ETLA
ELINKEINOELÄMÄN TUTKIMUSLAITOS
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
Lönnrotinkatu 4 B 00120 Helsinki Finland Tel. 358-9-609 900
Telefax 358-9-601 753 World Wide Web: http://www.etla.fi/

Keskusteluaiheita – Discussion papers

No. 1132

Jukka Jalava* – Ilja Kristian Kavonius**

DURABLE GOODS AND ICT: THE DRIVERS OF EURO AREA PRODUCTIVITY GROWTH? ***

* Eurostat/European Commission, E-mail: Jukka.Jalava@ec.europa.eu, Tel.: +352-4301 38435

** European Central Bank, E-mail: Ilja_Kristian.Kavonius@ecb.int Tel.: +49-69-1344 8417

*** This paper is part of the "Finland in the Global Competition" -project (Suomi globaalissa kilpailussa) of ETLA and its subsidiary Etlatieto Oy. The views expressed are those of the authors and do not necessarily reflect the views or policies of the European Commission or the ECB. We wish to thank Pirkko Aulin-Ahmavaara for helpful comments without implicating her for any remaining errors.

ISSN 0781-6847 18.04.2008

JALAVA, Jukka – **KAVONIUS**, Ilja Kristian, **DURABLE GOODS AND ICT: THE DRIVERS OF EURO AREA PRODUCTIVITY GROWTH?** ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 2008, 18 p. (Keskusteluaiheita, Discussion papers, ISSN 0781-6847; No. 1132).

ABSTRACT: The purpose of this paper is to estimate the effect of durable goods and ICT on Euro Area economic growth and productivity change; when expenditure on consumer durables is recorded as capital investment. The capitalization of consumer durables impacts both the levels and growth rates of the capital stock, productivity and GDP. Our growth accounting computations demonstrated that the capital services of durables contributed one-tenth of economic growth and one-eight of labour productivity growth in 1995-2004. ICT's impacts were larger, i.e., one-fifth of GVA growth and one-sixth of labour productivity growth.

KEY WORDS: durable good, asset, productivity, ICT, growth accounting, capital services, household production

JEL classification: E13, E21, E22, O11, O47, O52

JALAVA, Jukka – **KAVONIUS**, Ilja Kristian, **DURABLE GOODS AND ICT: THE DRIVERS OF EURO AREA PRODUCTIVITY GROWTH?** (KESTOKULUTUSTAVARAT JA ICT: EUROALUEEN KASVUN MOOTTORI?) ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 2008, 18 s. (Keskusteluaiheita, Discussion papers, ISSN 0781-6847; No. 1132).

TIIVISTELMÄ: Tämän työpaperin tavoitteena on arvioida kestokulutustavaroiden ja ICT:n vaikutusta Euroalueen talous- ja tuottavuuskasvuun vuosina 1995–2004, kun kestokulutustavaroita käsitellään investointihyödykkeinä. Kestokulutustavaroiden kapitalisoinnilla on vaikutus pääomakannan, tuottavuuden ja talouskasvun tasoihin ja kasvuasteisiin. Kasvutilinpitolaskelmamme osoittivat, että kestokulutustavaroiden pääomapalvelut kontribuoivat kymmenyksen talouskasvusta sekä kahdeksasosan työn tuottavuuden muutoksesta vuosina 1995–2004. ICT:n vaikutukset olivat suuremmat: viidesosa talouskasvusta sekä kuudesosa työn tuottavuuden kasvusta.

AVAINSANAT: kestokulutustavara, vara, tuottavuus, ICT, kasvutilinpito, pääomapalvelu, kotitaloustyö

JEL-koodit: E13, E21, E22, O11, O47, O52

1. Introduction

The Member States of the European Union are presently enjoying unprecedented levels of economic welfare.[2] The impact of both technology and productivity in this far-reaching transformation is by now well documented.[3] As the focus of the economy shifted from primary production to secondary production and services also family dynamics changed. Extended families are no longer predominant; nowadays nuclear families and single person households are more common. The availability of technically advanced consumer durable goods enabled small family units to cope with household production. Consumer durables have also facilitated increasing female labour force participation rates.

We argue that households *de facto* treat the purchase of durable goods as investments. However, this is not captured by the economic analysis based on current statistical conventions. The present System of National Accounts (SNA93) treats consumer durables as a part of private consumption, whereas Dale Jorgenson consistently treats consumer durables as capital inputs both on the output and the input sides.[4] Charles Hulten recently defined investments as such expenditures that are made at the expense of current consumption in order to increase or maintain future consumption.[5]

Without doubt the greatest force impacting economic production as well as everyday life is information and communication technology (ICT). Computers, the Internet and mobile phones have altered our way of living and doing business for good. Information and communications technology affects economic growth, both as a component of aggregate output in the form of ICT production and as a component of aggregate input in the form of ICT capital services.

The purpose of this paper is to estimate the effect of durable goods and ICT on euro area (EA) GDP growth and productivity change from 1995 to 2004. In this exercise expenditure on consumer durables is recorded as capital investment. This impacts both the levels and growth rates of the capital stock, productivity and GDP. The advantage of this treatment is that it

[2] Carreras and Tafunell (2004); Maddison (2007).
[3] E.g. Abramovitz (1956); Kuznets (1966); Easterlin (1996); Mokyr (2005).
[4] E.g. Jorgenson, Ho and Stiroh, (2005). Dale Jorgenson has consistently capitalized consumer durables and included their capital services in GDP at least since 1970 (Christensen and Jorgenson, 1970).

makes the treatment of consumer durables symmetric[6] to that used in the Systems of National Accounts to account for owner occupied dwellings.[7] As we also account for the effect of ICT the true proximate sources of growth are highlighted.

This paper is structured as follows. Section 2 provides a theoretical background, comparing the approach taken in this paper to traditional national accounting techniques. This section also summarises the steps which will be taken in the estimation procedure part of the paper. Section 3 addresses the question of data availability and presents the estimation procedure for different components. Section 4 describes the results of this paper. Finally, Section 5 draws some conclusions.

2. Theoretical background

The purpose of this section is to place the theoretical background in perspective. Section 2.1 discusses the current treatment of durable goods and why durables goods should be capitalised. Then, it shows how this new treatment of durable goods and ICT impacts the observed or rather currently measured GDP and its components. Section 2.2 discusses the effect of the proposed treatment within the growth accounting approach, including impact on capital stock and productivity measures.

2.1. The treatment of durable goods and the impact on GDP

In the case of goods, the SNA distinguishes between those that are durable and those that are non-durable. This distinction is not based on physical durability as such, but rather on whether the goods are used once only, or whether they are used repeatedly or continuously. A consumer durable good is thus defined as one, which may be used repeatedly or continuously over a period of more than a year, assuming a normal or average rate of physical usage.[8]

---

[5] Hulten (2006).

[6] Complete symmetry is not reached since certain products that are consumer durables when used by the household sector go in the business sector into intermediate consumption if they do not surpass the investment threshold of EUR 500 at 1995 prices. This threshold is defined by the ESA95 and it is applied in all the European Union Member States.

[7] Rents for owner occupied households are imputed into GDP; it can be argued that the treatment of durables as capital assets does not conceptually differ from the present treatment of owner occupied dwellings. Investment in housing increases future consumption possibilities, because housing investment produces a stream of housing services over time.

[8] SNA93, paragraph 9.38.

In practice, the SNA93 measures household consumption only by expenditure and acquisitions. Household consumption of durables is treated as "other household consumption". Thus, it is commonly assumed that the consumption of durables does not increase households' consumption possibilities in the future.[9] This means that durable goods are already consumed in the "use of disposable income account" and therefore diminish saving. They are definitely not considered as an investment in the "capital account" (where they would not decrease savings). Additionally, if they were classified as investments, they would provide a service or an income flow to the household and would thus increase GDP. To recognise households' repeated use of durables, this article extends the production boundary by postulating that these durables are gradually used up in hypothetical production processes whose outputs consist of services. These services are then recorded as being acquired by households over a succession of time periods.[10] The US Bureau of Economic Analysis already treats consumer durables as fixed assets in their capital stock calculations but does not include the services of these durables in GDP. In addition, Statistics Denmark has also compiled a satellite account for consumer durables (Statistics Denmark, 2004). Jorgenson and Landefeld (2006) have also recently recommended that consumer durables should be both treated as assets and their service flows be included in GDP.

The SNA treats expenditure on consumer durables as consumption on the grounds that household production is outside the scope of GDP.[11] This is arguably inconsistent as many durables (such as cars or different kinds of machines) do create a future stream of services. In previous work we have estimated the effect of capitalising consumer durables on household saving ratios and household disposable income.[12] This paper continues that exercise and estimates the effect of capitalising durables on GDP and productivity growth. We estimate the effect using an identical, systematic method for all the EA as a whole. Equation (1) presents the standard GDP equations from the output, income and expenditure approaches points of view. The codes in the brackets refer to the codes used in the SNA93 and ESA95.

$$
(1)\qquad
\begin{aligned}
& GDP(B1G) \\
& = OP(P1) - IC(P2) + TAX(D21) - SUBP(D31) \\
& = CE(D1) + OS(B2N/B3N) + TAXPRI(D2) - SUB(D3) + CFC(K1) \\
& = C(P31) + I(P5) + G(P32) + EXP(P6) - IMP(P7)
\end{aligned}
\quad ,
$$

[9] See: SNA93, paragraph 9.40.
[10] Ibid.
[11] See also Perozek and Reinsdorf (2002).
[12] Jalava and Kavonius (2007).

where OP stands for output, IC for intermediate consumption, TAX for taxes on products, SUBP for subsidies on products, CE for compensation of employees, OS for net operating surplus (mixed income), TAXPRI for taxes on production and imports, SUB for the respective subsidies, CFC for consumption of fixed capital, C for private consumption, I for investment, G for government consumption, EXP for export and IMP for import.

The reclassification of durable goods has an effect on GDP. The reallocation of consumer durables to gross fixed capital formation (instead of private consumption) increases output (and possibly intermediate consumption), since investment from the output approach point of view provides a service flow to production. From the income approach point of view this treatment affects two components: operating surplus and consumption of fixed capital. Together these effects are by definition exactly the same size as the service flow effect of the output approach. From the expenditure point of view, durable goods should first be reclassified from private consumption to investment. Second, the value of the service flow has to be classified as private consumption.

The interpretation of this treatment of durable goods is that household production is included in this alternative measured GDP and productivity. However, it can be argued that then also household work should be included in the measured GDP.[13] We have not included this aspect in this paper and consider that as a possible future work.

2.2. The effect of ICT and durable goods on productivity

The empirical literature applying the growth accounting approach usually sees the productivity effects of ICT as happening in three stages. Firstly, the industries using ICT undergo positive labour productivity impacts as they invest in new capital goods. Secondly, there are significant improvements in multi-factor productivity (MFP) in the industries producing ICT due to rapid technological progress. Thirdly, the industries using ICT experience a boost in multi-factor productivity growth as they introduce new modes of operation and continually improve the technology through phased product and process innovations (such spillovers may result from the re-organisation of production that ICT makes possible).[14]

[13] See for instance: Jorgenson and Fraumeni 1989.

[14] In this paper we do not account for such spillovers since there is not yet a standard procedure for the measurement of the spillover effect in the literature. David and Wright (1999, 2003) estimated cross-industry regressions for electricity and Basu and Fernald (2006) for ICT. Stiroh (2002) and Jalava and Pohjola (2008) used panel data econometrics for ICT.

The aggregate production function is expressed in the form of the production possibility frontier as defined by Jorgenson, Ho and Stiroh (2003, 2005):

$$(2) \qquad Y(Y_D(t), Y_{ICT}(t), Y_O(t)) = A(t)F(K_D(t), K_{ICT}(t), K_O(t), L(t)) \quad ,$$

where, at any point in time *t*, aggregate value added *Y* consists of the production of durable goods Y_D, ICT goods and services Y_{ICT} as well as of the production of other goods and services Y_O. These outputs are produced from aggregate inputs consisting of durable goods' capital services K_D, ICT capital services K_{ICT}, non-ICT capital services K_O and labour services *L*. The level of technology or multi-factor productivity is represented in the Hicks neutral or output-augmenting form by parameter A.

If the assumption of constant returns to scale as well as competitive product and factor markets holds, then growth accounting gives the share weighted growth of outputs as the sum of the share weighted inputs and a residual (growth in multi-factor productivity):

$$\begin{aligned} &\Delta \ln Y = \overline{w}_D \Delta \ln Y_D + \overline{w}_{ICT} \Delta \ln Y_{ICT} + \overline{w}_O \Delta \ln Y_O \\ &= \overline{v}_D \Delta \ln K_D + \overline{v}_{ICT} \Delta \ln K_{ICT} + \overline{v}_O \Delta \ln K_O + \overline{v}_L \Delta \ln L + \Delta \ln A \end{aligned} \quad (3) \quad ,$$

where Δ refers to a first difference, i.e. $\Delta x \equiv x(t) - x(t-1)$. The time index *t* has been suppressed for the economy of exposition. The weights $\overline{w}_D$, $\overline{w}_{ICT}$ and $\overline{w}_O$ depict the average nominal value-added shares of the production of durable goods, ICT and other production, respectively, and they sum to one. The weights $\overline{v}_D$, $\overline{v}_{ICT}$, $\overline{v}_O$ and $\overline{v}_L$ also sum to one and respectively represent the average nominal income shares of durable goods' capital, ICT capital, non-ICT capital and labour. All shares are averaged over the periods *t* and *t–1*.

To account for the inputs' and the residual's contribution to labour productivity, the number of hours worked are denoted by *H(t)* and labour productivity by *Y(t)/H(t)*. The basic growth accounting equation (3) can be rewritten as:

$$\begin{aligned} &\Delta \ln Y - \Delta \ln H = v_D(\Delta \ln K_D - \Delta \ln H) + v_{ICT}(\Delta \ln K_{ICT} - \Delta \ln H) \\ &+ v_O(\Delta \ln K_O - \Delta \ln H) + v_L(\Delta \ln L - \Delta \ln H) + \Delta \ln A \end{aligned} \quad (4)$$

There are five sources of labour productivity growth. The first one is durable goods' capital deepening, i.e., the share weighted increase of durable good capital services per hour worked. The second source is the share weighted deepening of ICT capital. The third source is the share weighted deepening of other capital. The fourth component is the improvement in labour quality which is defined as the difference between the growth rates of labour services and hours worked multiplied by labour's income share. The fifth component is a general advance in multi-factor productivity which increases labour productivity point for point.

3. Data availability and estimation procedure

The purpose of this section is to summarise which data is used in our computations and what the limitations of this data are. This is discussed in section 3.1. Section 3.2 explains how the capital stock of durable goods has been estimated. Finally, section 3.3 discusses how the output and value added of the service flow of the durables has been estimated.

3.1. Data availability

The data used in this paper, with the exception of data for consumer durables and the capitalisation calculation, comes from the EU KLEMS project.[15] Currently, the latest available year for EU KLEMS is 2005. However, our analysis stops at year 2004 since this is the latest year for which data on expenditure on consumer durables for Spain was available. The EU KLEMS consortium compiled the non-durable aggregated EA data by correcting national data for differences in purchasing power using the purchasing power parities (PPP)[16] for gross output at detailed industry level in the year 1997. However, it should be noticed that the concept of ICT includes only the ICT of other institutional sectors than the household sector. The ICT of the household sector is included in the concept of household durable goods.

The EA aggregate is a simple aggregation of available EA Member States (EA-MS). However, the EU KLEMS database does not include data for all the EA-MS, i.e. Greece, Ireland, Cyprus, Luxembourg, Malta, Portugal and Slovenia do not have any data available in the database. Since Slovenia is a member of the EA only since 2007, and Cyprus and Malta since

[15] The EU KLEMS-database, version November 2007; Productivity in the European Union: A Comparative Industry Approach (EU KLEMS2003), see www.euklems.net.
[16] Developed by Timmer, Ypma and van Ark (2007).

2008, it is not necessary to include them in the analysis. Thus, Greece, Ireland and Luxembourg are the only countries for which no data is available and they represent approximately five percent of the EA-GDP in 2006.[17] Therefore, levels in this paper are underestimated by approximately five percent.

The private consumption data is the so-called "Table 5 data" of the ESA 95 transmission programme. This data is available for almost all of the MS. The detail of the data is the two-digit level of the COICOP classification.[18] As discussed later this data is broken down in more detail to estimate the share of durable goods. Unfortunately, more detailed data than 2-digit level data is not available from the international databases. The data is not PPP corrected and therefore, we had to perform the PPP correction ourselves. This has been explained in more details in the following sub-section.

3.2. Stocks of consumer durables

Private consumption can be divided into services and goods that can be classified durable, semi-durable or non-durable. Owing to the lack of detailed expenditure data on durables, we used the same annual shares of consumer durables in each two-digit COICOP consumption group as in our previous work (see table 1) and multiplied these shares with the national two-digit current price consumption expenditure figures of the EA countries.[19] The national data on consumer durables by type of asset was PPP-corrected using the results of Timmer, Ypma and van Ark (2007) for the year 1997 and assuming that the parities for gross output by type of activity are applicable for durables as well (see table 2 for the bridge table). To update the nominal parities for the other years the methodology of Timmer, O'Mahony and van Ark (2007) was adopted:

$$PPP_{country,industry,year} = \frac{P^{D}_{country,asset,year} \Big/ P^{D}_{country,asset,1997}}{P^{D}_{FR,asset,year} \Big/ P^{D}_{FR,asset,1997}} * PPP_{country,asset,1997} \quad (5),$$

[17] See for instance Statistics Pocketbook, January 2008, European Central Bank. Additionally, Malta and Cyprus represent less than 1/10 of the EA-GDP and Slovenia around 0.4 percent of the EA-GDP.

[18] See: http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=5. In order to stay as closely to official classifications as possible we use the COICOP classification to decide which goods are durable.

[19] Jalava and Kavonius (2007).

where PPP is purchasing power parity, D is consumer durable, P is the price index of consumer durables and FR is France.

Table 1. Depreciation rates by type of consumer durable

Code	asset type	share of asset type durable	depreciation rate	source
C05.1	Furn. and furnish., carpets and oth. floor cov.	95.3 %	0.1179	Fraumeni 1997
C05.3	Household appliances	81.3 %	0.1500	Fraumeni 1997
C05.5	Tools and eq. for house and garden	39.2 %	0.1650	Fraumeni 1997
C06.1	Medical prod., appl. and eq.	35.9 %	0.2750	Fraumeni 1997
C07.1	Purchase of vehicles	100.0 %	0.2720	Jorgenson and Stiroh 2000
C08.1	Postal services	5.8 %	0.1833	Fraumeni 1997
C09.1	Audio-vis., photogr. and inform. proc. eq.	74.6 %	0.1833	Fraumeni 1997
C09.2	Oth. major dur. for recr. and culture	96.3 %	0.1650	Fraumeni 1997
C12.1	Personal care	2.8 %	0.1650	Fraumeni 1997
C12.3	Personal effects n.e.c.	51.4 %	0.1500	Fraumeni 1997

Source: Jalava and Kavonius (2007).

Table 2. Bridge table for PPP parity used for type of consumer durable

Code	asset type	Code	Industry
C05.1	Furn. and furnish., carpets and oth. floor cov.	20	Wood and of wood and cork
C05.3	Household appliances	31x	Other electrical machinery and apparatus nec
C05.5	Tools and eq. for house and garden	29	Machinery, nec
C06.1	Medical prod., appl. and eq.	33	Medical, precision and optical instruments
C07.1	Purchase of vehicles	34	Motor vehicles, trailers and semi-trailers
C08.1	Postal services	322	Telecommunication equipment
C09.1	Audio-vis., photogr. and inform. proc. eq.	323	Radio and television receivers
C09.2	Oth. major dur. for recr. and culture	35	Other transport equipment
C12.1	Personal care	31	Electrical machinery and apparatus, nec
C12.3	Personal effects n.e.c.	31	Electrical machinery and apparatus, nec

In making the EA volume indices of consumer durables by asset type the Törnqvist procedure of the EU KLEMS project was used (see Timmer, van Moergastel, Stuivenwold, Ypma, O'Mahony and Kangasniemi, 2007). The back series were made until year 1974. Having compiled the required consumer durable series in constant prices, we then applied the following perpetual inventory equation to obtain year-end stocks of consumer durables:

$$SCD_t = SCD_{t-1}(1-d) + I_t = \sum_{\tau=0}^{\infty}(1-d)^{\tau} I_{t-\tau} \quad (6),$$

where *SCD* denotes stock of consumer durables, *I* is investment, *d* is the rate of depreciation and *t* is time. The symbol for the type of consumer durable has been left out for notational simplicity. The rates of depreciation used can be seen in table 1.

3.3. Estimation of output and value added

In this paper, consumer durables are treated in the same way as imputed rents in the national accounts. In principle, the logic of capitalising durable goods follows exactly the same logic as imputed rents. The SNA postulates that heads of households who own the dwellings that the households occupy are formally treated as owners of unincorporated enterprises that produce housing services consumed by those same households. As well-organised markets for rented housing exist in most countries, the output of own-account housing services can be valued using the prices of the same kinds of services sold on the market, in line with the general valuation rules adopted for goods or services produced on one's own account. In other words, the output of housing services produced by owner-occupiers is valued at the estimated rental that a tenant would pay for the same accommodation, taking into consideration factors such as location, neighbourhood amenities, and so forth, as well as the size and quality of the dwelling itself. The same figure is recorded under household final consumption expenditure.[20]

The rental markets for durables are not necessarily as well organised as the rented housing market, and thus it is difficult to find prices for similar services. For this reason, the output of consumer durables is calculated using a user cost or rental price. This is defined as the rate of return plus depreciation, minus capital gain/loss plus an interaction term:

$$r_t = p_{(t-1)}(q_t + d_t - \pi_t + d_t\pi_t), \quad (7)$$

where, *r* is the user cost, *p* designates the price index for new capital goods, *q* is the net rate of return, *d* is the rate of depreciation and π is the holding gain or loss, i.e. the change in prices from time *t-1* to time *t* (Hall and Jorgenson 1967; Ho, Jorgenson and Stiroh 1999; Diewert, Harrison and Schreyer 2004). The subscript denoting asset type has been suppressed for

[20] SNA93, paragraph 6.89.

economy of exposition. The annual price changes were smoothed using a Hodrick-Prescott (1997) filter.[21] The net rate of return was calculated using the exogenous (external), ex-post method.[22]

The weights of alternative rates of return for durable goods have been calculated from the annual Monetary Union Financial Accounts (MUFA). Three different categories of assets have been used in the calculation: currencies and deposits, shares, and debt securities (including mutual funds). The returns of the currencies and deposits were calculated by using one-month Euribor (Euro Interbank Offered Rate). The returns of shares were calculated by using the Dow Jones Euro STOXX price index, and finally, the returns of debt securities were calculated by using the three-year EA Government benchmark bond yield. The rates of return were also smoothed using the same Hodrick-Prescott filter.

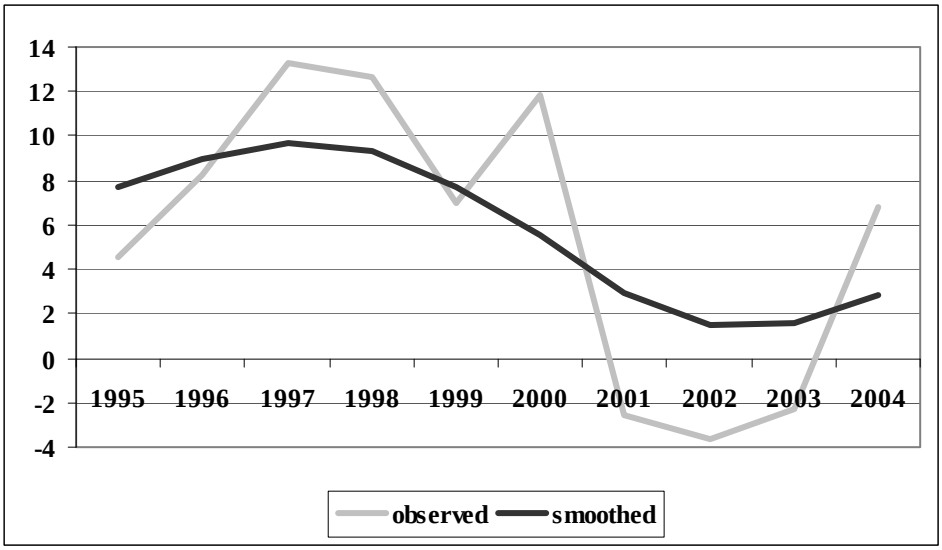

Figure 1: Observed and smoothed net rates of return, 1995-2004

Since we are assuming no intermediate consumption, the final step needed to calculate the outputs[23] is to multiply the user cost with the constant price average[24] stock of consumer durables in the year in question:

$$cpYCD_t = r_t \overline{SCD_t} \,. \tag{8}$$

[21] The smoothing parameter λ=6.25 was used.
[22] The same methodology was used in Jalava and Kavonius (2007).
[23] This output is on the use side of the total balance of supply and demand used as private consumption.
[24] Year *t* and *t-1* average since the stock is the year-end situation and the other economic transactions are valued at the average prices of the year.

Equation (8) gave us the current price value of the services of consumer durables. For growth accounting purposes we also need it in volume terms. For a homogeneous asset type the volume change is the change in the volume of that asset's productive capital stock.[25] In aggregating the separate consumer durable asset types we followed Jorgenson, Ho and Stiroh (2005) and used a Törnqvist aggregation procedure were the average year *t* and *t-1* outputs by type of asset were used as weights.

This paper assumes the value of the services of consumer durables to be equal to gross value added (GVA), i.e. it has been assumed that the service flows do not have any intermediate consumption. This is of course not fully true but most likely these flows are small. For instance in the case of fridges or cars these costs would be reparation costs; these costs are by assumption not very high in relation to the actual output value.[26]

4. Results

Treating consumer durables as investments has a surprisingly large impact on the level of EA gross value added. The ratio of the output of consumer durables to unrevised GVA (both at current prices) varies between 6.45 and 9.64 per cent annually. On average it is 8.03 per cent in the years 1995-2004 (table 3). The GVA impact is lessening towards the end of the period since the output of consumer durables only stayed level although nominal GVA increased by a quarter in the decade we are observing. The impact of consumer durable assets on the EA capital stock cannot yet be estimated since the capital stocks underlying the capital service calculations have not been released in the EU KLEMS database.

Table 3: Levels of (uncorrected) EA GVA and output of consumer durables in millions of PPP-converted EUR, 1995-2004

	1995	2000	2004	Average 1995-2004
GVA at current basic prices	**5,237,468**	**5,983,166**	**6,593,548**	
Output of consumer durables	**465,437**	**465,597**	**461,009**	
Ratio*	**8.89**	**7.78**	**6.99**	**8.03**
***=%**				

Sources: www.euklems.net and own calculations.

[25] OECD (2007).
[26] So, we have in fact capitalized the investments of household production.

According to the growth accounting results published by the EU KLEMS consortium in November 2007 the EA gross value added (GVA) grew in volume terms on average by 1.92 per cent annually in the years 1995-2004 (table 4). This growth stemmed nine-tenths from the combined effect of the inputs and the rest was attributed to multi-factor productivity (MFP) (equation 3). One third of economic growth came from labour services and almost sixty per cent from capital services (of which twenty percentage points was related to ICT capital services). Capitalising durables does not radically alter our general perception of the proximate sources of EA economic growth. The relative contributions of the inputs and the residual remain similar. There are, however, important differences. Economic growth was actually faster than previously perceived (2.00 per cent annually and not 1.92). Furthermore, the capital services of durable goods were one-tenth of economic growth. This naturally implies that the contributions of the other inputs were lower.

Table 4: Growth of EA GVA and its components with and without capitalized durables, 1995-2004

	EU KLEMS, Nov. 2007 1995-2004	EU KLEMS with durables 1995-2004
Quantity of GVA*	**1.92**	**2.00**
Capital services**	**1.11**	**1.24**
Durables	**-**	**0.21**
ICT	**0.39**	**0.36**
Other	**0.72**	**0.67**
Labour services**	**0.63**	**0.58**
MFP**	**0.18**	**0.18**
***=ln-%		
****=ln-%points		

Sources: www.euklems.net and own calculations. May not sum to totals due to averages and rounding.

Another way of looking at economic growth is to decompose it into the impacts of labour input and labour productivity (table 5). Hours worked increased in the observation period at the brisk rate of 0.79 per cent per annum. The new treatment of consumer durables boosted economic growth by 0.08 percentage points annually and labour productivity growth by 0.07 percentage points. Using equation 4 we found that of the new labour productivity growth estimate of 1.20 per cent annually as much as 0.15 percentage points, or one-eighth, was attributed to the share weighted increase of durable good capital services per hour worked by our calculations. One-sixth of labour productivity growth stemmed from ICT capital deepening.

Again, the contributions of the other inputs turned out to be lower than earlier thought. The residual remained unchanged.

Table 5: Growth of EA labour productivity and its components with and without capitalized durables, 1995-2004

	EU KLEMS, Nov. 2007 1995-2004	EU KLEMS with durables 1995-2004
Quantity of GVA*	1.92	2.00
Hours worked*	0.79	0.79
Labour productivity*	1.13	1.20
Capital deepening**	0.83	0.92
Durables	-	0.15
ICT	0.36	0.33
Other	0.47	0.44
Labour quality**	0.11	0.10
MFP**	0.18	0.18
*=ln-%		
**=ln-%points		

Sources: www.euklems.net and own calculations. May not sum to totals due to averages and rounding.

5. Conclusions

The purpose of this paper was to estimate the effects of ICT and durable goods, when they are treated as investments, on EA GDP and productivity growth. The increasing use of technology and the breakthrough of home/entertainment technology in the past few decades emphasises the importance of this kind of analysis. Capitalising consumer durables has a surprisingly large impact on the level of EA economic growth. In relation to unrevised GVA the share is around 8 per cent on average in the years 1995-2004.

The results of this paper also show that the new treatment of consumer durables increases annual GVA growth by 0.08 percentage points and labour productivity growth by 0.07 percentage points as the new growth of GVA is two and labour productivity growth is 1.2 per cent. Furthermore, our growth accounting computations demonstrated that the capital services of durables contributed one-tenth of economic growth and one-eight of labour productivity growth. It was no surprise that ICT's impacts were larger, i.e., one-fifth of GVA growth and one-sixth of labour productivity growth.

In conclusion we return to the question posed in the title of our paper: Are ICT and durables the drivers of EA productivity growth? The answer is yes; the combined contribution of ICT and durable capital deepening is the most important component of EA labour productivity growth. The role of other capital deepening is nearly as big. However, previously we thought that the deepening of other capital carried by far the largest contribution.

As the outcome of this paper is that the alternative treatment of durable goods as well ICT has a considerable effect on economic growth and productivity, it is not difficult to find a policy recommendation or justification for this paper. This paper emphasises that in fiscal as well as monetary policy decision-making a broader view is needed in order to scrutinise economic growth and its sources. The alternative or additional measures of GDP and its decomposition as presented in this paper help better to understand the proximate sources of economic growth.

References

Abramovitz, M. (1956): "Resource and output trends in the United States since 1870", *American Economic Review* 46, 5-23.

Basu, S. and Fernald, J. (2006): "Information and communications technology as a general-purpose technology: Evidence from U.S industry data", Working Paper 2006-29, Federal Reserve Bank of San Francisco.

Carreras, A. and Tafunell, X. (2004): "European Union economic growth experience, 1830–2000", in S. Heikkinen and J.L. van Zanden (eds.), *Explorations in economic growth. A festschrift for Riitta Hjerppe on her 60th birthday*, Amsterdam: Aksant Academic Publishers.

Christensen, L.R. and Jorgenson, D.W. (1970): "U.S. real product and real factor input, 1929-1967", *Review of Income and Wealth* 16, 19-50.

David, P.A. and Wright, G. (1999): "Early twentieth century production growth dynamics: An inquiry into the economic history of "our ignorance"", Discussion Papers in Economic and Social History, University of Oxford.

David, P. A. and Wright, G. (2003): "General Purpose Technologies and Surges in Productivity: Historical Reflections on the Future of the ICT Revolution", in P.A. David and M. Taylor (eds.), *The Economic Future in Historical Perspective*, Oxford: Oxford University Press.

Diewert, W.E., Harrison, A. and Schreyer, P. (2004): "Cost of capital services in the production account", paper presented to the meeting of the Canberra group on non-financial assets, 1-3 September 2004, in London, England.

Easterlin, R.A. (1996): *Growth triumphant. The twenty-first century in historical perspective*, Ann Arbor: University of Michigan Press.

ESA95 (1996): *European System of Accounts*, Luxembourg: Eurostat.

Hall, R.E. and Jorgenson, D.W. (1967): "Tax policy and investment behavior", *American Economic Review* 57, 391-414.

Ho, M.S., Jorgenson, D.W. and Stiroh, K.J. (1999): "U.S. high-tech investment and the pervasive slowdown in the growth of capital services", (http://ksgwww.harvard.edu/m-rcbg/ptep/hitech.pdf).

Hodrick, R.J., and Prescott, E.C. (1997): "Postwar U.S. business cycles: An empirical investigation", *Journal of Money, Credit and Banking* 29, 1-16.

Hulten, C.R. (2006): "The "architecture" of capital accounting: Basic design principles", in D.W. Jorgenson, J.S. Landefeld, and W.D. Nordhaus (eds.), *A new architecture for the U.S. national accounts*, NBER Studies in income and wealth, vol. 66, Chicago and London: University of Chicago Press.

Jalava, J. and Kavonius, I.K. (2007): "Durable goods and their effect on household saving ratios in the Euro Area", European Central Bank, Working Paper Series No. 755, May.

Jalava, J. and Pohjola, M. (2008): "The roles of electricity and ICT in economic growth: Case Finland", *Explorations in Economic History,* forthcoming.

Jorgenson, D. W and Fraumeni, B. M. (1989) The Accumulation of Human and Nonhuman Capital, 1984-84. In The Measurement of Saving, Investment, and Wealth, eds. R. E. Lipsey and H. S. Tice. Studies in Income and Wealth, vol. 52 (Chicago, IL, University of Chicago Press). Reprinted in D.W. Jorgenson (1995) Productivity, Volume 1: Postwar U.S. Economic Growth (Cambridge, MA and London, England: The MIT Press).

Jorgenson, D.W., Ho, M.S., and Stiroh, K.J. (2003): "Lessons from the US growth resurgence", *Journal of Policy Modeling* 25, 453–470.

Jorgenson, D.W., Ho, M.S. and Stiroh, K.J. (2005): *Productivity volume 3: Information technology and the American growth resurgence*, Cambridge, Massachusetts and London, England: The MIT Press.

Jorgenson, D.W. and Landefeld, J.S. (2006): "Blueprint for expanded and integrated U.S. accounts. Review, assessment, and next steps", in D.W. Jorgenson, J.S. Landefeld, and W.D. Nordhaus (eds.), *A new architecture for the U.S. national accounts*, NBER Studies in income and wealth, vol. 66, Chicago and London: University of Chicago Press.

Jorgenson, D.W. and Stiroh, K.J. (2000): "Raising the Speed Limit: U.S. Economic Growth in the Information Age", *Brookings Papers on Economic Activity*, No. 1.

Kuznets, S. (1966): *Modern economic growth: Rate, structure, and spread*, New Haven: Yale University Press.

Maddison, A. (2007): "World population, GDP and Per capita GDP, 1-2003 AD", (http://www.ggdc.net/Maddison/) (update: August 2007).

Mokyr, J. (2005): "Long-term Economic Growth and the History of Technology", in P. Aghion and S.N. Durlauf (eds.), *Handbook of Economic Growth, Volume 1B*, Amsterdam: North-Holland.

OECD (2007): "Measuring Capital, Revised Manual", OECD Working Party on National Accounts, STD/CSTAT/WPNA(2007)2, OECD.

Perozek, M.G. and Reinsdorf, M.B. (2002): "Alternative measures of personal saving", OECD meeting of national accounts experts, STD/NA(2002)8, OECD. (http://www.oecd.org/dataoecd/27/1/1958984.pdf)

SNA93 (1993): *System of National Accounts 1993*, UN, OECD, EU, IMF, World Bank, series F, no. 2, rev. 4,. New York: United Nations.

Statistics Denmark (2004): Værdien af varige forbrugsgoder 1966-2004.

Statistics Pocketbook, January 2008, European Central Bank.

Stiroh, K. (2002): "Are ICT Spillovers Driving the New Economy?", *Review of Income and Wealth* 48, 33-57.

Timmer, M., O'Mahony, M. and van Ark, B. (2007): "The EU KLEMS Growth and Productivity Accounts: An Overview", manuscript.

Timmer, M., van Moergastel, T., Stuivenwold, E., Ypma, G., O'Mahony, M. and Kangasniemi, M. (2007): "The EU KLEMS Growth and Productivity Accounts, Version 1.0, Part I Methodology", manuscript.

Timmer, M.P., Ypma, G. and van Ark, B. (2007): "PPPs for Industry Output: A New Dataset for International Comparisons", EU KLEMS Working Paper Series No. 16, March.

E L I N K E I N O E L Ä M Ä N T U T K I M U S L A I T O S (ETLA)
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
LÖNNROTINKATU 4 B, FIN-00120 HELSINKI

Puh./Tel. (09) 609 900 Telefax (09) 601753
Int. 358-9-609 900 Int. 358-9-601 753
http://www.etla.fi

KESKUSTELUAIHEITA - DISCUSSION PAPERS ISSN 0781-6847

Julkaisut ovat saatavissa elektronisessa muodossa internet-osoitteessa:
http://www.etla.fi/finnish/research/publications/searchengine

No 1101 TUOMO NIKULAINEN, Identifying Nanotechnological Linkages in the Finnish Economy. An Explorative Study. 25.09.2007. 31 p.

No 1102 HELI KOSKI, Do Technology Diffusion Theories Explain the OSS Business Model Adoption Patterns? 29.10.2007. 26 p.

No 1103 JUKKA JALAVA – PIRKKO AULIN-AHMAVAARA – AKU ALANEN, Intangible Capital in the Finnish Business Sector, 1975-2005. 29.10.2007. 25 p.

No 1104 BÖCKERMAN, Petri – JOHANSSON, Edvard – HELAKORPI, Satu – UUTELA, Antti, Economic Inequality and Health: Looking Beyond Aggregate Indicators. 05.11.2007. 21 p.

No 1105 MIKA MALIRANTA – RITA ASPLUND, Training and Hiring Strategies to Improve Firm Performance. 08.11.2007. 45 p.

No 1106 ESTEBAN FERNÁNDEZ VÁZQUEZ – BART LOS, A Maximum Entropy Approach to the Identification of Productive Technology Spillovers. 08.11.2007. 21 p.

No 1107 SAMI NAPARI, Is There a Motherhood Wage Penalty in The Finnish Private Sector? 20.11.2007. 46 p.

No 1108 ANTTI LÖNNQVIST, Intellectual Capital and Productivity: Identification and Measurement of the Relationship at Company-Level. 20.11.2007. 20 p.

No 1109 MIKA MALIRANTA – PETRI ROUVINEN, Aineettomat investoinnit Suomen yrityksissä vuonna 2004: kokeilu yritysaineistoilla. 20.11.2007. 16 s.

No 1110 ANNU KOTIRANTA – ANNE KOVALAINEN – PETRI ROUVINEN, Naisjohtoiset yritykset muita kannattavampia? 20.11.2007. 23 s.

No 1111 MIKA MALIRANTA – SATU NURMI – HANNA VIRTANEN, It Takes Three to Tango in Employment: Matching Vocational Education Organisations, Students and Companies in Labour Markets. 07.12.2007. 36 p.

No 1112 EDVARD JOHANSSON – PETRI BÖCKERMAN – ANTTI UUTELA, Alcohol Consumption and Sickness Absence: Evidence from Panel Data. 10.12.2007. 10 p.

No 1113 MIKA WIDGRÉN – KARI ALHO – MARKKU KOTILAINEN – NUUTTI NIKULA – VILLE KAITILA, Avautuva talous ja aluekehitys – suhteellinen etu ja kasautumisvoimat tuotannon sijoittumisen ohjaajina Suomessa. 12.12.2007. 79 s.

No 1114 MIKA MALIRANTA – SATU NURMI, Does Foreign Presence Stimulate Creative Destruction in Local Markets? 17.12.2007. 15 p.

No 1115 VILLE KAITILA – KARI E.O. ALHO – NUUTTI NIKULA, Growth Prospects of Emerging Market Economies in Europe – How Fast will They Catch up with the Old West? 31.12.2007. 46 p.

No 1116 MIKA MALIRANTA – PIERRE MOHNEN – PETRI ROUVINEN, Is Inter-firm Labor Mobility a Channel of Knowledge Spillovers? Evidence from a Linked Employer-Employee Panel.02.01.2008. 26 p.

No 1117 PIA NYKÄNEN, Sukupuolen vaikutus nuorten toimihenkilöiden urakehitykseen. 07.01.2008. 84 s.

No 1118 MIKA PAJARINEN – PETRI ROUVINEN, Verkostoitumisen yhteys yritysten kannattavuuteen ja kasvuun: Empiirisiä havaintoja. 14.01.2008. 14 s.

No 1119 JYRKI ALI-YRKKÖ – OLLI MARTIKAINEN, Ohjelmistoalan nykytila Suomessa. 21.01.2008. 19 s.

No 1120 SAMI NAPARI, Sukupuolten ammatillinen segregaatio Suomen yksityisellä sektorilla vuosina 1995-2004. 22.01.2008. 30 s.

No 1121 DEREK C. JONES – PANU KALMI – TAKAO KATO – MIKKO MÄKINEN, The Effects of Human Resource Management Practices on Firm Productivity – Preliminary Evidence from Finland. 28.01.2008. 29 p.

No 1122 KARI E.O. ALHO (Ed.), Tax/benefit Systems and Growth Potential of the EU. 31.01.2008. 89 p.

No 1123 VILLE KAITILA – ANNI NEVALAINEN – MIKA MALIRANTA – REIJO MANKINEN, Tuottavuuden mittaaminen – Suomi kansainvälisessä vertailussa. 27.02.2008. 39 s.

No 1124 KARI E.O. ALHO, Trade with the West and Russia – A Long-term Perspective on Finnish Economic Growth, Fluctuations and Policies. 22.02.2008. 28 p.

No 1125 OLAVI RANTALA, Sosiaalietuuksien rahoituksen alueelliset kuluttajahintavaikutukset. 03.03.2008. 25 s.

No 1126 PASI HUOVINEN – PETRI ROUVINEN, Does Mass Media Fuel, and Easy Credit Facilitate, Impulse Buys? 10.03.2008. 15 p.

No 1127 JUKKA LASSILA – TARMO VALKONEN, Applying The Swedish Pension Brake. 01.04.2008. 16 p.

No 1128 KARI E.O. ALHO, Regulation of Energy Prices in Russia. 25.03.2008. 20 p.

No 1129 ARI HYYTINEN – PETRI ROUVINEN, The Labour Market Consequences of Self-Employment Spells: European Evidence. 25.03.2008. 25 p.

No 1130 RAINE HERMANS – MARTTI KULVIK – ANTTI-JUSSI TAHVANAINEN, Biotekniikan ennakointi. 26.03.2008. 23 s.

No 1131 DEREK C. JONES – PANU KALMI – TAKAO KATO – MIKKO MÄKINEN, The Incidence and Determinants of Employee Involvement – Evidence from the Finnish Manufacturing Sector. 28.03.2008. 24 p.

No 1132 JUKKA JALAVA – ILJA KRISTIAN KAVONIUS, Durable Goods and ICT: The Drivers of Euro Area Productivity Growth? 18.04.2008. 18 p.

Elinkeinoelämän Tutkimuslaitoksen julkaisemat "Keskusteluaiheet" ovat raportteja alustavista tutkimustuloksista ja väliraportteja tekeillä olevista tutkimuksista. Tässä sarjassa julkaistuja monisteita on mahdollista ostaa Taloustieto Oy:stä kopiointi- ja toimituskuluja vastaavaan hintaan.

Papers in this series are reports on preliminary research results and on studies in progress. They are sold by Taloustieto Oy for a nominal fee covering copying and postage costs.