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An International Comparison of Rates of Return and the Estimation of Initial-period Capital Stocks: EU KLEMS and World KLEMS Dataset (1970-2014)

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Abstract

While EU KLEMS and World KLEMS database have been widely used for international comparison of growth accounting, there is a need for level comparison. The purpose of the present paper is to make an international comparison on ex-post rates of return by industries using both EU KLEMS dataset (Growth and Productivity Accounts 2017 Release) for selected 25 EU KLEMS member countries and United States (supplemented by EU KLEMS 2007 Release), EU KLEMS Data (2012 Release) and JIP database (2017 Release) for Japan and World KLEMS Data (2014 Release) and KIP database (2017 Release) for Korea. Our preliminary finding is that in almost all economies, the ex-post rates of return to capital have steadily declined during the period of 2000-2014. The real rates of return to capital in US have been higher than those in EU 12, Japan and non-EU 12 European economies (except a brief period of 1995-2004). We have also applied the estimation method of recovering the initial period capital stocks based on Dadkhah and Zahedi (1986), Pyo (2008) and OECD (2009). The estimation of alternative capital stocks series indicates the estimates of initial-period capital stocks in most of sample economies are within the tolerable range of margin from the initial-period estimates of EU KLEMS dataset except Spain, Czech Republic, Korea, Greece and Slovakia. We have also estimated the capital-output ratio which is a measure of inequality of wealth and income in Piketty (2014) from two alternative estimates of capital stocks. All of our estimates fall in the range of 2 – 4 and show upward trends and the estimates of capital-output ratio based on EU KLEMS capital stocks dataset have been higher than the estimates based on alternative capital stocks we have estimated.

JEL codes D24
Keywords: Rates of Return, ICT-intensive industries and Perpetual Inventory Method

1. Introduction

The purpose of the present paper is to make an international comparison of rates of return to capital among market economies and transition economies of EU and other selected countries (US, Japan and Korea). We also note that if we are interested in comparing level-productivity among nations including emerging market and transition economies, we may need to check the robustness of capital stock series in EU KLEMS which is based on Perpetual Inventory Method (PIM). For level comparison of productivities among nations we cannot ignore initial values of capital stocks in each country and therefore, and should come up with some ways of recovering initial values and supplementing perpetual inventory method adopted by EU KLEMS as noted in Pyo (2008) and OECD (2009).

We have estimated alternative capital stocks by estimating initial-period capital stocks based on the Cobb-Douglas production approach following Dadkhah and Zahedi (1986), Pyo (2008) and OECD (2009). The method is assuming that the initial level of capital stocks must be consistent with underlying output level and labor input. The economy-wide chart of estimates of rates of return indicates a slow downturn in all of sample economies during the period of 1970- 2014 even though each category has different time span of observations due to the limited availability of data. It is interesting to note the real rates of return to capital in US have been higher than EU 12, Japan and non-EU 12 (except a brief period of 1995-2004).

We have applied the model of Dadkhah and Zahedi (1986) and Pyo (2008) to the simultaneous estimation of production function and capital stock to a set of countries whose capital stock series have been released by EU KLEMS (2017 Release). Except estimates of Spain, Finland, Netherlands and Korea, the estimated initial capital stocks in most of sample countries were larger than EU KLEMS' estimates of initial capital stocks. In particular, the positive margin of difference is the largest with Spain (97.33%) followed by Czech Republic (46.54 %) and Korea (29.06 %). On the other hand, the negative margin of difference was large with Slovakia (- 60.03 %), Greece (- 42.10 %) and Japan (-17.73 %). Japan had relatively smaller negative margin of difference due to the fact that Japan reported to EU KLEMS 1970 National Census estimate as benchmark year's estimate. It should be noted that the percentage difference (-6.9 %) in the US capital stocks is relatively small because EU KLEMS data of US capital stocks comes from BEA which compiled long investment series beyond the lifetime of assets and applied PIM to long investment data by assets.

Another way of checking the robustness of EU KLEMS capital stocks database is to derive alternative initial stocks from the production function estimation. The derived initial capital stocks are used to accumulate investment series net of depreciation where we use the same rates of depreciation as EU KLEMS. We find that both profiles of capital stocks are very close to each other except Slovakia. There is another way of checking the validity of capital stocks

and its robustness as outlined in Piketty (2014) and Pyo (2018 forthcoming).

Piketty (2014) referred the ratio of capital to GDP (K / Q) as a macroeconomic indicator of inequality of wealth and income. His estimate of capital/ output ratio in Europe is in the range of 5 to 7 historically but his definition of capital includes land. Without land it could fall in the range of 2 – 4. Both profiles of capital – output ratio in our sample using EU KLEMS capital stock data and our alternative estimates fall in the range of 2 – 4 if capital stocks do not include land.

For this purpose, the paper is organized as follows. In section 2, we have generated real ex-post gross rates of return to capital of EU-KLEMS European member countries and selected non-European countries (US, Japan and Korea) and presents a comparative profile. In section 3, a simultaneous estimation of production functions and capital stocks proposed by Dadkhah and Zahedi (1986) and Pyo (2008) is applied to estimate the initial values of each country's capital stock from which PIM can be used. Section 4 presents estimates of capital-output ratio from two capital stocks series. The last section concludes the paper.

2. Estimates of Real Rates of Return to Capital from EU KLEMS and World KLEMS Dataset

We have applied the following formula to estimate real gross rates of return to capital:

Real Gross Rates of Return to Capital
= (Real Value-added – Real Compensation to Labor) / Real Net Capital Stock (1)

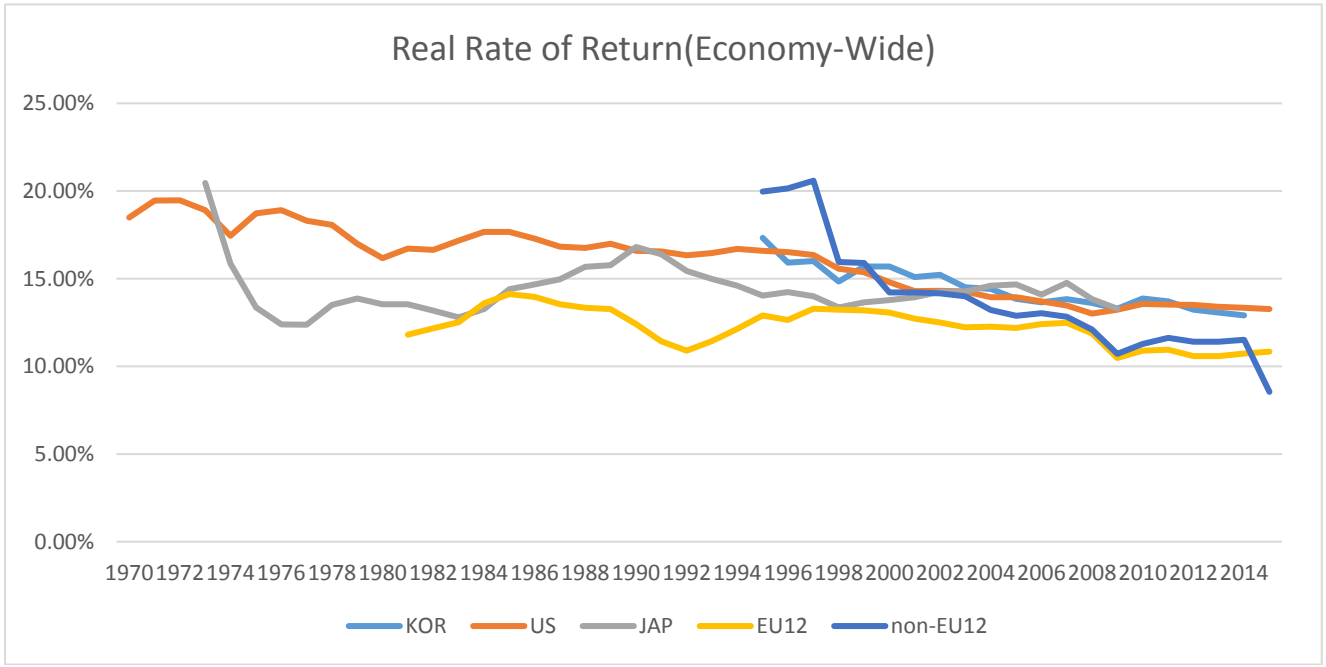
We have estimated the real gross rates of return from the EU KLEMS database (2017 Release) of 25 EU countries. We have included 21 EU countries (Austria, Cypress, Czech Republic, Denmark, Spain, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Lithuania, Luxembourg, Latvia, Netherlands, Portugal, Slovakia, Slovenia, Sweden and United Kingdom (UK)) and excluded 4 EU countries (Belgium, Croatia, Malta and Poland) due to lack of capital stock data in EU KLEMS database. The United States (EU KLEMS 2007 release is also used), Japan (JIP Database 2017 Release) and Korea (KIP Database 2017 Release) have been included in our sample for comparison with EU countries.

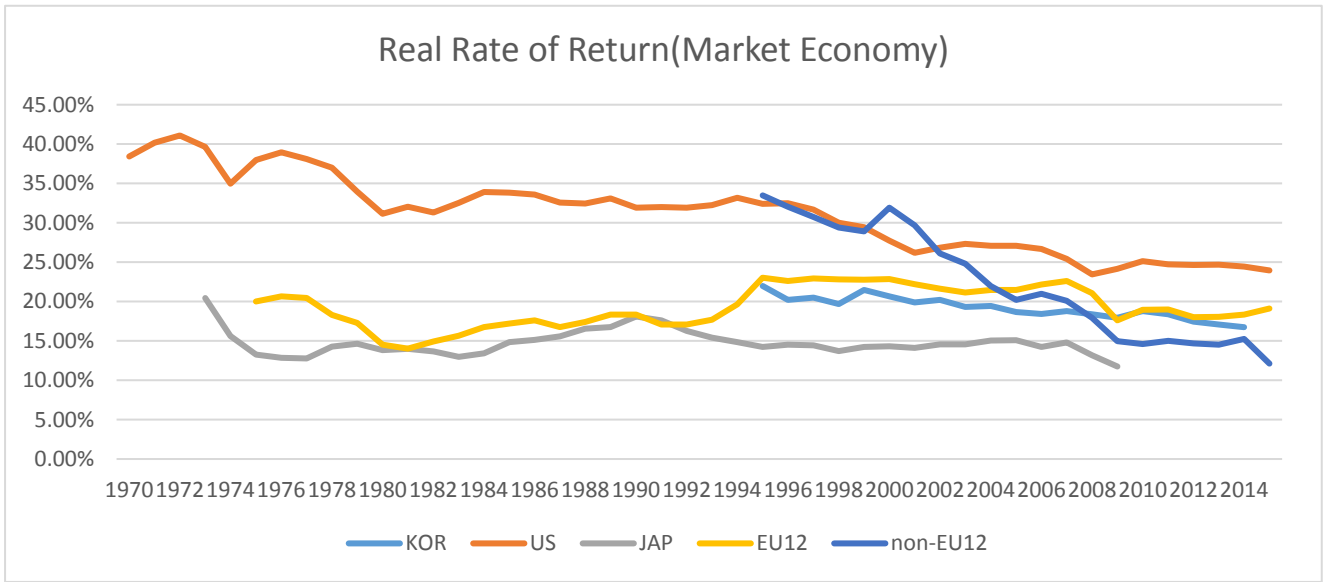
The above formula of the rate of return to capital is a gross before-tax rate of return. In deriving capital income from value-added we have not adjusted proprietors' income or so-called mixed income because each country has different treatment of self-employed income and the relative importance of mixed income are widely different among nations. Therefore, our estimates of return to capital is a kind of maximum return to capital assuming either no self-employed or no labor compensation to self-employed.

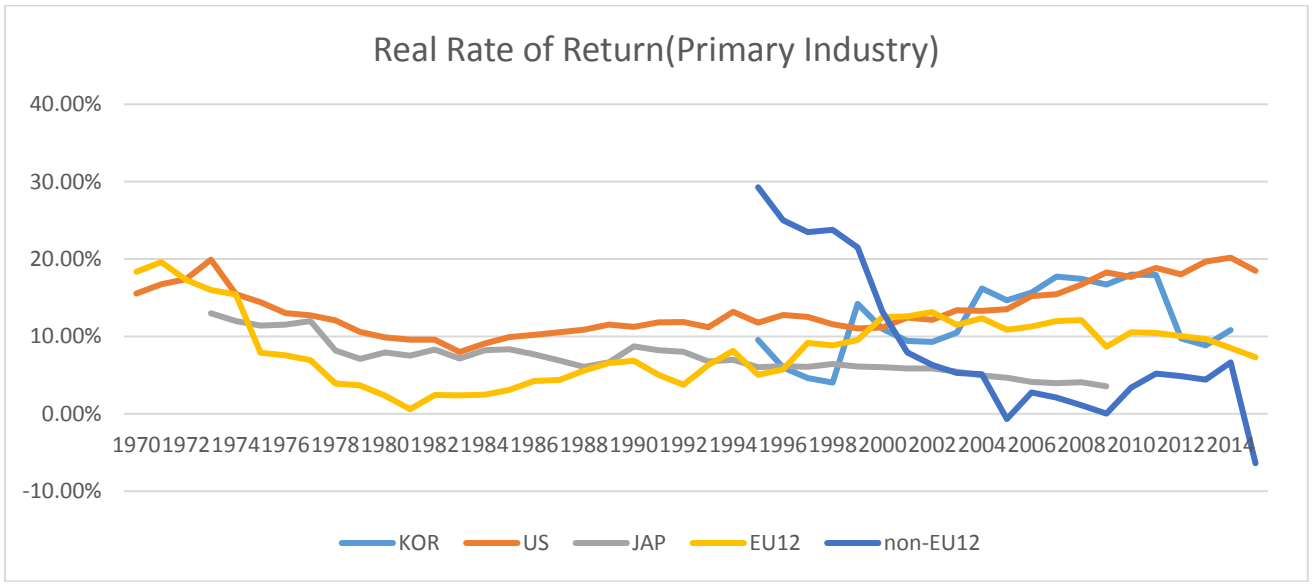
Figure 1 shows time profiles of estimated rates of return at economy-wide level in five categories of countries: EU 12, non-EU 12, US, Japan and Korea when we have used EU KLEMS database for capital stocks for EU 12, non-EU 12 and US and JIP database for Japan and KIP database for Korea. The economy-wide level chart indicates a slow downturn in real rate of return to capital during the period of 1970- 2014 even though each category has different time span of observations. It is interesting to note the real rates of return to capital in US have been higher than EU 12, Japan and non-EU 12 (except a brief period of 1995-2004). It is also interesting to note that the real rates of return to capital in Japan was higher than in EU 12 during the period of 1980—2014 even though the period includes the lost decades of Japan. We conjecture that the estimates of the Japanese capital stock in JIP database might have been under estimated making the real gross rates of return to capital overestimated. We should also note that the rates of return to capital in both non-EU 12 European countries and Korea started off from higher levels in mid-1990s but started to converge rapidly to the level of EU 12 countries.

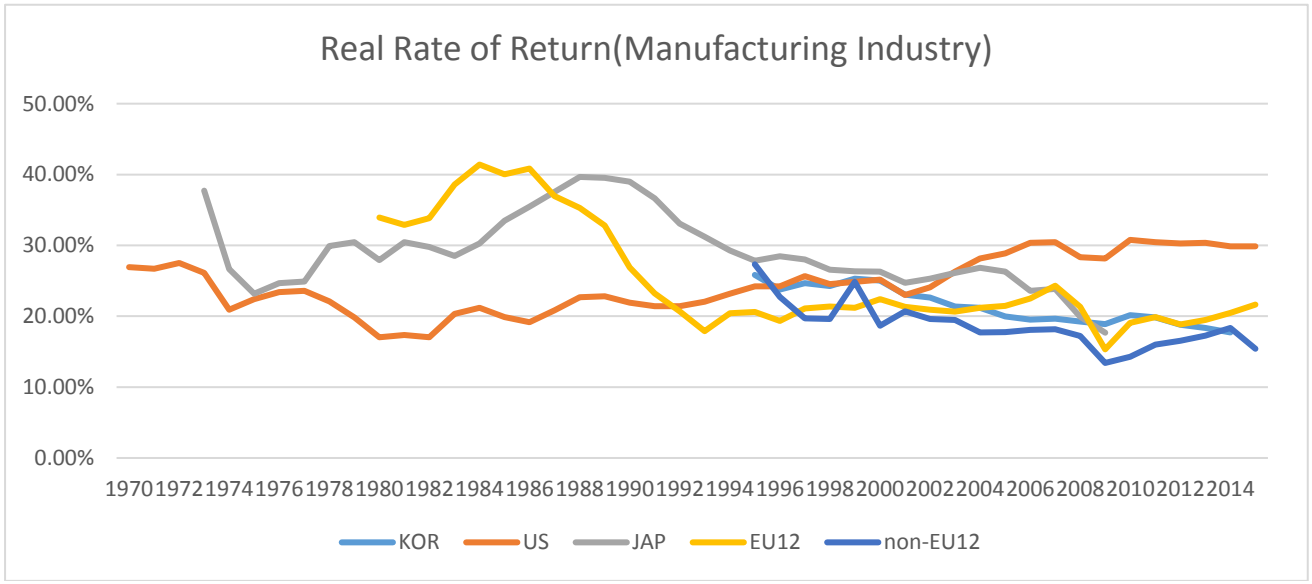
The second chart in Figure 1 illustrates estimated rates of return to capital in Market Economy in five categories of countries. It should be noted that Japan has the lowest rates of return to capital throughout the entire sample period. It implies that the public service sectors in Japan have played significant roles of maintaining higher rates of return to capital through fiscal stimulus packages. We also note that the rates of return in the US Market Economy have remained resiliently higher levels than in other economies. In the third chart for the primary industry, we note that the rates of return to capital in non-EU 12 European countries fell from high level of 30 % in 1995 to almost 0 % near 2014. The fourth chart illustrates rates of return to capital in Manufacturing. From 1980-1993, both Japan and EU 12 countries had a relatively higher levels of rates of return to capital than the US Manufacturing. But starting from mid-1990s the ICT revolution in the US Manufacturing started to yield higher rates of return than in Japan and EU-12 economies. The last chart in Figure 1 depicts time profiles of rates of returns to capital in Service industries. The US dominance over EU 12 and Japan throughout the sample period seems to be consistent with what we have observed in the service industry in the US in the form of ICT-related large-scale communication industry, software industry and large-scale distribution networks etc.

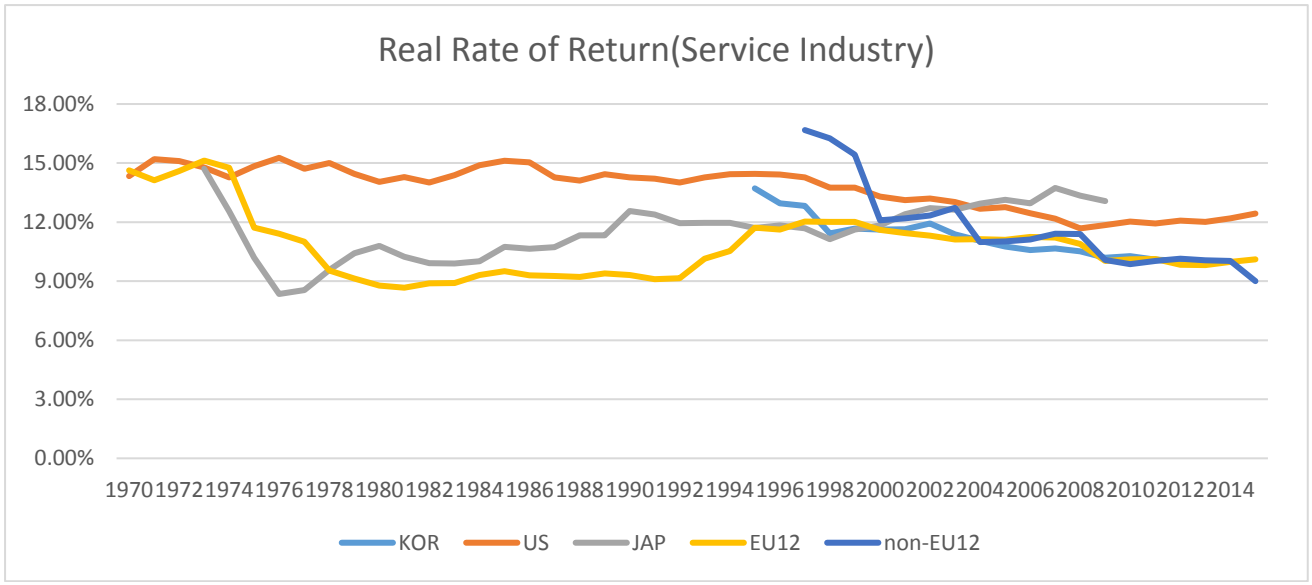
Figure 1 Real Rate of Return to Capital






Real Rate of Return(Primary Industry)
40.00%
30.00%
20.00%
10.00%
0.00%
-10.00%
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
KOR
US
JAP
EU12
non-EU12


Real Rate of Return(Manufacturing Industry)
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
KOR
US
JAP
EU12
non-EU12


Real Rate of Return(Service Industry)
18.00%
15.00%
12.00%
9.00%
6.00%
3.00%
0.00%
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
KOR
US
JAP
EU12
non-EU12

3. The Estimation of Initial Capital Stocks and Alternative Estimates of Capital Stocks

In applying PIM to estimate capital stocks at economy-wide level, we need reliable data or information on initial capital stocks, real investment series and depreciation rates by industries.

3.1.Model

Following Dadkhah and Zahedi (1986) and Pyo (2008), consider an aggregate Cobb-Douglas production function with the assumption of constant returns to scale:

$$Q_t = AK_t^{\alpha} L_t^{1-\alpha} \tag{2}$$

where Q_t = output produced during period t, K_t = capital stock at the beginning of period t, and L_t = labor utilized during periodt

It can be rewritten as:

$$K_t = (Q_t / AL_t^{1-\alpha})^{1/\alpha} \tag{3}$$

$$Q_t = [(1-\lambda)Q_{t-1}^{\frac{1}{\alpha}} L_{t-1}^{\frac{1-\alpha}{\alpha}} + I_{t-1}]^{\alpha} L_t^{1-\alpha} \tag{4}$$

Write the production function in a growth rate form as

$$\dot{Q}_t = \alpha \dot{K}_t + (1-\alpha)\dot{L} \tag{5}$$

The capital stock identity is as follows:

$$K_t = (1-\lambda)K_{t-1} + I_t \tag{6}$$

where I_{t-1}= grows investment during period t-1 and λ = depreciation rate.

Rewriting the above equation,

$$K_t^{\cdot} = I_{t-1}/K_{t-1} - \lambda \quad (7)$$

Combining production function and capital stock identity,

$$\dot{Q}_t = \alpha A^{1/\alpha}(I_{t-1}^{\alpha} L_{t-1}^{1-\alpha}/Q_{t-1})^{1/\alpha} - \alpha\lambda + (1-\alpha)\dot{L_t} \quad (8)$$

Now, let A=1, then

$$\dot{Q}_t = \alpha(I_{t-1}^{\alpha} L_{t-1}^{1-\alpha}/Q_{t-1})^{1/\alpha} - \alpha\lambda + (1-\alpha)\dot{L_t} \quad (9)$$

α and λ can be estimated by a search technique where the search is conducted for α over the open interval (0,1) or can be estimated from the regression of the following form of aggregate production function based on eq. (2):

$$\log (Q/L) = \log A + \alpha \log (Q/L) \quad (10)$$

3.2.Data and Results

We have applied the above model of simultaneous estimation of production function and capital stock to a set of countries whose capital stock series have been released by EU KLEMS (2017 Release). In case of Korea, we have used KIP database used in Pyo , Chun and Rhee (2017) and in case of Japan, we have used JIP database (because EU KLEMS Korea and Japan datasets have not been updated yet. We have used aggregate real value-added, real gross fixed capital formation and labor input data (in principle in men-hour data). In Pyo (2008), a search method was used to estimate two key parameters, share of capital compensation (α) and depreciation rate (λ). But in the present paper, we either estimated share of capital compensation only or have used data on share of capital compensation and have used assumed rates of depreciation by EU KLEMS.

In Table 1, currency unit and data period by each country are reported and in Figure 1, estimated profiles of each country's capital stocks with different estimated depreciation rates are presented together with EU KLEMS' capital stock series which must have been generated by PIM method with some benchmark year's estimates if such estimates were available.

Table 1 Currency Unit and Data Period by Country

Country	Unit	Period
Austria (AUT)	in millions of national currency(Euro)	1995−2015
Cypress (CYP)	in millions of national currency(Euro)	1995−2014
Czech Republic(CZE)	in millions of national currency (Koruna)	1995−2014
Denmark(DNK)	in millions of national currency(DKK)	1975−2015
Spain(ESP)	in millions of national currency(Euro)	1995−2015
Estonia(EST)	in millions of national currency(Euro)	2000−2014
Finland(FIN)	in millions of national currency(Euro)	1980−2015
France(FRA)	in millions of national currency(Euro)	1978−2015
Germany(GER)	in millions of national currency(Euro)	1995−2015
Greece(GRC)	in millions of national currency(Euro)	1995−2014
Ireland(IRL)	in millions of national currency(Euro)	1998−2014
Italy(ITA)	in millions of national currency(Euro)	1995−2014
Lithuania(LTU)	in millions of national currency(Euro)	2000−2014
Luxembourg(LUX)	in millions of national currency(Euro)	1995−2015
Latvia(LVA)	in millions of national currency(Euro)	2000−2014
Netherlands(NLD)	in millions of national currency(Euro)	2000−2015
Portugal(PRT)	in millions of national currency(Euro)	2012−2014
Slovakia(SVK)	in millions of national currency(Euro)	2004−2015
Slovenia(SVN)	in millions of national currency(Euro)	2000−2015
Sweden(SWE)	in millions of national currency(SEK)	1993−2014
United Kingdom(UK)	in millions of national currency(GBP)	1997−2015
United States(US)	in millions of national currency(Dollar)	1970−2015
Korea(KOR)	in millions of national currency (Won)	1970−2014
Japan(JAP)	in millions of national currency (Yen)	1973−2009

Sources: EU KLEMS (2017 Release)

In Table 2 the regression result of eq. (10) is reported. Most of estimated share of capital income (α) are statistically significant except Portugal (PRT) and Slovakia (SVK) ranging from 0.09 to0.88. The degree of fitness in terms of adjusted R-square are reasonably high except Cypress (CYP), Spain (ESP), Luxembourg (LUX). and Greece (GRC).

Table 2 Regression Result of Aggregate Production Function: Restricted Cobb-Douglas Model

	A	α	adjusted-R-square		A	α	adjusted-R-square
AUT	0.1542*** (-29.37)	0.7464*** (19.68)	0.9508	LTU	0.2033*** (-5.62)	0.8648*** (10.23)	0.881
CYP	0.0681*** (-4.33)	0.3614 (1.39)	0.0468	LUX	0.0831*** (-21.71)	0.0927 (1.52)	0.062
CZE	0.2311*** (-50.87)	0.8794*** (20.93)	0.9583	LVA	0.1279*** (-7.76)	0.853*** (9.64)	0.8679
DNK	0.3153*** (-226.02)	0.7303*** (42.33)	0.9782	NLD	0.1707*** (-17.93)	0.6776*** (11.43)	0.8963
ESP	0.0437*** (-27.38)	0.1029* (2.04)	0.1368	PRT	0.0562* (-7)	0.3937 (2.33)	0.6886
EST	0.067*** (-25.75)	0.5145*** (16.44)	0.9506	SVK	1.0318 (0.01)	0.6529 (1.16)	0.8373
FIN	0.1013*** (-9.03)	0.5893*** (5.63)	0.9585	SVN	0.1623*** (-9.02)	0.7978*** (9.58)	0.8581
FRA	0.1688*** (-47.4)	0.6887*** (36.39)	0.9728	SWE	0.3512*** (-84.75)	0.6062*** (14.67)	0.9107
GER	0.1836*** (-28.39)	0.7581*** (23.32)	0.9645	UK	0.1246*** (-39.64)	0.5282*** (25.38)	0.9728
GRC	0.0443*** (-19.37)	0.1386* (1.98)	0.133	US	0.156*** (-90.4)	0.5423*** (54.63)	0.9851
IRL	0.1464*** (-37.54)	0.5194*** (21.07)	0.9651	KOR	150.6816 (53.19)	0.4500*** (50.3)	0.9829
ITA	0.0431*** (-45.67)	0.1281*** (4.08)	0.452	JAP	0.1542*** (10.63)	0.7464*** (9.51)	0.9843

Notes: The values in parenthesis are t-values.

Table 3 presents estimated initial capital stock recovered from the estimated production function and Figure 2 presents the difference between estimated initial stock and EU KLEMS' estimate of initial stock. Except estimates of Austria and Netherlands, the estimated initial capital stocks were larger than EU KLEMS' estimates of initial capital stocks. In particular, the positive margin of difference is the largest with Spain (97.33%) followed by Czech Republic (46.54 %) and Korea (29.06 %). On the other hand, the negative margin of difference was large with Slovakia (- 60.03 %), Greece (- 42.10 %) and Japan (-17.73 %). Japan had relatively smaller negative margin of difference due to the fact that Japan reported to EU KLEMS 1970 National Census estimate as benchmark year's estimate. It should be noted that the percentage difference (-6.9 %) in the US capital stocks is relatively small because EU KLEMS data of US capital stocks comes from BEA which compiled long investment series beyond the lifetime of assets and applied PIM to long investment data by assets.

The estimated results of initial capital stocks and the seemingly large margin of difference in initial capital stocks are not surprising at all given that PIM crucially depends on the value of initial capital stock or assumed value of some benchmark year's estimates. Our estimates of initial stock have such implication that they are consistent with underlying aggregate production

structure. They may be quite different from the actual value of initial capital stock if the country went through a period of long recession or war. However, they provide us rough estimates of what level of capital stock must have been maintained to support the production level and labor input at the initial year. Therefore, it can provide us a way of indirectly checking whether the estimates based on PIM are significantly diverging from those estimate that may be consistent with underlying production structure.

Table 3 Initial Capital Stocks in EU KLEMS Database and Estimated Initial Capital Stocks

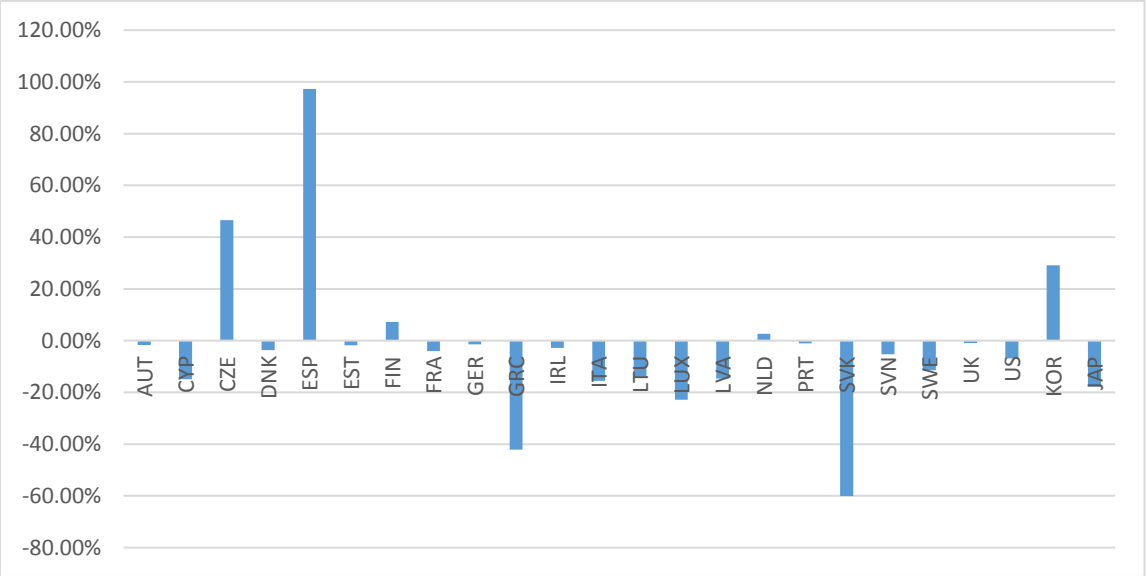
	AUT	CYP	CZE	DNK	ESP	EST
initial year	1995	1995	1995	1975	1995	2000
K_EUKLEMS (1)	793623.2	32705.75	7499237	2383924	1455472	21120.53
alpha hat	0.746404	0.361385	0.879382	0.730263	0.102879	0.514513
initial Q	193853.5	10247.09	2443563	792988	666424.6	9293.746
initial L	5129797	391135	7981616	3220158	18476323	1037624
estimated K1 (2)	779914.8	27841.45	10989497	2295362	2872083	20746
difference 1 (3)=(2)-(1)	-13708.3	-4864.3	3490260	-88561.9	1416611	-374.533
% difference 1 (4)=(3)/(1)	-0.01727	-0.14873	0.465415	-0.03715	0.9733	-0.01773

	FIN	FRA	GER	GRC	IRL	ITA
initial year	1980	1978	1995	1995	1998	1995
K_EUKLEMS (1)	271109.4	2791590	6386426	409243.7	216239.2	3965596
alpha hat	0.589253	0.688741	0.75812	0.138585	0.519412	0.128086
alpha bar	0.327006	0.316081	0.31484	0.474442	0.478069	0.32454
initial Q	80862.27	868957.7	1900448	143085	97464.44	1273734
initial L	3399700	31014290	49251000	4914719	2312861	40668720
estimated K1 (2)	290804.3	2679080	6293344	236943	210272.9	3349979
difference 1 (3)=(2)-(1)	19694.92	-112509	-93082	-172301	-5966.32	-615616.6
% difference 1 (4)=(3)/(1)	0.072646	-0.0403	-0.01457	-0.42102	-0.02759	-0.1552

	LTU	LUX	LVA	NLD	PRT	SVK
initial year	2000	1995	2000	2000	2012	2004
K_EUKLEMS (1)	55169.36	43016.85	61068.38	1588991	625506.1	256905.7
alpha hat	0.864768	0.092686	0.853028	0.677585	0.393668	0.652888
alpha bar	0.480707	0.432825	0.477637	0.305419	0.377398	0.493935
initial Q	13172.34	21333.52	10960.23	401578.3	118681.6	32706.3
initial L	2087969	316464	1538819	8483159	6747389	3493641
estimated K1 (2)	47563.47	33170.01	52112.47	1630176	619013.3	102695.5
difference 1 (3)=(2)-(1)	-7605.88	-9846.84	-8955.91	41184.5	-6492.76	-154210
% difference 1 (4)=(3)/(1)	-0.13786	-0.22891	-0.14665	0.025919	-0.01038	-0.60026

	SVN	SWE	UK	US	KOR	JAP
initial year	1995	1993	1997	1970	1970	1973
K_EUKLEMS (1)	91689.48	5794958	2398453	10866112	81756747.8	380661340.7
alpha hat	0.797788	0.606202	0.528182	0.542341	0.45000961	0.746404
alpha bar	0.269496	0.4455	0.323044	0.399487	0.399487	0.322016
initial Q	19649.81	1921854	1040171	5227342	96450919.2	218122397.5
initial L	1191268	6048230	36986991	1.39E+08	9821.91499	119768.4
estimated K1 (2)	86897.96	5128931	2374235	10116396	105519462	313189648.2
difference 1 (3)=(2)-(1)	-4791.52	-666027	-24217.8	-749716	23762713.8	-67471692.5
% difference 1 (4)=(3)/(1)	-0.05226	-0.11493	-0.0101	-0.069	0.29065	-0.17725

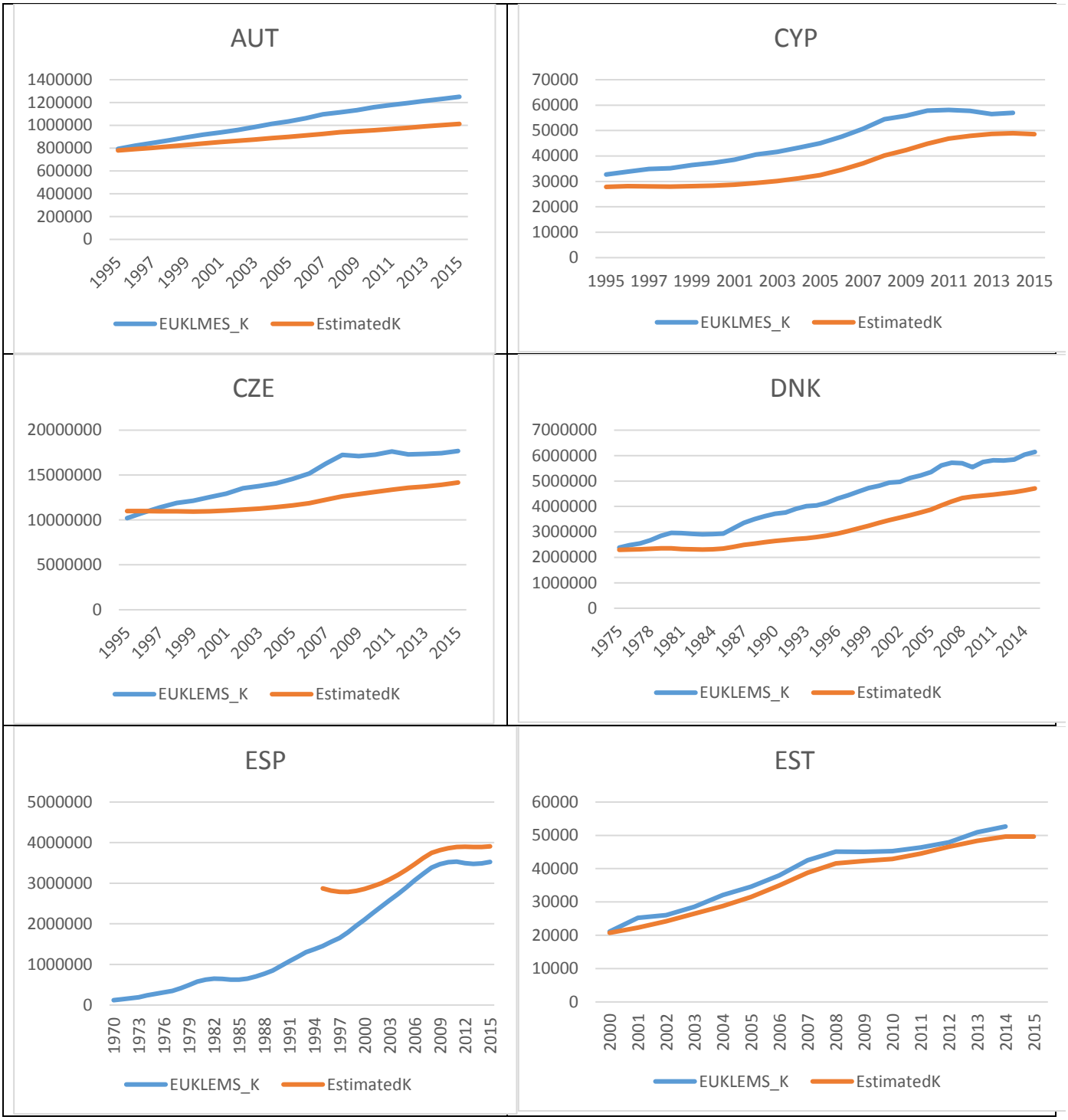
Figure 2. Percentage Difference between K_EUKLEMS and Estimated Initial Capital Stocks

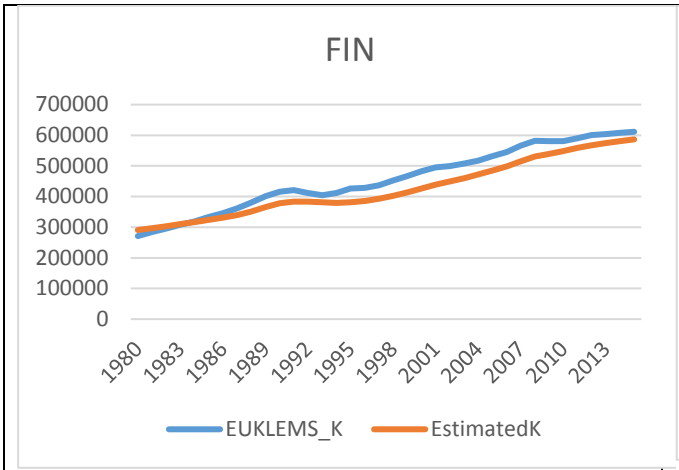


3.3 Comparison of EU KLEMS Capital Stocks and Alternative Estimates of Capital Stocks

One way of checking the robustness of EU KLEMS capital stocks database is to derive alternative initial stocks from the production function estimation. The derived initial capital stocks are used to accumulate investment series net of depreciation where we use the same rates of depreciation as EU KLEMS. As shown in Figure 3, both profiles of capital stocks are very close to each other except Slovakia. Therefore, the current capital stocks data in EU KLEMS (2017 Release) seem to be a reasonable approximation to most of countries capital stocks.

Figure 3 Comparison of EU KLEMS Capital Stocks and Alternative Estimates of Capital Stocks




FIN
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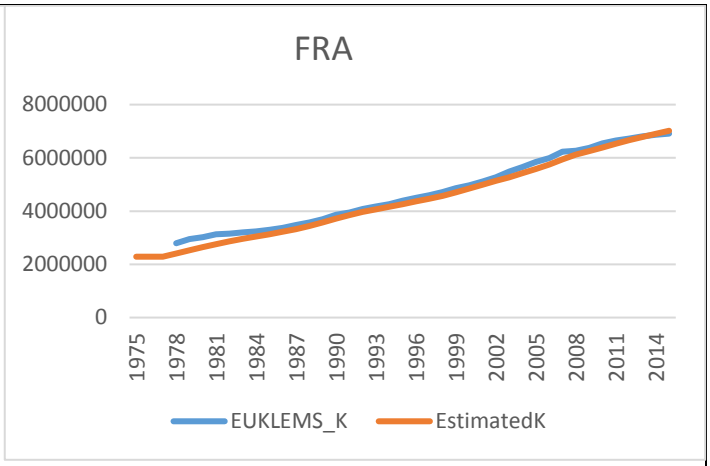
1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013
EUKLEMS_K
EstimatedK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EUKLEMS_K
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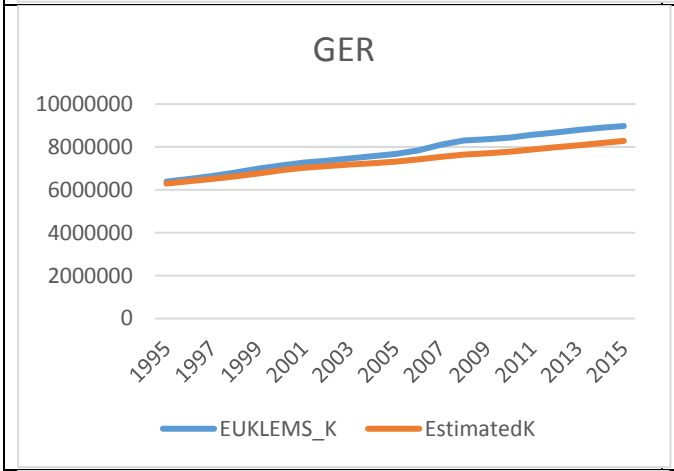
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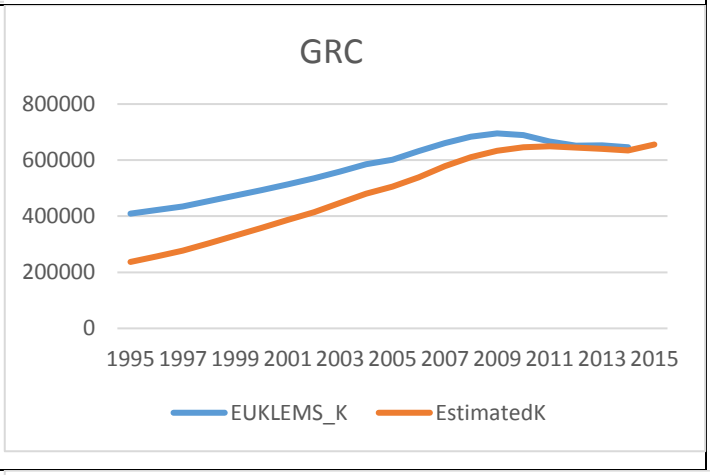
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
EUKLEMS_K
EstimatedK


GRC
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600000
400000
200000
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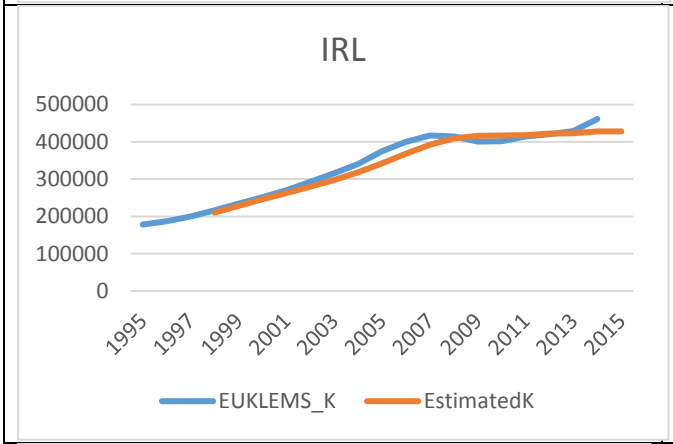
EstimatedK


IRL
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1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
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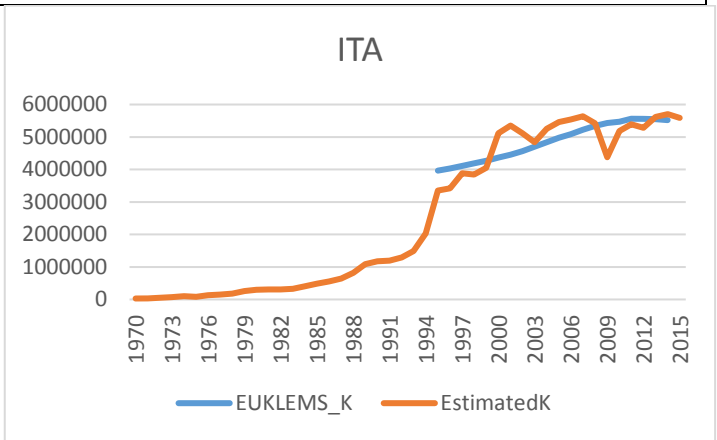
EstimatedK


ITA
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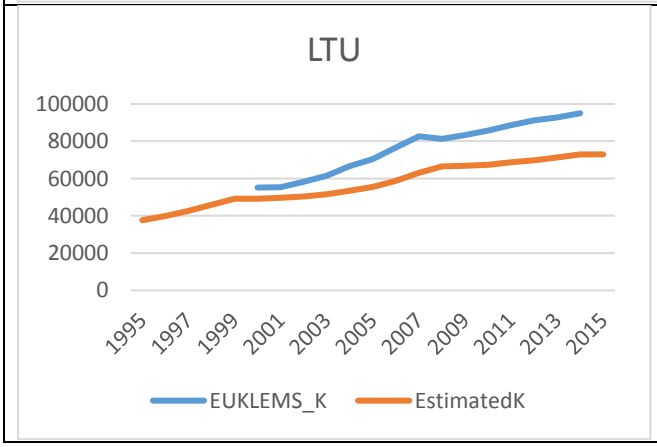
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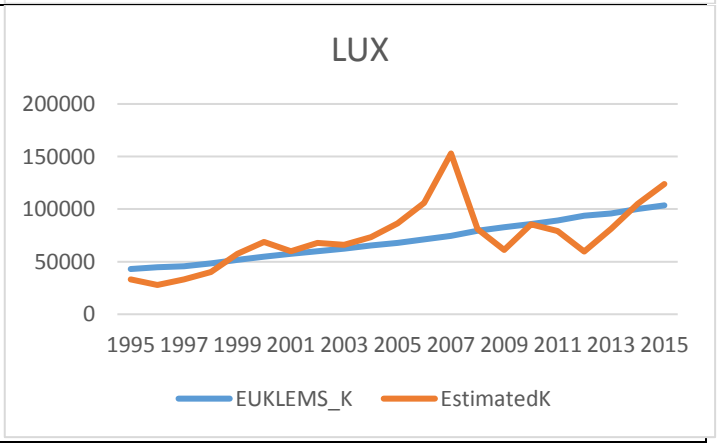
EUKLEMS_K
EstimatedK


LUX
200000
150000
100000
50000
0
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
EUKLEMS_K
EstimatedK


LVA
120000
100000
80000
60000
40000
20000
0
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
EUKLEMS_K
EstimatedK
NLD
2500000
2000000
1500000
1000000
500000
0
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
EUKLEMS_K
EstimatedK
PRT
1500000
1000000
500000
0
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
EUKLEMS_K
EstimatedK
SVK
400000
300000
200000
100000
0
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
EUKLEMS_K
EstimatedK
SVN
150000
100000
50000
0
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
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EstimatedK
SWE
15000000
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0
1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
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EstimatedK
UK
5000000
4000000
3000000
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1000000
0
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
EUKLEMS_K
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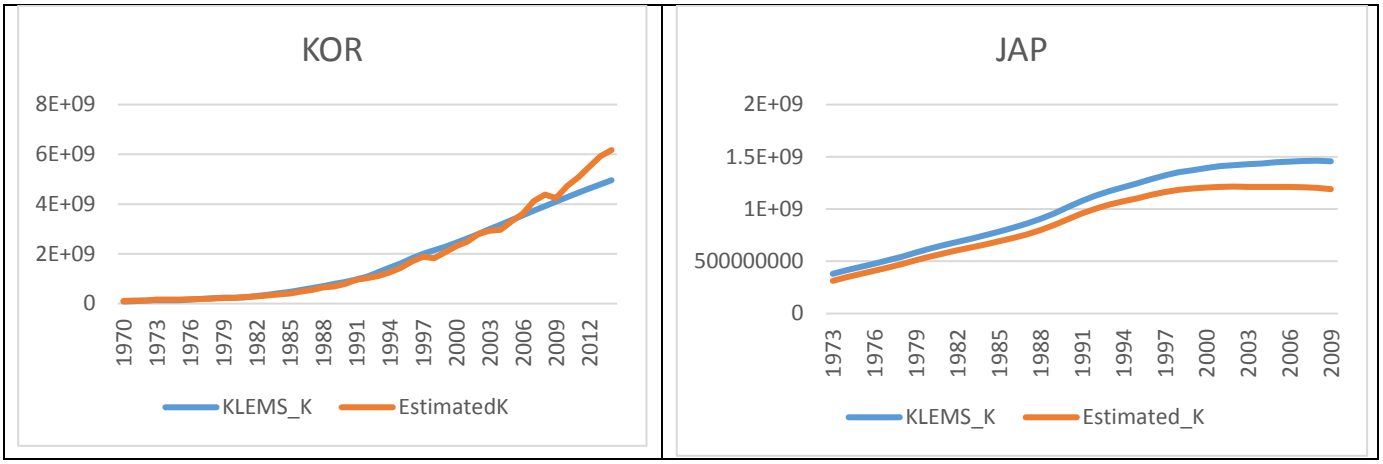
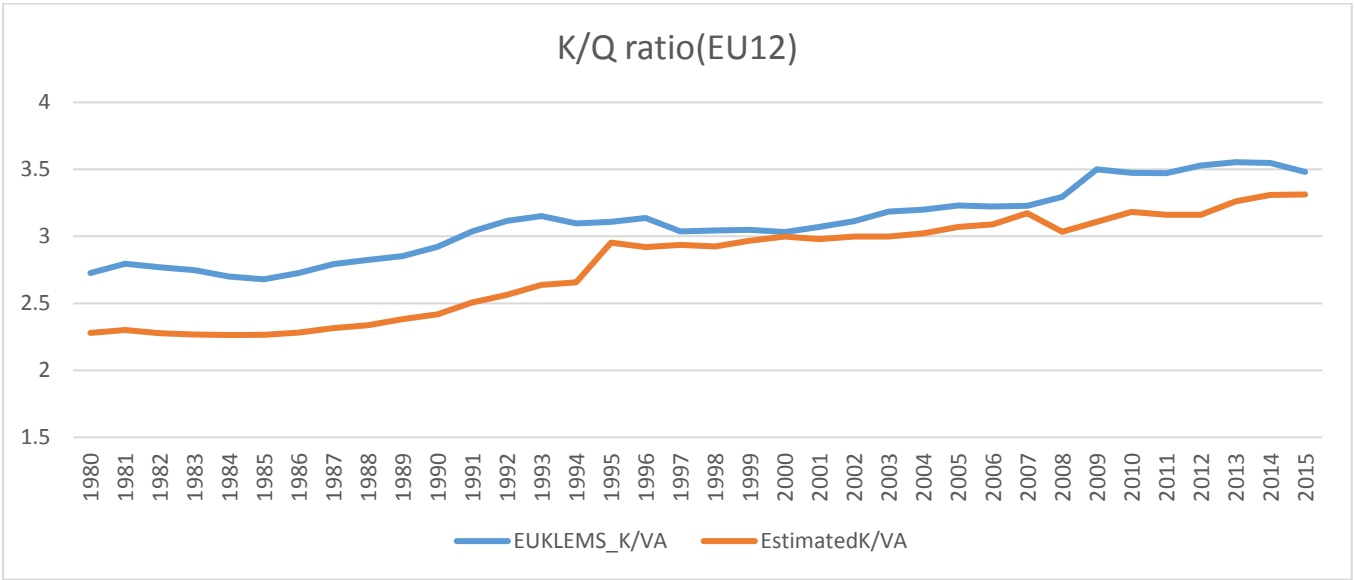
1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015
EUKLEMS_K
EstimatedK

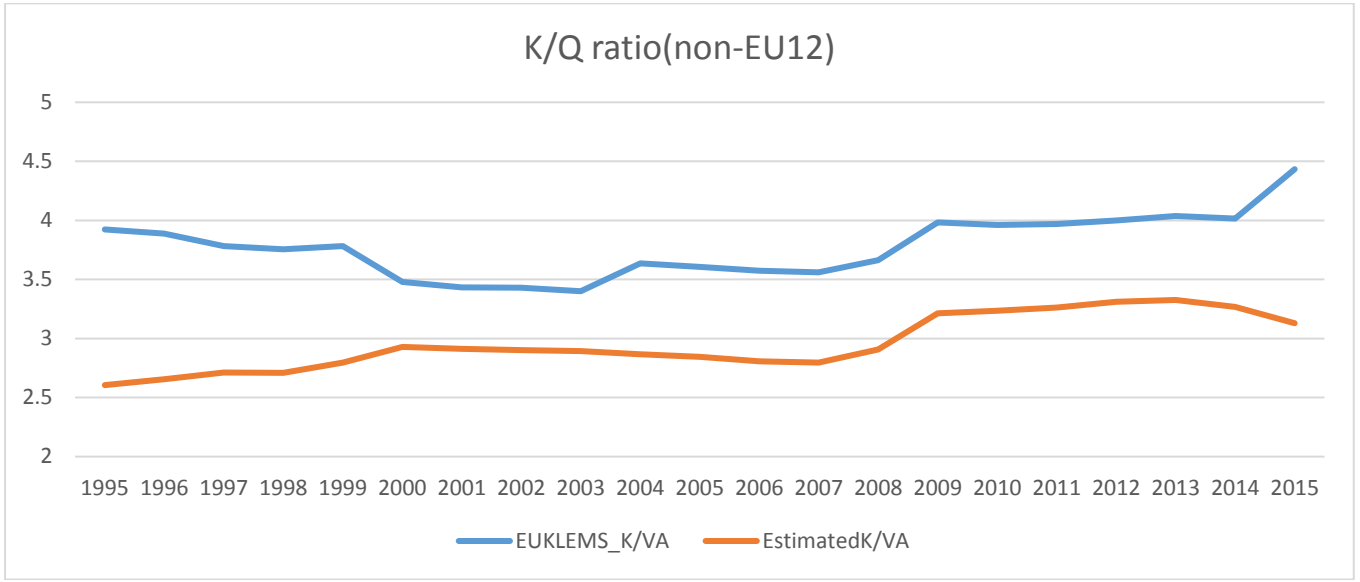


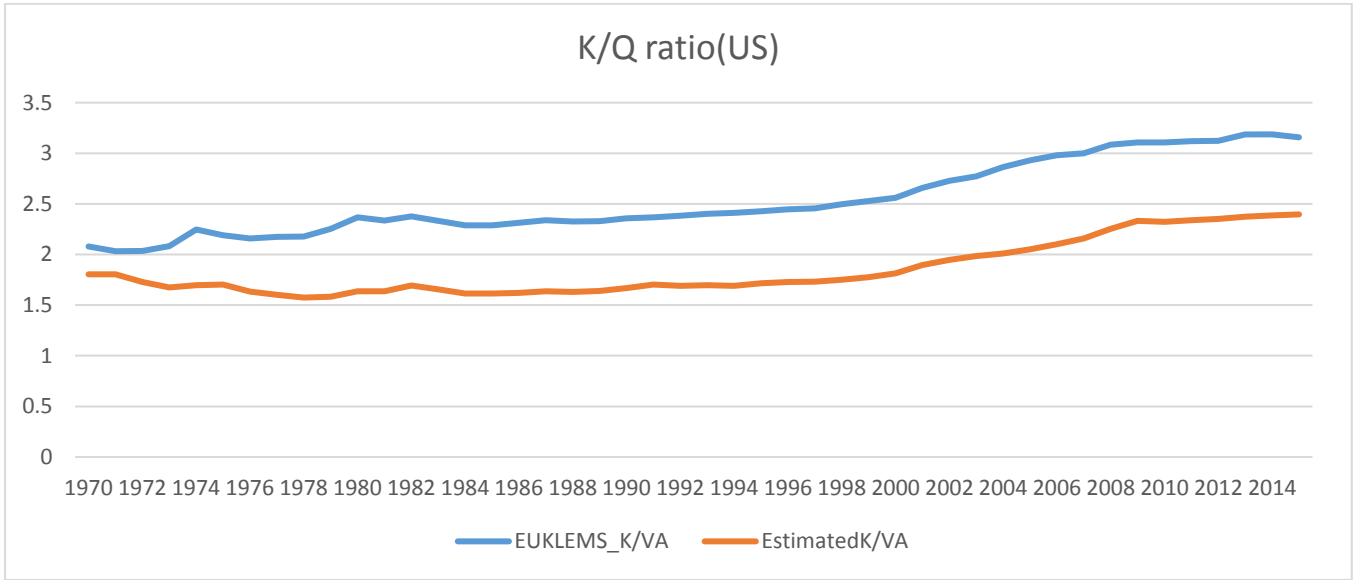
4. Comparison of Two Alternative Profiles of Capital-Output Ratio

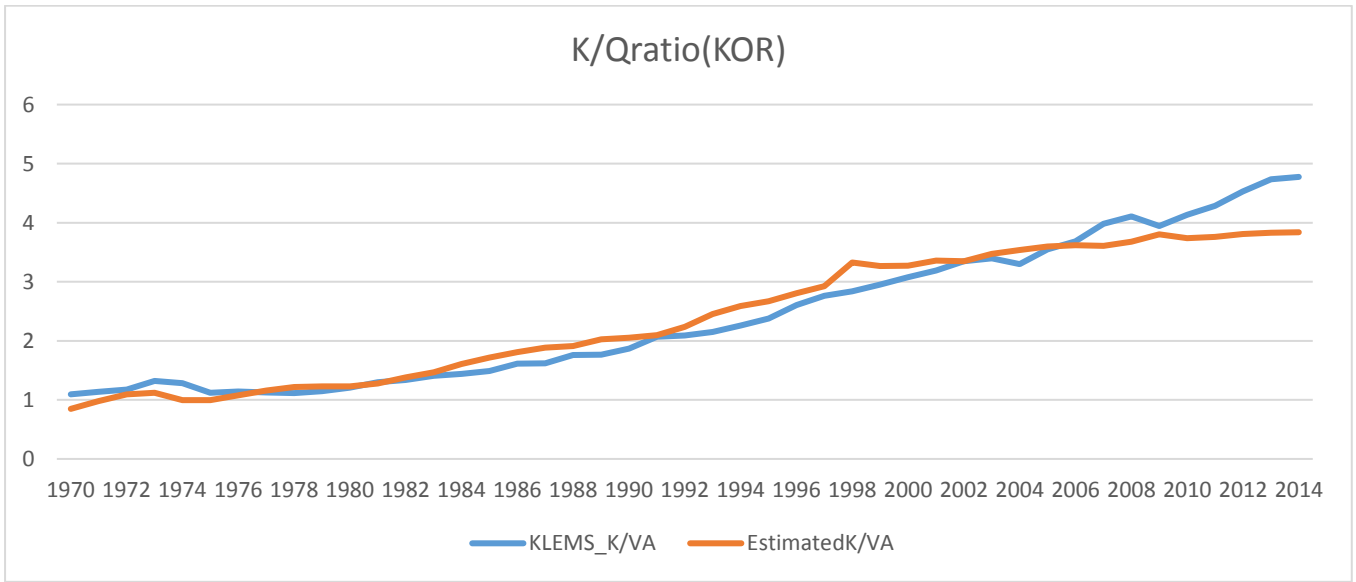
There is another way of checking the validity of capital stocks and its robustness as outlined in Piketty (2014) and Pyo (2018 forthcoming). Piketty (2014) referred the ratio of capital to GDP (K / Q) as a macro economic indicator of inequality of wealth and income. His estimate of capital - output ratio in Europe is in the range of 5 to 7 historically but his definition of capital includes land. Without land it could fall in the range of 2 – 4. Figure 4 shows two profiles of capital-output ratios in the categories of sample countries. Both profiles of capital – output ratio in our sample using EU KLEMS capital stock data and our alternative estimates fall in the range of 2 – 4 including US and Japan. Only non-EU 12 European countries' capital-output ratio after 2004 started to exceed 4. Korea's capital-output ratio has also exceeded 4 after the global financial crisis in 2007.

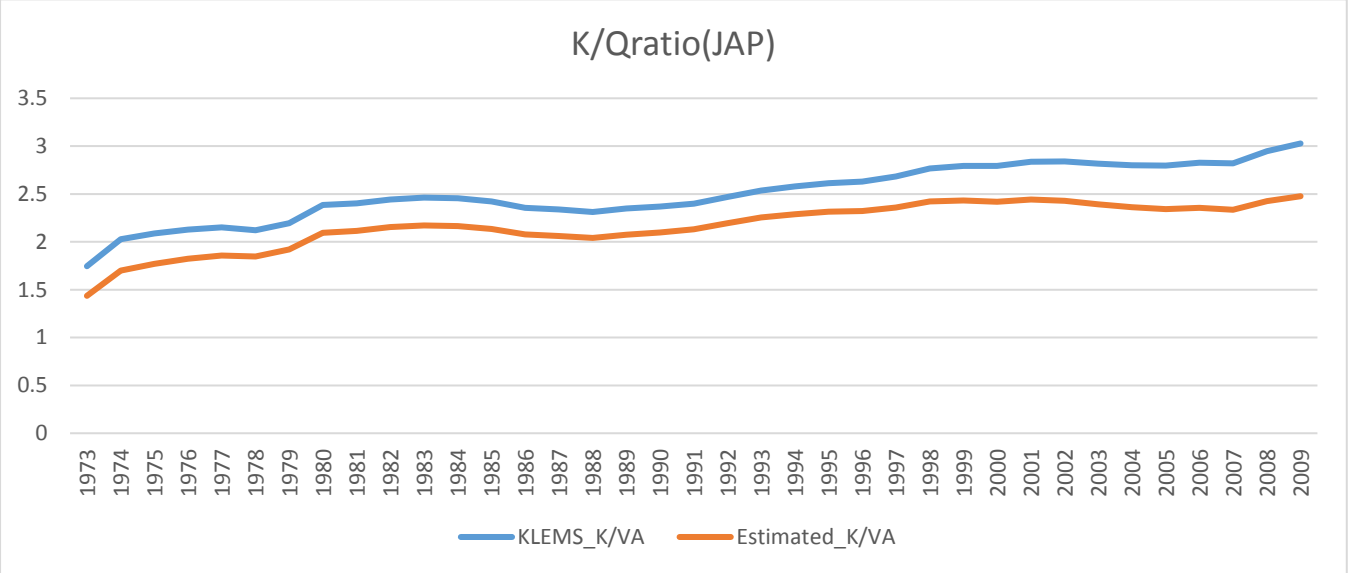
Figure 4 Comparison of Two Alternative Profiles of Capital-Output (K/Q) ratio




K/Q ratio(non-EU12)
5
4.5
4
3.5
3
2.5
2
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
EUKLEMS_K/VA
EstimatedK/VA


K/Q ratio(US)
3.5
3
2.5
2
1.5
1
0.5
0
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
EUKLEMS_K/VA
EstimatedK/VA


K/Qratio(KOR)
6
5
4
3
2
1
0
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
KLEMS_K/VA
EstimatedK/VA


K/Qratio(JAP)
3.5
3
2.5
2
1.5
1
0.5
0
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
KLEMS_K/VA
Estimated_K/VA

5. Concluding Remarks

In the present paper, we have estimated the real gross rates of return from the database of EU KLEMS and World KLEMS. Our estimates indicate the estimates of real capital stocks in most of European countries are underestimated when compared with estimates of selected non-European countries and therefore unusually higher estimates of rates of return to capital. As was pointed out in Pyo (2008) and quoted in OECD (2009), the application of PIM method by EU KLEMS to its member countries' relatively short time series of investment data may have generated a lot lower estimates of capital socks. It should be noted that the measurement of initial capital stock is important and essential for level comparison of industry-specific productivities among nations and the application of a pure PIM method to relatively shorter time–span of investment series may generate too lower estimates of capital stocks resulting in too higher estimates of rates of return to capital.

We have outlined an alternative method of indirectly checking the compatibility of initial values of net capital stock with underlying production structures and parameters by adopting the model of Dadkhah and Zahedi (1986) and using EU KLEMS Database. The estimated results of initial capital stocks for some countries diverge widely from EU KLEMS' estimates of initial values based on PIM. It suggests to use some reliable benchmark year's estimates as far as possible as done in JIP data base by the Japanese KLEMS team and in KIP database by the Korean KLEMS team: some information is better than no information or assuming zero value of initial capital stocks. Or alternatively, the use of a lot longer investment data by assets as done by BEA of the United States will make the estimate of initial capital stock more reasonable.

Pyo (2008) has pointed out that the depreciation rate (31.5 %) of Computing Equipment and Software assumed by EU KLEMS may turn out to be too high. Even though it may reflect higher user cost of such ICT assets, it will make the net capital stocks of these assets diverge from the realistic age-efficiency profile: for example, a typical notebook may depreciate in value by 31.5 percent in the first year of its usage but its efficiency level may decline by less than 10 percent. In case of Korea, the resulting estimates of ICT capital stock estimated by assuming 31.5 percent depreciation rate turn out to be declining rather than accumulating so that we had to use downward-adjusted rates of depreciation. Pyo (2008) has discussed the decomposition of ICT and Non-ICT assets and noted that EU KLEMS definition of ICT capital could be too narrow compared to that of OECD to reflect the contribution of ICT assets to economic growth. Both overestimated depreciation rates and the narrower definition of ICT assets adopted by EU KLEMS could have contributed to lower estimates of capital stocks and capital-output ratios and higher estimates of rates of return to capital.

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