

Internet Penetration and its Correlation to Gross Domestic Product: An Analysis of the Nordic Countries

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Abstract

Studies continually review the correlation of GDP growth in a country against Internet or ICT penetration. These studies lack a focus on causality however, leaving many to wonder which variable is the driving force for change and which is responding to that force. Rather than focusing on this ICT-to-GDP metric in a developing country, this analysis looks at the world's leading region in Internet adoption; the Nordic region. An analysis of GDP data confirms that these countries not only have some of the highest Internet adoption, but also some of the highest GDP levels per capita globally. This data is then examined over a time series, determining not only a correlation between the two variables but more importantly, demonstrating that Internet adoption is a direct driver of GDP growth in an economy.

Keywords: ICT, GDP, Socioeconomic

1.0 Introduction

“Today we live in a world where more people have access to ICT (usually a mobile phone) than to toilets or clean water or the electric grid” (INSEAD; World Economic Forum, 2011, p. 3). As our connections to information become more and more prevalent in every corner of the world, this access to information will begin to drive our economies, driving productivity and efficiencies, and adding to the value created by each employee and citizen. “Put differently, the ICT revolution can be seen as a large and long-lasting positive supply shock, causing higher and possibly also more stable economic growth without extra inflation” (Houben & Kakes, 2002).

Recent studies have drawn correlation between GDP and Internet adoption levels by region. For example one which stated: “a 10% increase in per capita GDP is associated with a 21.5% increase in the number of Internet users per capita” (Andres, Cuberes, Diouf, & Serebrinsky, 2010). Many of these studies have focused specifically on the introduction and growth of ICT in developing countries, and its subsequent impact to GDP. However, as was written in a 2003 study, “there are ambiguous conclusions concerning the link between ICT use and economic growth in developing countries...[the] issue of the direction of causality needs to be formally addressed. Did ICT endowed countries reach high-income levels as a result of higher use of these technologies or was ICT diffusion caused by higher economic growth” (Balioune-Lutz, 2003)?

It is this question we are looking to answer, but by looking at it from a different perspective. Since most studies focus on developing countries and the impact Internet adoption and ICT have on GDP growth, instead we will focus our attention on the countries that have the highest global ICT growth. If Internet adoption and GDP are truly correlated, these countries with the highest adoption rates should theoretically have the highest GDP levels per capita. Additionally, we will look at historical growth rates for GDP and Internet adoption and attempt to identify causality, with the ultimate goal of proving or disproving the hypothesis that Internet adoption is a driver behind GDP growth, rather than merely a result of it.

This study will focus on the major Nordic countries, which are defined as Denmark, Finland, Iceland, Norway and Sweden (Norden), because this co-operative of countries represents five of the top ten countries with the highest Internet penetration rate (Internet World Stats).

The study will include a review of Internet and telephony penetration in the region, a review of both infrastructure and network readiness across the countries and an analysis of GDP growth in the region, culminating in a conclusion regarding the hypothesis previously mentioned.

2.0 Penetration of Internet and Telephony

Across the Nordic region, connectivity to information is prevalent, via the Internet, mobile cellular telephone, and traditional telephone lines. The manner in which citizens access information, however, has changed drastically over the past decade. As depicted in Figure 1, in 2000 telephony was the primary method of communication with 63 telephone lines and 71 mobile cellular subscriptions on average per 100 users, and just slightly more than 38 percent of citizens using the Internet. Fast forwarding to 2010, mobile cellular subscriptions have exploded to an average of more than 123 per 100 users, indicating that many citizens carry more than one cellular phone subscription. Additionally, Internet use has grown to cover nearly 91 percent of the population in the region, but traditional telephone use has dramatically declined to just over 44 percent (World Bank, 2011).

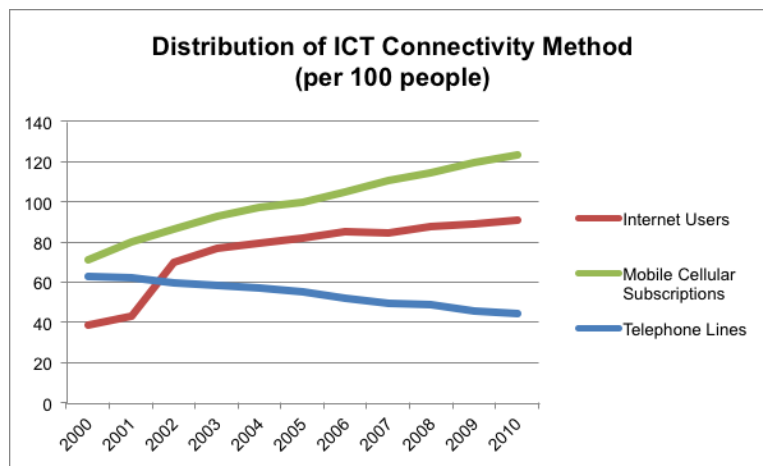


Figure 1 (World Bank, 2011)

Telephony

Home to Nokia, the largest mobile device manufacturer in the world, the Nordic countries have thoroughly embraced mobile cellular telephones as a means of communications (Nokia, 2010). Mobile cellular phone subscriptions have grown an average of nearly 5.25 percent year after year since 2000, and all five of the Nordic countries see mobile cellular subscriptions totaling more than 100 per 100 people. In 2010, average mobile cellular subscriptions per 100 people included 124.5 in Denmark, 109.7 in Iceland, 113.1 in Norway, 113.6 in Sweden, and 156.4 in Finland, where Nokia is based. With the manufacturer's presence through the decades, mobile phone use has always been high in this region; in the year 2000 when the Nordic region averaged 71 mobile cellular subscriptions per 100 people, the world average was barely more than 12. (World Bank, 2011) By contrast, average telephone line subscriptions have steadily fallen since 2000, at an average decline of 1.84 percent year after year. Deeper studies into the usage of traditional telephone lines per country show an average of 47.3 telephone lines per 100 people in Denmark, 64.3 in Iceland, 34.8 in Norway, 53.5 in Sweden, and 23.3 in Finland in 2010 (World Bank, 2011). As more and more citizens switch to mobile cellular telephones, and with other options available such as Internet-based telephony, it can be expected that this number will continue to decline.

2.1 Internet Penetration

With all five of the Nordic countries taking residence in the top seven spots on the list of percent of Internet penetration for 2010, the region is without debate the most connected in the world. Iceland has a higher percentage of Internet penetration than any other country in the world, with nearly 96% of its residents using the Internet with some level of frequency. Norway took second place with 93.4%, and Sweden, Denmark and Finland held spots five through seven with 90.0%, 88.8% and 86.9%, respectively. The average for the region was 90.1%, compared to the world average of only 30.5% (World Bank, 2011).

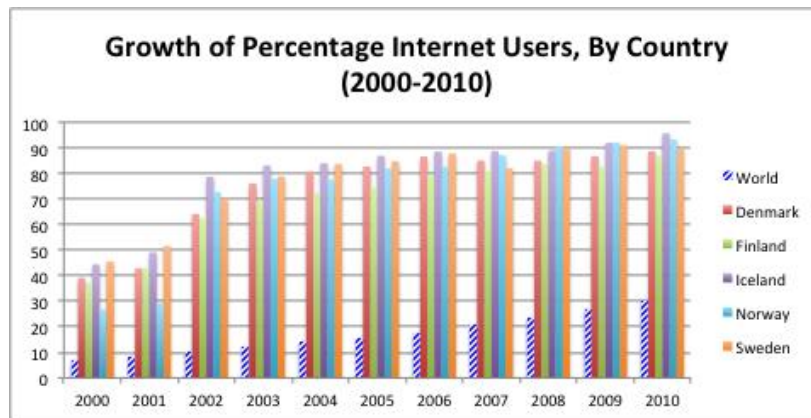


Figure 2 (World Bank, 2011)

Growth of Internet usage over the period 2000-2010 is depicted in Figure 2. Growth rates were extremely high in the first part of the decade for all of the Nordic countries, doubling the average Internet use from just below 40% to nearly 80% in a four-year period, and jumping by over 25% in 2002 alone. The remainder of the decade saw slight but steady growth, leaving the overall decade with an average growth rate of 5.17% per year, nearly keeping pace with the mobile cellular subscription growth rate (World Bank, 2011).

3.0 Infrastructure and Governmental Support

The basis of Internet penetration growth in both the Nordic region and the world at large, all comes down to having infrastructure in place to connect the people with the information they seek. Merriam-Webster defines “infrastructure” as both “the underlying foundation or basic framework” and “the system of public works of a country, state, or region” (Merriam-Webster). While many people think of infrastructure as the latter, more and more countries are beginning to think of this work of providing infrastructure as falling to the private sector. This is especially the case for the growing infrastructure of the Internet, with various entities each delivering data services via different types of technologies. In November 2011, the Ministry of Enterprise, Energy and Communications for Sweden published a report which touched on the need for infrastructure, stating:

“It is primarily the market players who are responsible for and make investments in the communication networks. Other important actors for favorable development are municipalities, county councils, regional co-operation bodies and government authorities, for example county administrative boards. The role of central government is to ensure that the market works effectively and, together with public actors, to give the companies the conditions they need to pursue their activity. But central government also has a responsibility, together with private actors, to ensure that communication services and the Internet work reliably and dependably. These are issues that are becoming increasingly important as the dependence of society on communication services increases.” (2011)

4.0 Reviewing the Connectivity Scorecard

Since 2006, Nokia Siemens Networks has commissioned the Berkeley Research Group to complete an annual study of international ICT infrastructure, which it calls the *Connectivity Scorecard*. This scorecard is unique compared to other studies, as it analyzes and ranks countries according to “not just the availability of infrastructure and the penetration rate of infrastructure, but also the usage level of the infrastructure by consumers, businesses and governments”. The goal is to identify a metric called “useful connectivity” or “the ability of connectivity to contribute to economic growth, especially through improvements in productivity that are widely held to be the key to sustained economic prosperity”. In the rankings depicted in Figure 3, Sweden was the top scoring country with a Connectivity Score of 7.84, while Denmark ranked third with 7.47, Norway ranked fifth with 7.09, and Finland ranked ninth with a score of 6.78; Iceland was not one of the fifty countries included in the Connectivity Score analysis due to the relatively small size of its economy (Berkeley Research Group, 2011).

Rank	Country	Final Score
1	Sweden	7.84
2	United States	7.82
3	Denmark	7.47
4	Netherlands	7.45
5	Norway	7.09
6	United Kingdom	7.06
7	Australia	6.93
8	Canada	6.88
9	Finland	6.78
10	Singapore	6.40

Figure 3
(Top Ten Countries Displayed)
(Berkeley Research Group, 2011)

The Berkeley group identifies consumers, businesses and government as the three pillars of the economy and evaluates each country's infrastructure and usage on these dimensions. Focusing on the consumer side, Sweden was cited for having strength in wireless penetration, internet usage by proportion of the population, and proportion of frequent Internet users; weaknesses were few, but slower than expected Internet speeds and fewer 3G subscribers compared to Asian countries were cited. Denmark was lauded for having "universal broadband and virtually universal 3G coverage," but it was noted that actual 3G penetration is below average. Norway was rated highly for having top scores in the study for Internet penetration, e-commerce and e-banking adoption, but was marked down for having lower-than-normal 3G coverage and penetration. Finally, Finland was rated very amicably for its extremely high mobile phone penetration rates, and also for the availability of DSL for internet use without the requirement of a voice contract, but it was observed that fixed broadband penetration and 3G coverage were lower than elsewhere in the Nordic region, partly due to its minimal 'hardwired' infrastructure (Berkeley Research Group, 2011).

Shifting the focus to the business and government pillars, Sweden was applauded for its high number of science and technology workers, cloud computing usage and proportion of businesses with websites, as well as the high level of ICT spending in the healthcare sector. Low marks were given, however, for its government's low online presence. Denmark received high marks for its overall levels of ICT investment, and especially high ratings in relation to government IT-related spending and online presence, but was marked down for low PC adoption and business broadband penetration. Norway businesses were cited as lead performers of IT services and corporate data spending, as was Norway's government, but the business sector was marked down for weak levels of mobile data and enterprise telephony. Finland received positive marks for high business investment in ICT per capita and business usage of broadband and mobile data as well as high marks for government spending on IT hardware and software per capita and adoption of e-government services. No real weaknesses were noted for Finland's business and government pillars (Berkeley Research Group, 2011).

5.0 Comparisons against the Economist's E-Readiness Rankings

Similar to Berkeley's research, another study from the Economist's Intelligence Unit titled *Digital economy rankings 2010: Beyond e-readiness* also reviewed "the quality of a country's ICT infrastructure and the ability of its consumers, businesses and governments to use ICT to their benefit" (2010, p. 1). In its rankings, displayed in Figure 4, it also placed Sweden in the top spot, giving it a score of 8.49 (out of 10); Denmark trailed Sweden again in second place with 8.41 and Finland and Norway came in fourth and sixth at 8.36 and 8.24, respectively (2010, p. 4). Interestingly, the Economist's study also published scores and rankings for its subsections, most notably "connectivity and technology infrastructure" and "government policy and vision". For connectivity and infrastructure the Nordic countries ranked very well, with Sweden, Finland, Norway and Denmark placing first, third, fourth, and sixth respectively (2010, p. 21). Government policy and vision, which is described as "e-ready governments supply[ing] their constituents—citizens and organizations—with a clear roadmap for the adoption of technology, and... [leading] by example in their use of technology to create efficiencies", looks much different (2010, p. 20). In these rankings, Sweden leads the Nordic countries in fifth place, Denmark takes ninth, Norway takes eighteenth and Finland nineteenth (2010, p. 21).

	Overall score	Connectivity	Business environment	Social and cultural environment	Legal environment	Government policy and vision	Consumer and business adoption
Category weight		20%	15%	15%	10%	15%	25%
Sweden	8.49	8.20	8.13	8.53	8.25	8.90	8.75
Denmark	8.41	7.85	8.18	8.47	8.10	8.70	8.90
United States	8.41	7.35	7.85	9.00	8.70	9.25	8.60
Finland	8.36	8.00	8.30	8.47	8.35	8.00	8.85
Netherlands	8.36	8.05	8.05	8.07	8.45	8.25	9.00
Norway	8.24	7.95	7.95	8.00	8.30	8.05	8.90
Hong Kong	8.22	7.65	8.40	7.27	9.00	9.18	8.28
Singapore	8.22	7.35	8.63	7.33	8.70	9.13	8.48
Australia	8.21	7.35	8.24	8.53	8.50	8.85	8.18
New Zealand	8.07	6.80	8.17	8.60	8.45	8.50	8.29

Figure 4 (Top Ten Countries) (Economist Intelligence Unit; IBM Institute for Business Value, 2010, p. 21)

While both the *Connectivity Scorecard* and the *Economist's* rankings represented the Nordic countries very strongly in terms of infrastructure, there is a significant drop in the Economist's perception of these countries in terms of their government's "ability to lead their countries towards a digital future". Closer studies of the government policy and vision section of the reporting shows points assessed and included answering questions such as: "Are governments employing technology to operate and provide public services with less resource investment? Are they spending on ICT to stimulate similar spending in the greater economy? Are 'savings' translated into service gains for citizens? Can more people interact with and receive information from the government regardless of their own access to technology?" (2010, p. 20). Despite the fact that these countries are the world leaders in ICT infrastructure, many developed and developing countries are working hard to improve their infrastructure and prod their people into the digital age. Without sound stewardship and continued at the government level to encourage consumers and businesses to continue moving into an ICT-enabled world, these countries have the potential to see themselves unseated from the throne of ICT world leaders in a matter of years.

6.0 Network Readiness in the Nordic Region

Annually for the past decade, the World Economic Forum has published *The Global Information Technology Report*, which at its heart defines the network readiness of 138 countries. This analysis of network readiness is based upon three principles as described in the report: "an ICT-conducive environment is a key precondition of networked readiness," "networked readiness requires a society-wide effort" and "ICT readiness leads to ICT usage and increased impact." On this foundation, 71 variables were created across nine pillars, which are: the environmental subindex; composed of market environment, political and regulatory environment, and infrastructure environment: the readiness subindex; which is comprised of individual readiness, business readiness, and government readiness: and the usage subindex; which looks at individual usage, business usage, and government usage. Each variable is assigned a value, which is rolled up to the subindex. These subindexes are then averaged to create the composite network readiness indicator (NRI) score (INSEAD; World Economic Forum, 2011, p. 6).

			Sweden	Finland	Denmark	Norway	Iceland
NRI	Overall	Rank	1	3	7	9	16
		Score	5.6	5.43	5.29	5.21	5.07
GCI	Overall	Rank	2	7	9	14	31
		Score	5.56	5.37	5.32	5.14	4.74
Environment Subindex	Overall	Rank	1	3	10	6	11
		Score	5.89	5.64	5.47	5.58	5.44
	Market Environment	Rank	7	6	11	8	35
		Score	5.36	5.37	5.13	5.29	4.64
	Political and Regulatory Framework	Rank	2	4	11	8	19
		Score	6.2	6.06	5.8	5.91	5.41
Infrastructure Environment	Rank	2	9	10	8	1	
	Score	6.11	5.49	5.47	5.55	6.25	
Readiness Subindex	Overall	Rank	3	2	9	20	13
		Score	5.48	5.52	5.3	5.08	5.17
	Individual Readiness	Rank	23	3	9	20	4
		Score	5.44	5.8	5.72	5.52	5.77
	Business Readiness	Rank	2	3	9	13	14
		Score	5.69	5.52	5.14	4.94	4.91
Government Readiness	Rank	8	10	16	26	24	
	Score	5.32	5.24	5.05	4.78	4.82	
Usage Subindex	Overall	Rank	3	6	7	11	23
		Score	5.42	5.12	5.1	4.95	4.6
	Individual Usage	Rank	1	2	5	10	6
		Score	6.45	6.17	5.84	5.66	5.76
	Business Usage	Rank	6	8	14	16	17
		Score	4.91	4.74	4.32	4.51	4.19
Government Usage	Rank	17	24	9	14	46	
	Score	4.91	4.45	5.14	4.98	3.86	

Figure 5 (Top and Bottom Rankings per Country Notated) (INSEAD; World Economic Forum, 2011, pp. 12-16)

Many of these variables of measurement are similar to those found in the previous two studies discussed, and many even pull from the same data sources. It is therefore of little surprise that the rankings of the NRI sound familiar to what we've already heard. Sweden ranks first place with a score of 5.60, followed by Finland in third place with 5.43, Denmark in seventh with 5.29, Norway in ninth at 5.21, and Iceland in sixteenth with a score of 5.07. Once again these countries have cemented the fact that they are international leaders in the ICT space. The Nordic countries have actually enjoyed dominance in the NRI for the past several years, but the 2011 report finds that the Asian Tigers, defined as Hong Kong, Korea, Singapore and Taiwan, have been quickly gaining and are now neck-and-neck with the Nordic contingent, as is displayed in Figure 6. If 2012 realizes the governments and businesses of the Nordic countries remaining complacent in their use and advancement of ICT, we will likely see the Asian Tigers crowned winners of the 2012 NRI study (2011, p. 17).

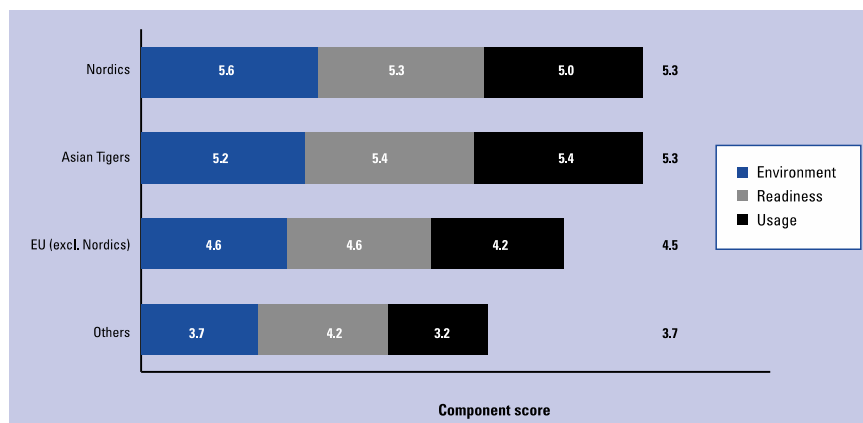


Figure 6 (INSEAD; World Economic Forum, 2011, p. 18)

Another interesting and related study regarding network readiness levels is the Global Competitiveness Report, also published by the World Economic Forum annually. As the WEF states in their Global Competitiveness Report 2010-2011, "Since 2005, the World Economic Forum has based its competitiveness analysis on the Global Competitiveness Index (GCI), a highly comprehensive index for measuring national competitiveness, which captures the micro- economic and macroeconomic foundations of national competitiveness...a more competitive economy is one that is likely to grow faster in the medium to long run." As we move into the digital age, levels of a country's network readiness will play a vastly more significant role in their overall competitiveness in the global environment, ultimately driving GDP levels. As such, we have also included each country's GCI score in Figure 5 (World Economic Forum, 2010, p. 4).

7.0 Individual Country Network Readiness Index Analysis

Denmark's Networked Readiness Index ranking has plunged in recent years from the first place ranking in years 2007, 2008 and 2009 to third in 2010, ending up in seventh place for 2011. Denmark took the top spot in two metrics considered in the survey; "freedom of the press" and "broadband Internet subscribers/100 pop[ulation]". But probably more notably, they ranked 129th out of 139 in "extent and effect of taxation" (INSEAD; World Economic Forum, 2011, p. 196), highlighting Denmark's 51.5% income tax rate in 2010, which was actually a decrease over 2009's 59% tax rate (taxrates.cc). Denmark was also ranked ninth in the Global Competitiveness Index for 2010-2011, a drop from fifth place in 2010 (World Economic Forum, 2010, p. 15).

Finland's NRI ranking for 2011 found them in third place globally, a strong improvement over their sixth-place ranking the three years prior. Finland took the top rank internationally in the variables of "availability of scientists and engineers" and "cellular subscriptions with data % total". They also had notable rankings in areas such as "venture capital availability" (fourth place), "intellectual property protection" and "property rights" (both second place), "tertiary education enrollment rate %" (second place), and "quality of math and science education" (third place). Like Denmark, Finland was also penalized for the "effect and extent of taxation" in the country, ranking 113th out of 139, but received much lower marks in "total tax rate" as a percent of profits, ranking 85th as opposed to Denmark's 28th (INSEAD; World Economic Forum, 2011, p. 203). Finland ranked seventh in the Global Competitiveness Index, a slight increase from their 2010 ranking of sixth (World Economic Forum, 2010, p. 15).

Iceland placed 16th in the 2011 NRI ranking, a four-place drop from 12th place in 2010 and a nine-position drop from its 2009 ranking of seventh, merely two years earlier. Despite Iceland's low overall ranking, it took the top spot in a many other areas, including "secure Internet servers/million pop[ulation]", "electricity production, kWh/capita", "accessibility of digital content", "households w/ personal computer", "Internet users/100 pop[ulation]", "Internet access in schools", "use of virtual social networks" and "firm-level technology absorption". Other significant achievements worth noting are its rankings in the "availability of latest technologies" and "quality of educational system" taking second and third place globally, respectively. Iceland ranked poorly in only two areas, coming in 104th place in "financial market sophistication" and 117th place in "government e-participation" (INSEAD; World Economic Forum, 2011, p. 215). In the GCI, Iceland ranked 31st, dropping five from its 26th place rank in 2010 (World Economic Forum, 2010, p. 15).

Remaining consistent over the past five years of the NRI, Norway ranked ninth globally in 2011, up one spot from 2010, but down one from 2009. In contrast Iceland, scored 16th but delivered a disproportionately high number of first-place rankings. Norway did not take the first place rank in any variables worth mentioning; Norway did place high in many areas, including second place for "venture capital availability" "electricity production kWh/capita" and "internet users/100 pop [ulation]" third place for "freedom of the press" and "extent of staff training", as well as finishing fourth in "impact of ICT on new organizational models" an important metric in relation to ICT and its impact on the country's economy. Norway did not have any abnormally low-ranked variables (INSEAD; World Economic Forum, 2011, p. 256). Like its overall NRI ranking, Norway held its 14th-place rank in the Global Competitiveness Index in both 2011 and 2010 (World Economic Forum, 2010, p. 15).

Country Name	Rank	2010 GDP per Capita
Luxembourg	1	\$ 105,437.67
Norway	2	\$ 84,538.24
Switzerland	3	\$ 67,463.71
Denmark	4	\$ 55,890.68
Macao SAR, China	5	\$ 51,429.89
Sweden	6	\$ 48,935.67
United States	7	\$ 47,198.50
Ireland	8	\$ 47,170.20
Netherlands	9	\$ 46,914.66
Canada	10	\$ 46,235.64
Austria	11	\$ 45,209.40
Finland	12	\$ 44,512.01
Belgium	13	\$ 43,144.34
Japan	14	\$ 42,831.05
Singapore	15	\$ 41,122.19
Germany	16	\$ 40,152.22
United Arab Emirates	17	\$ 39,624.70
Iceland	18	\$ 39,616.84
France	19	\$ 39,459.55
United Kingdom	20	\$ 36,143.94

Figure 7 (World Bank, 2011)

Taking up the rear alphabetically but winning in the rankings, Sweden has held the top ranking globally for the past two years, up from its second place ranking, which it held 2007, 2008 and 2009. With respect to its individual variable rankings, it is clear why Sweden tops the charts in nearly every ICT study. Sweden ranked first globally in the variables of “availability of latest technologies”, “laws relating to ICT”, “efficiency of legal system in challenging regulation[s]”, “intellectual property protection”, “company spending on R&D”, “impact of ICT on access to basic services”, “extent of business Internet use”, “impact of ICT on new services and products” and “impact of ICT on new organizational models”. Similar to Denmark and Finland, Sweden did not do well in the areas of “extent and effect of taxation” and “total tax rate, % of profits, ranking 109th and 110th respectively (INSEAD; World Economic Forum, 2011, p. 279). Sweden moved into second place in the 2011 Global Competitiveness Index rankings, up from fourth in the prior year (World Economic Forum, 2010, p. 15).

8.0 Gross Domestic Product: Analysis and Comparisons

Now that the dominance of the Nordic countries ICT adoption and infrastructure has been detailed, how does this correlate to the Gross Domestic Product (GDP) of the countries in the region? Under the hypothesis that higher levels of Internet penetration drive higher GDP growth, it would be presumed that GDP per capita in the Nordic countries would reflect some of the highest levels in the world. Surprisingly, a review of the 2010 GDP per capita data available via World Bank shows this as precisely the case. As represented in Figure 7, all five of the Nordic countries fall within the top 20 spots (of a possible 173) when ranking the global GDP per capita, with Norway at the top of the Nordic list in second place, Denmark in fourth, Sweden in sixth, Finland in 12th, and Iceland in eighteenth place (World Bank, 2011).

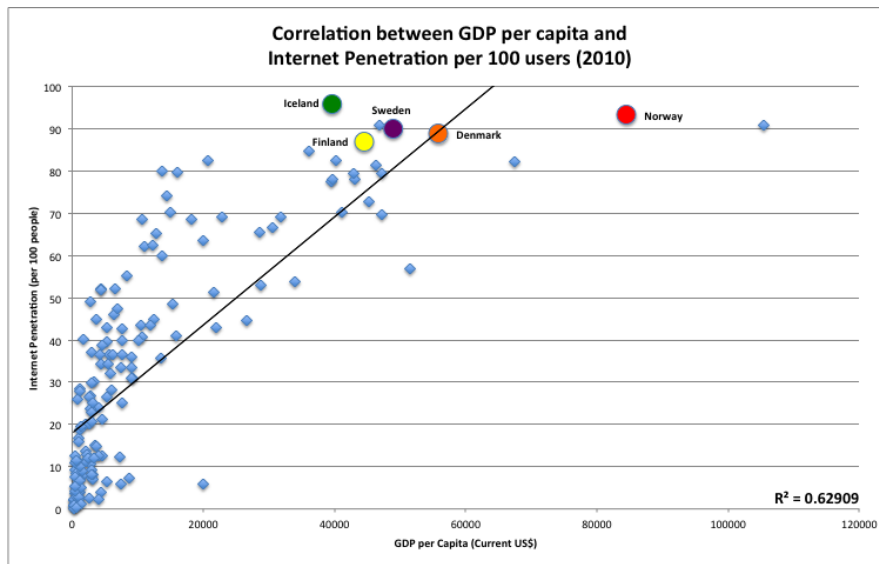


Figure 8 (World Bank, 2011)

These numbers become even more striking when they are matched with each country’s Internet penetration rates, as displayed in the scatterplot depicted as Figure 8. Analyzing the 162 countries for which World Bank contained data for both GDP per Capita and Internet Penetration per 100 users, it is clear that a level of correlation exists between GDP level and Internet usage, with all five Nordic countries being positioned at the top-right of the scatterplot. In fact, when a trendline is added to the scatterplot, it demonstrates an R-squared value of 0.629, a statistically significant correlation (World Bank, 2011).

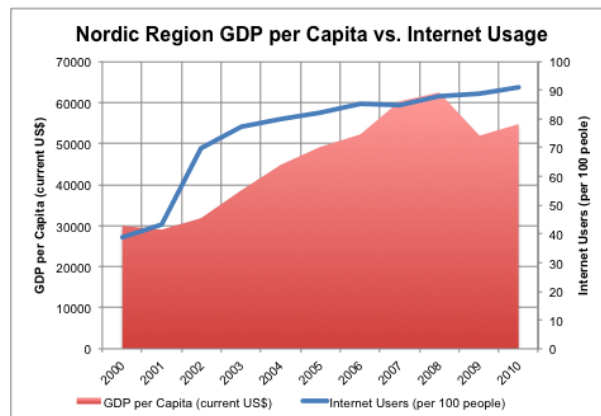


Figure 9 (World Bank, 2011)

The data presented clearly demonstrates that countries with the highest Internet penetration have the highest GDP, and vice-versa, however this only demonstrates correlation and not causality. To demonstrate that GDP growth actually is affected by Internet penetration growth, we must look at this data over a series of time and compare the performance of both indicators, which is done in Figure 9. As this graph displays, between the years 2000-2010, there is a general uptrend in both levels of GDP per capita and Internet penetration. During the period of the early-2000s the Nordic region’s Internet penetration rates grew at a very fast rate, shooting up by nearly 40 percentage points in just a few short years, and then slowing to a more sustainable rate. About two years after the initial spike in Internet growth, we begin to also see GDP levels starting to rise. The growth of GDP nearly mirrors the curve at a two-to-three year delay. As Internet penetration approaches levels near 90 percent and begins to level off and demonstrates a couple of years of nominal growth, the GDP per capita levels catch up to the growth levels of internet penetration, at which point they both grow at a similar pace for a period of another couple of years. Upon the world slipping into a global recession in 2008, the GDP levels of the Nordic countries also begin to decline and stray from the growth patterns of Internet penetration. (World Bank, 2011)

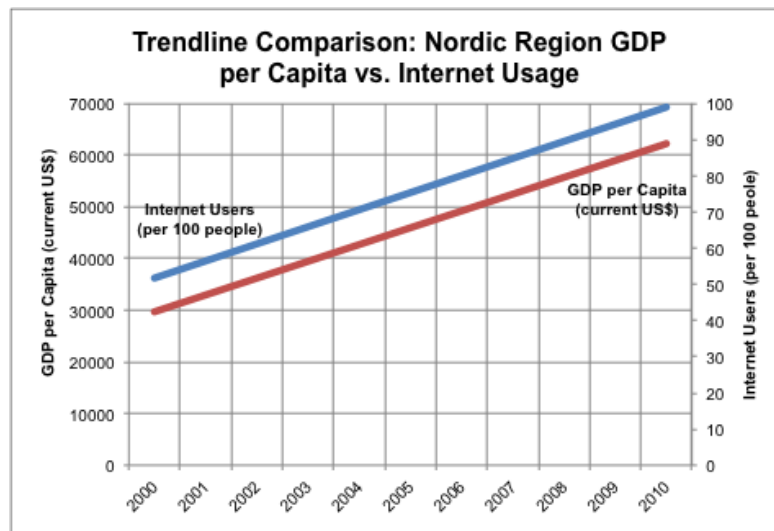


Figure 10 (World Bank, 2011)

In Figure 10, the data series are replaced with linear trendlines, with blue still representing Internet penetration growth and red GDP per capita levels. As is clearly depicted, there is a direct correlation between the growth rates of Internet penetration and GDP per Capita, with the trendlines essentially parallel to each other. Again there is an average of a two-year lag between the increase in Internet penetration and the impact being seen upon the region's GDP. Had the recession not occurred in 2008, it can be forecast that, based upon the trends predicted GDP would have continued to grow at the same rate as Internet penetration (World Bank, 2011).

Conclusion

The Nordic countries of Denmark, Finland, Iceland, Norway and Sweden are powerhouses of ICT, claiming nearly all of the top spots in Internet penetration and ranking at the top of every ICT study regarding connectivity, infrastructure, and network readiness. Similarly, these countries have strong financial results which place them at the top of the list economically as well with all five landing in the top twenty spots when ranking GDP per capita globally. Being leaders in both ICT and GDP is not necessarily a surprising feat. One might expect a country strong in one level to shore up the other. But which of these metrics is the leading variable, and which is the response variable?

Presenting the correlation of 2010 GDP per capita statistics against 2010 Internet penetration rates, the scatterplot depicts that the phenomenon of countries with high GDP also having high Internet penetration was not just restricted to the Nordic region, as nearly all countries reflected strong performance in both or neither. Reflecting on the growth of each of the variables however, a pattern begins to emerge; ICT growth occurs, and as the population becomes more comfortable with the technology and more productive, the GDP level begins to increase as well. The graphs and trend analysis presented show us that this GDP growth lags two-to-three years behind the increase in Internet penetration, but the growth rates are similar, barring major global events.

Third party research studies have shown results similar to those found in this study: "Estimates show that regions' score on ICT has a positive and significant correlation with the level of GDP per capita" (Vicente & Lopez, 2011). Granted, ICT and Internet adoption are not the only factors that have caused the fantastic economic performance in the Nordic countries, but they are likely one of the root causes of the increased benefits that resulted in GDP growth. As explained in a study conducted by the Centre for Economic Performance, direct gains related to ICT are not the only manifested gains: We find a large impact of ICT on firm productivity. Importantly, this impact is larger than would be expected given ICT's average share in firm output. This result is inconsistent with other microeconomic studies and is indicative of potential "complementary factors" that are closely associated with the use of ICT. As a central finding, this raises questions about the heterogeneity of the effect of ICT on firm productivity" (Bloom, Draca, Kretschmer, & Sadun, 2010). Ultimately, this analysis proves that there is a strong correlation between growth in Internet adoption and growth in GDP, and it is also clear that the growth in Internet precedes that of the GDP growth.

For countries which are lagging behind in Internet adoption, a supportive government, initial investment in ICT infrastructure and enactment of policies which drive growth of Internet usage can help create an environment which fosters economic development as well.

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