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Simulation Analysis Based on the East Asian Macroeconometric Model China-Japan-US-Korea 4-Country Model

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Abstract

The research is aimed at testing the properties of the Asian Link Model which has been developed since 2006, in which we deal with the model of Japan, the US, China and Korea and the bi-lateral trade linkage model. This model has expanded the conventional econometric model in several directions. One is to do farther investigation of changing bi-lateral trade patterns in more flexible form among those four countries. The second point is to use forward looking variables to evaluate the anticipated expectations to the new policy. The third is to add an energy model to simulate the future changes in the Asian economy with energy constraints.

In this version, we mainly present the structures of the model and the simulation results of the stimulus packages which are just carried in the world. For example, the government investment by 1% of real GDP will lead the increase close to 1.3% in real GDP in the US economy, and so forth. As to the appreciation of RMB +10%, it will reduce the real GDP by 3～5%. It is also notable that Chinese slowdown in exports leads the reduction in Korean exports simultaneously.

Keywords:

East Asian Macroeconometric Model, forward-looking model, bi-lateral trade, stimulus package, simulation analysis

JEL: E17, F17, F18

This research is supported by KAKENHI 20530223

1. Introduction

The research is aimed at testing the properties of the Asian Link Model which has been developed since 2005-2006, (*see* Ozaki (2006)), in which we deal with the model of Japan, the US, China and Korea and the bi-lateral trade linkage model. The model is also designed for evaluating the recent fiscal stimulus packages.

This model has expanded conventional econometric models in several directions. One is to do farther investigation of changing bi-lateral trade patterns which include those four countries. The second point is that the model uses forward looking variables to evaluate the anticipated expectations to the new policy. The third is to add an energy model to simulate the future changes in the Asian economy with the excess energy use or the limited energy constraints.

The trade relation has been so dramatically changed that it is inevitable for many countries to assign the vertical structure of production system beyond nations and we must develop the new method which is more flexible and is able to evaluate properly the role of the third country effects.

2. Model and Specification

(1) GDP definition

GDP=C+IF+GC+X -M

GDPV=CV+IFV+GCV+XV -MV

・・・V denotes the nominal value. Do the same for the following.

CV=PC*C/100

IFV=PIF*IF/100

GCV=PGC*GC/100

XV=PX*X/100

MV=PM*M/100

(2) Consumption

Consumption function is formulated applying the Permanent Income Hypothesis, in which technically "model consistent" expectation (sometimes confusing to Rational Expectation) is assumed. This type of the specification originally appeared in MULTIMOD, IMF (1998) , in which forward looking formulations are adopted.

The income constraint for a household is as follows;

$$W_{t+1} = (1 - t_w)\, YL_t - C_t + (1 + r)\, W_t$$

W ...wealth,

t_w ...tax rate,

YL ...household income,

C ...consumption,

r ...interest rate

We assumed to determine the consumption at the present time under the condition maximizing the discounted total utility/income in the future.

$$\max_{C_t} E\left(\sum_{i=0}^{\infty}\left(\frac{1}{1+\delta}\right)^i u(C_{t+i})\ |\Omega\right)$$

u ...utility function, δ ...discount rate,

Ω ...available information set

The expectation of the future gain is approximately substituted to the expectation of the series of the future income. There are many types of the expectation such as a typical distributed time-lag model, but, the most natural way to express the future income is to induce forward looking variables.

$$E\left(\sum_{i=0}^{\infty}\left(\frac{1}{1+\delta}\right)^i u(C_{t+i})\ |\Omega\right)=E\left(\sum_{i=0}^{\infty}\left(\frac{1}{1+\delta}\right)^i YL_{t+i})\ |\Omega + W_t\right)$$

$$C_t=\left(\frac{\delta}{1+\delta}\right)E\left(\sum_{i=0}^{\infty}\left(\frac{1}{1+\delta}\right)^i(1-t_w)YL_{t+i}+W_t\right)$$

The final specification of the consumption function is given by

$$C_t=c_0+c_1\left(\sum_{i=0}^{\infty}\left(\frac{1}{1+\delta}\right)^i(1-t_w)YL_{t+i}\right)+c_2 W_t$$

Brief notations using in EViews are as follows.

C=F(PEDYV/PC*100 ΣPENW(+i)/PC(+i)/(1+RLG(+i)))

PEDY...disposable income, PENW....wealth, RLG.... interest rate

Table 2.1 Consumption functions

	Income	t-value	Wealth	t-value
China	0.83 (*)	with lag	0.005	0.48
Japan	0.88 (*)	with lag	0.001	1.06
Korea	0.82 (*)	without lag	0.049	2.06
US	1.04 (*)	with lag	0.001	2.54

(*) propensity to consumption in the long run

PEDYV=PEWFP +PEOY -TY

PEWFP...wage income, PEOY...property income, TY...income tax

SV=PEDYV-CV

PENW=PENW(-1)+SV

SV....savings

PEWFP=F(ER*ET)

ER....earnings per capita, ET....employee

PEOY=F(RLB*PENW)

TY=F(PEDYV)

(3) Investment

The ratio of the shadow value of capital to the unit of investment is known as the marginal Q, and this derives a linear relation between the marginal Q and the investment.

The marginal Q is defined by the following formulation originally developed in Behr and Bellgart (2002).

In the basic Q-model, the firm is assumed to maximize the expected value of the sum of discounted profits.

$$\max_{\pi_t} E\left(\sum_{i=0}^{\infty}\left(\frac{1}{1+\delta}\right)^{i}\pi_{t+i}) \,|\Omega\right)$$

π ...corporate profit

We assume a Cobb-Douglas production function $Y_t = AK_t^{\alpha}L_t^{\beta}$, and a profit function as follows,

$$\pi_t = pAK_t^{\alpha}L_t^{\beta} - w_tL_t - q_tI_t$$

p ...output price, K ...capital stock,

L ...labor, w ...wage rate,

q ...unit cost of investment,

I ...investment

The marginal productivity of capital, MPK, is given by

$$\frac{\partial \pi}{\partial K} = \frac{\partial Y}{\partial K}p + \frac{\partial p}{\partial Y}\frac{\partial Y}{\partial K}Y = \theta\frac{Yp}{K}$$

Here, we presume $Yp \approx V$ (value added), then, the estimate of θ is .

$$\hat{\theta} = \frac{\sum (r_i + d_i)}{\sum \frac{V_i}{K_i}}$$

The ratio of the shadow value of capital to the unit of investment is known as the marginal Q, and this derives a linear relation between the marginal Q and the investment.

The marginal Q is defined by the next formulation.

$$Q_t = \sum_{i=1}^{\infty} E(MPK_i) \frac{(1+d_t)^i}{(1+r_t)^i} \approx \hat{\theta} \sum_{i=1}^{\infty} \frac{1}{(1+r_t)^i} \frac{V_i}{K_i}$$

As $d_t = \overline{d}$ is assumed, the effect of the depreciation is absorbed in $\hat{\theta}$ .Finally, we get the specification of the investment function.

$$\frac{I_t}{K_{t-1}} = \alpha_0 + \alpha_1 \left(\sum_{i=1}^{\infty} \frac{1}{(1+r_t)^i} \frac{GDP_i}{K_i} \right) + \alpha_2 \frac{Z_t}{K_{t-1}}$$

$$K_t = I_t + (1 - d_t) K_{t-1}$$

Z ...additional explanatory variables such as FDI and corporate operating surplus.

IF=IBUD +IFOR +ILON +IFF

IBUD...investment by the government fund

IFOR...investment by the foreign capital

ILON...investment by the private loan(?)

IFF....private corporate investment

IFF/K(-1)=F(ΣGDP(i)/K(i)/(1+RLG(i))　Z(k)/K(-1))

ΣGDP(i)/K(i)/(1+RLG(i))....proxy to marginal Q

(Z(k))....additional elements such as...

Z1=COGTP

Z2=RLB*PENW

Z3=Money supply etc

Estimated parameters are as following.

Table 2.2 Investment functions

	ΣGDP(i)/K(i)/	t-value	Z(k)/K(-1)	t-value
China	0.53	11.4	13.9(**)	3.14
Japan	0.12	0.91	17.6(*)	1.50
Korea	0.11	1.15	48.9(**)	3.60
US	0.15	2.45	43.8(**)	2.83

(*) Z=Money supply

(**) Z=corporate profit

K=IFF+K(-1)

(China's foreign investment)

IFOR=F(GDP(i) W(i)/W(j) GDP(j))

Foreign investment (FDI inflows) in China is substantially affected by Japan's GDP. Typical example is as follows;

log(IFOR)=-49.5-0.08*log(ER$/WWC$)+0.86*log(CN_GDP)+3.63*log(JP_GDP)

In this estimation, CN_GDP is not significant, and its elasticity is rather low.

(4) Exports and Imports

Trade functions are formulated by each combination of trading partners. The row sum of $T_{ch,kr}$, $T_{ch,jp}$ is, for example, the total exports of China .Xij$ denotes the exports in constant price of $ between i-j countries. The function contains indirect relative price combinations to reflect the substitution effect to the third party countries.

	China	Japan	US	Korea	RW	World	
China	–	T(c,j)					
Japan	T(j,c)	–	T(j,u)	T(j,k)	T(j,r)	T(j,w)	XV$ Total Export
US		T(u,j)	–				
Korea		T(k,j)		–			
RW		T(r,j)			Trr		
World		T(w,j)					
		MV$ Toatal Import					

Figure 2.1 Trading partners, exports and imports

Consider a specific bi-lateral trade relation between (i) and (j) countries. Of course, the country (i) has several options regarding the trading partners importing/exporting goods.

In the conventional model, the formulation of export T_{ij}, or import T_{ji} is typically a function of demand of the country(j) and the relative price $\frac{p_i}{p_j}$. This model implicitly implies that the domestic demand of j-country can be substituted by the foreign goods from i-country, but it does not tell how the change in i-j relation affects i-k relation explicitly.

To avoid this problem, we adopt the translog function formation to denote the j-i, i-k,...relations.

We assume a linear homogeneous function

$$M = f\left(M_1, M_2, \cdots\right)$$

M ...total real import, M_j ...import from j-country, here, j=1,2,

To minimize the cost function of M, we use the translog function with 2nd order approximation, and this is denoted by

$$\begin{aligned} \ln MV = \ln \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln P_i + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln P_i P_j \\ + \alpha_M \ln M + \frac{1}{2} \gamma_{MM} \left(\ln M\right)^2 + \sum_{i=1}^{n} \gamma_{iM} \ln P_i \ln M \end{aligned}$$

MV ....total cost, namely total import in nominal term

Using Shephard's lemma,

$$\begin{aligned} \frac{\partial \ln MV}{\partial \ln P_i} = \frac{\partial MV}{\partial P_i} \frac{P_i}{MV} = \frac{P_i M_i}{MV} = S_i \\ = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln P_i + \gamma_{iM} \ln M \\ = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln P_i + \gamma_{iM} \ln GDP \end{aligned}$$

Here, we simply assume $M = f(GDP)$.

Parameter constraints are as follows,

$$\sum_{i=1}^{n} \alpha_i = 1$$
$$\sum_{j=1}^{n} \gamma_{ij} = 0$$
$$\sum_{i=1}^{n} \gamma_{iM} = 0$$

The sum of j column of T(i,j) is the total imports of j country. Each element reflects the exporting price of respective country, which differs from each other and forms the composite import price.

Crude oil and natural gas are imported from the rest of the world and separately treated to evaluate the effect of oil price changes.

(Example of China)
CN_M$V=T(jpcn)$+T(krch)$+T(usch)$+T(rsch)$
CN_M$=T(jpch)$/JP_PX$*100+T(krch)$/KR_PX$*100+T(usch)$/US_PX$(us)*100
+XVrsch$
MVrsch$=MOIL$+MGAS$+MCOAL$ + Mrsch_others$
CN_PM$=CN_MV$/CN_M$*100
PM=F(CN_PM$*CN_RXD)
MV=F(CN_M$V*CN_RXD)
M=MV/PM*100

(5) Recent changes in the trading pattern

Drastic changes in the trading patterns have taken place since 1995. Table 2.3 shows that the role of China is becoming greater rapidly in exports/imports to/from the US and World. Accompanied by this, Korea has enforced its dependency to China.

Japan especially raises exports in the area of industrial supplies (BEC classification), this causes the increase in imports of equipments and parts through FDI.

Regarding consumption goods, relation between China and the US and Korea has enhanced compared to the relation between China and Jpanan.

Table 2.3 Changes in the trading pattern

2005/1995 BEC1 Food and Beverage

	CN	JP	KR	US	World
CN		1.74	4.73	4.51	2.06
JP	4.39		3.44	1.65	1.56
KR	2.99	0.73		1.77	0.98
US	3.07	0.67	1.09		1.23
World	2.63	0.97	1.82	1.99	1.47

2005/1995 BEC2 Industrial Supplies

	CN	JP	KR	US	World
CN		2.64	3.62	6.67	3.90
JP	3.39		1.99	1.17	1.55
KR	3.75	1.44		2.49	1.81
US	3.21	0.84	0.95		1.55
World	3.88	1.19	1.59	2.15	1.55

2005/1995 BEC3 Fuels

	CN	JP	KR	US	World
CN		1.57	3.23	2.29	3.26
JP	4.02		0.58	2.89	1.72
KR	6.64	4.10		18.96	6.46
US	7.06	0.58	0.66		2.71
World	12.55	2.47	3.51	4.73	4.08

2005/1995 BEC4 Capital goods and Parts

	CN	JP	KR	US	World
CN		7.37	20.88	13.43	12.22
JP	3.71		1.17	0.78	1.11
KR	18.09	1.86		1.19	2.69
US	3.79	0.88	1.25		1.45
World	6.25	1.85	1.77	1.75	1.58

2005/1995 BEC5 Transport equipment and Parts

	CN	JP	KR	US	World
CN		9.22	10.59	8.66	8.32
JP	4.07		1.52	1.46	1.47
KR	13.68	2.16		3.64	3.10
US	4.10	1.01	0.97		1.79
World	4.99	1.47	1.14	1.96	2.01

2005/1995 BEC6 Consumption goods

	CN	JP	KR	US	World
CN		2.20	4.35	4.42	3.64
JP	1.59		1.83	1.54	1.45
KR	2.96	0.46		0.89	0.96
US	5.45	0.83	1.09		1.57
World	3.36	1.38	2.40	2.37	2.10

2005/1995 BEC Total

	CN	JP	KR	US	World
CN		2.95	5.25	6.60	5.12
JP	3.64		1.49	1.11	1.34
KR	6.77	1.41		1.70	2.27
US	3.56	0.86	1.09		1.55
World	5.00	1.53	1.93	2.25	1.81

(6) Tax and Financial sector

(Example of China)

TAXES=TXAV+TXIV+TXTV+TY+TXOTH+TINT

TXAV...tax on the agricultural sctor

TXIV...tax on industry and commerce

TXTV...tariff on trade

TY...income tax

TXOTH...tax, miscellaneous

TINT...tax on interest

GREV=TAXES+GREVO

GEXP=GCV+GIV+GEOTH

GB=GBPRIM

=GREV-GEXP =-(GGDBTX) =GGDBT-GGDBT(-1)

(7) Money demand and interest rate

We chose the model with the monetary policy rule formulated originally by Clarida, Galf and Geltler (2000) and re-quoted in Cho and Moreno (2006). Theoretical model is as following,

$$R_t = \alpha + \rho R_{t-1} + (1-\rho)[\beta E_t \dot{p}_{t+1} + \beta ygap] + \varepsilon_{MP}$$

R_t is the combination of the past interest rate and the expected inflation rate and the deviation of output from trend or the potential output. ε_{MP} is the monetary policy rules or the monetary shocks. The parameter α denotes the long run reaction of the central bank to the expected inflation, and also, β denotes the measure to evaluate the effects of the deviation of the output from the potential output, here we adopt the money supply as a proxy instead of GDP gap.

(Short term interest rate)

RSH=F(αRSH(-1) (1-α)PGDP(+1)/PGDP βMON/PGDP)

Table 2.4 Interest function

	α	t-value	β	t-value
China	0.63	3.28	-0.99	-1.66
Japan	0.68	6.43	-1.50	-1.59
Korea	0.59	9.70	-3.51	-7.11
US	0.59	6.01	-2.16	-1.00

(Long term interest rate)
RLG=F(α RLG(+1) (1- α)RLG(-1) β RSH)

(8) Balance of payment
RES$=RES$(-1)+BCU$+BCAP$
BCU$=X$V-M$V
X$V...nominal export in dollar
M$V...nominal import in dollar
BCAP$=FDI$+NFDI$

(9) Deflator and price index
The equation for the price deflator is an application of the expanded Phillips theory.

$$p_t = \delta E_t p_{t+1} + (1-\delta) p_{t-1} + \lambda\, ygap + \varepsilon_t$$

This type of formulation is proposed in Calvo(1983) and Cho and Moreno (2006) in the context of the aggregate supply equation of new Keynesian macro models. Here, we propose tentatively that the deflator PIF can be formulated like those.
PGDP=GDPV/GDP*100
PX....exogenous
PM....determined by the trade sector, a combination of the price of exporting countries.
PC=F(PC(-1) ER)
ER...earning, wage
PIF=F(PM ER)
PGC=F(PC)

(10) Earnings
ER=F(GDPV/ET GDPGAP)
GDPHAT= Σ GDP(j)/3
World average wage index (exogenous here)
WW$=F(ER(ch)/RXD(ch) ER(jp)/RXD(jp) ER(kr)/RXD(kr) ER(us)/RXD(us))
WW$(ch)=F(ER(ch)/RXD(ch))

(11) Labor
ET=F(GDP GDP(-1)/ET(-1))
U=LS-ET
URATE=U/LS*100

ET....employee
U....unemployment
LS....labor supply

(12) Energy demand

Both of the translog approach and the conventional specification are tested to denote the substitutable relation between energy sources.

TDMD$=DOIL*POIL$+DCCAL*PCOAL$+DGAS*PGAS$

DOIL, DGAS, DCOAL....demand for crude oil, gas, coal in mtoe

DOIL*POIL$/TDMD$=F(GDP PGDP$ ΣP$(j))

DCOAL*PCOAL$/TDMD$=F(GDP PGDP$ ΣP$(j))

DGAS*PGAS$/TDMD$=F(GDP PGDP$ ΣP$(j))

We also tried to estimate the parameter β directly using CES function.

$$TPEN = A_0 \left\{ w_{coal} DCOAL^{-\beta} + w_{gas} DGAS^{-\beta} + w_{oil} DOIL^{-\beta} \right\}^{-\frac{1}{\beta}}$$

$$\varepsilon = 1 / (1 + \beta)$$

TPEN Total energy demand (mtoe)

DOIL primary energy demand for Oil (mtoe)

DGAS primary energy demand for Gas (mtoe)

DCOAL primary energy demand for Coal (mtoe)

Table 2.5 Elasticity of substitution

Total demand and CES function		coeff	t-value
China	cnst	1.897	15.3
	β	−0.816	−1.15
	elasticity	5.430	
Japan	cnst	3.226	106.6
	β	0.191	4.09
	elasticity	0.840	
Korea	cnst	2.647	100.8
	β	−0.158	−3.27
	elasticity	1.190	
US	cnst	3.434	60.4
	β	0.202	0.43
	elasticity	0.830	

Elasticity of substitution can vary depending on the nation's stage of development. China still seems to have high possibility of substitution among energy sources.

3. Testing the Model

To test and simulate the model, we need a little complicated procedure to deal with forward looking variables, which is originally developed in Fair (1984) and sometimes called "extended path method". This method calculates the future expected values to determine the present value of endogenous variables, therefore, for example, future GDP affects present consumption because we usually anticipate policy changes in the future.

We carried the final test from 1990 to 2006, results of GDPs as a base line of each country are presented in the following page.

In the Asian model it seems rather difficult to pursuit the deep trough during the crisis 1997-1999.

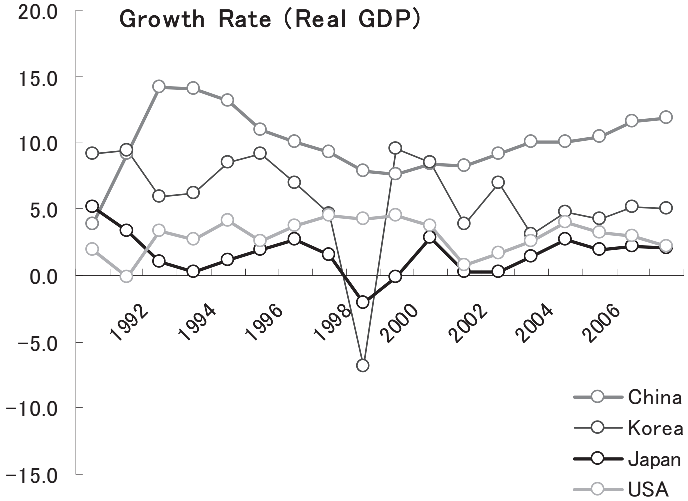

Figure 3.1 Growth rate of 4 countries

MAPE (Mean Absolute Percent Error) regarding principal endogenous variables are shown in the table.

Table 3.1　MAPE

	China	Korea	Japan	US
GDP(real GDP)	1.9	6.1	1.2	3.2
GDP(nominal GDP)	5.2	9.2	2.2	2.1
C(real consumptionl)	3.4	6.8	1.3	3.9
IF(real investment)	0.2	6.8	2.9	5.4
X(real exports)	6.3	13.6	7.6	1.2
M(real importsl)	5.6	12.4	7.3	6.5
PGDP(deflator)	5.3	4.9	1.8	1.5
PM(import price)	8.0	8.8	6.0	5.6
ET(employee)	2.3	2.2	0.4	1.6

(*) MAPE stands for the mean absolute percent errors (%)

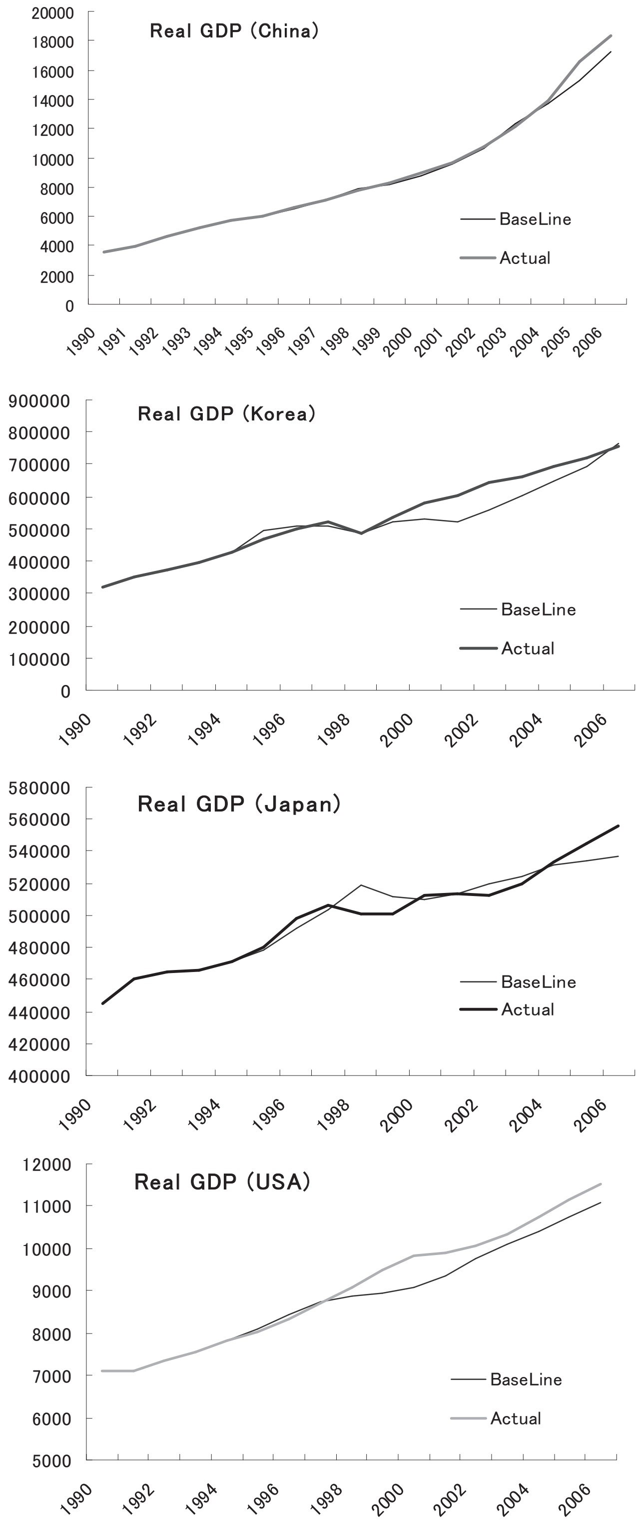

Figure 3.2 Results of dynamic simulation (final test)

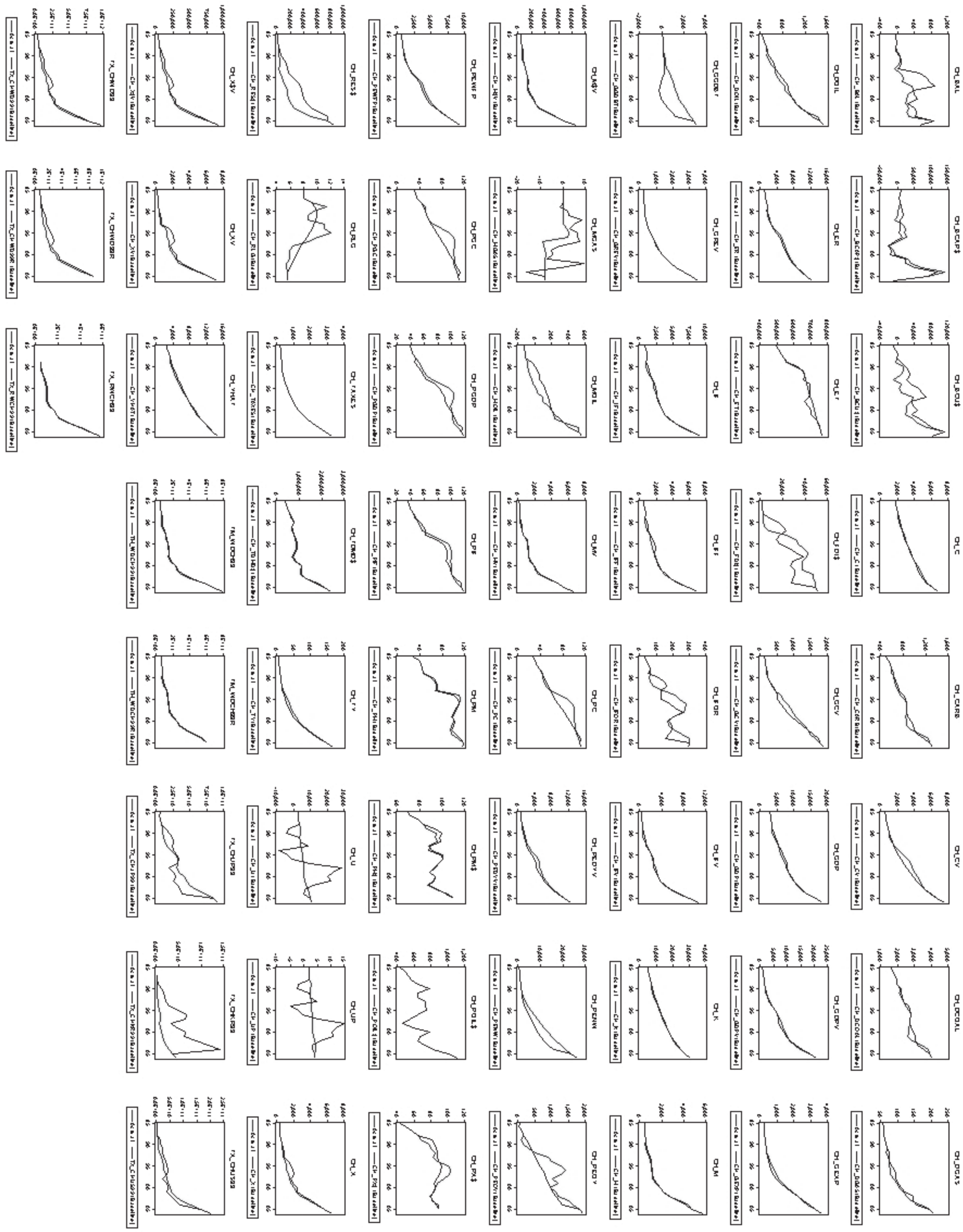

Figure 3.3 Final test of the case China

4. Simulation and Results

(1) Simulation Scenarios

Case 1 Fiscal expansion of China....government investment +1% of GDP at constant prices, sustained shock is assumed.

Case 2 Fiscal expansion of Japan....same

Case 3 Fiscal expansion of US....same

Case 4 Fiscal expansion of Korea....same

Case 5 China's expansion in government investment, as a part of recent big stimulus package, that is, +3.2% of nominal GDP for the 1st year, +5.2% for the 2nd year (Mizuho case, the maximum among similar estimates)

It is announced that the fiscal expenditure will become almost over 4000 billion RMB in total, which amounts for almost 16.0% of nominal GDP at 2007. However, several organizations such as IMF (2009a), Financial Times (Nov. 15, 2008) and Mizuho Research Institute (Japan,2009) have estimated that expenditures in reality may be restrained to the smaller amount than announced. For example, several estimates are the following;

IMF.... 1100 billion RMB in 3 years, 4.4% of nominal GDP (at 2007)

Financial Times.... 1180 billion RMB in 2 years (4.7%)

Mizuho Bank....2100 billion RMB in 2 years (8.4%), 1st year...800, 2nd year...1300 (3.2% and 5.2% respectively)

Case 6 US increase in government investment, as a part of recent big stimulus package, we assume increase in investment by 0.742% of nominal GDP for the 1st year, 0.895% (2nd year), 0.548% (3rd year) according to the proportion quoted in IMF (2009a)

Here, we assume the expenditure on the infrastructure, state aid and education can be regarded as the government investment which amounts for 314 billion $ in total, which is 2.18% of nominal GDP at 2007.

Table 4.1 IMF estimates of Stimulus Package

U.S. Stimulus Package
(in billions of dollars, CY basis)

	2009	2010	2011	Total
Total	283	259	121	663
(in percent of GDP)	2.0	1.8	0.8	4.6
Revenue measures	99	116	37	252
Individual income	37	80	32	149
Corporate income	57	32	-2	87
Other	5	4	7	16
Expenditure measures	184	143	84	411
Infrastructure and other	32	47	47	126
Safety nets	77	14	5	96
State aid and education	75	82	32	189

Source: U.S. CBO; Fund staff estimates.

(*) This table is quoted from IMF (2009a)

Case 7 Appreciation of RMB (China), +10%, sustained shock is assumed.

Case 8 Appreciation of Yen (Japan), +10%, sustained shock is assumed.

Case 9 World oil-price increase, doubled, sustained shock is assumed.

Case 10 US fiscal expansion.... a package of the tax cut and subsidiaries

Table 4.2 Tax cut in % of nominal GDP

	1st year	2nd year	3rd year
Income Tax cut	0.26	0.56	0.22
Corporate Tax cut	0.40	0.22	0.0
Safety Net	0.53	0.10	0.0

(*) We calculated from IMF table above.

Finally, we quote the IMF summary on the Stimulus Package in Large Countries (IMF(2009a)).

Table 4.3 Summary of stimulus packages

Stimulus Packages in Large Countries
(in percent of GDP)

	2008	2009	2010	Total
Canada	0.0	1.5	1.3	2.7
China	0.4	2.0	2.0	4.4
France	0.0	0.7	0.7	1.3
Germany	0.0	1.5	2.0	3.4
India	0.0	0.5	...	0.5
Italy	0.0	0.2	0.1	0.3
Japan	0.4	1.4	0.4	2.2
U.K.	0.2	1.4	-0.1	1.5
U.S.	1.1	2.0	1.8	4.8
Average 1/	0.5	1.6	1.3	3.4

Source: Fund staff estimates
1/ PPP GDP-weighted average.

(2) Simulation Results

(Overview)

These cases assume that the sustained expansion in governmental investments are carried by 1% of real GDP.

There are several views on the fiscal multiplier, it ranges from "negative" to 2 or 3. In average, many articles report 1% increase in G has been found to increase GDP by close to 1%. See IMF (2009b), Taylor (2009), ESRI (Japan, Cabinet Office, 2008), Christiansen (2008), Botman and Laxton (2006), Perotti(2005), Ban(2000, 2002).

Our results are following,

Fiscal expansion both in Japan and the US does not have so much serious effects on each economy, on the other hand, it does on China and Korea. However, the US is more dominant and the role of Japan has recently diminished.

China's expansion leads the 0.41% increase in Korea's GDP

In Japan and Korea, multipliers are rather low, which are 1.03, 0.87 respectively.

Summury on Multipliers		Peak Effect on GDP of			
		China	Japan	US	Korea
Expansion in G of	China	1.31	0.08	0.06	0.41
	Japan	0.35	1.03	0.03	0.14
	US	0.61	0.07	1.42	0.36
	Korea	0.06	0.01	0.01	0.87

Figure 4.1 Multiplier of fiscal stimulus (peak value)

Doug He, Zhiwei Zhang and Wenlang Zhang (2009) estimates the Chinese multiplier to be around 1.1 in the medium run as fiscal spending leads to higher household consumption and corporate investment over time.

Regarding Japanese case, Fumikazu Hida et. al (2009, ESRI) reports the effect of government investment (1% of real GDP) is 1.0% for the first year.

Table 4.2 Multiplier of Japan

Effects of Macroeconomic Policies in Japan on Real GDP

	Effect of Government Investments (1 % of Real GDP)	Effect of Income-Tax Reduction (1 % of Nominal GDP)	Effects of Short-Run Interest Rate Rise (1 %)
1st Year	1.00	0.23	-0.40
2nd Year	1.10	0.60	-0.43
3rd Year	0.94	0.60	-0.63

At the same time, they also show the real investment slows down by around 1%.

John F. Cogan, Tobias J. Cwik and John B. Taylor (2009) report the multiplier of the US economy.

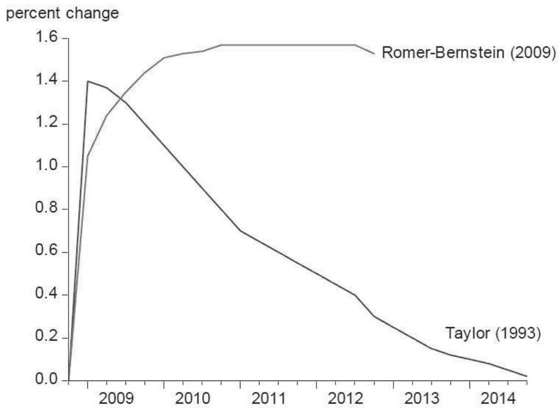

Figure 1. Estimated Impact on GDP of a Permanent Increase in Government Purchases of 1 percent of GDP

Figure 4.2 Multiplier of the US, quoted from Cogan(2009)

(Fiscal Expansion in China)

China's expansion affects 1.31 in the own multiplier, and has great influences on Korean economy. On the contrary, it does not have much effects both on the US and Japanese economies.

Table 4.3 China's expansion

	CN_GDP	JP_GDP	US_GDP	KR_GDP
−6	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00
−2	0.01	0.00	0.00	0.00
−1	0.04	0.00	0.00	0.01
0	0.19	0.01	0.01	0.05
1	1.10	0.05	0.03	0.27
2	1.29	0.05	0.04	0.32
3	1.31	0.06	0.04	0.35
4	1.21	0.07	0.05	0.40
5	1.05	0.08	0.06	0.41
6	1.02	0.08	0.06	0.41

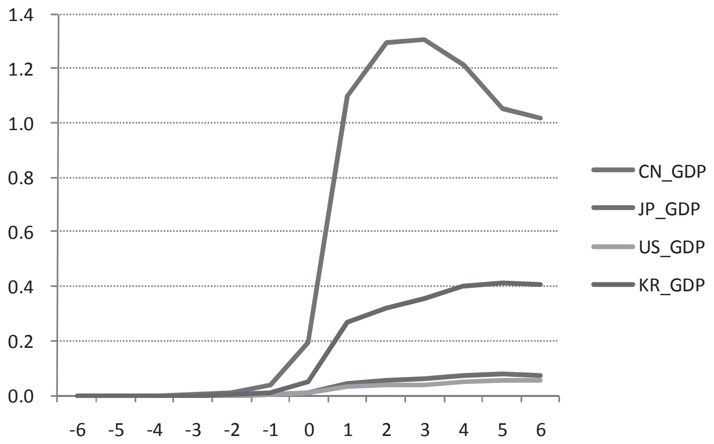

Figure 4.3 Multiplier for other countries

Table 4.4 China's domestic effects

	CN_GDP	CN_GDPV	CN_C	CN_IF	CN_X	CN_M	CN_ET	CN_PGDP
−6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−2	0.01	0.01	0.00	0.02	0.00	0.01	0.00	0.00
−1	0.04	0.04	0.01	0.09	0.00	0.04	0.02	0.01
0	0.19	0.22	0.03	0.51	0.02	0.23	0.09	0.03
1	1.10	1.27	0.16	3.14	0.10	1.43	0.52	0.17
2	1.29	1.56	0.32	3.54	0.11	1.50	0.41	0.27
3	1.31	1.63	0.46	3.55	0.11	1.45	0.28	0.32
4	1.21	1.64	0.56	3.33	0.12	1.40	0.18	0.42
5	1.05	1.51	0.61	2.94	0.12	1.26	0.09	0.45
6	1.02	1.48	0.62	2.77	0.10	1.26	0.10	0.46

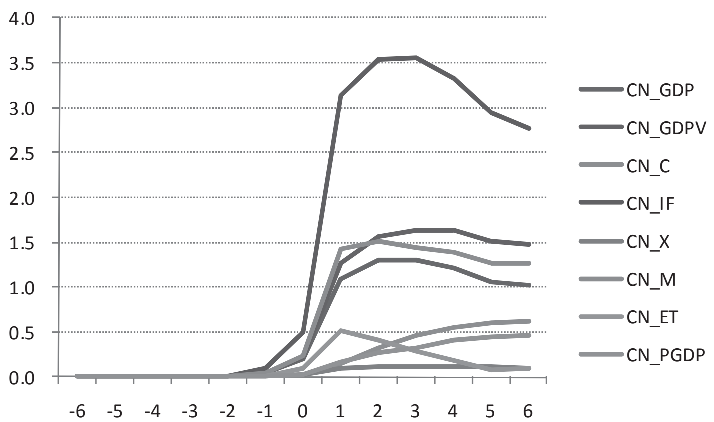

Figure 4.4 China's domestic effects

(Fiscal expansion in Japan)

Japanese expansion has the great effects on Chinese economy. Its multiplier is rather less than the case of China, namely 1.03 for own economy. However, it is 0.35 for China and 0.14 for Korea respectively.

Table 4.5 Japan's expansion

	CN_GDP	JP_GDP	US_GDP	KR_GDP
−6	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00
−2	0.00	0.00	0.00	0.00
−1	0.02	0.00	0.00	0.00
0	0.08	0.05	0.01	0.02
1	0.32	1.03	0.03	0.12
2	0.35	0.97	0.03	0.14
3	0.34	0.89	0.03	0.13
4	0.31	0.79	0.03	0.13
5	0.27	0.70	0.03	0.13
6	0.22	0.69	0.03	0.11

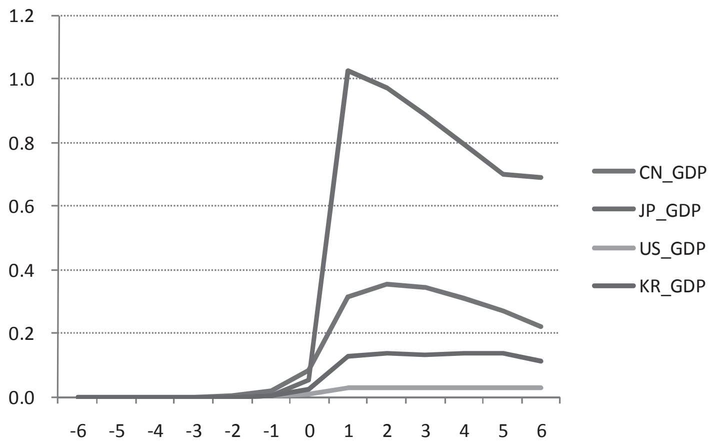

Figure 4.5 Multiplier for other countries

Table 4.6 Japan's domestic effects

	JP_GDP	JP_GDPV	JP_C	JP_IF	JP_X	JP_M	JP_ET	JP_PGDP
−6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−1	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
0	0.05	0.07	0.01	0.17	0.02	0.04	0.01	0.01
1	1.03	1.24	0.23	3.56	0.11	0.87	0.15	0.21
2	0.97	1.38	0.35	3.14	0.12	0.88	0.08	0.41
3	0.89	1.49	0.41	2.76	0.12	0.78	0.02	0.60
4	0.79	1.58	0.43	2.40	0.13	0.70	−0.04	0.78
5	0.70	1.66	0.43	2.10	0.13	0.68	−0.10	0.96
6	0.69	1.85	0.43	2.11	0.12	0.66	−0.13	1.15

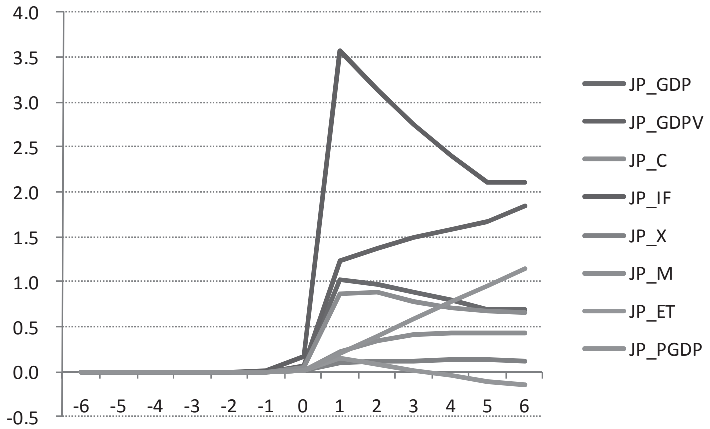

Figure 4.6 Japan's domestic effects

(Fiscal expansion in the US)

The US fiscal expansion has rather great effects on its economy which multiplier is 1.42 , and 0.61 on China, 0.36 on Korea respectively. Effects on Japan is estimated less than 1%.

Table 4.7 The US expansion

	CN_GDP	JP_GDP	US_GDP	KR_GDP
−6	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00
−2	0.01	0.00	0.00	0.00
−1	0.03	0.00	0.01	0.01
0	0.13	0.01	0.11	0.05
1	0.46	0.05	1.30	0.27
2	0.56	0.06	1.38	0.31
3	0.61	0.07	1.42	0.33
4	0.60	0.07	1.41	0.35
5	0.56	0.07	1.38	0.36
6	0.53	0.07	1.56	0.36

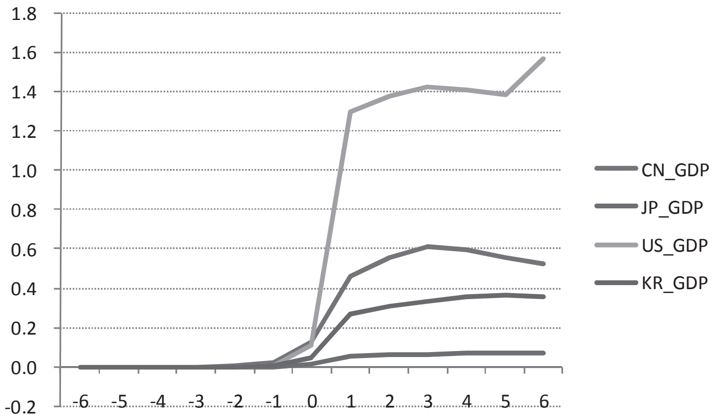

Figure 4.7 The US expansion

Table 4.8 The US domestic effects

	US_GDP	US_GDPV	US_C	US_IF	US_X	US_M	US_ET	US_PGDP
−6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−1	0.01	0.01	0.00	0.04	0.00	0.00	0.01	0.00
0	0.11	0.11	0.03	0.49	0.02	0.06	0.07	0.00
1	1.30	1.33	0.37	6.13	0.07	0.72	0.83	0.03
2	1.38	1.41	0.55	5.74	0.08	0.73	0.71	0.03
3	1.42	1.45	0.64	5.52	0.10	0.74	0.66	0.03
4	1.41	1.43	0.67	5.30	0.13	0.76	0.61	0.02
5	1.38	1.40	0.67	5.18	0.15	0.76	0.59	0.01
6	1.56	1.57	0.70	6.01	0.15	0.89	0.70	0.01

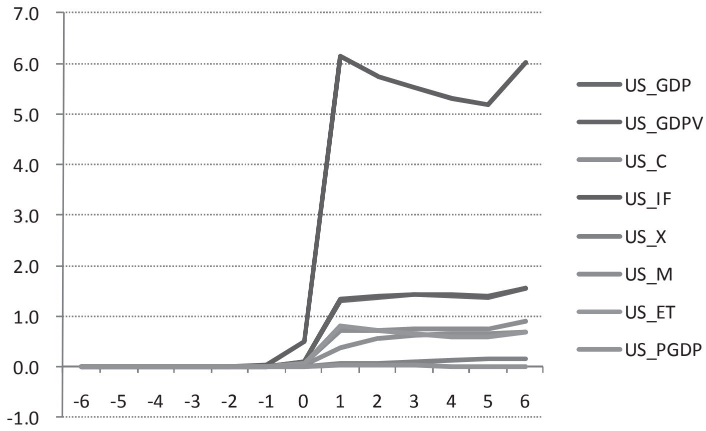

Figure 4.8 The US domestic effects

(Fiscal expansion in Korea)

Korea has the least multiplier among these 4 countries less than 1.0. Korea's economy does not have much influence on the other countries.

Table 4.9 Korea's expansion

	CN_GDP	JP_GDP	US_GDP	KR_GDP
−6	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00
−2	0.00	0.00	0.00	0.00
−1	0.00	0.00	0.00	0.00
0	0.01	0.00	0.00	0.03
1	0.05	0.01	0.01	0.87
2	0.06	0.01	0.01	0.76
3	0.06	0.01	0.01	0.70
4	0.06	0.01	0.01	0.62
5	0.05	0.01	0.01	0.57
6	0.05	0.01	0.01	0.69

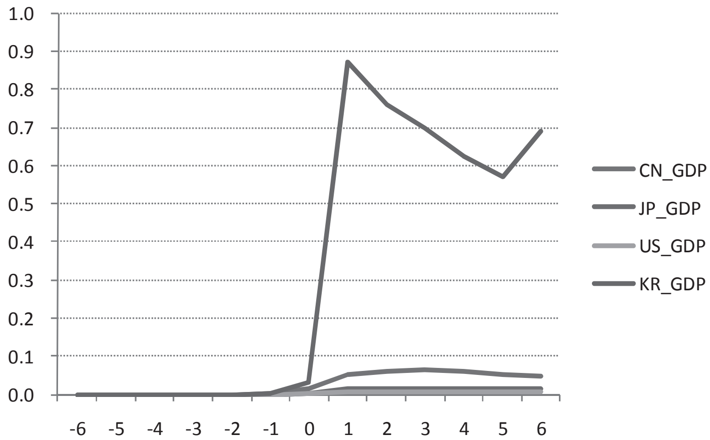

Figure 4.9 Korea's expansion

Table 4.10 Korea's domestic effects

	KR_GDP	KR_GDPV	KR_C	KR_IF	KR_X	KR_M	KR_ET	KR_PGDP
−6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0.03	0.04	0.01	0.11	0.01	0.03	0.01	0.01
1	0.87	1.05	0.48	2.93	0.03	0.81	0.40	0.18
2	0.76	1.08	0.40	2.80	0.04	0.74	0.24	0.31
3	0.70	1.11	0.33	2.64	0.04	0.67	0.20	0.41
4	0.62	1.08	0.27	2.58	0.04	0.62	0.17	0.46
5	0.57	1.06	0.22	2.59	0.04	0.57	0.16	0.48
6	0.69	1.21	0.28	3.13	0.04	0.64	0.22	0.52

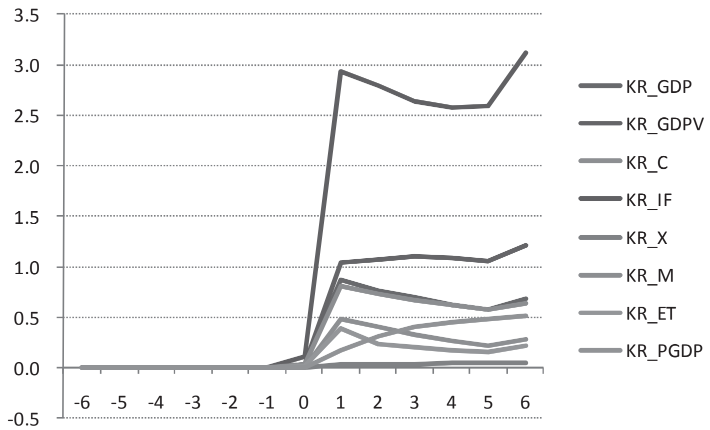

Figure 4.10 Korea's domestic effects

(China stimulus package)

China's stimulus package has a great effects on their economy, it raises GDP by 5.03% and 1.18% on Korean economy. However, in the long run, the effects will slow down less than minus, -0.67%.

Table 4.11 China's stimulus package

	CN_GDP	JP_GDP	US_GDP	KR_GDP
−6	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00
−2	0.02	0.00	0.00	0.00
−1	0.11	0.01	0.00	0.02
0	0.61	0.03	0.03	0.16
1	3.51	0.15	0.11	0.88
2	5.03	0.19	0.12	1.18
3	0.69	0.02	0.03	0.06
4	−0.16	−0.03	0.00	−0.16
5	−0.66	−0.07	−0.03	−0.33
6	−0.67	−0.08	−0.03	−0.32

This fiscal expansion will boost the employment up to 1.74%, on the other hand, rise in GDP deflator will remain less 1%.

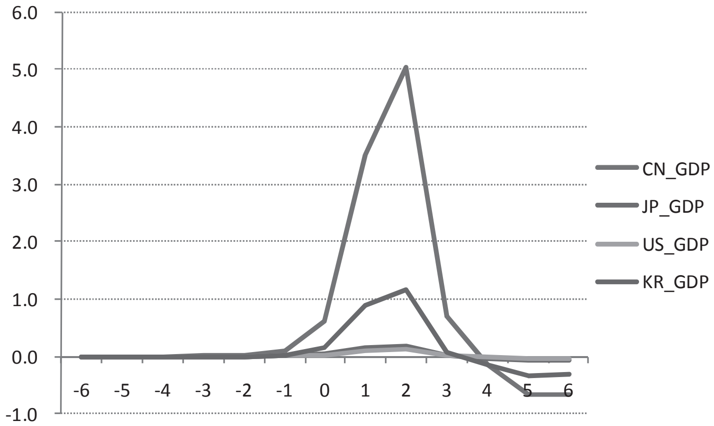

Figure 4.11 China' s stimulus package

Table 4.12 China's domestic effects

	CN_GDP	CN_GDPV	CN_ET	CN_PGDP
−6	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00
−2	0.02	0.02	0.01	0.00
−1	0.11	0.13	0.05	0.02
0	0.61	0.70	0.29	0.09
1	3.51	4.06	1.64	0.54
2	5.03	6.06	1.74	0.97
3	0.69	1.35	−1.03	0.65
4	−0.16	0.31	−0.83	0.47
5	−0.66	−0.39	−0.63	0.28
6	−0.67	−0.52	−0.33	0.16

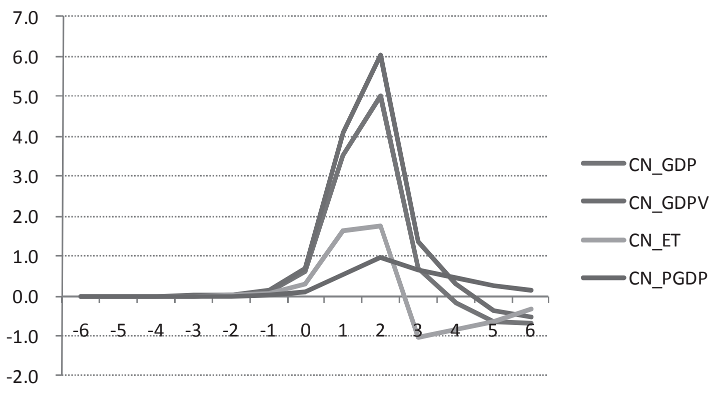

Figure 4.12 China's domestic effects

(US stimulus package)

The US stimulus package is somehow similar to the test of fiscal expansion above. The effects on GDP is estimated to be around 1.29%, and expected to raises the employment up to 0.67%.

Table 4.13 The US stimulus package

	CN_GDP	JP_GDP	US_GDP	KR_GDP
−6	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00
−2	0.00	0.00	0.00	0.00
−1	0.02	0.00	0.01	0.01
0	0.10	0.01	0.09	0.04
1	0.37	0.04	1.04	0.22
2	0.45	0.05	1.26	0.26
3	0.34	0.03	0.79	0.16
4	0.14	0.01	0.06	0.03
5	0.07	0.00	−0.01	0.01
6	0.05	0.00	0.04	0.01

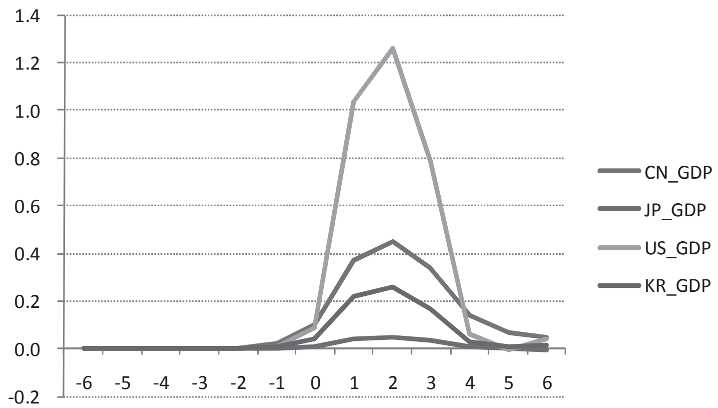

Figure 4.13 The US stimulus package

Table 4.14 The US domestic effects

	US_GDP	US_GDPV	US_ET	US_PGDP
−6	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00
−2	0.00	0.00	0.00	0.00
−1	0.01	0.01	0.00	0.00
0	0.09	0.09	0.05	0.00
1	1.04	1.06	0.66	0.03
2	1.26	1.29	0.67	0.03
3	0.79	0.81	0.28	0.02
4	0.06	0.08	−0.16	0.02
5	−0.01	0.01	−0.09	0.02
6	0.04	0.06	−0.01	0.01

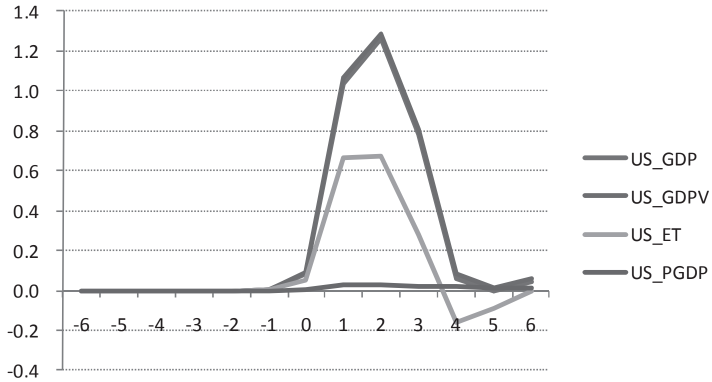

Figure 4.14 The US domestic effects

As to the US model, the fiscal expansion does not affect explicitly on the price deflator, the nominal GDP and the real GDP remain almost same. On the other hand, regarding Japan model, it affects a lot

(Appreciation of RMB)

Appreciation of RMB leads drastic slowdown in China's economy by around 6%. Adding to this, it is very distinctive that China's slowdown makes other nation's economy shrink at the same time up to -2.39% on Korea and -0.44% on Japan.

Table 4.15 Appreciation of RMB

	CN_GDP	JP_GDP	US_GDP	KR_GDP
−6	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00
−3	−0.01	0.00	0.00	0.00
−2	−0.03	0.00	0.00	0.00
−1	−0.16	−0.01	−0.01	−0.03
0	−0.88	−0.04	−0.03	−0.21
1	−4.08	−0.16	−0.12	−0.92
2	−4.99	−0.20	−0.13	−1.18
3	−5.75	−0.27	−0.17	−1.52
4	−6.17	−0.36	−0.24	−2.01
5	−6.27	−0.44	−0.31	−2.39
6	−5.78	−0.41	−0.30	−2.21

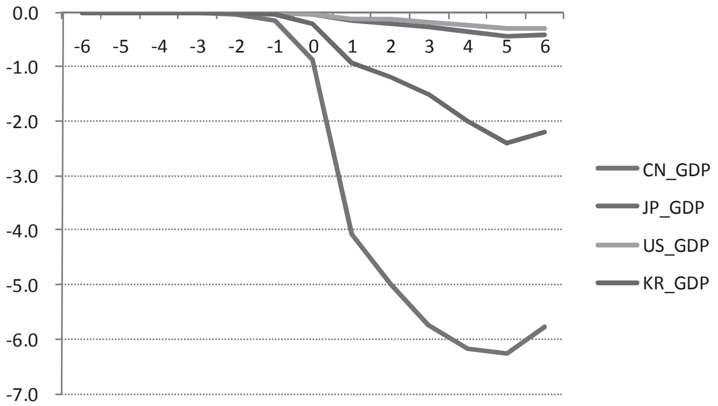

Figure 4.14 Appreciation of RMB

Table 4.16 Domestic effects of the appreciation of RMB

	CN_GDP	CN_GDPV	CN_C	CN_IF	CN_X	CN_M	CN_ET	CN_PGDP
−6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−3	−0.01	−0.01	0.00	−0.02	0.00	−0.01	0.00	0.00
−2	−0.03	−0.04	0.00	−0.08	0.00	−0.04	−0.01	0.00
−1	−0.16	−0.19	−0.03	−0.40	−0.02	−0.19	−0.08	−0.02
0	−0.88	−1.00	−0.13	−2.29	−0.10	−1.05	−0.41	−0.13
1	−4.08	−4.15	−0.60	−5.77	−9.61	−4.68	−1.91	−0.07
2	−4.99	−5.38	−1.19	−7.71	−9.70	−5.27	−1.64	−0.42
3	−5.75	−6.12	−1.84	−8.76	−9.89	−5.85	−1.51	−0.39
4	−6.17	−6.16	−2.41	−9.25	−10.08	−6.60	−1.34	0.01
5	−6.27	−5.74	−2.84	−8.69	−10.26	−7.04	−1.13	0.56
6	−5.78	−5.33	−3.07	−6.40	−10.20	−6.66	−0.72	0.48

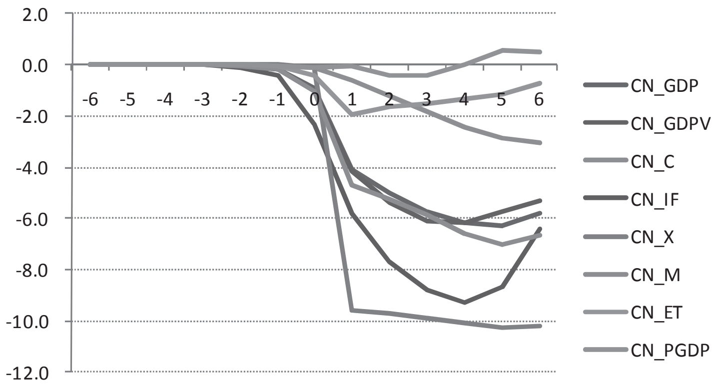

Figure 4.15 Domestic effects of the appreciation

In Ban (2000), the reduction of GDP is estimated around 3% at 2001. Our estimate is rather great, that is 3～6%. It is notable that Chinese slowdown in exports leads the reduction in Korean exports simultaneously.

(Appreciation of the yen)

Appreciation of the yen also affects largely its economy, it slows down GDP of Japan by around -1.38%. Large drop in GDP of neighboring countries can be -0.45% in China.

Table 4.17 Appreciation of the yen

	CN_GDP	JP_GDP	US_GDP	KR_GDP
−6	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00
−2	−0.01	0.00	0.00	0.00
−1	−0.03	−0.01	0.00	−0.01
0	−0.13	−0.15	−0.01	−0.04
1	−0.42	−1.38	−0.04	−0.17
2	−0.43	−1.08	−0.04	−0.17
3	−0.45	−1.12	−0.04	−0.18
4	−0.45	−1.17	−0.04	−0.20
5	−0.45	−1.26	−0.05	−0.24
6	−0.38	−1.22	−0.05	−0.20

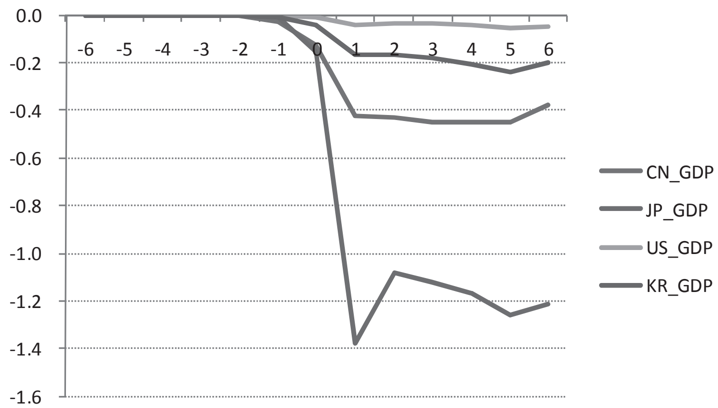

Figure 4.16 Appreciation of the yen

Reduction in Japan's GDP will induce largely the Chinese and Korean reduction in exports at the same time because of glowing mutual dependency comparing to one or two decades before.

For the reference, we quote the results of the simulation carried by Ban (2000), the reaction of China is quite different compared to the case above. According to their work, reduction in Japanese exports were simultaneously filled by 3-rd country exports, which boosted the other nation's economy. This means that the substitution among exporting countries has become diminished with the trend which cooperative and complementary relation has been brought up.

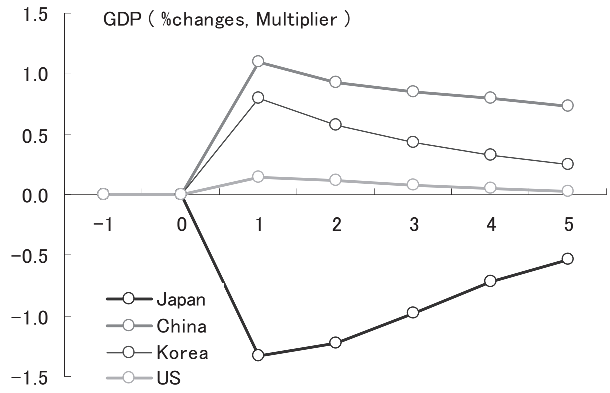

Figure 4.17 Ban's estimate of appreciation of Yen

Table 4.18 Domestic effects of appreciation of Yen

	JP_GDP	JP_GDPV	JP_C	JP_IF	JP_X	JP_M	JP_ET	JP_PGDP
−6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
−1	−0.01	−0.01	0.00	−0.03	−0.01	−0.01	0.00	0.00
0	−0.15	−0.19	−0.03	−0.51	−0.03	−0.12	−0.02	−0.03
1	−1.38	−0.74	−0.32	−0.48	−10.60	−1.25	−0.20	0.65
2	−1.08	−0.34	0.03	0.06	−10.59	−1.11	−0.08	0.75
3	−1.12	−0.24	0.19	−0.10	−10.57	−1.09	−0.02	0.89
4	−1.17	−0.09	0.30	−0.32	−10.58	−1.13	0.03	1.09
5	−1.26	0.15	0.42	−0.55	−10.57	−1.36	0.08	1.43
6	−1.22	0.57	0.62	−0.51	−10.53	−1.27	0.15	1.81

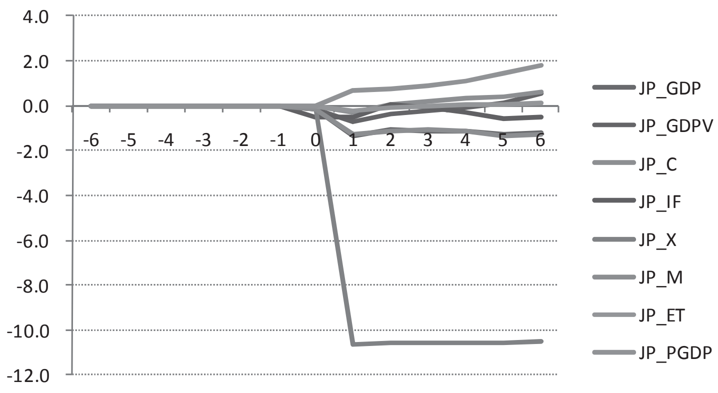

Figure 4.18 Domestic effects of appreciation of Yen

(High oil price, 2 times higher)

The US and China will be the most affected countries. Both countries are typically oil consuming/depending countries. Particularly, in the case of the US, the reduction in GDP goes beyond -5% .

Table 4.19 Effects of the high oil price

	CN_GDP	JP_GDP	US_GDP	KR_GDP
−6	0.00	0.00	0.00	0.00
−5	0.00	0.00	0.00	0.00
−4	0.00	0.00	0.00	0.00
−3	0.00	0.00	0.00	0.00
−2	−0.02	0.00	0.00	0.00
−1	−0.10	−0.01	−0.05	0.00
0	−0.42	−0.09	−0.62	−0.02
1	−1.18	−0.58	−4.19	−0.34
2	−1.16	−0.47	−4.07	−0.35
3	−1.12	−0.44	−4.31	−0.20
4	−0.86	−0.42	−4.78	−0.22
5	−0.57	−0.43	−5.42	−0.19
6	−0.42	−0.43	−5.64	−0.23

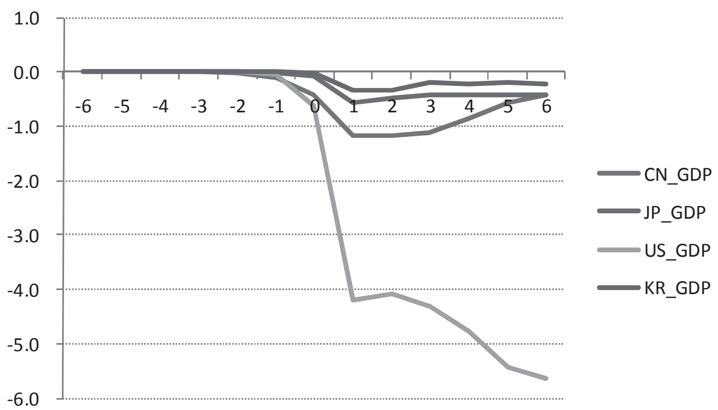

Figure 4.19 Effects of the high oil price

High oil price promotes adoption of oil saving technology and reduction of oil demand in the long run. However, this, of course, results in the reduction of GDP because of the rapid increase in imports in the short run.

On the other hand, oil price does not have such a drastic effects on GDP deflator for every countries.

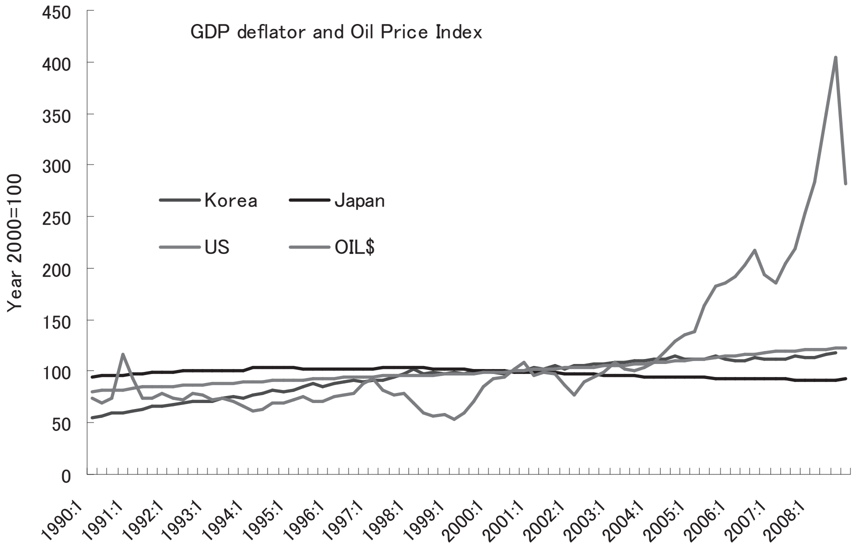

Figure 4.20 Oil price and deflators

(Stimulus Packages estimated by IMF)

IMF(2009b) estimates of multiplier of the fiscal expansion using GIMF model (Kumhof and Laxton (2009)). Japanese multipliers are estimated much smaller than our case.

Table 3. Growth Effects of Fiscal Stimulus in 2009 and 2010
(Deviation from baseline in percentage points)

		Stimulus in:				
	All	U.S.	Euro Area	Japan	Em. Asia	RoW
Effects on Growth in 2009						
World	1.4	0.5	0.2	0.1	0.4	0.2
United States	1.5	1.3	0.0	0.0	0.1	0.1
Euro Area	0.9	0.2	0.5	0.0	0.1	0.1
Japan	1.1	0.2	0.0	0.7	0.1	0.0
Emerging Asia	2.1	0.6	0.1	0.1	1.3	0.1
Remaining Countries	1.0	0.3	0.1	0.0	0.2	0.4
Effects on Growth in 2010						
World	0.7	0.9	-0.0	0.0	-0.2	-0.0
United States	1.5	1.4	0.0	0.0	0.0	0.0
Euro Area	0.3	0.5	-0.2	0.0	0.0	0.0
Japan	0.4	0.5	0.0	-0.2	-0.0	0.0
Emerging Asia	0.2	1.1	0.0	0.0	-0.9	0.0
Remaining Countries	0.6	0.7	0.0	0.0	-0.0	-0.1

Table 4. Level Effects of Fiscal Stimulus in 2009 and 2010
(Percent deviation from baseline in percent)

		Stimulus in:				
	All	U.S.	Euro Area	Japan	Em. Asia	RoW
Effects on GDP in 2009						
World	1.4	0.5	0.2	0.1	0.4	0.2
United States	1.5	1.3	0.0	0.0	0.1	0.1
Euro Area	0.9	0.2	0.5	0.0	0.1	0.1
Japan	1.1	0.2	0.0	0.7	0.1	0.0
Emerging Asia	2.1	0.6	0.1	0.1	1.3	0.1
Remaining Countries	1.0	0.3	0.1	0.0	0.2	0.4
Effects on GDP in 2010						
World	2.0	1.4	0.1	0.1	0.2	0.2
United States	3.1	2.7	0.1	0.1	0.1	0.1
Euro Area	1.2	0.6	0.3	0.1	0.1	0.1
Japan	1.5	0.7	0.1	0.5	0.1	0.1
Emerging Asia	2.3	1.6	0.1	0.1	0.4	0.1
Remaining Countries	1.7	1.0	0.1	0.1	0.2	0.3

Figure 4..21 Estimates of IMF

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Appendix

Equation List of the Model

(1) China Model

CN_GDP = CN_C + CN_IF + CN_GC + CN_X - CN_M
CN_GDPV = CN_CV + CN_IFV + CN_GCV + CN_XV - CN_MV
CN_CV = CN_C * CN_PC / 100
CN_IFV = CN_IF * CN_PIF / 100
CN_GCV = CN_GC * CN_PGC / 100
CN_XV = CN_X * CN_PX / 100
CN_BAL = CN_XV - CN_MV
CN_PEDYV = CN_PEWFP + CN_PEOY + CN_GEOTH - CN_TY
CN_PEWFP = CN_ER * CN_ET / 1000000
CN_IF = CN_IBUDV / CN_PIF * 100 + CN_IFOR + CN_ILON + CN_IFF + CN_GISIM
TX_CNWD99 = TM_CNJP99 + TM_CNKR99 + TM_CNUS99 + TX_CNRW99
TX_CNWD99R = TX_CNWD99 / CN_PX$ * 100
TM_WDCN99 = TM_JPCN99 + TM_KRCN99 + TM_USCN99 + TX_RWCN99
CN_TDMD$ = CN_DOIL * CN_POIL$ + CN_DGAS * CN_PGAS$ + CN_DCOAL * CN_PCOAL$

CN_C = 55.1098288494296 + 0.107503877384755*CN_PEDYV/CN_PC*100 + 0.00520340481779839*(1/(1 + CN_RLG(+1)/100))*CN_PENW(+1)/CN_PC(+1)*100 + 0.870631882370067*CN_C(-1)

CN_PENW = 1364.84127031431 + CN_PENW(-1) + 0.329341903462523*(CN_PEDYV - CN_CV) + [AR(1) = 0.915608903131739]

CN_TY = -0.127329959086739 + 1.01382979103514*CN_TAXRY*CN_PEDYV

CN_PEOY = 314.3109406 + 0.01134587101*CN_RLG*CN_PENW + [AR(1) = 0.746682051601995]

CN_TAXES = 0.855949653618957*CN_TXAV + 0.916406113204162*CN_TXIV + 1.05526966056057*CN_TXTV + 2.35731381507956*CN_TY + 0.93687281162488*CN_TXOTH + 1.08984936662715*CN_TINT

CN_GREV = 1.0000000000002*CN_TAXES + 0.999999999997089*CN_GREVO

CN_GEXP = 1.0812640*CN_GCV + 0.54052111058*CN_IBUDV + 1.08399219*CN_GEOTH

CN_GGDBT - CN_GGDBT(- 1) = -1.01023637841719*(CN_GREV - CN_GEXP)

CN_RES$ = CN_RES$(- 1) + 1*(CN_BCU$ + CN_BCAP$) + CN_RESZ$

CN_BCU$ = 0.586969456901675*CN_X$V - 0.520489461657387*CN_M$V

CN_BCAP$ = 1.00000016704546*CN_FDI$ + 1.00000084385903*CN_NFDI$

CN_RLG = 10.670350455566 + 0.375241237954898*CN_RLG(- 1) + (1 - 0.375241237954898)*LOG(CN_PGDP(+ 1)/CN_PGDP) - 1.53394871404643*LOG((CN_MON2 - CN_GGDBT)/CN_PGDP) - 19.2877639252982*LOG(CN_YHAT(- 1)/CN_GDP(- 1))

CN_PGDP = 1.04442058881425*CN_GDPV/CN_GDP*100

LOG(CN_PC) = 0.0109022516 + 0.80115826435*LOG(CN_PC(- 1)) + 0.0977534176923744*LOG(CN_ER) + 0.413334852154248*LOG(CN_MON2/CN_MON2(- 1))

LOG(CN_PIF) = -0.090354832799 + 0.4538117566*LOG(CN_PM) + 0.290992326508979*LOG(CN_ER) + 0.150568714831245*LOG(CN_MON2/CN_MON2(- 1))

LOG(CN_PGC) = 0.2882105620 + 0.832838992*LOG(CN_PGC(- 1)) + 0.0580324424334082*LOG(CN_ER)

LOG(CN_ET) = 6.8667497 + 0.5125263*LOG(CN_GDP) - 0.43549644*LOG(CN_GDP(- 1)/CN_ET(- 1))

LOG(CN_ER) = 7.8904945 + 0.88925976*LOG(CN_GDP/CN_ET) + 1.03606091*LOG(CN_PGDP(- 1))

CN_U = -10160.1817901348 + 0.0322629207296777*CN_LS - 0.00924026201263541*CN_ET

CN_UP = 3.73463480571854*(CN_U/CN_LS*100)

LOG(CN_DOIL) = 0.857694955972197 + 0.752128018095997*LOG(CN_GDP) - 0.0960375694936263*LOG(CN_POIL$*CN_RXD)

LOG(CN_DGAS) = -0.76866875534954 + 0.913496940725426*LOG(CN_GDP) -

0.352917065979573*LOG(CN_PGAS$*CN_RXD)

LOG(CN_DCOAL) = 3.76929257203961 + 0.29895065517729*LOG(CN_GDP) + 0.218270459870435*LOG(CN_PCOAL$*CN_RXD)

CN_MOIL = 0.63985401564813*(CN_DOIL - CN_QOIL)

CN_MGAS = 1.0399402613832*(CN_DGAS - CN_QGAS)

CN_CARB = 0.964353581600937*(0.209*CN_DOIL + CN_DCOAL*0.255 + CN_DGAS*0.145)

CN_POIL$ = -2.21739838816267e-014 + 1*WD_POIL$

CN_X$V = -1531.52278870982 + 1.00780073464527e-006*TX_CNWD99

CN_X = 189.764900566632 + 0.781502003031874*TX_CNWD99R*CN_RXD/1000000000

TM_WDCN99R = 1.64642193159752*TM_JPCN99/JP_PX$*100 + 0.176487884657229*TM_KRCN99/KR_PX$*100 + 0.509352452771488*TM_USCN99/US_PX$*100 + 0.85410762607773*TX_RWCN99/RW_PX$*100

TX_RWCN99 = -7431581572.57675 + 84150.0395365765*(CN_MOIL + CN_MGAS)*CN_POIL$ + 22616410707.9534*CN_MCOAL*CN_PCOAL$ + 1.0320338927866*TX_RWCN88

CN_PM$ = 0.999999827072569*TM_WDCN99/TM_WDCN99R*100

CN_PM = 0.130432588319043*CN_PM$*CN_RXD

CN_M$V = -956.496221820188 + 1.00609294490494e-006*TM_WDCN99

CN_MV = 1.84364271001144 + 0.000998713612425488*CN_M$V*CN_RXD

CN_M = 0.999999999814553*CN_MV/CN_PM*100

CN_IFF/CN_K(- 1) = -0.248745707916569 + 0.5*0.5346490800237*(1/(1 + CN_RLG(+ 1)/100)*CN_GDP(+ 1)/CN_K(+ 1) + (1/(1 + CN_RLG/100)*CN_GDP/CN_K)) + 0.702019898654833*CN_IFF(- 1)/CN_K(- 2) +

13.9613277531789*CN_COGTP/CN_PIF/CN_K(- 2)

CN_K = 408.660877263747 + 0.963853489159718*CN_K(- 1) + 0.425351418038649*CN_IF

LOG(CN_IFOR) = -14.0158281263784 - 0.22141984705619*CN_ER/(CN_WWC$*CN_RXD) + 2.33108919661624*LOG(CN_GDP)

CN_FDI$ = -2095.63909453938 + 1396.02459798886*(CN_IFOR*CN_PIF/100/CN_RXD)

LOG(CN_YHAT) = -5.9289424392867 + 0.914363099155609*LOG(CN_K) + 0.451663921164003*LOG(CN_ET)

TM_JPCN99/TM_WDCN99 = -1.21149143159054 + 0.162*LOG(CN_GDP) + 0.558080986845133*LOG(JP_PX$/WD_WPI) - 0.124148220888813*LOG(KR_PX$/WD_WPI) - 0.218047190721656*LOG(US_PX$/WD_WPI)

TM_KRCN99/TM_WDCN99 = -1.73733099904344 + 0.207*LOG(CN_GDP) + 0.284470544865336*LOG(JP_PX$/WD_WPI) - 0.0199091255781964*LOG(KR_PX$/WD_WPI) - 0.125173771768939*LOG(US_PX$/WD_WPI)

TM_USCN99/TM_WDCN99 = -1.27934645636062 + 0.157*LOG(CN_GDP) + 0.399323923604115*LOG(JP_PX$/WD_WPI) - 0.106601692205681*LOG(KR_PX$/WD_WPI) - 0.05885369873305*LOG(US_PX$/WD_WPI)

(2) Japan Model

JP_GDP = JP_C + JP_IF + JP_GC + JP_X - JP_M
JP_GDPV = JP_CV + JP_IFV + JP_GCV + JP_XV - JP_MV
JP_CV = JP_C * JP_PC / 100
JP_IFV = JP_IF * JP_PIF / 100
JP_GCV = JP_GC * JP_PGC / 100
JP_XV = JP_X * JP_PX / 100
JP_BAL = JP_XV - JP_MV
JP_PEDYV = JP_PEWFP + JP_PEOY + JP_GEOTH - JP_TY - JP_TYSIM
JP_IF = JP_GIV / JP_PIF * 100 + JP_IFF + JP_GISIM
TX_JPWD99 = TM_JPCN99 + TM_JPKR99 + TM_JPUS99 + TX_JPRW99
TX_JPWD99R = TX_JPWD99 / JP_PX$ * 100

JP_TDMD$ = JP_DOIL * JP_POIL$ + JP_DGAS * JP_PGAS$ + JP_DCOAL * JP_PCOAL$
JP_MOIL = JP_DOIL - JP_QOIL
JP_MGAS = JP_DGAS - JP_QGAS
JP_MCOAL = JP_DCOAL - JP_QCOAL
JP_POIL$ = WD_POIL$
JP_UP = JP_U / JP_LS * 100

JP_IFF/JP_K(- 1) = 2.71163872875469 + 0.121485769592464*(1/(1 + JP_RLG(+ 1)/100)*JP_GDP(+ 1)/JP_K(+ 1) + 1/(1 + JP_RLG/100)*JP_GDP/JP_K) + 17.6223512655347*JP_MON/JP_PIF/JP_K(- 1) + [AR(1) = 1.00122942592184]

JP_K = 75967.590550843 + 0.769995993615183*JP_K(- 1) + 1.28782539758328*JP_IF

LOG(JP_YHAT) = 5.77950298112739 + 0.428781755206771*LOG(JP_K) + 0.148215732140846*LOG(JP_ET) + [AR(1) = 0.945284113663761]

JP_X$V = 18.8066708974842 + 1.04163564046584e-009*TX_JPWD99

JP_X = -2773.19460951098 + 0.862082504354936*TX_JPWD99R*JP_RXD/1000000000

TM_WDJP99 = 0.708228417882714*TM_CNJP99 + 1.43184716145839*TM_KRJP99 + 0.795206534611138*TM_USJP99 + 1.00306403831966*TX_RWJP99

TM_WDJP99R = 0.229013598*TM_CNJP99/CN_PX$*100 + 2.94906609218751*TM_KRJP99/KR_PX$*100 + 1.25918970173311*TM_USJP99/US_PX$*100 + 0.802222131986311*TX_RWJP99/RW_PX$*100

TX_RWJP99 = -38698028349.5031 + 34736.9933020646*(JP_MOIL + JP_MGAS)*JP_POIL$ + 1133364.07921433*JP_MCOAL*JP_PCOAL$ + 1.1742393518371*TX_RWJP88

JP_PM$ = 0.905237728957978*TM_WDJP99/TM_WDJP99R*100

JP_PM = 0.0101986771420784*JP_PM$*JP_RXD

JP_M$V = 42.4407263043614 + 1.06630654783577e-009*TM_WDJP99

JP_MV = 2.1223673481173e-006 + 0.999999999959104*JP_M$V*JP_RXD

JP_M = 0.999736018059636*JP_MV/JP_PM*100

JP_TAXES = 1*(JP_TY + JP_TX + JP_TP + JP_TSS + JP_TC)

JP_GREV = 1*JP_TAXES + 1*JP_GREVO

JP_GEXP = 2.14306234249753*JP_GCV + 1.15950165645776*JP_GIV

JP_GGDBT - JP_GGDBT(- 1) = -1.27783631616987*(JP_GREV - JP_GEXP)

JP_RES$ = JP_RES$(- 1) + 0.955674446542304*(JP_BCU$ + JP_BCAP$)

JP_BCU$ = 0.812827151543807*JP_X$V - 0.657362591866052*JP_M$V

JP_PGDP = 1.00000311472015*JP_GDPV/JP_GDP*100

LOG(JP_PC) = -0.0183144502523389 + 0.467015826287765*LOG(JP_PC(- 1)) + 0.353075953149407*LOG(JP_ER)

LOG(JP_PIF) = -4.78683389970409 + 0.150334092044298*LOG(JP_PM(- 1)) + 1.24657789296207*LOG(JP_ER)

LOG(JP_PGC) = -0.838875419472126 + 0.399480810627606*LOG(JP_PGC(- 1)) + 0.515504757661689*LOG(JP_ER)

LOG(JP_ET) = 1.11387504796618 + 0.153083592061614*LOG(JP_GDP) - 0.206331790189208*LOG(JP_GDP(- 1)/JP_ET(- 1)) + 0.755930698294169*LOG(JP_ET(- 1))

LOG(JP_ER) = 0.672593184533595 + 0.331666819168976*LOG(JP_GDP/JP_ET) + 1.22232604175749*LOG(JP_PGDP(- 1))

LOG(JP_U) = 6.75737531991966 - 27.224127271824*LOG(JP_ET/JP_LS) + [AR(1) = 0.911992021111484]

LOG(JP_DOIL) = 2.95891814662397 + 0.332840072650684*LOG(JP_GDP) - 0.0334973949334944*LOG(JP_POIL$*JP_RXD)

LOG(JP_DGAS) = -24.5179952081087 + 2.39502451594215*LOG(JP_GDP) - 0.133523305687859*LOG(JP_PGAS$*JP_RXD)

LOG(JP_DCOAL) = -18.5226259695797 + 1.7961693553293*LOG(JP_GDP) + 0.0931892815953142*LOG(JP_PCOAL$*JP_RXD)

JP_CARB = 3.93987641944022*(0.209*JP_DOIL + JP_DCOAL*0.255 + JP_DGAS*0.145)

JP_C = -2430.54055702634 + 0.457893642650839*JP_PEDYV/JP_PC*100 + 0.0106853762169275*(1/(1 + JP_RLG(1)/100))*JP_PENW(1)/JP_PC(1)*100 + 0.477328671699225*JP_C(- 1)

JP_PENW = JP_PENW(- 1) + 1.84013822396056*(JP_PEDYV - JP_CV)

JP_PEWFP = -33113.3429634587 + 3748.84826831409*JP_ER*JP_ET/1000000

JP_TY = -3147.62118018004 + 1.21967531753741*JP_TAXRY*JP_PEDYV

JP_PEOY = 41138.1652574023 + 0.00162037243547515*JP_RLG*JP_PENW

TM_CNJP99/TM_WDJP99 = -7.05166893181901 + 0.547*LOG(JP_GDP) - 0.114484900838665*LOG(CN_PX$/WD_WPI) - 0.0153039393161118*LOG(KR_PX$/WD_WPI) + 0.0838931204270146*LOG(US_PX$/WD_WPI)

TM_KRJP99/TM_WDJP99 = -0.0825808235922132 + 0.01*LOG(JP_GDP) - 0.0220383970262284*LOG(CN_PX$/WD_WPI) + 0.0100584242623183*LOG(KR_PX$/WD_WPI) + 0.00985797825397443*LOG(US_PX$/WD_WPI)

TM_USJP99/TM_WDJP99 = 0.0611617927839649 + 0.01*LOG(JP_GDP) + 0.273819701822129*LOG(CN_PX$/WD_WPI) - 0.0893829651264526*LOG(KR_PX$/WD_WPI) - 0.00530178659962163*LOG(US_PX$/WD_WPI)

(3) Korea Model

KR_GDP = KR_C + KR_IF + KR_GC + KR_X - KR_M
KR_GDPV = KR_CV + KR_IFV + KR_GCV + KR_XV - KR_MV
KR_CV = KR_C * KR_PC / 100
KR_IFV = KR_IF * KR_PIF / 100
KR_GCV = KR_GC * KR_PGC / 100

KR_XV = KR_X * KR_PX / 100

KR_BAL = KR_XV - KR_MV

KR_PEDYV = KR_PEWFP + KR_PEOY + KR_GEOTH - KR_TY

KR_IF = KR_GIV / KR_PIF * 100 + KR_IFF + KR_GISIM

TX_KRWD99 = TM_KRCN99 + TM_KRJP99 + TM_KRUS99 + TX_KRRW99

TX_KRWD99R = TX_KRWD99 / KR_PX$ * 100

TM_WDKR99 = TM_CNKR99 + TM_JPKR99 + TM_USKR99 + TX_RWKR99

TM_WDKR99R = TM_CNKR99 / CN_PX$ * 100 + TM_JPKR99 / JP_PX$ * 100 + TM_USKR99 / US_PX$ * 100 + TM_RWKR99 / RW_PX$ * 100

KR_PM = KR_PM$ * KR_RXD / 1000

KR_M = KR_MV / KR_PM * 100

KR_MV = KR_M$V * KR_RXD

KR_TAXES = KR_TY + KR_TX + KR_TP + KR_TSS + KR_TC

KR_GREV = KR_TAXES + KR_GREVO

KR_BCAP$ = KR_FDI$ + KR_NFDI$

KR_U = KR_LS - KR_ET

KR_UP = KR_U / KR_LS * 100

KR_POIL$ = WD_POIL$

KR_C = -38340.0309451042 + 0.816970692809065*KR_PEDYV/KR_PC*100 + 0.0496482832799403*(1/(1 + KR_RLG(1)/100))*KR_PENW(1)/KR_PC(1)*100

KR_PENW = KR_PENW(- 1) + 2.78435033876675*(KR_PEDYV - KR_CV)

KR_PEWFP = 22041.5093698266 + 5385.57290730657*KR_ER*KR_ET/1000000

KR_TY = -106.933421399465 + 1.06131369439093*KR_TAXRY*KR_PEDYV

KR_PEOY = 180149.851182348 + 0.00182558010579404*KR_RLG*KR_PENW + [AR(1) = 0.940828254694104]

KR_IFF/KR_K(- 1) = -0.141018797899406 + 0.113021046627854*(1/(1 + KR_RLG(+ 1)/100)*KR_GDP(+ 1)/KR_K(+ 1) + 1/(1 + KR_RLG/100)*KR_GDP/KR_K) + 48.9674976173615*KR_COGTP/KR_PIF/KR_K(- 1)

KR_K = -32307.1636513003 + 0.942671481822959*KR_K(- 1) + 0.663388465312688*KR_IF

LOG(KR_YHAT) = 6.08533142925612 + 0.470303112781775*LOG(KR_K) + 0.208195050331536*LOG(KR_ET) +

[AR(1) = 0.986999381267564]

KR_X$V = -2.5627328775277 + 1.20731354448103*TX_KRWD99/1000000000

KR_X = 27459.4977622932 + 0.702597998504427*TX_KRWD99R*KR_RXD/1000000000

TX_RWKR99 = -12572367678.9852 + 60283.6081317785*(KR_MOIL + KR_MGAS)*KR_POIL$ + 1002834.86811676*KR_MCOAL*KR_PCOAL$ + 1.14557730451024*TX_RWKR88

KR_PM$ = 0.957037819749235*TM_WDKR99/TM_WDKR99R*100

KR_M$V = -7.68904801135076 + 0.12403713128088*TM_WDKR99/100000000

KR_GEXP = -6226.50806567065 + 1.50636020689519*KR_GCV + 0.355869028645152*KR_GIV

KR_GGDBT - KR_GGDBT(- 1) = -0.137688000770151*(KR_GREV - KR_GEXP)

KR_RES$ = KR_RES$(- 1) + 0.750264165083712*(KR_BCU$ + KR_BCAP$)

KR_BCU$ = 978.192817564911*KR_X$V - 991.87252657241*KR_M$V

KR_PGDP = 0.99938212311122*KR_GDPV/KR_GDP*100

LOG(KR_PC) = 0.1742906764297 + 0.635654373007736*LOG(KR_PC(- 1)) + 0.203871209941357*LOG(KR_ER)

LOG(KR_PIF) = 0.464548837683403 + 0.247785070891454*LOG(KR_PM) + 0.40148446752041*LOG(KR_ER)

LOG(KR_PGC) = -0.00336468014911174 + 0.660534812602557*LOG(KR_PGC(- 1)) + 0.214935978922877*LOG(KR_ER)

LOG(KR_ET) = 4.57285315566386 + 0.464599617155985*LOG(KR_GDP) - 0.234650041732172*LOG(KR_GDP(- 1)/KR_ET(- 1))

LOG(KR_ER) = -0.606711605819276 + 1.7028548217841*LOG(KR_GDP/KR_ET) + 0.540799138552119*LOG(KR_PGDP(- 1))

LOG(KR_DOIL) = -5.59537400211388 + 1.78887046984124*LOG(KR_GDP) - 0.898312473577685*LOG(KR_POIL$*KR_RXD)

LOG(KR_DGAS) = -36.238309465495 + 1.51166958762199*LOG(KR_GDP) + 1.56511550354618*LOG(KR_PGAS$*KR_RXD)

LOG(KR_DCOAL) = -9.9740432539897 + 0.516831595811475*LOG(KR_GDP) + 0.697537021176591*LOG(KR_PCOAL$*KR_RXD)

KR_MOIL = 1.0655916569946*(KR_DOIL - KR_QOIL)

KR_MGAS = 1.00085310178178*(KR_DGAS - KR_QGAS)

KR_CARB = 0.989249699639762*(0.209*KR_DOIL + KR_DCOAL*0.255 + KR_DGAS*0.145)

KR_RSH = 33.4656761192486 + 0.573240233497272*KR_RSH(- 1) - 3.7447837839747*LOG(KR_MON/KR_PGDP)

KR_RLG = 0.711448592488253 + 0.40008405047567*KR_RLG(- 1) + 0.562255608520624*(KR_RSH)

TM_JPKR99/TM_WDKR99 = -1.04637347432645 + 0.097*LOG(KR_GDP) + 0.233308992531836*LOG(JP_PX$/WD_WPI) - 0.140888495251301*LOG(CN_PX$/WD_WPI) + 0.0010387617819626*LOG(US_PX$/WD_WPI)

TM_CNKR99/TM_WDKR99 = -2.62108503878946 + 0.204*LOG(KR_GDP) - 0.0448959078550944*LOG(JP_PX$/WD_WPI) - 0.0348892564032068*LOG(CN_PX$/WD_WPI) + 0.1427641043648*LOG(US_PX$/WD_WPI)

TM_USKR99/TM_WDKR99 = 0.0853658846283998 + 0.01*LOG(KR_GDP) + 0.0996163155835093*LOG(JP_PX$/WD_WPI) + 0.180554207319012*LOG(CN_PX$/WD_WPI) - 0.186235573055883*LOG(US_PX$/WD_WPI)

(4) The US Model

US_GDP = US_C + US_IF + US_GC + US_X - US_M
US_GDPV = US_CV + US_IFV + US_GCV + US_XV - US_MV
US_CV = US_C * US_PC / 100

US_IFV = US_IF * US_PIF / 100

US_GCV = US_GC * US_PGC / 100

US_BAL = US_XV - US_MV

US_PEDYV = US_PEWFP + US_PEOY + US_GEOTH - US_TY + US_TYSIM + US_GESIM

US_IF = US_GIV / US_PIF * 100 + US_IFF + US_GISIM

TX_USWD99 = TM_USCN99 + TM_USJP99 + TM_USKR99 + TX_USRW99

TX_USWD99R = TX_USWD99 / US_PX$ * 100

US_M = US_MV / US_PM * 100

US_TAXES = US_TY + US_TX + US_TP + US_TSS + US_TC

US_GREV = US_TAXES + US_GREVO

US_GEXP = US_GCV + US_GIV + US_GEXPO

US_U = US_LS - US_ET

US_UP = US_U / US_LS * 100

US_C = -371.557749209496 + 0.502148550874109*US_PEDYV/US_PC*100 + 0.000904924219264766*((1/(1 + US_RLG(1)/100))*US_PENW(1)/US_PC(1)*100 + (1/(1 + US_RLG/100))*US_PENW/US_PC*100) + 0.515239287419497*US_C(-1)

US_PENW = US_PENW(-1) + 8.51285181280031*(US_PEDYV - US_CV) + 3.91289724345824*US_PENAF

US_PEWFP = -212.783482117039 + 3.7831876360112*US_ER*US_ET/1000000

US_TY = -9.95724489220604 + 1.15598807959686*US_TAXRY*US_PEDYV

US_PEOY = -836.381702993167 + 9.96053656312958e-005*US_RLG*US_PENW + [AR(1) = 1.02513923494637]

US_IFF/US_K(-1) = -0.155392624306906 + 0.149179005480337*(1/(1 + US_RLG(+1)/100)*US_GDP(+1)/US_K(+1) + 1/(1 + US_RLG/100)*US_GDP/US_K) + 43.777251673531*US_COGTP/US_PIF/US_K(-1) + [AR(1) = 0.795771130850516]

US_COGTP = -126.1551323 + 0.269463294*US_GDPV - 1.239961310e-006*(US_ER*US_ET) + US_TCSIM

US_K = 611.756110914415 + 0.843100307093612*US_K(-1) + 0.652683452730133*US_IF

LOG(US_YHAT) = 2.43646452480468 + 0.522984435937209*LOG(US_K) + 0.229219311746776*LOG(US_ET) + [AR(1) = 0.983466960287614]

TM_WDUS99 = 0.954857187443147*TM_CNUS99 + 1.23657769986111*TM_JPUS99 + 0.829795317087395*TM_KRUS99 + 0.911961012218496*TX_RWUS99

TM_WDUS99R = 0.652721521053436*TM_CNUS99/CN_PX$*100 + 2.31789478124179*TM_JPUS99/JP_PX$*100 - 0.396929995695996*TM_KRUS99/KR_PX$*100 + 0.0620449943098425*TX_RWUS99/RW_PX$*100

TX_RWUS99 = -66038846675.0038 + 215255.629736837*(US_MOIL + US_MGAS)*US_POIL$ + 0.994976398264621*TX_RWUS88

US_PM$ = 0.0184189414490122*TM_WDUS99/TM_WDUS99R*100 + [AR(1) = 1.00171298471744]

US_PM = 1.06807802398204*US_PM$

US_POIL$ = 0.494548611914445*WD_POIL$

US_MV = 25.0875458855176 + 0.115703714718782*TM_WDUS99/100000000

US_GGDBT - US_GGDBT(- 1) = -5.50987333113712*(US_GREV - US_GEXP)

US_BCU = 1.02816782598285*US_XV - 1.04921832551675*US_MV

US_RSH = 9.94032037310755 + 0.587551297337761*US_RSH(- 1) + (1 - 0.587551297337761)*LOG(US_PGDP(+ 1)/US_PGDP) - 2.15501760282872*LOG(US_MON/US_PGDP)

US_RLG = -0.30897263760474 + 0.633403259551814*US_RLG(+ 1) + (1 - 0.633403259551814)*US_RLG(- 1) + 0.0713691383339798*(US_RSH)

US_PGDP = 0.999950787478783*US_GDPV/US_GDP*100

LOG(US_PC) = 0.147992195472755 + 0.942525837317597*LOG(US_PC(- 1)) + 0.0150221901862347*LOG(US_ER)

LOG(US_PIF) = 0.789128515732354 + 0.423983688572536*LOG(US_PM) + 0.205180564364871*LOG(US_ER)

LOG(US_PGC) = -0.0116133102676131 + 1.00405628028565*LOG(US_PGC(- 1)) + 0.00267571332734592*LOG(US_ER)

LOG(US_ET) = 4.77923163302539 + 0.651430823939687*LOG(US_GDP) - 0.396736746357592*LOG(US_GDP(- 1)/US_ET(- 1))

LOG(US_ER) = 5.62944538839586 + 0.608878744161717*LOG(US_GDP/US_ET) + 1.11609889929355*LOG(US_PGDP(- 1))

LOG(US_DOIL) = 3.61385746333167 + 0.497659382790505*LOG(US_GDP) - 0.00072640461703685*LOG(US_POIL$)

LOG(US_DGAS) = 3.29985518058868 + 0.552492710498917*LOG(US_GDP) - 0.132582700778538*LOG(US_PGAS$)

LOG(US_DCOAL) = 4.48883721592655 + 0.383985304715288*LOG(US_GDP) - 0.0927586317645473*LOG(US_PCOAL$)

US_MOIL = 1.10993845053374*(US_DOIL - US_QOIL)

US_MGAS = 0.98579900685023*(US_DGAS - US_QGAS)

US_CARB = 3.92411290795846*(0.209*US_DOIL + US_DCOAL*0.255 + US_DGAS*0.145)

US_POIL = 5.73226725416803 + 0.115534896435618*WD_POIL$

US_XV = -15.4516620694033 + 1.44173169071446*TX_USWD99/1000000000

US_X = -31.1531830675894 + 1.41329128790618*TX_USWD99R/1000000000

US_GDP$ = 913.987175542379*US_GDP

TM_JPUS99/TM_WDUS99 = 0.0511826718598105 + 0.01*LOG(US_GDP) + 0.194239379206923*LOG(JP_PX$/WD_WPI) - 0.0720663974549859*LOG(KR_PX$/WD_WPI) + 0.0172281684958162*LOG(CN_PX$/WD_WPI)

TM_KRUS99/TM_WDUS99 = -0.26152170753349 + 0.032*LOG(US_GDP) + 0.0607647333540537*LOG(JP_PX$/WD_WPI) - 0.0342883030133738*LOG(KR_PX$/WD_WPI) +

0.000180616237685019*LOG(CN_PX$/WD_WPI)

TM_CNUS99/TM_WDUS99 = -1.68226065746258 + 0.196*LOG(US_GDP) - 0.211145855556541*LOG(JP_PX$/WD_WPI) + 0.226016254538955*LOG(KR_PX$/WD_WPI) - 0.126038359995253*LOG(CN_PX$/WD_WPI)

Variable Names

UNLESS OTHERWISE STATED, ALL LOCAL CURRENCY DATA ARE IN BILLION

The lists belllow are quoted from Oxford Economic Forecasting, presently Oxford Economics, and regard to Japan Model, however, variable names are same as other countries.

BASET	BANK TOTAL ASSETS (YEN TRILLION)	IFS Banking
BBIS	BANK's BIS RATIO (BT1+BT2 as % BRWA)	BOJ/other est
BBIST1	BANK's TIER 1 RATIO (BT1 as % BRWA)	BOJ/other est
BBOND	BANK BOND FINANCE (YEN TRILLION)	IFS Banking
BBP	Benchmark bond prices	Datastream
BCAP	Capital/financials account in BOP (Y bn) NSA	Datastream
BCU	Current account of the bal. of payments (Y bn) SA	Datastream
BCURRATE	Current account as % nominal GDP	OEF calculated
BFORA	BANK FOREIGN ASSETS (YEN TRILLION)	IFS Banking
BFORL	BANK FOREIGN LIABILITIES (YEN TRILLION)	IFS Banking
BGOV	BANK CLAIMS ON CENTRAL GOVERNMENT (YEN TRILLION)	IFS Banking
BINEX	BANK INTEREST EXPENSES (YEN TRILLION)	BOJ/other est
BININ	BANK INTEREST INCOME (YEN TRILLION)	BOJ/other est
BLIAB	BANK TOTAL LIABILITIES (YEN TRILLION)	IFS Banking
BNPERF	BANK's NON-performing loans within BPRIV (Y tr)	OEF ESTIMATE
BPERF	BANK's performing loans within BPRIV total (Y tr)	BPRIV-BNPERF
BPRIV	BANK DOMESTIC CLAIMS ON NON-CEN.GOV.(YEN TRILLION)	IFS Banking
BPROF	BANK TOTAL OPERATING PROFITS (YEN TRILLION)	BOJ/other est
BRES	BANK TOTAL RESERVES (YEN TRILLION)	IFS Banking
BRWA	BANK RISK WEIGHTED ASSETS (YEN TRILLION)	BOJ/other est
BSER	Invisibles/services balance in BCU (Y bn) SA	Datastream
BSURP	BANK's cumulative surplus after write-offs (Y tr)	BPRIV-BNPERF
BT1	BANK TIER 1 CAPITAL (YEN TRILLION)	BOJ/other est
BT2	BANK TIER 2 CAPITAL (YEN TRILLION)	BOJ/other est
BTOTH	BANK'S OTHER CAPITAL (YEN TRILLION)	BOJ/other est
BTUSD	BANK'S SUBORDINATED DEBT (YEN TRILLION)	BOJ/other est
BTUSP	BANK's UNREALISED STOCK PROFITS, net(YEN TRILLION)	BOJ/other est
BVI	Visible trade balance, BOP basis (Y bn) SA	Datastream
BWAGE	BANK's WAGE BILL (YEN TRILLION)	BOJ/other est
BWCUM	BANK's cumulative write-offs of bad loans (Y tr)	OEF ESTIMATE

BWRITE	BANK's write-offs of bad debt out of profits(Y tr)	OEF ESTIMATE
C	Consumers' expenditure, (Y bn, 1995 prices) SA	Datastream
CV	Consumers' Expenditure (Y bn) SA	Datastream
CARB	Carbon emissions, mill. metric tons	OEF calculated
CARS	Car sales, registrations (000s av.quarterly, sa)	Datastream
CBANK	BANK CREDIT FROM MONETARY AUTH. (YEN TRILLION)	IFS Banking
CD	Consumers' exp. - durables, (Y bn, 1995 prices)	Datastream, sa
CND	Consumers' exp. - non-durables, (1995 prices)	Identity C-CD
CODIV	Company sector dividend payments (Y bn)	Identity =PEDIV
COGTP	Company profits (Y bn)	OEF calculated
CONAF	Assets, net acquisit. fin. assets-companies (Ybn)	Identity
CONIR	Company sector net interest receipts (Y bn)	OEF calculated
CONSTR	Construction activity (1995=100) SA	METI
CONW	Company sector net wealth (Y bn)	Identity
CPI	Prices, CPI - total (1995=100) NSA	Datastream
CPIFU	Prices, CPI - fuel (1995=100) NSA	Datastream
CPIX	Prices, CPI - non-fuel goods & serv.	OEF calculated
CU	Capacity utilisation (%)	ESM key stats
CUMOD	Capacity utilisation - model consistent version	OEF calculated
DCOAL	Coal, Total demand (mtoe)	OECD IEA Energy
DELTA	Depreciation rate for the capital stock	OEF calculated
DGAS	Gas, Total demand (mtoe)	OECD IEA Energy
DIV	Dividends index	Datastream
DIVT	Target dividend yield ratio	OEF estimate
DOIL	Oil, Total demand (mtoe)	OECD IEA Energy
DOMD	Domestic Demand SA	C+IF+GC+IS
DOTH	BANK OTHER LIABILITIES (YEN TRILLION)	IFS Banking
DPRIV	BANK DEMAND/TIME/SAVINGS DEPOSITS (YEN TRILLION)	IFS Banking
DSMP	Stockmarket prices based on DY ratio model	OEF calculated
EE	Employees in Employment (000s)	QLFS Item 40
EQMON	Money Supply, Equilibrium	OEF calculated
ER	Earnings, economy-wide average (Y 000)	OEF calculated
ES	Employment, self employed (000s)	OEF calculated
ESTAR	Employment at the Nairu (000s)	OEF calculated
ET	Employment, total (000s) SA	Datastream
FASSET$	FOREIGN ASSETS (US$ BN)	IFS

FLIAB$	FOREIGN LIABILITIES (US$ BN)	IFS
GB	Government (general) balance (Y bn)	ARNA
GBCEN	Government balance, alternative (Y bn) NSA	Datastream
GBPUB	Government balance, public sector (Y bn) NSA	Datastream
GC	Public consumption, (Y bn, 1995 prices) SA	Datastream
GCV	Public consumption (Y bn) SA	Datastream
GCGPE	Transfers, personal sector from central gov.(Ybn)	ARNA Part 3 II
GDIP	Government interest payments, gross (Y bn)	ARNA Part 3 sa
GDIR	Government debt interest receipts (Y bn)	Identity GDIP-GNIP
GDP	GDP (Y bn, 1995 prices) SA	Datastream
GDPV	GDP (Y bn) SA	Datastream
GDP$	GDP US$ million, 1995 prices SA	World Bank, WDI
GDP$V	GDP nominal in US$ millions (SA)	Identity
GEXP	Government expenditure, total (Y bn)	ARNA Part3,II
GGDBT	Government (central) debt -stock gross (fin.liab.)	Datastream
GI	Investment by government , (Y bn, 1995 prices) SA	Datastream
GIV	Public investment spending (Y bn) SA	ARNA Part3,II
GNDBT	Government NET debt - stock, net (Y bn)	OEF calculated
GNIP	Government interest payments, net (Y bn)	ARNA Part3 sa
GREV	Government revenue, total (Y bn)	ARNA Part3,II
IF	Investment, total (Y bn, 1995 prices) SA	Datastream
IFV	Investment, total (Y bn) SA	Datastream
INRS	Investment, private nonresid. - structures	(12.4/26.1)*IPNR
IP	Industrial production index (1995=100) SA	Datastream
IPDE	Investment, private nonresid. - equipment	IPNR-INRS
IPEO	Investment, private investment - other equipment	0.7*IPDE
IPETR	Investment, private , equipment, transportation	0.3*IPDE
IPNR	Investment, priv. sec. business (Ybn,1995 pri.) SA	Datastream
IPRD	Investment in priv. dwellings, (Y bn,1995 pri.) SA	Datastream
IS	Stockbuilding, (Y bn, 1995 prices) SA	GDP-C-IF-GC
ISV	Stockbuilding (Y bn) SA	GDPV-CV-IFV
K	Capital stock, Constant prices	OEF calculated
LS	Labour supply (000s)	Identity ET+U
M	Imports of goods & services, total const prices SA	Datastream
MV	Imports of Goods & Services, total (Y bn) SA	Datastream
MFU	Imports of fuels, Constant prices (1995 base)	OECD ITCI

MG	Imports of Goods, (Y bn, 1995 prices)	100*MGV/PMG
MGV	Imports of goods, (Y bn) SA	Datastream
MGNF	Imports of goods, non fuel, Constant prices	MG-MFU
MMWP	Macro-model weighted profits	OEF calculated
MON	M2 Money demand - (Y bn) NEW DEFINITION Sept 2000	Datastream
MPK	Marginal physical productivity of capital (%)	OEF calculated
MS	Imports of services, (Y bn, 1995 prices) SA	M-MG
MSV	Imports of services, current prices SA	MV-MGV
NAIRU	Nairu (%)	OEF calculated
NAIRUR	Parameter used in wage equation = NAIRU/UP	OEF calculated
NETR	Net transfers abroad in BCU, BOP basis (Y bn) SA	Datastream
NIPDV	Net IPD, BOP basis (Y bn) SA	Datastream
NLCOST	Costs of production, non-labour (index 1995=100)	OEF calculated
PART	Labour Force Participation Rate (%)	OEF calculated
PC	Consumers' expenditure deflator (1995=100) SA	100*CV/C
PCOAL$	Coal, Price average INCL CARBON TAX, US$ per toe	OECD IEA Energy
PCOLBT	Coal, Price average in US$ per toe	OECD IEA Energy
PDFU	Fuel price, average 1995=100, local currency	Identity
PEDIP	Income, Pers sect debt interest payments (Y bn)	ARNA Part 3 sa
PEDIR	Income, Pers sect debt interest receipts (Y bn)	ARNA Part 3 sa
PEDIV	Income, Personal sect dividend receipts (Y bn)	ARNA Part 3 sa
PEDY	Income, Real personal disposable, const. price	OEF calculated
PEDYV	Income, Personal Disposable, current prices	ARNA Part 3 II
PEMPY	Income, Compensation from employment (Y bn)	Datastream
PENAF	Assets, acquisitions of financial assets- persons	ARNA Part 1(2)
PENIR	Interest, pers. sect. net debt int.receipts (Ybn)	Identity
PENW	Wealth, personal sector net wealth (Y bn)	OEF calculated
PEOCR	Pension fund contrib. by employers (Y bn)	ARNA Part 3 sa
PEOY	Income, "Other" personal income (Y bn)	OEF calculated
PERF	BANK's performing loans as proportion of BPRIV	(BPERF/BPRIV)
PERT	Target PE ratio	OEF estimate
PESR	Savings, Personal sector savings ratio (%)	OEF calculated
PESV	Savings, Personal sector (Y bn)	OEF calculated
PEWFP	Wages and salaries (Y bn)	ARNA Part 3 sa
PGAS$	Gas, Price average INCL CARBON TAX, US$ per toe	OECD IEA Energy
PGASBT	Gas, Price average in US$ per toe	OECD IEA Energy

PGC	Public consumption deflator (1995=100) SA	100*GCV/GC
PGDP	GDP deflator (1995=100) SA	100*GDPV/GDP
PGDPX	Expected price level for exchange rate eq	OEF/user defined
PIF	Investment deflator (1995=100) SA	100*IFV/IF
PINT	BANK's PROPORTION OF DEPOSITS INTEREST BEARING	OEF ESTIMATE
PM	Imports deflator - total (1995=100) SA	100*MV/M
PMFU	Import price of fuels (1995=100)	OECD ITCI
PMG	Imports Deflator, Goods NSA , 1995=100	Datastream
PMGNF	Imports deflator - goods, non fuel	OEF calculated
PMS	Import price of services (1995=100) SA	100*(MSV/MS)
POIL$	Oil, Price average INCL CARBON TAX, US$ per toe	OECD IEA Energy
POILBT	Oil, Price average in US$ per toe	OECD IEA Energy
POP	Population, total (000s)	OECD/Worldbank
POPW	Population of working age (000s)	Worldbank
PPI	Prices, Producer (1995=100) NSA	Datastream
PROD	Productivity , trend	OEF calculated
PSH	Stock exchange index, Tokyo (Jan 4 1968=100)	Datastream
PSMP	Stockmarket prices based on PE ratio model	OEF calculated
PSTAR	Price level target for interest rate rule	OEF/user fixed
PX	Exports deflator - total (1995=100) SA	100*XV/X
PXFU	Export price of fuels (1995=100)	OECD ITCI
PXG	Exports Deflator, Goods NSA , 1995=100	Datastream
PXGNF	Export deflator - goods, non fuel	OEF calculated
PXS	Export price of services (1995=100) SA	100*XSV/XS
QCOAL	Coal, Total production (mtoe)	OECD IEA Energy
QGAS	Gas, Total production (mtoe)	OECD IEA Energy
QOIL	Oil, Total production (mtoe)	OECD IEA Energy
QR	Relative return on investment - companies	OEF calculated
RDEP	BANK's DEPOSIT RATE (%)	Datastream
RES$	RESERVES, Central Bank forex (US$ BN)	IFS
RES$M	RESERVES, MONTHS OF IMPORTS COVER	IDENTITY
RISK	Exchange Rate Risk Premium	OEF calculated
RLEND	BANK's LENDING RATE (%)	IFSvia Datastream
RLG	Interest rate, benchmark long-bond (%)	Datastream
RRH	Interest rate, Personal sector real (%)	OEF calculated
RRX	Real effective exchange rate (1990=100)	OEF

RS	Retail sales, constant prices index (1995=100)	(JPRETAILA*100)
RSH	Interest rate, 3-month rate on cds (%)	Datastream
RX	Effective exchange rate (1990=100)	Datastream
RX1	Effective exchange rate (1990=100) OEF defn.	OEF
RXD	Exchange rate , dollar rate	Datastream
RXDM	Exchange rate , deutschemark rate	Datastream
RXDX	Expected exchange rate for exchange rate eq	OEF/user defined
RXEURO	Exchange rate , YEN/EURO	OEF estimate
RXPPP	Exchange rate , indicator for Yen/US$ rate	OEF calculated
RXPPT	Exchange rate , indicator for Yen/US$ rate	OEF calculated
SME	Stockmarket earnings	Datastream
SMP	Stockmarket index, Datastream total market	Datastream
ST	Stocks, total (Y bn, 1995 prices) SA	ST(-1)+IS
TBALRATE	Trade balance as % nominal GDP	OEF calculated
TC	Tax, corporate taxes (Y bn)	ARNA Part 3 II
TCARB	CARBON TAX , US$ PER TOE flat tax	OEF, zero base
TCOAL	Coal, Tax rate average (%)	OECD IEA Energy
TCOST	Costs, total (index 1995=100)	OEF calculated
TCR	Rate of corporate taxation (%)	OEF
TFE	Total Final Expenditure,(Y bn, 1995 prices) SA	C+GC+IF+IS+X
TGAS	Gas, Tax rate average (%)	OECD IEA Energy
TOIL	Oil, Tax rate average (%)	OECD IEA Energy
TP	Tax, payroll (employer social sec. contrib. Y bn)	ARNA Part 3 sa
TPEN	Energy, Total primary energy (mtoe)	OECD IEA Energy
TPR	Rate of payroll taxation (%)	OEF calculated
TRCOL	Time trend used in coal equations	OEF calculated
TREMP	Time trend in employment equation	1980 Q1 = 1
TREND	Trend productivity used in prod'tn func.	OEF calculated
TRGAS	Time trend used in gas equations	OEF calculated
TRM	Time trend in imports equation	1973 Q1 = 1
TROIL	Time trend used for oil 1973	OEF calculated
TRX	Time trend in exports equation	1973 Q1 = 1
TSS	Social ins. contributions, employees (Y bn)	ARNA Part 3 II
TSSR	Rate of employee social security contributions (%)	OEF calculated
TX	Tax, expenditure tax (Y bn)	ARNA Part3 II
TXFU	Tax, expenditure taxes on fuels (Y bn)	OEF calculated

TXNFR	VAT rate of expend taxation (%), excl fuel taxes	Min of Finance
TXR	Rate of expenditure tax, average effective (%)	OEF (TX/CV)
TY	Tax, personal income tax (Y bn)	ARNA Part3 II
TYR	Rate of income taxation (%)	Min of Finance
U	Unemployment (000s) SA	Datastream
UP	Unemployment (%) SA	Datastream
WC	Costs - unit wage whole economy (1995=100)	OEF calculated
WCMF	Costs - unit wage manufacturing (1995=100)	CSO (MRETS)
WCR	Costs, relative unit wage (1995=100)	CSO (MRETS)
WEDGE	"Wedge"	OEF calculated
WT	World trade index (1995=100)	OEF Calculated
WWC$	World wage costs index (1995=100)	OEF calculated
X	Exports of goods & services, total const prices SA	Datastream
XV	Exports of Goods & Services, total (Y bn) SA	Datastream
XFU	Exports of fuels, Constant prices (1995 base)	OECD ITCI
XG	Exports of Goods, (Y bn, 1995 prices)	100*XGV/PXG
XGV	Exports of goods, (Y bn) SA	Datastream
XGNF	Exports of goods, non fuel, Constant prices	XG-XFU
XS	Exports of services, (Y bn, 1995 prices) SA	X-XG
XSV	Exports of services, current prices SA	XV-XGV
YHAT	Capacity output (constant prices, Y bn)	OEF calculated
TX_jpcn	Trade from JP to CN in current US$ (exporting data)	
TM_jpCN	Trade from JP to CN (inporting data)	
	99 denotes all visible trade	