

A System Dynamics Simulation on KIKO Derivatives and its Implications from International Trade

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Abstract

Derivatives can be easily bought by those companies that need to hedge foreign currency debt or foreign currency assets through the financial market, considering their exchange rate exposure from international trade. The derivatives market has been growing rapidly due to the needs for investment and hedging. To manage foreign exchange risk, companies hedge risks through financial derivatives. According to our study, hedging is an effective way to mitigate the impact of exposure to exchange risk, as long as companies are only hedging underlying assets. Yet, covetous attitude toward the profit from derivatives and unexpected changes in exchange rate can cause problems for companies. This study analyzed the structural risks of derivatives with analysis of system dynamics. In particular, many companies suffered substantial loss due to KIKO during the economic crisis. We explained the problem therein through dynamic analysis. In addition, we revealed the structural problem that could cause a sudden spike in losses through simulations.

Keywords: Foreign Exchange Exposure, FX Hedge, Causal Loop Diagram, System Dynamics, KIKO, Derivatives, International Trade

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I. Introduction

The derivatives market in Korea has grown rapidly. Table 1 shows that domestic financial derivatives trading amounted to 57 quadrillion won in 2013. Considering that the annual budget of the Korean government is 385 trillion won, it is not hard to imagine how large the market for derivatives is. The securities derivatives are traded through securities companies; most of the currency derivatives are traded by banks. It is inevitable that such a large scale of trading has a significant impact on the domestic economy.

〈Table 1〉 Trading volume of derivatives by financial companies

(Unit: Trillion won, %)

Div	2012	2013					
			Bank	Securities	Insurance	Trust	Etc
Total	60,564	57,121	12,424	42,950	101	692	954
Stock	40,988	37,456	83	36,879	25	153	316
Derivatives Option	40,825	37,334	58	36,786	21	153	316
Interest Rate	9,203	9,634	3,605	5,352	32	152	493
Interest rate SWP	2,320	2,588	2,199	385	1	2	1
Currency	10,307	9,957	8,721	668	43	381	144
Forward Exchange	9,107	8,695	8,089	252	26	322	6
Credit	28	41	3	37	1	0	0
CDS	21	33	3	30	0	0	0
Etc	38	33	12	14	0	6	1

Financial Supervisory Service on April 1, 2014

The main reason of purchasing trading derivatives is to hedge their exchange rate risk (Kim and Ban, 2002). As the international trades by domestic companies have grown, the exposure from exchange rate has increased. It is why many companies manage the risk of exchange rate through derivatives. Therefore, the market has recorded rapid growth. Due to the excessive dependency upon foreign markets, many companies have been affected by changes in exchange rate in terms of managerial issues (Kwon and Hwang, 1999). To hedge this exchange rate risk, most of the companies choose derivatives.

The economic crisis triggered by sub-prime mortgages from the United States in 2008 had a huge impact on the Korean economy (Kim and Kim, 2009). The roller-coaster fluctuation

of macroeconomic variables such as exchange rate, stock prices, and interest rate drove the domestic economy into confusion. Particularly, due to a sudden spike in the exchange rate, many small and medium-sized companies were suffering for years. The companies that purchased KIKO (Knock-In Knock-Out) option faced a huge amount of foreign exchange losses. KIKO option is one of the derivatives that was used by many exports companies to manage exchange rate risk in a time when the exchange rate was stable before 2008 (Kim and Jun, 2012). It was developed to manage the risk caused by changes in exchange rate when the exchange rate was in a stabilizing trend. It was a financial product derived from forward exchange. KIKO has one of the inherent risks that derivatives have. But many companies overlooked the risks, and bought it only with the view of favorable aspects. Financial institutions also advertised favorable conditions (Kim and Jun, 2012).

But exchange rate changes have a hard-to-predict volatility (Kwon and Hwang, 1999). As the changes in exchange rate fluctuated from the financial meltdown, KIKO caused tremendous losses for companies. Losses of domestic companies reached 3 trillion and 200 billion won, and the related lawsuits are still ongoing despite the ruling by the Supreme Court in September 2013 (Edaily, April 2nd, 2014). The derivatives for managing exchange rate risk became a risky product that greatly increased the risk of exchange rate unintentionally. Companies might misunderstand the structural risk of derivatives. We analyzed the structure of derivatives using system dynamics, and we found the structural problems of KIKO. Through simulation, we try to confirm the risks involved in the fluctuation of exchange rates.

II. Literature Review

To understand derivatives hedging exchange rate risk, we need to know the exposure for exchange rate risk because companies conduct foreign exchange hedging to protect the value that otherwise can be lost due to foreign exchange exposure. Foreign exchange exposure is the very sensitive issue for a company's value due to unexpected changes in the exchange rate (Adler & Dumas, 1984).

Adler and Dumas (1984) researched foreign exchange exposure by measuring coefficient rings' exposure to the earning rate of stocks. Changes in value influenced by foreign exchange exposure were found in the empirical analysis. Jorison (1990) conducted an empirical analysis

on multinational corporations in the United States. Khoo (1994) analyzed foreign exchange exposure of mining companies in Australia. And Donnelly and Sheehy (1996) analyzed inherent foreign exchange exposure by researching export companies in Britain. There are many papers that study foreign exchange derivatives as a way to mitigate foreign exchange exposure. Allayannis and Ofek (2001) found that foreign exchange derivatives were useful in managing foreign exchange exposure. These studies have become a starting point of developing FX (Foreign Exchange) management skills. FX risk management strategies can be categorized into three (Bartram et al., 2010): financial, operational, and pricing strategies. Financial strategy is to manage exchange rate risk through FX hedging. Operational strategy is to manage exchange rate risk through foreign investment or diversification of a company. Pricing strategy is to shift the burden caused by exchange rate to a sales price. It can be said that companies do not consider only one strategy to map out hedging but consider various options.

In Korea, through the foreign exchange crisis of 1997 and the financial crisis of 2008, the importance of managing FX risk has been expanded. And studies on derivatives have been aggressively carried out. Kim and Ban (2002) said that the crucial factor to using derivatives is to hedge foreign exchange exposure. Koh and So (2012) examined the impact of FX risk hedging through currency derivatives on the value of a company. Kwon and Park (2013) explained that derivatives play a positive role in managing foreign exchange exposure by analyzing data of manufacturing companies listed on the Korea stock market from 2005 to 2010. In addition to those papers, many studies have found that derivatives played a positive role in managing foreign exchange exposure. Yet, Kwon *et al.* (2010) suggested that hedging through derivatives is not helpful for managing foreign exchange exposure by analyzing cash flows of listed companies in Korea from 2004 to 2008. It seemed that it was a time when the exchange rate was stable and thus did not have significant risks against foreign exchange exposure. However, many studies were done in a time of economic slowdown. And foreign exchange risk suggested that derivatives would be very useful. Based on this, we want to try dynamic analysis in relation to the impact of derivatives on companies through a causal loop diagram and simulation. Through these analyses, we aim to confirm the usefulness of derivatives and structural risks of KIKO.

III. System Dynamics and the Basic Model of Derivatives

1. System dynamics

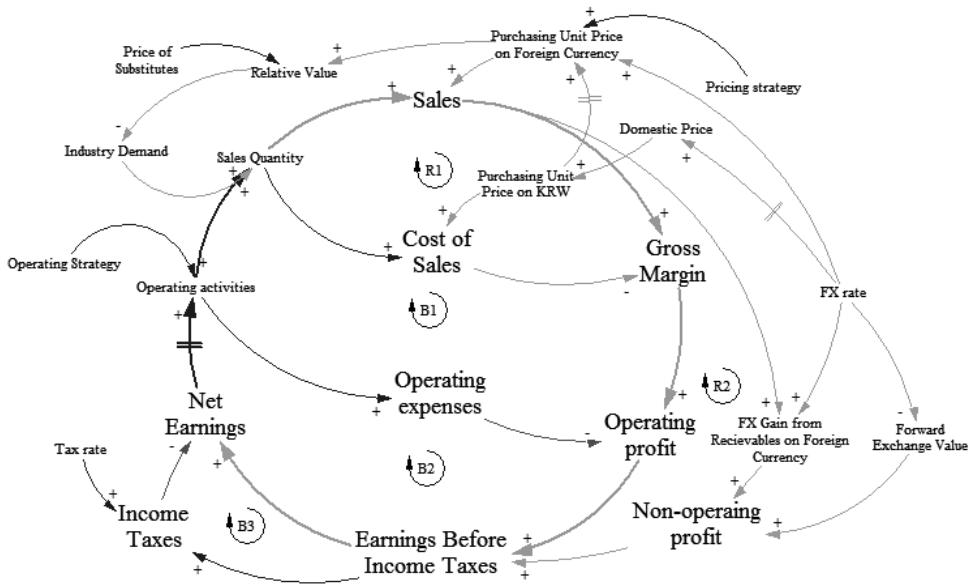
System dynamics was started by Jay Forrester, a professor at MIT, in the 1960s and developed into industrial dynamics, business dynamics, urban dynamics, business dynamics, and world dynamics (Forrester, 1961:1969; Sterman, 2010; Chung and Lee, 2012). Systems thinking requires holistic thinking, feedback and time-based thinking (Kim, 2008). Its characteristics include forming a causal relationship between each component, analyzing dynamic structures to understand the whole system, detecting problems, and finding solutions (Kim *et al.*, 1999; Jung and Kim, 2009).

The more the companies are engaged in sales, the more they are exposed to foreign exchange. That is why they hedge foreign exchange to maintain the value of a company. Dynamic analysis seems to be more appropriate than static analysis to analyze such activities. Kwon (2012) argued that the reason there were not many studies that adopted system dynamics in the financial market was that traditional economists and financial specialists were not comfortable with the system dynamics that originated from engineering. According to Soros and Gardner (1987), a financial market should be regarded as an organism in which interactions among market participants and expectations are always changing in a dynamic way, rather than a subject of static balance affected by the invisible hand, which they called reflexivity theory. The claim is in line with the systems thinking. In this regard, we adopted systems thinking to explain KIKO since it is originated from the financial market.

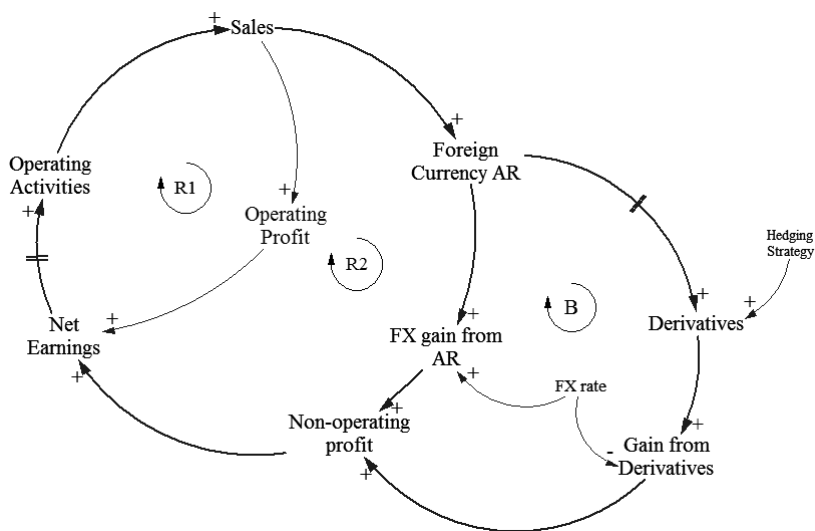
2. Drawing basic model

A basic model of derivatives was drawn from Figure 1, a causal loop diagram of financial strategy suggested by Eom *et al.* (2014). Figure 1 is a causal loop diagram of financial strategy that is standard for regular export companies. The reason why companies buy derivatives is to hedge the risks of foreign exchange exposure. Thus, we bring the basic model of derivatives from a causal loop diagram of financial strategy. Figure 1 shows various activities of companies. It is not easy to determine the causal effect of derivatives due to the

impact of net earnings caused by other factors. We made a model and simulation in this paper. Figure 2 was drawn from Figure 1. It shows a simplified causal loop diagram focusing on derivatives to more clearly understand the impact of derivatives. Sales are generated by the sales activities of a company; Account Receivables(AR) are generated from international trades.



[Figure 1] Causal loop diagram depending on the financial strategy(Eom et al., 2014)



[Figure 2] Simplified causal loop diagram of derivatives

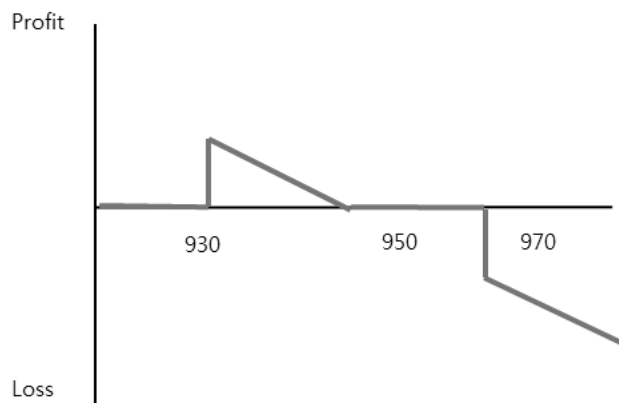
And, if AR are increased, foreign currency receivables are also increased. To hedge the exchange rate risk against foreign currency receivables, companies normally buy derivatives. There is some delay because of the observation of foreign currency receivables. Derivatives is normally expected not for gain, but for hedge. If FX gain from AR increase, Gain from Derivatives should decrease because of the purpose of the hedge.

IV. Causal Loop Diagram and Simulation for KIKO Derivatives

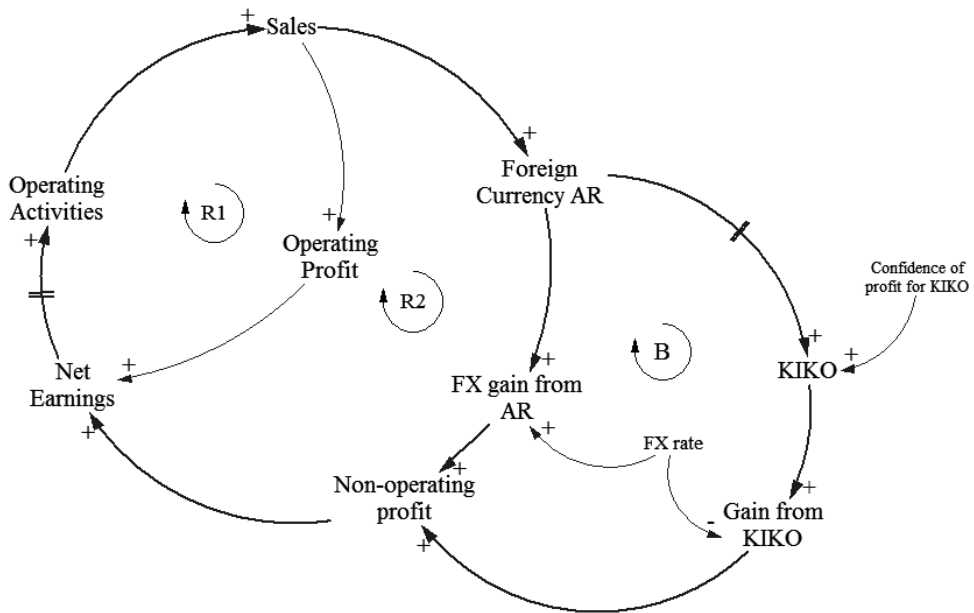
1. Structural analysis on KIKO derivatives

KIKO is a currency option contract consisting of “Knock-in” and “Knock-out”. It is a currency option combined with put option and call option. Knock-in means that the option becomes effective after a certain point, and Knock-out means that the option becomes invalid if the exchange rate reaches a certain point. In other words, if the exchange rate reaches a pre-contracted point, the contract becomes either knock-out or knock-in. This condition can control the wielding price and dealing price of an option to a level that a client wants. Knock-out condition to a purchasing put option can reduce the scope of hedge and increase the sale price of the call option higher than the purchase price of the put option, which increases the wielding price of the KIKO option. Existing hedging methods such as forward exchange or exchange risk insurance require fees or deposits. These can be accepted as a necessary cost to manage risks. But it would be considered a good change for companies not to pay such costs if possible. There can be a certain amount of foreign-exchange profit, which could be very attractive for companies. If the exchange rate slides into a range that forms knock-in and knock-out, there can be some profit. But, if the exchange rate escape from the range, the company has to bear a huge amount of losses. However, if an export company made a contract within the estimated amount of exports, foreign exchange exposure is minimized since it can have exchange profit in the export amount. In that case, it cannot expect exchange profit in a range, which was why it made a leverage contract exceeding the export amounts. Due to a sudden spike in the exchange rate, foreign exchange loss from KIKO exceeded the exchange profit from exports which led to a significant amount of losses

for companies. Figure 3 well represents the KIKO currency option(Kim *et. al.*, 2012). If a knock-in and knock-out range is set, this range does not have a cost price, and can generate profit. Put option becomes invalid in knock-out range and call option becomes valid in knock-in range. If a company has a KIKO contract only for hedging, it does not generate any particular losses since it offsets them in the sale of the call option. But it seems that companies made a mistake in this point. They overlooked the fact that there can be a low risk only when the exchange rate is stable. While they have a low risk in a stabilized exchange rate, the risk could skyrocket if the exchange rate increases suddenly. To get a zero cost and some profit in knock-in and knock-out, they had to make a contract twice size of put option price. That is why many companies made contracts far exceeding their export amount. Figure 4 is similar to the causal loop diagram of general derivatives. However, they have a structure of varying the purchase amount of KIKO depending on the certainty of having a profit. KIKO can also act like general derivatives if one purchases KIKO thinking of the function of general derivatives. To have the function of an option, one needs to make a contract twice the size of the put option price, which is why it increases risks if you try to have a profit from KIKO. We can see delay effect on R1 and B loop. If a company get good net earnings, CEO decides to strengthen operating activities to get more net earnings. And after a company finds out what foreign currency AR increase, it increases KIKO.



[Figure 3] Profit and loss structure of KIKO by each section(Kim *et. al.*, 2009)



[Figure 4] Causal loop diagram of KIKO derivatives

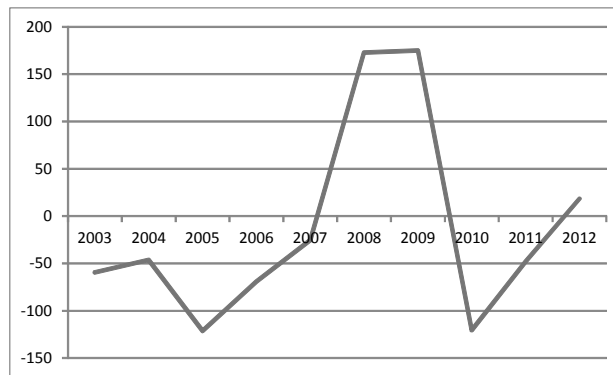
2. Financial crisis and KIKO

The world financial crisis that started from the sub-prime mortgage crisis in the United States in 2008 instantly changed the atmosphere of the world economy and dealt a major blow to the Korean economy (Kim and Kim, 2009). Many companies had not forecasted the financial crisis.

Table 2 suggests that there were no big fluctuations in the exchange rate from 2003 to 2008. The fluctuation got a sudden increase in the exchange rate after May 2008. The monthly change was more than 200 won. The fluctuation was stabilized in around January 2011. Table 3 shows how much loss companies had suffering from KIKO due to the exchange rate fluctuation caused by the economic shock. Consequently, KIKO caused a significant amount of losses, 3.2 trillion won in total; 2.3 trillion won of which was from small and medium-sized companies. This suggests that how inexperienced those small and medium-sized companies were with FX hedging. Financial institutions that sold KIKO did not give a sufficient explanation of the risks. After all, companies suffered from losses and filed lawsuits against banks. Many small and medium-sized companies were enraged at financial institutions that had sold KIKO as if it had no risks. As of April 2014, there are still

lawsuits, and indirect damages from KIKO would reach 1 trillion won (Edaily, April 2nd, 2004). Table 4 presents the list of lawsuits(Kim and Jun, 2012) Many companies suffered from material loss due to KIKO and filed lawsuits. Still, lawsuits have not been closed. That means that there were significant aftereffects. Most of the cases were ruled that financial institutions had not fulfilled their responsibility.

<Table 2> Yearly changes in FX rate(unit: won)



<Table 3> Losses of companies that made KIKO contracts

Division	Realized gain and loss (₩ 100 mil.)			Non-realized gain and loss (₩ 100 mil.)			Total gain and loss (= realized + non-realized) (₩ 100 mil.)		
	Dec. 31st. 2008	Dec. 31st. 2009	Dec. 31st. 2010	Dec. 31st. 2008	Dec. 31st. 2009	Dec. 31st. 2010	Dec. 31st. 2008	Dec. 31st. 2009	Dec. 31st. 2010
Small and Medium-sized companies	-14,970	-21,935	-22,582	-8,842	-1,459	-678	-23,812	-23,394	-23,260
Large corporations	-5,980	-8,645	-8,987	-2,807	-245	0	-8,787	-8,890	-8,987
Total	-20,950	-30,580	-31,569	-11,649	-1,704	-678	-32,599	-32,284	-32,247

Released by the Financial Supervisory Service in October 2010

<Table 4> Lawsuits in relation to KIKO

<p>August 2008, the first lawsuit on KIKO S&T Motors filed a lawsuit against SC Jeil Bank, arguing “We lost 4.8 billion due to an unfair contract.”</p>
<p>October 2008, the Court ruled to start a regenerative process for the first time for a company damaged by KIKO Daegu District Court ruled that IDH had to start recovery procedure.</p>
<p>November 2008, 97 small and medium-sized companies filed a class action against 13 banks that sold KIKO such as Citi, SC Jeil, Shinhan and Korea Exchange Bank in Seoul Central District Court</p>

arguing, “KIKO contracts are invalid.”

December 2008, the Court ruled that the banks were responsible for the sale of KIKO for the first time with regard to the injunction filed by Monami and DS LCD against SC Jeil bank.

January 2009, Seoul Central District Court dismissed the injunction to suspend KIKO filed by Jinyang Shipping against Shinhan.

April 2009, Seoul Investment, an investment firm, filed a class action against Jinseong TEC arguing that Jinseong caused losses to investors by falsely announcing quarterly earnings without disclosing losses from KIKO.

April 2009, Court dismissed most of the injunctions against KIKO. Seven cases were dismissed among 10 cases filed by 10 companies against five banks.

February 2010, Seoul Central District Court ruled against the plaintiff, Soosan, for a lawsuit against Woori Bank and Citi Bank for a claim for recapture of wrongful profits.

November 2010, Seoul Central District Court did not acknowledge the unfairness of KIKO in a lawsuit filed by 118 small and medium-sized companies against banks for restitution of unjust enrichment. Court ruled partial responsibilities of banks against 19 companies.

December 2011, Seoul High Court ruled partially for Saeshin Precision in a damage claim suit filed against Shinhan Bank and SC Jeil Bank arguing that KIKO caused 4 billion won in losses.

September 2013, The Supreme Court ruled for banks.
KIKO was ruled to be a product suitable for hedging exchange rate risk.

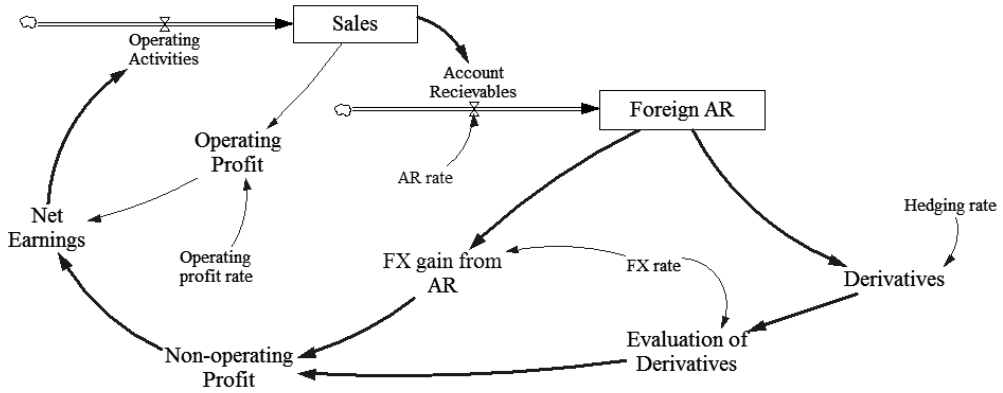
By the end of March 2014, lawsuits against KIKO include 15 cases in the first trial, eight cases in the second trial and 42 cases in the third trial. 151 companies appealed the case at the first trial and 82 companies appealed the case at the second trial.

(Revised from Kim and Jun, 2012)

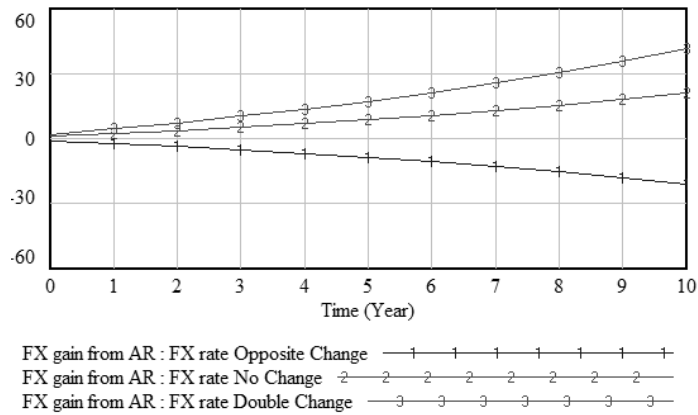
3. Stock-flow diagrams and simulation of general derivatives

For the simulation of the derivatives, the following figure 5 was made. Variables include the general financial conditions of companies. Since the causal loop diagram was made based on financial statements, the Stock-Flow Diagram was constructed considering financial statements, trade receivables and business profit rate. And, changes in exchange rate were added as ‘Opposite Change’, ‘No Change’, ‘Double Change’ to observe the changes according to influences; ‘No change’ means no changes in exchange rate; ‘Opposite Change’ means the exchange rate is in a downward direction; ‘Double Change’ means the exchange rate changes at a doubling speed. Assuming that other conditions are consistent, changes look linear. Foreign account receivables profits are offset with the value of derivatives, which means that non-operating profit does not have an impact. This shows hedge ratio is 1, assuming that it achieved complete hedge. And we can get the results of simulation like Figure 6, Figure 7,

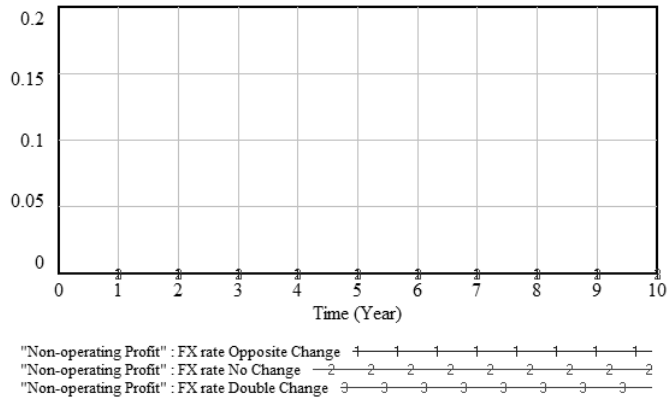
Figure 8, and Figure 9.



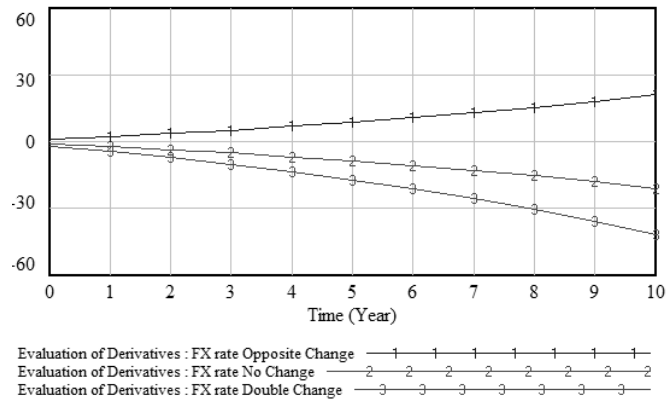
[Figure 5] Stock-flow diagram of general derivatives



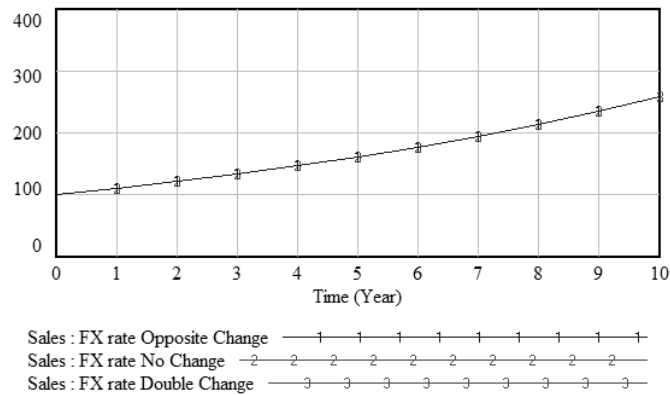
[Figure 6] Simulation results of the profits of foreign exchange AR in accordance with the changes in exchange rate



[Figure 7] Simulation results of the evaluation of derivatives in accordance with the changes in exchange rate



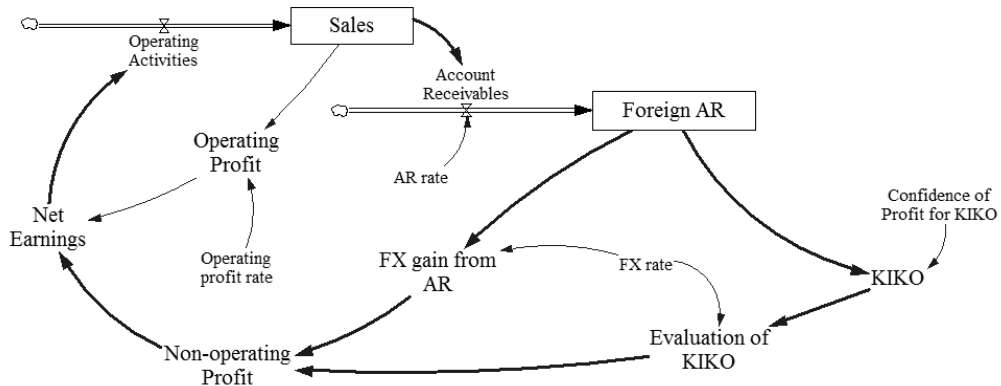
[Figure 8] Simulation results of non-operating profit in accordance with the changes in exchange rate



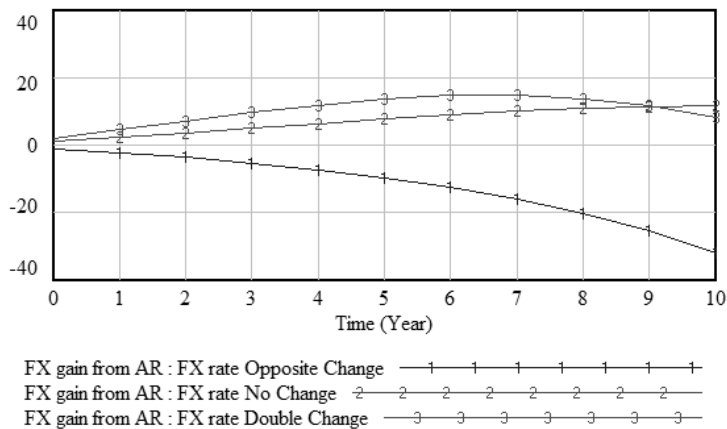
[Figure 9] Simulation results of sales in accordance with the changes in exchange rate

4. Stock-flow diagram and simulation of KIKO

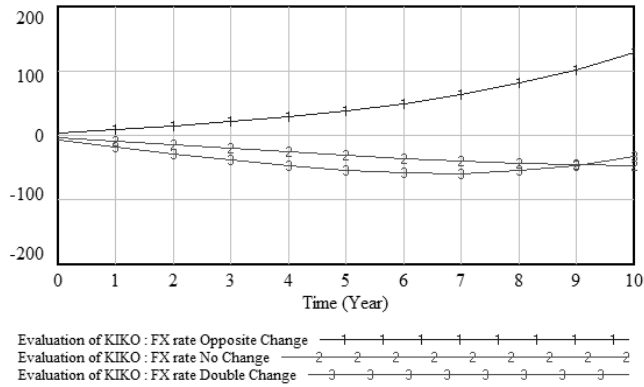
Stock-flow diagram(Figure 10) and simulation results of KIKO(Figure 11, 12, 13, 14) are as follows: net earnings during the term can significantly increase or decrease in accordance with the changes in exchange rate. Changes due to exchange rate fluctuation can be huge. If net earnings during the term are decreased, sales operation can be hampered and sales reduced. Profits from KIKO lead to excessive purchasing much more than what was planned, which can lead to a significant amount of loss due to a sudden spike in the exchange rate. This could return to the original goal somewhat.



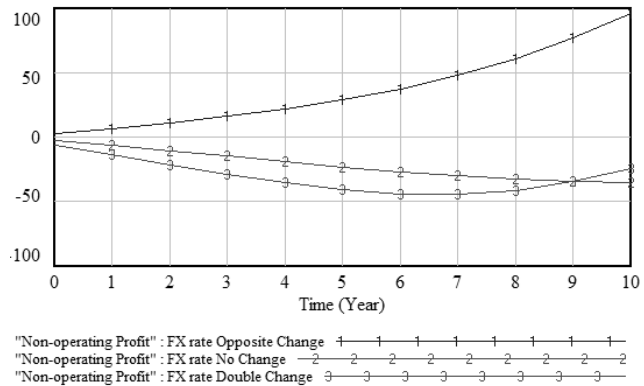
[Figure 10] Stock-flow diagram of KIKO derivatives



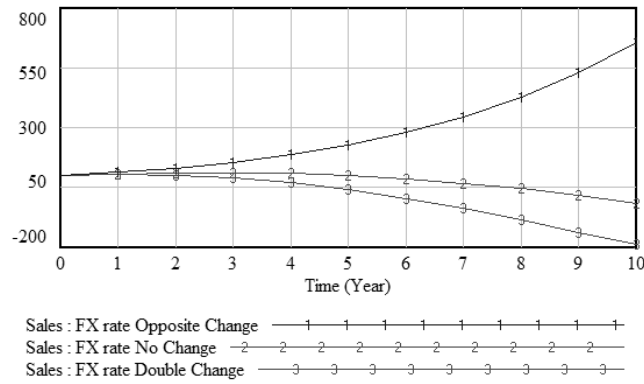
[Figure 11] Simulation results of the profits of foreign currency AR in accordance with the changes in exchange rate



[Figure 12] Simulation results of the evaluation of derivatives in accordance with the changes in exchange rate



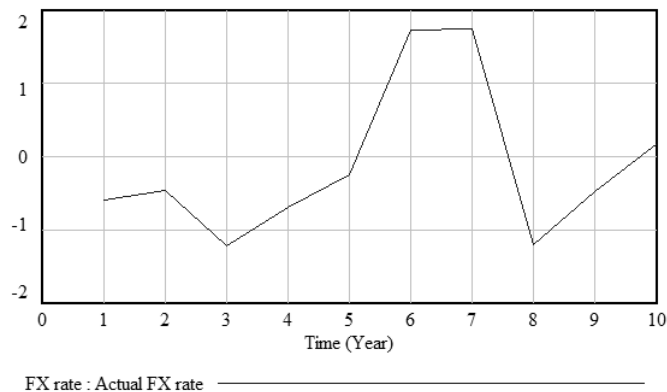
[Figure 13] Simulation results of non-operating profit in accordance with the changes in exchange rate



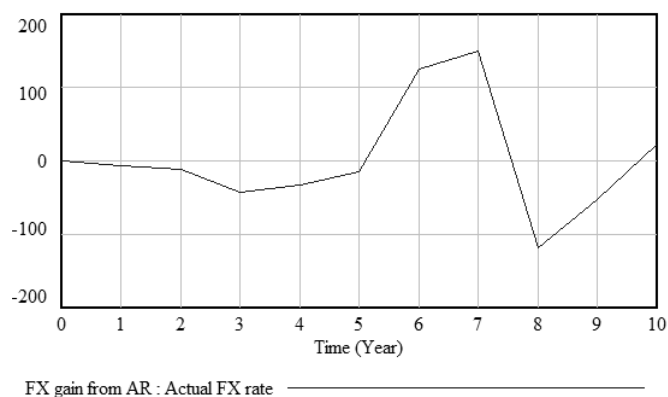
[Figure 14] Simulation results of sales in accordance with the changes in exchange rate

5. Simulation scenarios and results

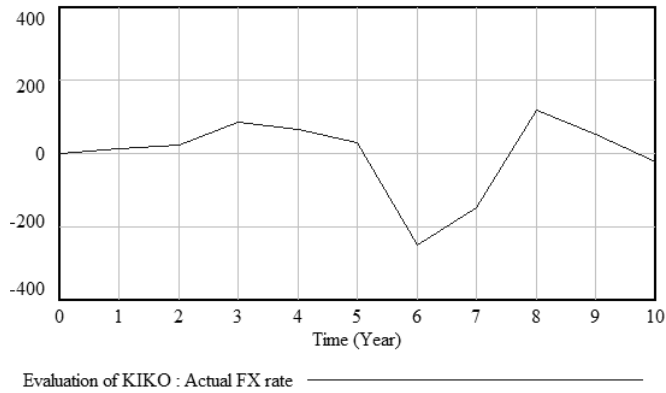
We reviewed the impact of exchange rate on the net earnings during the term through general derivatives and KIKO. Next is the simulation of the actual exchange rate fluctuation from 2003 to 2012. The results are as follows. Figure 15 shows the actual exchange rate fluctuation for 10 years, which shows a high increase in the sixth year (2008) and seventh year (2009). At that time, companies considered that the exchange rate could be in a stable condition or in a downward direction. That is why they regarded the product to be favorable in case of a stable or decreasing exchange rate. They did not expect the exchange rate would increase and profits from foreign accounts receivable would decrease risks at a certain level.



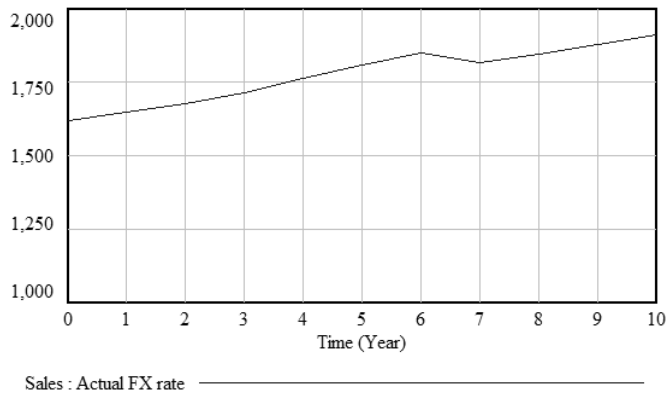
[Figure 15] Exchange rate fluctuations (2003-2012)



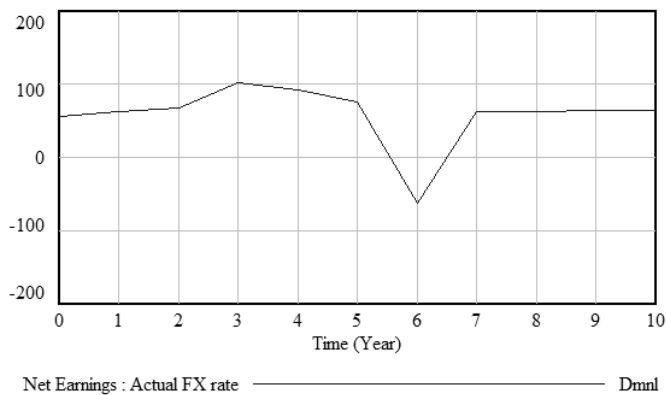
[Figure 16] Simulation results of the profits of foreign currency AR in accordance with the actual changes in exchange rate



[Figure 17] Simulation results of the evaluation of KIKO in accordance with the actual changes in exchange rate



[Figure 18] Simulation results of sales in accordance with the actual changes in exchange rate

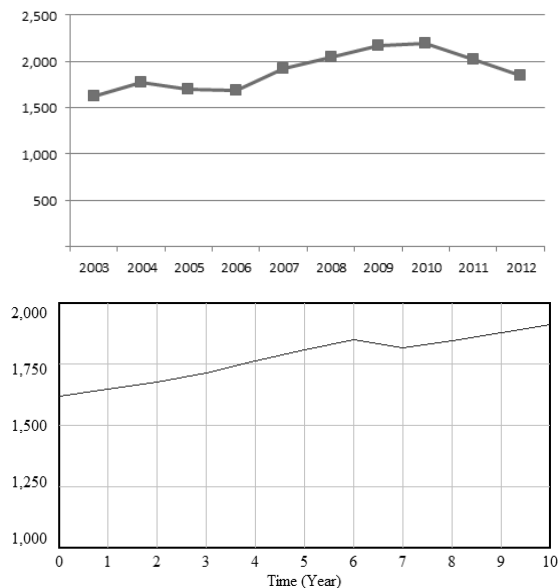


[Figure 19] Simulation results of Net Earnings during the term in accordance with the actual changes in exchange rate

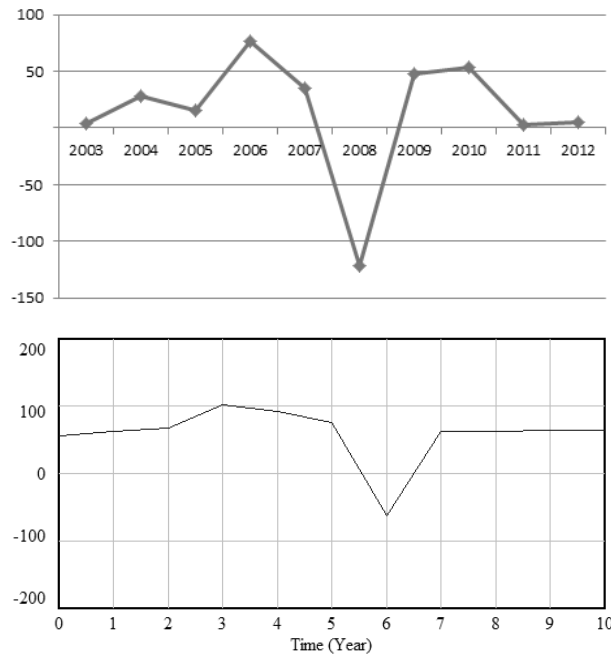
However, companies make contracts two times as the necessary amount. Even profits from foreign AR could be 110 to 120, the value of KIKO decreases by more than 200. This would result in negative net earnings during the term. While sales do not change significantly, the risks of KIKO increase to the amount of sales. Figure 15, 16, 17, 18 and 19 suggest the results.

6. Actual examples of companies

Figure 20 and 21 show the comparison between the trend line of sales and net earnings for Monami and the simulations of Figure 18 and 19, which is one of the representative companies that made a KIKO contract. The sales of Monami increased from 162 billion won in 2003 to 205 billion won in 2008. Exports increased as well, which was why it got exposure increased to foreign exchange. It used KIKO to hedge FX. Until 2006, Monami's net earnings during the term continued to increase. In 2007, net earnings started to decrease, and in 2008, it recorded -12.2 billion won including derivative losses of 6.7 billion won. We can confirm the actual results are similar as the simulated results. This follows the typical structure of limits to growth and reveals a dangerous structure that could generate sharp loss due to KIKO.



[Figure 20] Trend line of the sales of Monami with Figure 18(Unit: 100 million won)



[Figure 21] Trend line of net earnings of Monami with Figure 19(Unit: 100 million won)

V. Conclusions and Implications

This study examined the dynamic flows of derivatives. Companies buy derivatives to hedge foreign exchange, which would allow companies to reduce foreign exchange risk. However, if some companies try to make derivatives a means of generating profits with covetous attitudes, rather than a way to avoid risks, the risk can become huge. But banks don't say the high risk for getting their profit, sometimes. Financial specialists of companies should understand this.

Through simulation methods suggested in this study, companies can understand the impact of derivatives in accordance with the changes of exchange rate. Since the simulation method is not difficult, it will be easy to predict risks.

The Limits to Growth archetype of system dynamics articulates a structure where there could be accumulated risk during growth. Companies using KIKO show similar types. While companies kept focusing on growth or profit, the danger of KIKO accumulated; when it reached the threshold, losses became significant, even great enough to cause the bankruptcy of

a company. Leverage effects that derivatives have sometimes deliver profits to companies. But, they can cause a great amount of loss unintentionally. So, it is imperative to understand financial structures of companies, comprehend the structure of FX risk management through systems thinking, expect behavior over time in a systematic structure, and make efforts to establish appropriate measures when detecting signals. We need to consider that the exchange rate can suddenly fluctuate. Companies need to be ready for sudden changes in exchange rate.

Sales activities of companies are important. We need to know that endless observation on B loop is necessary for continual sales activity. In addition, financial institutions should give companies the information of evaluating the risks of derivatives. If they understood the structure, threshold, and R loop and B loop through system dynamics, they would have known the inherent risks of KIKO fully.

This study has implications that the understanding of KIKO structure would help to understand other derivatives in the future.

【REFERENCES】

- Chung Chang-kwon, Lee Dong-hyun, 2012, "Exploratory Study on Causality of Expansion Strategy into Emerging Market, pp. Systems Thinking Approach," Korea System Dynamics Review, Vol. 13, No.3, pp.67-98.
- Eom Jae-gun, Chung Chang-kwon, Sul Won-sik, 2014, "Exploratory Study on Causality of Foreign Exchange Exposure and Hedge Strategy : Systems Thinking Approach," Korea System Dynamics Review, Vol. 15, No.2, pp. 97-131.
- Jung Jae-un, Kim Hyun-soo, 2009, "A Study on Theoretical Improvement of Casual Mapping for Dynamic Analysis and Design," Korea System Dynamics Review, Vol. 10, No.1, pp.33-60.
- Kim Do-hun, Moon Tae-hun, Kim Dong-hwan, 1999, System Dynamics, Daeyoung Munwhasa.
- Kim Jeong-Kyo, Ban Hye-jung, 2002, "The Determinants of Hedging through Derivatives," Korean Academic Society of Business Administration, Vol. 31, No. 5, pp.1335-1365.
- Kim Sang-uk, 2008, systems thinking and scenario planning, Chungbuk National University Press.
- Kim Sung-hwa, Jun Sang-gyung, 2012, "A Case Study on KIKO Currency Option," KBR, Vol. 16, No.1, pp.1-34.
- Kim Sok-tae, Kim Tae-in, 2009, "A Study on the Effectiveness of KIKO as a Hedging Instrument," Productivity Review, Vol. 23, No.4, pp.223-246.
- Koh Seok-kwan, So Jong-il, 2012, "Foreign Exchange Risk Hedge and Fair Value," The Korean Journal of Financial Management, Vol. 29, No.3, pp. 23-54.
- Kwon Oh-sang, 2012, "Systems Thinking Approach to the Dynamic Relationship between Cash Market, Forward Market, and Options Market," Korea System Dynamics Review, Vol. 13, No.2, pp. 5-23.
- Kwon Taek-ho, Chang Uk, Jung Sung-chang, 2010, "The Usage of Currency Derivatives of Korean Firms and their Management of the Foreign Exchange Rate Exposure," The Korean Journal Of Financial Management, Vol. 27, No.4, pp.61-88.
- Kwon Taek-ho, Hwang Hee-kon, 1999, "The Characteristics of Currency Exposure in Korean Manufacturing Companies," International Business Studies, Vol. 9, No.2, pp.35-63.
- Kwon Taek-ho, Park Jong-won, 2013, "Derivatives Hedging, Earnings Management, and Foreign Exchange Exposure," Korean Journal Of Financial Studies, Vol. 42, No.5, pp.865-899.

- Adler, M., Dumas, B., 1984, "Exposure to currency risk: definition and measurement," *Financial Management*, No.13(2), pp.41-50.
- Allayannis, G., Ofek, E., 2001, "Exchange rate exposure, hedging, and the use of foreign currency derivatives," *Journal of International Money and Finance*, No.20(2), pp.273-296
- Bartram, S.M., Brown, G.W., Minton, B.A., 2010, "Resolving the exposure puzzle : The many facets of exchange rate exposure," *Journal of Financial Economics*, No.95, pp.148-173.
- Donnelly, R., Sheehy, E., 1996, "The Share Price of U.K. Exporters to Exchange Rate Movements: an Empirical Study," *Journal of International Business Studies*, 1Q, pp.157-165.
- Forrester, Jay W., 1961, *Industrial Dynamics*, Cambridge, The MIT Press.
- Forrester, Jay W., 1969, *Urban Dynamics*, Cambridge, The MIT Press.
- Soros, George., Gardner, Grover., 1987, "The Alchemy of Finance: Reading the Mind of the Market," Wiley Audio
- Sterman, John D. 2010, *Business Dynamics*, McGraw-Hill
- Jorion, P., 1990, "The exchange-rate exposure of U.S. multinationals," *Journal of Business*, No.63(3), pp.331-345.
- Khoo, A., 1994, "Estimation of Foreign Exchange Exposure: An Application for Mining Companies in Australia," *Journal of International Money and Finance*, No.13(3), pp. 324-363.

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【APPENDIX: Equations】

- (1) Sales=INTEG (Operating Activities), Initial Value 1,619
- (2) Operating Profit=Sales*Operating profit rate
- (3) Operating profit rate=0.034 (Constant)
- (4) Account Receivables=Sales*AR rate
- (5) AR rate=0.14 (Constant)
- (6) Foreign AR=INTEG (Accounts receivable/2), Initial Value 10
- (7) KIKO=(Foreign AR/10)*Confidence of Profit for KIKO
- (8) Confidence of Profit for KIKO=GET XLS DATA ('data.xls', 'data', '1', 'A3'), Data inputs.

Year	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	9 year	10 year
Confidence	2	2	2	2	2	2	1	1	1	1

- (9) FX gain from AR=(Foreign AR/10)*FX rate
- (10) FX rate=GET XLS DATA ('data.xls', 'data', '1', 'A2'), Data inputs. (Annual average rate)

Year	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	9 year	10 year
FX rate	-0.59	-0.46	-1.21	-0.69	-0.25	1.73	1.75	-1.2074	-0.479	0.1818

- (11) Evaluation of KIKO=KIKO*FX rate*-1
- (12) “Non-operating Profit”=Evaluation of KIKO+FX gain from AR
- (13) Net Earnings=“Non-operating Profit”+Operating Profit
- (14) Operating Activities=Net Earnings*0.5

국제통상에서 KIKO 파생금융상품과 그 영향에 대한 시스템 다이내믹스 시뮬레이션

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국제통상을 하는 기업은 위험 선호도에 따라 금융시장을 통해 외화자산 혹은 외화부채의 헷징 (hedging)을 목적으로 파생금융상품을 쉽게 구매할 수 있다. 파생금융상품 시장은 투자와 헷지의 필요에 따라 급속도로 성장해왔다. 기업은 금융 파생금융상품을 통해 환위험 관리를 하면서 위험을 헷징한다. 기초자산을 헷징할 때는 환노출 완화전략으로 헷징이 효과적일 수 있다. 하지만 파생상품을 통한 이익에 대한 욕심과 예상치 못한 환율 변동이 발생할 때 기업에 상당한 위험을 초래할 수도 있다. 본 논문은 환위험을 다루는 파생상품에 내재된 구조적인 위험을 시스템다이내믹스 관점에서 분석하고 있다. 대표적인 파생금융상품인 KIKO는 구조적인 위험 요인 때문에 금융위기에 크나 큰 손실을 끼쳤다. 본 논문에서는 KIKO의 구조적 위험 요인을 모델링하고 실제 사례를 통해 검증하여 파생금융상품의 시스템 구조를 파악하고 내재되어 있는 구조적 위험을 밝혔다.

주제어: 환노출, 환관리, 인과관계, 시스템 다이내믹스, KIKO, 파생상품, 국제통상

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