Creating an Electro Galvanized Steel Price Index for Jiangsu Aucksun Metal CO., LTD.

A Major Qualifying Project Report:

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WORCESTER POLYTECHNIC INSTITUTE

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Degree of Bachelor of Science

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Abstract

The goal of this project was to establish a price index model for Aucksun's electro galvanized steel products so that the top management would be able to accurately account for the salesmen's contributions to Aucksun's profit. By indentifying and analyzing various key factors affecting the supply and demand of the electro galvanized steel, we were able to create a price index model using multiple linear regression analysis. Additionally, we suggested detailed procedures for implementing and improving this price index model.

Acknowledgements

Our team is grateful to our kind hosts, Jiangsu Aucksun Metal CO., LTD and Southeast University for equipping us with the necessary resources to complete our project. We would like to thank Aucksun's CEO, Mr. Kai Chen, for helping us define the specific details of our project. Furthermore we would like to thank, Hui Zhu, Huifei Tang, Pengcheng Xu, Peichao Li, Fuzhi Shuai for providing answers to our questions and for their hospitality.

Our team is indebted to Professor Amy Zeng of WPI and Professor Lindu Zhao of Southeast University for their guidance throughout our stay in China. Their feedback and influential suggestions helped transform our project.

Finally, we would like to thank the graduate students from the Institute of Systems Engineering at Southeast University for their guidance in selecting an appropriate model for our project. Moreover, we are grateful to Tao Li from Nanjing University for his assistance in writing a computer program to further build our model.

Authorship Page

The project team consists of two students from Worcester Polytechnic Institute (WPI) and three students from Southeast University (SEU). Two student groups worked together on the administration, production, and evaluation of the Electro Galvanized Steel Index. Specifically, Zhongwen Zhang and Dongai Wu from SEU wrote the Findings section together and Zhongwen Zhang was the main translator for the team. Zhenqing Pan of SEU did extensive research on the background of the company and reflected those findings in the Company Profile section as well as writing the Introduction section. Kevin Vayda of WPI was the main developer of the Methodology section, as well as helping to sum up all Zhongwen Zhang and Dongai Wu's findings in the Conclusion and Future Work sections. Bennie Jones of WPI helped with the Methodology, Conclusion and Findings section and was the main contributor to the Literature Review chapter. Each team member also contributed to numerous presentations held at Southeast University and Huazhong University of Science and Technology (HUST).

Table of Contents

List of Equations

List of Figures

List of Tables

Nomenclature

HUST - Huazhong University of Science and Technology
IT – Information Technology
LMEX – London Metal Exchange Index
ERP – Enterprise Resource Planning
ARCH – Autoregressive Conditional Heteroscedasticity
GARCH – Generalize ARCH
EWMA – Exponentially Weighted Moving Average
ANN – Artificial Neural Network
SPI – Stock Price Index
PPI – Purchase Price Index
CPI – Consumer Price Index
LGMI- Lange Steel Index
Myspic – Mysteel Price Indices of China

1. Introduction

1.1. Problem Statement

As a professional metal logistics service provider for IT industry, Aucksun has successfully set up its core competitiveness through a series of strategies such as the forward purchasing strategy. Among the factors leading Aucksun to success, salesmen's performance is the most important. So Aucksun should find a way to stimulate its salesmen in order to improve the company's performance. Due to the unique nature of Aucksun's product production and sales tactics, it is quite hard to estimate salesmen's performance. So therein lay the problem of how to fairly reward the salesmen by bonus.

1.2. Project Goals

The goal of this project is to build up a mechanism to fairly reward Aucksun's salesmen. Since the industry at Aucksun is very specific and unique, we can not just estimate salesmen's performance just on the revenue they make for the company. We should evaluate their performance based on the profit they create for the company. Thus, a price index is required to figure out the real value that the salesmen create for Aucksun.

1.3. Project Scope

The goal of this project is to build up a mechanism to fairly reward Aucksun's salesmen. To figure out the value they create for the company we should first try to understand how existing indices are created. During a preparation phase, the project team will accumulate basic information pertaining to creating an index and review related literature. After that, over the

course of seven weeks the project team will visit Aucksun to do further research in order to collect accurate data and try to indentify practical solution to this problem. Furthermore, feedback and progress will be evaluated.

1.4. Expected Results

According to the goal, we must figure out the price index so that we can fairly compensate Aucksun's salesmen based on the profit they create. Upon learning how some popular indexes such as LMEX are calculated, we will establish an index of our own in order to gauge the salesmen's value more accurately. In addition to this, we may establish some metrics to gauge the index after we get a better understanding of the entire mechanism.

2. Company Profile

2.1. Company Information

2.1.1. The City of Zhangjiagang

Zhangjiagang is a newly rising city located in Yangtze River Delta, named as the first-classed harbor Zhangjiagang Harbor. The area of the city is 999 square kilometers, and the population is 0.898 million, what's more, the city consists of 8 towns and a modern agricultural demonstration garden. Zhangjiagang's GDP in 2008 was 125 billion Yuan, fiscal revenue was 25.4 billion Yuan, local general budgetary receipt is 10.4 billion, the average income of urban residents is 24.25 thousand Yuan, and the average income of rural residents is 11.6 thousand Yuan. Zhangjiagang generally achieves the goals of scale economy, non-governmental economy and outward-looking economy, building its competitive status in metallurgy, electromechanical, chemistry, textile, grain-oil-food, construction. In 2008, Zhangjiagang's revenue of industry is reached 370 billion Yuan, with 6 companies in top 500 of the service industry all over the country, and 2 logistics companies in the top 100 of China's logistics industry. What's more, the city dealt with 1412 foreign projects creating 5.5 billion dollars, and there are 10 companies in the top 500 foreign countries in China.

Zhangjiagang has 65 over-10,000-ton berths creating a 130 million cargo handling capacity in 2008, being the first harbor of county level with over 100 million cargo handling capacity. The city is also the first one in the province to have e-ports and the first international hygiene harbor all over the country. Zhangjiagang's service industry develops rapidly these years, in 2008, it created 45.2 billion Yuan added value, reached 16.7 billion Yuan in total retail sales of consumer goods and with a 60.1 billion Yuan volume of business. Zhangjiagang has a superior investment environment, forming the new joint-development pattern of bonded zone, provincial economic

development zones, Yangtze metallurgical industrial park and a number of key industrial parks. Zhangjiagang has a strategic location and unique traffic conditions. The coastline of the Yangtze River reaches 64 kilometers. Yanjiang Highway, Xizhang Highway and 204 National Highway form a smooth and convenient traffic network in the city.

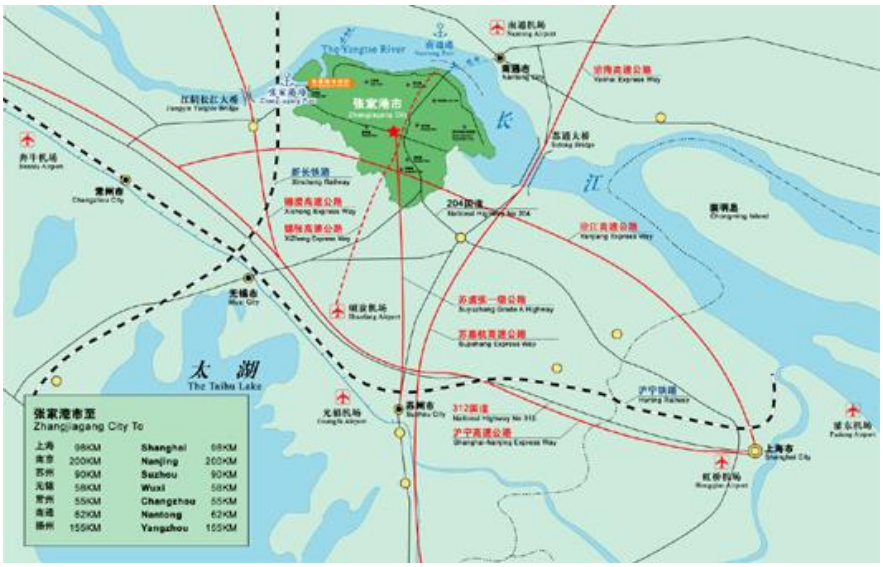

Figure 1: Zhangjiagang's Geographical Location

2.1.2. Aucksun Metal Co. Ltd.

Jiangsu Aucksun Metal CO., LTD is a foreign investment with registered capital of 60.8 million Yuan. In June 5, 2008, the company got public listed in Shenzhen Stock Exchange, with stock code 002245 and stock name Aoyangshunchang. Aucksun was a joint investment by Aoyang Group and Hong Kong Changzheng CO., LTD in September 30, 2002. The company is located in Yangtze River Delta, the most economically developed and dynamic region in China. And Zhangjiagang is one of the top 10 counties all over the country, sitting on two major coastal economic belts. Aucksun's total assets are worth about 800 million Yuan, and it covers an area of more than 96,000 square meters with a distribution and processing capacity of 120,000 ton steel sheets and 10,000 aluminum alloy sheets. The Organization chart is as follows:

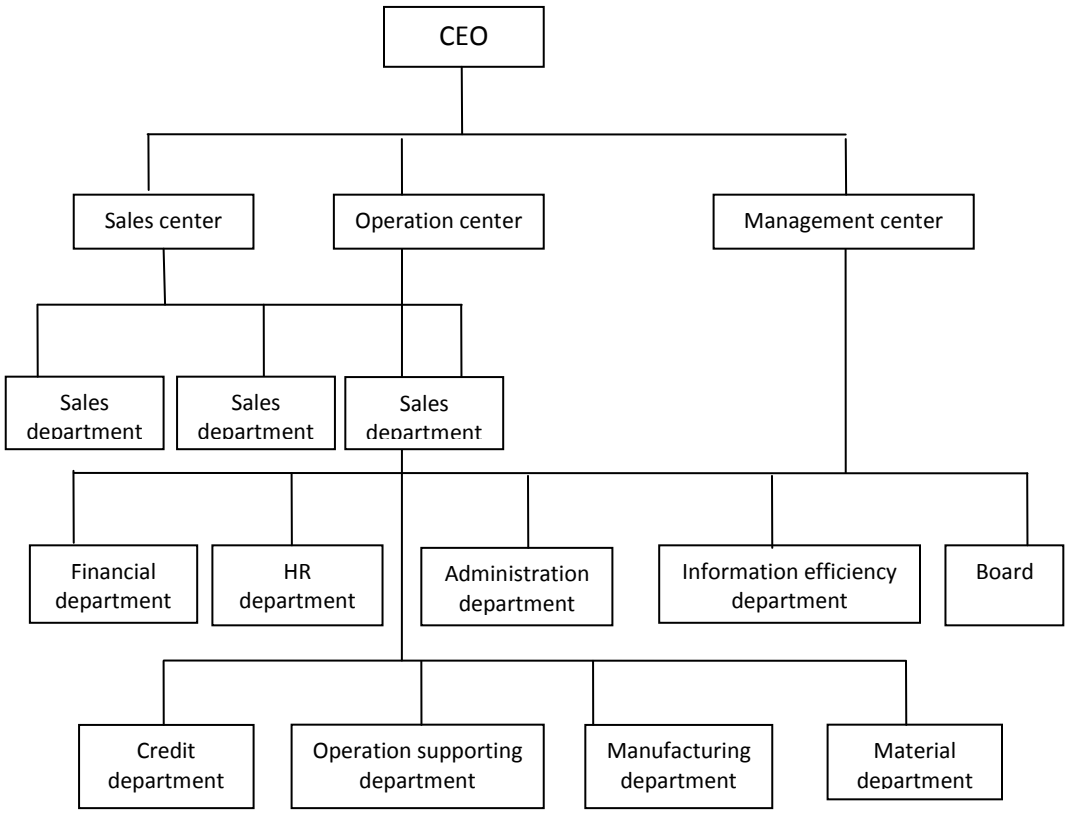

Figure 2: Organization Chart

2.2. Aucksun's Operations

2.2.1. Products

Aucksun's two main products are steel sheets and aluminum alloy sheets, focusing on steel sheets. The subsidiary company named Runsheng has provided cutting and distribution service since August, 2007, which is considered as extended service for similar customers. The steel sheets consist of galvanized fingerprint resistant sheets, general cold sheets and hot-rolled sheets. The galvanized fingerprint resistant sheets are the mainly needed metal material in IT industry and covered 88% of Aucksun's products in 2007. They are widely used in:

- Computer manufacturing industry, such as micro-computers, LCD monitors, copiers, printers, routers, PDAs, UPS(uninterruptible power supply) and other metal components in IT products
- Electronic consumer products industry, such as set-top boxes, scanners, LCD TVs, plasma TVs, and other metal components in IT products

Common cold and hot-rolled sheets can be used for IT manufacturing industry, white appliances and metal components for automotive manufacturing. To meet customers' increasing needs for IT products, IT manufacturers tend to choose these aluminum alloy sheets with characteristics of lighter, heat dissipates easily and good process ability**.** Compared to steel sheets, aluminum alloy sheets have higher demands for processing and distribution but higher profit. Though aluminum alloy sheets is now a smaller part for Aucksun compared to steel sheets, it is developing rapidly. Due to the factor of high cost, aluminum alloy sheets are now mainly used in top products in IT industry.

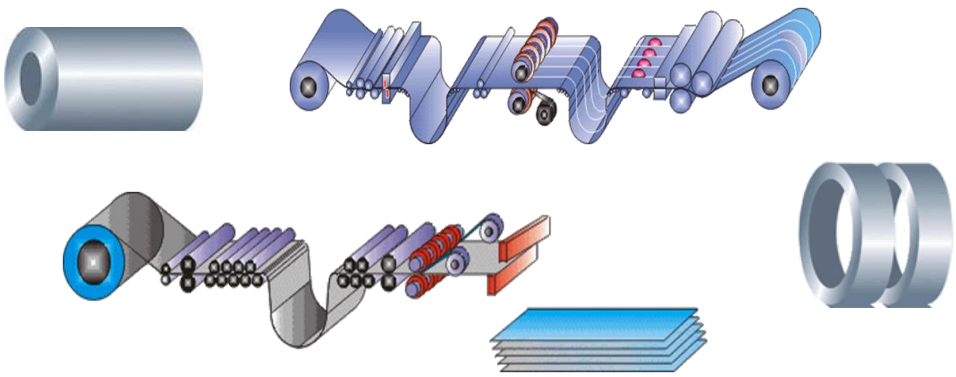

Figure 3: Aucksun's Products

2.2.2. Aucksun's Supply Chain

As the IT industry is a capital-and-technology-intensive industry, despite the research and development, companies have to focus on the control of cost and management risk. The prospective development of 3PL logistics companies in China makes it possible for IT companies to decrease their cost and outsource some of their business. Aucksun is a company that services the unique demands of the IT industry. It provides outsource services for the purchasing and processing links in IT companies and help its customers to cut cost and decrease deterioration.

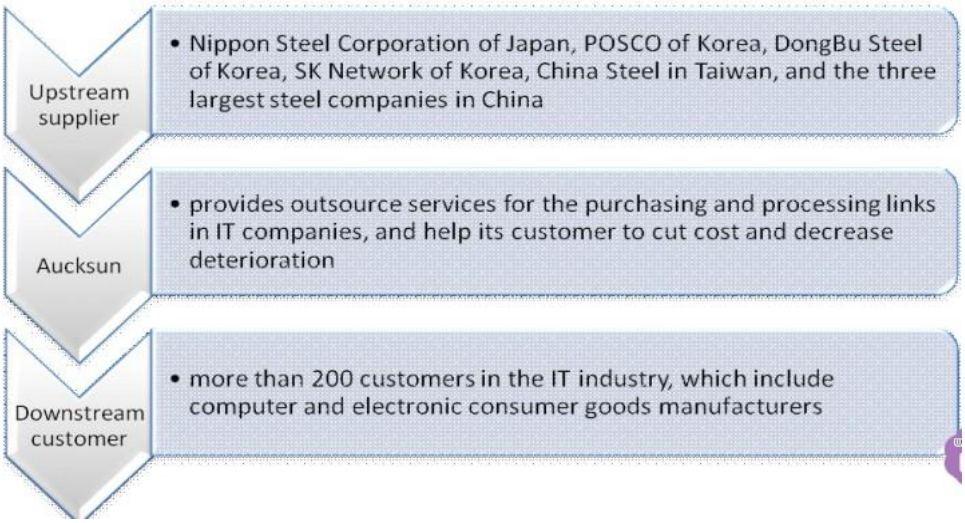

Figure 4: Supply Chain

2.2.3 Manufacturing Model

As Mr. Li, the manager of manufacturing department, said, Aucksun's manufacturing mode is quite simple. Aucksun processes and manufactures products in a make-to-order mode. The Operations Department takes the full responsibility to manage manufacturing, distribution, order picking, technical support, storage scheduling, and delivery scheduling.

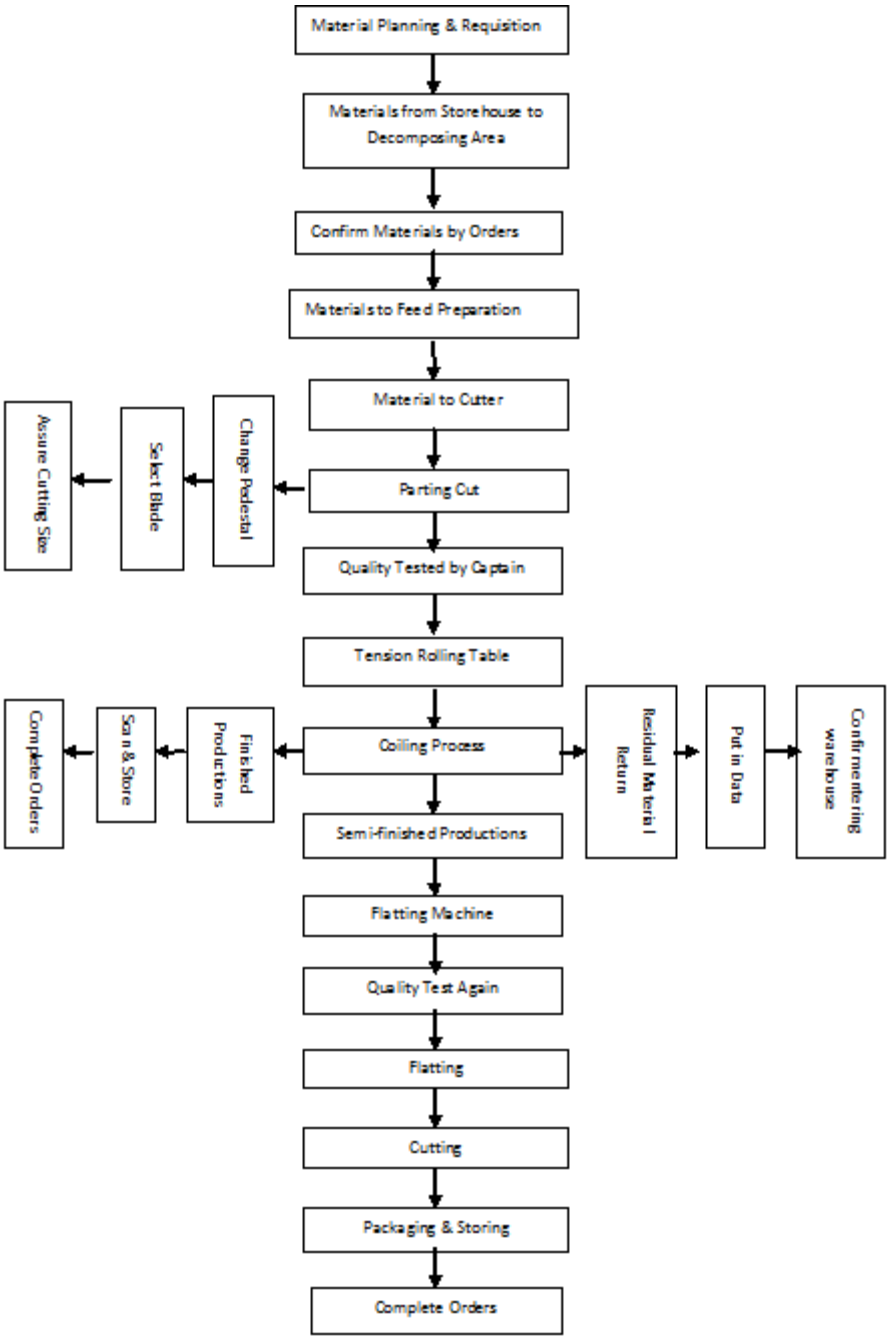

Figure 5: Manufacturing Flow

2.2.4. Operations Flow

Compared to normal companies, Aucksun's operations are a little bit different. Usually, customers place orders to the sales department, and the sales department transfers the orders to the procurement management center. Then raw materials are purchased and products are made to meet the demands. But for Aucksun, it usually has its inventory advanced for about 3 months. Figure 6 shows us how it works.

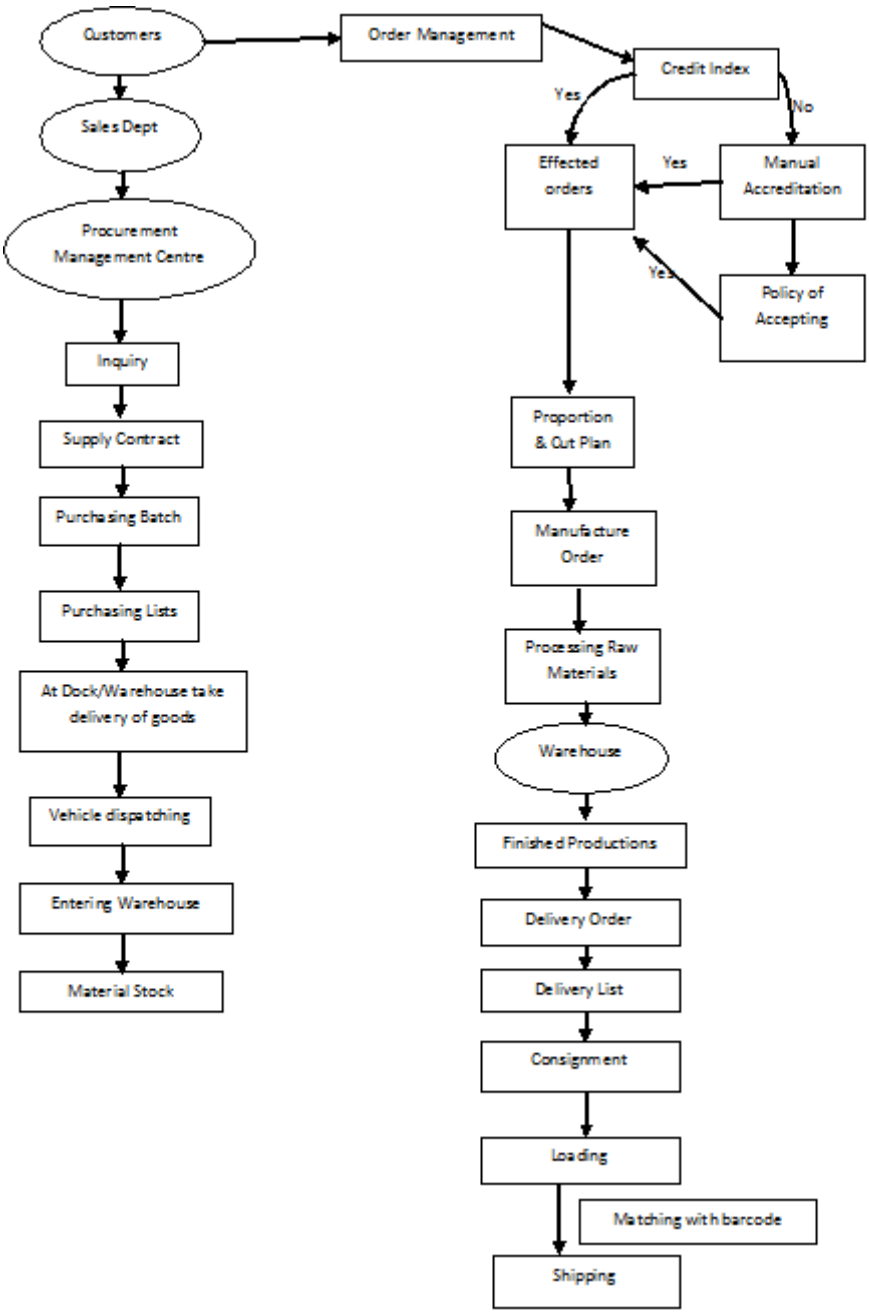

Figure 6: Operation Flow

2.2.5. ERP System

Aucksun has a self-invented ERP system, with which the company can operate harmoniously. The reason Aucksun don't use these famous ERP system is that they think its own system will fit its operations more due to its own specialty. This ERP system is composed of three main parts, execution part, management part and decision-making part. These three parts make sure Aucksun run smoothly.

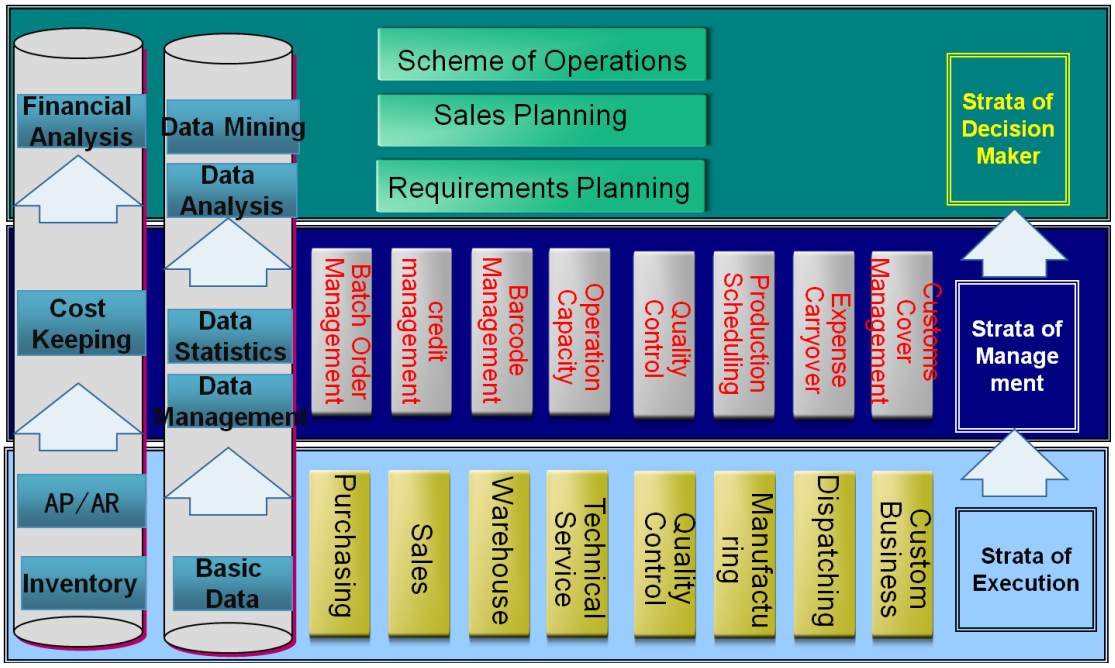

Figure 7: ERP System

2.3. Competition Circumstances

2.3.1. General Introduction

Presently, IT manufacturers in China are clustered in Yangtze River Delta, such as Shanghai, Jiangsu, Zhejiang, and Pearl River Delta cebtralized on Dongguan, Shenzhen and

Zhongshan. At the same time, the matched distribution companies are also in these areas. In fact, over 70% of the distribution amount in China is in these two deltas and highly centralized within these areas.

In Yangtze River Delta, IT industry of Jiangsu Province shows a great trend of development, attracting a large number of foreign IT capital investments. According to allchinadata.com and fpdisplay.com, the metal materials(steel sheets) consumed by IT manufacturers of Jiangsu Province cover 83.19% of Yangtze River Delta, equals to 36.59% of China(Data in 2006). Aucksun is a professional integrated logistics and distribution service provider, having the most kinds of distribution, most additional services and highest technology content. Thus Aucksun built its competitive status in the industry, with a 10.63% market share in Yangtze River Delta.

2.3.2. Main Competitors

Currently Aucksun is the bigest company in Yangtze River Delta providing cutting-processing and distribution service for IT metal materials. Its main competitors are the companies with certain scales in the industry. Due to the specilty of this industry, the competitors are all in the certain region. Nowadays there are three main competitors in the Yangtze River Delta: Suzhou Jijie Metal Co., Ltd, Wuxi Meifeng Metal Co., Ltd and Suzhou Nippon Metal Co., Ltd.

Jijie Metal Co., Ltd was invested by Taiwan Jijie steel Co., Ltd, using the steel sheets produced by Japan Nippon Co., Ltd and Taiwan China Steel Co., Ltd. Its service objectives are computer manufacturers (such as Asus) and LCD manufacturers (such as Auo).

Wuxi Meifeng Metal Co., Ltd

Wuxi Meifeng Metal Co., Ltd was invested by Japan Sumitomo Co., Ltd, Shanghai Sumitomo Co., Ltd and Taiwan Meisheng Co., Ltd, using the steel sheets produced by Japan Kobe Metal Co., Ltd. Its service objectives are LCD manufacturers(such as Sharp, Chimei)

Suzhou Nippon Metal Co., Ltd was invested by Japan Nippon Steel Co., Ltd, using the steel sheets produced by Japan Nippon Steel Co., Ltd. Its service objectives are copiers mabufacturers(such as Sharp).

2.3.3. Key Advantages

Scale advantage is the first advantage Aucksun has over its competitors. By the end of 2007, Aucksun's assets worth 421 million and its distribution amount reached 131,500 tons. Currently, Aucksun is No.1 whether on assets or distribution amount.. Due to its large assets and distribution capacity, Aucksun makes its customers depend more on it and decreases its operation cost.

Next, is customer advantage Aucksun has built a long term relationship with more than 200 customers in IT industry. Its products consist of desktop computers, laptops, LCD monitors, LCD TVs, servers and so on, selling to almost all over the world. It is not only benificial for decreasing the risk generated by passive need from single order, but also creates opportunities of touching high-end customers.

Another advantage Aucksun has is their technologic superiority. Aucksun has several teams working on metal logistics and research, they put the needed professional technology into the company's ERP system and maintain the data according to the market. Thus Aucksun connects its management and operations seamlessly and effectively reduces its operational risk, improves operational efficiency and provides better services for customers.

The next advantage is Aucksuns upstream channeling. Aucksun develops rapidly these years, and becoming a core custmoer of the famous steel corporations such as Donbu Steel Co., Ltd, Posco Steel Co., Ltd, SK Networks Co., Ltd, and the three lagest steel corporations in China. It is helpful for the company to keep its stable suppliers and improve company's reaction capability and competitiveness.

Finally, their competitive and highly respected Human Resources department is yet another Aucksun advantage. Compared to the companies in this industry, Aucksun has paid much attention to the cultivation of localization professionals. Through selecting and training a group of integrated talents who are good at both operations and manegement, Aucksun has built a mechanism for evaluation, motivation and constraint. At the same time, Aucksun has built a relationship of cooperation with Southeast University and other universities.

3. Literature Review

3.1 Introduction

Aucksun has a problem that, though little right now, could turn into a bigger problem later on down the road. As we have discussed, their upper level management would like a secure and consistent way of evaluating and rewarding their sales team accordingly. The only problem is that due to the unique nature of their product (Electro Galvanized Steel) it makes it borderline impossible to predict upcoming months sales. Aucksun's management team wants to reward their employees because they feel as if this keeps up moral and high sales, but without a prediction of profits it cannot. We were presented with the task of creating an index that would help estimate upcoming months in the electro galvanized steel industry. Therein was another problem. None of our team members had any idea or experience in creating indexes. That is where this literature review begins.

We decided to take a thematic approach to our organizational method for this literature review. We separated this section into three smaller centrally themed sections: Risk, Supply & Supply Contracts, and Price & Price Indices. Each section has numerous articles and studies that helped us further understand the process one must go through to create an accurate, easy-to-use steel index.

3.2 Risk Management

"What is Risk," by NO Author Cited

One may wonder, what exactly is risk? Risk is the likelihood that a small problem or hazard will turn into a severe problem. Different types of vulnerability and pity problems are not dangerous if they are small and taken solely by themselves, but if a company's vulnerability becomes too high and coincides with its hazards then they turn into risk, and risk can be dangerous to a company's survival. There is no need to worry yet though, because with any risk comes risk management making these risks manageable and able to be severely reduced. By reducing and managing risk, the probability that hazards will become disasters is minimized. In addition to this, managing risk helps promote sustainable development, which is the practice of long-term healthy living for all parties involved.

"Evaluation of the Risk Management Performance" by M.L. Carreno, O.D. Cardona and A.H. Barbat

The Risk Management Index explores different organizational actions and attributes with respect to risk levels. There are four policies that are explored which are "identification of risk, risk reduction, disaster management, and governance and financial protection." For risk to be analyzed, it must often be quantified. There are numerous models and software's to aid this effort.

"Quantify Risk to Manage Cost and Schedule" by Fred Raymond

Risk quantification may seem like an extraordinary task, but with current risk quantifying tools and software, this task is possible. These types of tools take a proactive approach for risk

management as they evaluate and recognize the impact of uncertainty and risk associated with schedule and cost projections. This information, if used properly, can certainly benefit any firm that may face uncertainty or risk.

3.3. Supply & Supply Contracts

"How Much You Know Versus How Well I Know You: Selecting for a Technically Innovative Component" by Glenn Hoetker

There are many different approaches to selecting the proper supplier for your firm. As stated before, diversifying your assets and raw materials is a great way to decrease balk, but there are other things one must take into consideration. Does the firm want an internal or external product process? What kind of transaction costs will be present? What type of capabilities have we obtained that other suppliers may or may not have? All very important questions that test the theory's of supplying you product with the actual logistical and tactical steps it takes to get from the raw materials to the end product. Uncertainty plays a huge role in this process because the more uncertain you are, the more drastic decisions will need to be taken to try to ensue and maintain a common equilibrium.

"Analysis of Supply Contracts with Total Minimum Commitment" by Yehuda Bassok and Ravian Anupind

In some supply contracts, there is a relationship used between the buyer and supplier which provide discounted pricing for a specific level of orders placed. This type of supply contract policy is helpful for the supplier when demand is uncertain because it guarantees a minimum order quantity, but it is also helpful for the buyer because it provides discounts. There

is a computational method for this policy which takes into account the minimum commitment (orders placed) by the buyer and it computes the discounted amount.

"Supply Contracts, Designing and Managing the Supply Chain" by NO Author Cited

Some supply contracts include the buy-back contract, revenue- sharing contract, quality-flexibility contract, and sales rebate contract. Buy-back is pretty self-explanatory: whatever the buyer cannot sell the seller agrees to buy it back at an already agreed-upon price. In a revenue-sharing contract the buyer shares its revenue with the seller so long as the seller provides a discount on the wholesale price. The buyer also transfers a portion of the revenue it sells to the customer back to the seller. Next, we have the quantity-flexibility contract. This contract is almost like the buy-back only instead of an already agreed upon buy-back price, the buyer would get fully refunded for product lost. Finally, we arrive at the sales rebate. The sales rebate deals completely and utterly with incentives. If the buyer increases their sales, by any means, then a rebate will be carried out by the supplier for said items sold. These contracts help to establish optimization within firms without the need for second-party decisions makers because the risk of selling and supplying is shared between the buyers and suppliers. Done right, contracts help to make sure every party comes out in the green.

"Selection of Contract Suppliers under Price and Demand Uncertainty in a Dynamic Market," by Shanling Li, Alper Murat, and Wanzhen Huang, European Journal of Operational Research, 2008

Shanling Li, Alper Murat, and Wanzhen Huang's "Selection of Contract Suppliers under Price and Demand Uncertainty in a Dynamic Market" examines different types of supply

contracts in situations where price and demand fluctuate significantly. Both long-term and short-term contracts are both analyzed with regard to different variables such as demand, price, inventory, and cancellation-fees. Different programming models were utilized in order to track these variables against the different types of contracts.

The results from the models in this article suggest that when demand volatility is significant, short-term contracts will benefit the buyers the most. When price volatility increases, long-term supply contracts are most beneficial to the buyer as long as variability in the amount purchased is allowed. If these long-term suppliers do not allow for variability in purchasing, total cost to the buyer is positively correlated with the specified purchasing amount. Furthermore, when both price and demand volatility are extremely high, long-term supply contracts are recommended, especially if there purchasing variability is allowed. On hand inventory throws another variable into the equation and complicates the models because it represents a possible risk as it represents a "state-space dimension."

"Supplier Performance", article in Howmet Castings, an Alcoa business packet, 2001

Ninety percent of Aucksun's aluminum supply comes from one supplier, with the other ten percent coming from random other sources, yet their steel supply comes from many different suppliers in many different countries. That got us to thinking that developing an index that evaluates our suppliers instead of the steal business may actually show why there are such irregularities in Aucksun's steel supply. When evaluating your suppliers your index can breakdown and dissect four different areas of interest: quality, delivery, service, and total cost.

Due to the quality of the product being so important it is probably best that it is weighted pretty heavily. This certain article weighs quality at 55 percent, but of course that number can be changed to fit our certain criteria's (anywhere's between 50 and 60 percent). Depending on the

volume of the orders two different approaches can be taken. Since Aucksun orders their steel in large quantities we will provide the formula for only one:

Next, there is the delivery section. Without the proper delivery system even the greatest product cannot be sold. That is why it is the second highest weighted part of measuring your supplier's price index (30-40 percent weighted). In this section you would develop a points system that if they meet or exceed their contracted delivery times then the number would stay the same (lets say 100 point scale), but if at any point they were to be late then it would subtract from it. The lower the number, the worse their delivery service is.

The final remaining weighted part would be the service (weighted anywhere from 5-15 percent depending on your other weighted averages). This is yet another self explanatory part: how well do Aucksun's people get along with the representatives of their suppliers. Just like the delivery section, this would be calculated through a point's scale which can be generated to fit Aucksun. If there is a solid relationship between both sides' representatives then numbers would be higher then if there were some hostilities.

Once these are all calculated Aucksun can decide the performance level they deem acceptable and if their supplier does not meet that standard it might be time to start looking around at different suppliers. Normally anything above 93percent should be given consideration. Then again there are still other factors to take into account. Just because one company scores higher then the other does not mean they are the best fit. You need to take into consideration one of, if not the most, important aspect of contracting to suppliers: the total cost you will enquire. By taking all these factors and calculations into account could make it easier for Aucksun's people to decide if their current suppliers suffice or if they should look otherwise. If they decided to stay then further indexes would need to be put into effect to further dissect why the market is

so unstable, but if a change were to be made then it's possible the price of steel remains the same, and Aucksun could continue to provide concrete bonuses for their sales department.

3.4. Price & Price Indices

"Duration and Characteristics of Metal Price Cycles" by Mark C. Roberts, Elsevier, 2009

Mark Roberts' "Duration and Characteristics of Metal Price Cycles" disagrees with the notion that metal price fluctuations can be characterized as "cycles". However, Roberts does suggest that metal prices do go through phases of "contractions" and "expansions." "Contractions" in prices tend to be longer than "expansions" in prices; and the volatility of these phases are generally similar in magnitude. Therefore, neither an expansion nor a contraction really experiences a greater degree of price change. Many of the tests that were run on the price data sets to confirm the theory that metal price characteristics and cycles exist did not confirm this theory. Although the magnitude of price changes can not be successfully predicted, the length of full phases is not haphazard. Furthermore, metal prices in this article cannot be described as "predictable" because they were shown as only a "probability distribution".

"Creating a Purchased Price Index as a Key Performance Indicator" by Robi Bendorf, C.P.M., Bendorf & Associates, May, 2007.

Creating a Price Index can help a company either prove or disprove if their organization is operating at the highest possible level it can. You need to first start by separating your index into the specific categories you feel may either be optimized or need improvement. In the case of Aucksun these categories would be products 005-006. You then need to start your data from a

base date, for accuracy sake we will start when the current partnership and layout of the company was established, which was in 2004. In the grand scheme of things you will place all your information into the Microsoft Excel (or similar) software and let the computer do the work for you, but establishing what information to use and where to place it is the main problem and task at hand. The base period will always start at 100 (standing for 100 percent) so if there is a problem within your product based on whatever underlying factors, it will either be above or below that original base value.

Of course just obtaining these numbers would not suffice, one needs to know what the numbers mean and how to alter your process accordingly so that better stats are achieved. If the numbers are above 100 percent there could be several underlying circumstances as to why this has happened. The most basic would be that your organization is not working as well or as efficient as they could be, or have been. Then again, in a decreasing economy these numbers could actually mean quite the opposite. If the price ratio of steel had risen by more in the general public versus from our suppliers then the data would tell us that our Supply Management was actually doing better then market value and Aucksun should keep its procedures going the way they are. It all depends on what the industry as a whole is doing. In Aucksun's case, the supply and sales of steel internationally has fluctuated so much that there is nothing to compare it to. That is where and why this index needs to be put in place.

Below is an ideal step-by-step process a corporation *could* take to create a Price Index:

1. From your annual spend profile determine the major spend categories and the percent of the total annual spend represented by each category. Most organizations would use the top 80% of the spend representing repetitive spends.
2. Select a specific part or service to represent the Category

3. Select the starting date, or “Base Date”, for your Index. To gain a historical perspective you might want to establish the base date to be at some point in the past.
4. Select the unit price on the base date for each item selected in step 2.
5. For each of the categories, select the most appropriate Producer Price Index available given to you (hopefully) by a national data collector or other source within the market segment. You will be comparing your index to theirs to pick an up to date, accurate model to use.
6. Determine and record the vale of the Index on the staring base date. You now have all the data you need to be loaded into your Excel spreadsheet. This means you can begin you PPI for the base period.
7. To apply the formulas noted below, you will need to obtain the price and index for each category for each subsequent period to be measured (monthly). Since the index starts at 100 it is simple to see the percentage change between each period and the base period.

“Forecasting the Volatility of Stock Price Index,” Tae Hyup Roh, Department of Business, Management Information Systems, Seoul Women’s University

Tae Hyup Roh’s “Forecasting the Volatility of Stock Price Index” discusses the challenges Korea had to go through whilst trying to estimate the upcoming stock price indexes. With the increasing volatility of the market, yet no real way to guess what was to come, economists and risk managers needed a way to properly calculate the KOSPI 200 (Korea Composite Stock Price Index 200) market. By taking many different aspects of the market, their data, as well as past experiences, managers have developed many different models, programs, and indexes that have come very close to estimating true future values. We could not help but

think about the problems Aucksun faces with the steel industry and its volatility. There are many different solutions that we could investigate to solve said problems. For instance the ARCH (Autoregressive Conditional Heteroscedasticity) model, the GARCH (Generalized ARCH) model, and EWMA (Exponentially Weighted Moving Average) model are some to name a few. Though, in several different instances these techniques have fallen short. A newer, upcoming model may prove to be the solution to Aucksun's problem. The Artificial Neural Network (ANN) model has been applied to many different markets. Instead of following a certain parametric system, it actually adapts its future forecasts by learning the past market patterns. It uses a repetitive trial-and-error based approach to help pinpoint key, underlying, determining factors which, when changed, help optimize the solutions. But what if you do not have the time needed to conduct all these trials? That is where new propositions came into account. What if you could take the best of every model and create one giant, hybrid index that could do and solve all your volatile needs? Sounds perfect, but is it possible?

By dissecting GARCH one understands that its main concern is to deal with conditional volatility rather than ANNs' flexible volatility. With the steel industry being seemingly flexible in its volatility, applying GARCH seemed unreasonable, until another approach was taken. First, you put your information through the GARCH model and obtain traditional answers. Then, take those numbers and run them through the ANN model, which we now know should take all other non-traditional conditions into effect, run them through a few trials, and produce an output that would hopefully satisfy our needs.

To start the technique a proper base of data and already existing indexes should be readily available. The higher the counts the better, but in our case data and indexes may be limited so coping with what we have may be a necessity. Also, there are a few tests that need to

be conducted to try and figure out if the dataset we decide fits is stable enough to actually create and use an index. Even still the hybrid ANN-GARCH model may not fit our exact needs so another test needs to be conducted to verify the models ability to properly forecast the steel industry. Many equations and computations need to be taken into account.

The probability that this model could help fix Aucksun's problem looks promising. Though, a lot of busy work and calculations must be done first. It has been proven that this approach helps extract new variables within a dataset while reducing volatility, but can it really solve the problem at hand? Applied correctly and through further investigation, this approach may be able to help create the desired index/indexes needed to solve Aucksun's steel problem.

CRU Steel Price Index, retrieved on 26 June 2009 from: CRUonline.crugroup.com

The CRU Steel Price Index is a "leading indicator of steel price trends." There are eight indices are weighted and compiled to form the "CRUspi" indices. On the CRU website there is a "Market Analysis" page in which the monitors listed above can be examined. The analysis of these monitors also provides historical and statistical data on steel indices, along with written analysis by CRU's full-time steel analysts with respect to market fundamentals and other important aspects. There is a new CRUspi "Futures" service at www.crumonitor.com which examines, in detail, forecasts for the steel indices for the future 18-24 months.

This company has two different methodologies for setting a steel price index and forecasting future prices. The first methodology begins when the steel analysts at CRU contact data providers via telephone and data providers submit a single price which represents the average ordering price over a given period of time. The analysts will then attribute a specific weight to the price given by the data providers. This results in the final price.

The second methodology pertains to types of steel that are being vastly used in many types of contracts. This methodology begins by having the data providers sign an agreement which allows the steel analysts to verify the given data. Price and volume data are sent to the analysts electronically; and no weight is attached. This results in the final price.

"The LME Metals Index – LMEX," by NO Author Cited

Nicknamed the "flat index", the LMEX stands for the London Metal Exchange index that predicts future prices of six different metals by examining the changes in their past prices. Data was collected from early July 1984 to late July 1999. During this time the prices for three maturities were examined for consecutive 1, 2, and 3-month prices.

Weighting plays a huge part in the way the LMEX works due to the fact that most of the data used to create it was collected 10-20 years ago. Every July 1st new weights are given to each metal to help ensure the accuracy of each prediction.

On top of LMEX's flat index there is also the Roll Index (Rlt) and the Total Return Index (TRlt). The Roll Index also uses the data collected decades ago, the only difference is that it takes a multiplicative constant (MCt) and multiplies it by the flat index rate (It). The equation looks like this:

$$Rlt = MCt * It$$

The Total Return Index (TRlt) uses Rlt in its equation. After the Roll Index is calculated it is multiplied by the bank account index (BAlt) given at the beginning of each year. This index helps to calculate an accurate price of the metals based on the increasing interest rates each year. The equation looks like this:

$$TRlt = BAlt * Rlt$$

This approach may change from company to company because of the different bank account index each corporation uses so each TRlt will be different, but each shows the designated estimations of the product at hand.

"Statistics Canada, Your Guide to the Consumer Price Index, Catalogue No. 62-557-XPB, 1996" by Louis Marc Ducharme, Margaret Parlor & Joanne Moreau, with previous help from Harold Harnarine

This article investigated the Consumer Price Index for the country of Canada from the fiscal year May 1995 to May 1996. The Consumer Price Index (or CPI) is the "measure of the rate of price change for goods and services bought by Canadian consumers". It helps individuals understand the value of their money and helps them to understand the purchasing power that is associated with that money. It was created with respect to a "typical" Canadian family consisting of a father, mother and three children. The first version of the CPI was created in the early 1900's and took into effect 29 food items, fuel and lighting prices, as well as your everyday consumer expenditures.

Inflation and deflation help power the CPI. It is a well known fact that when prices increase the purchasing power of the dollar decreases and vice versa. The CPI helps to back that theory up and inform everyday consumers of these changes. Even more, the CPI is a compilation of many different indices, all of which help consumers evaluate their financial situation. The table below will help better clarify the underlying indices.

Index	**Definition**
Industrial Product Price Index	Measures the changes in prices received by Canadian manufacturers for goods as soon as they leave the factories.
Raw Materials Price Index	Prices changes for the purchase of raw materials by different Canadian industry's
New Housing	Change over time of the selling prices of new homes

Price Index	
Machinery and Equipment Price Index	Change in price for the investment in machinery and equipment different industry's take
Non-residential Building Construction Price Index	Measures selling prices of non-residential institutions (i.e. factories, warehouses, etc.)
Farm Input Price Index	Change in price of goods and services purchased by farmers in the process of farming
Farm Product Price Index	Change through time prices received for agricultural commodities
Price Index of the National Accounts	Price change of goods and services that make up the Gross Domestic Product (GDP)

Table 1: Existing Indices within CPI

Nothing is held from the calculation of the CPI; there are no biases. Just because the typical American may not live lavishly, buying different commodities and "fun" items such as Jet Ski's and luxury vehicles. Just because some people do not purchase these items, some do, therefore they must be accounted for. That is one of the great aspects of CPI. Whereas other indices only measure certain products or aspects of an industry, CPI does it all. This was a very admirable quality we came across.

3.5. Conclusion

After reading many articles and discussing amongst ourselves what the future holds we have concluded that this is a fairly difficult task. Creating an index is not something you can just understand and do in minutes. It takes some serious brainwork and determination, both of which we all have. Though the task seems impractical we are staying very optimistic and hope to create something Aucksun can use for years and years.

4. Methodology

In order to create a price index for Aucksun's two products (p005 and p006), which utilize internationally purchased and sold electro galvanized steel, four main objectives needed to be satisfied. These objectives are outlined below:

1. Identify the problem.
2. Understand how other indices are created.
3. Develop and implement an index for the current problem.
4. Evaluate the implemented index.

Each of these objectives was achieved by performing a series of methods. The methods that were utilized are explored below, in correspondence with their objectives.

4.1. Identifying the Problem

4.1.1. Examining Risks

In order to identify the problem, our group first examined Aucksun's most prominent risks (inventory, supply, price, and customer segmentation). The examination of these risks gave our group a starting point. Our team researched these four areas for risk in order to figure out which one we should focus on. Our researched showed us that Aucksun's current customer base is plentiful, and business has been extremely well over the past few years; thus we were able to eliminate customer segmentation. Also, we realized that a recent study of Aucksun examines the risk associated with inventory, so we eliminated this risk as well. Lastly, as we were left to examine supply risk and price risk, a meeting was arranged with management.

4.1.2. Management Communication

Communication with management about identifying the problem was our second method. The meeting we had with management really helped to identify the problem because they were able to expose underlying risks associated with supply and price. It was during this meeting that management explained the troubles they have with properly compensating their employees, due primarily to fluctuating steel prices. Management then proposed that we try to create some sort of pricing index or model that would help represent the upcoming month's steel prices. Thus, our problem was identified.

4.2. Understanding How Indices Are Created

The only method of objective two was to find some existing indices and study their relation to the index we wanted to create. We discussed in earlier sections the different indices we investigated, but we did not clearly discuss how they could be relevant. This method let us sit down and really think about how the articles and indices we studied could help. By doing this we hoped to understand how they were all created and possibly take different aspect of their process to create our own index.

The LMEX is an index created to help corporations estimate and evaluate what the future prices of aluminum, copper, nickel, zinc, tin and lead will be. Though our main concern is the steel industry, we felt as if studying this index may help us in creating our own steel index. The different factors, calculations, risks, and problems that arise/arose from this index could potentially help our group construct our own index.

Another name for the LMEX is the flat index. Put quite simply, this means that when calculating the prices of the aforesaid metals they assume that a linear relationship is achieved.

LME also has a 3 month moving average that Aucksun has implemented within its company to keep the prices of their products consistent and accurate. There is a constants equation that is given to each metal:

Equation 1: $P_i = P1_i + P2_i + P3_i$

This is the future sales price for whichever specified metal "i" over the ensuing 1, 2 and 3 month period (that 3 month moving average). LME then uses the constant Pi to apply this equation:

Equation 2: $LMEX = C_0 \sum_i w_i \times P_i$

LMEX is calculated with the respect that C_0 is chosen so that normalization is reached. What is normalization? This means that for the said date of January 4, 1999 that a value of 1000 was achieved so we assume that to be "normalized" and calculate C_0 accordingly. This means that LME's estimates are normalized by applying certain weights to each metal with respect and compliance to an overall optimal and liquid solution. These weights were given to the metals at the beginning of the first business day in July and then revamped each September 18 to ensure accuracy. The weighted averages for years previous to 2000 are given below as a demonstration:

Year	Aluminum	Copper	Nickel	Zinc	Tin	Lead	TOTAL
1984	35.5	33.9	1.6	14.5	0.0	14.5	100
1985	35.6	32.2	1.6	15.3	0.0	15.3	100
1986	37.9	32.8	1.7	13.8	0.0	13.8	100

1987	36.9	33.4	1.7	14.0	0.0	14.0	100
1988	37.5	34.0	1.7	14.3	0.0	12.5	100
1989	39.0	33.9	1.6	13.6	0.0	11.9	100
1989	38.6	33.6	1.6	13.4	1.0	11.8	100
1990	38.6	35.3	1.6	13.4	1.0	10.1	100
1991	38.6	35.3	1.6	13.4	1.0	10.1	100
1992	38.6	35.3	1.6	13.4	1.0	10.1	100
1993	40.3	33.6	1.6	15.1	1.0	8.4	100
1994	39.6	34.6	1.6	14.9	1.0	8.3	100
1995	39.6	34.6	1.6	14.9	1.0	8.3	100
1996	39.5	34.5	2.0	14.8	1.0	8.2	100
1997	39.5	34.5	2.0	14.8	1.0	8.2	100
1998	40.1	33.4	2.0	15.1	1.0	8.4	100
1999	41.8	33.4	2.0	13.4	1.0	8.4	100

*(Table from CITATION: "The LME Metals Index – LMEX," by NO Author Cited)

Table 2: LMEX Volume Weights

As you can see the total volume of metals never exceeds 100 percent, but like we stated, more calculations must be made to ensure accuracy. When the September numbers come in equation 1 change to:

Equation 3: $C_0 old \sum_i w_i\ old \times P_i = C_0 new \sum_i w_i\ new \times Pi$ = first day of July

Now, for the entire year we take the old estimate, and the new, revised estimate and that will hopefully calculate the LMEX at the beginning of each fiscal year which starts on the first day in July.

LMEX is only one of the many metal indexes that exist out there in the world. Aucksun actually uses many others to help estimate the prices of their other products, but no such index exists for galvanized steel. Creating an index that consists of an array of equations that would then be placed into Excel so that an optimal solution can be achieved sounds about as hard and confusing as it is. Our group needed to find an index that may closely resemble what we wanted to create and model our index after it. This proved to be a challenge as well.

When you are dealing with nice, linear or exponentially sound data points it is extremely easy to estimate and determine what future sales may be. When you are dealing with fluctuating prices and data it makes it quite a bit more difficult. We have already discussed how LME created their index and calculates their prices, and yes, some of those techniques can be applied to what we want to accomplish, but some of it cannot due to the unique nature of our product and industry. Other indices were then researched.

The next index we examined was CRU Steel Price Index. They are the leading indicator of the steel price trends which seemed perfect for what we needed. It is a compilation of eight different indices which together form the CRUspi. This CRUspi takes many factors into place to help predict future steel prices of up to two years in advance. Data providers call in and report the selling prices of steel over a given period of time and CRU takes the average of all the entrants and places that number into the index. They also make contracts with certain contractors agreeing to let CRU's analysts do further investigations of the submitted data. This helps to ensure the accuracy of the final price.

We really liked how the CRUspi was created. It had actually dealers calling in prices and delivering up-to-date information and data, but therein lays the problem. Aucksun only supplied us with six months of their galvanized steel data, so trying to develop an index off this model did not seem plausible. More indices needed to be researched.

The next index we investigated was the Purchased Price Index (PPI). PPI creators started with a "base number" (usually 100 standing for 100 percent). They then decide what product, department, or factor they wanted to evaluate. Placing the past sales into an Excel-like spreadsheet, the numbers are crunched and an appropriate PPI is established. Sounded easy, but the problem with this is that the information that is placed into the spreadsheet are nationwide

data points and highly accessible, both of which we did not have because suppliers do not disclose that information.

Lastly, we investigated the Stock Price Index which seemed to be the most applicable. Though our product is steel and not stock prices, the stock market is a very volatile industry whose prices can change for the better or worse in mere minutes. The article discussed many different indices that exist in the stock market, but how none of them worked as efficiently as needed. Exactly what we needed; there are many different indices that exist for the steel industry, but no one can predict galvanized and electro galvanized steel because of its uniqueness. The author then proposes to create a hybrid index that consists of many different known indexes.

That was the solution. We needed to create a hybrid index that consisted of the many different aspects of existing indices that we liked. If we could figure out a way to combined different qualities of the already existing indices our problem may be solved.

In understanding how these indices were created and how they function, we were given the insight to be able to go onto our next objective: actually creating and implementing our model.

4.3. Developing and Implementing a Price Index for Electro Galvanized Steel

4.3.1. Risk Factors Influencing Index

The first method that was used in order to develop and implement an Index for electro galvanized steel was to study some risk factors that may influence the Index. In order to identify these major risk factors, we re-examined the entire supply chain and manufacturing process of Aucksun. We noticed that the risk factors could exist in three general transition points of

Aucksun's operation. These three transition points are (1) Upstream Supplier, (2) Process (manufacturing), and (3) Downstream Consumer.

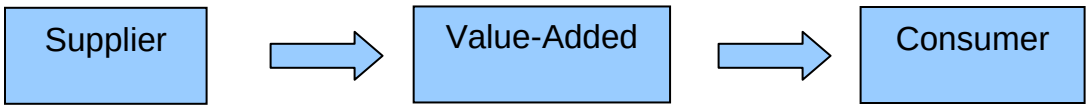

Figure 8: Transportation Points

An examination of the risk factors associated with the upstream supplier revealed that the price and availability of the raw material, Ironstone, could directly influence our price index for electro galvanized steel. Furthermore, we took into account the current prices of steel, which was given to us directly from Aucksun.

During Aucksun's electro galvanization process, an electric current is used to bind a layer of zinc to the sheet of steel in order to prevent against corrosion. One of the largest inputs for Aucksun's electro galvanization process is coal. Therefore, we identified the price of zinc and the price of coal, to be the two main risk factors for the value-added process of electro galvanization. The rest of the electro galvanization process, along with the process of cutting the steel into the specified dimensions, do not seem to have much more risk because many of the remaining inputs such as electricity costs are for the most part fairly constant and predictable.

As for the final transition point, the downstream consumer, we were able to identify several areas of potential risk. Simple economics tells us that if supply remains constant, the price for Aucksun's finished products and the price for the needed raw materials can increase as consumer demand increased. On the contrary, if this consumer demand decreases, the prices for these finished products and raw materials will also likely decrease. Therefore, we evaluated

specific indices which gave our team indications of the level of consumer demand. These indices are: The Enterpriser Confidence Index, The National Consumption Index, and the Business Climate Index for the IT Industry.

The Enterprise Confidence Index examines current government policies and the state of the economy. This index quantifies the economic confidence and places a specific value on a scale from zero to two hundred. If the value is less than or equal to 100, the confidence is thought to be optimistic. Anything less than 100 is the opposite.

The National Consumption Index is a hybrid which examines the consumption of specific types of IT products at the national level. The reason this is a hybrid index is because it is composed of two separate variables, each of which examines the price and consumption of specific types of IT products. The first variable, which we will denote as "k1" represents the national consumption of IT products and services specifically tailored to education and entertainment. The second variable, which we will denote as "k2" represents the national consumption of IT products and services specifically tailored to home appliances. Both of these variables are weighted and factored together to compose the National Consumption Index.

The Business Climate Index provides an measurement of the performance for the IT industry. We used this index in a similar way that we used the National Consumption Index as it provided us with a broader overview of the activity in the IT industry.

4.3.2. What Data Is Needed?

The second method that was used in order to achieve this objective was to determine what data would need to be collected. The identification of the risk factors in method one helped our team determine the specific data that would need to be collected.

First, our team spoke with management at Aucksun in order to see what information we could gather from them. We were interested in seeing the prices of steel in the past, and they were able to provide us with prices for the months of January to May of 2009. Therefore, we sought out information for the same months with regard to the risk factors identified in method one.

Aside from the prices of Iron for the five identified months, our group determined that we wanted to collect data for the Enterpriser Confidence Index, the National Consumption Index, the Business Climate Index for the IT industry, the Index of Ironstone, the Index of Coal, and the Index of Zinc, for the same respective months of 2009.

4.3.3. Data Collection

Once the necessary data was identified, our group performed third method of this objective which was to collect the data identified in method two. The tables below represent the numerical data which was collected with respect to each particular index (please note that the National Consumption Index is a hybrid index which is composed of two separate indices identified as "k1" and "k2"):

K1:

Month	2009.1	2009.2	2009.3	2009.4	2009.5
Index	100.3	98.9	99.3	99	99.2

Table 3: National Consumption Index (1)

K2:

Month	2009.1	2009.2	2009.3	2009.4	2009.5

Index	102.6	102.1	101.5	100.9	100.5

Table 4: National Consumption Index (2)

Month	2009.1	2009.2	2009.3	2009.4	2009.5
Index	101.65	100.78	100.59	100.12	99.96

Table 5: Composed National Consumption Index

Month	2009.1	2009.2	2009.3	2009.4	2009.5
Price (Dollar)	742	680	643	570	570

Table 6: Price for Electro Galvanized Steel

Month	2009.1	2009.2	2009.3	2009.4	2009.5
Index	94.44	94.01	94.48	95.28	95.4

Table 7: Enterpriser Confidence Index

Month	2009.1	2009.2	2009.3	2009.4	2009.5
Index	86.9	86.7	85.9	86.5	87.1

Table 8: Business Climate Index for IT Industry

Month	2009.1	2009.2	2009.3	2009.4	2009.5
Price (RMB/Ton)	660	550.3	465.2	417.6	416.5

Table 9: Index of Ironstone:

Month	2009.1	2009.2	2009.3	2009.4	2009.5
Price (RMB/Ton)	122.7	118.8	113.9	108.7	105.5

Table 10: Index of Coal

4.3.4. Using Microsoft Excel

The fourth method that was used in order to develop and implement an Index for electro galvanized steel was to utilize Microsoft Excel to develop correlation coefficients for the k1 and k2 which comprise the National Consumption Index, later denoted as x3. The reason our team used Microsoft Excel in order to do this is because we were very familiar with the program, and there exists a function that makes our particular task very easy. This function is the "CORREL" function and it is used to "return the correlation coefficient of the array1 and array2 cell ranges. Use the correlation coefficient to determine the relationship between two properties"[1]. In our particular situation, we have five months data for array1 and array2, which are represented as (k1, y) and (k2, y), so the "CORREL" function was able to determine the relationship between these two variables, thus allowing us to comprise x3 which is the National Consumption Index.

4.3.5. Utilizing MATLAB

The final method that was used in order to satisfy this objective was to utilize MATLAB to create a multiple linear regression model based on the data that we had collected. We chose to use MATLAB again because we were familiar with the program and have performed multiple linear regression analysis with this software before. Multiple linear regression analysis takes into account multiple independent variables and uses them to try to predict a single dependent

[1] (Microsoft Office Online Help: http://office.microsoft.com/en-us/excel/HP052090231033.aspx).

outcome. Here is what a standard multiple linear regression model should look like for our particular situation:

Equation 4: $$Y = a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + b$$

Based on the data we were able to collect, and the analyses performed in Excel and MATLAB, here is what our actual model looks like (note that the values for a1…a5 were calculated in MATLAB:

Equation 5: $$Y = -60.628X_1 - 9.887X_2 + 76.658X_3 + 0.482X_4 - 8.045X_5 + b$$

The variables in our model are represented below:

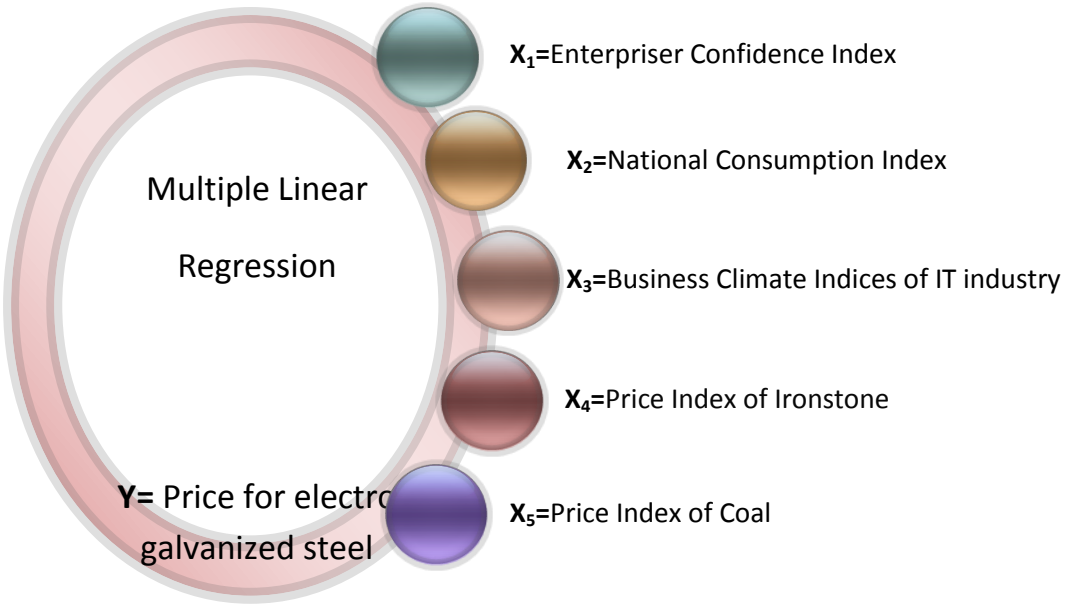

Figure 9: Multiple Linear Regression Model

Here are the steps that went into creating the model:

Upon opening MATLAB we reviewed the help function in order to have step by step directions on how to perform multiple linear regressions to ensure accuracy. Next, we considered the data points that we had and began to write a program, with the consultation of a Computer Science Major from Nanjing University. Once we were confident in the program that was written, we utilized the "Check Code with M-Lint" function in order to have the software scan our code to check for accuracy. The check was successful and we then ran the program, which provided us with our correlation coefficients. The code for the program, along with the resulting coefficients from the "Check Code with M-Lint" function is represented in Appendix E and Appendix F.

Although the price index for zinc was one of the data items we needed to collect, we did not include it in our model. There are a few reasons for this course of action. Due to the limitations on the available data for all of our indices, we were forced to limit the variables in our model to five. Therefore, we had to combine some variables, for example k1 and k2 were combined to composed x3. We attempted to combine the price index of coal with the price index of zinc, to help better represent the costs for electro galvanization, but when doing this we noticed that the correlation coefficient for zinc was negative. This turned our value for x5 negative. Therefore, there may be some error in the data for the price of zinc, so we had to leave this factor out.

It may seem that leaving this factor out could negatively impact our model, but on the contrary we feel the opposite. The reason for this is because the process of electro galvanization is relatively low with respect to cost and cost volatility. Thus, a minute detail such as the price index of zinc would not alter the result of our model significantly.

4.4. Evaluating the Index created for Electro Galvanized Steel

4.4.1. Obtaining Needed Data

In order to evaluate the model, we needed to accomplish our first method which was to obtain data for the month of June. So far we only were able to collect data for January through May, so the ability to collect data for June allowed us to evaluate the accuracy of our model for that given month. The following table shows the values for the month of June that correspond to their respective variable.

Variable	X1	X2	X3	X4	X5	Y

Value	95.8	88.78	100.1	418.45	105.3	545

Table 11: June Values

4.4.2. Solution Procedure

Our next method was to solve the equation and calculate the error. To accomplish this method, we input the above values into our model and solved for b. This is shown below:

Y = (-60.628*X1) – (9.887*X2) + (78.658*X3) + (0.482*X4) - (8.045*X5) + b

545 = (-60.628x95.80) - (9.887*88.78) + (78.658x100.10+ (0.482x418.45) – (8.045x105.30) + b

B = 545 - 542.3817233 = 2.618276683

Once we calculated the value for b, we were able to explore the degree of error between our calculated value for Y and the value that Aucksun provided us for Y. This is shown below:

(545-542.3817233 / 545) = 0.0048

The evaluation of this model, along with the degree of error is explained in detail in "Finding 3" of the findings section. Please refer to that section for further analysis of the model.

5. Findings/Results

5.1. Finding One

5.1.1. Present Theory about the Construction of Price Indices

Price Index is an index representing how the average prices of commodities change in a given time. When calculating the average, the prices of different commodities are dealt with a weight based on its economic importance generally. It is an economic indicator reflecting the price changes in direction, trends and degree, in different periods; a kind of economic indices, typically relative number measured in the reporting period and the base period; a tool to study the price variation, providing evidence for making, adjusting and examining economic policy, especially price policy. Price index is a comparative and comprehensive and average number.

With different range, price indices include: 1) individual indices which reflect fluctuations of a certain commodity price; 2) group indices which reflect fluctuations of a certain class of commodity prices; 3) general indices which reflect the whole commodity price fluctuations.

Generally, basing on different reference periods, indices are divided into chain index (on monthly basis), index compared with the same period of last year and fixed base index (a fixed period-based).

In addition, indices are classified on different types or produce locations.

What should be took into consideration when setting up a price index? Firstly, how to select weights, equal or various ones? Basing on a base period or a reporting period? Secondly, how to deal with the data, especially choosing a formula, Arithmetic Average, Geometrical Average, Harmonic Average or others?

5.1.2. Existing Method

5.1.2.1. Simple Indices Family

Simple indices are indices without weights, generally including six calculation methods, such as the simple aggregate index, the arithmetic average, the average of the countdown, the geometric mean, the mean of median and the mean of plural. The simple indices method is committed to exclude various importance and affections of commodities so that it can help to study the price fluctuations separately.

1. Simple aggregate index

This method is a ratio between the sum of commodity prices in the reporting periods and the sum in the base period. The formula is

Equation 6: $I = \Sigma P_i / \Sigma P_0$ (I for Price Index, P_i for price in the reporting period, P_0 for price in the base period.)

There is a shortcoming: in terms of different values, the outcome is affected by the price of high value commodities, concealing the weights; in a word, some high price commodities can dominate the index, covering the effects of the low price commodities.

2. Simple arithmetic average index

In this method, the sum of simple aggregate indices of commodities is divided by the number of goods, calculated as follow:

Equation 7: $I = \frac{1}{N} \Sigma \frac{P_1}{P_0}$ (N is the number of commodity types.)

This method overcomes the shortcoming of the former, but the weights of all goods are 1, which ignores the importance and price fluctuations.

3. Simple harmonic mean index

It's also called reciprocal averaging, because of its calculating process—the reciprocal of the simple arithmetic index, as:

Equation 8: $I = \frac{1}{\frac{1}{N}*\Sigma\frac{P_i}{P_0}} = \frac{N}{\Sigma\frac{P_i}{P_0}}$

But the index has unclear economic significance and complex calculation.

4. Simple geometric average index

It's an N-root of product of individual indices of N kinds of commodities, as

Equation 9: $I = \sqrt[n]{\frac{P_i(1)}{P_0(1)} * \frac{P_i(2)}{P_0(2)} * \ldots * \frac{P_i(N)}{P_0(N)}}$

Data need to be in same conditions, and the outcome is between the simple arithmetic one and the simple harmonic one. There are several usages in practices, but the calculation is complex when there are many commodities.

5. Simple median mean index

In the method, individual indices consist of a sequence, and the median is the combined index; in another word, it's calculated as:

Equation 10: $I = (\frac{P_i}{P_0})_{\frac{N+1}{2}}$

$\frac{N+1}{2}$ is the median position in the sequence. The shortcoming is evidence: if there are a few individual indices, the final numerical value is bigger than indexes in other methods so that it is lack of representativeness; if there are many, the index is affected by the variety of indices in median position, and it is lack of stability. And the index is without the effects of the prices at endpoints, lack of average and sensitive.

6. Simple plural index

A plural of individual indices represents the general index, as

Equation 11: $I = (\frac{P_i}{P_0})_{M_0}$ (M_0 is the plural in the sequence.)

When there are a few individual indices, the distribution is not obvious and M_0 is not easy to find out; while there are lots, the outcome shows less average and less sensitive. In fact, this method is rarely used in practice.

The simple indices family ignores the importance and affections of commodities, so its outcomes roughly reflect the price fluctuations. In consequence, nowadays it is rarely used.

5.1.2.2. Weighted Aggregative Indices Family

Compared with the simple indices family, the weighted aggregative indices family adds trade volume as a weight; as a result it combines the importance and influence to explore the price fluctuations. The weight not only solves the problem which the prices cannot directly add up, but also takes merchandise sales and effect level into account; all prices in the same conditions (at the base period or the reporting period), so the calculated average price variation makes the index more science. The family mainly includes the followings:

1. Weighted aggregative index with a fixed weight.

   The amount in the base period is used as the fixed weight. This method was created by Laspeyres, a German scholar, in 1864, and the formula is short for Laspeyres' formula, as:

   Equation 12: $I = \frac{\Sigma P_i Q_0}{\Sigma P_0 Q_0}$, P_i is the average price in the reporting period; P_0 is the average price in the base period; Q_0 is the trade amount in the base period, using as a weight.

The actual economic effect of price fluctuations can be expressed as $\Sigma p_i q_0 - \Sigma p_0 q_0$

To Laspeyres' index, if indices in calculating period are calculated basing on the same base period, they can be compared with each other directly, and it is helpful for comparison and trend predict. But if the time interval between the calculating period and the base period is long, commodity composition changes, weights change, so the outcome departs from the actual product transferences and hardly reflect the fluctuations.

2. Weighted aggregative index with a changeable weight.

   The weight is the amount in the reporting period. This index, or Paasche's index, is advocated by Paasches, as:

$$\textbf{Equation 13: } I = \frac{\Sigma P_i Q_i}{\Sigma P_0 Q_i}$$

   The actual economic effect of price fluctuations can be expressed as $\Sigma p_i q_i - \Sigma p_0 q_i = (\Sigma p_i q_0 - \Sigma p_0 q_0) + [\Sigma (p_i - p_0)(q_i - q_0)]$.

   Using the data in reporting period can help people observe the price fluctuations and the trade volume, in a word, it is more practically. But the timely data is hard to achieve Due to some complicated objective reasons.

3. Synthetic formulae from the former Soviet Union.

It has the same form with Paasche's, but covers different sample range. Paasche's index involves only several representative commodities, while this index needs data on all commodities.

4. Price change margin index

It is a modification of the Synthetic formulae from the former Soviet Union, using the change margin between reporting period and base period as an calculated object. And the formula is

Equation 14: $I = \frac{\Sigma P_i Q_i}{\Sigma P_i Q_i - \Sigma(P_i Q_i - P_0 Q_i)} = \frac{\Sigma P_i Q_i}{\Sigma P_i Q_i - \Sigma(P_i - P_0)Q_i}$

$P_i - P_0$ is the price balance between reporting period and base period; $\Sigma(P_i - P_0)Q_i$ is the sales increase (or decrease) if the reporting period price is higher (or lower) than the base period price; and$\Sigma P_i Q_i - \Sigma(P_i - P_0)Q_i$ is sales volume in the reporting period.

5.1.2.3. Weighted Average Indices Family

The weighted average index is a mean that each individual index multiplies its weight, and then adds up. Generally the weight is the circulation of goods, including price and transfer amount. This method avoids the shortcoming of simple index method, and shares the equal position with the weighted aggregative index method. The weighted average index method has four forms.

1) Weighted arithmetic average index

Equations 15 & 16: $I = \frac{\Sigma(\frac{P_i}{P_0} P_0 Q_0)}{\Sigma P_0 Q_0}$ $\qquad$ $I = \frac{\Sigma(\frac{P_i}{P_0} P_i Q_i)}{\Sigma P_i Q_i}$

This method is kind of similar with the weighted aggregative index method, but using the circulation as the weighted.

2) Weighted harmonic average index

Equations 17 & 18: $I = \frac{\Sigma P_0 Q_0}{\Sigma(\frac{P_i}{P_0} P_0 Q_0)}$ $\qquad$ $I = \frac{\Sigma P_i Q_i}{\Sigma(\frac{P_i}{P_0} P_i Q_i)}$

P_0Q_0 is the base period weight, P_iQ_i is a current period weight, and $\frac{p_i}{p_0}$ is an individual index. Which weight is suitable when setting an index? It mainly depends on your study goals. If you want to express the market dynamics, you should use a current

period weight; while you are studying price change and its rules, the base period weight is a better choice.

3) Weighted arithmetic average index with fixed weight

The formula is:

Equation 19: $I = \frac{\Sigma \frac{P_i}{P_0} W}{\Sigma W}$. W is an adjusted weight, which is adjusted data from commercial survey or census via relative numbers. Generally the weight is used for 5 or 10 years and then recalculated. Compared with the weighted arithmetic average index, W has different diameter range, time.

4) Weighted geometric average index with base period weight

The formula is:

Equation 20: $I = \sqrt[\Sigma P_0 Q_0]{\prod (\frac{P_i}{P_0}) P_0 Q_0}$, and its log is $\lg I = \frac{\Sigma (\lg \frac{P_i}{P_0} * P_0 Q_0)}{\Sigma P_0 Q_0}$

5.1.2.4. Adjusted Index Formulas

Due to different methods, there are differences between the calculated outcomes, which are biases. Later, scholars did some adjustment beyond the above-mentioned methods, and created the adjusted index formulas, aiming at decreasing the biases led by the subjective weights.

1. Arthur Young's weighted aggregative formula

Equation 21: $I = \frac{\Sigma P_1 Q_a}{\Sigma P_0 Q_a}$ or $\frac{\Sigma P_1 \bar{Q}}{\Sigma P_0 \bar{Q}}$

It is kind of similar with the weighted aggregative index, but Q_a is the actual amount from typical years (normal time), $\bar{Q}$ is the average amount in several years.

2. Driohish's index

It is a combination of Laspeyres' index and Paasche's, as

$$\textbf{Equation 22: } I = \frac{1}{2}\left(\frac{\Sigma P_i Q_0}{\Sigma P_0 Q_0} + \frac{\Sigma P_i Q_i}{\Sigma P_0 Q_i}\right)$$

3. Marshall F.Y. Edgworth's index

In this formula, the average of sum amount in base period and reporting period is used as a weight. The formula is

$$\textbf{Equation 23: } I = \frac{\Sigma P_i\left(\frac{Q_0+Q_i}{2}\right)}{\Sigma P_0\left(\frac{Q_0+Q_i}{2}\right)} = \frac{\Sigma P_i(Q_0+Q_i)}{\Sigma P_0(Q_0+Q_i)}$$

4. The "ideal index"

C.M.Walsh and Pigou have proposed successively relevant formulas, as

$$\textbf{Equation 24: } I = \sqrt{\frac{\Sigma P_i Q_0}{\Sigma P_0 Q_0} * \frac{\Sigma P_i Q_i}{\Sigma P_0 Q_i}}$$

It is a geometric mean of Laspeyres' index and Paasche's index.

5. Keynes' index

To avoid the biases of Laspeyres' index and Paasche's index, J.M.Keynes firstly created a weighted aggregative index with a highest common factor.

$$\textbf{Equation 25: } I = \frac{\Sigma P_i Q_{min}}{\Sigma P_o Q_{min}}$$

5.1.3. Samples of Indices

5.1.3.1. LMEX [38]

LME, London Metal Exchange, established in 1877, is a primary trading market of nonferrous metals in the world. In 19th centaury, England imported lots of industrial raw material, but metal price fluctuated seriously due to the uncertain arrival time of ships which had to travel across ocean, so merchants and consumers had to face great risks. Some merchants want

to set up a reasonable price index to present the market performance of non-ferrous metals in an exchange. Consequently, LME was established.

After many years, LMEX, London Metal Exchange Index has become a worldwide metal index. LMEX covers 7 metals, including Aluminium, Copper, Nickel, Zinc, Tin, Lead and Steel. In fact, Steel Index was set in April, 2008 and not widely used in Asia, so it is not evolved in the following introducing on LMEX.

LMEX is a normalized average of futures prices for six metals (Aluminium, Copper, Nickel, Zinc, Tin, and Lead) over three maturities (1, 2 and 3-months – the third Wednesday relevant maturities). $LMEX_{1999\text{-}04\text{-}01}$ is set to be the fixed base, and $LMEX_{1999\text{-}04\text{-}01}=1000$.

For each metal, LME has

$P_i = P1_i + P2_i + P3_i$, the sum of futures prices for metal *i* over maturities *1*, *2* and *3*-months.

$LMEX=C_0\sum_i W_i \times P_i$, (for $LMEX_{1999\text{-}04\text{-}01}=1000$, C_0 takes values $C_{0\ 1999\text{-}04\text{-}01}=0.002582340$.)

In the formula, the weighting W is based on an adjusted average of the percentage proportions of global production and LME trading volumes of each metal over the previous five years. And W has to be recalculated on July, 1st every year, and so is C_0 so as to give continuity to the index value on that particular date.

$$C_0^{old}\sum_i W_i^{old} \times P_i = C_0^{new}\sum_i W_i^{new} \times P_i = LMEX_{July,\ 1st}$$

Due to the mature development of LMEX, especially on Aluminum, Aucksun uses LMEX to direct sales price of Aluminum selling aboard.

5.1.3.2. CRU and LGMI

(1) CRU Index [39]

'CRU', British commodity research institution, works mainly at international trade analysis and makes a study of the cost and the forecast of the future market development of metal, mining industry, chemistry. It publishes the seven monthly reports on the steel, long sheet, flat steel product (stainless steel), steel-making raw material, ferroalloy, nickel-chromium-molybdenum, and it distributes eight weighted price index every week. In these eight price indexes, the carbon-steel adopted mainly at the international (global), flat sheet, North-American, European, Asian index, stainless steel index, pig iron index and steel scrap index. International (global) steel price index is formed form the 39 market prices of five steel product (hot rolled coiled sheet, cold rolled coiled sheet, hot galvanizing plate, thread steel, profile) in the Central West America, Germany and South China. Then, consumption share weighted according to the five steel products in the North American, West European and Asian market, to obtain a international (global) steel price index, CRUspi. This index chooses the weighing average price in April, 1994, as the standard. The index was 100, and was published once in a week.

(2) LGMI Index [40]

Domestic steel information research institution, Lange steel information market research center, recommends Lange steel index, also called LGMI, which is a price index referred to the CRU price index. It aims at illustrating the trend of domestic steel market.

This index weighted according to the variety and the regional steel consumption on the base of the price in domestic steel market. Through many analysis and comparisons, LGMI select August, 23, 2002, as the standard day. The index was 100. Therefore, the exponential curve structure and the value of the exponent would be better, and illustrate the change of the price of domestic steel market excellently to be helpful for the research.

LGMI selects 22mm-in-diameter secondary thread steel, 6.5mm-in-diameter common high speed wire steel, 20mm-thick medium plate, the 3.0mm-thick hot rolled coil, the 1.0mm-thick cold rolled sheet and 1.0mm-thick galvanizing coil as the variety samples. LGMI selects seven regions, East China, South China, Central South China, North China, Southwest China, Northeast China and Northwest China, to represent the region.

LGMI divided into four categories: composite index, category index, specifies index, regional index. It can reflect the trend of the domestic steel market price from different aspects.

LGMI publishes in 12:00 AM, every Friday, and select the last week's index in the month as the monthly index.

At present, LGMI has all opened for the whole world. Anyone can realize the trend of the steel price from its website.

5.1.3.3. Myspic[41]

Myspic index is the current tool used by Aucksun to observe price fluctuations and set a sales price, mainly in coiled sheet, hot-rolled sheet and galvanized steel sheet selling at home.

The construct of 'Mysteel price indices of China', in consideration of many factors such as the weighing of the long sheet and the flat sheet in the Chinese steel consumption and the weighing of steel consumption in the seven region of East China, South China, Southwest China, Central South China, North China, Northeast China and Northwest China, is a weighted price index combined of the variety and the district factors.

The long sheet selects the 20mm-in-diameter and 335Mpa-in-yield-strength hot rolled ribbed bar (secondary thread steel) and the 6.5mm-in-diameter common high speed wire steel (Q235) as the samples. Flat steel product select the 20mm-thick medium plate (Q235), the 3.0mm-thick hot

rolled coil (SS400), the 1.0mm-thick cold rolled sheet (coil SPCC) and galvanizing coil (SPCC) as the samples.

The knockdown price offers the price. Composite specific index selects seven major cities' market knockdown price to be on behalf of the local price level. These are Shanghai, Guangzhou, Beijing, Wuhan, Chongqing, Shenyang, Xi an.

Myspic index appoints the July of 2000 as 100, from then on, the index formed. In order to understand the development history easily, the monthly price index can go back to January of 1997.

The adopted price data from July of 2000 comes from the market price data in www.Mysteel.com. Before July of 2000, all of the data is formed from the arrangement of historical summary.

5.1.4. Summary of Finding One

In this part, we firstly introduce some formulas which help to create price indices and make comparisons. Secondly, we summarize biases in each indices family and give some advises. Finally, we present some samples about how current indices both home and abroad are established, which backup our creation in a certain extent.

But, in the following part, the creating index part, we did not use these methods absolutely for four reasons. Firstly, the data Aucksun provided are limited, only 5 months; secondly, some data used are statistic, not original, for example the enterpriser confidence index, which cannot be put in the formulas directly; thirdly, weights are subjective which cannot reflect the true situations; finally the existing indexes used at Aucksun, that is LMEX and Myspic, are not based on theses methods. So we try another approach to create a proper index.

5.2. Finding Two

5.2.1 Electro Galvanized Steel: Supply and Demand

The price of electro galvanized steel is resulted from the supply and demand factors behind it. In this part, we analyze the detailed factors in supply and demand, then discuss how these factors function and how supply and demand come to a balance that determines the price of electro galvanized steel. This chapter will also show how the fluctuation of the factors affects the fluctuation of the price of electro galvanized steel.

5.2.2. Demand Factors Affecting the Price of Electro Galvanized Steel

The main customers of electro galvanized steel are IT companies. In the global economy development, the industry transference leads to the conglomeration of IT industry in China, and increases the demand of metal material. What is more, the conglomeration of IT industry makes it possible to turn individual demand into social demand.

The report from the Ministry of Information Technology and Telecommunications shows the economy situation in China. As one of the biggest industries in China, IT industry increase has been increasing rapidly in recent years. The sales revenue in 2000 for IT industry is about 988 billion, and it rose to above 4750 billion in 2006. Making up for above 80% sales revenue in IT industry, the sales revenue of electronic information products also rose sharply from about 823 billion in 2000 to 3882 billion in 2006. The production chains of IT industry and electronic information products industry combine with each other, and these two processes stimulate each other. During the “Tenth Five Plan” Period in China, the IT industry increases quickly and continuously, and it became more and more important in the national economy. In 2005, the sales revenue of IT industry is 44000 billion which is 3.8 times the sales revenue in 2000. The

main products that contribute to the sharp increase are LCD TV, laptop, LCD and microcomputer. In the Plan Of IT industry For Eleventh Five Period, the increase rate of IT industry will be above 18%.

1. Keep the increasing production of microcomputer

As the government is stimulating the development of internet and individual computer, the domestic market for microcomputer is increasing. A report from IDC shows that in the coming five years, the average combined increasing rate for microcomputer will be 11.7%. Accordingly, the IT companies in the Yangzi River delta are improving their production capability to meet the demand of the market. As a result, the production of microcomputer in 2006 was 1.35 times the production in 2005.

2. LCD will be the main products in the monitor market

As the developed countries are moving several IT industries to China, there are more and more IT companies in the Yangzi River delta and Pearl delta, and the production of LCD is increasing correspondingly. A report from IDC shows that the increasing rate of LCD in the coming five years will be over 13%.

3. The market for LCD TV will continue significantly

As the technology of TFT is becoming more and more mature, and the cost is decreasing, LCD TV is becoming a star product. In 2006, although the LCD TV only accounts for 11% of TV industry, the production of LCD TV increased two times than 2005. Ministry of Information Technology and Telecommunications forecasts the market of LCD TV will continue increasing.

4. The manufacturing capability will increase rapidly

As the development of LCD in China is still in a low level, we cannot produce all the products by ourselves, parts of the LCD modules are imported from foreign countries. And the

manufacturing capability still cannot meet the demand of the domestic market; the production of LCD module s for microcomputer can only meet about 72.26% of the total demand. However, as the domestic demand is increasing, the manufacturing capability will increase too. In the coming four years, the increasing rate of LCD modules for microcomputer, monitor and TV will increase 19.29%, 27.32% and 50.94 respectively.

5. The production of other IT products will be about 20%

Among the other IT products, the set-top box and the server are in great demand. With better technology, the set-top box is more and more widely used in TV to get digital signal. And the server is used for the developing internet and communication market. Both of the two products are estimated to enjoy a boom in the coming years.

As described in the above paragraphs, the increasing demand for IT products stimulates the demand for electro galvanized products. According to an estimation based on the steel consumption of IT industry, the consumption will be 4.82 million ton in 2011.

Steel is mainly used to make the following production in IT industry: LCD monitor, printer, desktop, LCD TV, duplicating machine, laptop, set-top box and server. More details are shown in the table below.

Main material	**Product name**	**Field of use**
Iron Plate	LCD monitor	Base of monitor, bracket, revolving shaft
	Printer	Inside structure, crust, radiator
	Desktop	Chassis, power case, CD-ROM, keyboard and radiator
	LCD TV	Base of monitor, bracket, revolving shaft, Rear cover
	Duplicating Machine	Inside structure, crust
	Display module for LCD TV	Backboard and frame for LCD TV

	Display module for LCD monitor	Frame for LCD monitor
	Set-top box	Inside structure, crust, radiator
	Server	Chassis, crust, CD-ROM, radiator

Table 12: Usages of Steel in IT Industry

In the principle of economics, the prices offered by buyers are called demand price. The demand price is determined by the marginal utility of certain products to the customer. And the prices offered by sellers are called supply price. The supply price is determined by the effort given in the production of the products. From the buyers' view, as the marginal utility of the products decrease as the volume increase. The demand of the products decreases correspondingly. From the suppliers' view, the price depends on the reward for producing the products. When the demand price equals the supply price, the demand volume will also equal the supply volume. So generally speaking, the price is determined by the supply and demand.

Marshall thinks that it is hard to choose whether demand or supply as the main factor to decide the equilibrium price, because it is like to decide which side is more important in a pair of scissors. And arguing about whether utility decides value or cost decides vale is just like arguing about which side of the scissors cutting the paper, it's just meaningless. However, Marshall also thinks that due to the length of period is different, demand and supply influence differently to the equilibrium price. Generally, longer period means demand influences more, and vice verse. In a word, when the factors of demand and supply change, demand and supply change as well, making the price changed. The price of electro galvanized steel is also like this, to research on its price index we must first analyze the factors influence its demand and supply.

5.2.3. Analysis of the Supply Factors of Electro Galvanized Steel

The first factor that influences the price of electro galvanized steel is the price of iron stone. Then, in the process of producing steel, the output of steel depends on the cost and technology level. The prices of iron stone, coal, energy, and transportation change, the manufacturing cost change, and so does the supply. The advance of technology will decrease the cost and increase the efficiency of energy, which means under every certain price there is more supply. In the processing period of electro galvanized steel, technology and the prices of oil, water and human resource also count.

5.2.4. Price-Forming Mechanism of Supply and Demand

Previously we have analyzed on the factors forming the price of electro galvanized steel, and in this chapter we will see how these factors work. In a word, the price of electro galvanized steel is just the equilibrium price of demand and supply. The main work of analyzing the price of electro galvanized steel is to analyze the processing period of electro galvanized steel and its downstream industry.

5.2.4.1. Price-Forming Mechanism of Demand

The factors that influence the demand of electro galvanized steel can be divided into two parts, direct factors and indirect factors. Direct factor is downstream industry climate (focus on IT industry), and indirect factors are government policy and macro economic climate and so on.

Since direct factors influence the demand directly and thus influence the price of electro galvanized steel directly, it is quite easy to see the positive relativity between the factors and the changes of prices. IT industry blooms since 2000, and that makes the demand of electro

galvanized steel increase, pushing the price of electro galvanized steel up. However the financial crisis in 2008 influenced a lot to the IT industry, pulling the sales down, and the demand decreased as well. At the same time, the low price of steel made the IT manufacturers tend to use their own inventory, expecting the price of electro galvanized steel decrease more. And when the inventory are used up and the economy is warming up, the price of electro galvanized steel is increasing.

Though indirect factors don't influence the price of electro galvanized steel directly, they can work by influence other factors. It is recognized that macro economic climate influence the climate of IT industry and some relative industries. When the macro economic climate is good, IT industry blooms, the demand of electro galvanized steel increases, and the price of electro galvanized steel increases. Take the year of 2002 for an example, the world economy is blooming and so does China, thus the price of steel reached the highest position ever. In these circumstances, the price of electro galvanized steel must be increasing. Though nowadays China's economy is market economy, we can't ignore the government policy.

Base in the previous analysis, we can illustrate it in Figure 10.

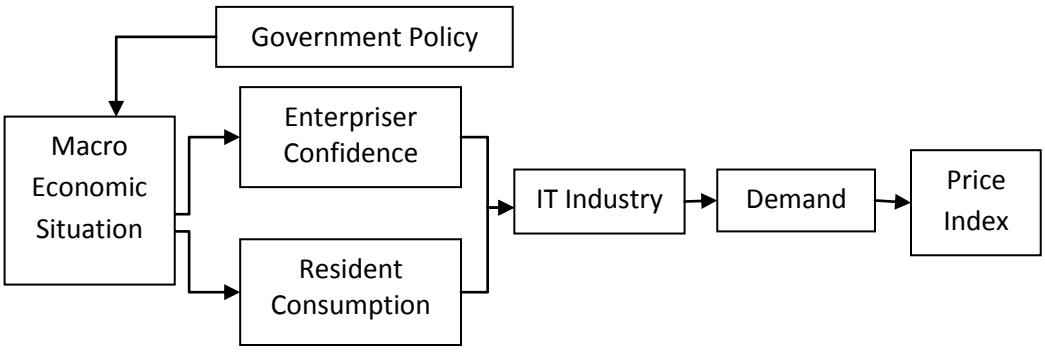

Figure 10: The demand factors that affect electro galvanized steel

5.2.4.2. Price-Forming Mechanism of Supply

Due to the specialty of electro galvanized steel industry, the factors influencing supply are quite simple, they are raw material supply, manufacturing materials, and producing technology. The main raw material is iron stone, so when the price of iron stone fluctuates, the price of electro galvanized steel changes. The manufacturing materials are also components producing electro galvanized steel, their prices influence the price of electro galvanized steel. And since the prices of manufacturing materials are relatively low, their influences are small. Advanced producing technology makes the cost low, decreasing the price of electro galvanized steel. Due to the long period of technology advancing, its influence is also quite small in short period.

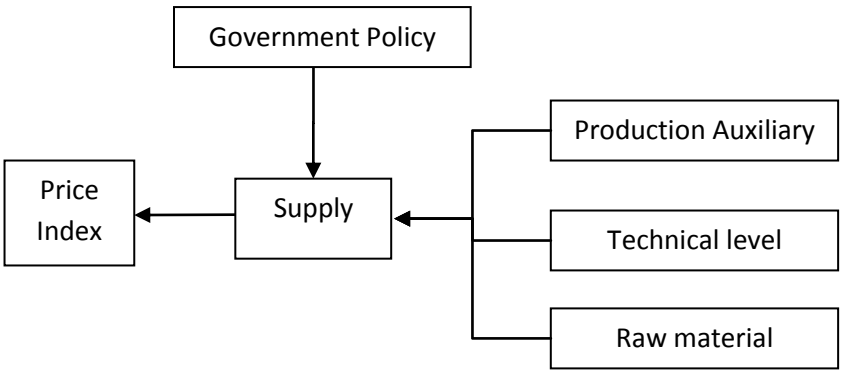

Figure 11: The supply factors that affect electro galvanized steel

5.2.4.3. Analysis of the Price-Forming Mechanism of Supply and Demand

The factors of demand and supply influence the price of electro galvanized steel at the same time, forming the equilibrium price. So we should put these two processes together to analyze the mechanism of forming the price of electro galvanized steel. Figure 12 illustrates this process.

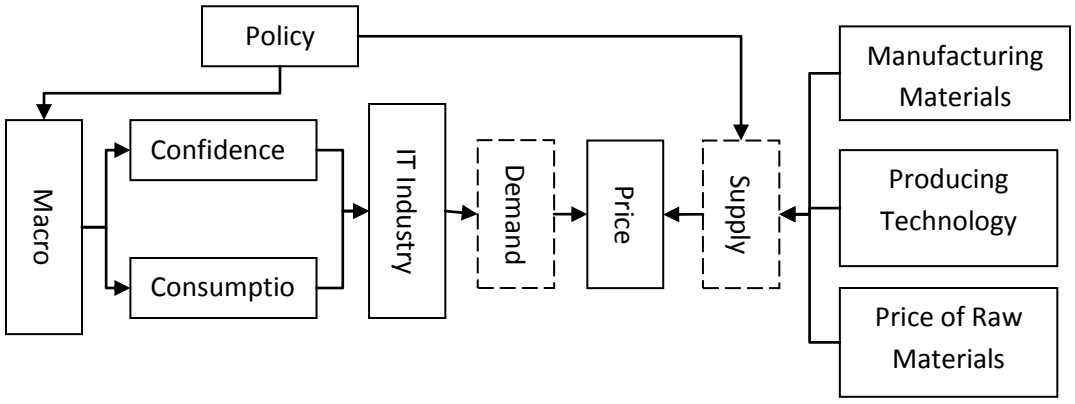

Figure 12: Factors influencing the price of electro galvanized steel

5.3. Finding Three

In the previous chapters, based on supply and demand principle, we identified the main factors that affect the price of electro galvanized steel. And in this chapter, we will analyze and quantize these factors. During the process, our biggest problem is how to quantize the factors and how to collect the data. In order to collect data that is reliable and can reflect the fluctuation of the factors that we selected, we use the statistical data from the National Bureau of Statistics. We choose several kinds of indices that can reflect the factors that we selected instead of collect the initial data which is really difficult to find.

We obtained a graph about the price of electro galvanized steel from January 2009 to July 2009. These data points are used as the value of Y. The unknown unit in Table 13 is resulted from the break of purchasing, and we consider this price as the same with the price of similar kinds of products.

Product name	Price						
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.

Export electro galvanized steel	**$742**	**$700**	**$655**	**$580**	**$540**	**$540**	**$600**
Export electro galvanized steel. Pohang	unknown	**$660**	**$630**	**$560**	**$600**	**$550**	**$580**
Average price	**$742**	**$680**	**$643**	**$570**	**$570**	**$545**	**$590**

Table 13: The Spot Market Price of Electro Galvanized Steel

5.3.1. Demand factors

The government policy is a very important factor that affects the macro economy situation, and then the macro situation affects the faith of enterpriser and the national consumption power. So, here we focus on the three factors that have relatively directive effect on the price of electro galvanized steel, they are Enterpriser Confidence Index, National Consumption Composed Index and Business Climate Indices of IT industry.

5.3.1.1. Enterpriser Confidence Index

The Enterpriser Confidence Index is also called Macroeconomic Climate Index. It reflects the judgments of the enterprisers about the present macroeconomic situation. The value of the index varies from 0 to 200. If the index is larger than 100, it means the judgment is optimistic, otherwise, the judgment is pessimistic.

Phoenix Website offers data about the Enterpriser Confidence Index of IT industry which is really useful and fits the field we want to study well. However, the website has only data for January and February in 2009, and we need data from January to June. As it is too difficult for us to complete the information, we used Enterpriser Confidence Index instead of Enterpriser Confidence Index of IT industry.

Date	Alertness Index	Coincident Index (Take the number in 2006 as 100)	Leading Index (Take the number in 2006 as 100)
2009.01	78.7	94.44	98.61
2009.02	77.3	94.01	99.10
2009.03	82.7	94.48	100.08
2009.04	82.0	95.28	101.12
2009.05	82.0	95.40	101.70

***** Information source: National Bureau of Statistics of China

Table 14: Enterpriser Confidence Index from January to May 2009

The Coincident Index reflects the current trend of the macro-economy, and it consists of industry manufacturing, employment, social demand and national revenue. The leading index is composed from a series of leading indicators, and it can be used to forecast the trend of macro-economy. The Alertness Index divides the condition of economy into five levels, red light means overheated economy, yellow light means heated economy, green light means normal economy, light blue light means cold economy and blue light means freezing economy.

As we want an index that can describe the present economy situation in China, we used the Coincident Index in the price index model of electro galvanized steel. The data we used is shown in the table below.

Date	Coincident Index (Take the number in 2006 as 100)
2009.01	94.44
2009.02	94.01
2009.03	94.48
2009.04	95.28
2009.05	95.40

***** Information source: National Bureau of Statistics of China

Table 15: Enterpriser Confidence Coincident Index

5.3.1.2. National Consumption

Here we chose two branch indices of National Consumption Index to reflect the national consumption situation of IT industry, they are National Consumption Index for Home Appliance and National Consumption Index for Education and Entertainment.

National Consumption Index for Entertainment and Education is a branch index of the National Consumption Index, and it reflects the fluctuation of the domestic consumption of the products and service for entertainment and education. The index is the relative number compared with the price in the same month of previous year. The value of National Consumption Index for Home Appliance from January to May 2009 is shown in the graph below.

Date	National Consumption Index for Entertainment and Education
2009.01	100.3
2009.02	98.9
2009.03	99.3
2009.04	99.0
2009.05	99.2

***** Information source: National Bureau of Statistics of China

Table 16: National Consumption Index for Entertainment and Education

National Consumption Index for Home Appliance is a branch index of the National Consumption Index, and it reflects the fluctuation of the domestic consumption of the home appliance products and service. The index is the relative number compared with the price in the same month of previous year. The value of National Consumption Index for Home Appliance from January to May 2009 is shown in the table below.

Date	National Consumption Index for Home Appliance
2009.01	102.6
2009.02	102.1
2009.03	101.5
2009.04	100.9

2009.05	100.5

***** Information source: National Bureau of Statistics of China

Table 17: National Consumption Index for Home Appliance

As we only have five month data for the construction of the model, we can only have five variables, so we have to compose some variables together. Here we list how we compose the above two factors together and get a new variable.

1. Step one, we calculated the correlation coefficients in Excel and got the following numbers:

   C1 = Correlation Coefficients of National Consumption Index for Entertainment and Education and Price Index of Electro Galvanized Steel =0.688703

   C2 = Correlation Coefficients of National Consumption Index for Home Appliance and Price Index of Electro Galvanized Steel =0.981823

2. Step two, we processed the correlation coefficients to make the sum of them are 1, and got the following numbers:

$$C_1' = \frac{1}{0.688703 + 0.981823} \times 0.688703 = 0.412267154$$

$$C_2' = \frac{1}{0.688703 + 0.981823} \times 0.981823 = 0.587732846$$

3. Step three, we used the two new correlation coefficients to weigh the above two indices and got a new index which is called National Consumption Composed Index as follow:

Date	National Consumption Composed Index
2009.01	99.9640527
2009.02	100.1166924
2009.03	100.5930123

2009.04	100.7807451
2009.05	101.6517855

Table 18: National Consumption Composed Index

5.3.1.3. The Development of the IT Industry

Business Climate Indices by Sector is always used to reflect the current condition of the industry. Data collected from different companies are weighted and then summed up to reflect the condition of the whole industry. The value of the index varies from 0 to 200. If the index is larger than 100, it means the development of the industry is optimistic, otherwise, the development of the industry is pessimistic. The Business Climate Indices is calculated based on the method of diffusion index.

The index we used is the index for IT industry, and the value of the index is shown below:

Date	Business Climate Index for IT industry
2009.01	86.9
2009.02	86.7
2009.03	85.9
2009.04	86.5
2009.05	87.1

***** Information source: National Bureau of Statistics of China

Table 19: Business Climate Index for IT Industry

5.3.2. Supply Factors

The fluctuation of prices of raw materials affects the price of electro galvanized steel. Another factor that affects the price is the technical level, but as the technical level for manufacturing electro galvanized steel has not changed a lot in the past years, we chose to eliminate this factor.

5.3.2.1 Raw Materials

Here the main raw material is iron ore. The price of iron ore is a relatively expensive and the prices fluctuates a lot, so the price of electro galvanized steel is affected this way. The price of iron ore is shown as follow. The iron ore here is a certain kind that has iron content above or equals 60% percent, this kind of iron ore is used to make steel.

Date	The price of iron ore (RMB/Ton)
2009.01	660
2009.02	550.3
2009.03	465.15
2009.04	417.6
2009.05	416.5

* Information source: www.ifeng.com/

Table 20: The Price of Iron Ore

5.3.2.2. Production Auxiliary Materials

The process of manufacturing electro galvanized steel is divided into two steps, the first one is from iron ore to steel, the second one is electro galvanizing the steel. Here we focus on two factors here, the price of coal and zinc. The prices of them are listed as follows.

Date	The price index of coal
2009.01	122.7
2009.02	118.8
2009.03	113.9
2009.04	108.7
2009.05	105.5

* Information source: www.ifeng.com/

Table 21: The Price of Coal

Date	The price index of Zinc
2009.01	57.0
2009.02	59.4
2009.03	58.6
2009.04	64.4
2009.05	62.6

* Information source: www.ifeng.com/

Table 22: The Price of Zinc

Then we calculated the correlation coefficients of coal and the price of electro galvanized steel using Excel and the number is 0.981777, and the correlation coefficients of zinc and the price of electro galvanized steel is -0.92427. Based on our understanding of the process of manufacturing electro galvanized steel, the correlation coefficient should not be negative. So here the negative value reflects the time delay of the effect due to the changing macro economy, so we chose to eliminate the factor zinc, because we are afraid the factors may mislead the model.

5.3.3. Construction of the Model

Based on the information we found in above paragraphs, we can construct a multi linear regression. Multiple linear regression attempts to model the relationship between two or more explanatory variables and a response variable by fitting a linear equation to observed data. Every value of the independent variable x is associated with a value of the dependent variable y. The original equation is as follow:

$$Y = a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + b$$

Here, Y represents the price of electro galvanized steel, X_1 represents the Enterpriser Confidence Index, X_2 represents Business Climate Index for IT industry, X_3 represents National Consumption Composed Index, X_4 represents the Price Index of Iron Ore, X_5 represents the price Index of Coal, and b is the adjustment.

As we only have the data for Y from January to July 2009, and data for other variables before June 2009. And we have to match the data. So the matched period is from January to May 2009. Thus, we used these data to construct the model. The data used are listed as follow.

Variable	Jan.	Feb.	Mar.	Apr.	May
Y	742	742	742	742	742
X1	94.44	94.44	94.44	94.44	94.44
X2	86.9	86.9	86.9	86.9	86.9
X3	101.6517855	101.6517855	101.6517855	101.6517855	101.6517855
X4	660	660	660	660	660
X5	122.7	122.7	122.7	122.7	122.7

Table 23: Data of past five months

Based on the data above, the program is written as follows:

```
format long; X = [94.44, 86.9, 101.6517855, 660, 122.7;
    94.01, 86.7, 100.7807451, 550.3, 118.8;
    94.48, 85.9, 100.5930123, 465.15, 113.9;
    95.28, 86.5, 100.1166924, 417.6,  108.7;
    95.4 , 87.1, 99.9640527 , 416.5,  105.5];
Y = [742;680;643;570;570];
Coef = inv(X)*Y     %  Coef = inv(X) * Y
```

After checking the program, we ran the program, and got the output as follows:

Coef =

-60.62796196506718

-9.88683941790828

78.65753128949883

0.48230922852320

-8.04508163021860

Then we take the number into the model and got:

$$Y = -60.628X_1 - 9.887X_2 + 78.658X_3 + 0.482X_4 - 8.045X_5 + b$$

5.3.4. The Evaluation and Adjustment of the Model

In the above part, we construct the model using data from January to May 2009. In this part, we use the data for June 2009 to evaluate the model and calculate the adjustment b. The data for June is listed as follows.

Variable	X1	X1	X1	X1	X1
Data for June	95.80	88.78	100.10	418.45	105.30

We then took these numbers and placed them into our model to get:

$$Y = (-60.628 \times 95.80) - (9.887 \times 88.78) + (78.658 \times 100.07) + (0.482 \times 418.45)$$
$$- (8.045 \times 105.30) + b$$

After some simple math we arrived at:

$$b = Y - 542.3817233 = 2.618276683$$

If we estimate the original b to be 0, then the deviation of Y' and Y is:

$$\frac{545 - 542.3817233}{545} \approx 0.0048$$

So when the original b is 0, the deviation of Y' (the price of electro galvanized steel calculated by the model) and Y (the accurate value of price of electro galvanized steel) is about 0.48%. Then we can use 2.618276683 as the value of b to calculate the price of electro galvanized steel next month in the model. As the reason of the error is similar in this month and next month, so we can get the conclusion that with this adjustment, the price calculated by the model will be more accurate with the adjustment b.

Then, when the accurate price of a certain month is obtained, we can go through similar process to get a new value of b which can be used for calculating the price of electro galvanized steel the next month. In this way, we can decrease the error of the model making it as small as possible.

6. Conclusions

Upon evaluation of our model, our team was able to determine the degree of accuracy for the studied month. If you recall from chapter 4, our equation,

$Y = (-60.628*X_1) – (9.887*X_2) + (78.658*X_3) + (0.482*X_4) - (8.045*X_5) + b$, was solved for the variable "b" regarding the month of June. The value of "b" tells us the level of adjustment that is needed to make the equation more accurate. The value of "Y" was calculated to be 542.3817233, supposing the value of "b" equals to 0, where the actual value of "Y" was 545.

Next, by calculating the deviation between our calculated value and the actual value, we were able to determine the degree of accuracy. If you can again recall from chapter 4, our calculation for deviation was:

(Actual – Calculated)/(Actual)

(545-542.3817233) / (545) = 0.0048

This tells us that our model was accurate to a degree +/- 0.48%. Our team was excited to see such exceptional results.

Although our model proved to be fairly accurate for the month of June, there are still some potential areas for the model to falter. One of the factors that may limit the potential of our model is the fact that our particular study was done with such limited data. Our team only had access to five month's data, and some of the indices' data had to be forecasted based on specific trends. Therefore, factors like this may pose potential risk to our model. Thus, these factors are further explored in the subsequent chapter, along with some recommendations to improve upon the work we have done thus far.

Also, Aucksun provided us with a difficult task when they assigned us this project. Electro Galvanized Steel prices are extremely challenging to predict because they seem to

fluctuate in price like the tides do to the moon. Not only did Aucksun have this problem, but the electro galvanized steel industry as a whole could not figure out this problem. At times this made it hard to stay optimistic about developing an index that the steel industry could not even do, but our group kept a positive attitude.

The first thing we did was research many different aspects and characteristics of the steel and IT industry. This was compiled of understanding steel itself (the many different steps, products, and processes that our raw materials must go through to become our final product). Also, researching the IT industry helped us to understand where and for what purpose our product was used for.

This helped us move onto the next step: what factors and variables should we take into account. If the price of our raw material was raising then chances are our final products price would rise also or maybe if the laborers working in one of our suppliers steel mills had been producing at a sub-par level then the price of our final product would be affected. We needed to dig deep and find the real cause of this volatility. Next we constructed a model. Our group had to work and rework every aspect of this equation to try and make it as feasible, applicable, and accurate as possible.

After developing it from data points given to us, we still did not know if it would work. As she said we used data from the months of January to May (the only data points available), and June's data was not yet readily accessible. Thankfully it finally was released and further evaluation could be done. After crunching June's numbers into our equation we found our model to be accurate to a +/- 0.48 % margin. Less than one percent! We had done it; we had created a working model for electro galvanized steel.

7. Recommendations and Future Work

The fact that there were many limitations in terms of available data creates some areas for potential recommendations and future work. The collection and record keeping of data is one recommendation that our team feels is essential to ensure the integrity of our model. For example, the Enterpriser Confidence Index only had information available for the months of January and February for the IT industry specifically. Therefore, we were forced to broaden our focus and use a more general portion of this index, which may dilute the accuracy of our model. This general portion of the index included the IT specifics for January and February, but also encompassed other less-relevant subjects. Therefore, in the future, if data specifically pertaining to the IT industry could be utilized, this may improve the integrity of our model.

Likewise, some of the data for the month of June, pertaining to our variables $X_1 \ldots X_5$ had to be forecasted based on specific trends our team identified. There seems to be a lack of some of this data because we are trying to collect data for the current month, which may not be available yet. Therefore, if in the future, our model's accuracy can be evaluated after the current month's data for all of the variables is made available, the results may be more feasible.

This brings us to our third recommendation for future work, which has to do with the amount of variables considered in the model. Surely there are more than the five risk factors we used that truly affect the price for electro galvanized steel. Our team feels that the five factors we evaluated are among the most prominent, but if more factors could be added into the model, we feel the accuracy would increase. Again, the reason our model is limited to five variables goes back to the fact that our data was limited; we were only able to obtain data for five months and even some of those data points had to be forecasted to some degree. Therefore, our team

feels that there is much value in considering more variables in the future when additional data becomes available.

Another important factor to consider is that our model does not take into account Aucksun's three month forward purchasing strategy. Our team focused our efforts on evaluating the current electro galvanized steel prices. We feel that there may be some value in considering the time delay in Aucksun's operation. If this is done, then there can be a comparison made between these two models to evaluate which one is more accurate.

Our team would like reiterate that we created a linear model. However, the price for electro galvanized steel is not linear with respect to time. Therefore, our team would like to see our model serve as a foundation for future work to be done in creating a non-linear model that may gauge price levels more accurately.

Next, we give our recommendations to our sponsors. If you accept the model as is and simply implement it into your company it could prove detrimental and actually hurt versus help Aucksun's electro galvanized steel problem. We think it would be beneficial for Aucksun to place this model on the backburner for the next 6 to 12 months. By letting it sit for the next few quarters you are able to collect data for the passing months and evaluate it once the data points are made public. Even more, over that waiting period you can adjust "b" accordingly. By calculating x1 thru x5 (as the data becomes available) and placing the actual prices of electro galvanized steel as the value of Y over those months then solving the equation you can help make "b" more accurate of an adjustment. By taking this step Aucksun can help both our group and themselves figure out if this index is actual plausible and feasible.

We discuss what variables we thought may be significant when calculating our products price, but Aucksun's team might feel differently. By evaluating the already existing variables

Aucksun can pick and choose what they feel is relevant and either delete some, add more, or do a combination of both to help strengthen the index. Also, we never took into account Aucksun's three-month forward purchasing process. This may in fact have some sort of effect on the prices at which Aucksun buys their steel at or affect the results calculated by our model. Another variable to take into consideration is the economic price of zinc. As explained in our Findings section there is an inverse correlation between the price of zinc and the price of electro galvanized steel which does not make sense because zinc is used in the electro galvanizing process. Further investigation into why this is so needs to be done.

Finally, we feel as though it would be beneficial to Aucksun's team to possibly hire individuals with expertise in the statistical analysis field. We weighed the ideas of hiring an outside consulting firm, but felt this would cost a lot more then Aucksun hiring and making their own internal consulting department. Also, if they created this department it would ensure that all classified information would stay within the company and not be accessible to outside firms.

Overall, our team is very satisfied with the results of our model because it is surely a great step towards discovering how to accurately gauge the price of electro galvanized steel. If our recommendations are explored, we feel that there are many possibilities for our model to play an essential role in assisting Aucksun with determining proper pricing for electro galvanized steel.

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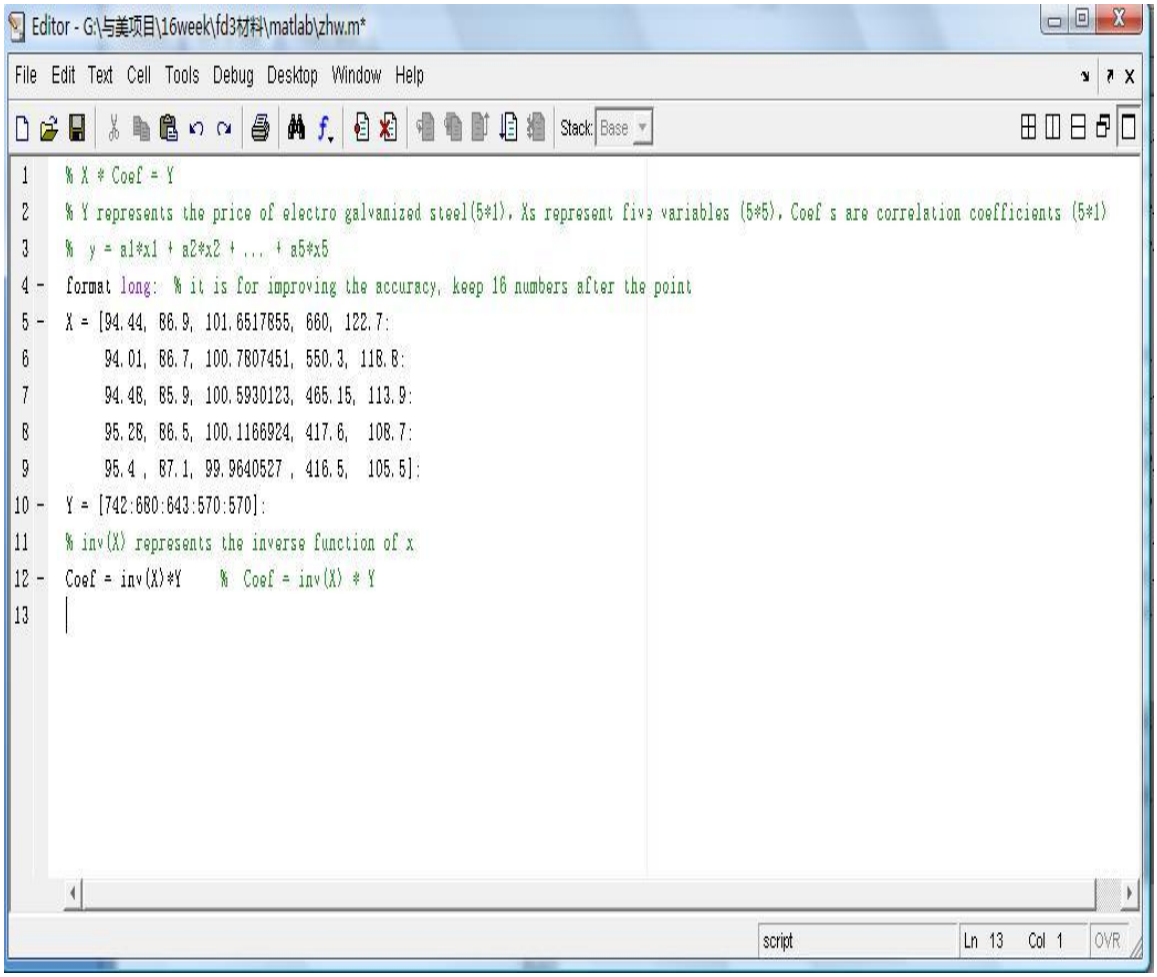
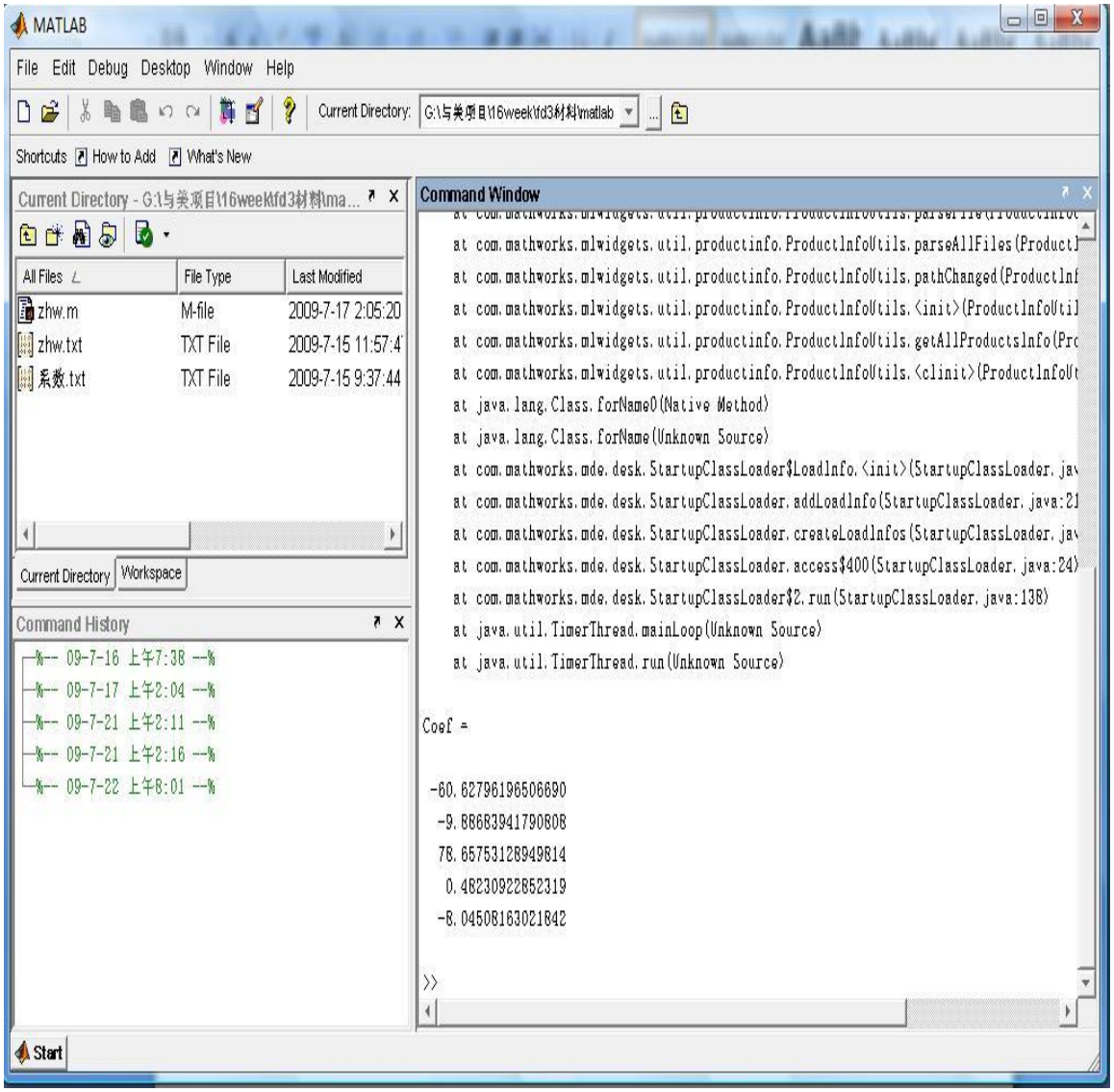
Appendix

Appendix A



Appendix B


MATLAB
File Edit Debug Desktop Window Help
Current Directory: G:\与美项目\16week\fd3材料\matlab
Shortcuts How to Add What's New
Current Directory - G:\与美项目\16week\fd3材料\ma...
All Files
File Type
Last Modified
zhw.m
M-file
2009-7-17 2:05:20
zhw.txt
TXT File
2009-7-15 11:57:4
系数.txt
TXT File
2009-7-15 9:37:44
Current Directory
Workspace
Command History
%-- 09-7-16 上午7:38 --%
%-- 09-7-17 上午2:04 --%
%-- 09-7-21 上午2:11 --%
%-- 09-7-21 上午2:16 --%
%-- 09-7-22 上午8:01 --%
Command Window
at com.mathworks.mlwidgets.util.productinfo.ProductInfoUtils.parseAllFiles(Product
at com.mathworks.mlwidgets.util.productinfo.ProductInfoUtils.pathChanged(ProductInf
at com.mathworks.mlwidgets.util.productinfo.ProductInfoUtils.<init>(ProductInfoUtil
at com.mathworks.mlwidgets.util.productinfo.ProductInfoUtils.getAllProductsInfo(Pro
at com.mathworks.mlwidgets.util.productinfo.ProductInfoUtils.<clinit>(ProductInfoUt
at java.lang.Class.forName0(Native Method)
at java.lang.Class.forName(Unknown Source)
at com.mathworks.mde.desk.StartupClassLoader$LoadInfo.<init>(StartupClassLoader.ja
at com.mathworks.mde.desk.StartupClassLoader.addLoadInfo(StartupClassLoader.java:21
at com.mathworks.mde.desk.StartupClassLoader.createLoadInfos(StartupClassLoader.ja
at com.mathworks.mde.desk.StartupClassLoader.access$400(StartupClassLoader.java:24)
at com.mathworks.mde.desk.StartupClassLoader$2.run(StartupClassLoader.java:138)
at java.util.TimerThread.mainLoop(Unknown Source)
at java.util.TimerThread.run(Unknown Source)
Coef =
-60.62796196506690
-9.88683941790808
78.65753128949814
0.48230922852319
-8.04508163021842
>>
Start

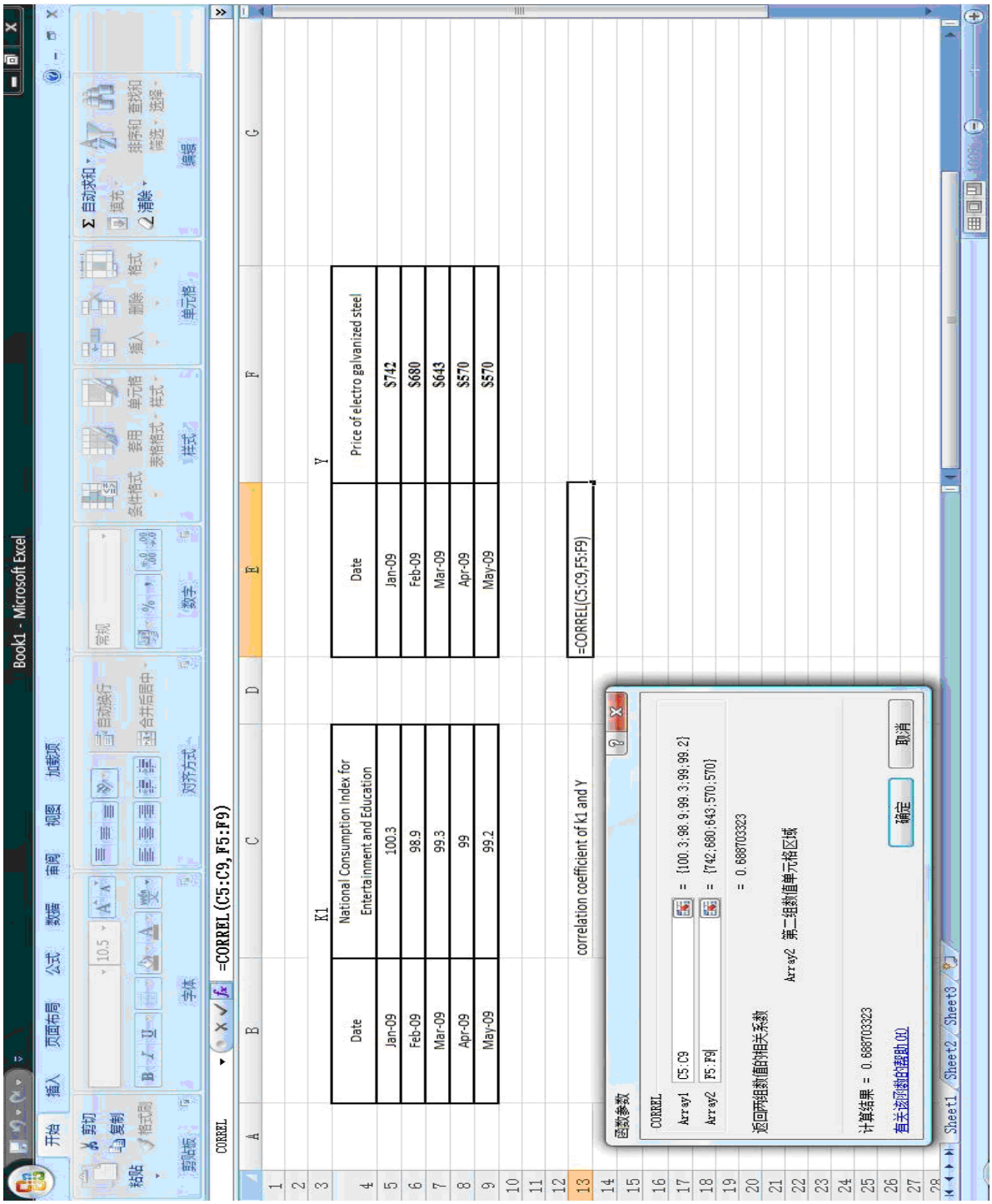
Appendix C

MATLAB code
The words after % are explanations

```
% X * Coef = Y
% Y represents the price of electro galvanized steel(5*1),   Xs represent five variables (5*5), Coef s are correlation coefficients (5*1)
%  y = a1*x1 + a2*x2 + ... + a5*x5
format long;  % it is for improving the accuracy, keep 16 numbers after the point
X = [94.44, 86.9, 101.6517855, 660, 122.7;
    94.01, 86.7, 100.7807451, 550.3, 118.8;
    94.48, 85.9, 100.5930123, 465.15, 113.9;
    95.28, 86.5, 100.1166924, 417.6,  108.7;
    95.4 , 87.1, 99.9640527 , 416.5,  105.5];
Y = [742;680;643;570;570];
% inv(X) represents the inverse function of x
Coef = inv(X)*Y     %  Coef = inv(X) * Y
```

Appendix D

The first picture is calculating the correlation coefficient of K1 and Y in EXCEL



Appendix E

The picture is calculating the correlation coefficient of K2 and Y in EXCEL