SOURCES OF TRADE IN VALUE ADDED OF ICT GOODS AND SERVICES: DOES SKILL BUILDING MATTER TO COMPARATIVE ADVANTAGE?

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Background

- Trade in ICT goods and services is still important even after decline due to economic crisis in 2008.

- Shift in comparative advantage of developed countries from goods to services in the context of GVCs (Timmer, et al., 2012a; OECD, 2003)

- Shift in activities in use from low- and medium-skilled labour to high-skilled and capital in matured economies

Approach

- Take advantage of new data (WIOD , TiVA and MSTI)

- Observations from RCA indices based on OECD/WTO Trade in Value Added (TiVA) database. -> New indicators

- Regression based on factor proportions theory with theoretical basis from Heckscher-Ohlin-Vanek (HOV) model using various data for production factors.

Sectors for regression (ICT goods)

- Office machinery and computers (ISIC 30)
  - *int30: Intermediates;*
  - *cap30: Capital goods*
- Radio, television and communication equipment and apparatus (ISIC 32)
  - *int32: Intermediates;*
  - *con32: Consumption goods;*
  - *cap32: Capital goods*

Sectors for regression (services)

ICT services sectors

- *tot72: Computer and related services (total trade)*
- *tot64: Post and telecommunication services (total trade)*

IT enabled services (ITES)

- *tot65-67: Financial intermediation services (total trade)*
- *tot74: Other business services (total trade)*

Traditional RCA

- Gross-export-based RCA (RCA_EXGR)

$$RCA\_EXGR_{c,i} = \frac{EXGR_{c,i} / \sum_i EXGR_{c,i}}{\sum_c EXGR_{c,i} / \sum_{c,i} EXGR_{c,i}}.$$

(1a)

- No longer reflect the reality of relative advantage of a certain country in international trade. (Yamano and Meng, 2013)

TiVA RCA

- RCA based on domestic value-added embodied in gross exports (RCA_EXGRDVA)

$$RCA\_EXGRDVA_{c,i} = \frac{EXGRDVA_{c,i}/\sum_i EXGRDVA_{c,i}}{\sum_c EXGRDVA_{c,i}/\sum_{c,i} EXGRDVA_{c,i}}. \quad (1b)$$

- RCA based on domestic value-added embodied in foreign final demands (RCA_VAFD):

$$RCA\_VAFD_{c,i} = \frac{VAFD_{c,i}/\sum_i VAFD_{c,i}}{\sum_c VAFD_{c,i}/\sum_{c,i} VAFD_{c,i}}. \quad (1c)$$

Figure 1. RCA based on domestic value-added embodied in foreign final demands (VAFD)
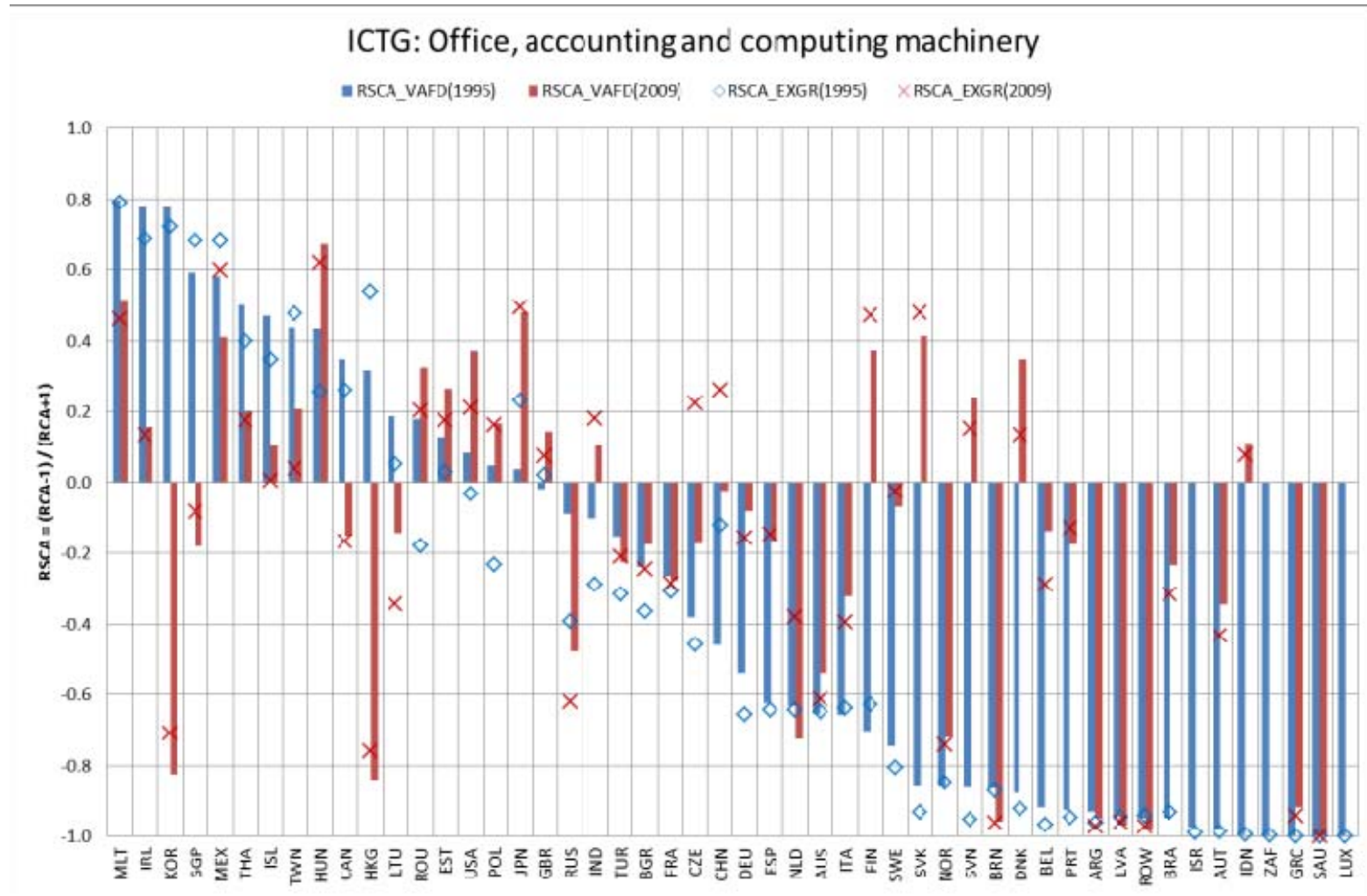
Figure 1.(cont.) RCA based on domestic value-added embodied in foreign final demands (VAFD)
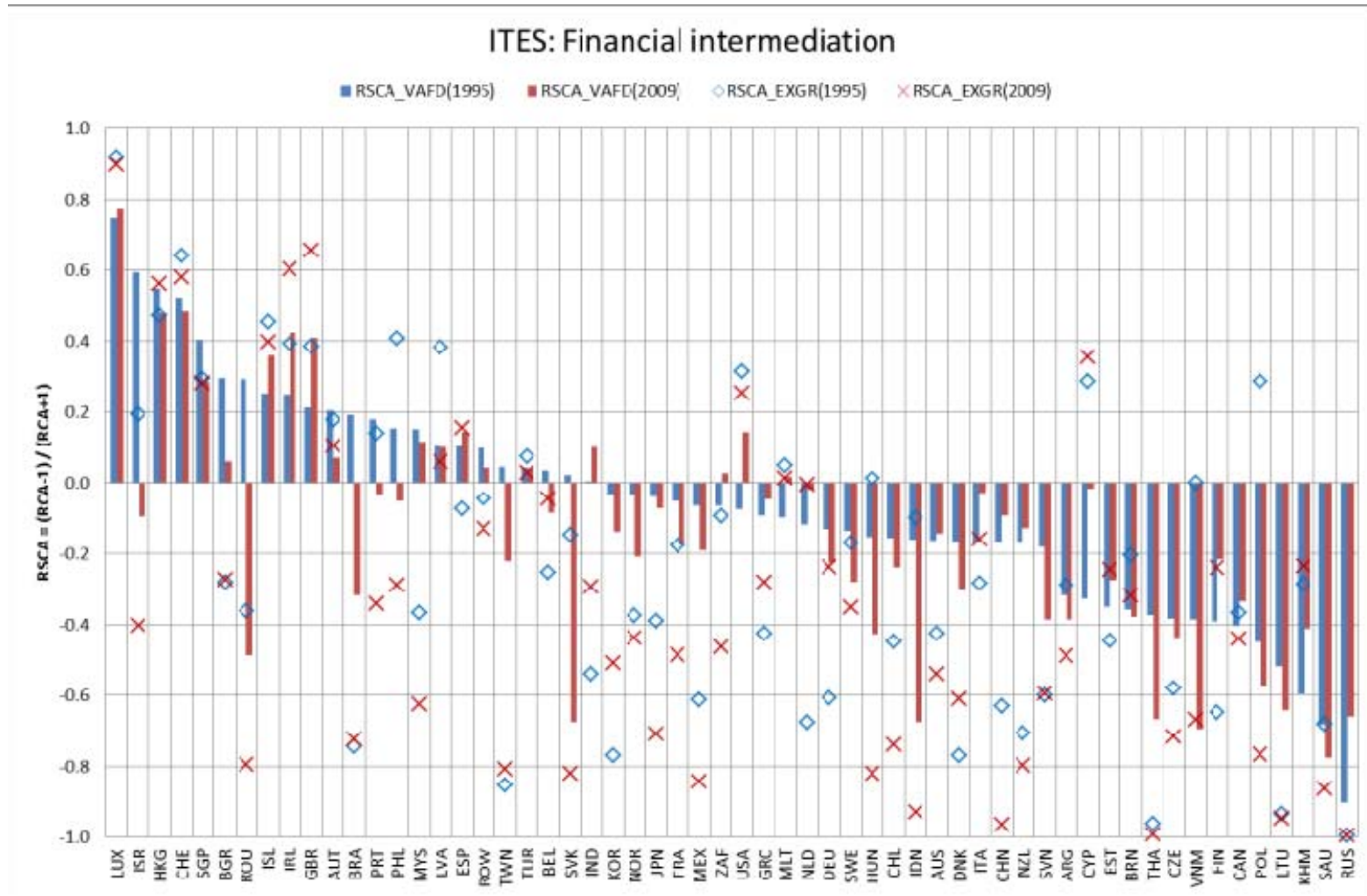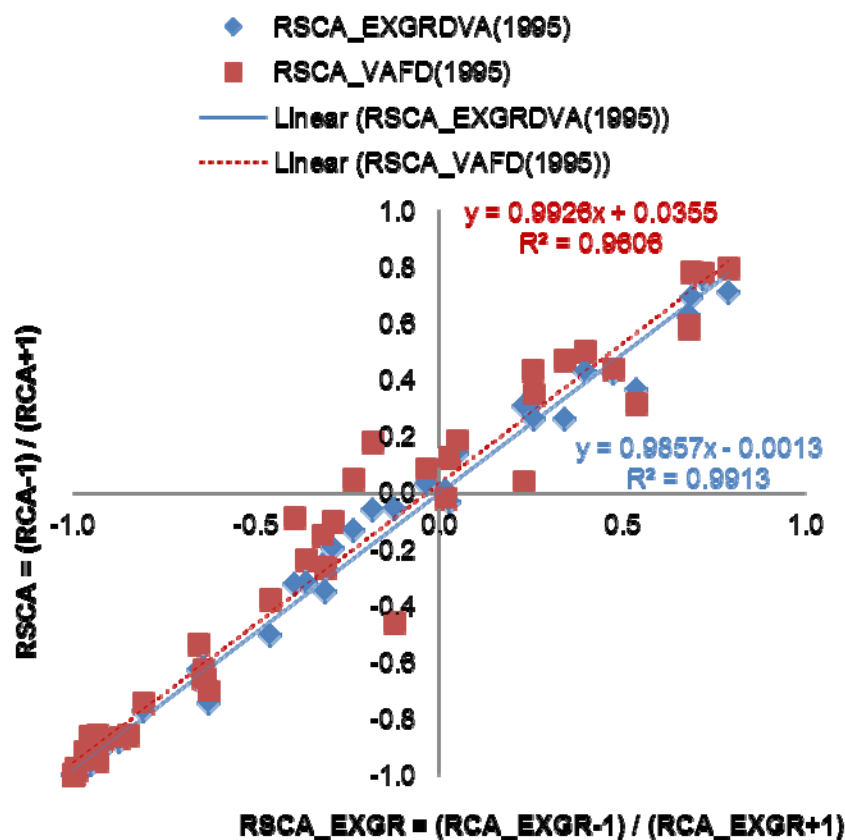
Figure 2. Correlation between RCA based on Gross Export and TiVA-RCAs
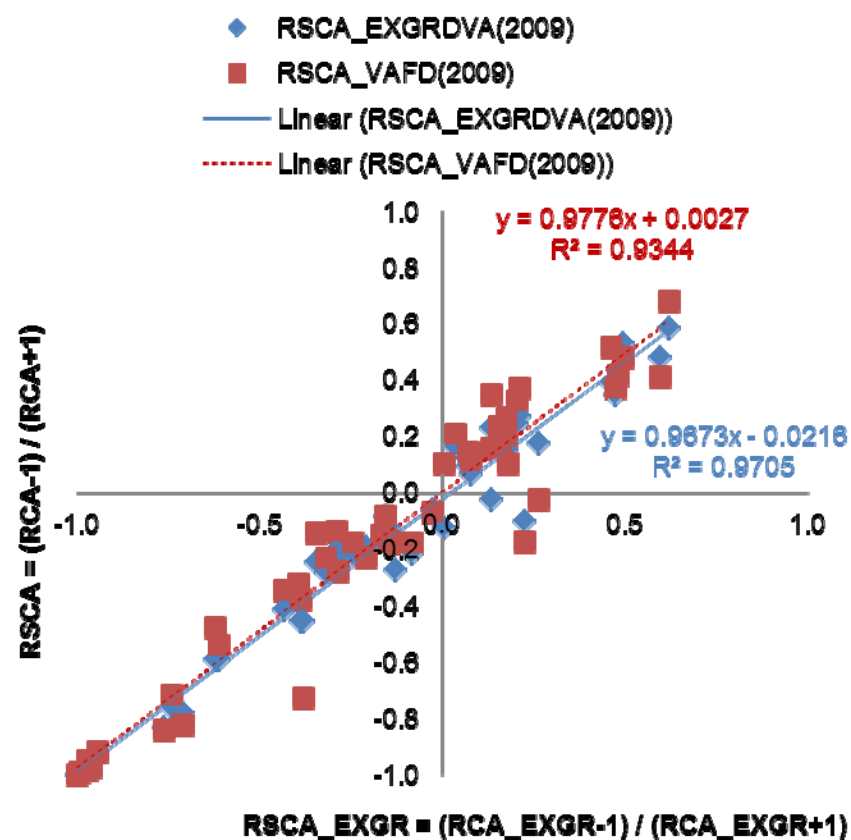
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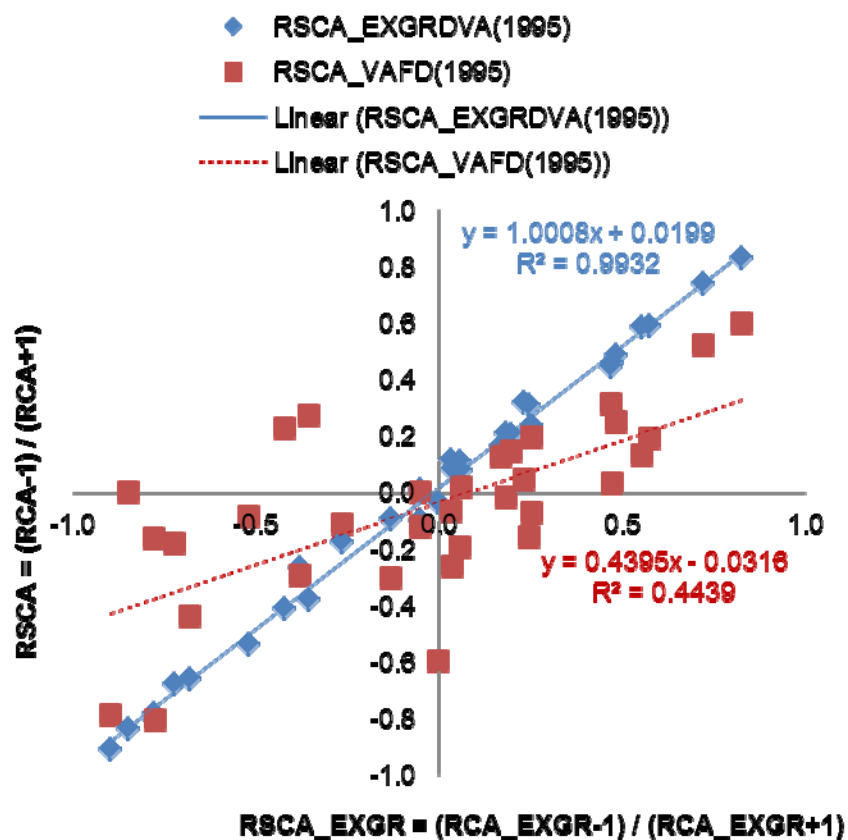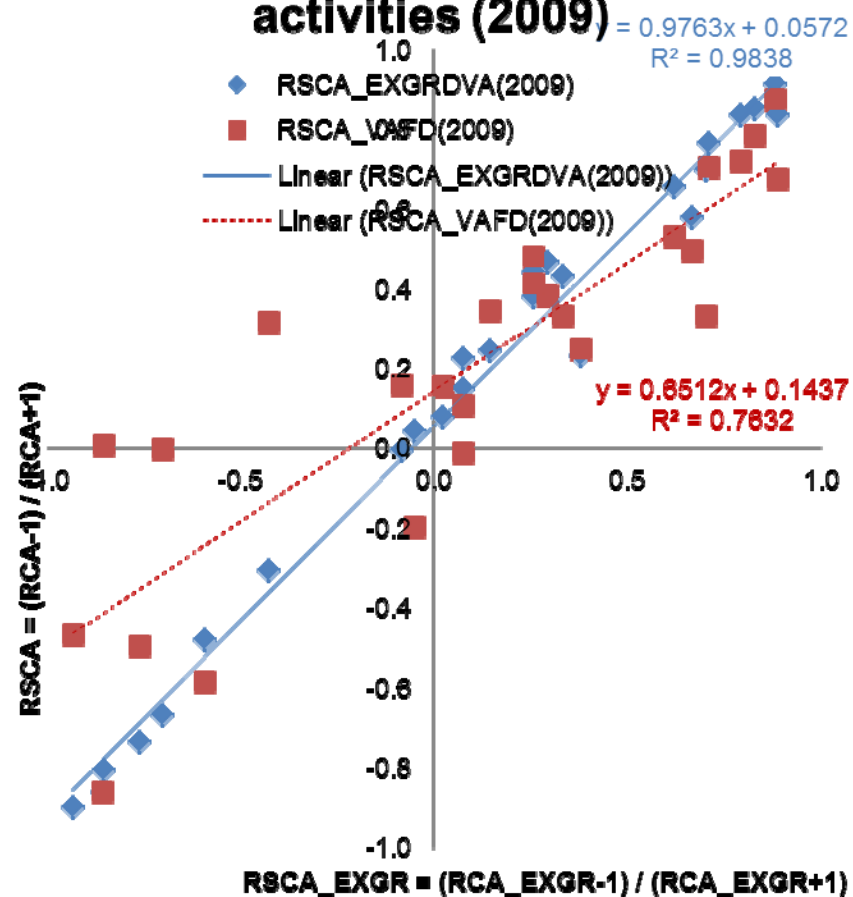
Observations

(a) Traditional RCA tends to be higher than value-added based RCAs.

(b) More modest shifts in value-added based measure than traditional indicators over the past 15 years.

(c) In general, differences between RCA based on gross export and RCA_VAFD are larger than differences between the former and RCA_EXGR, especially for services.

(d) Differences between gross trade and trade in value added has become wider for services, while those for manufacturing sectors remains marginal.

Regression analysis based on factor proportions theory

- **Specification for cross-country regression model**

$$T_j = \sum_{j=1}^{3} \beta_j \cdot \omega_j + \varepsilon_j$$

T_j : net export of good or service j,

ω_j : excess supply of factor j,

$\beta's$: parameters to be estimated, and

ε_j : a well behaved error term.

Variables and data sources

- Dependent variables: Mean adjusted net trade by sector calculated from WIOD International Trade data.

- Independent variables: Mean adjusted national "excess factor supply" calculated using current GDP (United Nations, Analysis of Main Aggregates) as national demand share in world consumption.

- All values in national currency are converted to US dollar using WIOD exchange rates.

Table 1. WIOD 40 World: Capital stock, high skilled and less skilled labour in terms of education (linear)

(a) 1995-1999

	ICT goods					ICT services		IT enabled services (ITES)	
	Office machinery and computers		Radio, televison and communication equipment and apparatus			Computer and related services	Post and telecommunication services	Financial intermediation services	Other business services
	Intermediate	Capital goods	Intermediate	Consumption	Capital goods	Total	Total	Total	Total
	int30	cap30	int32	con32	cap32	tot72	tot64	tot65-67	tot74
K : capstk	0.2515 **	0.2676 **	0.2108 *	0.5229 ***	0.4998 ***	-0.8222 ***	0.1933	0.3443 **	-0.3679 **
	(2.087)	(2.105)	(1.674)	(6.349)	(4.465)	(-6.949)	(1.541)	(2.324)	(-2.283)
H : hlabor	-0.3565 **	-0.3597 **	-0.3119 **	-0.1381	-0.3280 **	-0.0887	0.1785 *	0.3363 **	-0.0774
	(-2.174)	(-2.223)	(-2.186)	(-1.528)	(-2.326)	(-1.124)	(1.899)	(2.221)	(-1.037)
L : llabor	0.1041 **	0.2007 ***	-0.5819 ***	0.4491 ***	-0.0848	-0.2483 ***	0.0806	0.2104 **	-0.1397
	(2.484)	(3.538)	(-6.109)	(6.353)	(-1.492)	(-2.765)	(0.587)	(2.412)	(-1.370)
Year dummy	NO	NO	NO	NO	NO	NO	NO	NO	NO
Observations	200	200	200	200	200	200	200	200	200
Adjusted R^2	0.3011	0.3499	0.5560	0.5796	0.5601	0.6539	0.0189	0.1221	0.1133

(b) 1995-1999

	ICT goods					ICT services		IT enabled services (ITES)	
	Office machinery and computers		Radio, televison and communication equipment and apparatus			Computer and related services	Post and telecommunication services	Financial intermediation services	Other business services
	Intermediate	Capital goods	Intermediate	Consumption	Capital goods	Total	Total	Total	Total
	int30	cap30	int32	con32	cap32	tot72	tot64	tot65-67	tot74
K : capstk	0.0172	-0.0844	0.0376	-0.2451 ***	-0.1004	-0.1032	-0.0721	0.1933	0.1184 **
	(0.196)	(-1.175)	(0.555)	(-3.490)	(-1.514)	(-1.537)	(-0.879)	(1.225)	(2.433)
H : hlabor	-0.3683 ***	-0.1343 **	-0.2971 ***	-0.5398 ***	-0.4153 ***	-0.0622	0.0919	0.2749 *	0.1641 **
	(-3.403)	(-2.205)	(-4.673)	(-8.226)	(-6.817)	(-0.659)	(1.188)	(1.890)	(2.095)
L : llabor	0.4907 ***	0.7006 ***	-0.6826 ***	0.4049 ***	0.5307 ***	0.3492 ***	0.0251	-0.0223	-0.0092
	(3.028)	(3.626)	(-4.192)	(3.072)	(3.129)	(3.393)	(0.339)	(-0.167)	(-0.219)
Year dummy	NO	NO	NO	NO	NO	NO	NO	NO	NO
Observations	170	170	170	170	170	170	170	170	170
Adjusted R^2	0.4944	0.6206	0.4275	0.6794	0.6392	0.1640	0.0000	0.0768	0.0153

ICT goods

- Table 1: Basic model based on authentic methods in the context of factor proportion empirics.
  - High skilled labour in terms of education has significantly negative signs for all ICT goods except *con32* for 1995-99. -> different from prediction
  - Both capital and less skilled labour have positive signs for all these sectors. -> different from prediction
  - In 2005-09, all signs for high-skilled labour remains (or turns) to be significantly negative for all these products.
  - Coefficients for capital lost their significance for positive signs, too.

Services sector

- As for the service sectors, only *(tot65-67)* has a significantly positive significant coefficient with educated labour as well as those for capital and less-skilled labour for 1995-95.

- Then become insensitive to factor supply.

- A similar pattern to the *con32* because both sectors seem to be influenced by imported intermediates greatly.

Possible explanations for unexpected

(1) Skill required in these sectors are more specific rather than just college graduates whose skills differ a lot by countries and by fields;

(2) Capital substitutes for skilled labour; and/or

(3) Either (or both) of "technology similarity" or "consumption similarity" behind HOV model is invalid

(4) Standardisation of ICT products made the industry less skilled labour intensive;

(5) If skills of workforce increases, sectors not skill intensive will shrink (Rybczynski effect)

(6) factor proportions theory itself lost its validity because of increased trade in intermediates and intra-industry trade under more fragmented GVCs
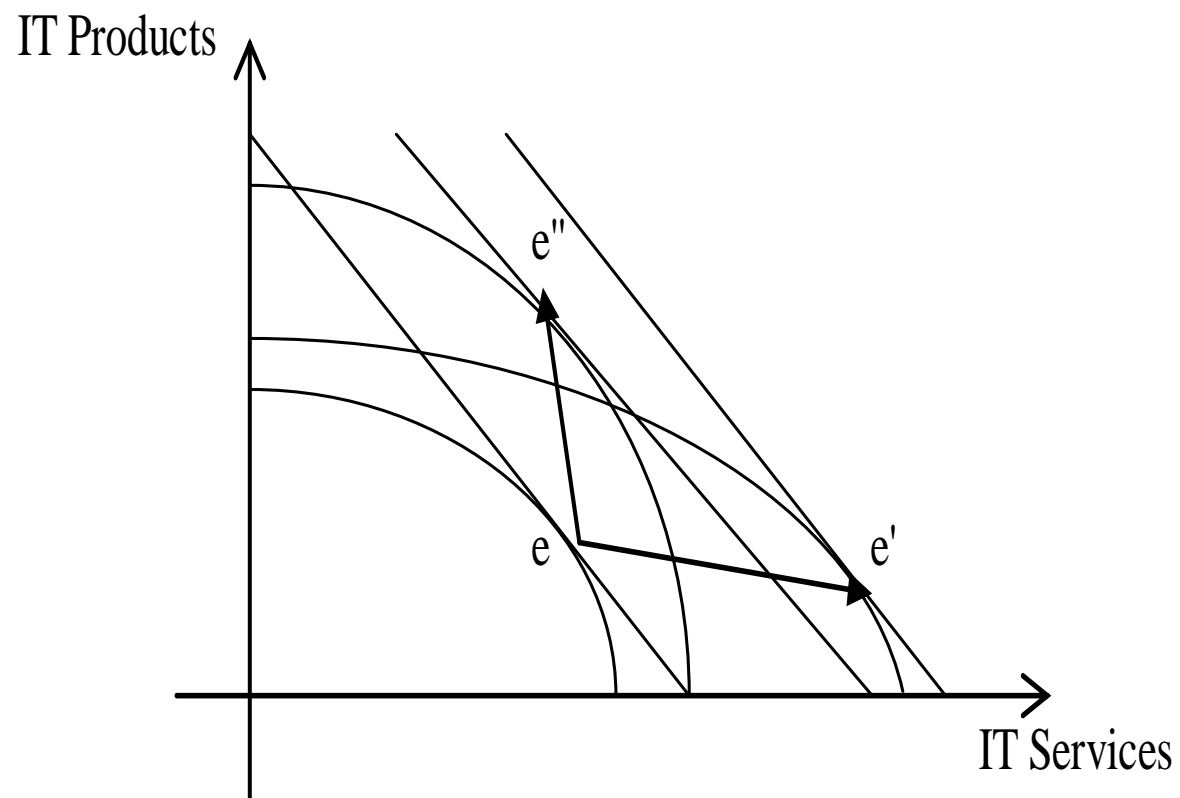
Figure 3. Rybczynski Effect

Table 5. OECD 28 World: Capital stock, researcher and non-researcher (linear)

(a) 1995-1999

	ICT goods					ICT services		IT enabled services (ITES)	
	Office machinery and computers		Radio, televison and communication equipment and apparatus			Computer and related services	Post and telecommunication services	Financial intermediation services	Other business services
	Intermediate	Capital goods	Intermediate	Consumption	Capital goods	Total	Total	Total	Total
	int30	cap30	int32	con32	cap32	tot72	tot64	tot65-67	tot74
K : capstk	0.3957 ***	0.4542 ***	0.2974 ***	0.5410 ***	0.6066 ***	-0.7795 ***	0.0771	0.1055	-0.3215 ***
	(3.140)	(3.831)	(2.871)	(4.668)	(6.362)	(-6.951)	(0.521)	(0.967)	(-2.835)
H : resfte	0.5076 ***	0.4582 ***	0.4291 ***	0.0917 **	0.4762 ***	0.0036	0.0834	-0.2888 ***	0.2206 **
	(6.398)	(8.601)	(6.264)	(2.026)	(7.655)	(0.050)	(0.876)	(-3.611)	(2.184)
L : nrsfte	-0.0814	-0.0124	-0.5896 ***	0.4938 ***	-0.0353	-0.3068 ***	0.2137	0.2871 ***	-0.1116 *
	(-0.625)	(-0.100)	(-7.191)	(3.294)	(-0.339)	(-2.979)	(1.506)	(3.327)	(-1.912)
Year dummy	NO	NO	NO	NO	YES	NO	NO	NO	NO
Observations	117	117	117	117	117	117	117	117	117
Adjusted R^2	0.4833	0.4671	0.7468	0.5457	0.6405	0.7088	0.0292	0.1836	0.1340

(b) 2005-2009

	ICT goods					ICT services		IT enabled services (ITES)	
	Office machinery and computers		Radio, televison and communication equipment and apparatus			Computer and related services	Post and telecommunication services	Financial intermediation services	Other business services
	Intermediate	Capital goods	Intermediate	Consumption	Capital goods	Total	Total	Total	Total
	int30	cap30	int32	con32	cap32	tot72	tot64	tot65-67	tot74
K : capstk	-0.2091	-0.2691 **	-0.1934 **	-0.0751	-0.1060	-0.0288	-0.1104	0.3761 *	-0.1247 ***
	(-1.304)	(-2.519)	(-2.221)	(-0.917)	(-0.778)	(-0.379)	(-0.490)	(1.906)	(-3.243)
H : resfte	0.7301 ***	0.4670 ***	0.9068 ***	0.1664 **	0.5972 ***	-0.1067	0.0039	-0.5019 ***	0.1204 **
	(4.569)	(4.376)	(8.991)	(2.402)	(4.671)	(-1.362)	(0.018)	(-2.723)	(2.116)
L : nrsfte	0.0547	0.2474 **	-0.4524 ***	0.9081 ***	0.5022 ***	-0.0192	-0.0197	-0.3598 ***	-0.0957 ***
	(0.726)	(2.197)	(-7.156)	(11.648)	(8.764)	(-0.407)	(-0.225)	(-3.388)	(-3.622)
Year dummy	NO	NO	NO	YES	NO	NO	NO	NO	NO
Observations	104	104	104	104	104	104	104	104	104
Adjusted R^2	0.3498	0.1484	0.7313	0.8109	0.5720	-0.0113	-0.0162	0.2144	-0.0085

Researchers as high-skilled labour

- Table 5: Use of total researcher and no-researcher as labour data.
  - All the signs of coefficients for both K and H turn out to be statistically significant and positive for all the sub-sectors of products in 1995-99.
  - All the signs for H remain significantly positive and increase their for products while those for capital changed to either negative or statistically insignificant in all of them for 2005-09.
  - Skilled labour (in terms of researcher) as a production factor has strengthen its importance to have competitiveness in ICT products both as intermediates and final good.
  - Services sectors have opposite results.

Other interesting results

- Table 7: Interaction term with the combination of R&D expenditure and researcher.
  - The signs of interaction terms demonstrate, in general, that a higher R&D expenditure leads to a weaker impact of the number of researchers on exports. A larger number of researchers leads to a greater impact of R&D expenditure.
- Table 8: The combination of KBC stock, high-skilled and less skilled labours in terms of education.
  - A great improvement in the performance of this capital factor.
  - KBC play an important role in the competiveness of ICT goods and services used as intermediates in recent GVCs
- Table 10: Interaction term between KBC and researcher.
  - Larger KBC leads to a greater impact of number of researchers on exports.

Ideas for policy consideration

(i) Upgrading of required skill (researcher) and investment (KBC).

- Factor proportion theory based on HOV is still valid, if we introduce narrower and/or new definition of these factors.
- Need focused approach in skilled building and support to investment.

Ideas for policy consideration

(ii) Capital and skilled workers become more substitutable over these 15 years

- Increase in R&D expenditure alone does not lead to the competitiveness of ICT sector if growth of researcher does not accompany with this.

- Increase in number of researcher is not sufficient to improve competitiveness unless appropriate investment is done in knowledge based capital.