Q_2^S (P_1^{World} - P_1^{Ukr}) - P_1^{Ukr} (Q_2^S - Q_1^S) + \int_{Q_1^S}^{Q_{21}^S} f(q)dq =$$

$$= -Q_2^S (P_1^{World} - P_1^{Ukr}) - P_1^{Ukr} (Q_2^S - Q_1^S) + \int_{Q_1^S}^{Q_2^S} (Q/B)^{\alpha} dq =$$

$$= -Q_2^S P_1^{World} + P_1^{Ukr} Q_1^S + \frac{(Q_2^S / B)^{\alpha+1} - (Q_1^S / B)^{\alpha+1}}{\alpha+1}$$

$$\Delta CS = Q_2^D (P_1^{World} - P_1^{Ukr}) - P_1^{Ukr} (Q_1^D - Q_2^D) + \int_{Q_2^D}^{Q_1^D} f(q)dq =$$

$$= Q_2^D (P_1^{World} - P_1^{Ukr}) - P_1^{Ukr} (Q_1^D - Q_2^D) + \int_{Q_2^D}^{Q_1^D} (Q/A)^{\beta} dq =$$

$$= Q_2^D P_1^{World} - P_1^{Ukr} Q_1^D + \frac{(Q_1^D / A)^{\beta+1} - (Q_2^D / A)^{\beta+1}}{\beta+1}$$

$$\Delta GR = (P_2^{World} - P_1^{Ukr}) X_2$$

$$\Delta TS = P_1^{World} (Q_2^D - Q_2^S) - P_1^{Ukr} (Q_1^D - Q_1^S) + \frac{(Q_2^S / B)^{\alpha+1} - (Q_1^S / B)^{\alpha+1}}{\alpha+1}$$
$$+ \frac{(Q_1^D / A)^{\beta+1} - (Q_2^D / A)^{\beta+1}}{\beta+1} + X_2 (P_2^{World} - P_1^{Ukr})$$

APPENDIX 4

Estimation of the indirect subsidy rate due to the tax privileges to steel producers.

According to Legeida (2002) subsidy as the percentage of tax exemption is not to be necessary included into the market cost of production, but it can compensate the part of productivity costs. Available data gives the information on the amount of subsidy only on the aggregated level. She takes the gross profits of steel enterprises and calculates the amount of tax exemption from 30% to 9%. Therefore, the amount of subsidy equals 21% from gross profits.

*Total amount of subsidy=gross enterprise profit*0,21=700 mln UAH* ≈ 130 *mln $*[28]

Hence, ad-valorem subsidy s=2,6%.

We are going to choose the alternative way of estimation of the indirect subsidy rate using the available data on combined tax privileges that includes not only the profit tax reduction for the enterprises but also such privileges as softening the innovation fund fee, the fee for the environmental pollution, the road fund fee, and also writing-off the debts prior to the year 1999[29].

The total amount of combined tax privileges for the period 1999 (III, IV Q)-2001 constituted 3270,1 mln UAH. Dividing this amount by the total volume of steel produced for the period in monetary units (UAH) we are able to obtain the amount of the ad-valorem production subsidy rate.

3270,1/43027,63=0.076=7.6%[30]

In the year 2002 due to the strategic importance of the steel sector for Ukraine government adopted the law "On further development in the mining and smelting industry". Due to the law the 50% of an income tax should have been transferred to the accounts of the State Treasury with the purpose of further investment therefore the tax benefits have been preserved.

[28] Source: adopted from N. Legeida, Economic Consequences of Government Support of Ukrainian Steel Enterprises, 2002
[29] Source: Ukraine experiment – Russia learns lessons, www.metal.com.ru/analytics
[30] Source: State Statistics Committee, IISI

Estimation of indirect subsidy rate due to the lower input price for iron-ore on the domestic market with that on the world market.

Since the price for the input for Ukrainian producers is permanently below the world price this policy appear to be an indirect support of steel producers by the government. Table 4.1 represents the appropriate estimations of the amount of implicit production subsidy.

Table 4.1. **Estimation of indirect production subsidy due to the iron ore price differential**

Period	Average price benefit for iron-ore products, *[aggregate world price-aggregate domestic price]/world price*	Relative value of 1 ton of iron-ore to that of steel	The amount (ton) of iron-ore used in the production of 1 ton of steel	The amount of indirect subsidy for steel producers
1	*2*	*3*	*4*	*5=2x3x4*
1997	12.24%	39.8%	1.28	6.24%
1998	13.43%	38.3%	1.28	6.60%
1999	12.23%	35.4%	1.28	5.55%
2000	17.24%	33.6%	1.28	7.42%
2001	8.06%	34.0%	1.28	3.51%
2002	5.04%	32.9%	1.28	2.12%
2003	8.62%	36.7%	1.28	4.05%

Source: Estimations are based on the data of State Statistics Committee.

APPENDIX 5

Table 5.1. Residual Correlation Matrix

	Krivorozhstal	Illich	Azovstal	Zaporozhstal	Alchevsk	Dzerzhinskogo	Petrovskogo	Yenakievskiy	Donetskiy	Dneprospetstal	Libnehta	Fringe Ent	todem_dom	totdem_imp
Krivorozhstal	1,0000	0,9429	0,9048	0,9695	0,4875	0,9141	0,7196	0,3609	0,8286	0,6081	0,8630	-0,2741	-0,0664	0,2342
Illich	0,9429	1,0000	0,9675	0,8910	0,6030	0,7580	0,8785	0,5125	0,6034	0,6768	0,8826	-0,1814	-0,0683	0,3457
Azovstal	0,9048	0,9675	1,0000	0,8521	0,6900	0,7768	0,9348	0,3523	0,5792	0,4994	0,7566	-0,1355	-0,1236	0,3728
Zaporozhstal	0,9695	0,8910	0,8521	1,0000	0,5806	0,9165	0,6383	0,4080	0,8360	0,4924	0,7788	-0,2016	-0,0693	0,2849
Alchevsk	0,4875	0,6030	0,6900	0,5806	1,0000	0,4049	0,7051	0,4330	0,1482	-0,0499	0,2202	0,2535	-0,1781	0,5788
Dzerzhinskogo	0,9141	0,7580	0,7768	0,9165	0,4049	1,0000	0,5405	0,0420	0,9522	0,3184	0,6446	-0,3221	-0,1023	0,1181
Petrovskogo	0,7196	0,8785	0,9348	0,6383	0,7051	0,5405	1,0000	0,3871	0,2899	0,4564	0,6467	-0,0779	-0,1218	0,4061
Yenakievskiy	0,3609	0,5125	0,3523	0,4080	0,4330	0,0420	0,3871	1,0000	-0,0349	0,6248	0,5814	-0,0377	0,0601	0,3432
Donetskiy	0,8286	0,6034	0,5792	0,8360	0,1482	0,9522	0,2899	-0,0349	1,0000	0,3319	0,6060	-0,3963	-0,0397	-0,0353
Dneprospetstal	0,6081	0,6768	0,4994	0,4924	-0,0499	0,3184	0,4564	0,6248	0,3319	1,0000	0,9116	-0,3602	0,1163	0,0293
Libnehta	0,8630	0,8826	0,7566	0,7788	0,2202	0,6446	0,6467	0,5814	0,6060	0,9116	1,0000	-0,3948	0,0231	0,1320
Fringe Ent	-0,2741	-0,1814	-0,1355	-0,2016	0,2535	-0,3221	-0,0779	-0,0377	-0,3963	-0,3602	-0,3948	1,0000	-0,0380	0,4709
todem_dom	-0,0664	-0,0683	-0,1236	-0,0693	-0,1781	-0,1023	-0,1218	0,0601	-0,0397	0,1163	0,0231	-0,0380	1,0000	-0,1647
totdem_imp	0,2342	0,3457	0,3728	0,2849	0,5788	0,1181	0,4061	0,3432	-0,0353	0,0293	0,1320	0,4709	-0,1647	1,0000

Table 5.2. **Estimation output for Specification 1.**

System: SYS2
Estimation Method: Seemingly Unrelated Regression
Date: 05/21/04 Time: 20:17
Sample: 1997:07 2003:12
Included observations: 78
Total system (unbalanced) observations 1020
Linear estimation after one-step weighting matrix

	Coefficient	Std. Error	t-Statistic	Prob.
C(6)	10.18910	2.136647	4.768731	0.0000
C(1)	**0.445313**	**0.038386**	**11.60081**	**0.0000**
C(2)	-0.670938	0.423487	-1.584317	0.1134
C(3)	-0.572867	0.148679	-3.853045	0.0001
C(4)	-0.065602	0.052966	-1.238564	0.2158
C(5)	0.179579	0.063166	2.842995	0.0046
C(18)	-0.352025	0.075132	-4.685386	0.0000
C(7)	10.10360	2.136645	4.728723	0.0000
C(8)	9.833629	2.136648	4.602362	0.0000
C(9)	9.784754	2.136649	4.579486	0.0000
C(10)	9.463611	2.136669	4.429143	0.0000
C(11)	9.298452	2.136664	4.351854	0.0000
C(12)	8.294007	2.136645	3.881790	0.0001
C(13)	9.137919	2.136652	4.276746	0.0000
C(14)	8.593639	2.136697	4.021927	0.0001
C(15)	7.683506	2.136647	3.596059	0.0003
C(16)	7.867111	2.136644	3.681994	0.0002
C(17)	8.477384	2.138608	3.963973	0.0001
C(19)	14.52897	0.966735	15.02891	0.0000
C(20)	**-0.851242**	**0.127348**	**-6.684380**	**0.0000**
C(21)	1.913219	0.621934	3.076240	0.0022
C(22)	-0.481813	0.161187	-2.989157	0.0029
C(23)	-0.025516	0.085765	-0.297510	0.7661
C(24)	0.164288	0.050924	3.226125	0.0013
C(25)	-0.597765	0.100823	-5.928838	0.0000
C(26)	-14.97358	14.44453	-1.036626	0.3002
C(27)	**-7.591715**	**2.234494**	**-3.397509**	**0.0007**
C(28)	1.491075	0.418881	3.559665	0.0004
C(29)	6.843254	0.671355	10.19320	0.0000
C(33)	-0.447348	0.130137	-3.437522	0.0006
C(31)	-0.487297	0.085383	-5.707199	0.0000
Determinant residual covariance		3.40E-49		

Equation: LOG(TOTALMETALS__1) = C(6) + C(1)*LOG(PRICE) + C(2) *LOG(PRICE_COAL__1) + C(3)*LOG(PRICE_ELECTR__1) + C(4) *LOG(WAGE_METAL__1) + C(5)*LOG(TOTDEM(-12)) +C(18) *LOG(PRICE_ORE__1)
Observations: 72

R-squared	0.743817	Mean dependent var	6.170665
Adjusted R-squared	0.720169	S.D. dependent var	0.135334
S.E. of regression	0.071590	Sum squared resid	0.333136
Durbin-Watson stat	0.824848		

Equation: LOG(TOTALMETALS__2) = C(7) + C(1)*LOG(PRICE)+ C(2) *LOG(PRICE_COAL__2) + C(3)*LOG(PRICE_ELECTR__2) + C(4) *LOG(WAGE_METAL__2) +C(5)*LOG(TOTDEM(-12)) +C(18) *LOG(PRICE_ORE__2)
Observations: 72

R-squared	0.842874	Mean dependent var	6.085112
Adjusted R-squared	0.828370	S.D. dependent var	0.152201
S.E. of regression	0.063054	Sum squared resid	0.258429
Durbin-Watson stat	1.072519		

Equation: LOG(TOTALMETALS__3) = C(8) + C(1)*LOG(PRICE)+ C(2)
*LOG(PRICE_COAL__3) + C(3)*LOG(PRICE_ELECTR__3) + C(4)
*LOG(WAGE_METAL__3) +C(5)*LOG(TOTDEM(-12)) +C(18)
*LOG(PRICE_ORE__3)
Observations: 72

R-squared	0.812539	Mean dependent var	5.815115
Adjusted R-squared	0.795235	S.D. dependent var	0.151933
S.E. of regression	0.068751	Sum squared resid	0.307236
Durbin-Watson stat	0.922179		

Equation: LOG(TOTALMETALS__4) = C(9) + C(1)*LOG(PRICE)+ C(2)
*LOG(PRICE_COAL__4) + C(3)*LOG(PRICE_ELECTR__4) + C(4)
*LOG(WAGE_METAL__4) + C(5)*LOG(TOTDEM(-12))+C(18)
*LOG(PRICE_ORE__4)
Observations: 72

R-squared	0.827757	Mean dependent var	5.766209
Adjusted R-squared	0.811858	S.D. dependent var	0.148382
S.E. of regression	0.064361	Sum squared resid	0.269254
Durbin-Watson stat	1.059579		

Equation: LOG(TOTALMETALS__5) = C(10) + C(1)*LOG(PRICE)+ C(2)
*LOG(PRICE_COAL__5) + C(3)*LOG(PRICE_ELECTR__5) + C(4)
*LOG(WAGE_METAL__5) + C(5)*LOG(TOTDEM(-12))+C(18)
*LOG(PRICE_ORE__5)
Observations: 72

R-squared	0.866566	Mean dependent var	5.444727
Adjusted R-squared	0.854249	S.D. dependent var	0.219623
S.E. of regression	0.083846	Sum squared resid	0.456961
Durbin-Watson stat	0.678711		

Equation: LOG(TOTALMETALS__6) = C(11) + C(1)*LOG(PRICE)+ C(2)
*LOG(PRICE_COAL__6) + C(3)*LOG(PRICE_ELECTR__6) + C(4)
*LOG(WAGE_METAL__6) + C(5)*LOG(TOTDEM(-12)) +C(18)
*LOG(PRICE_ORE__6)
Observations: 72

R-squared	0.154934	Mean dependent var	5.280101
Adjusted R-squared	0.076928	S.D. dependent var	0.110120
S.E. of regression	0.105800	Sum squared resid	0.727582
Durbin-Watson stat	0.414702		

Equation: LOG(TOTALMETALS__7) = C(12) + C(1)*LOG(PRICE)+ C(2)
*LOG(PRICE_COAL__7) + C(3)*LOG(PRICE_ELECTR__7) + C(4)
*LOG(WAGE_METAL__7) + C(5)*LOG(TOTDEM(-12)) +C(18)
*LOG(PRICE_ORE__7)
Observations: 72

R-squared	0.859215	Mean dependent var	4.275521
Adjusted R-squared	0.846220	S.D. dependent var	0.166835
S.E. of regression	0.065424	Sum squared resid	0.278221
Durbin-Watson stat	0.978925		

Equation: LOG(TOTALMETALS__8) = C(13) + C(1)*LOG(PRICE)+ C(2)
*LOG(PRICE_COAL__8) + C(3)*LOG(PRICE_ELECTR__8) + C(4)
*LOG(WAGE_METAL__8) + C(5)*LOG(TOTDEM(-12)) +C(18)
*LOG(PRICE_ORE__8)
Observations: 72

R-squared	0.903126	Mean dependent var	5.119265
Adjusted R-squared	0.894183	S.D. dependent var	0.216698
S.E. of regression	0.070491	Sum squared resid	0.322981
Durbin-Watson stat	0.927624		

Equation: LOG(TOTALMETALS__9) = C(14) + C(1)*LOG(PRICE) +
C(2)*LOG(PRICE_COAL__9) + C(3)*LOG(PRICE_ELECTR__9) +
C(4)*LOG(WAGE_METAL__9) + C(5)*LOG(TOTDEM(-12)) +C(18)
*LOG(PRICE_ORE__9)
Observations: 72

R-squared	-2.617292	Mean dependent var	4.575477
Adjusted R-squared	-2.951196	S.D. dependent var	0.078351
S.E. of regression	0.155744	Sum squared resid	1.576644

Durbin-Watson stat	0.223094		

Equation: LOG(TOTALMETALS__10) = C(15) + C(1)*LOG(PRICE)+ C(2)*LOG(PRICE_COAL__10) + C(3)*LOG(PRICE_ELECTR__10) + C(4)*LOG(WAGE_METAL__10) + C(5)*LOG(TOTDEM(-12)) +C(18)*LOG(PRICE_ORE__10)
Observations: 72

R-squared	0.614389	Mean dependent var	3.665291
Adjusted R-squared	0.578794	S.D. dependent var	0.145267
S.E. of regression	0.094279	Sum squared resid	0.577752
Durbin-Watson stat	0.624996		

Equation: LOG(TOTALMETALS__11) = C(16) + C(1)*LOG(PRICE)+ C(2)*LOG(PRICE_COAL__11) + C(3)*LOG(PRICE_ELECTR__11) + C(4)*LOG(WAGE_METAL__11) + C(5)*LOG(TOTDEM(-12)) +C(18)*LOG(PRICE_ORE__11)
Observations: 72

R-squared	0.714308	Mean dependent var	3.848786
Adjusted R-squared	0.687937	S.D. dependent var	0.137735
S.E. of regression	0.076942	Sum squared resid	0.384807
Durbin-Watson stat	0.782541		

Equation: LOG(TOTALMETALS__12) = C(17) + C(1)*LOG(PRICE)+ C(2)*LOG(PRICE_COAL__12) + C(3)*LOG(PRICE_ELECTR__12) + C(4)*LOG(WAGE_METAL__12) + C(5)*LOG(TOTDEM(-12)) +C(18)*LOG(PRICE_ORE__12)
Observations: 72

R-squared	0.215364	Mean dependent var	4.452689
Adjusted R-squared	0.142936	S.D. dependent var	0.831726
S.E. of regression	0.769993	Sum squared resid	38.53778
Durbin-Watson stat	0.698245		

Equation: LOG(TOTDEM_DOM) = C(19) + C(20)*LOG(PRICE__1) + C(21)*LOG(UKR_GDPR)+ C(22)*LOG(UKR_GDPR) *LOG(UKR_GDPR) +C(23)*LOG(TOTSUPPLY(-6)) +C(24) *LOG(EXCH_RATE)+C(25)*LOG(CHI_METAL)
Observations: 78

R-squared	0.967884	Mean dependent var	6.459651
Adjusted R-squared	0.965170	S.D. dependent var	0.293342
S.E. of regression	0.054746	Sum squared resid	0.212792
Durbin-Watson stat	0.962327		

Equation: LOG(TOTDEM_IMP) = C(26) + C(27)*LOG(US_PRICEMET) + C(28)*LOG(US_PRICE_NF__1) + C(29)*LOG(US_GDPR) + C(33)*LOG(TOTSUPPLY(-6))+C(31)*LOG(EXCH_RATE)
Observations: 78

R-squared	0.931928	Mean dependent var	7.472741
Adjusted R-squared	0.927201	S.D. dependent var	0.359145
S.E. of regression	0.096902	Sum squared resid	0.676081
Durbin-Watson stat	1.056353		

Table 5.3. **Estimation output for Specification 2.**

System: SYS3
Estimation Method: Seemingly Unrelated Regression
Date: 05/21/04 Time: 20:48
Sample: 1997:07 2003:12
Included observations: 78
Total system (unbalanced) observations 1020
Linear estimation after one-step weighting matrix

	Coefficient	Std. Error	t-Statistic	Prob.
C(6)	10.65882	1.801028	5.918188	0.0000
C(32) Krivirozhstal	**0.234490**	0.037912	6.185181	0.0000
C(2)	-0.596831	0.357432	-1.669774	0.0953
C(3)	-0.502310	0.126649	-3.966161	0.0001

C(4)	0.014160	0.047134	0.300423	0.7639
C(5)	0.120774	0.054966	2.197229	0.0282
C(18)	-0.358472	0.068978	-5.196904	0.0000
C(7)	10.24217	1.802810	5.681224	0.0000
C(33) Illich MetalPlant	**0.297769**	0.039147	7.606510	0.0000
C(8)	10.00922	1.802850	5.551887	0.0000
C(34) Azovstal	**0.290682**	0.039907	7.283927	0.0000
C(9)	9.944582	1.800484	5.523284	0.0000
C(35) Zaporozhstal	**0.293679**	0.038215	7.685000	0.0000
C(10)	8.155848	1.802278	4.525301	0.0000
C(36) Alchevsk Metal Plant	**0.574047**	0.041996	13.66909	0.0000
C(11)	10.44566	1.802761	5.794257	0.0000
C(37) Dzerzhinskogo Metal Plant	**0.105023**	0.041427	2.535162	0.0114
C(12)	8.179555	1.803631	4.535049	0.0000
C(38) Petrovskogo Metal Plant	**0.346124**	0.040693	8.505835	0.0000
C(13)	7.848301	1.800204	4.359672	0.0000
C(39) Yenakievskiy Metal Plant	**0.570668**	0.038258	14.91625	0.0000
C(14)	10.81666	1.803453	5.997750	0.0000
C(40) Donetskiy Metal Plant	**0.010052**	0.043214	2.326251	0.0202
C(15)	8.301687	1.807423	4.593107	0.0000
C(41) Dneprospetstal	**0.206218**	0.045439	4.538355	0.0000
C(16)	8.402740	1.802819	4.660889	0.0000
C(42) Libnehta Metal Plant	**0.221942**	0.039489	5.620290	0.0000
C(17)	-0.320964	2.284821	-0.140477	0.8883
C(43) Fringe enterprise	**2.003973**	0.277782	7.214202	0.0000
C(19)	14.60633	0.971050	15.04179	0.0000
C(20)	-0.840185	0.127587	-6.585195	0.0000
C(21)	1.926487	0.623428	3.090153	0.0021
C(22)	-0.484634	0.161562	-2.999676	0.0028
C(23)	-0.041923	0.085874	-0.488195	0.6255
C(24)	0.160839	0.051005	3.153403	0.0017
C(25)	-0.599534	0.100972	-5.937652	0.0000
C(26)	-18.40274	14.23563	-1.292724	0.1964
C(27)	-3.779047	2.032728	-1.859101	0.0633
C(28)	0.420288	0.362765	1.158569	0.2469
C(29)	4.736357	0.609986	7.764691	0.0000
C(31)	-0.249030	0.078691	-3.164649	0.0016

Determinant residual covariance	1.80E-50

Equation: LOG(TOTALMETALS__1) = C(6) + C(32)*LOG(PRICE) + C(2)*LOG(PRICE_COAL__1) + C(3)*LOG(PRICE_ELECTR__1) + C(4)*LOG(WAGE_METAL__1) + C(5)*LOG(TOTDEM(-12)) +C(18) *LOG(PRICE_ORE__1)

Observations: 72

R-squared	0.835887	Mean dependent var	6.170665
Adjusted R-squared	0.820738	S.D. dependent var	0.135334
S.E. of regression	0.057299	Sum squared resid	0.213410
Durbin-Watson stat	1.324470		

Equation: LOG(TOTALMETALS__2) = C(7) + C(33)*LOG(PRICE)+ C(2) *LOG(PRICE_COAL__2) + C(3)*LOG(PRICE_ELECTR__2) + C(4) *LOG(WAGE_METAL__2) +C(5)*LOG(TOTDEM(-12)) +C(18) *LOG(PRICE_ORE__2)

Observations: 72

R-squared	0.859538	Mean dependent var	6.085112
Adjusted R-squared	0.846572	S.D. dependent var	0.152201
S.E. of regression	0.059617	Sum squared resid	0.231021
Durbin-Watson stat	1.252563		

Equation: LOG(TOTALMETALS__3) = C(8) + C(34)*LOG(PRICE)+ C(2) *LOG(PRICE_COAL__3) + C(3)*LOG(PRICE_ELECTR__3) + C(4) *LOG(WAGE_METAL__3) +C(5)*LOG(TOTDEM(-12)) +C(18) *LOG(PRICE_ORE__3)

Observations: 72

R-squared	0.829145	Mean dependent var	5.815115
Adjusted R-squared	0.813374	S.D. dependent var	0.151933

S.E. of regression	0.065635	Sum squared resid	0.280019
Durbin-Watson stat	1.053301		

Equation: LOG(TOTALMETALS__4) = C(9) + C(35)*LOG(PRICE)+ C(2)
*LOG(PRICE_COAL__4) + C(3)*LOG(PRICE_ELECTR__4) + C(4)
*LOG(WAGE_METAL__4) + C(5)*LOG(TOTDEM(-12))+C(18)
*LOG(PRICE_ORE__4)
Observations: 72

R-squared	0.857403	Mean dependent var	5.766209
Adjusted R-squared	0.844240	S.D. dependent var	0.148382
S.E. of regression	0.058561	Sum squared resid	0.222911
Durbin-Watson stat	1.330610		

Equation: LOG(TOTALMETALS__5) = C(10) + C(36)*LOG(PRICE)+
C(2)*LOG(PRICE_COAL__5) + C(3)*LOG(PRICE_ELECTR__5) +
C(4)*LOG(WAGE_METAL__5) + C(5)*LOG(TOTDEM(-12))+C(18)
*LOG(PRICE_ORE__5)
Observations: 72

R-squared	0.895728	Mean dependent var	5.444727
Adjusted R-squared	0.886103	S.D. dependent var	0.219623
S.E. of regression	0.074120	Sum squared resid	0.357095
Durbin-Watson stat	0.957189		

Equation: LOG(TOTALMETALS__6) = C(11) + C(37)*LOG(PRICE)+
C(2)*LOG(PRICE_COAL__6) + C(3)*LOG(PRICE_ELECTR__6) +
C(4)*LOG(WAGE_METAL__6) + C(5)*LOG(TOTDEM(-12)) +C(18)
*LOG(PRICE_ORE__6)
Observations: 72

R-squared	0.631268	Mean dependent var	5.280101
Adjusted R-squared	0.597231	S.D. dependent var	0.110120
S.E. of regression	0.069887	Sum squared resid	0.317470
Durbin-Watson stat	0.947852		

Equation: LOG(TOTALMETALS__7) = C(12) + C(38)*LOG(PRICE)+
C(2)*LOG(PRICE_COAL__7) + C(3)*LOG(PRICE_ELECTR__7) +
C(4)*LOG(WAGE_METAL__7) + C(5)*LOG(TOTDEM(-12)) +C(18)
*LOG(PRICE_ORE__7)
Observations: 72

R-squared	0.845733	Mean dependent var	4.275521
Adjusted R-squared	0.831493	S.D. dependent var	0.166835
S.E. of regression	0.068485	Sum squared resid	0.304865
Durbin-Watson stat	0.943584		

Equation: LOG(TOTALMETALS__8) = C(13) + C(39)*LOG(PRICE)+
C(2)*LOG(PRICE_COAL__8) + C(3)*LOG(PRICE_ELECTR__8) +
C(4)*LOG(WAGE_METAL__8) + C(5)*LOG(TOTDEM(-12)) +C(18)
*LOG(PRICE_ORE__8)
Observations: 72

R-squared	0.936964	Mean dependent var	5.119265
Adjusted R-squared	0.931145	S.D. dependent var	0.216698
S.E. of regression	0.056862	Sum squared resid	0.210164
Durbin-Watson stat	1.549004		

Equation: LOG(TOTALMETALS__9) = C(14) + C(40)*LOG(PRICE) +
C(2)*LOG(PRICE_COAL__9) + C(3)*LOG(PRICE_ELECTR__9) +
C(4)*LOG(WAGE_METAL__9) + C(5)*LOG(TOTDEM(-12)) +C(18)
*LOG(PRICE_ORE__9)
Observations: 72

R-squared	0.187537	Mean dependent var	4.575477
Adjusted R-squared	0.112541	S.D. dependent var	0.078351
S.E. of regression	0.073811	Sum squared resid	0.354122
Durbin-Watson stat	0.966222		

Equation: LOG(TOTALMETALS__10) = C(15) + C(41)*LOG(PRICE)+
C(2)*LOG(PRICE_COAL__10) + C(3)*LOG(PRICE_ELECTR__10)
+ C(4)*LOG(WAGE_METAL__10) + C(5)*LOG(TOTDEM(-12))
+C(18)*LOG(PRICE_ORE__10)
Observations: 72

R-squared	0.731022	Mean dependent var	3.665291
Adjusted R-squared	0.706193	S.D. dependent var	0.145267
S.E. of regression	0.078740	Sum squared resid	0.403003
Durbin-Watson stat	0.933354		

Equation: LOG(TOTALMETALS__11) = C(16) + C(42)*LOG(PRICE)+
C(2)*LOG(PRICE_COAL__11) + C(3)*LOG(PRICE_ELECTR__11)
+ C(4)*LOG(WAGE_METAL__11) + C(5)*LOG(TOTDEM(-12))
+C(18)*LOG(PRICE_ORE__11)
Observations: 72

R-squared	0.819541	Mean dependent var	3.848786
Adjusted R-squared	0.802884	S.D. dependent var	0.137735
S.E. of regression	0.061151	Sum squared resid	0.243065
Durbin-Watson stat	1.275646		

Equation: LOG(TOTALMETALS__12) = C(17) + C(43)*LOG(PRICE)+
C(2)*LOG(PRICE_COAL__12) + C(3)*LOG(PRICE_ELECTR__12)
+ C(4)*LOG(WAGE_METAL__12) + C(5)*LOG(TOTDEM(-12))
+C(18)*LOG(PRICE_ORE__12)
Observations: 72

R-squared	0.454294	Mean dependent var	4.452689
Adjusted R-squared	0.403921	S.D. dependent var	0.831726
S.E. of regression	0.642143	Sum squared resid	26.80261
Durbin-Watson stat	1.004821		

Equation: LOG(TOTDEM_DOM) = C(19) + C(20)*LOG(PRICE__1) +
C(21)*LOG(UKR_GDPR)+ C(22)*LOG(UKR_GDPR)
*LOG(UKR_GDPR) +C(23)*LOG(TOTSUPPLY(-6)) +C(24)
*LOG(EXCH_RATE)+C(25)*LOG(CHI_METAL)
Observations: 78

R-squared	0.967786	Mean dependent var	6.459651
Adjusted R-squared	0.965064	S.D. dependent var	0.293342
S.E. of regression	0.054829	Sum squared resid	0.213443
Durbin-Watson stat	0.951997		

Equation: LOG(TOTDEM_IMP) = C(26) + C(27)*LOG(US_PRICEMET)
+ C(28)*LOG(US_PRICE_NF__1) + C(29)*LOG(US_GDPR) +
C(33)*LOG(TOTSUPPLY(-6))+C(31)*LOG(EXCH_RATE)
Observations: 78

R-squared	0.902848	Mean dependent var	7.472741
Adjusted R-squared	0.896102	S.D. dependent var	0.359145
S.E. of regression	0.115764	Sum squared resid	0.964895
Durbin-Watson stat	1.164323		

***Table 5.4*. Results of the estimation the enterprises specific supply elasticities with the employment OLS and SUR methods.**

Enterprise	Elasticity of Supply (OLS)	Elasticity of Supply (SUR)	Enterprise	Elasticity of Supply (OLS)	Elasticity of Supply (SUR)
Krivirozhstal	**0.352532*** **	**0.234490****	Petrovskogo Metal Plant	**0.419075*** **	**0.346124****
Illich Metal Plant	**0.425389*** **	**0.297769****	Yenakievskiy Metal Plant	**0.581495*** **	**0.570668****
Azovstal	**0.492673*** **	**0.290682****	Donetskiy Metal Plant	**0.098922***	**0.010052****
Zaporozhstal	**0.360631*** **	**0.293679****	Dneprospetstal	**0.216674*** **	**0.206218****
Alchevsk Metal Plant	**0.721668*** **	**0.574047****	Libnehta Metal Plant	**0.279845*** **	**0.221942****
Dzerzhinskogo Metal Plant	**0.329144*** **	**0.105023****	Fringe enterprise	**1.319912****	**2.003973****
Total		**0.445313****			

****-1% level of significance, **-5% level of significance,*-10% level of significance*

Wald Test for common coefficient

Wald Test: System: SYS1			
Null Hypothesis:	C(33)=C(35) C(34)=C(35)		
Chi-square	0.094903	Probability	0.953657

Wald Test: System: SYS1			
Null Hypothesis:	C(32)=C(42) C(41)=C(42)		
Chi-square	0.393083	Probability	0.821567

Wald Test: System: SYS1			
Null Hypothesis:	C(36)=C(39)		
Chi-square	0.007045	Probability	0.933110

Since some enterprises have approximately the same values of individual supply elasticities (Wald Test), we run the SUR regressions for these particular enterprises within the restricted system (separating the coefficient for supply elasticities); we have also put the common coefficient restriction within the restricted system and within the entire system. The results are represented in Table 5.5.

Table 5.5. **The common coefficient estimation for enterprise specific supply elasticity**

1) Illich= Azovstal = Zaporozhstal: c(33)=c(34)=c(35)		
Enterprise coefficient	Coefficient value	
C(33)=Illich	0.390424***	Individual coefficient
C(34)=Azovstal	0.384204***	Individual coefficient
C(35)=Zaporozhstal	0.385686***	Individual coefficient
c(33)=c(34)=c(35) within restricted system	0.352976***	Common coefficient
c(33)=c(34)=c(35) within entire system	0.306689***	Common coefficient
****-1% level of significance, **-5% level of significance,*-10% level of significance*		

2) Krivorozhstal=Dneprospetstal=Libnehta: C(32)= C(41)= C(42)		
Enterprise coefficient	Coefficient value	
C(32)=Krivorozhstal	0.290059***	Individual coefficient
C(41)=Dneprospetstal	0.265309***	Individual coefficient
C(42)=Libnehta	0.279439***	Individual coefficient
C(32)= C(41)= C(42) within restricted system	0.280614***	Common coefficient
C(32)= C(41)= C(42) within entire system	0.229957***	Common coefficient
****-1% level of significance, **-5% level of significance,*-10% level of significance*		

3) Alchevsk=Yenakievskiy: C(36)= C(39)		
Enterprise coefficient	Coefficient value	
C(36)= Alchevsk	0.642371***	Individual coefficient
C(39)= Yenakievskiy	0.638940***	Individual coefficient
c(36)=c(39) within restricted system	0.640464***	Common coefficient
c(36)=c(39) within entire system	0.571539***	Common coefficient
****-1% level of significance, **-5% level of significance,*-10% level of significance*		

Thus we can see that estimated common coefficient within the whole system is substantially lower than that estimated for the restricted system for enterprises with similar elasticities of supply. It can be explained by the fact that the upward bias of supply elasticity for the restricted system is captured by activity of other enterprises that substantially influences the supply dynamics.

APPENDIX 6

Table 6.1. **Changes in prices and quantities from subsidies elimination in "large" country**

	initial level of steel supply, metric ton, (Q1-s)	ad-valorem subsidy rate, (s)	initial level of price with subsidy for producers ($), (P2-ukr)	initial level of domestic price without subsidy for consumers ($), (P1-ukr)	domestic supply parameter constant, B	domestic demand with subsidy, c	domestic supply at P1-ukr, d
Jan 03	2 904	11.65%	283.48	253.56	215.37	471.74	2600.30
Feb 03	2 671	11.65%	281.01	251.35	198.90	470.40	2391.92
Mar 03	3 120	11.65%	281.34	251.64	232.20	464.40	2793.97
Apr 03	3 008	11.65%	282.51	252.69	223.44	447.64	2693.54
May 03	2 993	11.65%	281.57	251.85	222.67	439.87	2680.21
June 03	2 900	11.65%	283.76	253.81	214.98	439.69	2596.69
July 03	3 287	11.65%	281.23	251.55	244.67	433.48	2943.53
Aug 03	3 257	11.65%	280.82	251.18	242.61	429.06	2916.72
Sept 03	3 150	11.65%	287.60	257.25	232.06	421.16	2820.09
Oct 03	3 228	11.65%	297.10	265.74	234.27	398.12	2888.79
Nov 03	3 144	11.65%	290.61	259.94	230.51	307.84	2814.37
Dec 03	3 110	11.65%	297.87	266.43	225.43	304.21	2783.11
Jan 04	3 297	11.65%	302.25	270.35	237.38	322.50	2949.94
Feb 04	3 132	11.65%	305.85	273.57	224.27	414.45	2801.91

	domestic demand parameter constant, A	world steel free trade price ($), (P*)	level of steel supply w/o subsidy at Pw, (Q2-s)	domestic supply at Pw, (Q2-d)	import demand constant, C	import demand at price P1-ukr, Q1-exp	import demand at Pw, Q2-exp
Jan 03	9798.21	264.56	2650.45	440.78	7.63946E+21	2432.26	2209.67
Feb 03	9723.38	262.23	2437.99	439.57	6.46017E+21	2200.60	1998.41
Mar 03	9605.57	263.11	2850.56	433.44	7.86708E+21	2655.60	2417.12
Apr 03	9280.11	263.51	2744.84	418.40	7.83195E+21	2560.36	2326.44
May 03	9102.22	265.96	2746.78	408.27	7.61175E+21	2553.13	2338.51
June 03	9137.21	268.73	2664.29	407.49	7.78545E+21	2460.31	2256.80
July 03	8964.24	266.93	3023.20	401.27	8.42871E+21	2853.52	2621.93
Aug 03	8865.69	272.08	3023.55	392.66	8.25936E+21	2827.94	2630.89
Sept 03	8817.04	274.59	2904.10	388.52	9.57715E+21	2728.84	2515.58
Oct 03	8484.26	276.61	2941.38	372.34	1.2751E+22	2829.88	2569.05
Nov 03	6481.36	279.23	2906.54	282.95	1.07829E+22	2836.17	2623.59
Dec 03	6492.23	283.34	2861.24	281.13	1.28974E+22	2805.79	2580.11
Jan 04	6937.80	284.46	3018.26	299.77	1.52968E+22	2974.50	2718.49
Feb 04	8973.95	286.90	2862.54	385.91	1.53092E+22	2717.55	2476.63

***Table 6.2*. Welfare effect in "large" country from elimination of production subsidy**

	CONSUMER SURPLUS (Thousand $)	PRODUCER SURPLUS (Thousand $)	GOVERNMENT REVENUE (Thousand $)	TOTAL SURPLUS (Thousand $)	ROW WELFARE (Thousand $)	EFFICIENCY GAIN (Thousand $)
Jan 03	-2317.64	-60151.02	73635.06	11166.40	-19292.41	1572.47
Feb 03	-2287.43	-54896.69	67134.72	9950.61	-16380.86	1433.66
Mar 03	-2377.77	-61680.20	78512.90	14454.93	-20518.04	1676.64
Apr 03	-2164.26	-62689.39	76010.44	11156.80	-19048.20	1623.20
May 03	-2764.11	-47938.31	75379.25	24676.83	-22489.09	1609.72
June 03	-2918.54	-43916.46	73604.97	26769.97	-22449.30	1571.83
July 03	-2965.08	-46524.91	82683.92	33193.94	-26420.81	1765.71
Aug 03	-3965.75	-19973.35	81809.12	57870.02	-30371.82	1747.03
Sept 03	-3242.56	-38294.78	81033.37	39496.02	-27221.77	1730.46
Oct 03	-1934.90	-73084.98	85780.94	10761.07	-21486.37	1831.84
Nov 03	-2632.90	-30572.78	81724.39	48518.71	-30039.11	1745.22
Dec 03	-2286.12	-43862.77	82859.95	36711.06	-28138.28	1769.47
Jan 04	-2028.83	-61577.46	89132.96	25526.67	-27022.98	1903.43
Feb 04	-2464.81	-63445.47	85681.34	19771.06	-23872.74	1829.72
TOTAL	-36350.68	-708608.56	1114983.33	370024.09	-334751.79	23810.37
Average	-2596.48	-50614.90	79641.67	26430.29	-23910.84	1700.74

APPENDIX 7

Export tax introduction by the government

Table 7.1. **5% export tax introduction**

	export tax, t	PRODUCER SURPLUS	CONSUMER SURPLUS	GOVERNMENT REVENUE	TOTAL SURPLUS
Jan 03	5%	-51657.8	35881.826	27811.3186	12035.35
Feb 03	5%	-47056	21292.629	24903.5554	-859.811
Mar 03	5%	-56768.4	46608.577	30180.1466	20020.34
Apr 03	5%	-52916.6	43653.982	29219.4634	19956.89
May 03	5%	-62225.9	45641.414	29045.585	12461.12
June 03	5%	-62742.1	41386.372	28193.0123	6837.253
July 03	5%	-72408.4	62779.497	32475.6271	22846.73
Aug 03	5%	-89489.5	63974.544	32137.7781	6622.862
Sept 03	5%	-75961.8	60560.35	31754.429	16352.96
Oct 03	5%	-58121.4	70668.215	34053.5762	46600.39
Nov 03	5%	-82121.8	90466.906	33467.8966	41813.03
Dec 03	5%	-74450.6	90937.935	33936.8013	50424.13
Jan 04	5%	-70232.6	96847.674	36505.9229	63121
Feb 04	5%	-64597.2	63639.598	33633.7723	32676.13
TOTAL		-920750	834339.52	437318.885	350908.4
Average		-65767.9	59595.68	31237.0632	25064.88

Table 7.2. **10% export tax introduction**

	export tax, t	PRODUCER SURPLUS	CONSUMER SURPLUS	GOVERNMENT REVENUE	TOTAL SURPLUS
Jan 03	10%	-74230.5	37698.721	52504.182	15972.45
Feb 03	10%	-67635	23088.42	46978.0192	2431.453
Mar 03	10%	-80835.9	48383.621	57019.0997	24566.79
Apr 03	10%	-76218.7	45372.248	55203.9522	24357.47
May 03	10%	-85333.4	47324.12	54881.1019	16871.85
June 03	10%	-85305.4	43081.447	53256.7615	11032.82
July 03	10%	-97755	64435.782	61411.1901	28092
Aug 03	10%	-114568	65611.552	60772.7361	11816.18
Sept 03	10%	-100803	62206.096	60041.5603	21444.19
Oct 03	10%	-84418.4	72275.267	64423.2167	52280.11
Nov 03	10%	-107175	91682.439	63394.5195	47901.81
Dec 03	10%	-99850.4	92169.075	64283.2485	56601.96
Jan 04	10%	-97554.7	98171.971	69149.7594	69767.02
Feb 04	10%	-90859.9	65361.594	63600.1179	38101.79
TOTAL		-1262544	856862.35	826919.465	421237.9
Average		-90181.7	61204.454	59065.6761	30088.42

Table 7.3. **15% export tax introduction-optimal**

	export tax, t	PRODUCER SURPLUS	CONSUMER SURPLUS	GOVERNMENT REVENUE	TOTAL SURPLUS
Jan 03	15%	-94692	39402.393	74524.5652	19234.92
Feb 03	15%	-86289.9	24772.347	66628.5676	5111.033
Mar 03	15%	-102650	50047.828	80994.4775	28392.56
Apr 03	15%	-97338.2	46983.177	78416.0288	28060.97
May 03	15%	-106276	48901.663	77965.5727	20591.41
June 03	15%	-105755	44670.604	75638.9195	14554.68
July 03	15%	-120730	65988.803	87311.2078	32569.67
Aug 03	15%	-137301	67146.508	86404.0475	16249.8
Sept 03	15%	-123318	63749.005	85356.3484	25787.54
Oct 03	15%	-108252	73781.921	91634.0684	57163.95
Nov 03	15%	-129881	92822.018	90283.2051	53223.83
Dec 03	15%	-122876	93323.554	91548.5204	61996.21
Jan 04	15%	-122320	99413.675	98479.7633	75573.11
Feb 04	15%	-114669	66976.458	90421.0239	42728.4
TOTAL		-1572348	877979.96	1175606.32	481238.1
Average		-112311	62712.854	83971.8797	34374.15

Table 7.4. **17% export tax introduction**

	export tax, t	PRODUCER SURPLUS	CONSUMER SURPLUS	GOVERNMENT REVENUE	TOTAL SURPLUS
Jan 03	17%	-113316	41003.887	80104.5814	7792.411
Feb 03	17%	-103269	26355.255	71561.3995	-5352.54
Mar 03	17%	-122509	51612.558	87123.938	16227.67
Apr 03	17%	-116564	48497.692	84350.6464	16284.68
May 03	17%	-125343	50385.005	83874.1978	8916.347
June 03	17%	-124374	46164.97	81350.4406	3141.127
July 03	17%	-141643	67448.754	94003.123	19808.45
Aug 03	17%	-157993	68589.51	93026.9231	3623.072
Sept 03	17%	-143814	65199.66	91889.5931	13275.02
Oct 03	17%	-129951	75198.581	98699.7022	43947.36
Nov 03	17%	-150553	93893.483	97365.367	40705.88
Dec 03	17%	-143832	94408.734	98730.9002	49307.24
Jan 04	17%	-144866	100581.14	106205.234	61919.99
Feb 04	17%	-136340	68494.47	97349.0913	29503.53
TOTAL		-1854369	897833.7	1265635.14	309100.2
Average		-132455	64130.979	90402.5098	22078.59

Table 7.5. **20% export tax introduction**

	export tax, t	PRODUCER SURPLUS	CONSUMER SURPLUS	GOVERNMENT REVENUE	TOTAL SURPLUS
Jan 03	20%	-130337	42513.333	89565.4715	1741.323
Feb 03	20%	-118791	27847.523	79949.7404	-10993.7
Mar 03	20%	-140659	53087.384	97486.4611	9914.485
Apr 03	20%	-134135	49925.213	94383.5471	10173.37
May 03	20%	-142768	51782.997	93859.9792	2874.988
June 03	20%	-141388	47573.143	91013.234	-2801.46
July 03	20%	-160757	68824.773	105278.365	13346.47
Aug 03	20%	-176903	69949.401	104186.209	-2767.36
Sept 03	20%	-162548	66567.046	102900.972	6919.616
Oct 03	20%	-149779	76533.594	110586.449	37340.77
Nov 03	20%	-169446	94903.366	109225.175	34682.77
Dec 03	20%	-162989	95431.716	110757.21	43200.07
Jan 04	20%	-165470	101681.39	119142.845	55354.22
Feb 04	20%	-156148	69925.377	109022.585	22799.79
TOTAL		-2112119	916546.26	1417358.24	221785.4
Average		-150866	65467.59	101239.875	15841.81