Imperial College London

東京大学 THE UNIVERSITY OF TOKYO

Energy and Green House Gas Mitigation Technologies

Japan Society for the Promotion of Science-Imperial College London-University of Tokyo Symposium on Climate Change

Thursday 28th and Friday 29th September 2006

energy futures lab

Imperial College London, South Kensington Campus, London SW7 2AZ

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A STUDY ON GOVERNMENTAL POLICIES TO MANAGE RISKS IN CDM

2006.9.29

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Section Ⅰ. Adopted Measures

- Application of Real Option Theory to CDM -

Risks accompanying CDM projects

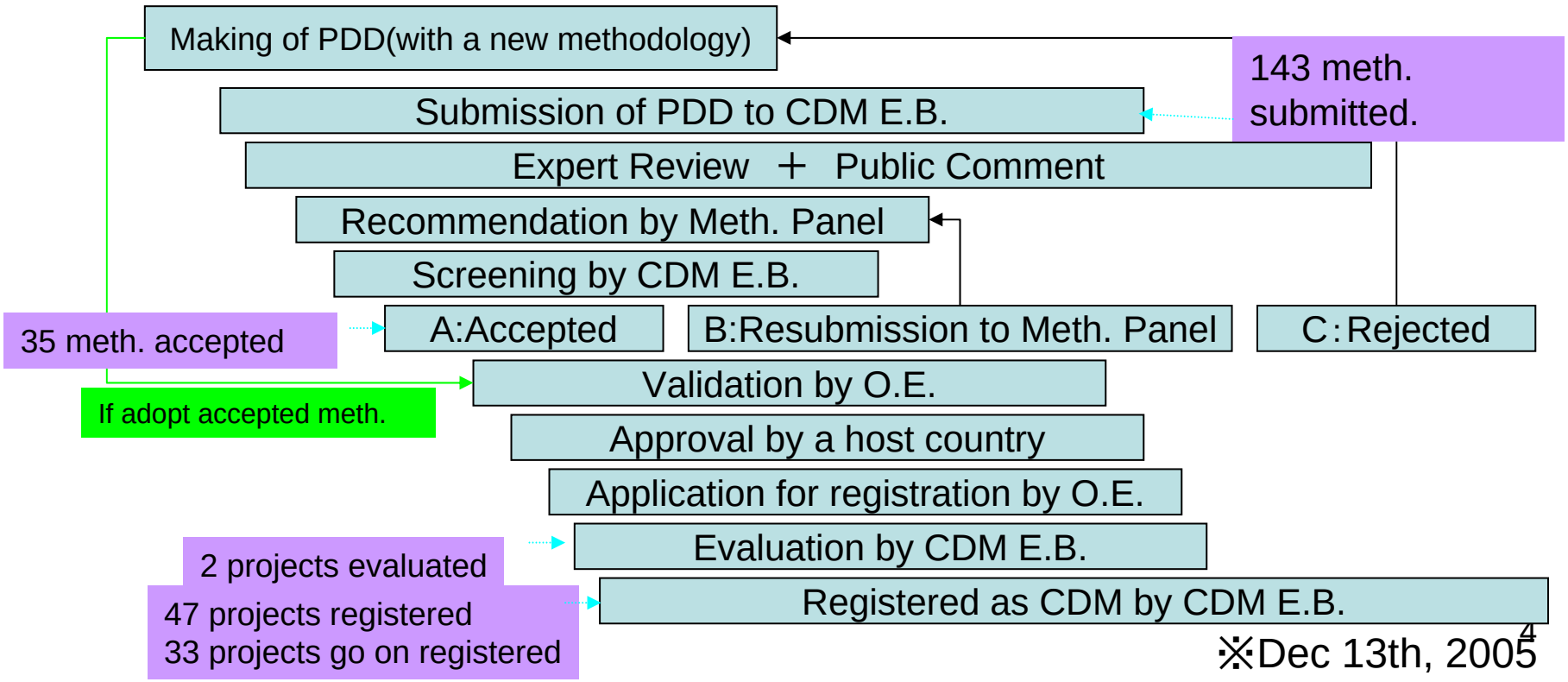
1. The risk is certainly crucial, whether a project could be registered as CDM or not. The risk is named as 'registration risk'.
2. If the basic framework of Kyoto Protocol should drastically change, value of CER might be lost after 2012. We name this risk as 'Post-2012 risk'.
3. We should pay attention also to a risk that the asset value of CER will change due to fluctuation of CER price in future. We call this 'CER risk'.
4. A CDM project is also accompanied by country risks due to political or economical instability in host countries. Here we call these risks as 'country risks'.

→Among the above-mentioned risks, this presentation mainly focus risks of 1, 2 and 3.

Institutional risk 1 of CDM

Registration risk

- The risk, that a project could not be registered ad CDM
  - So as to register the project as CDM, applicants need to prove that a project could not be executed unless it is registered as CDM. Namely, they need to prove the additionality as CDM.
  - The following procedures are necessary for the registration.
    - In the case of methodologies, it takes another two months at least, if it is once rejected by the CDM Executive Board.

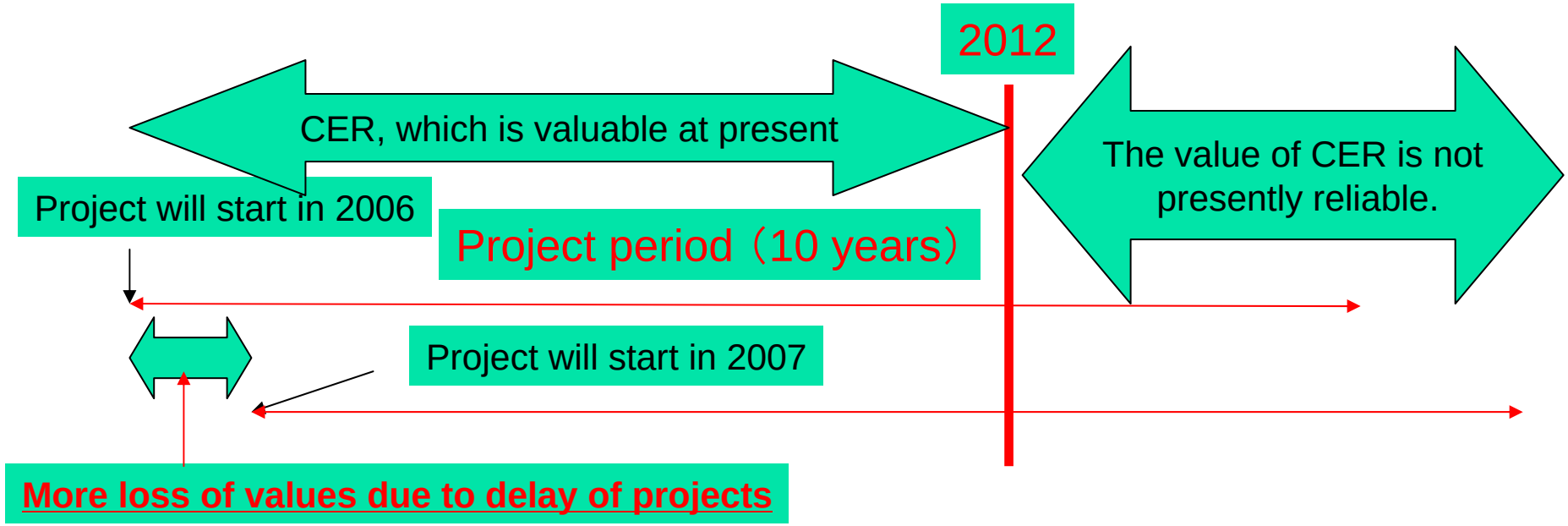


※Dec 13th, 2005

Institutional risk 2 of CDM

The post-2012 risk

- Since nothing is determined on a framework after 2012 (during second commitment period), almost no CER after 2012 is presently distributed.
- Value of CER after 2012 is not reliable in decision-making for investment.



Application of Real Option theory to CDM1

1. CER values and other project assets are assumed to follow geometric Brownian motion.

$$dV/V = \mu dt + \sigma dz$$

2. The value of investment opportunity, F(V,t) is assumed to be equivalent to a call option, the right but not the obligation to buy a share of stock at a pre-specified price.

3. Decision-making processes comprise primarily two steps, registration as CDM and investment in plants.

4. So as to estimate the above option values, we adopt numerical calculation methods utilizing following binomial models. First we decompose total period, *T* by *n* to acquire Δt, *T/n*. Then we determine a rising rate, *u* and a falling rate, *d* in a period, Δt as in the following equations.

$$u = \exp(\sigma \cdot \Delta t) \qquad d = 1/u = \exp(-\sigma \cdot \Delta t)$$

Application of Real Option theory to CDM2

5. We determine risk neutral probability, taking account of the convenience yield, δ as follows.

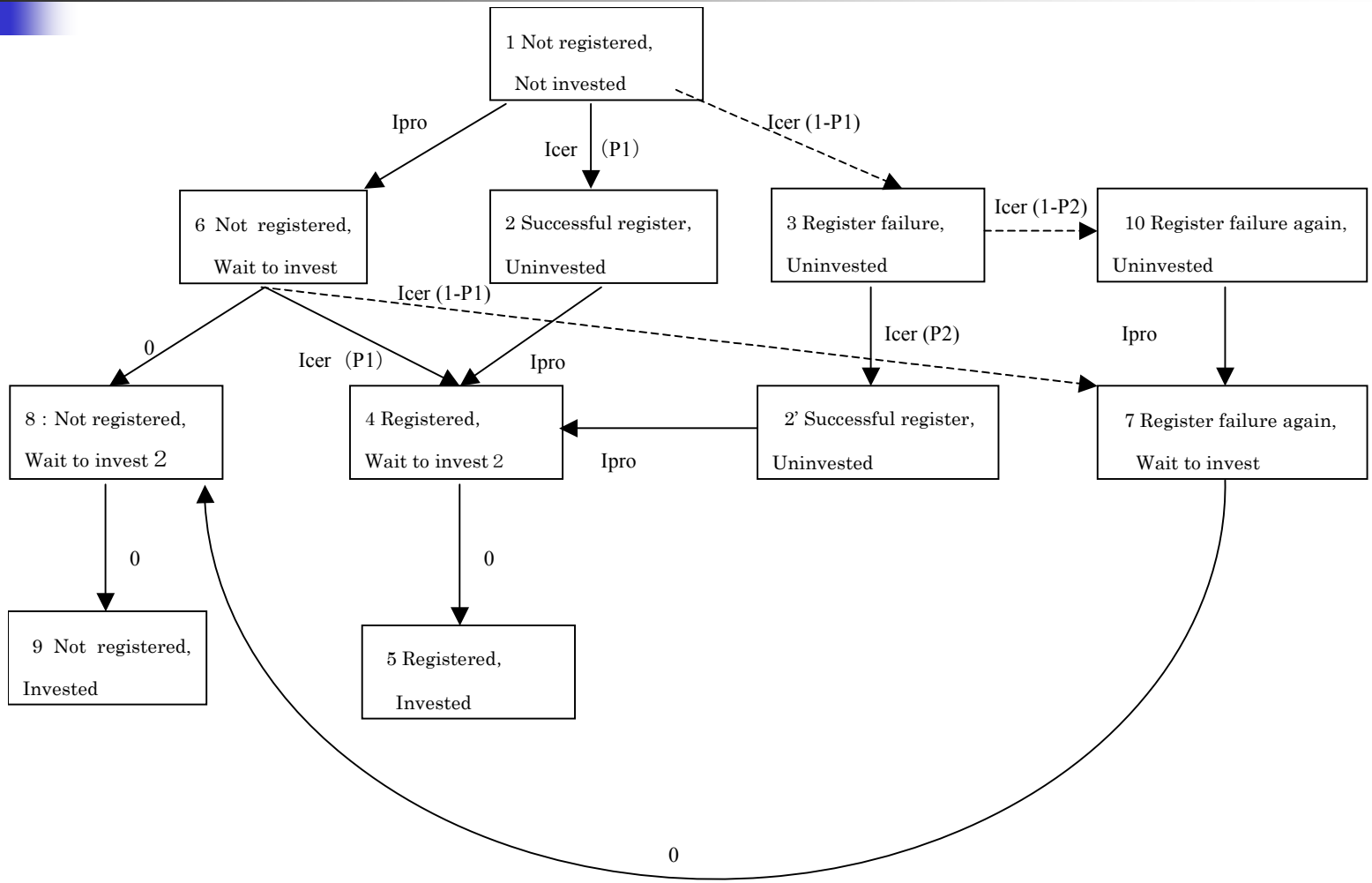
$$rnp = \frac{\exp\{(r-\delta)\Delta t\} - d}{u - d}$$

6. Dynamic programming is adopted for estimating the above option values, in which optimal decision-making processes are clarified by backward propagation using the principle of optimality.

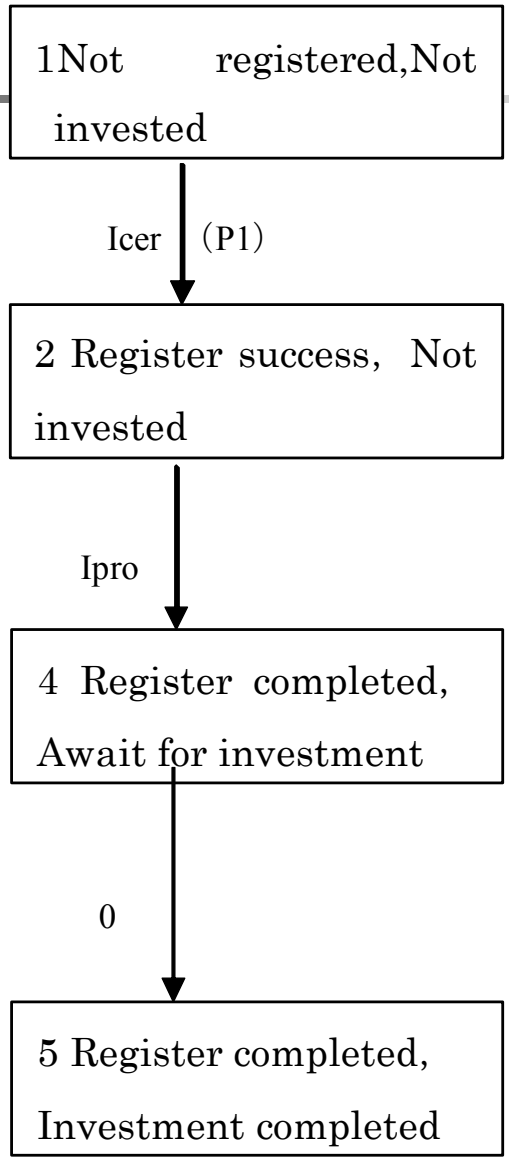
7. We also estimate project values without flexible decision-making processes. Here we call this passive present value.

8. The option values estimated, F(V,0) will coincide with the passive present value, V-I in points with project assets larger than a certain value, which is called the critical point.

Procedures of registration and investment with flexibility

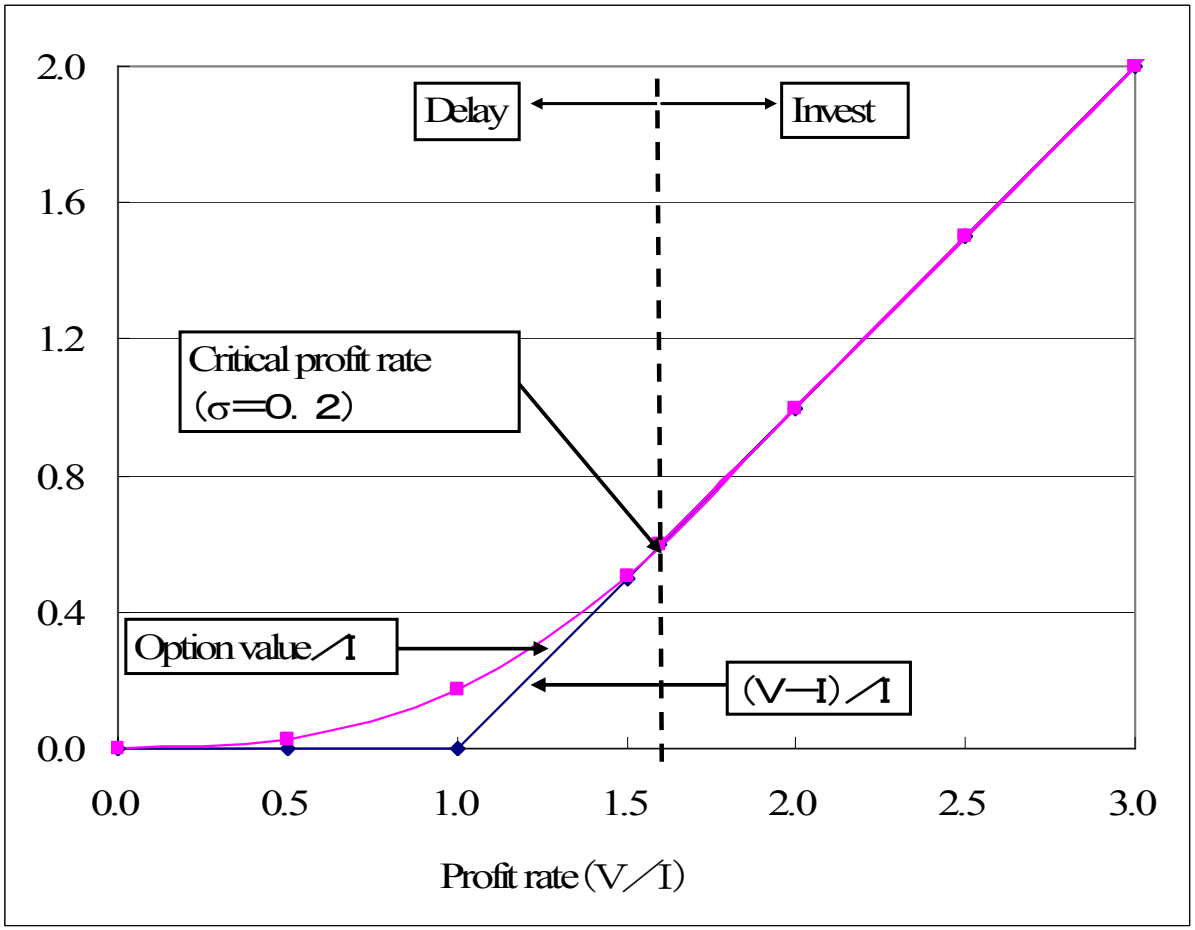


Procedures of registration and investment without flexibility



Critical point - threshold value for investment -

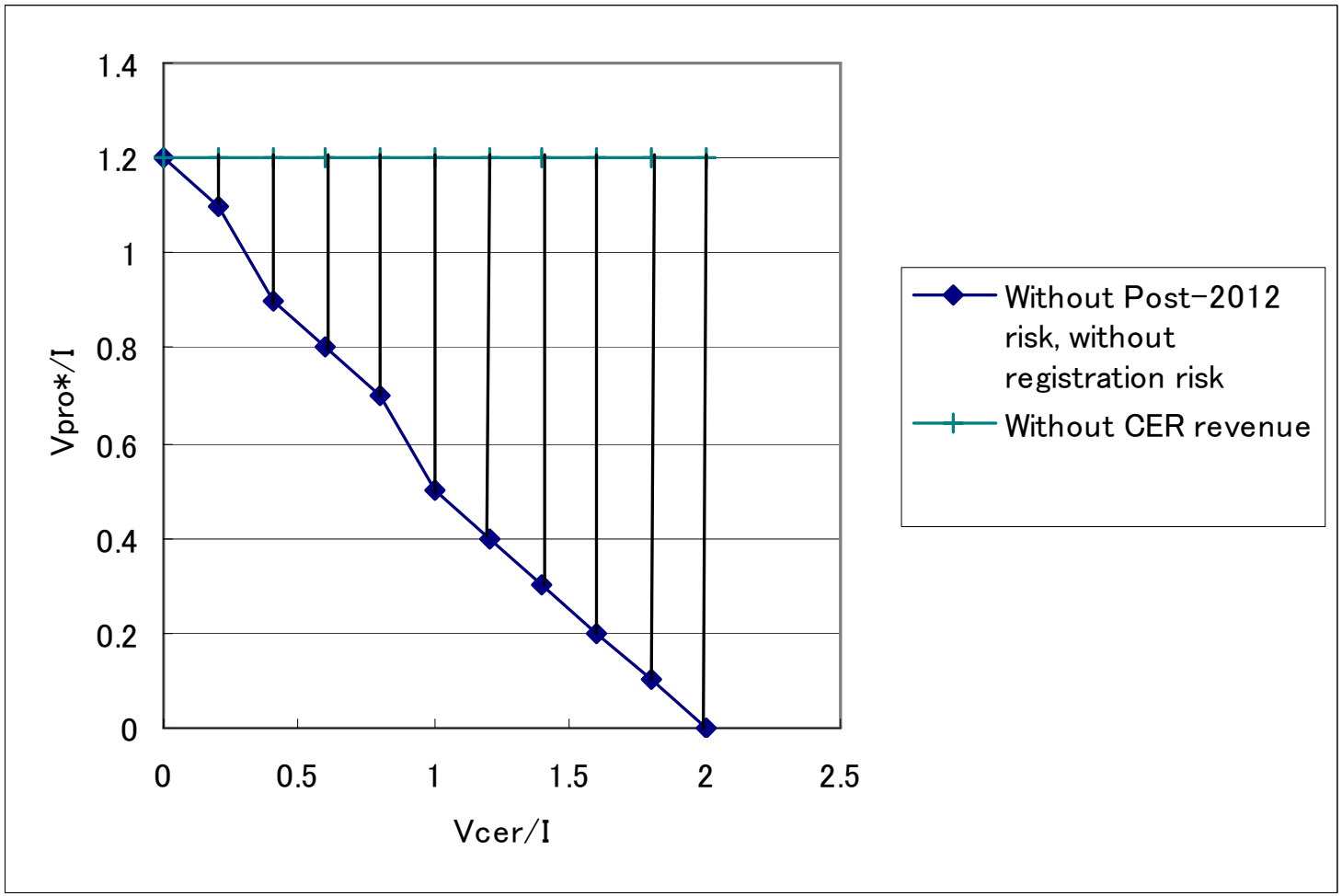
- If a project asset is larger than the critical point, they generally judge to invest in the project immediately. In this sense, the critical point can be a threshold value for investment. We estimate this critical point so as to clarify how the uncertainties affect investment in CDM.



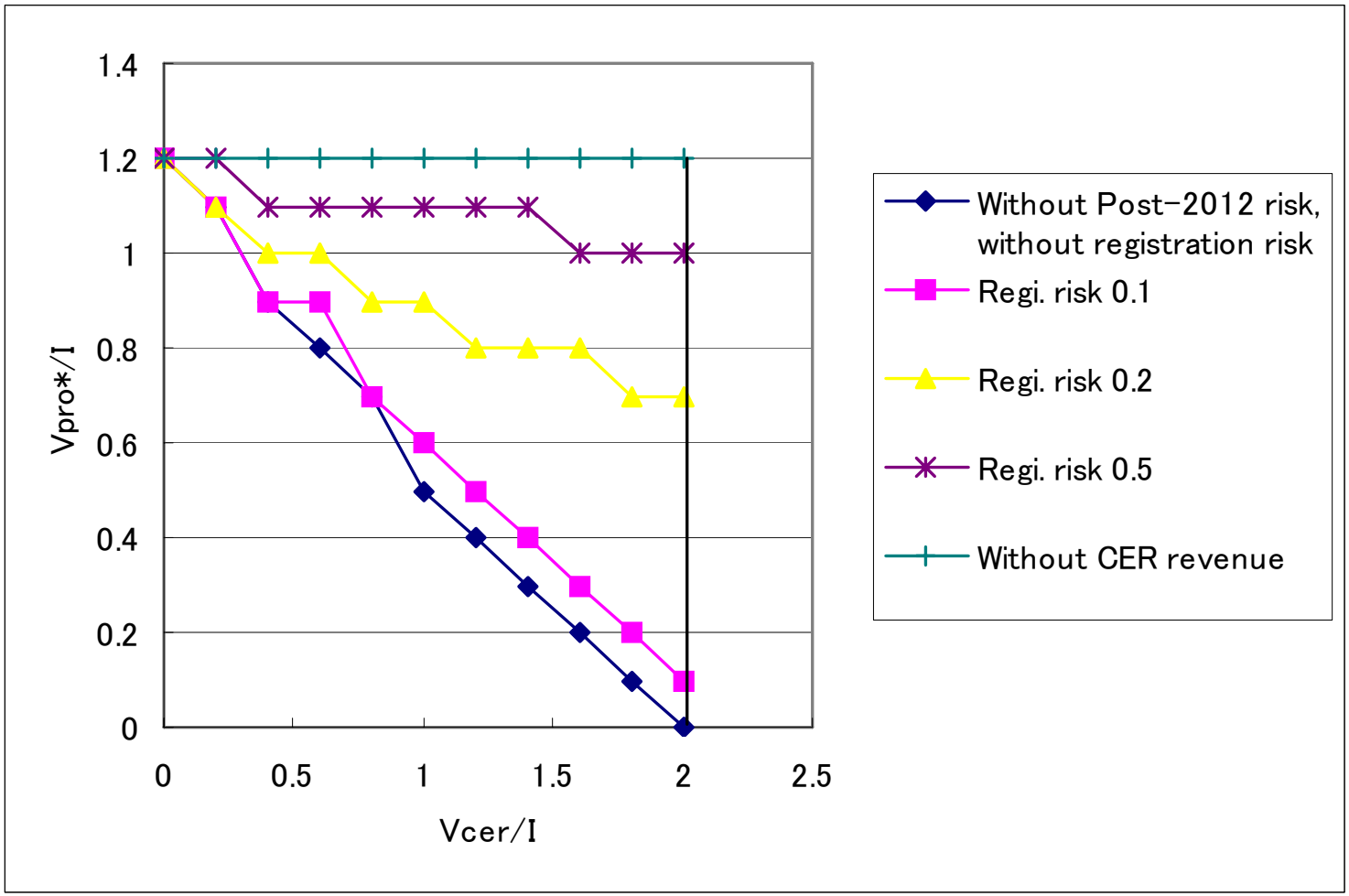
Section Ⅱ. Computed Results

- Identification of “Window” for CDM -
- Institutions to Manage Risks in CDM -

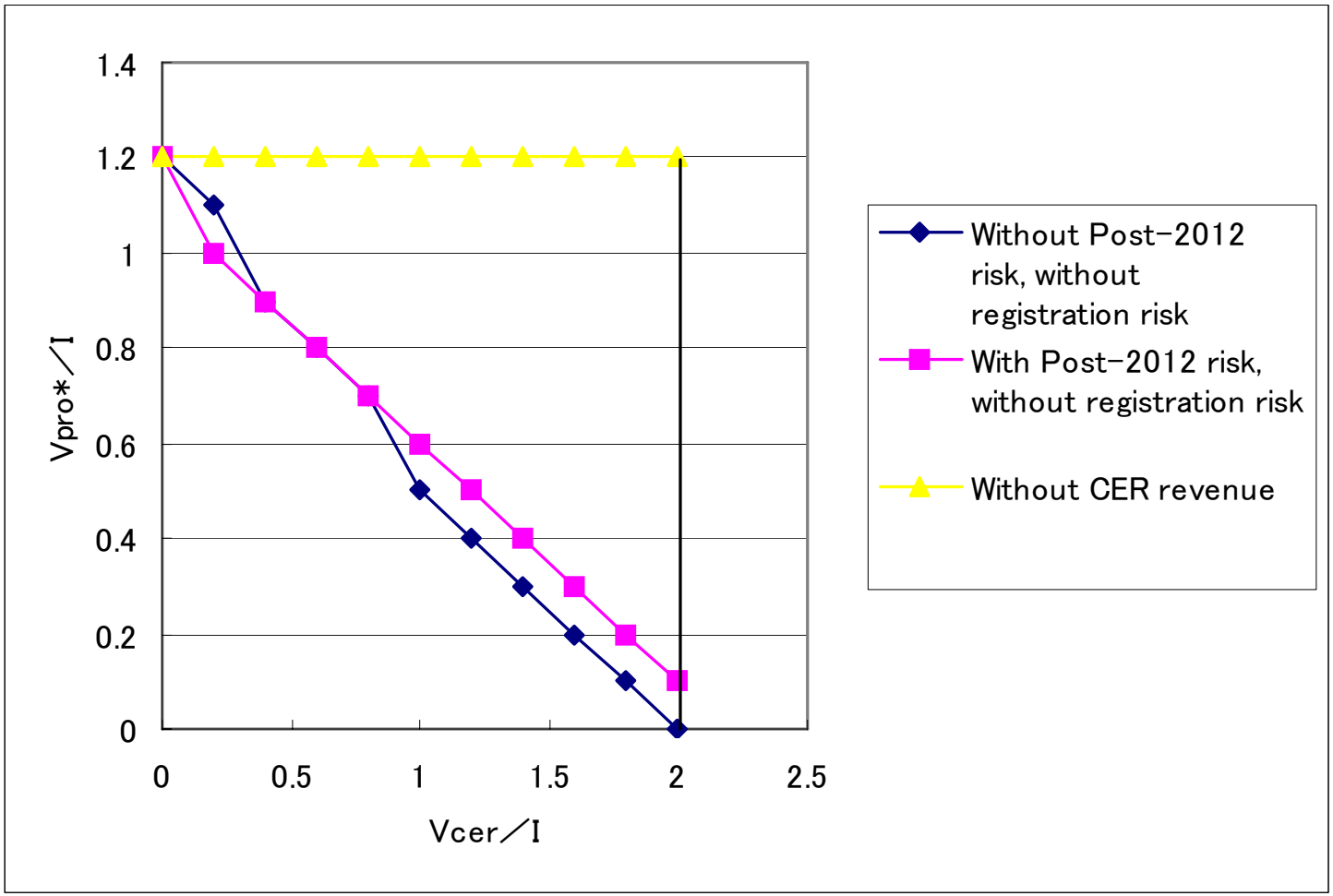
The window of projects to be invested as CDM



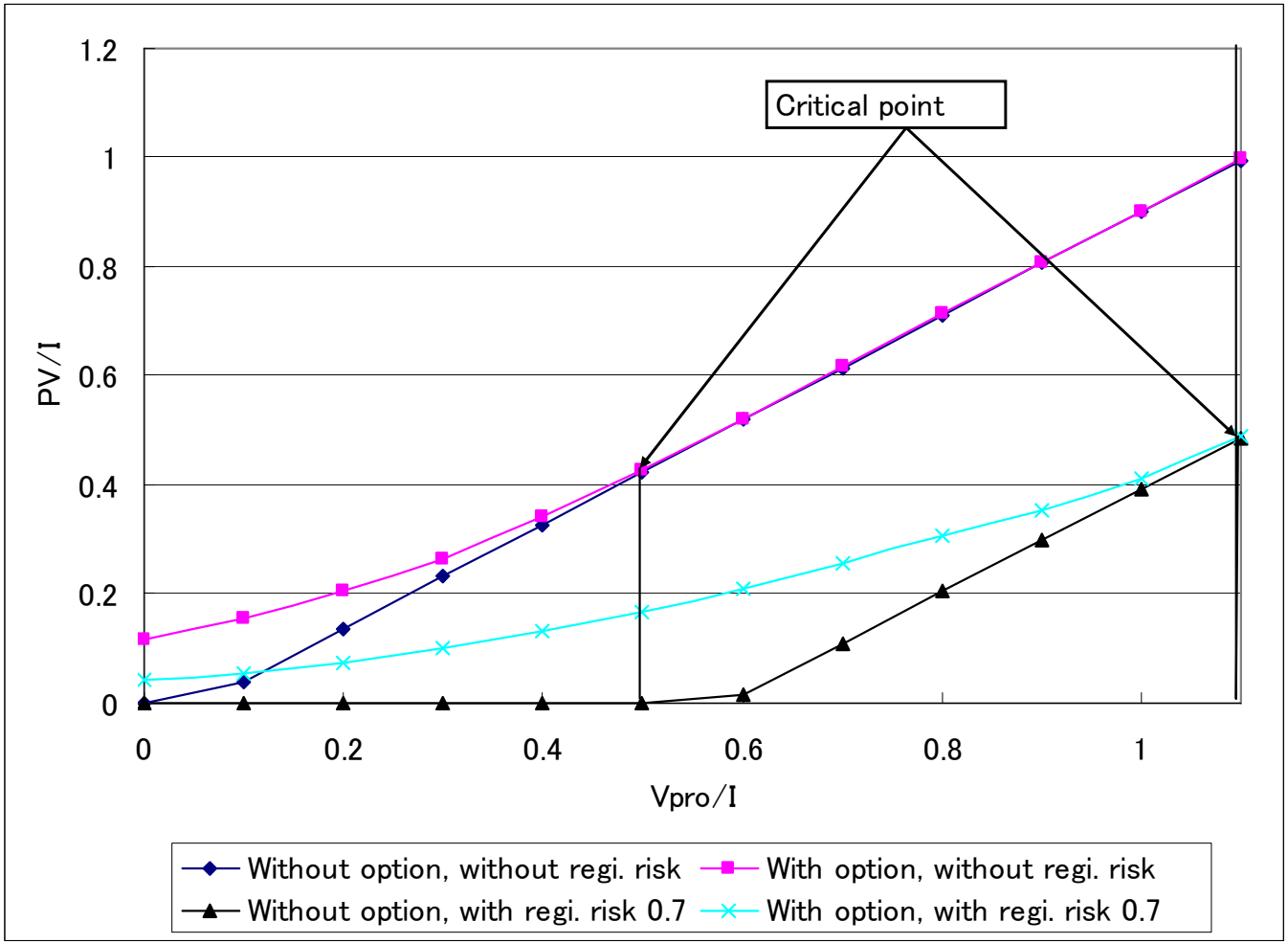
Relationship between the window and the registration risk



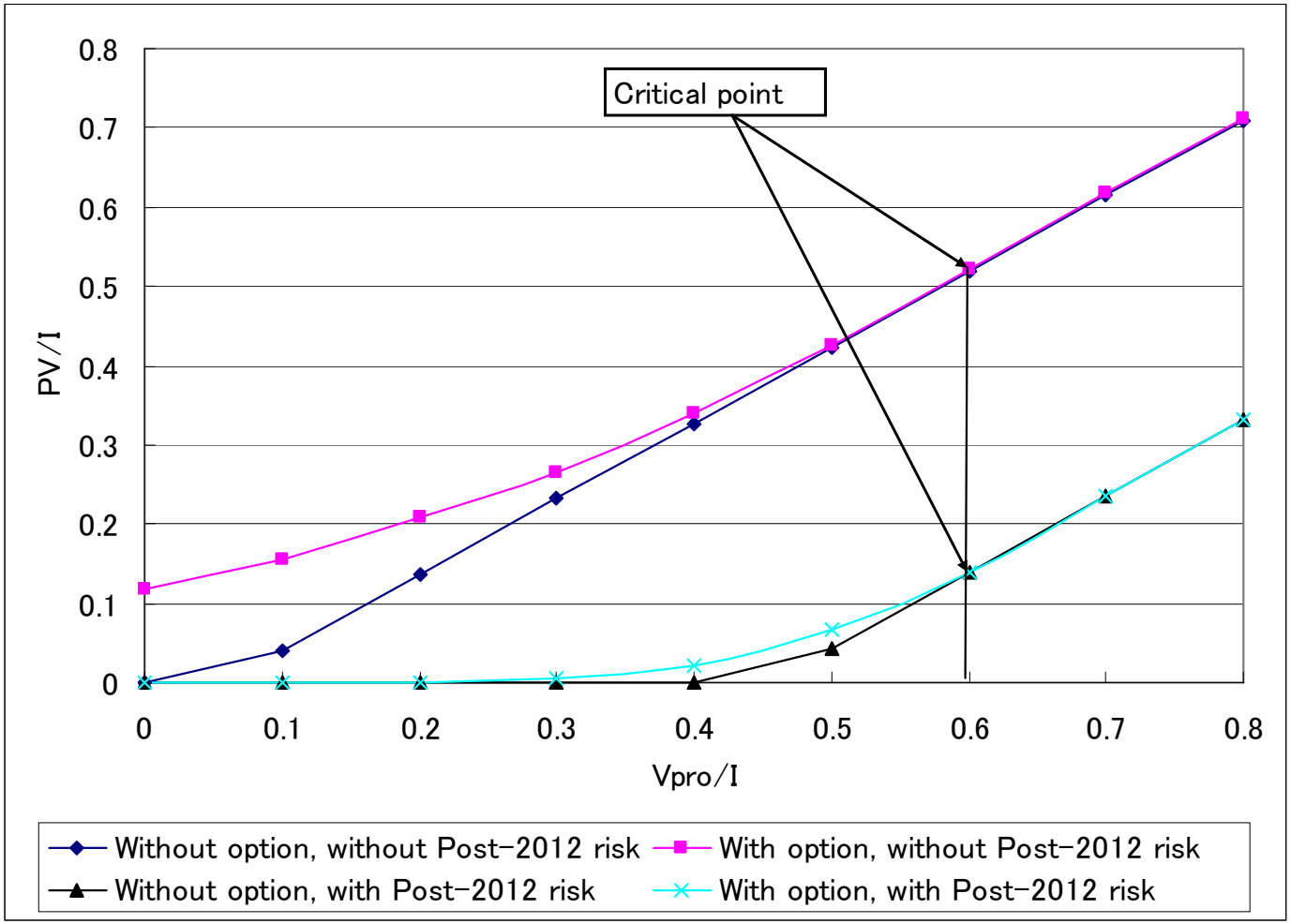
Relationship between the window and the Post-2012 risk



The option values and intrinsic values with and without the registration risk



The option values and intrinsic values with and without the Post-2012 risk



CER procurement by Japanese Government

1. METI and MOE will make contracts of 12.2 billion yen in 2006 fiscal year.

2. METI and MOE will procure CER units of 12.2 billion yen through NEDO.

3. On the above contract, NEDO will partly make up-front payment and partly make payment on delivery.

→What are the effect of the policy to activate CDM？

CER procurement by Japanese Government

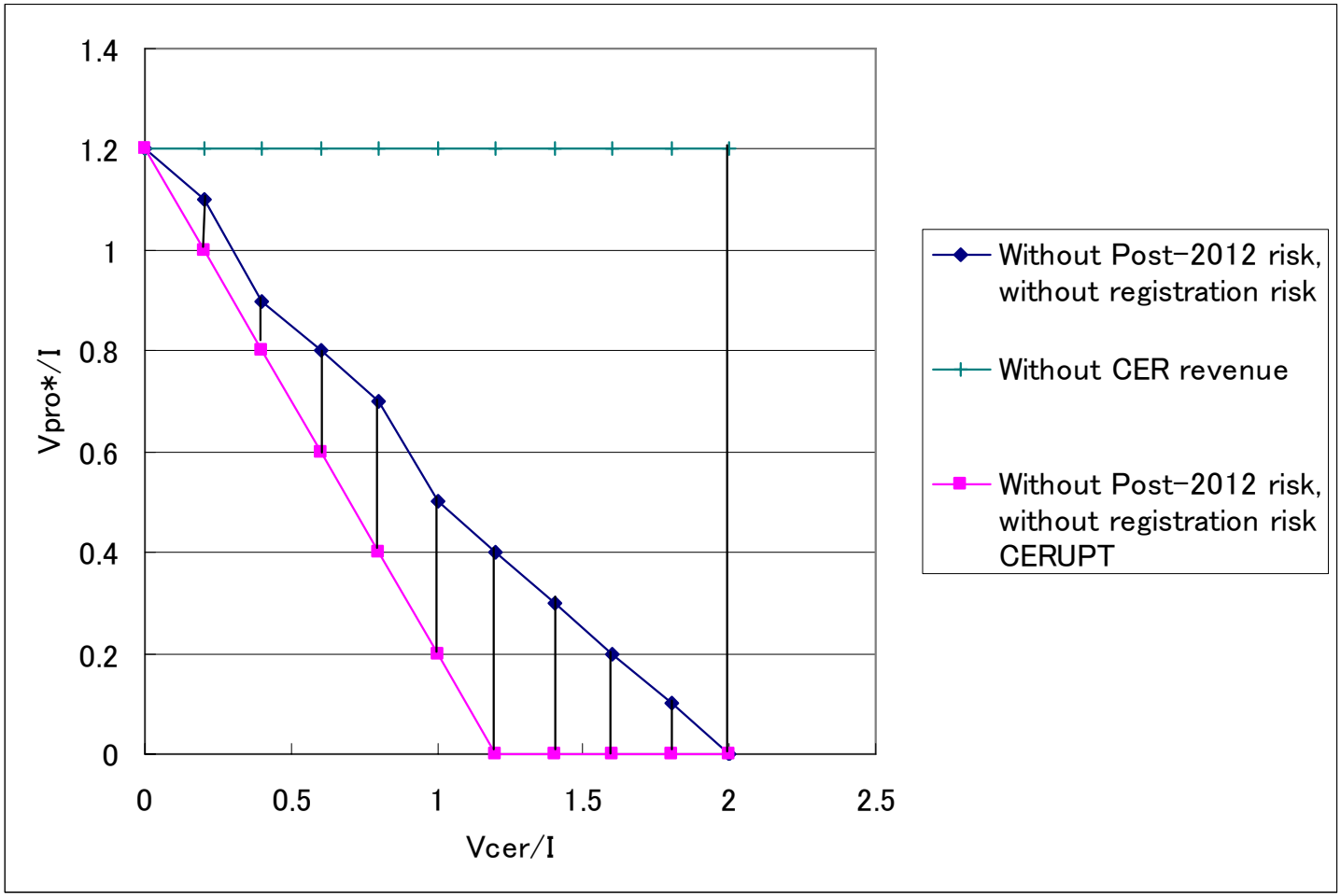
Up-front payment

- If they adopt up-front payment, the government must pay for CER throughout project periods in advance to executing CDM. In order to hedge risk in CER revenue from executer's viewpoint, up-front payment is desirable. In this paper, we assume fixed CER price during CDM period.

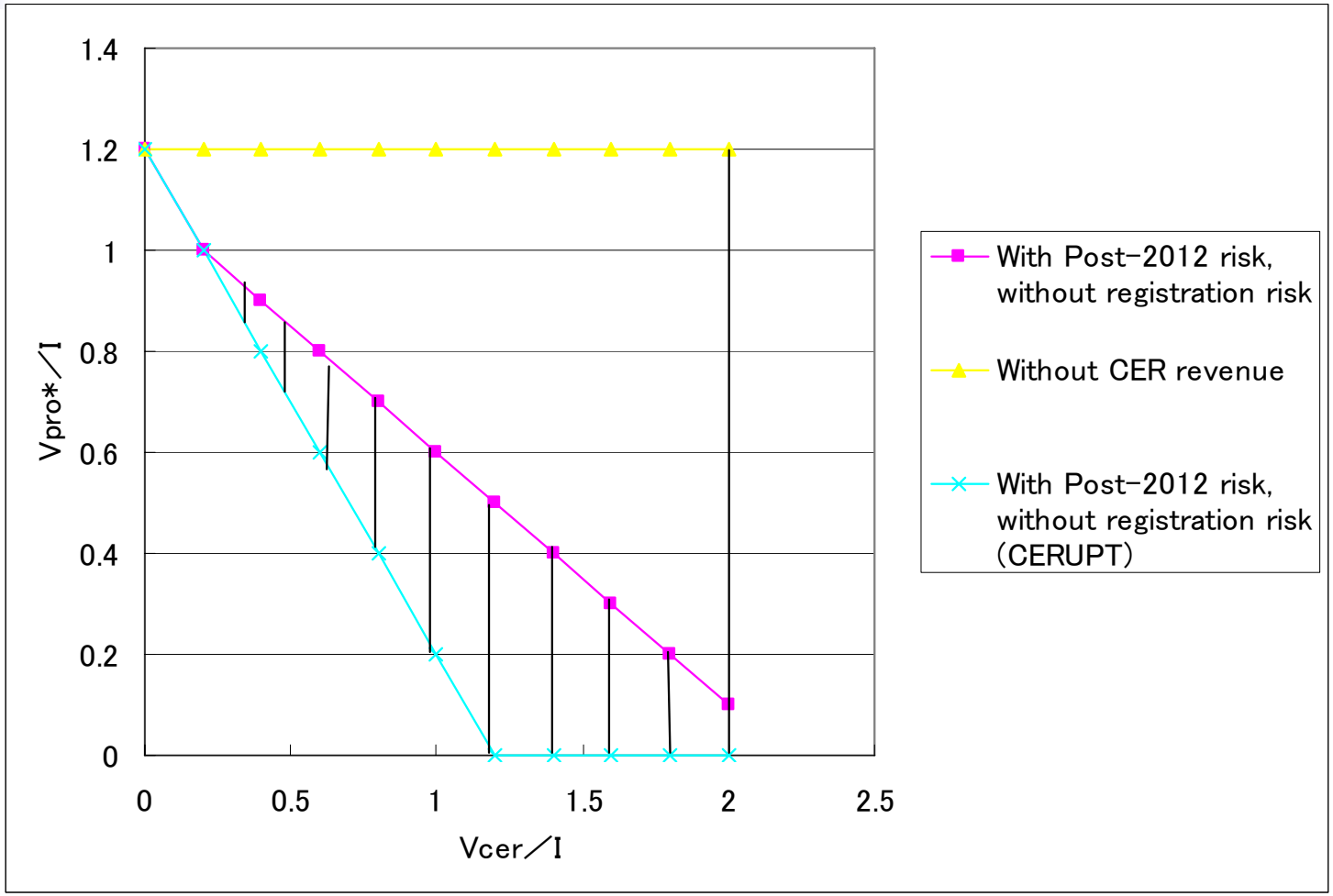
Payment on delivery

- If they adopt payment on delivery, the government must exchange money for receiving CER every year. If CER price is projected to escalate, payment on delivery is preferred to obtain higher revenue in future. In this paper, we assume annually changing CER price during CDM period.

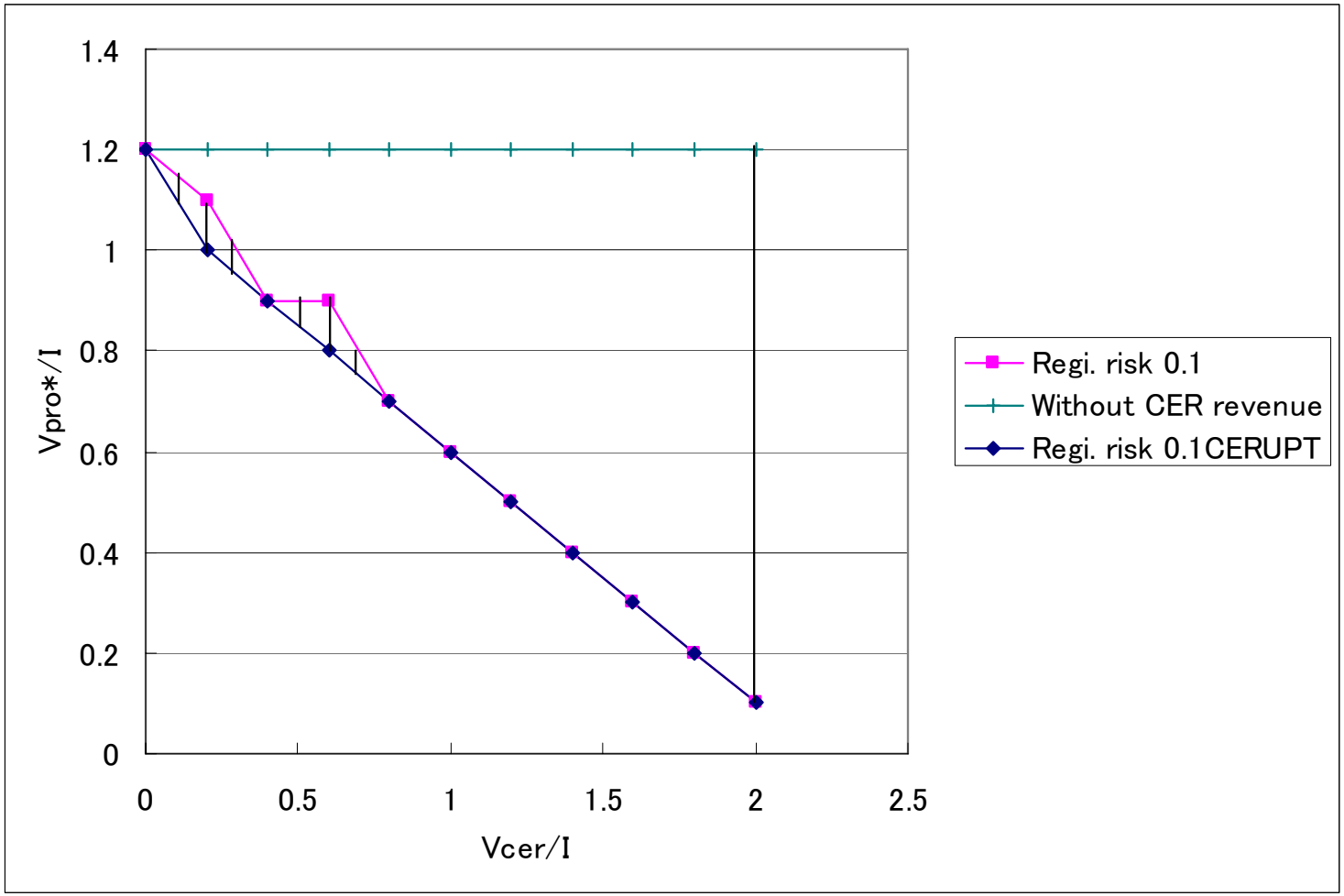
The windows in the two payment procedures without the Post-2012 risk and the registration risk



The windows in the two payment procedures with the Post-2012 risk



The windows in the two payment procedures with the registration risk

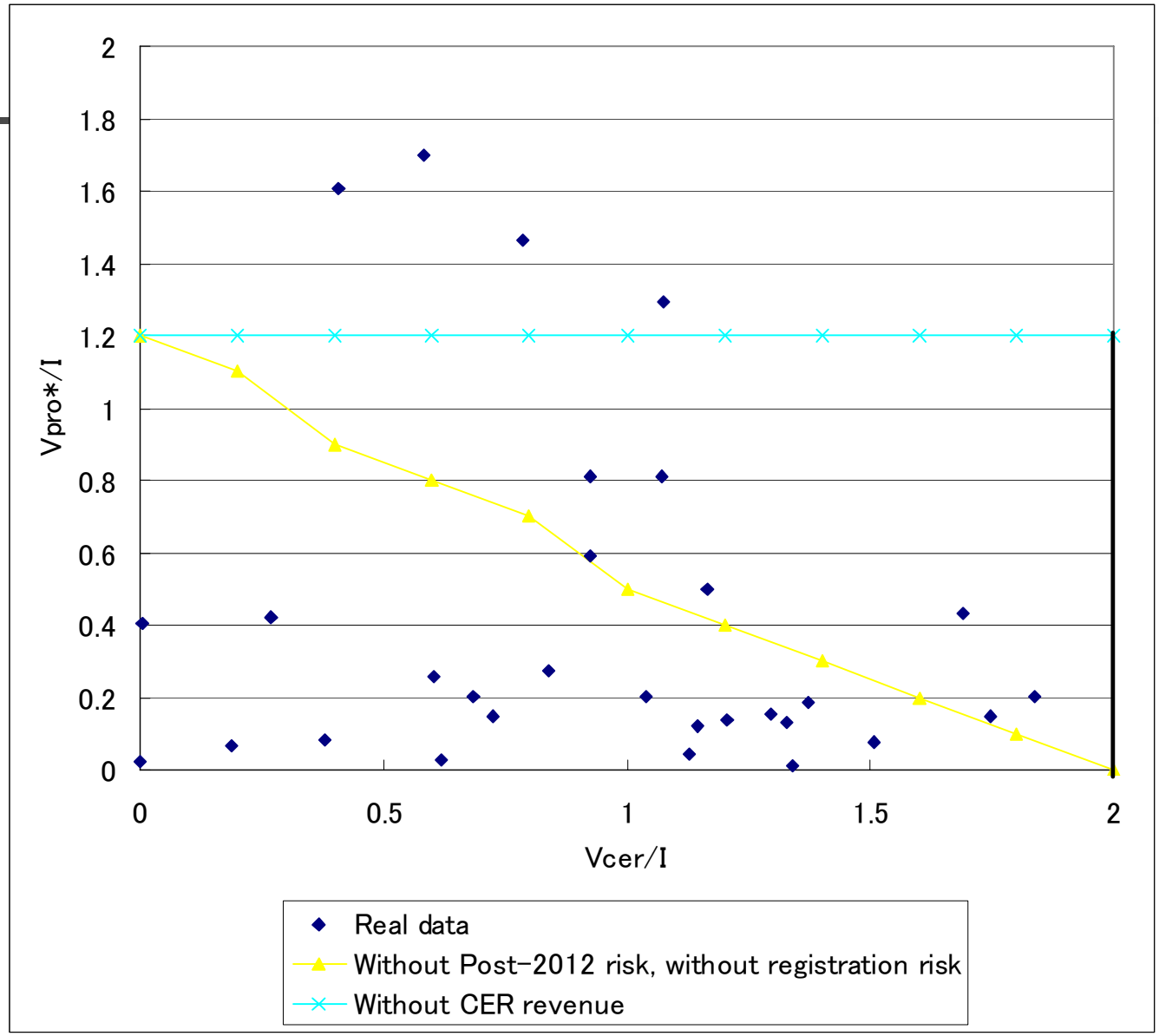


Section Ⅲ. Case Studies

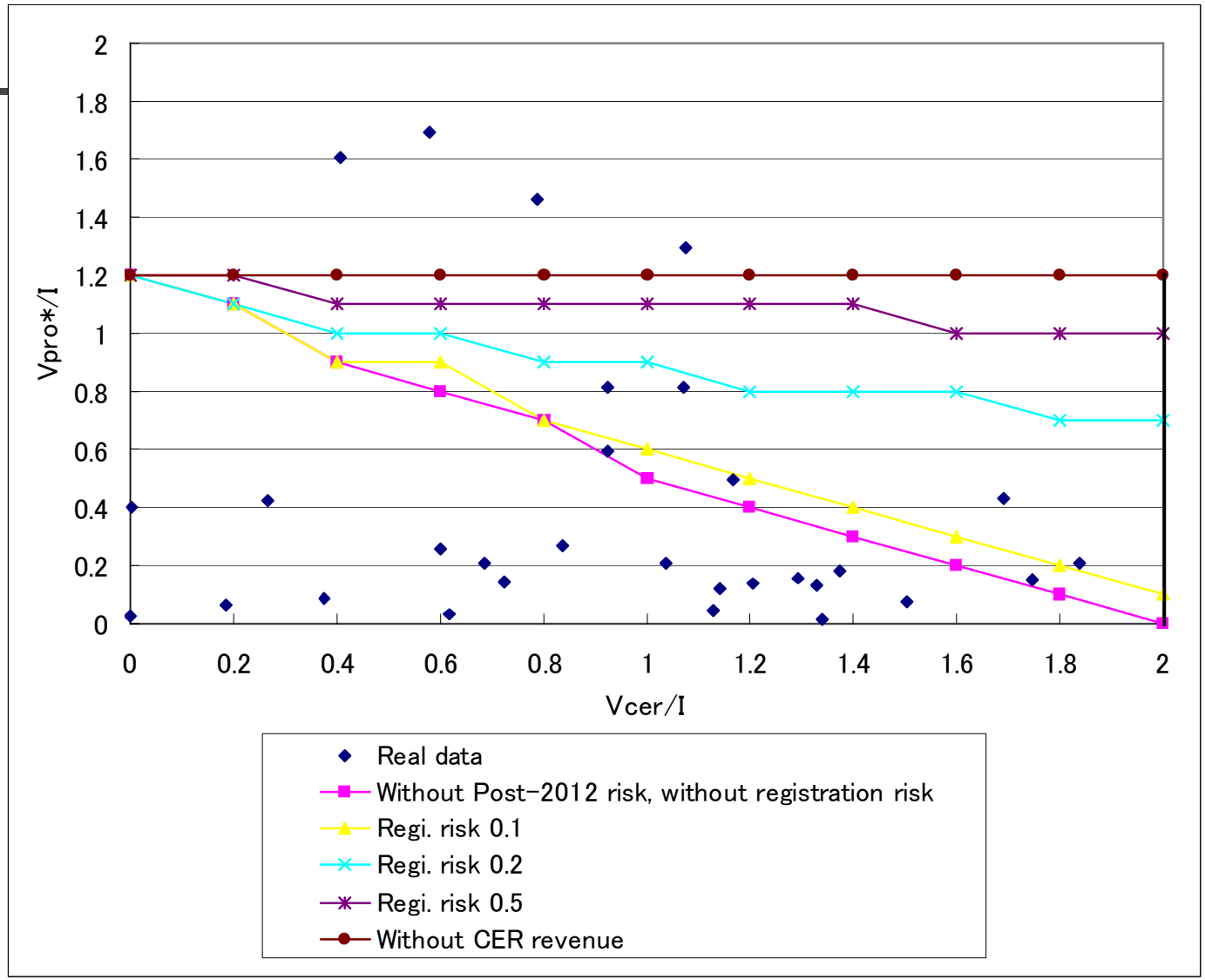
- Actual data on CDM included in the Window -

Titles of projects	Nation
Direct ironore reduction of the Sidetool steel plant and rehabilitation in steel	Venezuela
Feasibility study of introducing high performance industrial furnace	Poland
Feasibility study of introducing high performance industrial furnace	Poland
Feasibility study of introducing high performance industrial furnace	Poland
Survey on modernization of district heating system in Plague	Uzbekistan
Energy recovery and utilization of thermal energy by pressure difference in natural ga	Brazil
Rehabilitation of iron production in Helwan steel plant in Egypt	Egypt
Rehabilitation of iron production in Helwan steel plant in Egypt	Egypt
Energy saving options by recovering thermal energy in low temperature in Asominath	Brasil
Energy saving project of Bienchiang steel plant	Lao
Forced methane extraction from organic waste-water treatment plants for grid-connec	Malaysia
Feasibility study of biogas utilization from anaerobic digestion of sewage sludge in Da	China
Feasibility study of acquiring carbon credits from power generation utilizing landfill ga	Brazil
Feasibility study of suppressing methane emissions from landfill site by composting	Malaysia
Feasibility study on ethanol production from wasted sugar, molasses	India
Feasibility study on ethanol production from wasted sugar, molasses and bagasse	India
Feasibility study on ethanol and sugar production from sugarcane	Vietnam
Feasibility study of cogeneration using bagasses and rice husc	Thailand
Feasibility study of producing bio-diesel fuel from sunflower as energy crops	Thailand
Project of energy conversion from sugar waste	Brazil
Feasibility study of suppressing methane emissions and biomass industries using sol	Malaysia
Feasibility study of acquiring carbon credits from biomass power generation	Thailand
Feasibility study of acquiring carbon credits from power generation using palm bunch	Malaysia
Project of hydropower generation	Chile
Project of power generation utilizing landfill gas in Durban	South Africa
Project of producing alternative energy using baggasses in sugar factory in Smatra is	Indonesia
Project of constructing biodiesel refinery	South Africa
Project of introducing natural gas cogeneration in Tongkou city	China
Project of producing Ammonia synthesis gas in high efficiency	China
Survey of energy conservation for district heating system with cogeneration in Shang	China
Survey of energy conservation in Gjaraht oil refinery plant	India
Project of establishing infrastructures for Nunchack industrial park	Vietnam
Project of energy conservation in Bialao factory	Lao
ESCO project for commercial buildings	Thailand
Project of modernizing cement sector in the neighbor of Hanoi	Vietnam
Feasibility study on introducing high efficiency furnaces for process of hot rolling in s	Thailand
Project of utilizing coal mine methane in Shenjiang district	China
Project of utilizing coal mine methane in Binchao mountain	China
Feasibility study on promoting district heating system using renewable energy	China

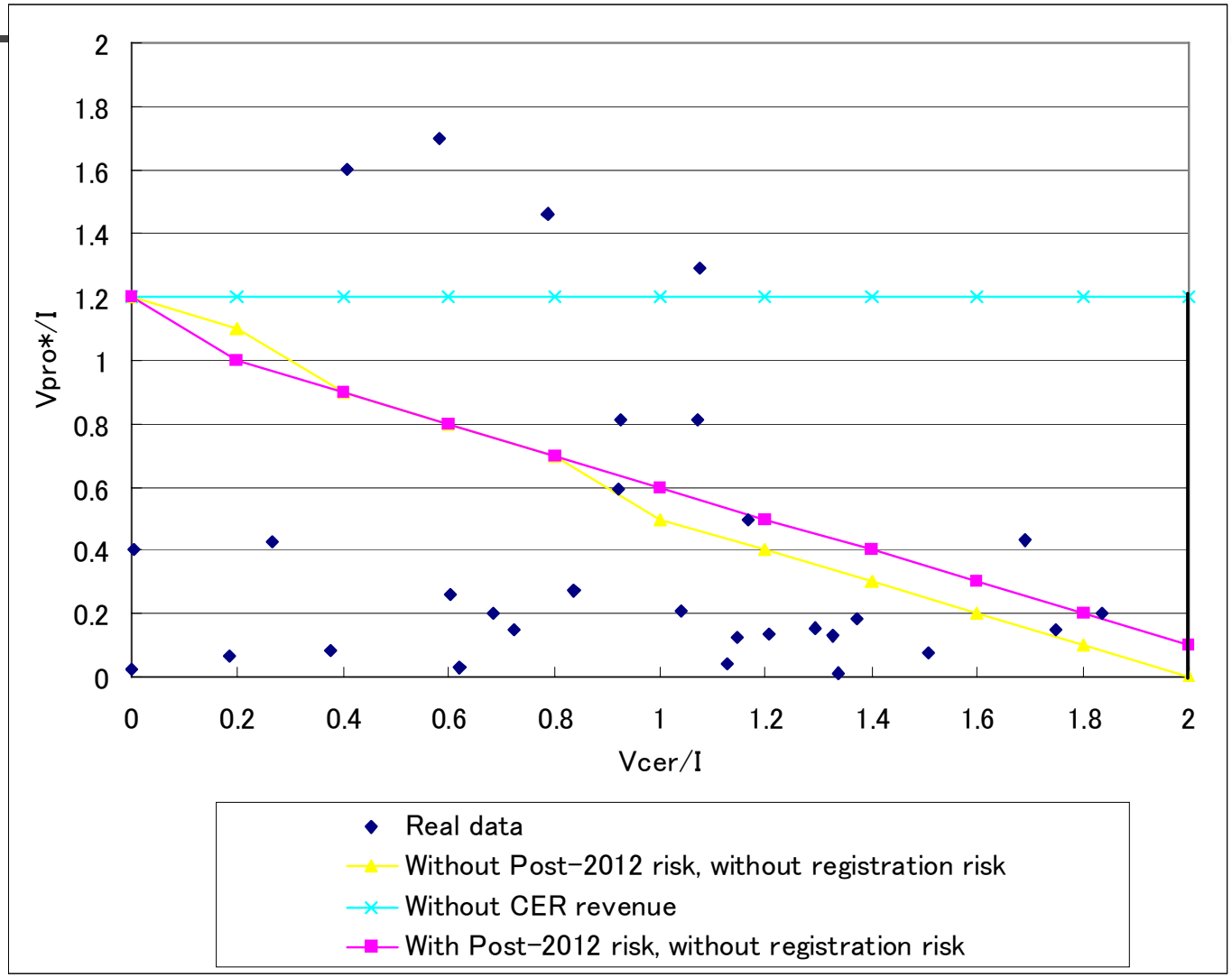
The window and actual data of projects to be invested as CDM



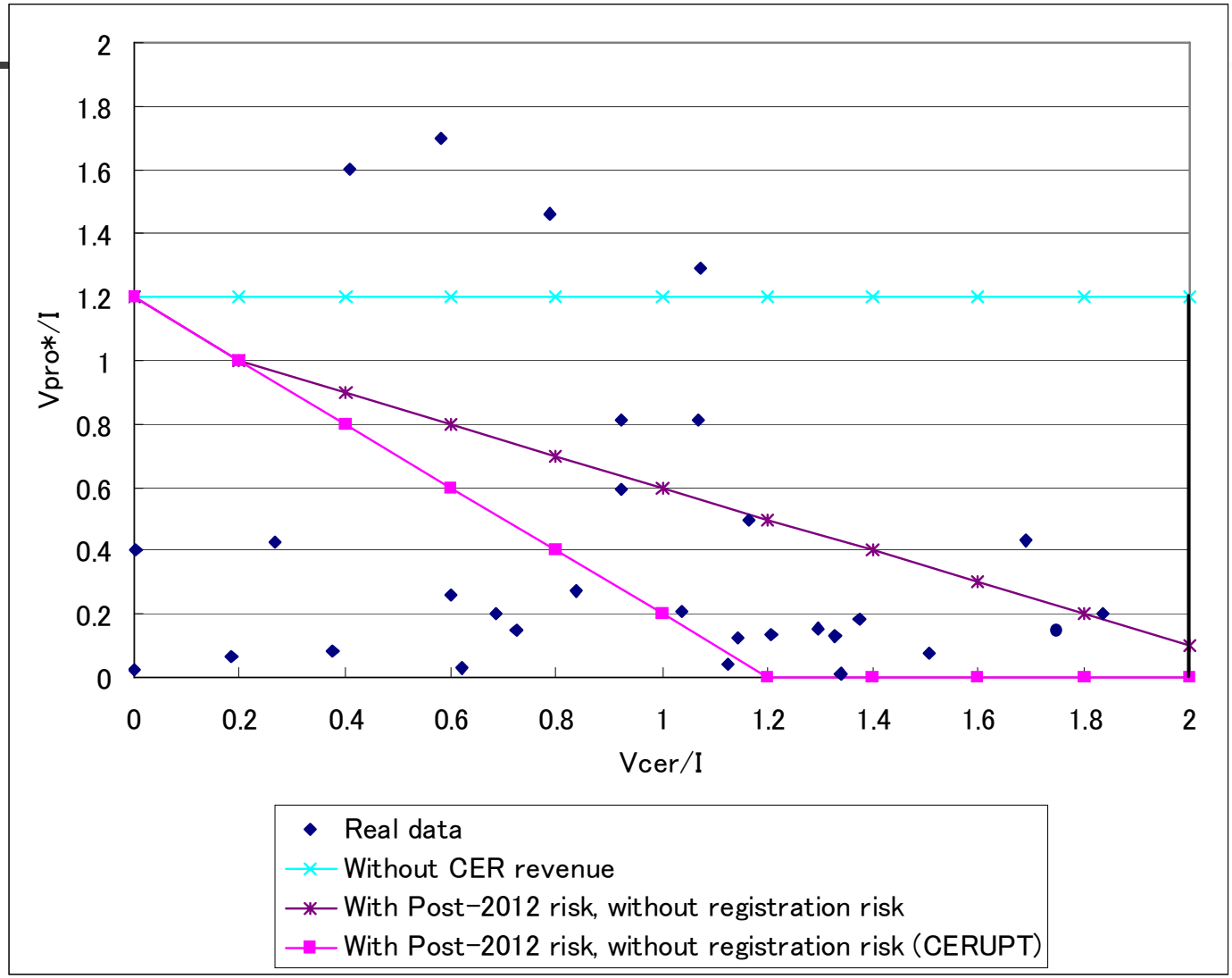
The windows under the various registration risks and actual data



The windows with and without the Post-2012 risk and actual data



The windows in the two payment procedures and actual data



CONCLUSION1

1. Since management of project risks is crucial in CDM, real option theory is applied to evaluate CDM projects. Risks in CDM were expressed as compound rainbow options.

2. We dealt with two kinds of risks, registration risk and the post-2012 risk, while two kinds of uncertainties, prices of CER and of main products, were also included.

3. The model of CDM was developed, which are continuous procedures from registration to investment, so that we could quantitatively compute the option values.

4. The evaluated results identified the window for CDM, condition of profitability, in which investment as CDM are feasible.

CONCLUSION 2

5. We quantified how the registration risk and the post-2012 risk make the window smaller. As conclusion, registration risk could make stronger adverse impact on investment in CDM than the post-2012 risk does.

6. We also investigated the effect of CER procurement policies by government. Namely, we compared the two payment procedures and quantified how the up-front payment is superior to the payment on delivery.