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Experience Curve Pricing and Cost Inflation: Evidence from South Korea

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ABSTRACT: Experience curve pricing rests on the notion that as cumulative production doubles, businesses achieve cost reduction through time saving learning. This principle has been applied to various fields such as production management and planning, budget control, pricing and strategy. While the existence of experience curve is documented in various industrial sectors (Boston Consulting Group, 1975) in the USA, however, the literature offers very little evidence of it in international setting. In this paper, we explore experience curve pricing in several industries in South Korea, for two reasons. First, it is a major exporting power in global trade of consumer and high technology products, and second, the period under study, 2003-2008, Korean manufacturing experienced inflation in producer prices. We tested 156 products in 11 industries and found that the cost inflation hindered the experience curve effects, and, once corrected for the inflation, more products display the experience curve effect.

Keywords: *experience curve, pricing strategy, Korean manufacturing.*

JEL Classifications: *M21.*

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1. INTRODUCTION

Since 1920s in airplane production (Wright, 1936), experience curve effect has been an important organizing principle for businesses. In its simplest form, experience curve effects capture the cost reduction solely attributable to learning-by-doing effects. In other words, if no additional capital investment is made, simply by virtue of learning from cumulative production, would lead to cost reduction over time. Arrow (1961) documents that an iron works factory in Sweden realized productivity increases of 2% per annum even though there was no capital investment in 15 years.

The effect has led multitude of researches, so there are several review papers for all the related areas or some specific areas such as Yelle (1979), Day and Montgomery (1983), Alberts (1989), Weiss et al. (2010) and Yeh and Rubin (2012). Reflecting this concern, experience curve became a statistical law (Sallenave, 1985) or even a doctrine (Alberts, 1989) already in the 1980s.

2. LITERATURE REVIEW

Discussions on experience curve effects can be grouped into four categories: confirmation of the experience curve, issues on estimation or forecasting, application, and other factors than experience curve effect.

The first group can be defined as researches for checking the existence of the effect and measure the progress ratio. The effect was found in airplane (Wright, 1936), iron works (Arrow, 1961), various products (Boston Consulting Group, 1970), ship production (Thornton and Thompson, 2001), consumer products (Bass, 1980; Hossain, 2011), environmental control technologies (Rubin et al., 2004a, Yeh et al., 2007), medical device (Brown et al., 2007; Brown et al., 2008) and ethanol (Hettinga et al., 2009; van den Wall Bakea, 2009). In recent years, there seems to be increasing interest in applying experience curve to energy technologies (Neij, 1997; McDonald and Schrattenholzer, 2001); Neij et al., 2004; Nemet, 2006; Rubin et al., 2006; Yeh and Rubin, 2007; 2012; Weiss et al., 2009; 2010).

The second group of studies deals with estimating and forecasting the effect. From this group, various types and sources of experience curve are defined (Yelle, 1979; Day and Mongomery, 1983; Alberth, 2008; Sark, 2008; Weiss et al., 2010; Yeh and Rubin, 2012). In addition, solutions to problems in estimations are offered (Naim and Towill, 1990; Sharp and Price, 1990; Chang, 2010).

The third group can be defined as the application of the experience curve effect. In earlier studies, break even analysis and budget control were popular topics (Yelle, 1979), but application has been extended to government procurement (Anton and Yao, 1987), technology and marketing capability (Chang, 2010), export (Ursic and Czinkota, 1984), assessment of energy policy (Neij, 2004), restoration of cultural heritage (Kim et al., 2010), pricing strategy (Ghemawat, 1985; Brown et al., 2008) and diffusion (Hossain, 2011)

The fourth group is the studies for purposes other than experience curve effect. Jakob and Madlener (2004) pointed out the effect of standardization, and Greaker and Sagen (2008) analyzed the competition between suppliers. Nemet (2006) analyzed that all the cost decrease could not be explained by the experience effect, but considerable portion of it was attributable to market dynamics such as moving to low quality, changes in demand elasticity, fierce competition and standardization. Hong et al. (2010) showed the experience in an area of urology not efficient in urology service, but the experience in the area of oncology is more efficient.

Until now we tried to show all the branches of the effect studies since our main concern is quite different from the past studies. Our research interest starts with the question if the experience curve effects hold in the Korea—a country with one of the largest manufacturing sector but ignored by the previous researchers. Secondly, we include a diverse number of industries to understand if the experience curve is particular to a few or a rule applicable to all kinds of industries. Further, most prior experience curve studies covered periods of stable external conditions such as input price inflation. This study aims to examine the impact of material price inflation on experience curve effects as the data set overlaps with times of rapid input price inflation in South Korea.

3. THE EXPERIENCE CURVE PRINCIPLE AND RESEARCH QUESTIONS

The concept of experience curve indicates that the number of hours needed to manufacture decreased at a uniform rate as the quantity of production increased. The mathematical expression for the experience curve between unit cost and cumulative volume is given by (Day and Montgomery, 1983, p 44)

$$C_n = C_1 n^{-\lambda} \qquad (1)$$

Where

C_n=cost of the nth unit
C_1 = cost of the first unit,
n = cumulative number of units
λ = elasticity of unit costs with respect to cumulative volume.

The above expression suggests that cost per unit will fall by a constant rate of $1\text{-}2^{-\lambda}$. For example, when λ=1, we are dealing with a 50% experience curve, suggesting that cost (or price) will fall to 50% of their original value as experience (measured by cumulative units produced) doubles.

Once plotted the relationship between variable unit cost and cumulative output in logarithmic scales, a linear line that best fit the data is considered the experience curve. An 80% experience curve is considered normal, which bears the following interpretation: every time experience doubles, cost per unit will fall to 80% of their original value (Kortge et al., 1994). In other words, cost is expected to fall by 20% for each doubling of cumulative volume produced. The slope of the experience curve varies widely from product to product and from industry to industry. For example, Ghemawat (1985) compiled empirical estimates of experience curves for over 100 products that show the average slope at 85%, while 15% of the products displayed slope under 70%. Boston Consulting Group (1975) also showed varying rate of learning experience for various sizes of motor cycle engines produced in United Kingdom.

The South Korean Context

Experience curve effect in the United States is widely documented in literature and very little research is done in international markets. Over time, South Korea has become a major manufacturing power in the world, already surpassing China in 2010 (Theglobaleconomy.com). We ask the question whether the widely documented evidence of experience curve effects is a global phenomenon, or a principle observed only in a select number of countries. Although testing experience curve in multiple countries would add much to the existing body of knowledge, due to the punitive data collection difficulty, we add to the literature one country at a time. Being a major manufacturing power in the world today, South Korea lends itself as a natural candidate for extension of the evidence for or against experience curve effects. To our knowledge, this study presents a first attempt to document the South Korean experience on the topic.

There is another reason for choosing South Korea as the context for this study. The notion of experience curve holds well when the underlying economic conditions, such as cost inflation, remain stable. During the period of secondary data collection chosen for this study, 2003-2008, many South Korean industries felt sharp increases in material costs of manufacturing. Rising material cost may offset or mask the decline in cost attained by learning or experience attained due to repeated production routines. Working with a data set for a period known for input cost increase presents an opportunity to examine how far input price increase hinder the statistical evidence for or against the experience curve effect.

Based on the foregoing discussion, we pose the two following research questions:

RQ1: What product categories exhibit statistically significant experience curve effects?

RQ2: Does accounting for input price increase qualify more product categories to exhibit statistically significant experience curve effects?

This paper attempts to make a significant contribution to the literature by expanding the investigation to a major exporting source of the global economy, and by examining the role of input price increase on evidence for or against the experience curve effects. The standard null hypothesis would be that the coefficient λ in equation (1) would be zero. Since we are working with a different country, and the data set includes periods of input price inflation, it would be premature to expect overwhelming evidence for experience curve in South Korea. Hence we approach this study with these two research questions in mind.

4. DATA AND METHODOLOGY

This paper uses time series secondary data on 156 products spanning 11 diverse industries such as machinery, electronics, food and beverage, clothing, and pharmaceuticals. The data is compiled from annual reports of 50 listed companies in the Korean stock market, for the time period 2003 to 2008. The wide number of products and industries are chosen for replication consideration.

The data set, however, is by far one of the most comprehensive among the ones used in the experience curve literature. The potential benefit of analyzing a large number of companies in diverse industries should generate interesting and managerially useful insights. The data set contains information on product name, quantity produced, cost of production, and industry the company belongs to. The main variables of interest are unit cost and level of production units. The units are added over time to arrive at cumulative units. In estimating process we adjust the data along with consumer price index reflecting the price changes during the period. GNP deflator may be used for price adjustment, but we give up the deflator since it can distort some industry as noted by Day and Montgomery (1983).

Once taken logarithm of prices and cumulative units, the experience curve model becomes

$$ln\, C_n = \ln C_1 - \lambda \ln n \tag{2}$$

Where *ln* implies natural logarithm. Model (2) is the so called log-log model that represents the experience curve. Estimation by ordinary least squares regression provides the constant cost elasticity estimate, λ and the first part of the right hand side representing a constant. It is noteworthy that this model does not preclude including other factors that are likely to influence the experience curve. Among these factors that are tested in other research includes degree of product standardization, and economies of scale (Stobaugh and Townsend, 1975), however, cumulative experience showed the most predictive power in explaining price changes. Further, it is common in literature to use either cost or average industry price as the dependent variable, depending on data availability (Day & Montgomery, 1983, p 48; Brown et al., 2007).

5. EMPIRICAL ESTIMATES OF EXPERIENCE CURVES

Ordinary least square regressions are applied to the log-log specification (equation 2) to derive the slope of the curve. Table 1 is the summary of the estimation of 156 products by industry, and all the results with slope parameters as well as the experience curve are attached in the appendix A. As Table 1 demonstrates, adjusting for input price inflation increases the number of products with statistically significant experience curve effect, from 17 percent of all products to 30 percent. Specifically, of the total 156 products, 47 of them show statistically significant experience effects after the adjustment. There were only 26 products showing the effect prior to making price adjustments.

TABLE 1

Evidence of Experience Curve Effects

Industry	# of Products with Statistically Significant Experience Curve		Total No. of Products
	Before Inflation Adjustment	After Inflation Adjustment	
Electronics	15	23	56
Machinery	4	3	26
Pharmaceuticals	4	11	15
Food & Beverage	1	2	17
Chemical / Cosmetics[1]	0	2	17
Metal	0	1	10
Non-metal	0	1	3
Electricity	0	2	7
Clothes	2	2	4
Other Manufacturing	0	0	1
Total	26	47	156

Note 1: Two products in cosmetics industry having no effect are included in chemical industry.

Further, Table 1 shows that experience effect is shown in all industries except other manufacturing and non-metal industry. Despite making allowance for input price inflation, the overall evidence of experience curve effects is mixed. Possible explanations will be provided in the next section and we turn to examining the magnitudes of the experience curve effects.

As for the research question one, the results, as provided in Appendix A, show a range of magnitudes of experience curve on an industry by industry basis. At 73%, Pharmaceuticals show the highest percentage of product categories to exhibit experience curve effects, followed by Clothes (50%), Electronics (41.0%). Only 30% of product categories are statistically significant at 10% (or lower significance level). The experience curve effect range from 1.2% to 53.6% with the median experience curve effect stands at 87% and the average at 84%, suggesting that cost will diminish by about 10-15% every time cumulative output is doubled.

These numbers are consistent with previous studies. For example, Hossain (2011) estimated experience curves for 20 consumer electronics products using U.S. data and found the average experience curve at 90%, with all 20 products displaying statistically significant experience effect. The average estimates compare at about the same level found by the Boston Consulting Group (1975) which found the experience rate at 88%, 76%, and 81% for less than 50 cc, 126-250 cc and 51-125 cc motorcycle engines. It is noteworthy that there are some product categories where the reverse experience curve effect is observed with some of them being statistically significant. This could be attributable to cost increases due to raw material price inflation or wage increase. Unfortunately, our data set is not rich enough to capture all these covariates. The color television in Bass (1980) using data for the first 10 years stood at 95% versus 96% in this study. Note that the other products tested in Bass (1980) were refrigerator, air conditioners, dishwashers, and clothes dryers clocking within 80% to 90% experience curve.

However, the results also indicate huge variations in experience rate. This is understandable given the diverse industries the data is chosen from. One source of this variation is product specific factors such as the level of standardization and the number of product models carried. For instance, color televisions come in various sizes whereas telephone answering machines were sold in much fewer variations. Another potential source of variation is the state of technology prevailing around the time period the products had their growth cycle. In addition, camouflaged in the numbers is the quality improvement over time in many of these products. Color television was broken into a separate product after introduction of stereo sound and improved color reproduction (e.g. digital comb filter) in the mid 1980s.

6. REASONS FOR NON-DETECTION OF EXPERIENCE EFFECT

Even if we estimated the effect using adjusted cost with consumer price index reflecting price level change, we fail to detect statistical evidence in almost 70 percent of all products. This mixed results points to the fact that not all possible factors affecting experience curve effects are accounted for in our estimation. These reasons appear to be idiosyncratic to the diverse industries included in our study. We attempted to trace the reasons for non-existence of experience curve from various sources including the annual reports, websites of the company, and market sources. Table 2 shows the main possible reasons by industry. Although the reasons to be given below would appear qualitative, taken together with the statistical evidence we gathered, they should offer important insights.

The possible reasons are classified into five big groups and 9 small categories: technology, irregular production pattern, producing below capacity, on-demand production, business decision for shut down and relocation, and market related factors. In technology, technological change and specification are categorized. In production pattern, three categories are included: sharp increase in production, production below capacity and on-demand production. In market group, there are two categories: price promotion and competitive reaction.

Among 109 products having no effect, the adverse exchange rate movement is the biggest reason as this potentially accounts for 33 cases, of which 13 are from food & beverage industry, 7 from metal industry and 7 from chemical industry. The exchange rate of Korean Won to 1 US Dollars had increased 22% from 1191.35 in 2003 to 929.16 in 2007, and decreased 18.7% to 1,103.36 in 2008. Different industries are affected differently due to exchange rate movement as the exposure to import and export intricately varies from one company to another. Empirically tackling this matter would be very difficult as most annual reports do not contain foreign market exposure index. The second biggest group is the technology with 29 cases, 22 of which are from the various specifications of product and 7 cases are from technological change, which radically increases cost structure when new technology is adopted and thus makes it difficult for experience curve estimate. The third reason is due to market related factors that most likely affected 19 cases. Production of 17 cases had been unstable during the period, which leads nonexistence of experience effect, because of unstable production volume. This was primarily the case for the machinery industry. Two cases are from real competitive reaction. The fourth group is the production with 17 cases; 10 cases are from below capacity production so there is little experience effect. 6 cases are from production on demand which is especially in the electricity and chemical industry. One case is exceptional since the reason is the quick expansion of production capacity. The fifth reason is an intended gradual business shutdown, perhaps caused by lack of profitability or product obsolescence. Entry and exist of firms in an industry can have significant impact on experience curve and it is important to be mindful of that.

TABLE 2

Reasons for Non-significant Effects

		Electron	Mach	Phar	F&B	Chem	Metal	N-metal	Electric	Cloth	Other	Total
Experience effects		23	3	11	2	2	1	1	2	2		47
Technology	change	6	1									7
	specification	6	7	1	2	2		2		2		22
Production	Sharp increase	1										1
	Below Capacity	5		1		4						10
	On-demand	1				2			2		1	6
Business Shutdown		8	3									11
Adverse Exchange Rate			3		13	7	7		3			33
Market	Price	6	9				2					17
	Competition			2								2
Total		56	26	15	17	17	10	3	7	4	1	156

7. DISCUSSION

While there are overwhelming evidence for the existence of experience curve effects documented in the U.S., the less than perfect evidence found in the Korean manufacturing merits further discussion. We are stretching our analysis to a qualitative level when we cataloged a number of likely reasons for the lack of statistical evidence for a number of products; however, we posit these reasons as a foundation for a future research that could include more quantitative variables surrounding some of these factors cited here. We demonstrate this line of thought by taking material price inflation into consideration and statistically measure the effect using consumer price index adjustment to the cost variable. Material price is one of the major factors to impact the experience curve effect (Staubaugh et al., 1975; Yelle, 1979; Day and Montgomery, 1983; Nemet, 2006; Hettinga et al., 2009; Weiss et al., 2010). The second reason comes from technology such as technological change or various kinds of specification. The other side of various specification, standardization was discussed in Staubaugh and Townsend (1975), Yelle (1979), Day and Montgomery (1983), Jacob and Medlener (2004). The less specification means the more standardization, and the bigger effect. The third reason is from production such as little production, on-demand production and sharp increase. The little production is the other side of scale effects or operation ratio discussed in Liberman (1981), Ghemawat (1985), Alberts (1989), Nemet (2006) and Greaker and Sagen (2008). One reason of on-demand production, which can make unstable production, is not found elsewhere in the existing literature.

8. CONCLUSION, LIMITATIONS, AND FUTURE RESEARCH

This study presented experience curve estimates for 156 products from various South Korean industries and found about 30 percent of them display significant experience curve effect in spite of the worst market dynamics from exchange rate change. It is also noteworthy that the effect appears in 9 industries among 11 sample industries. This is the results from publicly available data, and not from the desired refined in-house data. Even if a further refined data set is used, sometimes negative experience curve effect is reported in literature (see McDonald and Schrattenholzer, 2001, for examples). Therefore, we believe significance in 30 percent of the cases provides a good contribution to the literature.

The model is estimated in its classic form because of data limitation to include possible additional factors such as production below capacity, uneven technological adoption in manufacturing, and international market exposure affected by exchange rate fluctuation. Many of the advantages of the classic model are also its disadvantages, according to critics (Monroe & Della Bitta, 1978). Among the shortcomings are the static nature of the model and the lack of scale effects. In other words, the rate of experience is monotonic in levels of output, regardless of timing or competitor reaction. Further, blindly following the experience curve as a guide for strategic pricing have proved erroneous in certain cases because the expected cost reductions did not materialize (Ghemawat, 1985, p 143). Nevertheless, the simplistic model provides product managers a benchmark on which to base pricing and output decisions. The model can be updated as new cost data is realized from additional production. Further, observing experience curve for several related factors provide a possible range to consider in decision making. Incorporating the factors cited as possible reasons for non-existence of evidence for experience curve effects, macroeconomic data (e.g. per capita income and unemployment rate) and competitive structure of the market will provide excellent extension to the current study.

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Appendix A

Experience Curve Estimates (Adjusted for price inflation): Annual Data (2003-2008)

Note: Lambda= coefficient of cumulative quantity, Experience Curve= 1-2^-lambda,
Experience curve effect is shown in case of 10% significant level.

Industry	Company	Product	Number	Lambda	t-ratio	Experience Curve
Chemical	MH Ethanol	fermented alcohol	1	-0.111	-9.13	0.074
Chemical	MH Ethanol	raw alcohol	2	-0.194	-1.71	
Chemical	Korea Alcohol Ind	acetaldehyde (MT)	3	0.338	2.67	
Chemical	Korea Alcohol Ind	ethyl acetate(MT)	4	0.348	1.73	
Chemical	Korea Alcohol Ind	ethyl alcohol (KL)	5	0.092	1	
Chemical	Korea Alcohol Ind	anhydrous ethyl alcohol (KL)	6	0.049	0.98	
Chemical	Korea Alcohol Ind	raw alcohol (KL)	7	0.114	1.88	
Chemical	Daebong LS	Thiomin-NS	8	-0.051	-0.55	
Chemical	Daebong LS	L-Cysteine HCl H2O	9	0.086	1	
Chemical	Daebong LS	L-Cysteine Free-base	10	0.025	0.16	
Chemical	Daebong LS	ATG-NS	11	-0.06	-0.53	
Chemical	Daebong LS	N-Acetyl-L-Cysteine	12	0.12	1.92	
Chemical	Daebong LS	Erdosteine	13	-0.195	-2.39	0.126
Chemical	Daebong LS	L-Cystine	14	0.302	3.92	
Chemical	Daebong LS	S-Carboxy Methyl Cysteine	15	0.341	4.81	
Clothes	netishion.com	clothes EnC	16	-0.01	-0.2	
Clothes	netishion.com	clothes 96ny	17	0.055	0.88	
Clothes	netishion.com	clothes A6	18	-0.246	-2.86	0.157
Clothes	Goodpeople	clothes	19	-0.234	-4.39	0.15
Cosmetics	Koreana	basic cosmetics	20	-0.021	-0.4	
Cosmetics	Koreana	color cosmetics	21	0.091	0.99	
Electricity	Cheryong Industrial	supporters of ground wire	22	0.221	3.12	
Electricity	Cheryong Industrial	steel pole	23	-0.004	-0.05	
Electricity	Cheryong Industrial	rack	24	-0.142	-0.89	
Electricity	Cheryong Industrial	pole transformer	25	0.054	0.65	
Electricity	Cheryong Industrial	amorphous transformer	26	-0.386	-2.94	0.235
Electricity	Cheryong Industrial	insulation cover	27	-0.118	-2.83	0.078
Electricity	Cheryong Industrial	optical fiber splice closure	28	-0.035	-1.61	

Electronics	**Samyoung Electronics**	**condenser**	**29**	**0.162**	**1.03**	
Electronics	**Samwha Capacitor**	**condenser**	**30**	**-0.162**	**-1.19**	
Electronics	**CU Electronics**	**ear**	**31**	**0.196**	**3.62**	
Electronics	**CU Electronics**	**mould**	**32**	**-0.51**	**-3.14**	**0.298**
Electronics	**DS LCD**	**TV BLU**	**33**	**-0.126**	**-2.64**	**0.084**
Electronics	**Mogem Co**	**window**	**34**	**0.11**	**1.53**	
Electronics	**AMOTECH**	**BLDC motor**	**35**	**-0.185**	**-3.42**	**0.12**
Electronics	**UBTRON**	**DY Part**	**36**	**-0.408**	**-4.96**	**0.246**
Electronics	**UBTRON**	**Magnetron**	**37**	**2.079**	**2.05**	
Electronics	**Interflex**	**FPCB**	**38**	**0.089**	**0.96**	
Electronics	**BI EMT**	**IC-Tray**	**39**	**-0.197**	**-5.08**	**0.128**
Electronics	**BI EMT**	**module-tray**	**40**	**-0.301**	**-4.42**	**0.188**
Electronics	**Sungwoo Techron**	**LOC lead frame**	**41**	**-0.208**	**-2.95**	**0.134**
Electronics	**Nextech**	**scanner for car check**	**42**	**-0.608**	**-4.55**	**0.344**
Electronics	**Wizit**	**water meter**	**43**	**0.452**	**3.35**	
Electronics	**Wizit**	**calorie meter**	**44**	**-0.244**	**-2**	
Electronics	**Wizit**	**gas meter**	**45**	**0.027**	**0.26**	
Electronics	**Wizit**	**electricity meter**	**46**	**0.011**	**0.06**	
Electronics	**CAS**	**LP electronic scale**	**47**	**-0.077**	**-5.05**	**0.052**
Electronics	**CAS**	**MW electronic scale**	**48**	**0.185**	**3.59**	
Electronics	**CAS**	**load cell**	**49**	**0.135**	**2.89**	
F&B	**Lottechilsung Beverage**	**beverage**	**50**	**-0.039**	**-1.94**	
F&B	**Lottechilsung Beverage**	**alcohol**	**51**	**-0.001**	**-0.05**	
F&B	**Maniker**	**fowl**	**52**	**0.601**	**8.77**	
F&B	**Maniker**	**meat processing**	**53**	**-0.006**	**-0.08**	
F&B	**Maniker**	**young chicken**	**54**	**0.113**	**3.17**	
F&B	**Samlip**	**bread**	**55**	**0.035**	**1.35**	
F&B	**Samlip**	**noodle**	**56**	**-0.079**	**-1.28**	
F&B	**Samlip**	**flour for bread**	**57**	**-0.109**	**-1.15**	
F&B	**Samlip**	**snack**	**58**	**-0.09**	**-1.27**	
F&B	**Samlip**	**frozen food**	**59**	**-0.017**	**-0.59**	
F&B	**Orion**	**biscuit**	**60**	**0.024**	**0.28**	
F&B	**Orion**	**chocolate**	**61**	**0.071**	**1.57**	
F&B	**Orion**	**gum**	**62**	**-0.053**	**-2.36**	**0.036**
F&B	**Orion**	**pie**	**63**	**0.026**	**0.51**	
F&B	**Choheung**	**food additive**	**64**	**0.018**	**0.43**	
F&B	**Choheung**	**food**	**65**	**-0.361**	**-3.68**	**0.222**

F&B	**Choheung**	**meat processing**	**66**	**0.087**	**2.03**	
Electronics	**Net Wave**	**network monitor**	**67**	**-0.136**	**-1.7**	
Electronics	**Net Wave**	**optical transmitter**	**68**	**-0.599**	**-4.93**	**0.34**
Electronics	**Net Wave**	**optical transceiver**	**69**	**-0.26**	**-1.72**	
Electronics	**Net Wave**	**amplitude modulator**	**70**	**0.696**	**0.72**	
Electronics	**Net Wave**	**trunk bridge amplifier**	**71**	**-0.101**	**-1.41**	
Electronics	**Net Wave**	**extension amplifier**	**72**	**-0.484**	**-0.96**	
Electronics	**Net Wave**	**coupler**	**73**	**-0.292**	**-3.61**	**0.183**
Electronics	**Enter Tech**	**karaoke mike**	**74**	**-0.066**	**-1.43**	
Electronics	**Enter Tech**	**sub mike**	**75**	**0.421**	**0.72**	
Electronics	**Enter Tech**	**additional chip**	**76**	**-0.116**	**-1**	
Machinery	**Kodaco**	**throttle body**	**77**	**0.033**	**0.53**	
Machinery	**Kodaco**	**Solended valve**	**78**	**0.115**	**1.38**	
Machinery	**Kodaco**	**oil pump**	**79**	**0.089**	**1.07**	
Machinery	**Kodaco**	**manifold**	**80**	**0.011**	**0.16**	
Machinery	**Kodaco**	**air-conditioning parts**	**81**	**0.063**	**1.63**	
Machinery	**Kodaco**	**steering parts**	**82**	**0.209**	**5.38**	
Machinery	**KCW**	**blade**	**83**	**-0.04**	**-0.92**	
Machinery	**KCW**	**arm**	**84**	**0.194**	**1.73**	
Machinery	**KCW**	**linkage**	**85**	**0.012**	**0.25**	
Machinery	**KyungYoon Hydro Energy**	**grain**	**86**	**-0.104**	**-5.47**	**0.07**
Machinery	**KyungYoon Hydro Energy**	**split & synthetic**	**87**	**-0.192**	**-1.26**	
Machinery	**Daedong**	**tractor**	**88**	**0.015**	**1.41**	
Machinery	**Daedong**	**combine**	**89**	**-0.101**	**-2.03**	**0.068**
Machinery	**Daedong**	**cultivator**	**90**	**0.069**	**0.88**	
Machinery	**Daedong**	**rice planting machine**	**91**	**-0.013**	**-0.1**	
Machinery	**KIC Limited**	**hard facing**	**92**	**-0.217**	**-1.94**	
Electronics	**THN Corporation**	**wiring harness for Ecus**	**93**	**-0.734**	**-7.57**	**0.399**
Electronics	**THN Corporation**	**wiring harness for Tuscany**	**94**	**-0.756**	**-8.21**	**0.408**
Electronics	**THN Corporation**	**wiring harness for Santafe**	**95**	**-0.299**	**-9.85**	**0.187**
Electronics	**THN Corporation**	**wiring harness for Avante**	**96**	**-0.18**	**-4.81**	**0.117**
Machinery	**DIO**	**wrapping machine (automatic)**	**97**	**-0.106**	**-1.24**	
Machinery	**Romanson**	**watch**	**98**	**-0.217**	**-4.6**	**0.14**
Machinery	**Solco Biomedical**	**health care**	**99**	**-0.236**	**-0.74**	
Machinery	**Solco Biomedical**	**surgical instruments**	**100**	**-0.283**	**-0.96**	
Machinery	**Solco Biomedical**	**metallic biomaterials**	**101**	**0.283**	**1.34**	
Electronics	**Mirae Corporation**	**test handler**	**102**	**0.294**	**2.2**	

Electronics	**Mirae Corporation**	**chip mounter**	**103**	**-0.147**	**-2.94**	**0.097**
Machinery	**Chokwang ILI**	**security valve**	**104**	**0.162**	**1.56**	
Machinery	**Chokwang ILI**	**steam trap**	**105**	**-0.071**	**-0.17**	
Machinery	**Chokwang ILI**	**pressure valve**	**106**	**0.103**	**0.59**	
Machinery	**Chokwang ILI**	**strainer**	**107**	**-0.233**	**-0.7**	
Machinery	**Jinsung TEC**	**under carriage roller**	**108**	**0.152**	**6.26**	
Electronics	**Hankwang**	**laser processor (hybrid type)**	**109**	**-0.265**	**-3.49**	**0.168**
Electronics	**Hankwang**	**laser processor (flying optic type)**	**110**	**-0.145**	**-3.62**	**0.095**
Electronics	**Nexentech**	**wiring harness for car**	**111**	**0.04**	**0.88**	
Metal	**dongyang steel pipe**	**coated steel pipes for water works**	**112**	**0.129**	**1.57**	
Metal	**dongyang steel pipe**	**uncoursed pipe**	**113**	**0.156**	**1.52**	
Metal	**dongyang steel pipe**	**gas pipe**	**114**	**0.315**	**6.1**	
Metal	**dcm corporation**	**laminated color steel plate**	**115**	**0.025**	**0.53**	
Metal	**dcm corporation**	**industrial film**	**116**	**0.137**	**3.66**	
Metal	**Shinhwasilup**	**tin plate**	**117**	**0.155**	**2.81**	
Metal	**Korean Cast Iron Pipe**	**ductile iron pipes**	**118**	**0.06**	**1.39**	
Metal	**Korean Cast Iron Pipe**	**coated steel pipes for water works**	**119**	**0.079**	**1.41**	
Metal	**Hanil Iron & Steel**	**steel plate**	**120**	**-0.202**	**-2.04**	**0.13**
Metal	**Hanil Iron & Steel**	**steel processing**	**121**	**-0.065**	**-0.66**	
Non metal	**ChosunRefrector**	**refractories (formal)**	**122**	**0.214**	**4.94**	
Non metal	**ChosunRefrector**	**refractories (informal)**	**123**	**-0.004**	**-0.17**	
Non metal	**ChosunRefrector**	**refractories (special)**	**124**	**-0.07**	**-2.63**	**0.047**
Other	**Daewonsanup**	**car sheet**	**125**	**-0.117**	**-1.29**	
Pharma	**Green cross**	**Zenol**	**126**	**0.799**	**1.67**	
Pharma	**Green cross**	**Eeurokinase**	**127**	**-0.363**	**-3.57**	**0.222**
Pharma	**Dong-a Pharm**	**Baccus D 100ml**	**128**	**-0.022**	**-0.95**	
Pharma	**Dong-a Pharm**	**Nicetil 60T**	**129**	**-0.072**	**-7.42**	**0.049**
Pharma	**Dong-a Pharm**	**Phanpirin F 20ml**	**130**	**-0.106**	**-2.28**	**0.071**
Pharma	**Dong-a Pharm**	**Gaglin 250ml**	**131**	**-0.15**	**-8.15**	**0.099**
Pharma	**Dong-a Pharm**	**Circuran 120c**	**132**	**-0.036**	**-0.31**	
Pharma	**Dong-a Pharm**	**Stilen 500 cap**	**133**	**-0.017**	**-2.49**	**0.012**
Pharma	**Dong-a Pharm**	**Epocerin 1gx10**	**134**	**-0.121**	**-2.5**	**0.081**
Pharma	**Kwangdong Pharm**	**Ssanghwatang**	**135**	**-0.043**	**-4.69**	**0.03**
Pharma	**Kwangdong Pharm**	**Cheongsimwon**	**136**	**-0.198**	**-3.71**	**0.128**
Pharma	**Kwangdong**	**Hardyol**	**137**	**-0.242**	**-2.78**	**0.155**

	Pharm					
Pharma	**Kwangdong Pharm**	**Vita 500**	**138**	**-0.044**	**-2.86**	**0.03**
Pharma	**Kwangdong Pharm**	**Copolang**	**139**	**-0.282**	**-2.52**	**0.178**
Pharma	**Kwangdong Pharm**	**Doxipluridin**	**140**	**-0.161**	**-1.28**	
Electronics	**LG Electronics**	**CTV**	**141**	**0.258**	**2.04**	
Electronics	**LG Electronics**	**monitor**	**142**	**0.469**	**1.27**	
Electronics	**LG Electronics**	**mobile unit**	**143**	**0.402**	**1.84**	
Electronics	**LG Electronics**	**RMC(DRM)**	**144**	**-0.581**	**-7.58**	**0.332**
Electronics	**LG Electronics**	**storage**	**145**	**0.187**	**3.71**	
Electronics	**LG Electronics**	**PC**	**146**	**-0.19**	**-1.08**	
Electronics	**LG Electronics**	**AV(DAV)**	**147**	**0.483**	**3.7**	
Electronics	**LG Electronics**	**PDP**	**148**	**1.36**	**3.87**	
Electronics	**LG Electronics**	**refrigerator**	**149**	**0.233**	**2.63**	
Electronics	**Samsung Electronics**	**CTV**	**150**	**1.348**	**6.51**	
Electronics	**Samsung Electronics**	**Monitor**	**151**	**11.653**	**2.78**	
Electronics	**Samsung Electronics**	**HHP**	**152**	**-0.059**	**-0.44**	
Electronics	**Samsung Electronics**	**Memory**	**153**	**-1.107**	**-10.3**	**0.536**
Electronics	**Samsung Electronics**	**LSI**	**154**	**-0.383**	**-6.24**	**0.233**
Electronics	**Samsung Electronics**	**HDD**	**155**	**-0.172**	**-2.29**	**0.112**
Electronics	**Samsung Electronics**	**TFT-LCD**	**156**	**-0.276**	**-4.44**	**0.174**