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Climate Protection Potential of Digital Transformation - the Role of Production Relocation

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Abstract

Information and communication technologies (ICTs) are a potential source of energy efficiency improvements as they enhance both the quantity and the quality of data and therefore the overall efficiency of production processes. Previous sector-level studies find large energy saving contributions of ICTs. However, existing literature relies on data for the early phase of digitalisation, and does not sufficiently control for the facilitated possibility of relocating energy intensive production processes to low-cost countries due to the diffusion of ICT. This paper analyses the relationship between ICT/digitalisation and energy demand at the industry level. Our cross-country cross-industry panel data set for nine OECD countries, 28 industries and the period 2000 to 2014 also includes data about energy demand along the global value chain (GVC). We are therefore able to provide a more realistic view on the impact of digitalisation on the relative energy demand. Our econometric analysis confirms the negative association between ICT and energy demand (meaning less energy consumption) found in previous studies but with a much smaller effect size. Controlling for the energy use for the production of intermediate inputs along whole global value chain for the goods and services produced in our nine OECD countries, we still find a significant relationship between ICT and energy demand.

Keywords: Digitalisation, ICT, Production relocation, Energy use.

JEL Classification Numbers: O33, O44, Q43.

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1 Introduction

"Digital technologies are a critical enabler for attaining the sustainability goals of the Green deal in many different sectors" (European Green Deal; European Commission 2019). This sentence from European Green Deal shows the high hopes that politicians are putting in digitisation to achieve the climate goals. On the one hand, information and communication technologies (ICT) or more general digitalisation is a potential source of energy efficiency improvements (see e.g. GeSI & Accenture 2015) as ICTs improve the quantity and quality of information leading to a reduction of energy consumption (e.g., smart manufacturing). On the other hand, ICTs consume energy themselves and improvements in performance per watt may not offset the higher demand for computing power in a more a more digitalised world. A priori, the net effect of digitalisation is therefore unclear.

Although, the empirical literature on digitalisation and energy consumption at the industry level is still rather scarce, there is some evidence on a positive link (meaning less energy consumption) between investments in ICT and energy demand at the sectoral level (Taneja and Mandys 2022, Schulte et al. 2016, Bernstein and Madlener 2010, Collard et al. 2005). However, there are certain drawbacks of these studies. The most recent data used in these studies ends in 2007, and therefore ignoring the fast pace of digitalisation in the 2010s. Furthermore, as digitalisation advances it is easier to outsource energy intensive production processes to foreign countries. So the measured positive impact of digitalisation might just be driven by the ICT induced relocation of energy intensive production processes to foreign countries instead of actual energy savings.

The contribution of this paper is twofold. Firstly, as in Schulte et al. (2016), we use a translog cost function for estimating the impact of ICT on energy demand at the sectoral level for nine OECD countries based on the share of energy costs in total variable costs, but using more recent data for the period 2000 to 2014. Secondly, we use World Input Output Tables to incorporate the energy consumption of the whole value chain to control for the relocation of energy-intensive production processes to foreign countries. These results give a more detailed insight in the overall impact of ICT on energy demand and climate change and policies can be implemented more efficiently and based on a more evidence-based understanding of all effects ICT has on energy usage.

Our empirical analysis confirms that the negative association between ICT and energy demand of Schulte et al. (2016) still holds in the more recent time period 2000 to 2014. However, the size of the effect is smaller and the results are less robust than in the paper by Schulte et al. (2016). We find that a one percent increase in ICT capital is associated with a 0.110 percent decrease in energy demand which is about half of the effect measured by Schulte et al. (2016) of 0.235 percent. When controlling for the energy demand of the whole value chain, there is still a significantly negative relationship (meaning less energy consumption) between ICT and energy. However the relationship is slightly less significant and the effect size is also slightly lower. So at least a small part of the previously measured positive effect of ICT on energy demand might be explained by the relocation of energy intensive production processes and not by efficiency improvements of ICT.

The paper is organised as follows. Section 2 provides an overview of the current literature. Section 3 gives an overview of the variety of data sources used in this study. The basic empirical approach based on the methodology of Schulte et al. (2016) with an extension for the inclusion of the whole value chain is described in Section 4. Sections 5 and 6 provide descriptive statistics and the regression results of our cost share equations. Section 7 discusses the result and 8 concludes.

2 Related Literature

The ongoing digital transformation as well as climate change and global warming are dominant topics in current public debates. In addition, the relationship between them, i.e., whether digital technologies mitigate or worsen environmental outcomes is increasingly coming into focus. However, the overall impact of digital technologies on the environment is still under debate.

Digital technologies potentially influence energy and resource consumption through different impact channels (Berkhout and Hertin, 2004; Hilty et al., 2006; Horner et al., 2016; Lange et al., 2020). On the one hand, digital technologies may lead to environmental benefits via efficiency improvements as well as an increased dematerialisation and tertiarisation. This idea is mainly based on the thought that the exchange of information does not need any physical body (Berkhout and Hertin, 2004). In a digital economy – instead of mass – bits are exchanged, which are nearly weightless and therefore imply a lower energy and resources usage (Coyle, 1998).

On the other hand, impact channels exist through which digital technologies may hamper environmental improvements. Production, use, and disposal of ICT consume energy and resources themselves. This channel is often called the direct environmental impact of ICT (Berkhout and Hertin, 2004; Horner et al., 2016; Lange et al., 2020). Moreover, ICT-induced economic growth as well as further structural and behavioural changes such as rebound effects may have additional detrimental effects on the environment. For example, economic growth increases income. The resulting additional consumption could be spend on goods that may reduce potential environmental improvements trough ICT.

Accordingly, a wide range of mechanisms needs to be considered when analysing the overall environmental impact of the digital transformation and it may depend on the perspective whether digital technologies mitigate or worsen environmental outcomes. Related empirical studies come to different conclusions (Chimbo, 2020; Lange et al., 2020). For instance, the following studies confirm an increased electricity use due to digitalisation. Sadorsky (2012) analyses emerging economies between 1993 and 2008 and finds an increased electricity demand at the country level. Salahuddin and Alam (2016) come to a similar result in an analysis of 26 OECD countries (1990 to 2012). They find, for example, that a growing number of Internet users relates to a per capita increase in electricity consumption. Evaluating European economies from 1990 to 2017, Magazzino et al. (2021) confirm a positive effect on electricity demand due to ICT usage for Europe. Chimbo (2020), however, finds mixed results for electricity consumption depending on the econometric approach when examining transitional economies from 1995 to 2014.

Moreover, studies exist at the country level that show mixed results with respect to overall energy use or carbon emissions. Using panel data between 1994 and 2014 on BRICS economies, Haseeb et al. (2019) state that Internet usage and mobile cellular subscriptions are linked to lower carbon emissions. Also considering fast-emerging countries, Faisal et al. (2020) find that the relationship between ICT usage and carbon emissions is inverse u-shaped indicating that carbon emissions decline after ICT usage reaches a certain threshold. Kopp and Lange (2019) investigate 37 countries and differentiate between a production side (data from 1990 to 2009) and a consumption side (data from 2008 to 2014). They measure that ICT (slightly) promotes environmental sustainability on both sides. Moreover they consider global value chains for the consumption side, but not for the production side.

Literature that exclusively focus on economic sectors as in our paper also shows mixed results. Analysing ICT usage in ten OECD countries and 27 industries between 1995 and 2007, Schulte et al. (2016) find that ICT usage is related to significant reductions in energy demand. Moreover, it is only significantly associated with a lower demand in non-electric energy, but not with reductions in electric energy demand. In comparison, Collard et al. (2005) measure for the French service sector (1986 to 1998) that electricity intensity grows with computers and software, while it declines with the application of communication devices. Using data on eight European countries from 1991 to 2005, Bernstein and Madlener (2010) find that the direction of effects with respect to computer and software usage depends on the analysed sector and confirm electricity savings related to communication technologies across sectors. Considering production processes, all these studies only look at specific sets of countries or sectors and do not consider global values chains, which go across observational units. In other words, a potential relocation of production processes has mainly remained unconsidered in previous literature. However, "ICT reduces the transaction and adjustment costs of moving activity outside the firm, and of carrying it out at greater geographic distance" (Abramovsky and Griffith, 2006, p.594).[1] One reason for this is that ICT improves coordination. Accordingly, digital technologies facilitate the geographically-decentralized organization of production processes. This may have various consequences. In particular, it potentially leads to the issue that energy-intensive production processes become easier to relocate at places with lower production costs. This means for the analysis of the impact of ICT on energy use that the change in energy use may have not been correctly accounted for in previous studies. Those studies investigating countries or sectors where energy-intensive production processes are outsourced to offshore locations may overestimate energy savings. Analogously, studies focusing on countries or sectors where energy-intensive production processes are relocated to may underestimate environmental benefits.

One motivation for relocating production processes abroad is to save energy costs. These, for instance, can diverge due to different environmental regulation regimes across countries. As digital technologies reduce transaction and adjustment costs associated with outsourcing, they increase the attractiveness of relocating production processes to less regulated regions where energy costs may be lower. Arguments here are closely related to the pollution heaven hypothesis or the carbon leakage discussion. Ideas in this regard basically state that environmental regulation will generate incentives to shift affected production processes to less regulated regions (Levinson and Taylor, 2008). For example, see Cole and Elliott (2005); Dean et al. (2009); Aichele and Felbermayr (2015); Naegele and Zaklan (2019) and Zhang et al. (2017) for studies examining this issue. Our study contributes to this discussion by analysing whether digital technologies relate to a relocation of energy-intensive production processes abroad and therefore facilitate pollution heavens or carbon leakage.

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[1] See also Bartel et al. (2005) for similar ideas.

3 Data

We combine four different main data sets and some auxiliary statistics in order to unify a comprehensive sample set. The main building block of our data set is the EU KLEMS database release 2017[2]. This EU KLEMS release provides measures for growth and productivity accounts comprising detailed information about ICT (Software ($Soft$), Hardware (HW), Communications Equipment (CT)) and non-ICT assets (N), labour inputs and output variables for 28 EU member states and the US over the time frame of 1995 to 2015 for 33 distinct[3] industries (see Van Ark and Jäger 2017). Our sample consists of the following countries AUT, DNK, ESP, FIN, GER, ITA, NLD, UK, and USA.[4]

As we want to include the energy consumption along the whole value chain in a second step of our analysis, we need World Input-Output Tables. The WIOD World Input-Output Tables (WIOT) Release 2016[5] provides data for 43 countries and one "synthetic" country for the rest of the world (ROW) for 56 industries for the time period 2000 to 2014. World-Input-Output-Tables are built in the sense that every observation corresponds to a country-specific industry (see Timmer et al. 2015 for a detailed description of the WIOD World Input-Output Tables).

For the energy quantities, we rely on the environmental accounts (EA).In previous WIOD releases, the environmental accounts were directly part of WIOD. For the WIOD 2016 release, the data on EA is provided by the Joint Research Centre (JRC) of the European Commission (European Commission. Joint Research Centre. 2019). The JRC environmental accounts are linked to the WIOD but not directly part of it, in contrast to the Environmental Accounts (EA) 2013 release which was part of WIOD.[6] We follow the approach by Schulte et al. (2016) and aggregate different energy variables for non-electric energy and electric energy. Within non-electric energy we classify energy variables into four different groups: coal, gasoline, oil and natural gas (see Table A.3). For example, the category for coal includes hcoal (anthracite), bcoal (lignite), and coke (coke oven coke). These three are summed up and multiplied by a constructed price for energy of coal. The new version of the EA by the JRC is not as disaggregated as the WIOD EA 2013 release. This aggregation causes problems for the coal category, because coal and crude oil are combined in the group COAL_COKE_CRUDE. Another problem is that the WIOD 2013 distinguishes between energy distribution loss, heat production and electricity, whereas JRC EA does not (see Figure A.1 in the Appendix).

As in the WIOD Environmental Accounts (EA) 2013, the new data provided by the JRC also has two

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[2] `http://www.euklems.net/`. In the 2018 update of the 2017 release of EU KLEMS (September 2017 release, Revised July 2018) data on ICT capital does not seem reliable as the share of ICT capital compensation on total factor compensation is far too high for Germany and is therefore not considered.

[3] Following Schulte et al. (2016), Industries 19 (Manufacture of Coke and Refined Petroleum Products) and D-E (Electricity, Gas, Steam and Air Conditioning Supply, Water Supply; Sewerage, Waste Management and Remediation Activities) are excluded from the regressions since "both are energy producing sectors and thus have a completely different production structure concerning energy demand than the remaining industries". Furthermore, again following Schulte et al. (2016), industry 68 (Real Estate Activities) as well as T (Activities of Households as Employers) and U (Activities of Extraterritorial Organizations and Bodies) are excluded from the sample.

[4] The sample in Schulte et al. (2016), who are relying on data from an earlier EU KLEMS release, additionally includes JPN. Unfortunately, the 2017 EU KLEMS release does not contain data for Japan. The even newer EU KLEMS release 2019 (`www.euklems.eu`) does include Japan, but uses different distinction between ICT and Non-ICT capital, as software is now part of the new asset category intangible assets.

[5] See `http://www.wiod.org/database/wiots16`.

[6] See `http://www.wiod.org/database/eas13`.

different ways of measuring energy use: (1) gross energy use and (2) emission relevant energy. The later excludes non-energy use of energy commodities (e.g. naphtha for basic chemicals production) and input of energy commodities for transformation into other fuels.[7], which is more appropriate for our research question.

Our empirical analysis is based on a cost function approach. Apart from energy quantities, we therefore also need energy prices. The main source for the energy prices are the IEA Energy Prices and Taxes Statistics 2020[8].

Separate PPPs for output intermediate input, labour input and for capital input are not available anymore.[9] We therefore, use just plain USD data. As a robustness check, we present our descriptive statistics and our main regression also in national currencies and general PPPs in Appendix A.3.5. In our second part of the analysis including the whole value chain, nominal energy costs are deflated by industry-specific US intermediate input deflators, labour costs by industry-specific US value added deflators.

4 Empirical Framework

4.1 Baseline Model

Our empirical model is based on the work of Schulte et al. (2016), who are using a variable cost function approach with capital as a quasi-fixed factor (compare Brown 1981) for estimating the relationship between ICT and energy consumption. Variable costs are defined by Energy (E) and labour (L) and the corresponding energy prices P_E and labour prices P_L:

$$VC = P_E E + P_L L \tag{1}$$

The cost function is approximated by a twice differentiable, linearly homogeneous translog function that is concave in factor prices:

$$\begin{aligned} lnVC =&\beta_0 + \beta_Y lnY + \frac{1}{2}\beta_{YY}ln(Y)^2 + \beta_T t + \frac{1}{2}\beta_{TT}t^2 + \sum_k \beta_k lnP_k + \sum_m \beta_{K_m} lnK_m \\ &+ \frac{1}{2}\sum_k\sum_l \beta_{kl} lnP_k lnP_l + \frac{1}{2}\sum_m\sum_n \beta_{K_mK_n} lnK_m lnK_n + \sum_k \beta_{kY} lnP_k lnY \\ &+ \sum_m \beta_{K_mY} lnK_m lnY + \sum_k\sum_m \beta_{kK_m} lnP_k lnK_m + \sum_k \delta_{kT} lnP_k t \\ &+ \sum_m \delta_{K_mT} lnK_m t + \delta_{YT} lnYt \end{aligned} \tag{2}$$

Making use of Shepard's Lemma and also applying homogeneity of degree one in input prices leads to

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[7] See European Commission. Joint Research Centre. (2019), page 17.

[8] See `https://doi.org/10.1787/eneprice-data-en`.

[9] Schulte et al. (2016) used these detailed output and input PPPs from the GGDC Productivity Level Database. See Inklaar and Timmer (2008) for details.

the standard cost share equation:

$$S_E = \beta_E + \beta_{EE} ln(\frac{P_E}{P_L}) + \beta_{EK_{ICT}} ln(\frac{K_{ICT}}{Y}) + \beta_{EK_N} ln(\frac{K_N}{Y}) + \beta_{EY} lnY + \delta_{ET} t \tag{3}$$

with $k, l \in \{E, L\}$ and $m, n \in \{ICT, N\}$.

S_E denotes the share of energy costs in variable costs as defined above. E denote the energy quantity in TJ and L the labour input (labour services) and P_E and P_L are the prices for energy and labour respectively. The ICT and non-ICT capital services[10] are denoted as K_{ICT} and K_N while Y is the real value added plus energy costs. t is the time period of 2000 to 2014.

Our empirical model is estimated in first-differences as follows:

$$\begin{aligned} \Delta S_{Eit} = \beta_{EE} \Delta \ln \left(\frac{P_E}{P_L}\right)_{it} + \beta_{EK_{ICT}} \Delta \ln \left(\frac{K_{ICT}}{Y}\right)_{it} \\ + \beta_{EK_N} \Delta \ln \left(\frac{K_N}{Y}\right)_{it} + \beta_{EY} \Delta \ln Y_{it} + \delta_i + e_{it}, \end{aligned} \tag{4}$$

with $e_{it} = \lambda_t + \Delta\mu_{it}$. λ_t are year specific shocks and $\Delta\mu_{it}$ the first-differenced stochastic error term.

The elasticity of energy demand with respect to a change in the quasi-fixed ICT capital input is given as follows:[11]

$$\epsilon_{EK_{ICT}} = \frac{\beta_{K_{ICT}}}{S_E} - S_{K_{ICT}} = -\frac{\partial \ln(Y/E)}{\partial \ln K_{ICT}}, \tag{5}$$

with $S_{K_{ICT}} = \frac{P_{K_{ICT}} K_{ICT}}{VC}$ being the share of ICT capital compensation in total variable costs.

4.2 Including the Energy Consumption of the Global Value Chain

However, as mentioned before, the standard cost share equation neglects any effects of production relocation, which are especially relevant in the case of digitalisation as the outsourcing of production processes is getting easier (e.g. Abramovsky and Griffith 2006, Rasel 2017 and Fort 2017). Ideally we would re-run the regression for the cost share equation above with data for all countries in the world and at the same time controlling for the level of digitalisation and energy use along the whole value chain. Unfortunately, there are no reliable industry-level data available on digitalisation for most of the countries in the world.

Therefore, our alternative approach is to focus again on the nine OECD countries, as before, but incorporate the energy consumption of the intermediate products used for the production of the final products of these nine countries along the value chain of the 43 countries plus the synthetic ‘Rest of the World’ country (ROW) available in the WIOD data base. This gives us an approximation of the net effect of digitalisation in these nine OECD countries on energy consumption controlling for changes in the energy consumption in the whole value chain. However, with this approach, we neglect any posi-

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[10] See e.g. O’Mahony and Timmer (2009) Appendix B for detailed discussion of capital services compared to capital stocks especially in the case of ICT capital.

[11] See Schulte et al. (2016) Appendix 2 for a detailed discussion.

tive or negative impact of ICT on energy consumption in the countries other than our nine focus countries.

To estimate the net effect of digitalisation in our nine OECD countries on energy consumption, we therefore define an augmented cost share equation which with additional controls for the energy demand along the chain of production:

$$\Delta S_{Eit} = \beta_{EE} \Delta \ln \left(\frac{P_E}{P_L}\right)_{it} + \beta_{EK_{ICT}} \Delta \ln \left(\frac{K_{ICT}}{Y}\right)_{it} + \beta_{EK_N} \Delta ln \left(\frac{K_N}{Y}\right)_{it} \\ + \beta_{EE_{foreign}} \Delta \left(\frac{E^{foreign}}{E^{io}}\right)_{it} + \beta_{EE_{home}} \Delta \left(\frac{E^{home}}{E^{io}}\right)_{it} + \beta_{EY} \Delta ln Y_{it} + \delta_{ETi} + e_{it} \tag{6}$$

What is different to equation 4 is the inclusion of $(E^{foreign}/E^{io})$ and (E^{home}/E^{io}). Both jointly reflect the share of energy inputs E used for intermediate products from abroad $(foreign)$ and in other industries in the *home* country for the final production in our industry. E^{io} is the total energy use along the value chain for the final goods production of the respective industry in our nine focus countries. It is defined as the sum of the energy consumption for final goods production of the own industry E^{self}, the energy use in intermediate goods from other industries of the own country $(home)$, plus the energy use intermediate goods from other countries that are used in the production process $(foreign)$.

The methodology to calculate the energy consumption along the global value chains (GVC) is based on the Leontief framework. A detailed description of our adoption of the Leontief framework following the approach of Timmer et al. (2015) is available in Appendix A.2. Also, as before, the term is transformed in first differences and a stochastic error term is added to extract country-industry specific time fixed effects.

5 Descriptive Statistics

Table 5.1 reports descriptive statistics of the cost shares in our estimation sample.[12] The energy cost (S_E - our dependent variable) is 0.086, which is comparable to previous studies. Tables A.7 and A.8 presents the average cost shares for the subperiods 2000 to 2007 and 2008 to2014. It shows that the overall cost share of energy decline from 0.087 in 2000 to 2007 to 0.084 in 2008 to 2014. The decline is mainly driven by reduction of the non-energy cost share S_{NElec} from 0.045 to 0.042.

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[12] Full sample descriptive statistics of the cost shares can be found in Table A.9

Table 5.1: Average cost shares, 2000–2014 - USD - estimation sample

	N	Mean	Median	SD	Min	Max
S_L	2646	.91	.95	.1	.022	1
S_E	2646	.086	.047	.1	.00038	.98
S_{Elec}	2646	.042	.023	.056	8.9e-06	.47
S_{NElec}	2646	.044	.023	.064	.0001	.61
S_{K_N}	2646	.45	.32	.81	.00029	22
$S_{K_{ICT}}$	2646	.073	.034	.16	.0011	1.7

Notes: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped.

Table 5.2 shows the average annual changes (multiplied by 100) of the variables in our regressions as well as some auxiliary variables for a broader picture of the data used in our analysis.[13] As seen in the cost share tables, overall energy cost (S_E) are slightly declining during the period 2001 to 2014, which is driven by the decrease in non-electric energy costs. We see the same pattern for the energy quantities ($\Delta \ln(E)$, $\Delta \ln(Elec)$ and $\Delta \ln(NElec)$).[14] The ICT capital intensity $\Delta \ln(K_{ICT}/Y)$, our main variable of interest, grows by 3.4 percent during the period 2001 to 2014. Tables A.5 and A.6 report the estimation sample descriptive statistics for the periods 2001 to 2007 and 2008 to 2014. It shows that the growth rate of (K_{ICT}/Y) with 3.8 percent in the period 2001 to 2007 is higher than it was between 2008 to 2014.

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[13] Full sample statistics are shown in Table A.10

[14] The energy demand by country energy type and year is displayed in Figures A.2 and A.3 in the Appendix.

Table 5.2: 100x annual change 2001–2014 - USD - estimation sample

	N	Mean	Median	SD	Min	Max
Cost shares						
ΔS_L	2445	.038	-.0033	.79	-3.1	3.8
ΔS_E	2445	-.038	.0033	.79	-3.8	3.1
ΔS_{Elec}	2445	.0028	.0047	.53	-3	2.4
ΔS_{NElec}	2445	-.041	-.0065	.57	-3.5	2.2
Flexible factor quantities:						
$\Delta \ln(L)$	2445	-.037	.22	3.8	-17	15
$\Delta \ln(L)^{h\_empe}$	2445	-.37	-.04	4	-22	19
$\Delta \ln(E)$	2445	-1.3	-.83	8.3	-36	23
$\Delta \ln(Elec)$	2445	.0071	.39	8.7	-45	26
$\Delta \ln(NElec)$	2445	-2.5	-1.8	11	-53	30
Flexible factor prices:						
$\Delta \ln(P_L)$	2445	3.1	2.8	7.7	-35	34
$\Delta \ln(P_L^{h\_empe})$	2445	3.5	3.1	7.8	-34	38
$\Delta \ln(P_E)$	2445	4.4	4.2	8.6	-21	28
$\Delta \ln(P_{Elec})$	2445	3.9	2.9	9.2	-18	35
$\Delta \ln(P_{NElec})$	2445	4.4	4.9	11	-38	29
$\Delta \ln(P_E/P_L)$	2445	1.3	1.1	8.4	-26	27
Fixed input and output quantities:						
$\Delta \ln(K_{ICT})$	2445	6.5	6	9.4	-26	38
$\Delta \ln(K_N)$	2445	3.1	2.7	7.4	-30	29
$\Delta \ln Y$	2445	3.1	3.4	8.1	-27	21
$\Delta \ln(K_{ICT}/Y)$	2445	3.4	3.2	7.3	-18	26
$\Delta \ln(K_N/Y)$	2445	.016	.22	5.3	-18	18
Flexible factor intensities:						
$\Delta \ln(L/Y)$	2445	-3.1	-3.1	7.7	-29	32
$\Delta \ln(E/Y)$	2445	-4.4	-4.6	10	-44	36
Costs:						
$\Delta \ln C_L$	2445	3.1	3.2	8.1	-27	28
$\Delta \ln C_E$	2445	3.1	3.7	12	-50	39
Quantity shares:						
$\Delta(E_{self}/E^{io})$	2445	-.19	-.14	1.8	-15	9.2
$\Delta(E_{home}/E^{io})$	2445	-.4	-.4	2.2	-16	18
$\Delta(E_{foreign}/E^{io})$	2445	.59	.6	2	-12	17

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped.

6 Econometric Results

6.1 Econometric Results - Baseline Results for Nine OECD Countries

Table 6.1 presents the regression results for the standard cost share equation as defined in Equation 4. Our main variable of interest is the growth of the ICT capital services intensity $\Delta \ln(K_{ICT}/Y)$. The most preferred specification is the regression with country-industry dummies and year fixed effects in column

(2). The ICT capital coefficient $\beta_{EK_{ICT}}$ is -0.0031 and significant at the five percent level. For easier interpretation, the elasticity energy demand with respect to ICT capital as described in equation 5 is provided in the third last row of Table 6.1. An elasticity of -0.110 means that a one percent increase in ICT capital is associated with a 0.110 percent decrease in energy demand. However, we do not find any significant relationship between ICT and energy demand if we split up the sample into manufacturing ($Manu$) and services ($Serv$) sector subsamples.[15]

Table 6.1: Baseline results - 2001–2014 - dependent variable: ΔS_E

	(1) POLS	(2) CxI	(3) C+I	(4) CxI Manu.	(5) CxI Serv.	(6) C+I Manu.	(7) C+I Serv.
$\Delta\ln(P_E/P_L)$	0.0343***	0.0360***	0.0360***	0.0741***	0.0240***	0.0738***	0.0242***
	(0.002)	(0.002)	(0.002)	(0.007)	(0.003)	(0.006)	(0.002)
$\Delta\ln(K_{ICT}/Y)$	-0.0064**	-0.0031**	-0.0046***	0.0005	-0.0001	-0.0011	-0.0011
	(0.002)	(0.001)	(0.001)	(0.003)	(0.002)	(0.003)	(0.002)
$\Delta\ln(K_N/Y)$	-0.0079**	-0.0139**	-0.0141***	-0.0262*	-0.0116*	-0.0242**	-0.0119**
	(0.003)	(0.005)	(0.004)	(0.013)	(0.005)	(0.009)	(0.004)
$\Delta\ln Y$	-0.0048**	-0.0044	-0.0044*	-0.0080	0.0019	-0.0069	0.0017
	(0.002)	(0.003)	(0.002)	(0.005)	(0.003)	(0.005)	(0.003)
Year DVs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Industry	No	Yes	No	Yes	Yes	No	No
Country DVs	No	No	Yes	No	No	Yes	Yes
Industry DVs	No	No	Yes	No	No	Yes	Yes
Elasticities	-0.149	-0.110	-0.127	.	.	.	.
Adjusted R^2	0.332	0.328	0.349	0.408	0.439	0.434	0.445
Observations	2445	2445	2445	989	1255	989	1255

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014.

6.2 Econometric Results - Robustness Checks

To verify the validity of our baseline results, several robustness checks are conducted. Table A.11 provides the results for different sub-periods. It shows that especially the period 2011 to 2014 is highly significant. In Table A.13 results for several additional sector definitions like market sector and market services are displayed. However, our coefficient of interest $\beta_{EK_{ICT}}$ is always insignificant, which nevertheless might be driven by the reduced sample size. Table A.14 shows the results with hours worked instead of labour services.[16] These results are qualitative similar to the baseline results in Table 6.1. Moreover, Table A.15 provides results equivalent to the baseline results but without weights. Again, the results are qualitative

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[15] See Table A.2 for the industries included in the full sample and the manufacturing and services sector subsample.

[16] Labour services instead of plain hours worked take the heterogeneity of the labour force (educational attainment, age and gender) into account. See Timmer et al. (2007) Section 5 for an elaborate discussion.

the same as in Table 6.1. Table A.18 shows results with capital stocks and instead of our preferred measure of capital services as well as a split of total ICT into software ($Soft$), hardware (HW) and communications equipment (CT). Interestingly, our coefficient of interest $\beta_{EK_{ICT}}$ is now slightly larger than before. The split up of the ICT capital stock into $Soft$, HW and CT does not show any significant coefficients. As a further robustness check, we provide results for the baseline regressions but without dropping the percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities in Table A.16. The variable of interest $\beta_{EK_{ICT}}$ in the full sample regressions is less significant as expected, but the effect size is larger. Also there is now a rather large effect in the services sector subsample. Both is most likely caused by a certain number of extreme values as described in Section 5. The reasons for that, among other things, are breaks in time series of the raw data, especially with the energy prices. Tables A.26 and A.29 present results similar to the baseline results in Table 6.1, but instead of using USD, these regressions are based on national currencies or PPP values. The coefficients for our main variable of interest are qualitatively the same. Furthermore, Tables A.20, A.21, A.22 and A.23 provide results similar to our most preferred specification (2) of Table 6.1 but excluding all countries and industries once. Here, we see that the exclusion of the US A.20 column (10) as well as industry M-N (professional, scientific, technical, administrative and support service activities) in Table A.23 column (6) leads to insignificant values of the coefficient of interest $\beta_{EK_{ICT}}$.

6.3 Econometric Results - Incorporating the Energy Consumption of the Global Value Chain

By including the energy consumption along the whole value chain we can get a first indication whether or not the measured positive relationship between digitalisation and the reduction of energy demand in found in previous studies and in Section 6.1 might be rather driven by the ICT induced relocation of energy intensive production processes to foreign countries instead of actual energy savings. Our sample still consists of the nine OECD countries ('focus countries' in Table A.1) as in Section 6.1.

Table 6.2 presents the regression results for the cost share equation controlling for the energy consumption along the value chain as defined in Equation 6. [17] The coefficients for $E^{foreign}/E^{io}$ and E^{home}/E^{io} have the expected sign, meaning that an increase in the energy share in intermediate goods from other industries ($home$) and abroad ($foreign$) decreases S_E, the share of energy costs in variable costs. When controlling for the energy consumption along the value chain ($E^{foreign}/E^{io}$ and E^{home}/E^{io}), our coefficient of interest $\beta_{EK_{ICT}}$ (in column 3) is now slightly smaller and less significant as in the baseline specification shown in column (1) of Table 6.2 and in column (2) of Table 6.1.

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[17] An earlier version of the paper used a different methodology to control for the energy consumption along the value chain. Instead of adding $\frac{E^{home}}{E^{io}}$ and $\frac{E^{foreign}}{E^{io}}$ as control variables, we did adjust the left hand side variable se for the relative costs of energy along the value chain as well as the explanatory variable $\frac{P_E}{P_L}$ along the value chain. Apart from quality issues with energy prices for the 43 countries, the overall approach was too restrictive, as more or less all variables were insignificant.

Table 6.2: Controlling for energy consumption of the global value chain - 2001–2014 - dependent variable: ΔS_E

	(1) CxInoGVC	(2) CxI	(3) C+I	(4) CxI Manu.	(5) CxI Serv.	(6) C+I Manu.	(7) C+I Serv.
$\Delta \ln(P_E/P_L)$	0.0360***	0.0411***	0.0413***	0.0778***	0.0271***	0.0775***	0.0274***
	(0.002)	(0.002)	(0.002)	(0.005)	(0.003)	(0.004)	(0.002)
$\Delta \ln(K_{ICT}/Y)$	-0.0031**	-0.0028*	-0.0038**	-0.0017	0.0008	-0.0016	-0.0002
	(0.001)	(0.001)	(0.001)	(0.006)	(0.001)	(0.005)	(0.001)
$\Delta \ln(K_N/Y)$	-0.0139**	-0.0104**	-0.0112***	-0.0181*	-0.0092**	-0.0178**	-0.0099**
	(0.005)	(0.003)	(0.003)	(0.010)	(0.004)	(0.007)	(0.003)
$\Delta \ln Y$	-0.0044	0.0030	0.0028	0.0020	0.0082***	0.0027	0.0079***
	(0.003)	(0.003)	(0.003)	(0.006)	(0.002)	(0.005)	(0.002)
$\Delta(E_{home}/E^{io})$		-0.0692***	-0.0717***	-0.0971*	-0.0377*	-0.1001*	-0.0382*
		(0.018)	(0.019)	(0.045)	(0.019)	(0.044)	(0.018)
$\Delta(E_{foreign}/E^{io})$		-0.1232***	-0.1256***	-0.2075***	-0.0879***	-0.2096***	-0.0890***
		(0.017)	(0.017)	(0.031)	(0.017)	(0.031)	(0.016)
Year DVs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Industry	Yes	Yes	No	Yes	Yes	No	No
Country DVs	No	No	Yes	No	No	Yes	Yes
Industry DVs	No	No	Yes	No	No	Yes	Yes
Elasticities	-0.110	-0.107	-0.117	.	.	.	.
Adjusted R^2	0.328	0.397	0.418	0.521	0.488	0.544	0.493
Observations	2445	2445	2445	989	1255	989	1255

Notes: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014.

As a robustness check, we also present results for capital stocks instead of capital services and the split up of the ICT capital stock into $Soft$, HW and CT in Table A.19. The results are again less significant than in Table A.18. Table A.12 shows the split up of the sample into different time periods. Compared to the baseline results (Table A.11), controlling for the energy consumption along the value chain leads to a much smaller coefficient for the period 2011-2014.

7 Discussion

Our econometric results in Section 6 might be prone to endogeneity issues. From a theoretical standpoint, reverse causality, i.e. that the energy costs share might drive the investment decision in ICT seems to be rather unlikely. However, our results might still be biased due to omitted variables as well as measurement errors. As we are controlling for country-industry specific effects in our preferred specification, we are able to at least reduce the omitted variable bias. Measurement errors on the other hand might still be an issue. Especially the measurement of ICT investments at the industry level is still a challenging.[18] Another issue could be the data quality, especially for the prices of energy commodities. Furthermore, the quality of the energy use data for the second part of our analysis in Section 6.3, when we control for energy consumption along the global value chain, might be worse than the energy use data in our nine OECD countries. Another issue could be general data quality issues like break in series. We reduce this problem by excluding the 1^{th} and 99^{th} percentiles of all regression variables as well as energy prices and quantities from our regression.

8 Conclusions

Our empirical analyses confirm that the negative association between ICT and energy demand of Schulte et al. (2016) still holds in the more recent time period 2000 to 2014. However, the size of the effect is smaller and the results are less robust than in the paper by Schulte et al. (2016). A one percent increase in ICT capital is associated with a 0.110 percent decrease in energy demand which is about half of the effect measured by Schulte et al. (2016) of 0.235 percent.

When controlling for the energy demand of the whole value chain, there is still a significantly negative relationship (meaning less energy consumption) between ICT and energy. However the relationship is slightly less significant and the effect size is also slightly lower. So at least a small part of the previously measured positive effect of ICT on energy demand might be explained by the relocation of energy intensive production processes and not by efficiency improvements of ICT.

The results for the inclusion of the energy demand of the whole value chain need to be carefully interpreted as we cannot rule out that our results might be partly driven by data quality issues as described in Section 7. Therefore, further research and especially improvements with respect to the data availability of detailed worldwide energy and ICT data at the industry level is needed to confirm our results. Furthermore, due to the data limitations, our approach, only covers the energy efficiency gains of ICT in our nine focus countries. Any positive effect of ICT on energy demand in the countries along the value chain that are not part of our nine OECD countries is neglected.

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[18] Germany for example, still does not provide official data on IT and CT investments at the industry level in the national accounts.

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A Appendix

A.1 Detailed Data Appendix

A.2 Detailed Description of the Adjusted Leontief Framework

The methodology to calculate the global value chains (GVC) is based on Leontief. We have $S_1, S_2, ..., S_n$ industries and an intermediate input of industry S_i to produce output for industry S_j. The final demand f_i is defined as the output that is demanded of the final consumer rather than of one of the industries S_j. y_i is the total produced output of industry S_i that is composed of the demanded amount of all other industries and the final output, therefore $y_i = \sum_{j=1}^{N} m_{i,j} + f_i$. Then y_j is the total produced output of industry S_j that is composed of all intermediate inputs that are produced and required for production respectively. Accordingly, $y_j = \sum_{i=1}^{n} m_{i,j}$ and the system of linear equations for every industry to capture the global production system is the following:

$$\begin{aligned} y_1 &= m_{1,1} + m_{1,2} + m_{1,3} + \cdots + m_{1,n} + f_1 \\ y_2 &= m_{2,1} + m_{2,2} + m_{2,3} + \cdots + m_{2,n} + f_2 \\ &\vdots \\ y_n &= m_{n,1} + m_{n,2} + m_{n,3} + \cdots + m_{n,n} + f_n \end{aligned} \tag{7}$$

In a generalized form this corresponds to: $y_i = \sum_{j=1}^{n} m_{i,j} + f_i$ for $n \in 1, \ldots, n$, where y_i equals the total output of an industry i and $m_{i,j}$ is the value of units produced by i for j. $\sum_{j=1}^{n} m_{i,j}$ then defines the total output of i that is produced for all country-industry-pairs meaning the total intermediate output of i which is summed up with the final demand for i f_i.
$a_{i,j}$ is the share of intermediate input of industry S_i for industry S_j of the total output y_j, accordingly $a_{i,j} = \frac{m_{i,j}}{y_j}$. Equivalent to the above equation system:

$$\begin{aligned} y_1 &= a_{1,1}y_1 + a_{1,2}y_2 + a_{1,3}y_3 + \cdots + a_{1,n}y_n + f_1 \\ y_2 &= a_{2,1}y_1 + a_{2,2}y_2 + a_{2,3}y_3 + \cdots + a_{2,n}y_n + f_2 \\ &\vdots \\ y_n &= a_{n,1}y_1 + a_{n,2}y_2 + a_{n,3}y_3 + \cdots + a_{n,n}y_n + f_n \end{aligned} \tag{8}$$

This corresponds in matrix notation to:

$$\underset{n\times 1}{y} = \underset{n\times n}{A} \times \underset{n\times 1}{y} + \underset{n\times 1}{f} \quad \leftrightarrow \quad y = (I_n - A)^{-1} f \tag{9}$$

whereas the latter leads by transforming to the known Leontief-Inverse. Thus, one can calculate for every given final demand level the produced output per industry that is induced by the demand. For instance, for finding out what the resulting output for different industries gives that evolves of the demand for German automobiles, the Leontief-Inverse is multiplied with the vector f, for which the whole final demand other than the German automobile industry is set to zero. Thereby, for any variable with industry-specific information, the share of the total output of the industry can be calculated that can be traced back to the final demand of certain industries. Solely, the value of the variables must be divided by the total output of the industry, after the input-output calculation. The value added along the chain of production, for example, can be computed by multiplying the share of value added of the total output of the certain industry corresponding to $p_j = \frac{v_j}{y_j}$ with the Leontief-Inverse times the final demand. In matrix form this equals:

$$v = \underset{n \times n}{\hat{p}} \times (I_n - A)^{-1} f \quad \text{with} \quad \hat{p} = diag(p) \tag{10}$$

It is possible to use any variable in the production process such as emission, labour or capital input instead of v. In our case we have electric and non-electric energy quantities and cost, labour costs and quantities. We can therefore for e.g. distinguish between energy demand of the own industry (self), the own country without the industry (home) and foreign countries (see Figure A.5). Also f can be changed for any vector of final demand that is of interest.

The performed input-output analysis is no dynamic model. For instance, to simulate a decline in demand of an industry, industry-specific value added can be calculated and compared with the actual values of demand given any values of the final demand. But, thereby one disregards that this could impact prices as well as relocations of production and suppliers as well. The dynamic response of such a decline in demand cannot be computed with the Leontief approach described here.

A.2.1 Data Issues Regarding Incorporating the Energy Consumption of the Global Value Chain

The WIOD and JRC data bases provide information for 43 countries and a synthetic ‘Rest of the World’(ROW) country. The production structure in the ROW countries and therefore the energy consumption during the production process could vary tremendously. In case one of our nine focus countries does source a large amount of intermediate inputs from this country, the average of the ROW countries is not representative and the results might be biased.

A.3 Additional Tables

A.3.1 Definitions

Table A.1: List of Countries

Country	***Acronym***	***Country***	***Acronym***	***Country***	***Acronym***
Australia	AUS	United Kingdom	GBR*	Norway	NOR
Austria	AUT*	Greece	GRC	Poland	POL
Belgium	BEL	Croatia	HRV	Portugal	PRT
Bulgaria	BGR	Hungary	HUN	Romania	ROM
Brazil	BRA	Indonesia	IDN	Russia	RUS
Canada	CAN	India	IND	Slovak Republic	SVK
Switzerland	CHE	Ireland	IRL	Slovenia	SVN
China	CHN	Italy	ITA*	Sweden	SWE
Cyprus	CYP	Japan	JPN	Turkey	TUR
Czech Republic	CZE	Korea	KOR	Taiwan	TWN
Germany	DEU*	Lithuania	LTU	United States	USA*
Denmark	DNK*	Luxembourg	LUX	*Rest of the World*	*ROW*
Spain	ESP*	Latvia	LVA		
Estonia	EST	Mexico	MEX		
Finland	FIN*	Malta	MLT		
France	FRA	Netherlands	NLD*		

NOTE: Countries with * are 'focus countries', all other countries are only used in the value chain analysis.

Table A.2: List of industries (NACE 2)

Code	***Manu***	***Serv***	***MServ***	***MSec***	***Description***
A				✓	Agriculture, forestry and fishing
B				✓	Mining and quarrying
C10-C12	✓			✓	Food products, beverages and tobacco
C13-C15	✓			✓	Textiles, wearing apparel, leather and related products
C16-C18	✓			✓	Wood and paper products; printing and reproduction of recorded media
C20-C21	✓			✓	Chemicals and chemical products
C22-C23	✓			✓	Rubber and plastics products, and other non-metallic mineral products
C24-C25	✓			✓	Basic metals and fabricated metal products, except machinery and equipment
C26-C27	✓			✓	Electrical and optical equipment
C28	✓			✓	Machinery and equipment n.e.c.
C29-C30	✓			✓	Transport equipment
C31-C33	✓			✓	Other manufacturing; repair and installation of machinery and equipment
F				✓	Construction
G45		✓	✓	✓	Wholesale and retail trade and repair of motor vehicles and motorcycles
G46		✓	✓	✓	Wholesale trade, except of motor vehicles and motorcycles
G47		✓	✓	✓	Retail trade, except of motor vehicles and motorcycles
H49-H52		✓	✓	✓	Transport and storage
H53		✓	✓	✓	Postal and courier activities
I		✓	✓	✓	Accommodation and food service activities
J58-J60		✓	✓	✓	Publishing, audiovisual and broadcasting activities
J61		✓	✓	✓	Telecommunications
J62-J63		✓	✓	✓	IT and other information services
K		✓	✓	✓	Financial and insurance activities
M-N		✓	✓	✓	Professional, scientific, technical, administrative and support service activities
O		✓			Public administration and defence; compulsory social security
P		✓			Education
Q		✓			Health and social work
R-S		✓			Arts, entertainment, recreation and other service activities

NOTES: Following Schulte et al. (2016), Industries 19 (Manufacture of Coke and Refined Petroleum Products) and D-E (Electricity, Gas, Steam and Air Conditioning Supply, Water Supply; Sewerage, Waste Management and Remediation Activities) are excluded from the regressions since "both are energy producing sectors and thus have a completely different production structure concerning energy demand than the remaining industries". Furthermore, again following Schulte et al. (2016), industry 68 (Real Estate Activities) as well as T (Activities of Households as Employers) and U (Activities of Extraterritorial Organizations and Bodies) are excluded from the sample. ***Manu***: Manufacturing Sector, ***Serv***: Services Sector, ***MServ***: Market Services Sector ***MSec***: Market Sector.

Table A.3: List of energy commodities in World input-output database environmental accounts: update 2000 2016

Energy Commodity	***Description***
COAL_COKE_CRUDE	Hard coal and derivatives, Lignite and derivatives, Coke, Crude oil, NGL and feedstocks
JETFUEL	Jet fuel (kerosene and gasoline)
DIESEL	Diesel oil for road transport
GASOLINE	Motor gasoline
FUEL_OIL	Light Fuel oil, Heavy fuel oil
OTHPETRO	Other petroleum products
WASTE*	Industrial and municipal waste
RENEWABLES_NUCLEAR*	Geothermal, Hydroelectric, Nuclear, Wind power, Other combustible renewables, Solar
NATGAS	Natural gas
OTHGAS	Derived gas
ELECTR_HEATPROD	Electricity, Heat, Distribution losses
LIQUID_GASEOUS_BIOFUELS*	Biogasoline also including hydrated ethanol, Biodiesel, Biogas
OTHSOURC*	Other sources

NOTES: *Following Schulte et al. (2016), these commodities are not included in the analysis. SOURCE: European Commission. Joint Research Centre. (2019).

Table A.4: Variable description

Variable	***Description***
ΔS_L	Delta (Labour share of variable cost)
ΔS_E	Delta (Energy share of variable cost)
ΔS_{Elec}	Delta (Electric energy share of variable cost)
ΔS_{NElec}	Delta (Non-electric energy share of variable cost)
$\Delta\ln(L)$	Delta Ln(=Labour Services (H_EMP (2010) * LAB_QI / 100))
$\Delta\ln(L)^{h\_empe}$	Delta Ln(Total hours worked by employees (H_EMPE*1000))
$\Delta\ln(E)$	Delta Ln(Total energy, (non-electric + electric) (TJ))
$\Delta\ln(Elec)$	Delta Ln(Electric energy (Electricity, distribution loss, heat production) (TJ))
$\Delta\ln(NElec)$	Delta Ln(Non-electric energy (TJ))
$\Delta\ln(P_L)$	Delta Ln(Labour comp. per hour worked by persons engaged in 2010 prices, in USD)
$\Delta\ln(P_L^{h\_empe})$	Delta Ln(Labour comp. per hour worked by employees in 2010 prices, in USD)
$\Delta\ln(P_E)$	Delta Ln(Energy price, 2010 in USD/TJ)
$\Delta\ln(P_{Elec})$	Delta Ln(Electric energy price, 2010 in USD/TJ)
$\Delta\ln(P_{NElec})$	Delta Ln(Non-electric energy price, 2010 in USD/TJ)
$\Delta\ln(P_E/P_L)$	Delta Ln((P_E/P_L))
$\Delta\ln(K_{ICT})$	Delta Ln(ICT capital services in 2010 prices, in USD)
$\Delta\ln(K_N)$	Delta Ln(Non-ICT capital services in 2010 prices, in USD)
$\Delta\ln Y$	Delta Ln(Output | value added + energy costs at 2010 prices, in USD)
$\Delta\ln(K_{ICT}/Y)$	Delta Ln(ICT capital services divided by output Y, in USD)
$\Delta\ln(K_N/Y)$	Delta Ln(Non-ICT capital services divided by output Y, in USD)
$\Delta\ln(L/Y)$	Delta Ln(Labour services per hours worked divided output Y, in USD)
$\Delta\ln(E/Y)$	Delta Ln(Energy input (TJ) divided by output Y, in USD)
$\Delta\ln C_L$	Delta Ln(Labour compensation (capital services based))
$\Delta\ln C_E$	Delta Ln(Energy costs (at 2010 prices in USD))
$\Delta(E_{self}/E^{io})$	Delta (Share own industry emission relevant energy use in total final demand energy use)
$\Delta(E_{home}/E^{io})$	Delta (Share own country without own industry energy use in total final demand energy use)
$\Delta(E_{foreign}/E^{io})$	Delta (Share foreign country emission relevant energy use in total final demand energy use)
S_L	Labour share of variable cost
S_E	Energy share of variable cost
S_{Elec}	Electric energy share of variable cost
S_{NElec}	Non-electric energy share of variable cost
S_{K_N}	Non-ICT capital compensation of variable costs
$S_{K_{ICT}}$	ICT capital compensation share of variable costs

A.3.2 Further Estimation Sample Descriptives

Table A.5: 100x annual change 2001-2007 - USD - estimation sample

	N	Mean	Median	SD	Min	Max
Cost shares						
ΔS_L	1255	.0046	-.021	.77	-2.8	3.8
ΔS_E	1255	-.0046	.021	.77	-3.8	2.8
ΔS_{Elec}	1255	.029	.018	.55	-3	2.3
ΔS_{NElec}	1255	-.034	-.01	.54	-3.4	2.2
Flexible factor quantities:						
$\Delta \ln(L)$	1255	.19	.37	3.7	-13	15
$\Delta \ln(L)^{h\_empe}$	1255	-.12	.17	3.9	-17	19
$\Delta \ln(E)$	1255	-.35	.033	7.9	-35	23
$\Delta \ln(Elec)$	1255	1.4	1.6	7.8	-45	26
$\Delta \ln(NElec)$	1255	-1.4	-.9	10	-44	29
Flexible factor prices:						
$\Delta \ln(P_L)$	1255	5.9	5.4	7.3	-20	34
$\Delta \ln(P_L^{h\_empe})$	1255	6.2	5.7	7.6	-23	38
$\Delta \ln(P_E)$	1255	6.9	7.2	7.9	-21	28
$\Delta \ln(P_{Elec})$	1255	6.7	5.4	9.3	-17	31
$\Delta \ln(P_{NElec})$	1255	6.5	6.9	9.3	-28	29
$\Delta \ln(P_E/P_L)$	1255	1	.87	8.4	-26	27
Fixed input and output quantities:						
$\Delta \ln(K_{ICT})$	1255	10	9.9	9	-16	38
$\Delta \ln(K_N)$	1255	6	4.7	6.9	-23	29
$\Delta \ln Y$	1255	6.2	5.9	6.9	-19	21
$\Delta \ln(K_{ICT}/Y)$	1255	3.8	3.9	7.6	-18	26
$\Delta \ln(K_N/Y)$	1255	-.2	.077	5.2	-18	18
Flexible factor intensities:						
$\Delta \ln(L/Y)$	1255	-6	-5.6	7.1	-29	16
$\Delta \ln(E/Y)$	1255	-6.5	-6.6	9.9	-38	31
Costs:						
$\Delta \ln C_L$	1255	6.1	5.3	7.2	-27	28
$\Delta \ln C_E$	1255	6.6	6.8	10	-31	39
Quantity shares:						
$\Delta(E_{self}/E^{io})$	1255	-.33	-.23	1.8	-15	9
$\Delta(E_{home}/E^{io})$	1255	-.38	-.37	2.3	-16	18
$\Delta(E_{foreign}/E^{io})$	1255	.71	.68	1.8	-6.7	7.9

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped.

Table A.6: 100x annual change 2008-2014 - USD - estimation sample

	N	Mean	Median	SD	Min	Max
Cost shares						
ΔS_L	1016	.11	.061	.78	-3.1	3.4
ΔS_E	1016	-.11	-.061	.78	-3.4	3.1
ΔS_{Elec}	1016	-.03	-.007	.5	-2.6	2.4
ΔS_{NElec}	1016	-.081	-.03	.61	-3.5	2.2
Flexible factor quantities:						
$\Delta \ln(L)$	1016	-.27	.12	3.8	-17	14
$\Delta \ln(L)^{h\_empe}$	1016	-.73	-.22	4.1	-22	15
$\Delta \ln(E)$	1016	-2.7	-2.3	8.6	-36	23
$\Delta \ln(Elec)$	1016	-1.9	-1.4	9.4	-45	26
$\Delta \ln(NElec)$	1016	-3.8	-3	11	-53	29
Flexible factor prices:						
$\Delta \ln(P_L)$	1016	-.63	-.22	6.6	-35	24
$\Delta \ln(P_L^{h\_empe})$	1016	-.17	.015	6.6	-34	25
$\Delta \ln(P_E)$	1016	.14	-.16	7.4	-20	24
$\Delta \ln(P_{Elec})$	1016	-.48	.58	6.2	-18	20
$\Delta \ln(P_{NElec})$	1016	.23	-.11	11	-38	29
$\Delta \ln(P_E/P_L)$	1016	.77	.71	7.7	-25	24
Fixed input and output quantities:						
$\Delta \ln(K_{ICT})$	1016	1.5	2.1	7.8	-26	29
$\Delta \ln(K_N)$	1016	-.86	.13	6.3	-30	28
$\Delta \ln Y$	1016	-.89	.29	7.8	-27	21
$\Delta \ln(K_{ICT}/Y)$	1016	2.4	2.3	6.7	-18	25
$\Delta \ln(K_N/Y)$	1016	.029	.16	5.5	-16	18
Flexible factor intensities:						
$\Delta \ln(L/Y)$	1016	.62	-.27	7	-27	32
$\Delta \ln(E/Y)$	1016	-1.8	-2.2	10	-44	36
Costs:						
$\Delta \ln C_L$	1016	-.9	-.19	7.5	-26	23
$\Delta \ln C_E$	1016	-2.5	-1.9	11	-50	26
Quantity shares:						
$\Delta(E_{self}/E^{io})$	1016	-.11	-.085	1.7	-7.6	9.2
$\Delta(E_{home}/E^{io})$	1016	-.34	-.43	2	-12	13
$\Delta(E_{foreign}/E^{io})$	1016	.45	.52	2.3	-12	17

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped.

Table A.7: Average cost shares, 2000–2007 - USD - estimation sample

	N	Mean	Median	SD	Min	Max
S_L	1454	.91	.95	.11	.026	1
S_E	1454	.087	.046	.11	.0004	.97
S_{Elec}	1454	.042	.022	.058	.00027	.44
S_{NElec}	1454	.045	.023	.065	.00013	.61
S_{K_N}	1454	.46	.32	.93	.00029	22
$S_{K_{ICT}}$	1454	.073	.036	.15	.0015	1.7

Notes: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped.

Table A.8: Average cost shares, 2008–2014 - USD - estimation sample

	N	Mean	Median	SD	Min	Max
S_L	1192	.92	.95	.096	.022	1
S_E	1192	.084	.049	.096	.00038	.98
S_{Elec}	1192	.042	.023	.053	8.9e-06	.47
S_{NElec}	1192	.042	.023	.063	.0001	.61
S_{K_N}	1192	.44	.3	.65	.00034	13
$S_{K_{ICT}}$	1192	.074	.032	.16	.0011	1.6

Notes: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped.

A.3.3 Full Sample Descriptives

Table A.9: Average cost shares, 2000–2014 - USD - full sample

	N	Mean	Median	SD	Min	Max
S_L	3262	.9	.95	.12	.019	1
S_E	3262	.095	.049	.12	.00038	.98
S_{Elec}	3262	.047	.024	.065	8.4e-06	.52
S_{NElec}	3262	.049	.024	.073	.0001	.62
S_{K_N}	3262	.5	.32	1.1	.00029	22
$S_{K_{ICT}}$	3262	.076	.034	.2	.0011	6.6

NOTES: Observations with negative capital compensation shares are dropped.

Table A.10: 100x annual change 2001–2014 - USD - full sample

	N	Mean	Median	SD	Min	Max
Cost shares						
ΔS_L	3064	-.035	-.016	1.4	-29	11
ΔS_E	3064	.035	.016	1.4	-11	29
ΔS_{Elec}	3064	.062	.012	1.1	-12	29
ΔS_{NElec}	3064	-.028	-.0031	1.1	-13	12
Flexible factor quantities:						
$\Delta \ln(L)$	3065	-.4	.044	4.3	-23	18
$\Delta \ln(L)^{h\_empe}$	3065	-.75	-.2	4.5	-25	19
$\Delta \ln(E)$	3064	-1.2	-.77	14	-161	215
$\Delta \ln(Elec)$	3064	-.57	.43	22	-668	256
$\Delta \ln(NElec)$	3065	-2.4	-1.5	17	-192	169
Flexible factor prices:						
$\Delta \ln(P_L)$	3065	3	2.7	8.9	-41	46
$\Delta \ln(P_L^{h\_empe})$	3065	3.4	2.9	9	-41	48
$\Delta \ln(P_E)$	3064	4.6	4.2	11	-54	137
$\Delta \ln(P_{Elec})$	3065	4.5	3	11	-31	52
$\Delta \ln(P_{NElec})$	3065	4.2	4.7	15	-81	146
$\Delta \ln(P_E/P_L)$	3064	1.5	1.1	11	-73	129
Fixed input and output quantities:						
$\Delta \ln(K_{ICT})$	3065	6.8	6.2	11	-36	82
$\Delta \ln(K_N)$	3065	3.1	2.5	8.3	-66	111
$\Delta \ln Y$	3064	2.7	3.1	9.8	-55	39
$\Delta \ln(K_{ICT}/Y)$	3064	4.1	3.6	9.3	-40	80
$\Delta \ln(K_N/Y)$	3064	.35	.27	7.4	-71	109
Flexible factor intensities:						
$\Delta \ln(L/Y)$	3064	-3.1	-3	9.1	-46	57
$\Delta \ln(E/Y)$	3064	-4	-4.4	16	-169	178
Costs:						
$\Delta \ln C_L$	3065	2.6	2.9	9.6	-48	44
$\Delta \ln C_E$	3064	3.3	4	17	-161	198
Quantity shares:						
$\Delta(E_{self}/E^{io})$	3060	-.079	-.1	2.8	-39	49
$\Delta(E_{home}/E^{io})$	3060	-.46	-.4	2.6	-44	18
$\Delta(E_{foreign}/E^{io})$	3060	.54	.56	2.4	-12	23

Notes: Observations with negative capital compensation shares are dropped.

A.3.4 Robustness Checks

Table A.11: Different time periods - dependent variable: ΔS_E

	(1) 2000-2007	(2) 2011-2014	(3) wo 2009/2010	(4) 2008,2011-2014
$\Delta \ln(P_E/P_L)$	0.0287***	0.0506***	0.0363***	0.0453***
	(0.001)	(0.004)	(0.002)	(0.003)
$\Delta \ln(K_{ICT}/Y)$	0.0016	-0.0160**	-0.0021*	-0.0007
	(0.001)	(0.006)	(0.001)	(0.005)
$\Delta \ln(K_N/Y)$	-0.0087	-0.0160	-0.0146***	-0.0306***
	(0.005)	(0.014)	(0.004)	(0.008)
$\Delta \ln Y$	0.0020	-0.0088	-0.0059	-0.0197**
	(0.005)	(0.013)	(0.003)	(0.007)
Year DVs	Yes	Yes	Yes	Yes
Country × Industry	Yes	Yes	Yes	Yes
Elasticities	.	-0.254	-0.097	.
Adjusted R^2	0.259	0.390	0.309	0.449
Observations	1255	774	2203	948

Notes: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014.

Table A.12: Controlling for energy consumption of the global value chain - different time periods - dependent variable: ΔS_E

	(1) 2000-2007	(2) 2011-2014	(3) wo 2009/2010	(4) 2008,2011-2014
$\Delta \ln(P_E/P_L)$	0.0349***	0.0437***	0.0407***	0.0443***
	(0.004)	(0.003)	(0.003)	(0.003)
$\Delta \ln(K_{ICT}/Y)$	0.0009	-0.0099**	-0.0014	0.0040
	(0.002)	(0.004)	(0.001)	(0.005)
$\Delta \ln(K_N/Y)$	-0.0073*	-0.0149	-0.0093**	-0.0202**
	(0.003)	(0.010)	(0.004)	(0.006)
$\Delta(E_{home}/E^{io})$	-0.0497	-0.1636**	-0.0690***	-0.1410***
	(0.032)	(0.049)	(0.018)	(0.022)
$\Delta(E_{foreign}/E^{io})$	-0.1163**	-0.1984***	-0.1309***	-0.1670***
	(0.040)	(0.040)	(0.018)	(0.019)
$\Delta \ln Y$	0.0055	-0.0002	0.0040	-0.0026
	(0.003)	(0.008)	(0.004)	(0.008)
Year DVs	Yes	Yes	Yes	Yes
Country × Industry	Yes	Yes	Yes	Yes
Elasticities	.	-0.185	.	.
Adjusted R^2	0.309	0.536	0.378	0.542
Observations	1255	774	2203	948

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014.

Table A.13: Results for different sectors - 2001-2014 - dependent variable: ΔS_E

	(1) All	(2) Manu	(3) Serv	(4) Manu+Serv	(5) MServ	(6) MSec
$\Delta \ln(P_E/P_L)$	0.0360***	0.0741***	0.0240***	0.0357***	0.0219***	0.0388***
	(0.002)	(0.007)	(0.003)	(0.002)	(0.003)	(0.002)
$\Delta \ln(K_{ICT}/Y)$	-0.0031**	0.0005	-0.0001	-0.0022	0.0035	-0.0020
	(0.001)	(0.003)	(0.002)	(0.001)	(0.003)	(0.001)
$\Delta \ln(K_N/Y)$	-0.0139**	-0.0262*	-0.0116*	-0.0180**	-0.0156***	-0.0162***
	(0.005)	(0.013)	(0.005)	(0.007)	(0.004)	(0.005)
$\Delta \ln Y$	-0.0044	-0.0080	0.0019	-0.0028	-0.0008	-0.0072**
	(0.003)	(0.005)	(0.003)	(0.002)	(0.005)	(0.003)
Elasticities	-0.110	.	.	.	.	.
Adjusted R^2	0.328	0.408	0.439	0.337	0.422	0.314
Observations	2445	989	1255	2244	836	2026

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014. All regressions include year and country × industry dummies. Manu: Manufacturing Sector, Serv: Services Sector, MServ: Market Services Sector MSec: Market Sector. See Table A.2 for details.

Table A.14: Results with hours worked instead of labour services - 2001–2014 - dependent variable: ΔS_E

	(1) POLS	(2) CxI	(3) C+I	(4) CxI Manu.	(5) CxI Serv.	(6) C+I Manu.	(7) C+I Serv.
$\Delta\ln(P_E/P_L^{h\_empe})$	0.0341***	0.0358***	0.0358***	0.0766***	0.0241***	0.0760***	0.0243***
	(0.002)	(0.002)	(0.002)	(0.007)	(0.003)	(0.006)	(0.002)
$\Delta\ln(K_{ICT}/Y)$	-0.0064***	-0.0035***	-0.0045***	-0.0007	-0.0006	-0.0018	-0.0015
	(0.002)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)	(0.001)
$\Delta\ln(K_N/Y)$	-0.0083**	-0.0135**	-0.0141***	-0.0230	-0.0111*	-0.0215*	-0.0118**
	(0.003)	(0.006)	(0.004)	(0.013)	(0.005)	(0.010)	(0.004)
$\Delta\ln Y$	-0.0050**	-0.0045	-0.0043*	-0.0084	0.0021	-0.0074	0.0020
	(0.002)	(0.003)	(0.002)	(0.005)	(0.003)	(0.005)	(0.003)
Year DVs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Industry	No	Yes	No	Yes	Yes	No	No
Country DVs	No	No	Yes	No	No	Yes	Yes
Industry DVs	No	No	Yes	No	No	Yes	Yes
Elasticities	-0.149	-0.114	-0.126	.	.	.	.
Adjusted R^2	0.336	0.331	0.352	0.424	0.443	0.449	0.449
Observations	2445	2445	2445	989	1255	989	1255

Notes: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014.

Table A.15: Results without weights - 2001-2014 - dependent variable: ΔS_E

	(1) POLS	(2) CxI	(3) C+I	(4) CxI Manu.	(5) CxI Serv.	(6) C+I Manu.	(7) C+I Serv.
$\Delta \ln(P_E/P_L)$	0.0490***	0.0477***	0.0485***	0.0707***	0.0245***	0.0710***	0.0251***
	(0.004)	(0.003)	(0.003)	(0.008)	(0.003)	(0.008)	(0.003)
$\Delta \ln(K_{ICT}/Y)$	-0.0075***	-0.0055**	-0.0065***	-0.0014	-0.0026	-0.0022	-0.0031*
	(0.002)	(0.002)	(0.002)	(0.006)	(0.002)	(0.005)	(0.002)
$\Delta \ln(K_N/Y)$	-0.0090*	-0.0117**	-0.0094*	-0.0176	-0.0032	-0.0146**	-0.0028
	(0.004)	(0.005)	(0.004)	(0.009)	(0.004)	(0.006)	(0.004)
$\Delta \ln Y$	-0.0060*	-0.0062	-0.0050	-0.0017	-0.0026	-0.0001	-0.0030
	(0.003)	(0.004)	(0.003)	(0.006)	(0.003)	(0.005)	(0.003)
Year DVs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Industry	No	Yes	No	Yes	Yes	No	No
Country DVs	No	No	Yes	No	No	Yes	Yes
Industry DVs	No	No	Yes	No	No	Yes	Yes
Elasticities	-0.162	-0.137	-0.150	.	.	.	-0.179
Adjusted R^2	0.311	0.326	0.323	0.380	0.335	0.395	0.316
Observations	2445	2445	2445	989	1255	989	1255

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

Table A.16: Full sample results - 2001–2014 - dependent variable: ΔS_E

	(1) POLS	(2) CxI	(3) C+I	(4) CxI Manu.	(5) CxI Serv.	(6) C+I Manu.	(7) C+I Serv.
$\Delta\ln(P_E/P_L)$	0.0191*	0.0207*	0.0198*	0.0822***	-0.0005	0.0818***	-0.0017
	(0.009)	(0.010)	(0.010)	(0.011)	(0.007)	(0.011)	(0.007)
$\Delta\ln(K_{ICT}/Y)$	-0.0293*	-0.0306*	-0.0315*	0.0014	-0.0389***	0.0003	-0.0415**
	(0.015)	(0.015)	(0.015)	(0.006)	(0.012)	(0.006)	(0.013)
$\Delta\ln(K_N/Y)$	-0.0596*	-0.0861	-0.0782	-0.0057	-0.1921**	-0.0061	-0.1721**
	(0.028)	(0.050)	(0.045)	(0.006)	(0.064)	(0.006)	(0.062)
$\Delta\ln Y$	0.0365	0.0213	0.0265*	0.0040	0.0286*	0.0039	0.0387**
	(0.024)	(0.012)	(0.012)	(0.006)	(0.013)	(0.006)	(0.014)
Year DVs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Industry	No	Yes	No	Yes	Yes	No	No
Country DVs	No	No	Yes	No	No	Yes	Yes
Industry DVs	No	No	Yes	No	No	Yes	Yes
Elasticities	-0.381	-0.394	-0.404	.	-0.939	.	-0.994
Adjusted R^2	0.169	0.190	0.214	0.338	0.362	0.353	0.371
Observations	3064	3064	3064	1242	1505	1242	1505

NOTES: Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employeed in the respective industry of the period 2000-2014.

Table A.17: Results for electric (ΔS_{Elec}) and non-electric (ΔS_{NElec}) energy demand - 2001–2014

	(1) POLS	(2) CxI	(3) C+I	(4) CxI Manu.	(5) CxI Serv.	(6) C+I Manu.	(7) C+I Serv.
ΔS_{Elec}							
$\Delta \ln(P_{NElec}/P_L)$	-0.0003	0.0002	0.0003	-0.0061***	-0.0017**	-0.0063***	-0.0016**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
$\Delta \ln(P_{Elec}/P_L)$	0.0178***	0.0181***	0.0181***	0.0563***	0.0108***	0.0558***	0.0107***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)
$\Delta \ln(K_{ICT}/Y)$	-0.0042***	-0.0029**	-0.0033***	-0.0012	-0.0031***	-0.0024	-0.0032***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)
$\Delta \ln(K_N/Y)$	0.0002	-0.0005	-0.0009	-0.0221***	0.0016	-0.0240***	0.0019
	(0.002)	(0.002)	(0.002)	(0.005)	(0.002)	(0.005)	(0.002)
$\Delta \ln Y$	0.0002	0.0002	0.0002	-0.0084**	0.0004	-0.0085**	0.0005
	(0.001)	(0.002)	(0.002)	(0.004)	(0.001)	(0.004)	(0.001)
ΔS_{NElec}							
$\Delta \ln(P_{NElec}/P_L)$	0.0251***	0.0254***	0.0254***	0.0432***	0.0176***	0.0435***	0.0181***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
$\Delta \ln(P_{Elec}/P_L)$	-0.0003	0.0002	0.0003	-0.0061***	-0.0017**	-0.0063***	-0.0016**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
$\Delta \ln(K_{ICT}/Y)$	-0.0029*	-0.0007	-0.0017	0.0000	0.0029*	-0.0002	0.0018
	(0.001)	(0.002)	(0.002)	(0.004)	(0.002)	(0.004)	(0.002)
$\Delta \ln(K_N/Y)$	-0.0085***	-0.0126***	-0.0124***	-0.0061	-0.0131***	-0.0034	-0.0137***
	(0.002)	(0.003)	(0.003)	(0.006)	(0.003)	(0.005)	(0.003)
$\Delta \ln Y$	-0.0032*	-0.0015	-0.0017	-0.0019	0.0028	-0.0006	0.0024
	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)	(0.004)	(0.002)
Year DVs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Industry	No	Yes	No	Yes	Yes	No	No
Country DVs	No	No	Yes	No	No	Yes	Yes
Industry DVs	No	No	Yes	No	No	Yes	Yes
R_1^2	0.212	0.282	0.228	0.467	0.316	0.426	0.282
R_2^2	0.403	0.463	0.426	0.523	0.551	0.503	0.514

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014.

Table A.18: Baseline results - capital stocks instead of capitals services and ICT split - 2001–2014 - dependent variable: ΔS_E

	(1) CS	(2) Stocks	(3) ITCTSoft	(4) ManuStocks	(5) ManuITCTSoft	(6) ServStocks	(7) ServITCTSoft
$\Delta\ln(P_E/P_L)$	0.0360***	0.0358***	0.0362***	0.0744***	0.0744***	0.0236***	0.0237***
	(0.002)	(0.002)	(0.003)	(0.007)	(0.007)	(0.003)	(0.003)
$\Delta\ln(K_{ICT}/Y)$	-0.0031**						
	(0.001)						
$\Delta\ln(K_N/Y)$	-0.0139**						
	(0.005)						
$\Delta\ln Y$	-0.0044	-0.0026	-0.0034	-0.0063	-0.0061	0.0041	0.0039
	(0.003)	(0.003)	(0.002)	(0.005)	(0.004)	(0.005)	(0.005)
$\Delta\ln(K_{ICT}^{Stock}/Y)$		-0.0062***		-0.0048		-0.0046***	
		(0.002)		(0.004)		(0.001)	
$\Delta\ln(K_N^{Stock}/Y)$		-0.0064	-0.0088*	-0.0194	-0.0218*	-0.0001	-0.0024
		(0.004)	(0.004)	(0.013)	(0.010)	(0.004)	(0.003)
$\Delta\ln(K_{HW}^{Stock}/Y)$			0.0019		0.0062		0.0012
			(0.002)		(0.004)		(0.002)
$\Delta\ln(K_{Soft}^{Stock}/Y)$			-0.0034		-0.0057		-0.0003
			(0.002)		(0.004)		(0.001)
$\Delta\ln(K_{CT}^{Stock}/Y)$			-0.0027		-0.0038		-0.0026
			(0.002)		(0.003)		(0.002)
Adjusted R^2	0.328	0.326	0.329	0.408	0.410	0.436	0.436
Observations	2445	2445	2393	989	978	1255	1219

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014. All regressions include year and country × industry dummies. Manu: Manufacturing Sector, Serv: Services Sector.

Table A.19: Controlling for energy consumption of the global value chain - capital stocks instead of capitals services and ICT split- 2001–2014 - dependent variable: ΔS_E

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	CS	Stocks	ITCTSoft	ManuStocks	ManuITCTSoft	ServStocks	ServITCTSoft
$\Delta \ln(P_E/P_L)$	0.0411***	0.0410***	0.0412***	0.0780***	0.0781***	0.0268***	0.0267***
	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.003)	(0.003)
$\Delta \ln(K_{ICT}/Y)$	-0.0028*						
	(0.001)						
$\Delta \ln(K_N/Y)$	-0.0104**						
	(0.003)						
$\Delta(E_{home}/E^{io})$	-0.0692***	-0.0708***	-0.0703***	-0.0967*	-0.0969*	-0.0389**	-0.0380*
	(0.018)	(0.017)	(0.018)	(0.046)	(0.045)	(0.017)	(0.020)
$\Delta(E_{foreign}/E^{io})$	-0.1232***	-0.1237***	-0.1240***	-0.2079***	-0.2064***	-0.0891***	-0.0903***
	(0.017)	(0.016)	(0.018)	(0.031)	(0.030)	(0.015)	(0.019)
$\Delta \ln Y$	0.0030	0.0051*	0.0045	0.0032	0.0033	0.0108**	0.0108***
	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.003)	(0.003)
$\Delta \ln(K_{ICT}^{Stock}/Y)$		-0.0062**		-0.0058		-0.0038**	
		(0.003)		(0.006)		(0.002)	
$\Delta \ln(K_{N}^{Stock}/Y)$		-0.0021	-0.0039	-0.0130	-0.0142	0.0030	0.0013
		(0.002)	(0.002)	(0.010)	(0.008)	(0.002)	(0.002)
$\Delta \ln(K_{HW}^{Stock}/Y)$			0.0003		0.0011		-0.0001
			(0.002)		(0.003)		(0.002)
$\Delta \ln(K_{Soft}^{Stock}/Y)$			-0.0028		-0.0034		0.0009
			(0.002)		(0.004)		(0.001)
$\Delta \ln(K_{CT}^{Stock}/Y)$			-0.0024		-0.0025		-0.0023
			(0.001)		(0.002)		(0.002)
Adjusted R^2	0.397	0.395	0.397	0.522	0.521	0.486	0.485
Observations	2445	2445	2393	989	978	1255	1219

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014. All regressions include year and country × industry dummies. Manu: Manufacturing Sector, Serv: Services Sector.

Table A.20: Baseline results - drop each country once - 2001–2014 - dependent variable: ΔS_E

	(1) full	(2) woAUT	(3) woDEU	(4) woDNK	(5) woESP	(6) woFIN	(7) woGBR	(8) woITA	(9) woNLD	(10) woUSA
$\Delta \ln(P_E/P_L)$	0.0360***	0.0362***	0.0369***	0.0363***	0.0368***	0.0359***	0.0362***	0.0338***	0.0358***	0.0373***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.004)
$\Delta \ln(K_{ICT}/Y)$	-0.0031**	-0.0030**	-0.0034***	-0.0032**	-0.0034**	-0.0030**	-0.0037**	-0.0022**	-0.0033**	-0.0004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
$\Delta \ln(K_N/Y)$	-0.0139**	-0.0135**	-0.0142*	-0.0141**	-0.0156**	-0.0140**	-0.0179**	-0.0144**	-0.0137**	-0.0084***
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.001)
$\Delta \ln Y$	-0.0044	-0.0042	-0.0044	-0.0044	-0.0047	-0.0044	-0.0085***	-0.0038	-0.0041	-0.0024
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
Adjusted R^2	0.328	0.330	0.341	0.329	0.344	0.327	0.319	0.327	0.330	0.308
Observations	2445	2157	2241	2127	2197	2159	2117	2172	2226	2164

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014. All regressions include year and country × industry dummies.

Table A.21: Baseline results - drop each industry once (I) - 2001–2014 - dependent variable: ΔS_E - see Table A.2 for industry description

	(1) full	(2) woA	(3) woB	(4) woC10C12	(5) woC13C15	(6) woC16C18	(7) woC20C21	(8) woC22C23	(9) woC24C25	(10) woC26C27
$\Delta \ln(P_E/P_L)$	0.0360***	0.0326***	0.0359***	0.0333***	0.0356***	0.0356***	0.0347***	0.0354***	0.0346***	0.0360***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
$\Delta \ln(K_{ICT}/Y)$	-0.0031**	-0.0023**	-0.0027**	-0.0036**	-0.0034**	-0.0025*	-0.0025*	-0.0030**	-0.0032**	-0.0034**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\Delta \ln(K_N/Y)$	-0.0139**	-0.0141**	-0.0151*	-0.0127**	-0.0144**	-0.0134**	-0.0139**	-0.0132**	-0.0092**	-0.0146**
	(0.005)	(0.004)	(0.007)	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)	(0.003)	(0.006)
$\Delta \ln Y$	-0.0044	-0.0038	-0.0044	-0.0048*	-0.0041	-0.0035	-0.0042	-0.0042	-0.0036	-0.0047
	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Adjusted R^2	0.328	0.321	0.327	0.319	0.331	0.334	0.336	0.338	0.338	0.324
Observations	2445	2374	2405	2334	2338	2344	2363	2346	2343	2347

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014. All regressions include year and country × industry dummies.

Table A.22: Baseline results - drop each industry once (II) - 2001–2014 - dependent variable: ΔS_E - see Table A.2 for industry description

	(1) woC28	(2) woC29C30	(3) woC31C33	(4) woF	(5) woG45	(6) woG46	(7) woG47	(8) woH49H52	(9) woH53	(10) woI
$\Delta \ln(P_E/P_L)$	0.0360***	0.0360***	0.0362***	0.0394***	0.0361***	0.0365***	0.0360***	0.0340***	0.0362***	0.0367***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$\Delta \ln(K_{ICT}/Y)$	-0.0033**	-0.0033**	-0.0027**	-0.0037*	-0.0032**	-0.0032**	-0.0039***	-0.0050*	-0.0032**	-0.0025**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
$\Delta \ln(K_N/Y)$	-0.0145**	-0.0139**	-0.0143**	-0.0164**	-0.0139**	-0.0140**	-0.0155**	-0.0054	-0.0140**	-0.0168**
	(0.006)	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.004)	(0.005)	(0.006)
$\Delta \ln Y$	-0.0046	-0.0045	-0.0040	-0.0038	-0.0044	-0.0042	-0.0048	-0.0064	-0.0044	-0.0049*
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.002)
Adjusted R^2	0.327	0.327	0.332	0.346	0.327	0.327	0.309	0.341	0.329	0.320
Observations	2345	2355	2346	2355	2399	2385	2385	2404	2404	2334

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014. All regressions include year and country × industry dummies.

Table A.23: Baseline results - drop each industry once (III) - 2001–2014 - dependent variable: ΔS_E - see Table A.2 for industry description

	(1) full	(2) woJ58J60	(3) woJ61	(4) woJ62J63	(5) woK	(6) woMN	(7) woO	(8) woP	(9) woQ	(10) woRS
$\Delta \ln(P_E/P_L)$	0.0360***	0.0364***	0.0359***	0.0365***	0.0377***	0.0394***	0.0369***	0.0359***	0.0374***	0.0364***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$\Delta \ln(K_{ICT}/Y)$	-0.0031**	-0.0030**	-0.0032**	-0.0035**	-0.0034**	-0.0024	-0.0032**	-0.0022*	-0.0030***	-0.0031**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\Delta \ln(K_N/Y)$	-0.0139**	-0.0143**	-0.0138**	-0.0139**	-0.0147**	-0.0151*	-0.0142**	-0.0145**	-0.0149**	-0.0143**
	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.007)	(0.005)	(0.005)	(0.006)	(0.005)
$\Delta \ln Y$	-0.0044	-0.0043	-0.0043	-0.0046	-0.0039	-0.0035	-0.0042	-0.0066**	-0.0048	-0.0044
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Adjusted R^2	0.328	0.329	0.328	0.330	0.336	0.332	0.324	0.329	0.323	0.322
Observations	2445	2341	2372	2356	2337	2342	2338	2333	2339	2351

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014. All regressions include year and country × industry dummies.

A.3.5 Tables in National Currencies and PPPs

National Currencies

Table A.24: 100x annual change 2001–2014 - national currencies - estimation sample

	N	Mean	Median	SD	Min	Max
Cost shares						
ΔS_L	2451	-.021	-.02	.75	-3.3	3.7
ΔS_E	2451	.021	.02	.75	-3.7	3.3
ΔS_{Elec}	2451	.037	.01	.49	-2.7	2.4
ΔS_{NElec}	2451	-.016	-.0012	.57	-3.5	2.3
Flexible factor quantities:						
$\Delta\ln(L)$	2451	-.1	.19	3.8	-19	15
$\Delta\ln(L)^{h\_empe}$	2451	-.45	-.06	4	-24	17
$\Delta\ln(E)$	2451	-1.4	-.85	8.4	-40	23
$\Delta\ln(Elec)$	2451	-.086	.39	8.9	-45	26
$\Delta\ln(NElec)$	2451	-2.5	-1.8	11	-53	30
Flexible factor prices:						
$\Delta\ln(P_L)$	2451	1	.75	4.8	-19	29
$\Delta\ln(P_L^{h\_empe})$	2451	1.4	1	4.9	-23	30
$\Delta\ln(P_E)$	2451	2.9	2.4	7.5	-21	25
$\Delta\ln(P_{Elec})$	2451	2.5	2.2	7.8	-19	30
$\Delta\ln(P_{NElec})$	2451	2.7	2	10	-40	28
$\Delta\ln(P_E/P_L)$	2451	1.8	1.8	8.2	-26	27
Fixed input and output quantities:						
$\Delta\ln(K_{ICT})$	2451	4.4	4	6.8	-18	34
$\Delta\ln(K_N)$	2451	.97	1	3.7	-20	28
$\Delta\ln Y$	2451	.92	1.1	4.9	-21	15
$\Delta\ln(K_{ICT}/Y)$	2451	3.5	3.3	7.3	-18	26
$\Delta\ln(K_N/Y)$	2451	.047	.21	5.3	-18	18
Flexible factor intensities:						
$\Delta\ln(L/Y)$	2451	-1	-.59	4.8	-28	24
$\Delta\ln(E/Y)$	2451	-2.3	-1.9	8.8	-41	31
Costs:						
$\Delta\ln C_L$	2451	.93	.97	5	-24	26
$\Delta\ln C_E$	2451	1.5	1.8	11	-45	42

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped.

Table A.25: Average cost shares, 2000–2014 - national currencies - estimation sample

	N	Mean	Median	SD	Min	Max
S_L	2651	.92	.95	.1	.022	1
S_E	2651	.083	.045	.1	.00039	.98
S_{Elec}	2651	.041	.021	.055	8.8e-06	.47
S_{NElec}	2651	.042	.022	.064	.0001	.62
S_{K_N}	2651	.46	.32	.93	.00029	22
$S_{K_{ICT}}$	2651	.074	.034	.16	.0011	1.7

Notes: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped.

Table A.26: Baseline results - 2001–2014 - dependent variable: ΔS_E

	(1) POLS	(2) CxI	(3) C+I	(4) CxI Manu.	(5) CxI Serv.	(6) C+I Manu.	(7) C+I Serv.
$\Delta \ln(P_E/P_L)$	0.0305***	0.0321***	0.0321***	0.0645***	0.0222***	0.0646***	0.0224***
	(0.002)	(0.003)	(0.003)	(0.008)	(0.002)	(0.007)	(0.002)
$\Delta \ln(K_{ICT}/Y)$	-0.0081***	-0.0041***	-0.0055***	0.0007	0.0001	-0.0010	-0.0011
	(0.002)	(0.001)	(0.001)	(0.004)	(0.002)	(0.004)	(0.001)
$\Delta \ln(K_N/Y)$	-0.0089***	-0.0077**	-0.0097***	-0.0002	-0.0064**	-0.0040	-0.0089*
	(0.002)	(0.003)	(0.003)	(0.009)	(0.003)	(0.008)	(0.004)
$\Delta \ln Y$	-0.0079	0.0020	-0.0001	0.0228	0.0092	0.0183	0.0065
	(0.007)	(0.009)	(0.008)	(0.015)	(0.010)	(0.013)	(0.011)
Year DVs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Industry	No	Yes	No	Yes	Yes	No	No
Country DVs	No	No	Yes	No	No	Yes	Yes
Industry DVs	No	No	Yes	No	No	Yes	Yes
Elasticities	-0.171	-0.123	-0.140	.	.	.	.
Adjusted R^2	0.341	0.343	0.363	0.391	0.481	0.414	0.482
Observations	2451	2451	2451	990	1259	990	1259

Notes: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014.

PPPs

Table A.27: 100x annual change 2001–2014 - PPPs - estimation sample

	N	Mean	Median	SD	Min	Max
Cost shares						
ΔS_L	2446	-.024	-.019	.75	-3.3	3.7
ΔS_E	2446	.024	.019	.75	-3.7	3.3
ΔS_{Elec}	2446	.035	.0099	.49	-2.7	2.4
ΔS_{NElec}	2446	-.011	-.0004	.57	-3.5	2.3
Flexible factor quantities:						
$\Delta\ln(L)$	2446	-.071	.2	3.8	-19	15
$\Delta\ln(L)^{h\_empe}$	2446	-.41	-.056	3.9	-24	17
$\Delta\ln(E)$	2446	-1.3	-.78	8.3	-40	23
$\Delta\ln(Elec)$	2446	-.022	.43	8.8	-45	26
$\Delta\ln(NElec)$	2446	-2.3	-1.7	11	-53	30
Flexible factor prices:						
$\Delta\ln(P_L)$	2446	1.7	1.4	5	-19	28
$\Delta\ln(P_L^{h\_empe})$	2446	2	1.8	5.1	-23	29
$\Delta\ln(P_E)$	2446	3.5	3.3	7.6	-21	26
$\Delta\ln(P_{Elec})$	2446	3.1	2.9	8	-17	30
$\Delta\ln(P_{NElec})$	2446	3.4	2.7	10	-38	30
$\Delta\ln(P_E/P_L)$	2446	1.8	1.8	8.2	-26	27
Fixed input and output quantities:						
$\Delta\ln(K_{ICT})$	2446	5	4.6	6.9	-17	37
$\Delta\ln(K_N)$	2446	1.6	1.6	3.9	-19	28
$\Delta\ln Y$	2446	1.6	1.7	5.1	-20	15
$\Delta\ln(K_{ICT}/Y)$	2446	3.4	3.3	7.3	-18	26
$\Delta\ln(K_N/Y)$	2446	.035	.21	5.3	-18	18
Flexible factor intensities:						
$\Delta\ln(L/Y)$	2446	-1.7	-1.4	5	-27	24
$\Delta\ln(E/Y)$	2446	-2.9	-2.7	8.9	-42	31
Costs:						
$\Delta\ln C_L$	2446	1.6	1.7	5.1	-25	28
$\Delta\ln C_E$	2446	2.2	2.5	11	-46	43

NOTES: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped.

Table A.28: Average cost shares, 2000–2014 - PPPs - estimation sample

	N	Mean	Median	SD	Min	Max
S_L	2646	.92	.95	.1	.022	1
S_E	2646	.083	.045	.1	.0004	.98
S_{Elec}	2646	.041	.021	.055	8.8e-06	.47
S_{NElec}	2646	.042	.022	.064	.0001	.62
S_{K_N}	2646	.45	.32	.88	.00029	22
$S_{K_{ICT}}$	2646	.074	.034	.16	.0011	1.7

Notes: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped.

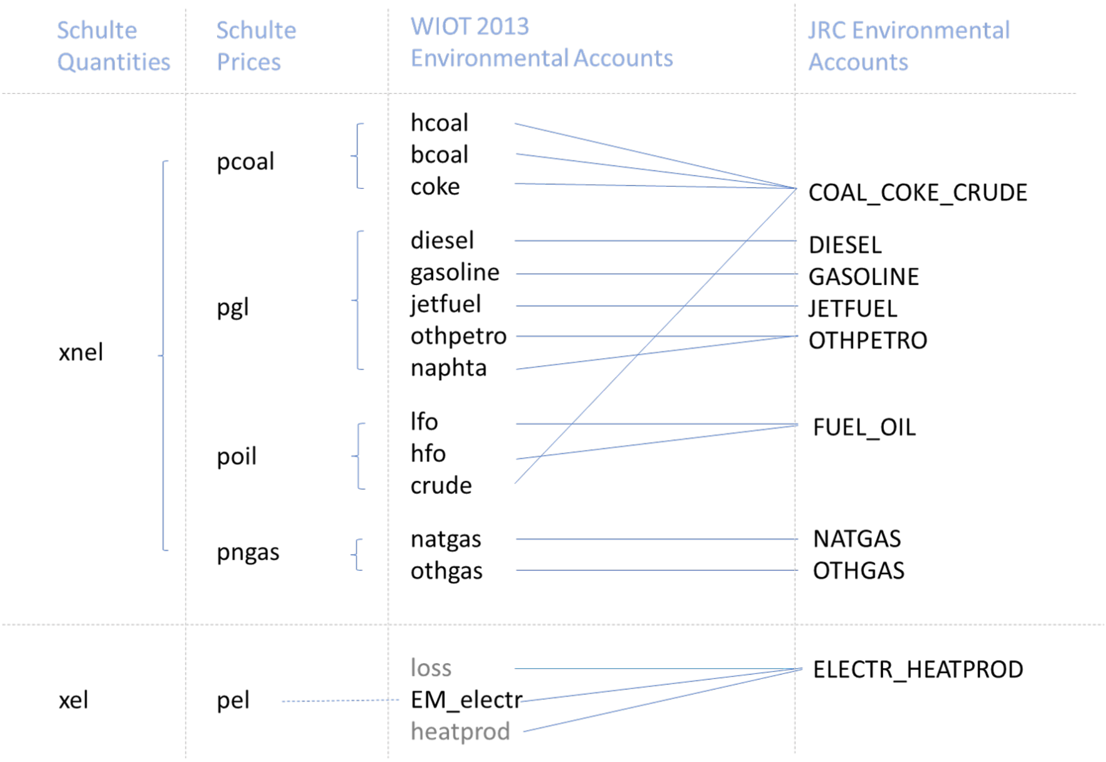
Table A.29: Baseline results - 2001–2014 - dependent variable: ΔS_E

	(1) POLS	(2) CxI	(3) C+I	(4) CxI Manu.	(5) CxI Serv.	(6) C+I Manu.	(7) C+I Serv.
$\Delta \ln(P_E/P_L)$	0.0312***	0.0331***	0.0331***	0.0665***	0.0232***	0.0662***	0.0233***
	(0.002)	(0.003)	(0.002)	(0.007)	(0.002)	(0.007)	(0.002)
$\Delta \ln(K_{ICT}/Y)$	-0.0074***	-0.0032**	-0.0048**	0.0030	0.0002	0.0008	-0.0012
	(0.002)	(0.001)	(0.002)	(0.004)	(0.002)	(0.003)	(0.002)
$\Delta \ln(K_N/Y)$	-0.0077**	-0.0083***	-0.0102***	-0.0047	-0.0091***	-0.0079	-0.0109**
	(0.002)	(0.002)	(0.002)	(0.008)	(0.002)	(0.008)	(0.004)
$\Delta \ln Y$	-0.0090	-0.0013	-0.0037	0.0122	0.0060	0.0080	0.0038
	(0.005)	(0.007)	(0.007)	(0.010)	(0.010)	(0.009)	(0.010)
Year DVs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Industry	No	Yes	No	Yes	Yes	No	No
Country DVs	No	No	Yes	No	No	Yes	Yes
Industry DVs	No	No	Yes	No	No	Yes	Yes
Elasticities	-0.162	-0.112	-0.132	.	.	.	.
Adjusted R^2	0.335	0.343	0.360	0.375	0.483	0.395	0.483
Observations	2446	2446	2446	985	1260	985	1260

Notes: Estimation sample excludes percentiles ≤ 1 and ≥ 99 of all regression variables as well as energy prices and quantities. Observations with negative capital compensation shares are dropped. Clustered standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. All regressions are weighted by the average hours worked of persons employed in the respective industry of the period 2000-2014.

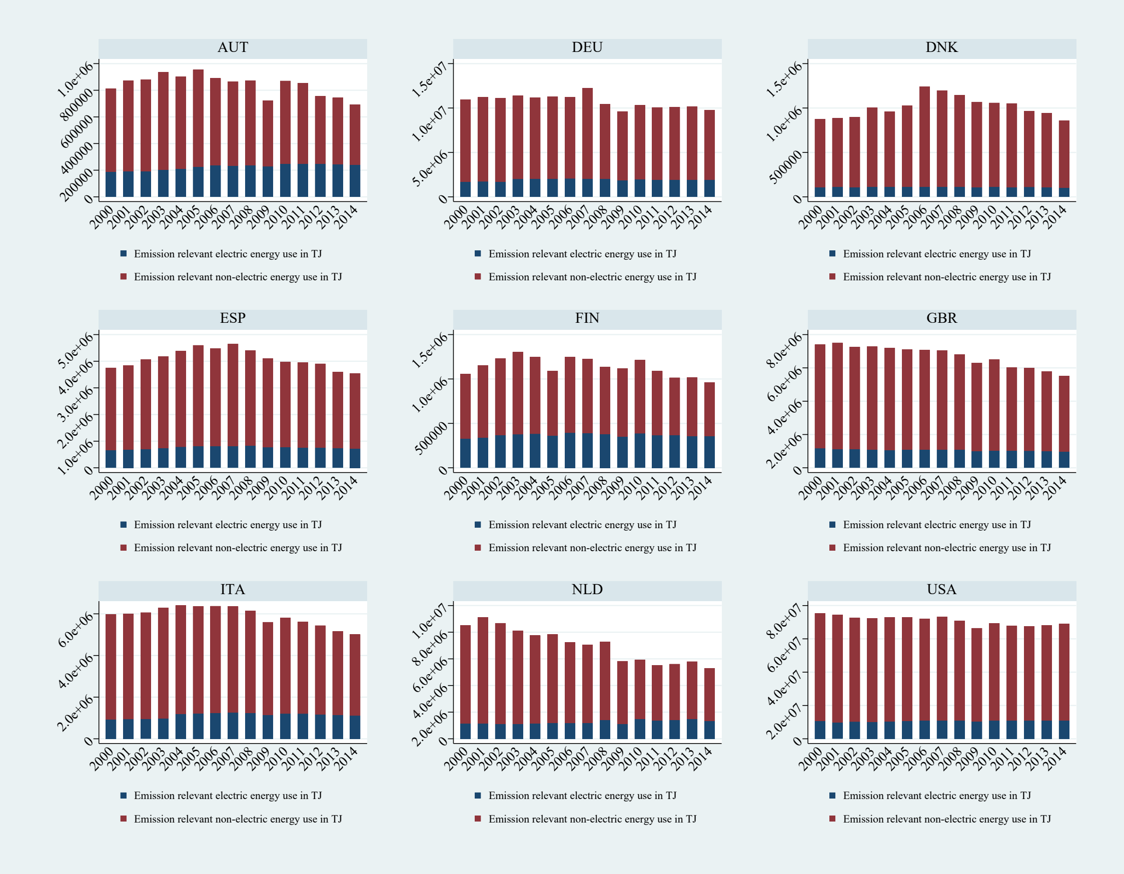
A.4 Additional Figures

Figure A.1: Relationship between energy variables



Notes: Based on Schulte et al. (2016), Genty et al. (2012) and European Commission. Joint Research Centre. (2019). See Table A.3 for a detailed description of the energy commodities.

Figure A.2: Total emission relevant energy use - electric vs. non-electric



Source: European Commission. Joint Research Centre. (2019), own calculations.

Note: Energy commodities as described in Table A.3.

Figure A.3: Total emission relevant energy use - only industries as described in Table A.2 - electric vs. non-electric

Source: European Commission. Joint Research Centre. (2019), own calculations.

Note: Energy commodities as described in Table A.3.

Figure A.4: Total emission relevant energy use - shares self home foreign

SOURCE: European Commission. Joint Research Centre. (2019) and WIOD World Input-Output Tables (WIOT) Release 2016, own calculations.

NOTE: Energy commodities as described in Table A.3.

Figure A.5: Total emission relevant energy use - only industries as described in Table A.2 - shares self home foreign

Source: European Commission. Joint Research Centre. (2019) and WIOD World Input-Output Tables (WIOT) Release 2016, own calculations.

Note: Energy commodities as described in Table A.3.