

# **The Swedish Information Economy: Current Evidence and Key Governmental Policy Implications**

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## **ABSTRACT**

It is well known that most of the largest economies in the world are becoming information economies (understood as an aggregate of economic activities that produce information outputs) in terms of value added (GNP) and jobs. Sweden is among the most advanced adopters of ICT and represents therefore a suitable empirical base for the investigation of an information economy. The data reveal that the largest part of the Swedish economy in terms of GNP value added is constituted by information services. This study presents some surprising economic structures never before uncovered, which are discussed here and then contextualized in terms of implications for public policy making.

**Keywords:** Information Society, Information Economy, Information Job, Information Services, Information Intensity.

## **1. INTRODUCTION**

That we live in an ‘information age’ is pronounced in its many variants [9; 11-14; 47] and where one key aspect often highlighted is the ‘information economy’, the latter being frequently contrasted to the agricultural economy and the industrial economy [47]. Whether that statement is self-evident or not, there have been very few attempts to empirically measure an information economy, with some few exceptions, where the most notable are measurements of the US information economy [3-6; 32; 33; 38]. However, there are no published empirical measurements of the Nordic countries’ information economies even though various surveys suggest that the Nordic countries are among the leading information nations, including the most extensive adoption of new digital technologies [18; 25; 37]. OECD has attempted to measure information economies in some developed countries (OECD, 1981), yet that attempt is regarded to offer limited value as no longitudinal measurement was attempted [6].

The lack of knowledge about a country’s information economy hinders governmental policy makers to understand and direct

appropriately their economies. To remedy the mentioned gap and thus to provide an understanding of the Nordic economies, a novel research program is pursued in order to produce the first ever measurement of the Nordic information economies.

This paper presents the results of empirical research that addresses the Swedish information economy in 2001, 2005, 2008 and 2012, which is being conducted in the context of a research program aimed at a comprehension of the Nordic information economies. This paper offers new, never before presented, insights that may inform governmental policy-making.

The remaining of this article is structured as follows. The next section summarizes the received literature in terms of previous research findings and key conceptualizations. The section thereafter briefs the here utilized research approach. Next is the very research result, where the decomposition of the Swedish information economy, particularly in terms of its various industries and their share of information economy is presented. Section thereafter discusses these results while the paper ends with key conclusions obtained.

## **2. LITERATURE OVERVIEW**

The first serious attempt to empirically measure an information economy was made by F. Machlup that assesses the size, structure and dynamics of the US information economy [32; 33]. For example, he found that 29 percent of the US GNP was generated by information industries in 1958.

A key follower to Machlup was Porat who studied extensively information-based activities in the US economy on the behalf of the US Department of Commerce. His measurement of the US information economy adopted however a distinct conceptualization [38], as it assumed the conventional national income accounting framework, which Machlup did not. In short, the difference is between Machlup’s more detailed definition of information economy and Porat’s conception that was less detailed yet more compatible with the available economic data hence offered more comprehensive results [24]. Another key

difference was that Porat distinguished, and thus measured, the so-called 'Primary Information Sector' (PRIS), understood as organisations whose marketed output is constituted by information (e.g. books or music), and the so-called 'Secondary Information Sector' (SIS), understood as information products being produced for an internal consumption by organisations, who produce material products for its external market (e.g. engineers' design of a car).

Next, the first serious attempt to measure and compare several information economies was made by the OECD, who followed Porat's conception of an information economy and studied information sectors in nine of its member nations in 1978 and 1979 [36]. While that study produced results that could be compared to the previous measurements of the US information economy, they provide less value for the other nations who lacked previous measurements of information economies as the OECD study did not produce a longitudinal measurement.

The most up-to-date measurement of an information economy is provided by Apte and his colleagues [3-6], who studied the US information economy in 1992 and 1997. They followed Porat's conception of an information economy, which enabled them to compare their findings to Porat's results and thus to aggregate the longest assessment of an information economy ever made [ibid.]. The present study of the Swedish information economy assumes the Porat conception of an information economy and compares the figures for the Swedish information economy to those for US information economy, the latter offered by Apte and his colleagues [ibid.]. There have been some other minor attempts to measure information economies such as for Canada [39], India [30] and economies in the Pacific region [26; 41; 46].

Some critical assessments of information economy conceptions as such and its measurements are offered by Engelbrecht [17], Karunaratne [29], Lamberton [31], Miles [34], Apte & Nath [4], Fitzgerald et al. [19]. Overall these deliver the following critique. One key message here is that different attempts to conceptualize and measure information economies assume different conceptual foundations, which make these measurements incompatible with each other – this is the case with the above mentioned studies made by Machlup and Porat. While that is a valid critique, there is now enough of available data based on Porat's conceptualization of an information economy, which also motivates why the present study of the Swedish information economy is based on Porat's conception. Secondly and partly as a consequence of the foregoing, is the issue of available data. As national statistical agencies typically do collect and categorise data based on the orthodox industrial economic conception, the available data is not suited directly to populate the categories assumed by information economy conceptions. This is also the reason, we believe, why Porat's conception of an information economy dominates over Machlup's; the former's conception has a closer fit with the available data than Machlup's conception offers, which again motivates the present study's adoption of Porat's notion. Finally, the third key critical trust is the statement that information economy studies are a-theoretical, i.e. lack a firm foundational theory. While we believe that this is probably the most serious critical remark, we also believe that there are at least two sides to this claim. Firstly, as the underlying assumption is that information societies took momentum in the second half of the 20th century [11; 23; 28; 43; 47], and very few studies of information societies have been attempted, it is not strange that there is no new and original theoretical

foundation of information economies – clearly, more studies are needed to accumulate empirical finds and thereby generate theoretical bodies. The second reflection here is that while information economies have emerged recently and are understudied, no information economy exists in a vacuum, fully isolated from the remaining industrial and agricultural economies. This means that the available empirical characterizations of information economies can and should be integrated into existing economic theoretical bodies, where the latter require modifications and thereby further developments to account for the actual, and more complex, economic and societal realities emerged. As the present study's results shows, investigation of an information economy uncovers some economic structures and dynamics that are important to understand.

### **3. RESEARCH APPROACH**

A measurement of an information economy adopts much of the orthodox economic wisdom, such as measurement of GNP, economic value added, type of industries present in an economy, and the workforce employed to conduct the work in the economic organisations that constitute these industries. To that we have added some additional key components that are very briefly summarised as follows. Products provided by economic organizations are typically categorized in terms of their form, on the goods-services continuum [44]; however products can and should also be conceived in terms of their content, with regard to being information or matter / energy (also called here non-information or material) [38]. Taken together, the two taxonomies generate a two-by-two matrix, offering four kinds of products: material-goods such as a car, material-services, such as a car repair, information-goods, such as having acquired a film on a DVD or a downloaded file, and information-services, such as movie theatre show. Next key distinction here is between the so-called PRIS and the SIS. The former is understood as all those industries that produce goods and services constituted by information, such as software, music, film, but also design, marketing, information, broadcasting, teaching, accounting, physician diagnoses, research and development. On the other hand, SIS is understood as information products produced for internal consumption by organisations that in turn produce material products for their markets, for example when research and development designs a new car to be produced by operations [38].

Given those distinctions of products and of their industries, we can derive that there is a distinction between production activities that mainly transform information and those that mainly transform material – e.g., a high level functional requirement specification may be further processed into a technical specification for a new machine, on the other hand an unpainted fence may be painted.

The here employed categories and algorithms for measurement of an information economy are adopted from Apte et al. [6]. All data for the Swedish economy was provided by the Swedish official statistical services agency 'Sweden Statistics' [42].

The first analysis addresses the economic value added as a share of GNP for information economy, where production output is categorised in terms of product form (goods vs. services) and product content (informational vs. material). For the Swedish economy data was obtained for the following years: 2001, 2005,

2008, and 2012. The second analysis focuses on the two information sectors, PRIS and SIS, for the same years as detailed above for Sweden. The third analysis focuses on the value added contributions of major industries to the primary and secondary information sectors and to the total information economy.

Limitations and quality of datasets are the following: the economic value represents different levels of disaggregation; this required us to match these numbers manually, which may introduce a source of error. We have conducted a check of that matching where no error was detected; in the absence of more disaggregated industry-level data, we had to make our own assessments of the SIS volumes, again this was made manually, which may introduce a source of error; as mostly is the case in time series of macro data of that kind, there are structural changes over time (e.g. in industrial classifications).

#### 4. RESULTS

The distribution of the Swedish GNP is decomposed by the product-form (goods vs. services) and by the product-content (non-information vs. information) for 2001, 2005, 2008, 2012. These numbers show that the investigated 11-year period manifested information products accounted for more than half of the GNP, with a rather stable pattern around 60 % of GNP, including minor fluctuations, yet with a small increase from 59.8 % in 2001 to 60.4 % in 2012. The Swedish information economy grew at an average growth rate of 3.49 % during the 4 years between 2001 and 2005, retains its position during 2005–2008 with the same average growth rate (3.49 %), and 1.93 % between 2008 and 2012. The numbers show that the share of information goods decreased slowly, from 11.4 % in 2001 to 9 % in 2012 while the share of information services increased from 48.4 % to 51.4 %. This means that information services represented the single largest share of economic value added in the Swedish economy, and showed a slow annual average growth of app. 0.27 %, for 2001–2012.

In 2001, 59.8 % of the total Swedish GNP was generated in the information sector where 42 % of total GNP was generated in the PRIS and the rest was contributed by the SIS (17.8 %).

In 2012, the share of the information sector in the total Swedish GNP rose to 60.4 %, of which the larger part (44.6 %) was accounted for by the PRIS. It is evident that the PRIS has shown a substantial growth in the 11 years since 2001.

Contrary to PRIS, SIS manifested a decrease of 2.0 % for that 11-year period, or 0.18 % annual decrease for that period, yet the total information economy grew from 59.8 % in 2001 to 60.4 % in 2012, which is thus caused by the PRIS growth.

The shares of service sector industries in both PRIS and SIS increased substantially over the 11 years. The share of service industries was 54.6 % in total value added generated in the PRIS in 2001 and this share rose to 54.76 % in 2005, to 55.75 % in 2008, and then to 59.04 % in 2012. Similarly, the share of service industries in the SIS increased from 29.4 % in 2001 to 30.14 % in 2005, and to 30.56 in 2008. However, the share of service in the SIS slightly decreased in 2012 and constitutes 30.44 %.

At a more detailed level of industries within manufacture and

service categories, we can observe that (contribution to PRIS):

- in 2001, ‘business services’ made the largest contribution (14.98 %);
- this is followed by the contributions of ‘real estate and rental services’ (12.23 %) and ‘communication services’ (11.72 %);
- in 2005, 2008 and 2012, ‘business services’ constituted the largest component (15.24 % in 2005, 16.25 % in 2008 and 17.09 % in 2012) of the PRIS, followed by ‘communication services’ (11.35 % in 2005, 11.15 % in 2008, and 11.53 % in 2012) and ‘real estate and rental services’ (11.20 % in 2005, 12.40 % in 2008, and 11.75 % in 2012);
- obviously, ‘business services’ have shown a high rate of growth during 2001–2012.

Within the SIS, some changes were observed:

- in 2001, ‘wholesale and retail trade’ was the largest contributor (16.84 %), followed by ‘construction’ (7.81 %) and ‘transportation services’ (7.56 %);
- in 2005, the ‘wholesale and retail trade’ retained its position with 17.42 % of total SIS value added. In 2005, ‘construction’ (8.71 %) and ‘transportation services’ (7.45 %) took the second and third positions respectively;
- the same trend was observed in 2008 and 2012, ‘wholesale and retail trade’ with 17.74 % in 2008 and 17.54 % in 2012 of total SIS value added had the largest contribution, followed by ‘construction’ (10.06 % in 2008 and 9.24 % in 2012) and ‘transportation services’ (7.36 % in 2008 and 7.04 % in 2012) respectively.

For the Swedish information economy as a whole:

- in 2001, the ‘business services’ was the largest contributor (10.54 %) followed by ‘real estate and rental services’ (8.75 %) and ‘communication services’ (8.25 %) respectively;
- in 2005, ‘business services’ had the largest contribution (10.92 %), followed by ‘real estate and rental services’ (8.14 %) and ‘communication services’ (8.14 %);
- in 2008 and 2012, ‘business services’ retains its position at the top (12.03 % in 2008 and 12.61 % in 2012), followed by ‘real estate and rental services’ (9.29 % in 2008 and 8.75 % in 2012 %) and ‘communication services’ (8.25 % in 2008 and 8.51 % in 2012).

Among the broad industry categories, information activities in services were growing at 3.65 % per year between 2001 and 2005, at 3.99 % between 2005 and 2008 and 2.56 % between 2008 and 2012. These rates are slightly higher than in the average for the Swedish information economy.

Within the service sector, value added of ‘medical, educational services and non-profit organizations’, ‘amusements’, and ‘other services’ were each growing at rates higher than 4 % annually between 2001 and 2008.

During 2008–2012, ‘medical, educational services and non-profit organizations’, and ‘finance and insurance’ registered growth rates higher than 4 %. In the manufacturing sector, ‘petroleum and coal products’ was the fastest growing industry during 2001–2005. However, information activities in most manufacturing industries experienced a decline during this period (2001–2012). Among them, ‘textile mill products, apparel and other textile products, leather and leather products’, ‘printing and publishing’, ‘paper and allied products’ were declining at an annual average rate of more than 1 %.

These declines may reflect two factors. Firstly, there could have been substantial outsourcing of information activities in the manufacturing industries to outside vendors. Secondly, we agree with the Apte & Nath [6] point that the estimation methodology for the SIS suggested by Porat [38] may have caused an underestimation of actual contribution of the manufacturing industries to the information economy. However, we support the Apte and Nath [ibid.], Bardhan & Kroll [7] conclusion, that outsourcing of information services is the most likely cause of declining contribution of manufacturing industries to the information economy. However, it needs further investigation to fully substantiate this argument.

The Swedish GNP was growing at an average annual growth rate of 3.4 % between 2001 and 2005, 4.0 % between 2005 and 2008, and a slower rate of 1.4 % between 2008 and 2012. Among the broad sectors, mining was growing at 7.5 %, which is twice higher than the average for the economy during the 4 years between 2001 and 2005, and was growing at 11.2 %, which is almost three times higher than the average for the economy between 2005 and 2008. The manufacturing sector on the other hand was growing merely 2.6 % annually during the same period. Analysis shows that the service sector was growing at a rate higher than the average annual growth rate for the overall economy. We assume that the high growth rate might have been driven by the growth of the high-tech sector. Information value-added of service sector was growing faster than total value added of the respective sector between 2001 and 2012. The patterns of growth of information components within broad sector reinforce our finding that the share of the information economy in the Swedish GNP has grown from 59.8 % in 2001 to 60.4 % in 2012.

## 5. DISCUSSION

The above presented analysis of the Swedish information economy has revealed a number of underlying patterns that are highlighted here and discussed.

Information services represented nearly fifty two percent, with a growing trend, accounting for most of the growth in the whole economy and therefore growing at a faster rate than the total economy. A key question is thus what is driving this growth of information services. It may be reasonably to assume that this strong growth of information services, as part of the Swedish information economy, is caused by a more general trend of products servitization [16; 44] and the associated trend of material goods substitution for information services, e.g. music CD for streamed music [9; 35].

A brief contextualisation of the presented research result is offered here, in relation to the underlying question of what are the potential implications of the nature of the Swedish information economy, or to put it in other words, what is the relevance of an information economy being measured and understood.

Firstly, Sweden, just as virtually any country, is struggling with managing its economic development and growth. The current political doctrine has assumed the orthodox conception of production, with the polarization between goods vs. services, as a foundation for its analysis and policy formulation. The here assumed conceptualisation of information economy adds one dimension to that orthodoxy of product form, namely product

content, distinguishing between non-information and information products. The present study shows the fruitfulness of such a conception as it unearths some underlying and hidden economic structures that cannot be identified otherwise. The question becomes thus, what are the implications of the here identified Swedish information economy in terms of policy formulation for such domains as labour markets, education, technology adoption, productivity growth, taxation and innovation. Surely, it is beyond the scope of the present paper to elaborate these policies.

A second contextualization here, as a potential implication of the identified Swedish information economy, is the current heated debate regarding the so-called second machine age [10]. One of its key messages is that digital technologies are becoming so smart that they are more extensively used as substitutes for human workers, something that may, at least in part, put many workers out of jobs, with all the consequences to that. Some argue that this will not be the case as new jobs will emerge [1; 8; 15; 21], just as it was the case with the first machine age that produced mechanization (i.e. job mechanization substitutes human physical powers with mechanical machines, such as the steam engine while job automation substitutes human cognitive powers with digital technologies such as the digital computer). Whether such substitution of old kinds of jobs being automated while replaced with new kinds of jobs will come or not, is not the concern here. Rather, the here presented analysis of the Swedish information economy shows that more than half of the workforce is occupied with information production, which generates more than half of the economic value added. Assuming then that all information work could be automated, shows that all existing jobs cannot currently be automated, as more than half of all workforces are occupied with information production while the remaining part is occupied with non-information production. Further, the fact that a little less than half of the workforce is still occupied with non-information work, and thus have not been subjected to full mechanization or substitution with mechanical technology, suggest that the argument used to support the thesis that a full automation will emerge as that was the case with mechanization, is flawed in some sense and cannot be sustained.

A third and final contextualization here is even broader than the two above mentioned. Given the numbers presented here, more than half of the Swedish economy is represented by information production. Assuming that a great share of the information economies could be executed with the help of various kinds of digital technologies – whether by means of full automation or partial enablement – the implication is that a major part of the economies will be governed by the so-called ‘information rules’, to use Shapiro and Varian’s label [40]. This implies that digitalized information gives rise to different kind of conditions for the conduct of economic affairs. This is no place to provide a compressive account of ‘digital rules’, so its brief account will have to suffice. Starting with operational aspects, scholars have elaborated the distinction between material objects and digitalised information, among other in the proposal for a ‘theory of digital objects’ [27]. Its thesis is that digitalized information manifests some characteristics that are fundamentally different from material object, where these distinguishing attributes include editability, interactivity, openness and distributness [ibid.]. As a consequence of that and other observations, another set of scholars have made an attempt to develop the notion of digital platforms, to be

radically distinguished from conventional physical infrastructures, such as roads [22]. Both for digital objects and digital platforms, the message is that these operate so radically differently, compared with its analogies in the material world, that a completely new set of theoretical notions is needed in order to comprehend adequately the digital fabric and thus to govern it. Moving from the operational realm to the economic, the digital fabric tends to manifest, in several respects, quite different economic conditions. One is the so-called strong network effects [40], another is the elimination of marginal cost [ibid.], yet another is the tendency to assume several complementary, and often indirect, revenues sources [ibid.]. Still another insights is that economic value creation and appropriation in the context of digitalized businesses cannot be understood in terms of one single conventional economic theory, which has caused scholars to provide synthesis of several theoretical bodies to account for some of the distinguishing features of digital businesses, such as its tendencies to rely on a network of actors [2]. Finally, moving to the realm of ethics, some scholars argue that the digital fabric gives rise to new kind of behavior requiring in turn new kind of moral conceptions, for example due to the so-called autonomy of digital objects that when interacting with each other and with human agents can give rise to a global behavior patterns that were never intended, not even conceived [20]. While this account could go on to review also social, political, and other realms [9], the point made here would be the same. Namely, given that we have just started to identify some basic principles that govern the structure and behavior of digitalised information, and which suggest that these principles in some respects differ radically from the principles used in the material world, combined with the fact that more than half of the total economy is occupied with information production, suggests that we currently employ the old principles, as generated from empirical observations of the material world, to conceive and manage the digitalized world, which the here presented analysis suggest is a large share of a developed economy.

## 6. CONCLUSIONS

Elaboration of potential consequences of the here identified Swedish information economy require dedicated efforts, hence is outside the scope of the present paper. We point only shortly to some key areas of governmental policy formulation.

To start with, the numbers presented here show the Swedish information economy accounts for more than half of the total GNP and is slowly growing; this means that information economy and its unique nature must no longer be ignored and therefore mandate policy design practices to account for this fact. The single largest and fastest growing sector of the Swedish information economy is the information services provision, which requires highly professional workers, such as engineers, managers, physicians, and teachers. This indicates the particular importance of various educational and training policies that need to be adopted to support and facilitate the ongoing transformation of the Swedish economy into a full-blown information economy.

Secondly, the identified structure of the Swedish economy offers major opportunities for the introduction of new digital technologies aimed at automation of tasks and also whole jobs [48; 49] – this is particularly relevant for well-structured jobs, e.g. call-center agents. Such ongoing substitutions need to be met with governmental policies that facilitate the flow of

workforce into new jobs, typically through various educational and training efforts but also motivated by various incentives.

Thirdly, to facilitate a further growth of the Swedish information economy, governmental bodies need to secure that the nation has the needed digital infrastructure, such as wireless broadband with the required capacities, and more challenging and important that the many governmental organizations in the country, such as municipalities, schools, healthcare centers, and various authorities, do digitalize their operations so as to enable a smooth interaction with each other and current and new firms.

Fourthly, the fact that the primary information sector is circa three times the size of the secondary information sector, shows that most of information products are produced for the free market rather than for internal needs in organizations. This is supported by the radical decrease of transaction costs due to the use of digital technologies [45]), and the massive outsourcing trends of many traditionally internal functions, such as finance, human resource, and IT-services. This trend has produced a general decrease of the size of firms which is likely to continue and thus to the increase of the number of firms. The above suggested policy measures need to facilitate this transformation.

Finally, there are a number of domains that deserve additional investigations, including further analysis of the Swedish information economy using additional time series data, correlation tests with other factors such as investments in education, innovation practices, and new firm establishments, and then comparisons between the Swedish and other information economies, such as the US and the Nordic countries – such compression may unearth some cause and effect relationships which in turn may offer more precise instruments for policy makers to govern information economies.

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