SOFT INNOVATION RESOURCES: ENABLER FOR REVERSAL IN GDP GROWTH IN THE DIGITAL ECONOMY

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ABSTRACT

While Finland and Singapore have been maintaining world digital leaders position, they demonstrate interlaced contrast: high welfare with low GDP growth in Finland and higher GDP growth with lower welfare in Singapore. This provokes an uncaptured GDP postulate that Finnish wellbeing has developed more than one might conclude by GDP. However, a recent reversal in the GDP growth trend suggests the possibility that uncaptured GDP contributes to remove structural impediments in GDP growth.This paper demonstrates this hypothesis. An empirical analysis elucidating the inside the national accountings and institutional systems revealed that soft innovation resources have substituted for service capital in Finland and created uncaptured GDP which disseminated in tangible capital and removed structural impediments impeding development leading to GDP growth. In addition, this growth enables next generation intellectual property product (IPP) development. An insightful suggestion in overcoming a productivity paradox in the digital economy was thus provided.

KEYWORDS

Digital economy, soft innovation resources, structural impediments in growth, productivity paradox, Finland and Singapore

1. INTRODUCTION

Digital economy transforms the traditional concepts of economic growth. While Finland and Singapore have been maintaining world digital leaders position, both countries demonstrated a contrasting structure. Finland enjoyed high level of happiness/welfare under the great stagnation while Singapore accomplished conspicuously high economic growth in the lower level of happiness/welfare. This observation prompts us a hypothetical view that "well-being of the Finnish people has developed in a more positive direction than one might conclude by GDP data" [1].

Furthermore, the recent reversal trend in GDP growth in two countries (Fig. 1) suggests a possibility of a transformation of the traditional concepts of GDP growth [2].
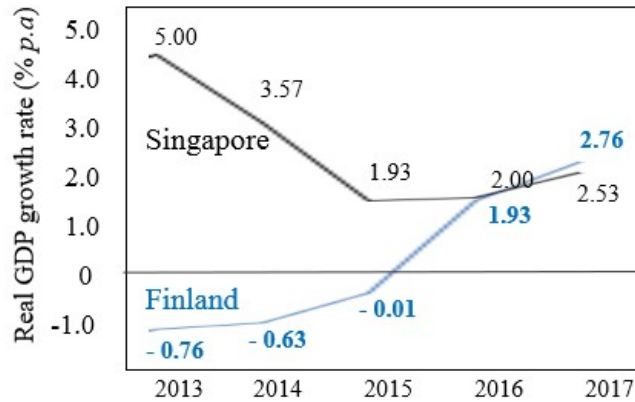

Figure. 1. Recent reversal trend in GDP growth of digital leaders (2013-2017).

Source: [3].

Confronting a productivity decline in the digital economy, global ICT leaders are transforming business models into those with uncaptured GDP creation for their survival. This can be attributed to the harnessing soft innovation resources against a productivity decline. This in turn activates a self-propagating function and induces supra-functionality beyond economic value corresponding to a shift in people's preferences [4].

Authors demonstrated that this dynamism also contributes to removing structural impediments in GDP growth, thus uncaptured GDP dependence by harnessing soft innovation resources contributes to overcoming economic stagnation by its hybrid functions [2].

They then postulated that the recent reversal trend in GDP growth of ICT leaders Finland and Singapore can be attributed to this contribution, and attempted to demonstrate this hypothetical view.

They first identified that Finland's recent GDP growth recovery can largely be attributed to its gross fixed capital formation to which negative contribution in Singapore as demonstrated in **Table 1**.

They then identified that contrary to increasing share in Singapore, Finland has been shifting to less dependent on intellectual property products (IPP) in its gross fixed capital formation as demonstrated in **Fig. 2**.

Table 1. Contribution to expenditure on GDP growth in Finland and Singapore (2013 – 2017)
- real growth rate (% *p.a*).

Finland	2013	2014	2015	2016	2017
Private consumption	-2.09	0.11	1.50	0.83	0.96
Government consumption	2.28	0.00	0.10	0.37	0.32
Gross fixed capital	-9.50	-0.11	0.20	**1.19**	**1.49**
Net exports of goods and services	8.45	-0.63	-1.98	-0.18	0.53
Others (inventories and net acquisitions of variables)	0.10	0.00	0.17	-0.28	-0.54
Total	**-0.76**	**-0.63**	**-0.01**	**1.93**	**2.76**

Original source: [5].

Singapore	2013	2014	2015	2016	2017
Private consumption	1.27	1.37	1.40	0.33	0.98
Government consumption	0.98	0.00	0.61	0.17	0.35
Gross fixed capital	1.67	1.74	0.44	**-0.08**	**-0.42**
Net exports of goods and services	1.27	1.56	1.58	0.92	-0.56
Others (inventories and net acquisitions of variables)	-0.19	-1.10	-2.10	0.66	2.18
Total	**5.00**	**3.57**	**1.93**	**2.00**	**2.53**

Adjusted to IMF statistics using the share of respective contribution by respective statistics.
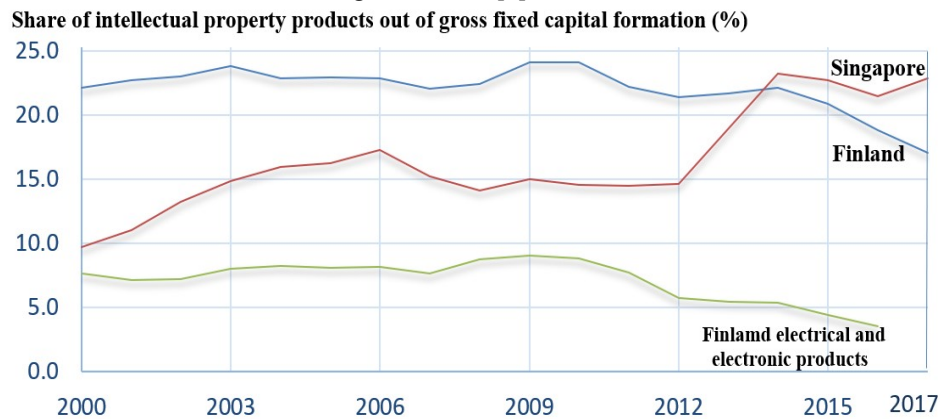
Original source: [6].

Figure 2. Trends in share of intellectual property products (IPP) out of gross fixed capital formation in
Finland and Singapore (2006-2017) - %.
Sources: Same as original sources of Table 1. Finland 2017 value is estimated based on the trend in 2014-
2016.

Recalling recent noteworthy improvements in Finland on the effective utilization of soft innovation resources such as trust (e.g., government-labor union reform pact in June 2016) and untapped resources utilization (e.g., female business executives increase through gender balance improvement), they interpreted these contrasting trajectories in two digital leaders as higher dependence on soft innovation resources rather on ICT R&D in Finland and cling to ICT R&D in Singapore. However, no substantial evidences has provided to this interpretation.

This paper attempts to demonstrate this hypothetical interpretation.

Following up the preceding analysis and insights obtained thereon, this paper attempts further elucidation of the hybrid role of soft innovation resources-driven uncaptured GDP creation. Spontaneous creation of this uncaptured GDP satisfies a shift in people's preferences to supra-functionality beyond economic value and also removes structural impediments in GDP growth.

On the basis of an empirical analysis elucidating the inside the national accountings and institutional systems it was revealed that soft innovation resources have substituted for service capital (IPP) in Finland and created uncaptured GDP which disseminated in tangible capital and removed structural impediments impeding its formation. This formation leads to GDP growth. In addition, this growth enables next generation IPP development.

Fig. 3 illustrates framework of the demonstration of this hypothetical view.
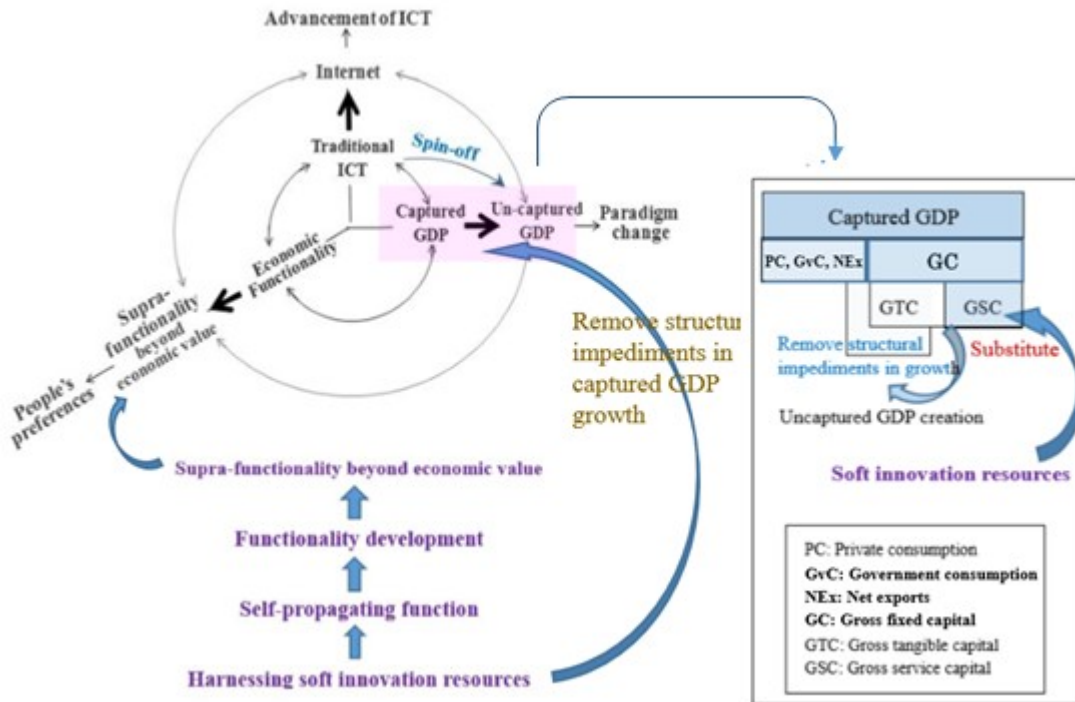

Figure 3. Dynamism of hybrid role of soft innovation resources: Creation of uncaptured GDP and remove structural impediments in captured GDP growth.

An insightful suggestion to a productivity paradox in the digital economy was thus provided.

Section 2 analyzes contributor to capital increase. Role of soft innovation resources is reviewed in Section 3. Section 4 demonstrates soft innovation resources substitution for IPP. Section 5 analyzes effects of dissemination of soft innovation resources in tangible capital. Section 6 summarizes the noteworthy findings, policy suggestions, and future research.

2. CONTRIBUTOR TO CAPITAL INCREASE

In light of primal contribution of gross fixed capital formation (GC) to the recent reversal trend in GDP growth between Finland and Singapore as demonstrated in Table 1, contributor of GC growth was analyzed by dividing GC into gross service capital (GSC) and gross tangible capital (GTC). Here, GSC is represented by IPP in the national accounts while GTC includes such tangible assets as machinery, vehicles, plant, dwellings, buildings, and land improvements. **Table 2** compares focus of respective resources.

Table 2. Focus of gross capital investment and possible substitution by soft innovation resources

Gross service capital	Gross tangible capital	Soft innovation resources
R&D	Machinery	Driving force of preferences shift to supra-functionality
Software and data bases	Vehicles	
	Plant	Sleeping resources
Mineral exploration and evaluation	Dwellings	Trust by overdrawing past information
	Buildings and	Utmost gratification ever experienced
Entertainment, literary or artistic originals	structures	Memory and future dream
	Land improvements	Untapped resources and vision

GC can be decomposed as follow:

$$GC = \kappa\, GC + \lambda\, GC \tag{1}$$

where κ and λ: share of GSC and GTC, respectively. $\kappa + \lambda = 1$

Differentiate by time t:

$$\frac{dGC}{dt} = \Delta GC = (\Delta\kappa \cdot GC + \kappa \cdot \triangle GC) + (\triangle\lambda \cdot GC + \lambda \cdot \triangle GC) \tag{2}$$

Thus, growth rate can be depicted as follows:

$$\frac{\triangle GC}{GC} = (\triangle\kappa + k \cdot \frac{\triangle GC}{GC}) + (\triangle\lambda + \lambda \cdot \frac{\triangle GC}{GC}) \tag{3}$$

Table 3 compares contribution of GSC and GTC to GC growth rate in Finland and Singapore over the period 2013-2017. **Fig. 4** compares contribution of GTC to GC in two countries.
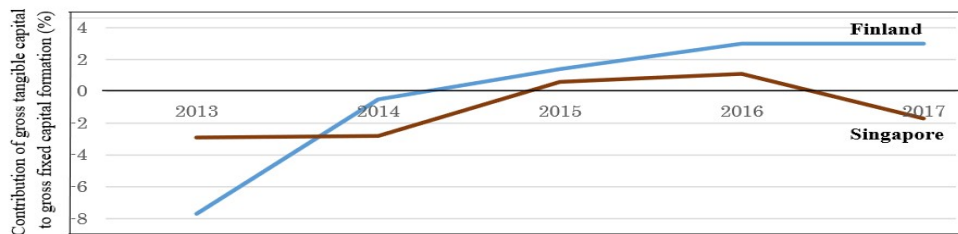

Figure 4. Trend in gross tangible capital (GTC) contribution to gross fixed capital (GC) formation in Finland and Singapore (2013-2017).

Looking at this figure we note that while Finland has been shifting from dependence on gross *GSC* to *GTC* for its *GC* formation, Singapore has been clinging to *GSC*. This suggests that soft innovation resources substitute for *GSC* and induce *GTC* in Finland that leads its GDP growth.

Table 3. Contribution of growth rate of gross fixed capital (*GC*) formation in Finland and Singapore (2013-2017) - %.

		2013	2014	2015	2016	2017
Finland	κ	21.7	22.1	20.9	18.8	17.0*
	λ	78.3	77.9	79.1	81.2	83.0*
	$\dfrac{\Delta GC}{GC}$	-9.50	-0.11	0.20	1.19	1.49
	$\Delta\kappa$	0.3	0.4	-1.2	-2.1	-1.8
	$\Delta\lambda$	-0.3	-0.4	1.2	2.1	1.8
	$\Delta\kappa + \kappa\dfrac{\Delta GC}{GC}$	-1.8	0.4	-1.2	-1.8	-1.5
	$\Delta\lambda + \lambda\dfrac{\Delta GC}{GC}$	-7.7	-0.5	**1.4**	**3.0**	**3.0**
Singapore	κ	18.9	23.2	22.7	21.5	22.9
	λ	81.1	76.8	77.3	78.5	77.1
	$\dfrac{\Delta GC}{GC}$	1.67	1.74	0.44	-0.08	-0.42
	$\Delta\kappa$	4.3	4.3	-0.3	-1.2	1.4
	$\Delta\lambda$	-4.3	-4.3	0.3	1.2	-1.4
	$\Delta\kappa + \kappa\dfrac{\Delta GC}{GC}$	4.6	4.5	-0.2	-1.2	1.3
	$\Delta\lambda + \lambda\dfrac{\Delta GC}{GC}$	-2.9	-2.8	**0.6**	**1.1**	**-1.7**

* indicates estimate based on the trend in 2014-2016.

GTC contribution to GDP (% *p.a*)		2013	2014	2015	2016	2017
Finland	**GDP**	**-0.76**	**-0.63**	**-0.01**	**1.93**	**2.76**
	GC contribution to GDP	-9.50	-0.11	0.20	1.19	1.49
	GSC contribution to GC	-1.80	0.40	-1.20	-1.81	-1.51
	GTC contribution to GC	-7.70	-0.51	1.40	3.00	3.00
Singapore	**GDP**	**5.00**	**3.57**	**1.93**	**2.00**	**2.53**
	GC contribution to GDP	1.67	1.74	0.44	-0.08	-0.42
	GSC contribution to GC	4.57	4.54	-0.16	-1.18	1.28
	GTC contribution to GC	-2.90	-2.80	0.60	1.10	-1.70

3. ROLE OF SOFT INNOVATION RESOURCES
3.1. SOFT INNOVATION RESOURCES

Confronting productivity decline in the digital economy, leading global ICT firms have been endeavoring to transform into a new business model that creates supra-functionality beyond economic value corresponding to a shift in people's preferences by not largely depending on R&D investment which may accelerate productivity decline [7].

Against such circumstances, highly R&D intensive firms endeavor to effective utilization of soft innovation resources rather than depending on further ICT R&D as demonstrated in **Fig. 5** [7] [8]. Soft innovation resources activate potential of self-propagating function indigenous to ICT (see Note) which induces functionality development leading to supra-functionality creation.

Note: ICT in which network externalities function to alter the correlation between innovation and institutional systems which creates new features of the innovation leading to exponential increase in a self-propagating way [9].
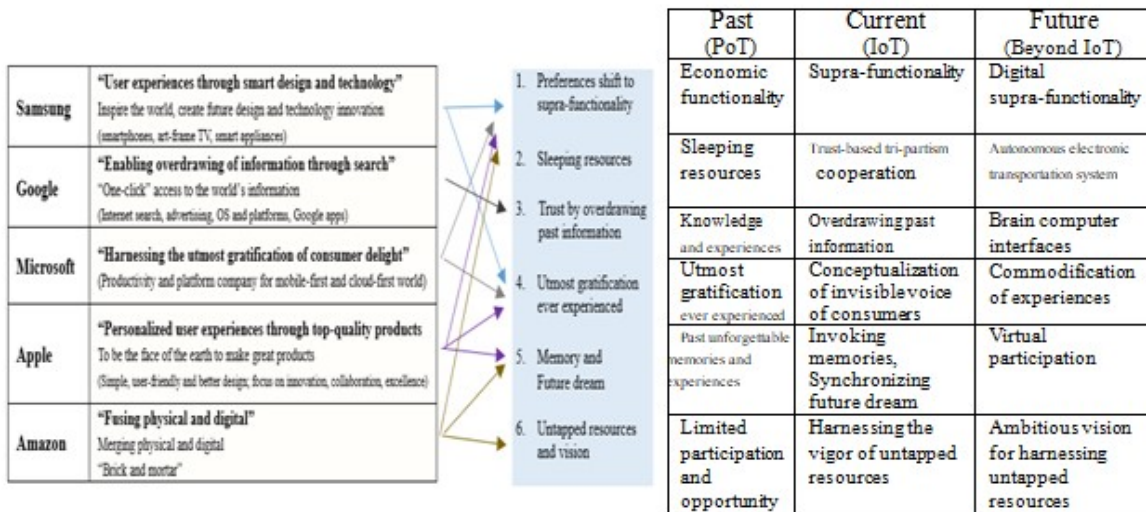
Note: ICT in which network externalities function to alter the correlation between innovation and institutional systems which creates new features of the innovation leading to exponential increase in a self-propagating way [9].

Figure 5. Soft innovation resources initiated by global ICT firms' pioneering endeavor.

3.2 THE ROLE OF THE INTERNET FOR HARNESSING THE VIGOUR OF SOFT INNOVATION RESOURCES

Soft innovation resources can be emerged by harnessing the vigor of non-monetary function such as:

(i) Driving force of co-evolutionary dynamism among the Internet advancement, uncaptured GDP dependence and a shift in people's preferences to supra-functionality beyond economic value (Fig. 6-1).
(ii) Sleeping resources as non-operational cars and drivers as well as idling time which can be awoken and utilized effectively by means of the Internet and smartphones (Fig. 6-2).
(iii) Trust by overdrawing past information which can be accelerated by the Internet (Fig. 6-3).
(iv) Utmost gratification ever experienced leading to consumption which effectively recalled by the Internet (Fig. 6-4).
(v) Memory and dream recalled and drawn actively by the Internet (Fig. 6-5).
(vi) Untapped resources effectively utilized and envisioned by the Internet (Fig. 6-6).

All can largely be depended on the advancement of the Internet and further activated toward the IoT society [10] [11] [12].

Fig. 6 outlines dynamism of typical soft innovation resources in activating self-propagating function.
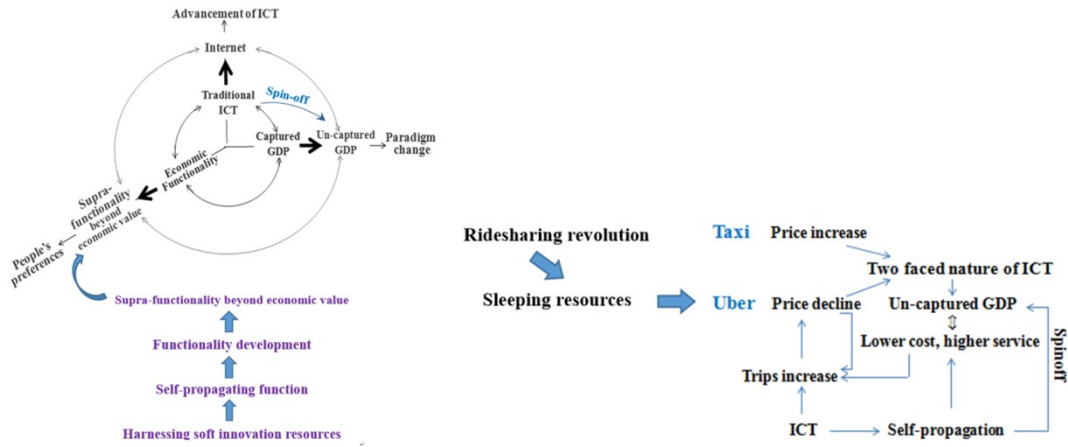
Fig. 6-1. Driving force of co-evolutionary dynamism.
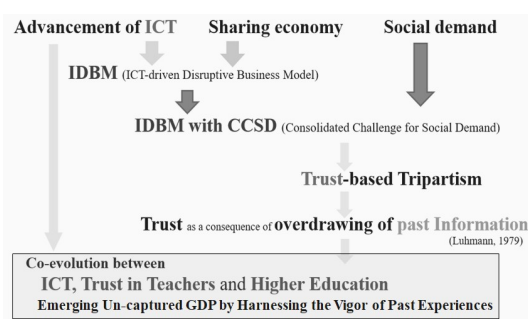Source: [4].

Source: [13].

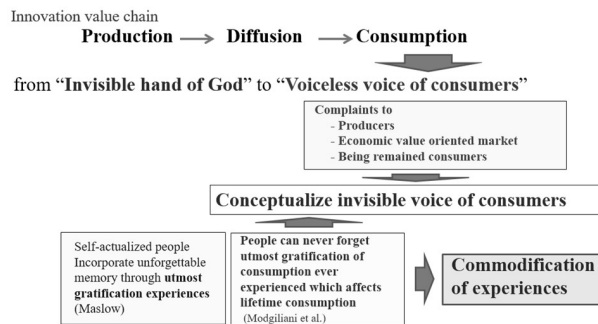Fig. 6-3. Trust by overdrawing past innovation.
Source: [14].

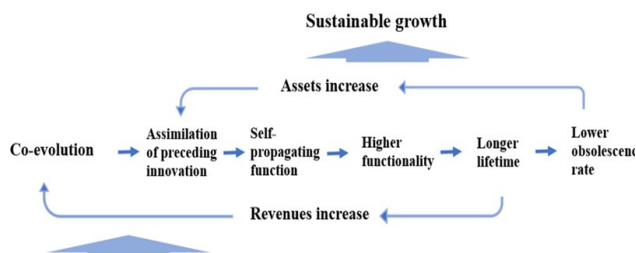Fig. 6-4. Utmost gratification ever experienced.
Source: [15].

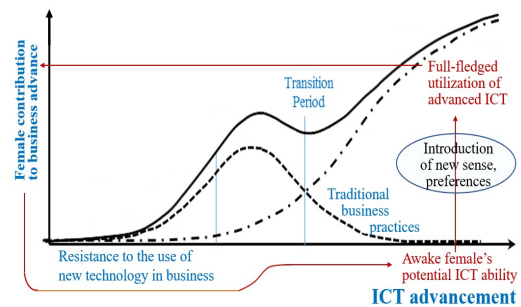Fig. 6-5. Memory and future dream.
Source: [16].

Fig. 6-6. Untapped resources and vision.
Source: [17].

4. SOFT INNOVATION RESOURCES SUBSTITUTE FOR IPP
4.1. BURDEN OF R&D INVESTMENT

Figs. 7 and **8** compare trends in R&D expenditure between Finland and Singapore over the period 1994-2016 by decomposing business enterprise R&D and government R&D.
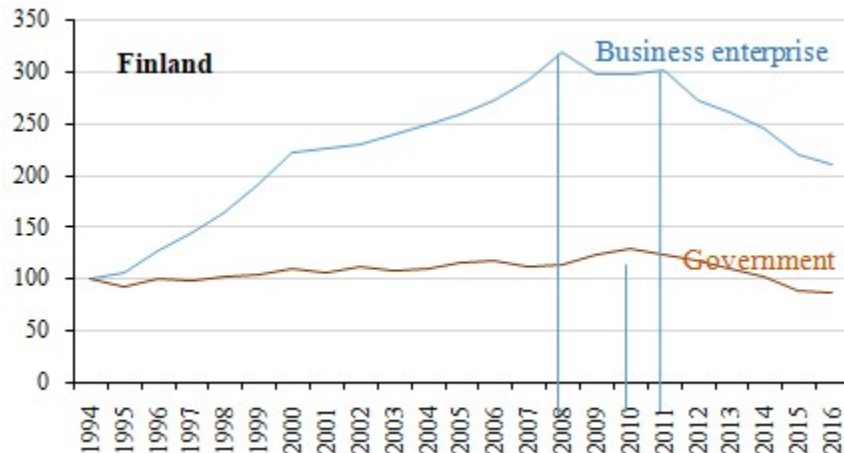

Figure 7. Trend in R&D by source of funding in Finland (1994-2016) – Index: 1994 = 100.
Source: [18].
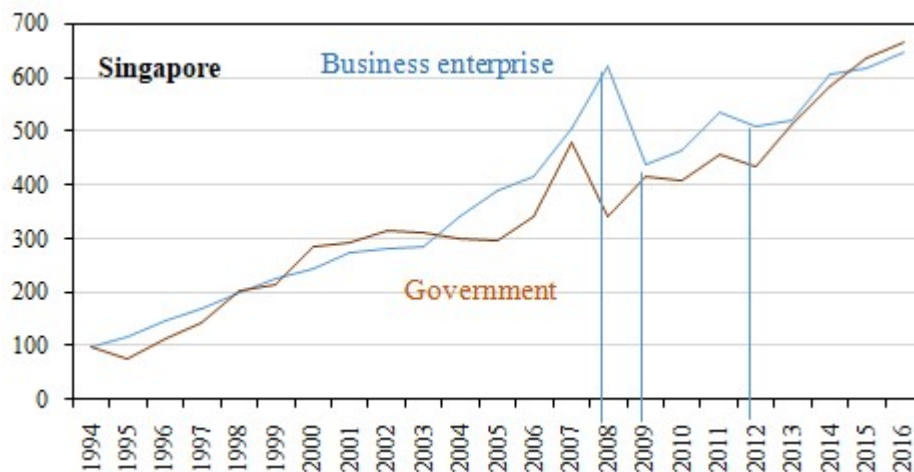
Figure 8. Trend in R&D by source of funding in Singapore (1994-2016) – Index: 1994 = 100.
Source: [19].
Note: 2015 and 2016 values are estimated by [6] and [20].

While both leaders experienced sharp decrease in their R&D investment both government and business enterprise after the Lehman shock in 2008. However, contrary to Singapore's prompt recovery from 2010 under strong government initiative, Finland suffered longer stagnation both in government and business enterprise.

In Finland, while business-funding R&D started to decline due to the Lehman shock in 2008, government funding of R&D continued to grow. However, it switched from expansionary to

contractionary policy after 2010 which exacerbated a massive drop in business-funded R&D [21]. Consequently, growth rate of gross service capital (IPP) has shown decreasing trend in Finland from 2010 as demonstrated in Fig. 2. While government contractionary policy continued till 2015 and slightly relaxed from 2016 corresponding to the nation's economic resurgence, Finland R&D funding continued to decline with clear contrast in Singapore's sharp increase.

Given the increasing burden of traditional ICT R&D investment (which shares the majority of IPP) while its productivity has been declining as a consequence of the two-faced nature of ICT [22], Finland has been considering to substitute IPP to soft innovation resources which create new functionality corresponding to a shift in people's preferences to supra-functionality beyond economic value with smaller capital investment [7]. This corresponds to spontaneous creation of uncaptured GDP initiated in the forefront of global ICT firms endeavor amidst the digital economy [7].

In "Finland's National Innovation Strategy" published in 2008 [23] following fundamental concepts were introduced:

- Finland's success has largely been based on its high-quality education system, long-term investments by enterprises and the public sector in R&D, and its well-functioning, networked institutions.
- The challenges of growth and competitiveness can no longer be tackled only by means of a sector-based, technology-oriented strategy, instead, a demand-based innovation policy must be strengthened alongside a supply-based innovation policy.

- Innovation emerges as a combination of many competencies. Broad-based innovation policy creates the preconditions for operating models combining the needs of users, consumers and citizens, alongside knowledge, creativity and competence.

- Demand and user orientation are required to attain Finnish strategic goals: Innovation steered by demand, playing attention to the needs of customers, consumers and citizens in the operation of the public and private sector alike, requires a market with incentives and shared innovation processes between users and developers.

- There is room for improvement in Finland, particularly as concerns the development and introduction of user-oriented service innovations.

- The success of innovative communities is based on sharing competence and knowledge, and the ability to combine different perspectives and approaches. Increasingly often, innovations are created on the interfaces of various competence areas.

- The connections between producers and users of information are exceptionally close in Finland. Generally, Finland's innovation enterprises corporate with other parties exceptionally often.

- A systematic approach is the key concept in implementing a broad-based innovation policy. New incentives accelerate changes of perspective in the innovation precesses, bringing individuals as end users into the core of innovation activity. Therefore, the innovation

potential of citizens, which previously remained partly hidden, can now be able to capitalized on as the driver of development in the national economy and society.

- Ultimately, pioneering lead markets will be created on the basis of market players' own decisions, but their hoped-for development can be promoted by methodologically implementing measures to support innovative demand.

- Strategic cooperation in assessment, foresight and strategic work across administrative fields will be intensified and precipitated.

Following these fundamental concepts, more concrete action plans for development and utilization of soft innovation resources were proposed in recent years as follows:

- Open platforms for co-creation as Finland is good at visions and roadmaps as a future oriented country [24].

- Use new instruments to link a wide range of actors (knowledge producers, users, intermediaries etc.) in addressing innovation and social challenges [21].

- Finland's national innovation agency TEKES' merge with Finpro from the beginning of 2018 brings Finland's support schemes for research and innovation under one roof and will enable a more networked type of innovation, boosting collaborations between research institutes, universities and companies leading to offering better services for customers and enriching the innovation ecosystem [25].

- Finland considers new business models, products, services and ecosystems enabled by the digital platform economy are included in key issues in the EU's ninth Framework Programme (2021-) for research and innovation. The Programme should enhance measures to include citizens and the civil society in setting and planning the priorities of research and innovation and actual research and innovation activities [26].

- Involving users in the innovation process and providing new impetus to innovation by making use of findings produced by broad stakeholders (Min. of Economic Affairs and Employment [27].

4.2. SOFT INNOVATION RESOURCES SUBSTITUTE FOR IPP

Given that soft innovation resources are crystal of the advancement of the Internet, as reviewed earlier (Fig. 6), provided that extent of utilization of soft innovation resources is represented by dependence of the Internet, their substitution for IPP can be examined by the following equation:

$$\ln \frac{I}{J} = a + \epsilon_{ij} \ln \frac{p_j}{p_i} \tag{4}$$

where I: Internet dependence, J: IPP, p_i: Internet price, p_j: IPP price, ϵ_{ij} : elasticity of substitution between Internet and IPP, and a: coefficient.

$\epsilon_{ij} > 1$, I substitutes for J (see **Note**)

Note *I* substitution for *J*

$$\chi \equiv \frac{Internet\ expenditure}{IPP\ expenditure} = \frac{I \cdot p_i}{J \cdot p_j} \quad \ln \chi = \ln \frac{I}{J} - \ln \frac{p_j}{p_i} = a + (\epsilon_{ij} - 1) \ln \frac{p_j}{p_i}$$

When $\epsilon_{ij} > 1$, p_j increase reacts to Internet expenditure increase (*I* substitutes for *J*)

Table 5 tabulates trends in the Internet, gross service cost (IPP), gross tangible cost and their prices in Finland and Singapore over the period 2000-2017.

	Internet dependence		GSC/GC (κ)		GTC/GC (λ)		Internet price		IPP price	
	I_F	I_S	J_F	J_S	K_F	K_S	p_{iF}	p_{iS}	p_{jF}	p_{jS}
2000	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2001	115.7	115.8	102.7	114.6	99.2	98.5	91.6	89.5	103.7	103.3
2002	167.5	130.6	104.1	137.5	98.8	96.0	73.4	81.8	106.7	99.5
2003	185.8	149.4	107.7	154.2	97.8	94.2	69.0	73.9	108.2	101.1
2004	194.4	172.2	103.6	165.6	99.0	93.0	67.1	66.5	112.4	101.2
2005	200.0	169.4	103.6	168.8	99.0	92.7	65.9	67.3	116.0	102.5
2006	213.8	163.9	103.6	180.2	99.0	91.5	63.4	69.5	119.2	104.6
2007	216.8	194.2	99.5	158.3	100.1	93.8	62.9	60.8	122.4	106.7
2008	221.6	191.7	101.4	146.9	99.6	95.0	62.1	61.3	129.6	114.0
2009	224.6	191.7	109.0	156.3	97.4	94.0	61.6	61.3	134.2	110.9
2010	233.2	197.2	109.0	152.1	97.4	94.5	60.2	60.1	136.7	116.1
2011	238.1	197.2	100.5	151.0	99.9	94.6	59.5	60.1	140.6	119.8
2012	241.4	200.0	96.8	152.1	100.9	94.5	59.0	59.5	144.7	121.3
2013	245.5	224.7	98.2	196.9	100.5	89.7	58.3	54.4	147.8	126.8
2014	246.6	219.4	100.0	241.7	100.0	85.2	58.0	55.5	149.6	122.7
2015	248.9	219.4	94.6	236.5	101.5	85.5	57.9	55.5	151.3	129.2
2016	250.7	225.0	85.1	224.0	104.2	86.8	57.6	54.4	153.6	128.9
2017	252.2*	226.4*	80.7*	238.5	106.5*	85.3	57.4*	54.2*	155.5*	129.9

Table 5. Trends in the Internet, gross service cost, gross tangible cost and their prices in Finland and Singapore (2000-2017) – Index: 2000 = 100 (*F*: Finland, *S*: Singapore)

*Estimated value based on trends in 2014-2016.
Sources: [5] [6] [28].

Note: Following [29] IPP price was estimated by using the following learning equation:

Finland $p_{iF} = 55.3J^{-0.60}$, Singapore: $p_{iS} = 46.5J^{0.75}$ where p_i: Index (2000 = 100), J: Internet dependence (%).

Based on equation (4), **Fig. 9** illustrates correlation between IPP/Internet price ratio and Internet/IPP ratio in Finland and Singapore over the period 2000-2017. Here, IPP implies GSC share out of GC and Internet implies the Internet dependence.

In order to gain a general idea on the possibility of soft innovation resources substitution for IPP, **Fig. 10** illustrates trend in R&D funding (which shares majority of IPP) in Singapore and Finland over the same period as Fig. 9. Looking at Figs. 9 and 10 we note that while R&D demonstrates declining trend in Finland in recent years, its Internet/IPP ratio demonstrates sharp increase and opposite trends is observed in Singapore. These observations suggest a possible soft innovation resources substitution for IPP in Finland and their complement in Singapore
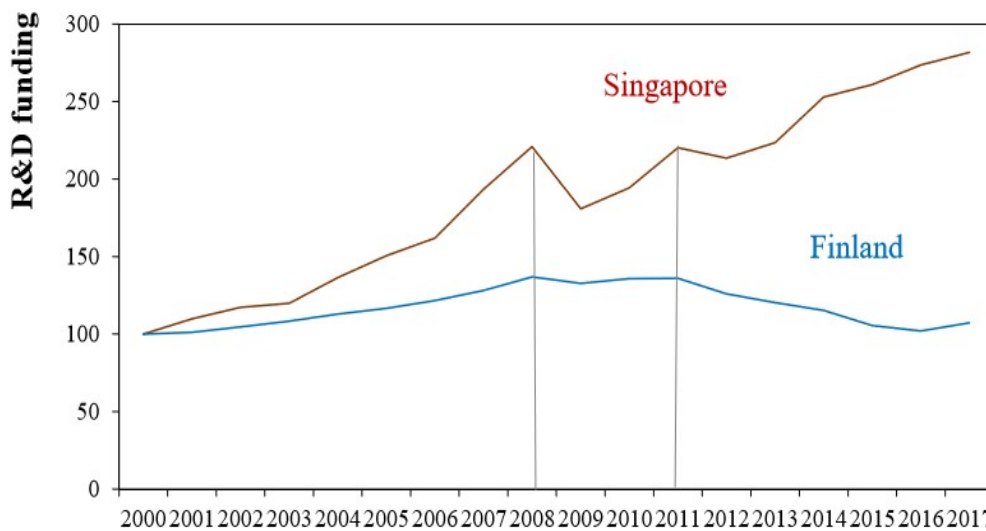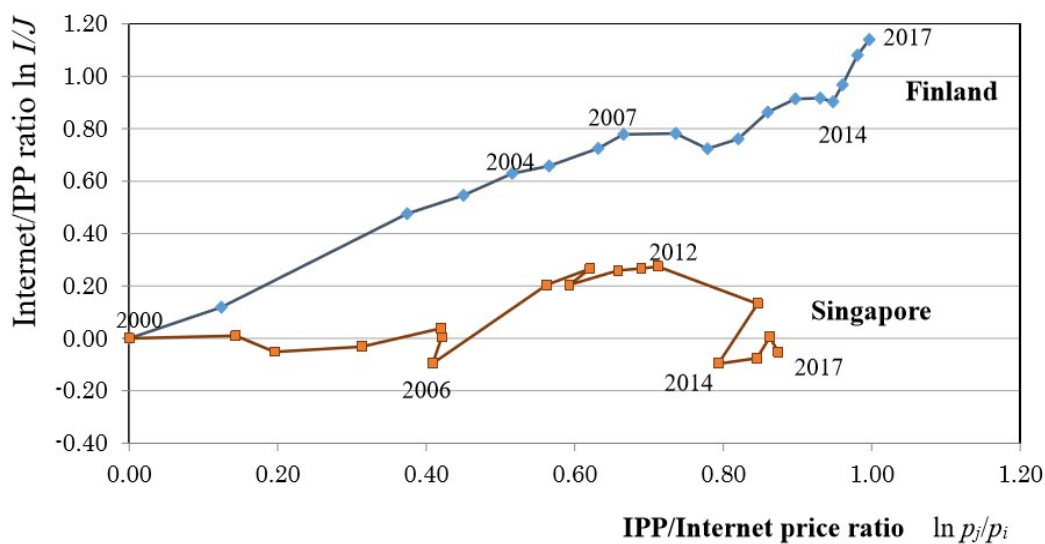
Figure 10. Trend in R&D funding in Singapore and Finland (2000-2017) – Index: 2000 = 100.
Source: [19].

Note: 2017 value for Finland is estimated by [30].
        2015-2017 values for Singapore are estimated by [31] [32].

With such pre-estimation in mind, **Table 6** demonstrates the result of the correlation analysis between IPP/Internet price ratio and Internet/IPP ratio in Finland and Singapore over the period 2000-2017. The result demonstrates statistically significant.

Table 6. Correlation between p_j/p_i and I/J in Finland and Singapore (2000-2017)

Finland

$$\ln \frac{I}{J} = 0.087 + 0.952\, D_1 \ln \frac{p_j}{p_i} + 4.926\, D_2 \ln \frac{p_j}{p_i} - 3.818 D_1 + 0.087 D_3 \qquad adj.\ R^2\ 0.969$$

$$\quad\ (2.18)\quad\ (18.55)\qquad\qquad (3.54)\qquad\quad (-2.83)\quad\ (2.18)\qquad DW\quad 1.24$$

D: Dummy variables

D_1: 2000-2014 = 1, 2015-2017 = 0; D_2: 2000-2014 = 0, 2015-2017 = 1; D_3: 2004, 2007 = 1, others = 0.

Singapore

$$\ln \frac{I}{J} = -0.101 + 0.494\, D_1 \ln \frac{p_j}{p_i} - 1.609\, D_2 \ln \frac{p_j}{p_i} + 1.516 D_2 - 0.196 D_3 - 0.183 D_4 \quad adj.\ R^2\ 0.746$$

$$\quad (-2.22)\quad (5.15)\qquad\qquad (-3.10))\qquad (3.52)\quad (-2.67)\quad (-3.01)\quad DW\quad 1.20$$

D: Dummy variables

D_1: 2000-2011 = 1, 2012-2017 = 0; D_2: 2000-2011 = 0, 2012-2017 = 1; D_3: 2006 = 1, others = 0
D_4: 2014-2015 = 1, others = 0.

The figures in parentheses indicate t-statistics: All are significant at the 1% level.

Table 7 compares elasticities of substitution between Internet and IPP in two countries depending on periods.

Finland maintained positive correlation for whole period examined and demonstrated strong soft innovation resources substitution for IPP from 2015. This strong substitution corresponds to its resurgence in GDP growth.

Contrary to Finland's conspicuous substitution in recent years, Singapore demonstrates opposite and demonstrates still clinging to IPP rather than soft innovation resources as clearly observed in Fig. 10.

Table 7. Elasticity of substitution between Internet and IPP in Finland and Singapore (2000-2017)

	Finland		**Singapore**
2000 - 2014	0.952	2000 - 2011	0.494
2015 - 2017	4.926	2012 - 2017	-1.609

This result demonstrates a hypothetical view that Finland resurgent in GDP growth through gross fixed capital formation notwithstanding increasing burden of R&D investment can largely be attributed to soft innovation resources substitution for IPP.

5. DISSEMINATION OF SOFT INNOVATION RESOURCES IN TANGIBLE CAPITAL

Increasing dependency on soft innovation resources as substitute for IPP in Finland has disseminated steadily in gross tangible capital and removed structural impediments in its formation and enabled sustainable increase in gross fixed capital formation leading to captured GDP resurgence in recent years.

In order to confirm this effect **Table 8** first compared the impact of the Internet dependence (a proxy of soft innovation resources) on gross tangible capital formation in Finland and Singapore over the period 2000-2017.

Table 8 Impact of the Internet dependence on gross tangible capital formation in Finland and Singapore (2000-2017)

Finland

$$\ln K_F = 4.512 + 0.017\, D_1 \ln I_F + 0.046\, D_2 \ln I_F + 0.018\, D_3 - 0.022\, D_4 \quad adj.\, R_2\; 0.870 \quad DW\, 2.23$$
$$\quad\;\; (73.18)\quad (1.43)^* \qquad\quad (1.65)^* \qquad\quad (6.14)\qquad (-3.34)$$

K_F: gross tangible capital ratio; I_F: Internet dependence.
D: dummy variables D_1: 2000-2012 = 1, 2013-2017 = 1; D_2: 2000-2012 = 0, 2013-2017 = 1;
$\quad D_3$: 2016, 2017 = 1, others = 0; D_4: 2009, 2010 = 1, others = 0.

Singapore

$$\ln K_S = 4.969 - 0.082\, D_1 \ln I_F - 0.094\, D_2 \ln I_F \quad adj.\, R_2\; 0.853 \quad DW\, 1.55$$
$$\quad\;\; (41.99)\, (-3.53) \qquad\quad (-4.28)$$

K_S: gross tangible capital ratio; I_S: Internet dependence.
D: dummy variables D_1: 2000-2012 = 1, 2013-2017 = 1; D_2: 2000-2012 = 0, 2013-2017 = 1.

The figures in parentheses indicate t-statistics: All are significant at the 1% level except *: at the 15% level.

Looking at Table 8 we note that while Finland depended on soft innovation resources (proxied by the Internet dependence), particularly largely on them after 2013, Singapore reacted negative as dependence on soft innovation resources decrease gross tangible capital formation.

This finding suggests that in Finland soft innovation resources that substituted for IPP disseminated and spilled-over into gross tangible capital. This disseminated soft innovation resources are considered to removed structural impediments that impeded gross tangible capital formation and contributed to Finland's resurgence in GDP growth in recent years.

This resurgence is expected to resurge decreased IPP for next generation digital innovation [21] [25].

Inspired by this finding **Fig. 11** demonstrates Finland's success in removing structural impediments impeding gross tangible capital formation by means of effective utilization of soft innovation resources in recent years.
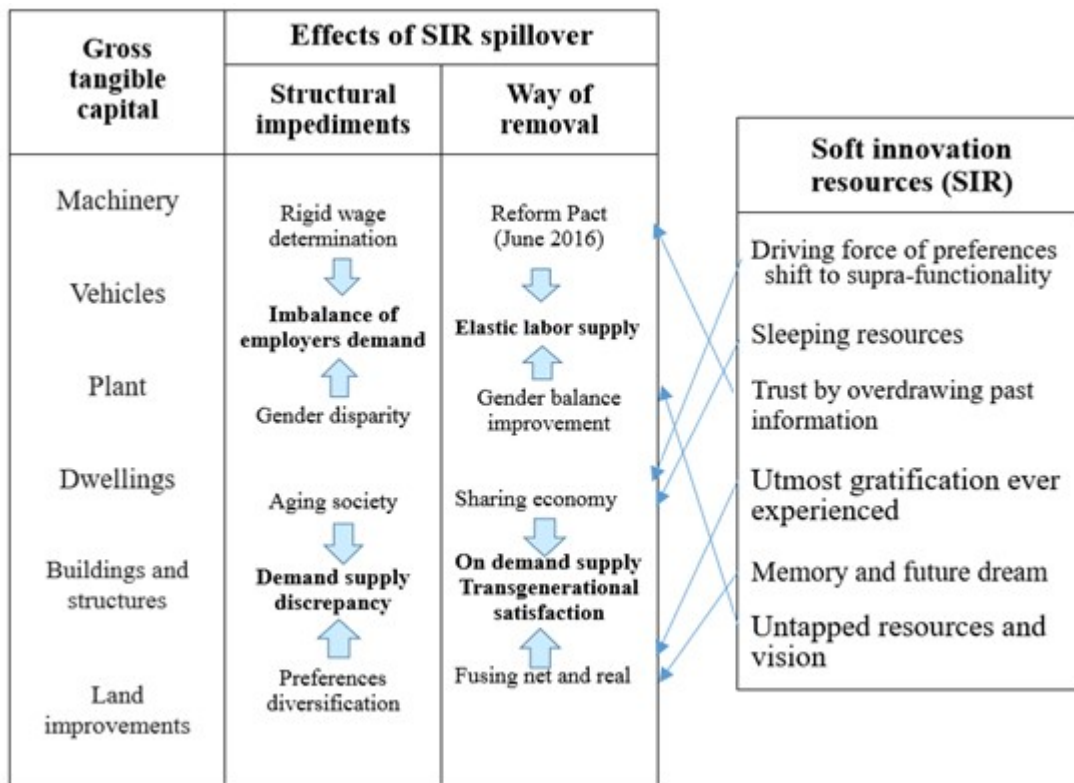

Figure 11. Effects of soft innovation resources spillover.

While Finland had the most rigid wage negotiation system in the world that impeded its growth and competitiveness for long years, government's historic ambitious decision, Reform Pact in June 2016 has relaxed this rigid system by shifting away from centralized wage-setting toward company-level labor deals and removed long-lasting impediments in growth and competitiveness. This can largely be appreciated as a consequence of effective utilization of soft innovation resource, trust (Fig. 6-3). Success in constructing coevolution between ICT development and promotion and activation of female potential in business (Fig. 6-6) can also be attributed to utilization of soft innovation resources, untapped resources.

As a consequent of such efforts, demand-supply discrepancy has dramatically decreased [33] and enabled gross tangible capital positive contribution to GDP growth. For example, machinery and equipment has changed from long lasting negative contribution to positive contribution to GDP growth from 2016 as: -0.06% (2013), -0.04% (2014), -0.03% (2015) to 0.05% in 2016 [34]. Recent policy decisions of relaxation of car inspection laws (May 2018) and taxi market liberalization (July 2018) accelerate effective utilization of such soft innovation resources as driving force of preferences shift to supra-functionality (Fig. 6-1) and sleeping resources (Fig. 6-2). These decisions are expected to remove demand supply discrepancy toward the aging society and people's preferences diversification and enable on demand supply and transgenerational satisfaction.

6. CONCLUSION

In light of a noteworthy contrast in the world ICT leaders as high welfare with low GDP growth in Finland and higher GDP growth with lower welfare in Singapore, an uncaptured GDP postulate that Finnish wellbeing has developed more than one might conclude by GDP was provoked. In addition, the possibility that uncaptured GDP contributes to remove structural impediments in GDP growth was postulated by a recent reversal trend in the GDP growth.

This paper attempted to demonstrate these hypotheses. An empirical analysis elucidating the inside the national accountings and institutional systems in world ICT leaders Finland and Singapore was conducted.

Noteworthy findings include:

(i)   Finland's recent GDP growth recovery can largely be attributed to its gross fixed capital formation.
(ii) This formation depends on gross tangible capital while gross service capital (IPP) contributes to negative.
(iii) This is due to substitution of soft innovation resources for service capital in Finland.
(iv) This substitution creates uncaptured GDP which disseminates in tangible capital and removes structural impediments impeding tangible capital formation.
(v)   This removal leads to resurgence of GDP growth.
(vi) In addition, this growth enables next generation IPP.

These findings give rise to the following insightful suggestions for optimal trajectory management in the digital economy both national and firm levels:

(i)   Further exploration and utilization of soft innovation resources should be continued.
(ii) Effective mechanism of soft innovation resources substitution for IPP should be developed.
(iii) Optimal balance between soft innovation resources dependence and sustainable IPP should be sought.
(iv) Effective dissemination of soft innovation resources-driven uncaptured GDP into gross tangible capital should be developed.
(v)   Similar substitution mechanism in consumption should be analyzed.

An insightful suggestion in overcoming a productivity paradox in the digital economy was thus provided.

Future works should focus on further international comparisons. In addition, careful monitoring of the reversal trend should be continued.

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