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Offshoring and the polarisation of the demand for capital

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Non-technical summary

Research Question

Empirical studies show that the relocation of production abroad (offshoring) significantly contributes to the decline of the demand for low-skilled workers with a concomitant fall in their wages relative to those of high-skilled workers. In contrast, the implications of offshoring for the demand for capital are less clear.

Contribution

We contribute to the literature by analysing the effect of offshoring on domestic fixed capital by asset class. We apply and extend the approach of estimating relative factor demand equations stemming from a translog cost function using a rich panel of 11 advanced economies and 32 sectors between 1995 and 2014, including a detailed breakdown of fixed capital into ten different asset classes. In order to gauge the effect of offshoring on the demand for capital, we treat capital as a variable input factor. A challenge that arises in this regard stems from the need to obtain data for the price of the capital input (i.e. rental rates or user costs), which – in contrast to the price for labour and intermediate inputs – is usually not readily available and has to be estimated.

Results

The empirical evidence suggests that non-information and communication technology (non-ICT) capital is squeezed by offshoring, while the demand for research and development capital is only slightly affected and that for ICT capital is not affected in a statistically significant way. Our results are robust against a wide range of different specifications and methodological choices, including sluggish adjustments of the input factors to long-run levels and an instrumental variable approach to address endogeneity concerns. Hence, offshoring is – along with technological change – one factor behind the structural change in the composition of the demand for capital observed in advanced economies. Potential explanations for the offshoring-induced changes in the demand for capital are (i) the direct offshoring of capital-intensive stages of production deriving from cross-country differences in the cost of capital and (ii) capital-labour complementaries.

Nichttechnische Zusammenfassung

Fragestellung

Empirische Studien zeigen, dass die Verlagerung von Produktionsschritten ins Ausland (Offshoring) wesentlich zum Rückgang der Nachfrage nach geringqualifizierten Arbeitskräften und ihrer Löhne im Vergleich zu denen von hochqualifizierten Arbeitskräften beigetragen hat. Die Auswirkungen von Offshoring auf die Kapitalnachfrage sind hingegen wenig erforscht.

Beitrag

Wir analysieren die Auswirkungen von Offshoring auf das inländische Anlagevermögen nach Kapitalgüterklassen. Hierzu verwenden und erweitern wir den in der empirischen Literatur etablierten Ansatz der Schätzung relativer Faktornachfragegleichungen, die sich aus einer Translog-Kostenfunktion ergeben. Der verwendete Datensatz umfasst jeweils 32 Wirtschaftsbereiche in 11 fortgeschrittenen Volkswirtschaften für den Zeitraum der Jahre 1995 bis 2014 sowie eine detaillierte Aufteilung des Anlagevermögens in zehn verschiedene Kapitalgüterklassen. Um den Effekt von Offshoring auf die inländische Kapitalnachfrage abzuschätzen, betrachten wir den Produktionsfaktor Kapital als variablen Einsatzfaktor. Hierdurch ergibt sich die Notwendigkeit, dessen Preis (d.h. Kapitalnutzungskosten) zu bestimmen. Diese sind jedoch im Gegensatz zu den Preisen für den Faktor Arbeit und für Vorleistungsgüter in der Regel nicht ohne Weiteres verfügbar und müssen daher geschätzt werden.

Ergebnisse

Die empirische Evidenz deutet darauf hin, dass Kapital, welches nicht den Informations- und Kommunikationstechnologien (IKT) zugeordnet werden kann, durch Offshoring verdrängt wird, während die Nachfrage nach Forschungs- und Entwicklungskapital durch Offshoring nur leicht und jene nach IKT-Kapital nicht in statistisch signifikanter Weise beeinflusst werden. Die Ergebnisse sind hinsichtlich einer Vielzahl von Spezifikationen und methodischen Annahmen robust. Als mögliche Erklärung für die Veränderung der Kapitalnachfrage kommen (i) die direkte Verlagerung kapitalintensiver Produktionsschritte und (ii) Komplementaritäten zwischen den Produktionsfaktoren Kapital und Arbeit in Betracht.

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Offshoring and the polarisation of the demand for capital*

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Abstract

While there is a consensus in the literature that offshoring has a polarising effect on the skill structure of labour demand, little is known about its impact on the capital side. In this paper, we analyse the effect of offshoring on the demand for capital by asset class using a rich country-sector panel dataset. Estimating a system of factor demand equations, we document that offshoring reduces the relative demand for non-ICT capital, thereby also polarising the demand for capital. Our results are robust against a wide range of specifications and methodological choices including an IV approach to address endogeneity concerns.

Keywords: offshoring, trade, global value chains, demand for capital, user costs of capital, ICT

JEL classification: F14, F62, F20, E22

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1 Introduction

In the past decades, falling trade and communication costs have fundamentally altered the way production is organised. For centuries, production was limited by the input factors available in close geographic proximity. As it has become less costly to coordinate and monitor value chains across time and space, the production process has been split into increasingly smaller tasks, allowing firms to capitalise on factor price differences across countries. The resulting international fragmentation of production and its organisation along global value chains has been a defining feature of the world economy in the recent past, with far-reaching ramifications for the pattern of international trade flows and the structure of domestic labour markets.

Offshoring and the ensuing emergence of international production networks is accompanied by trade in intermediates (Campa and Goldberg, 1997; Hummels, Ishii, and Yi, 2001; Johnson and Noguera, 2012). According to data from the World Input-Output Database (WIOD), the share of imported intermediates in global production increased from 6.2% in 1995 to 8.3% in 2014. As a consequence, almost two-thirds of world trade in 2014 was in intermediate goods and services. While production networks used to be primarily regional in nature, they have become more and more global in the past two decades (Los, Timmer, and de Vries, 2015).

Countries are attractive as offshoring destinations if the savings accruing from factor price differences outweigh the coordination and trade costs associated with the additional fragmentation of the production process (Feenstra and Hanson, 1997; Kohler, 2004; Grossman and Rossi-Hansberg, 2008). In this regard, certain tasks show a greater potential to be offshored than others. For example, routine tasks without the need for face-to-face interactions and geographical proximity are generally thought to be good candidates for offshoring, while those associated with complex and tacit knowledge are not (e.g. Blinder, 2006; Becker, Ekholm, and Muendler, 2013).

While offshorability is assessed at the task level, most previous work on offshoring has focused on labour demand effects by skill type. From a theoretical perspective, international outsourcing may decrease (Feenstra and Hanson, 1999) or increase (Egger and Falkinger, 2003) wages and employment of (unskilled) labour-intensive stages of production. On the empirical side, country studies show that offshoring significantly contributes to the decline of the demand for low- and medium-skilled workers with a concomitant fall in their wages relative to those of high-skilled workers (Feenstra and Hanson, 1997, 1999; Strauss-Kahn, 2004; Hijzen, Görg, and Hine, 2005; Becker et al., 2013; Hummels, Jørgensen, Munch, and Xiang, 2014). A cross-country study based on a sample of 40 countries over the period 1995 to 2009 finds that offshoring has a negative impact on labour demand for all skill types, but particularly so for medium-skilled workers (Foster-McGregor, Stehrer, and de Vries, 2013). Overall, a consensus has emerged in the empirical literature that offshoring has a polarising effect on the skill structure of labour demand (Crinò, 2009).[1]

The implications of offshoring for the demand for capital, however, are less clear.[2] In

[1] A related literature analyses the relationship between technological change and the observed increase in the demand for high-skilled labour over the past decades (e.g. O'Mahony, Robinson, and Vecchi, 2008; Goldin and Katz, 2009; Michaels, Natraj, and Van Reenen, 2014).

[2] A strand of the literature examines the relationship between foreign and domestic investment activity

principle, the relationship between offshoring and R&D investment is theoretically ambiguous. Glass and Saggi (2001) analyse the effects of increased offshoring to a low-wage country and find that it creates greater incentives for innovation. While their results suggest that offshoring and expenditures on R&D should be positively correlated, offshoring and R&D may be either complements or substitutes depending on the degree of competition, the size of the market, and the specific type of R&D investment (Marjit and Mukherjee, 2008; Beladi, Marjit, and Yang, 2012). In contrast, the literature on the relationship between ICT and offshoring tends to support the view that both are positively correlated. Abramovsky and Griffith (2006), for instance, show that more ICT-intensive firms in the UK are more likely to offshore business services than less ICT-intensive firms. Broadly similar results for Germany are obtained by Rasel (2017), who also points towards a positive relationship between ICT and firms' offshoring decisions.

We contribute to the literature by analysing the effect of offshoring on domestic fixed capital by asset class. This paper applies and extends the approach of estimating relative factor demand equations stemming from a translog cost function using a rich panel of 32 sectors in 11 advanced economies between 1995 and 2014 including a detailed breakdown of capital into ten different asset classes. In order to gauge the effect of offshoring on the demand for capital, we treat capital as a variable input factor instead of assuming that it is quasi-fixed in the short run.[3] In principle, changes in the capital stock might be subject to adjustment costs (Lucas, 1967; Gould, 1968). In a robustness analysis, we show that allowing for sluggish adjustments of the input factors, which may result from e.g. costs of adjustment or regulatory restrictions, does not have a bearing on our results. A challenge of treating capital as a variable input arises from the need to obtain data for the price of the capital input (i.e. rental rates or user costs), which – in contrast to the price for labour and intermediate inputs – is usually not readily available and has to be estimated. The literature typically distinguishes between ex post and ex ante measures of the user costs of capital, which differ conceptually in the information available to agents when making investment decisions. In this paper, we compute both an ex post and several ex ante measures of the user costs of capital for the estimation of the relative factor demand equations.

Our empirical results indicate that offshoring has a negative impact on non-ICT capital, while we find only a weak negative effect on R&D capital and no evidence for a significant effect on ICT capital. Hence, offshoring is – along with technological change – one factor behind the structural change in the composition of the demand for capital observed in advanced economies (Colecchia and Schreyer, 2002; Corrado, Hulten, and Sichel, 2009). In a large number of sensitivity tests, we show that our main result is robust against the particular method for computing the user costs of capital as well as a range of different specifications and methodological choices. In particular, we address endogeneity concerns using an instrumental variable approach by exploiting the exogenous variation of the world export supply of intermediate inputs as predictors for changes in offshoring,

of multinational enterprises (for an overview, see Goldbach, Nagengast, Steinmüller, and Wamser, 2017).

[3]See, for example, Berman, Bound, and Griliches (1994) and Hijzen et al. (2005), among others. However, the assumption of quasi-fixedness of the capital input in previous contributions appears more an empirical convenience than a theoretical necessity. First, prices for the capital input are usually not readily available. Second, the main focus of the empirical offshoring literature is on labour market outcomes.

a variant of which was proposed by Hummels et al. (2014).

Potential explanations for the polarising effect of offshoring on the demand for capital by asset class include (i) the direct offshoring of capital-intensive stages of production and (ii) capital-labour complementaries, both of which we discuss in the context of simple variants of the trade-in-tasks model by Grossman and Rossi-Hansberg (2008). First, the offshoring-induced reduction in the relative demand for non-ICT capital may reflect differences in the cost of non-ICT capital goods across countries. While factor price differences for labour are commonly considered the major factor behind offshoring decisions, whether the marginal product of capital is equalised across countries remains a matter of some debate (e.g. Banerjee and Duflo, 2005; Caselli and Feyrer, 2007). If it is not equalised, lower rental rates for non-ICT capital abroad could result in the offshoring of non-ICT capital-intensive stages of production depending on the cost of offshoring production. Second, capital-labour complementaries may be an explanation for the negative effect on non-ICT capital even if the marginal product of capital is equalised across countries. In this case, offshoring of labour-intensive stages of production may bring about adjustments on the capital side due to input factor complementaries.

The remainder of the paper is structured as follows. Section 2 describes the methodology and details the calculation of the user costs of capital. Section 3 presents information on the dataset and descriptive statistics. The main results from our empirical analysis are discussed in Section 4 including a comprehensive assessment of their robustness. Section 5 provides a discussion of the potential channels underlying the polarisation of the demand for capital, and Section 6 offers some concluding remarks.

2 Methodology

2.1 Derivation of factor share equations

We analyse the relationship between offshoring and the demand for capital by estimating a system of relative factor demand equations derived from a translog cost function (Christensen, Jorgenson, and Lau, 1971, 1973). Consider a production function at the sector level that combines labour, capital, and intermediate inputs in order to produce output:

$$Y_{i,j,t} = f(L_{i,j,t}, K_{i,j,t}, M_{i,j,t}, Z_{i,j,t}),$$

where $Y_{i,j,t}$ denotes gross output of sector j in country i at time t, $L_{i,j,t} \equiv L_{1,i,j,t}, ..., L_{l,i,j,t}$ are different types of labour inputs, $K_{i,j,t} \equiv K_{1,i,j,t}, ..., K_{k,i,j,t}$ are capital inputs by asset class, and $M_{i,j,t} \equiv M_{1,i,j,t}, ..., M_{m,i,j,t}$ are different types of intermediate inputs. $Z_{i,j,t} \equiv Z_{1,i,j,t}, ..., Z_{z,i,j,t}$ denote levels of technology which reflect how efficiently the inputs are combined in the production process.

Under standard assumptions, the duality of the firm's optimisation problem implies that the cost function contains all economically relevant information on the production technology. Assuming that input prices are given and that the firm aims at producing a certain fixed level of gross output, Y, the cost function is given by

$$C(p_L, p_K, p_M, Y, Z) \equiv \min_{\{L_n\}_{n=1}^{l}\{K_n\}_{n=1}^{k}\{M_n\}_{n=1}^{m}} \sum_{n=1}^{l} p_{n,L} L_n + \sum_{n=1}^{k} p_{n,K} K_n + \sum_{n=1}^{m} p_{n,M} M_n,$$
$$\equiv \min_{\{Q_n\}_{n=1}^{N}} \sum_{n=1}^{N} p_{n,Q} Q_n,$$

where $p_L \equiv p_{1,L}, ..., p_{l,L}$, $p_K \equiv p_{1,K}, ..., p_{k,K}$, and $p_M \equiv p_{1,M}, .., p_{m,M}$ denote input prices of the labour, capital, and intermediate inputs, respectively, and Q is the set of variable input factors with $N = l + k + m$.[4] Sector, country, and time subscripts are omitted for notational simplicity. As indicated above, we assume that the associated variable cost function can be approximated by a translog functional form which is given by

$$\begin{aligned}\ln(C) = \alpha_0 + \sum_{n=1}^{N} \alpha_n \ln(p_{n,Q}) + \beta_y \ln(Y) + \sum_{n=1}^{z} \gamma_n Z_n \\ + \frac{1}{2} \sum_{n=1}^{N} \sum_{o=1}^{N} \alpha_{no} \ln(p_{n,Q}) \ln(p_{o,Q}) + \frac{1}{2} \beta_{yy} \ln(Y)^2 + \frac{1}{2} \sum_{n=1}^{z} \sum_{o=1}^{z} \gamma_{no} Z_n Z_o \\ + \sum_{n=1}^{N} \delta_{ny} \ln(p_{n,Q}) \ln(Y) + \sum_{n=1}^{N} \sum_{o=1}^{z} \delta_{no} \ln(p_{n,Q}) Z_o + \sum_{n=1}^{z} \delta_{yn} \ln(Y) Z_n,\end{aligned} \quad (1)$$

where C represents the total variable cost by sector.[5] We assume capital to be a variable input factor as opposed to being quasi-fixed in the short run. Hence, the price of capital rather than its quantity enters the cost function in Equation (1). In Section 4.2.2, however, we show that allowing for sluggish adjustment of the capital stock (and other input factors) does not have a bearing on our results. Linear homogeneity in input prices and symmetry

[4] l, k, and m depend on the degree of disaggregation of the labour, capital, and intermediate inputs, respectively. In the empirical analyses below, an aggregate measure of intermediate inputs and labour will always be used (i.e. $m = 1$ and $l = 1$). For capital inputs, however, different degrees of disaggregation are considered. In general, the capital input is split into three asset classes (ICT, non-ICT, and R&D capital), $k = 3$, but a higher level of disaggregation in which $k = 7$ is also considered in Section 4.1.

[5] Note that the level of technology, Z, which is in general proxied by a measure for offshoring, does not enter the translog cost function in logs, as it is already measured in percentages (see Section 3.1). Changes in the relative demand for the input factors may also be due to technological change per se. The literature on the relation between offshoring and labour demand therefore typically controls for technological change by including some measure of ICT or R&D intensity (e.g. Feenstra and Hanson, 1999; Hijzen et al., 2005). Given that ICT and R&D factor shares are among the independent variables used in our empirical analysis, following this strategy does not seem to be appropriate. Our baseline specification controls for year fixed effects and, hence, accounts for technological change other than offshoring that is common across countries and sectors. This specification yields unbiased estimates if the part of technological change contained in the error term (i.e. technological change that is not captured by offshoring or year fixed effects) is uncorrelated with the explanatory variables. We show that explicitly controlling for technological change in a number of different ways does not have a bearing on our results (Section 4.2.4).

imply that

$$\sum_{n=1}^{N} \alpha_n = 1,$$

$$\sum_{n=1}^{N} \alpha_{no} = \sum_{o=1}^{N} \alpha_{no} = \sum_{n=1}^{N} \delta_{ny} = \sum_{n=1}^{N} \delta_{no} = 0,$$

and

$$\alpha_{no} = \alpha_{on}.$$

By Shephard's lemma, the demand for the input factors conditional on output can be obtained by differentiating the cost function with respect to input prices, i.e. $\partial C/\partial p_{n,Q} = Q_n, \forall n = 1, ..., N$. Hence, the partial derivative of the translog cost function with respect to the nth input price yields the cost share of input n in total cost:

$$S_n \equiv \frac{\partial \ln C}{\partial \ln p_{n,Q}} = \frac{p_{n,Q} Q_n}{C} = \alpha_n + \sum_{o=1}^{N} \alpha_{no} \ln(p_{o,Q}) + \delta_{ny} \ln(Y) + \sum_{o=1}^{z} \delta_{no} Z_o, \tag{2}$$

where $n = 1, ..., N$.

2.2 User costs of capital

While prices for the labour input (i.e. wages) as well as intermediates are usually easy to obtain, market information on the price of the capital input (i.e. rental rates or user costs) is typically not available. Hence, user costs need to be estimated for all asset classes. In principal, the literature distinguishes between ex post and ex ante approaches for calculating the user costs of capital.

The ex post method exclusively builds on national accounts data and can be calculated in a straightforward way without the need for additional estimation steps. The approach relies only on realised data and no assumptions on the nature of the expectation formation process are required. Our baseline results rely on an ex post measure that was calculated in line with the EU KLEMS methodology[6] under the assumption that the nominal rate of return is equalised across different assets in a particular sector (Jorgenson and Griliches, 1967; Jorgenson, Gollop, and Fraumeni, 1987). The resulting user costs of asset i at time t, $uc_{i,t}$, are given by

$$uc_{i,t} = q_{i,t-1} i_t + \delta_{i,t} q_{i,t} - (q_{i,t} - q_{i,t-1}),$$

where i_t is the nominal rate of return on alternative capital investments (i.e. the opportunity cost), $\delta_{i,t}$ is the depreciation rate, and $q_{i,t}$ is the investment price of asset i. Note that the composite term $q_{i,t} - q_{i,t-1}$ reflects asset-specific capital gains of investing in asset i. From a theoretical point of view, however, investment decisions are based on expected, rather than realised outcomes leading to the so-called ex ante user cost approach originally proposed by Diewert (1980). In the absence of taxation, the ex ante user costs of

[6]The methodology to calculate ex post user costs proposed in EU KLEMS has been used extensively in the literature. For more details, see O'Mahony and Timmer (2009), among many others.

asset i at time t, $\widetilde{uc}_{i,t}$, can be defined following Auerbach (1983) as

$$\widetilde{uc}_{i,t} = [r_t^e + \delta_{i,t} - (\pi_{i,t}^e - \pi_t^e)] \frac{q_{i,t}}{p_{y,t}},$$

where r_t^e is the expected real rate of return, $\pi_{i,t}^e$ is the expected asset-specific price inflation, π_t^e is the expected economy-wide price inflation, and $p_{y,t}$ is the value added price. Note that the composite term $\pi_{i,t}^e - \pi_t^e$ now reflects the expected relative capital gains of investing in asset i.

Depreciation rates, $\delta_{i,t}$, investment prices, $q_{i,t}$, and value added prices, $p_{y,t}$, are directly taken from EU KLEMS. The nominal rate of return, i_t, is given by the sector-mean rate of return across all asset classes based on the EU KLEMS methodology. Asset price inflation, $\pi_{i,t}$, is measured as the percentage change in the investment price index, whereas economy-wide inflation, π_t, is based on the value added deflator of the total economy. The ex ante approach requires estimates of the expected real rate of return, r_t^e, and asset-specific expected price gains, $\pi_{i,t}^e - \pi_t^e$. For both, first, we estimate autoregressive models using data up until t and, second, produce out-of-sample forecasts for $t+1$ using the estimated processes (e.g. Oulton, 2007).

In both ex post and ex ante approaches, we compute user costs of capital at the most disaggregated level for all ten asset classes available in EU KLEMS. Aggregate measures of user costs are obtained by aggregating over user costs of individual assets according to their average share in the total compensation of the respective capital aggregate:

$$p_{i,K,t} = \sum_{j=1}^{J} \frac{(\nu_{j,t}^i + \nu_{j,t-1}^i)}{2} uc_{j,t}, \tag{3}$$

where $p_{i,K,t}$ denotes the user costs for capital aggregate i comprising J subcomponents and $\nu_{j,t}^i$ denotes the jth asset's share in the compensation of capital aggregate i given by $uc_{j,t}K_{j,t}/\sum_{k=1}^{J} uc_{k,t}K_{k,t}$ for the ex post approach.[7] Equivalent expressions for the ex ante approach are omitted for brevity.[8]

3 Data and descriptive statistics

3.1 Data sources and construction

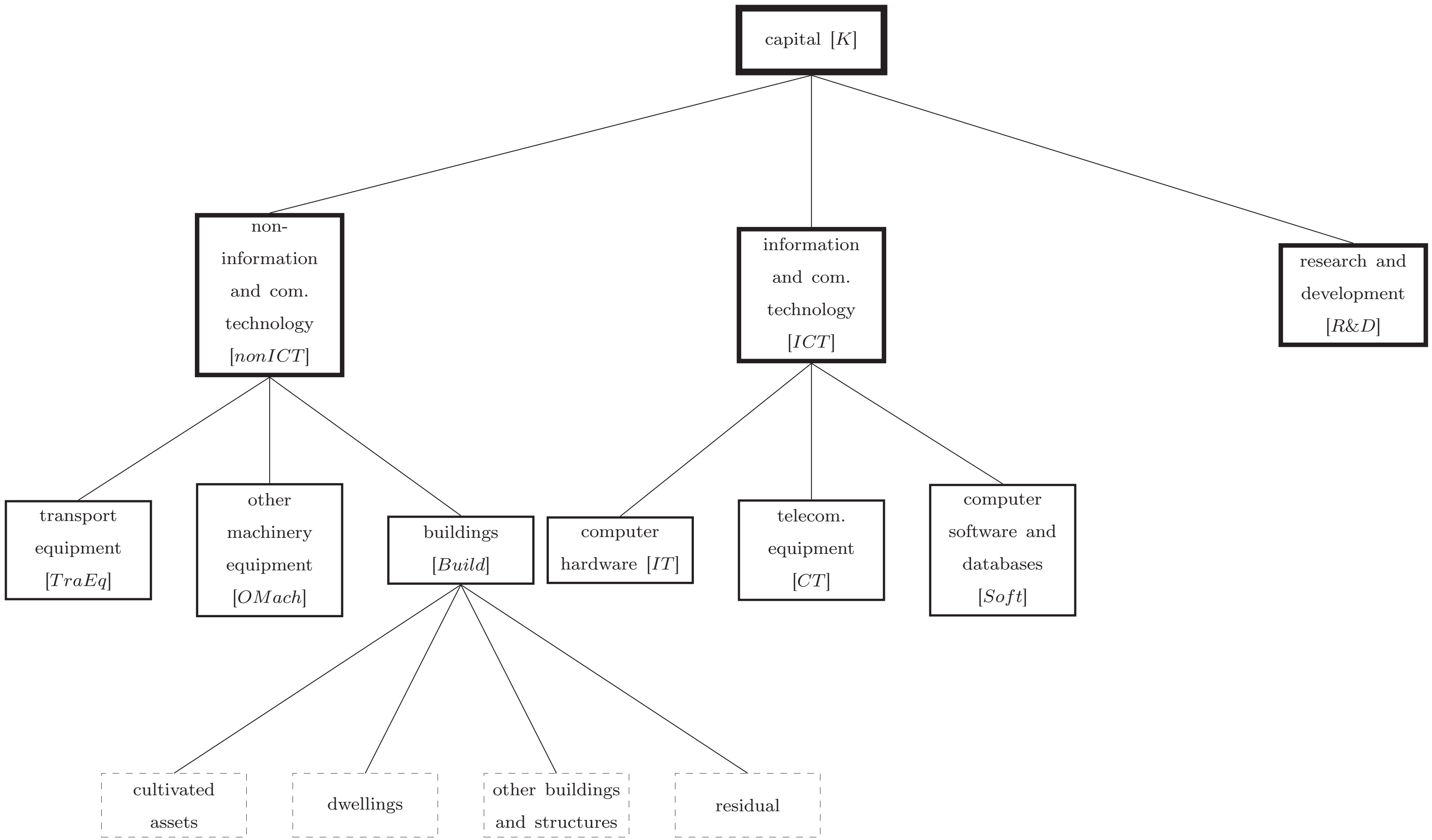
The main data sources are the EU KLEMS September 2017 release (Jäger, 2017) and the WIOD release 2013 and 2016 (Timmer, Dietzenbacher, Los, Stehrer, and de Vries, 2015). EU KLEMS contains data on gross output, prices of intermediates, labour compensation, total hours worked by persons engaged, and a detailed breakdown of investment prices and the capital stock for the time period from 1995 to 2014[9] for 11 countries: Austria, Denmark, Finland, France, Germany, Italy, the Netherlands, Spain, Sweden, the United

[7]Note that in Equation (3) $uc_{j,t}$ denotes user costs of the most disaggregated asset classes; $p_{i,K,t}$ refers to the user costs of the capital aggregates that enter the empirical analyses below.

[8]For all ex ante measures of the user costs of capital we use predicted shares based on out-of-sample forecasts from autoregressive models.

[9]This is true for most of the countries and industries. In some cases, however, certain variables are only available for shorter time periods.

Figure 1: Classification of fixed capital



Kingdom, and the United States.[10] We consider a sample including information on 32 sectors (Table A.1).[11] In principle, information on 10 different asset classes is available in EU KLEMS (Figure 1), which we aggregate for each country-sector-year cell into the three broad asset classes: non-ICT (1: transport equipment; 2: other machinery equipment; 3: cultivated assets; 4: dwellings; 5: other buildings and structures; 6: residual: mineral exploration and artistic originals), ICT (7: computer hardware; 8: telecommunications equipment; 9: computer software and databases), and R&D capital (10: research and development).[12] In Section 4.1, we also perform an additional analysis at a more fine-grained level with seven capital aggregates. Average wages are computed as the ratio of labour compensation to total hours worked. The dependent variables in the empirical analysis are the compensation shares of each production factor in total costs, which are computed as the labour compensation, capital compensation, or the intermediate inputs at current purchaser prices relative to total costs.

The 2016 release (2013 release) of the WIOD includes information on the source of imported intermediates for 43 (40) countries and 56 (35) sectors for the period 2000 to 2014 (1995 to 2011). We follow Berman et al. (1994) and Campa and Goldberg (1997), and define offshoring in sector s of country c as the share of imported intermediates in gross output:

$$O_{cs} = \sum_{i \neq c}^{C} \sum_{j}^{S} \frac{M_{cs,ij}}{y_{cs}},$$

where $M_{cs,ij}$ denotes the intermediates used in the production of sector s of country c sourced from sector j of country i, y denotes gross output, and time subscripts are omitted for brevity.[13] The offshoring measure is based on the 2016 release of WIOD for 2000 to 2014, and we extend the sample to 1995 by backcasting the time series using growth rates of the offshoring measure based on the 2013 release of WIOD. Correspondence tables between the sectors of the two WIOD releases and EU KLEMS are detailed in the appendix (Tables A.2 and A.3).

[10]Data for other EU countries is available, but lacks the detailed breakdown required for our analysis, with the exception of the Czech Republic and Slovakia, which were excluded given that they are more commonly considered offshoring destinations.

[11]We drop sectors T ("Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use") and U ("Activities of extraterritorial organisations and bodies").

[12]We disaggregate the capital input into its ICT, non-ICT, and R&D components in order to ensure comparability of our results with the previous literature. Note that our paper is based on the September 2017 revision of the EU KLEMS Growth and Productivity Accounts. While previous versions of EU KLEMS inter alia did not recognise expenditures on R&D as investment, the concepts and methodologies in the 2017 release are in line with the current version of the European System of National Accounts introduced in September 2014. Expenditures on R&D are now, for instance, counted as investment and therefore add to GDP.

[13]Alternative definitions of offshoring such as dividing imported intermediates by domestic value added instead of gross output exist in the literature (Hijzen et al., 2005), but do not qualitatively change our results (Section 4.2.4).

3.2 Descriptive statistics

This section presents summary statistics on the offshoring measure as well as the factor shares and factor prices over time by country (Table 1) and sector (Table 2). The tables present the offshoring measure, O, and the levels of the input factor shares, s_i with $i \in \{L, nonICT, ICT, R\&D, M\}$ in 2000 as well as changes of the respective variables over time between 2000 and 2014. For factor prices, annual price changes of the input factors between 2000 and 2014 are shown. Prices of the capital inputs are based on estimates of the user costs of capital from the ex post approach detailed in Section 2.2.

Overall, the evolution of the variables shows a substantial degree of heterogeneity across countries and, particularly, across sectors, but some general patterns are also discernible. The degree of offshoring amounted to around 10% by 2000 across the sample of countries and increased on average by 2.6 percentage points until 2014. Services sectors had a lower share of imported intermediates than manufacturing sectors in 2000 and also offshored less in absolute terms between 2000 and 2014. For the average country, the labour share declined (-1.1 percentage points), while wages increased noticeably (+2.9% per year). The share of intermediate inputs in gross output, which includes both domestic and imported intermediates, also increased on average (+1.9 percentage points) and became more expensive overall (+1.9% per year).

Table 1: Summary statistics by country

	2000 levels					
	s_L	s_{nonICT}	s_{ICT}	$s_{R\&D}$	s_M	O
Austria	33.4	16.2	1.7	1.5	47.2	12.1
Denmark	32.5	15.4	1.9	1.6	48.3	13.4
Finland	28.8	13.9	1.1	2.6	53.4	10.2
France	31.6	14.6	2.2	2.3	49.3	9.1
Germany	33.1	13.2	2.2	1.9	49.4	9.1
Italy	25.8	16.7	1.8	0.9	54.7	7.7
Netherlands	31.6	12.4	1.4	1.5	52.9	13.2
Spain	27.9	15.9	2.0	0.9	53.2	10.8
Sweden	27.3	15.9	2.9	3.3	50.6	11.8
United Kingdom	32.9	17.0	1.6	0.5	47.6	7.3
United States	33.9	17.2	2.3	1.6	44.6	3.5
Mean	30.8	15.3	1.9	1.7	50.1	9.9
	Changes 2000-2014 (in percentage points)					
	Δs_L	Δs_{nonICT}	Δs_{ICT}	$\Delta s_{R\&D}$	Δs_M	ΔO
Austria	-3.0	-2.3	0.2	0.4	4.7	3.6
Denmark	-1.7	-2.5	0.1	0.9	3.2	4.1
Finland	-1.7	-2.3	0.1	0.5	3.4	4.0
France	0.4	-1.4	-0.2	-0.6	1.8	2.4
Germany	-2.6	1.0	-0.8	0.7	1.7	3.4
Italy	1.4	-1.8	-0.4	0.1	0.8	1.6
Netherlands	-0.7	-1.3	0.3	-0.2	1.9	6.6
Spain	-2.0	-0.2	-0.2	0.5	1.8	0.5
Sweden	0.5	-0.6	-0.4	0.5	-0.1	0.5
United Kingdom	-0.6	-1.1	-0.0	0.1	1.7	1.4
United States	-2.2	1.9	-0.1	0.4	-0.1	0.9
Mean	-1.1	-1.0	-0.1	0.3	1.9	2.6
	Annual price changes 2000-2014 (in %)					
	Δp_L	Δp_{nonICT}	Δp_{ICT}	$\Delta p_{R\&D}$	Δp_M	
Austria	2.9	1.2	-0.0	0.9	1.9	
Denmark	3.2	0.6	-2.7	3.1	1.7	
Finland	3.0	-0.3	-6.2	3.2	1.8	
France	2.8	-1.8	-1.7	-0.2	1.7	
Germany	1.9	3.6	-9.0	2.9	1.1	
Italy	2.5	-0.5	-0.6	-0.8	2.3	
Netherlands	2.7	0.5	-6.3	1.8	1.8	
Spain	2.6	0.9	-5.9	0.5	2.1	
Sweden	3.5	0.7	-4.1	1.7	2.1	
United Kingdom	3.2	2.0	-2.6	2.4	1.9	
United States	3.1	2.0	-5.7	2.2	2.5	
Mean	2.9	0.8	-4.1	1.6	1.9	

Notes: Country values are weighted averages by each sector's share in gross output. "Mean" refers to the unweighted average across countries.

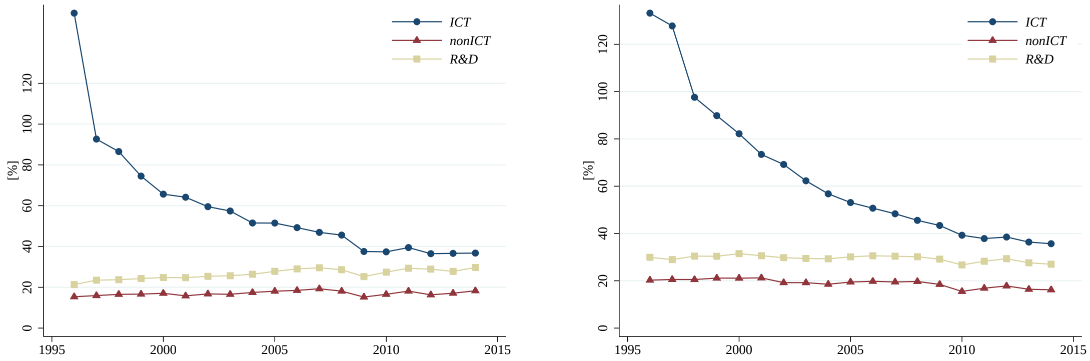
Table 2: Summary statistics by sector

	2000 levels						Changes 2000-2014 (in percentage points)						Annual price changes 2000-2014 (in %)				
	s_L	s_{nonICT}	s_{ICT}	$s_{R\&D}$	s_M	O	Δs_L	Δs_{nonICT}	Δs_{ICT}	$\Delta s_{R\&D}$	Δs_M	ΔO	Δp_L	Δp_{nonICT}	Δp_{ICT}	$\Delta p_{R\&D}$	Δp_M
Agriculture, forestry and fishing	38.2	12.7	0.3	0.1	48.6	7.9	-5.5	-1.3	-0.0	-0.0	6.9	4.0	2.7	2.2	-5.4	2.1	3.0
Mining and quarrying	18.0	32.7	1.0	0.7	44.0	9.3	-2.4	1.2	-0.1	0.2	1.0	2.5	3.6	0.3	-4.2	2.3	2.5
Food products, beverages and tobacco	16.3	9.5	0.8	0.5	72.8	9.8	-2.0	-1.4	-0.2	0.2	3.4	4.5	2.7	0.9	-4.5	1.7	2.1
Textiles, wearing apparel, leather and related products	25.7	7.0	0.7	0.5	66.1	20.6	-0.3	-0.8	0.0	0.4	0.6	8.9	3.4	0.4	-4.2	1.9	1.5
Wood and paper products; printing and reproduction of recorded media	22.9	10.9	1.5	0.5	64.3	14.6	-1.4	-3.6	-0.5	0.3	5.2	3.4	2.6	-1.4	-4.9	0.6	1.5
Coke and refined petroleum products	3.8	7.2	0.6	0.8	87.6	41.5	-1.4	-4.3	-0.4	-0.6	6.6	13.0	3.5	-3.5	-8.0	-3.1	6.2
Chemicals and chemical products	16.1	11.8	1.1	7.0	64.0	19.3	-2.6	-2.7	-0.1	2.8	2.7	8.6	3.4	0.8	-3.5	2.2	2.4
Rubber and plastics products, and other non-metallic mineral products	25.6	11.5	1.0	1.3	60.6	16.4	-2.7	-2.9	-0.1	0.5	5.2	5.9	2.8	-0.5	-4.4	1.0	2.2
Basic metals and fabricated metal products, except machinery and equipment	25.2	9.1	1.0	0.9	63.8	18.9	-3.5	-1.6	-0.2	0.1	5.2	5.5	2.8	0.4	-4.3	1.5	2.6
Electrical and optical equipment	19.9	6.4	2.2	7.9	63.6	21.7	3.2	-1.4	-0.2	2.8	-4.3	5.4	3.2	-2.2	-4.9	-0.3	-0.0
Machinery and equipment n.e.c.	24.6	7.2	1.4	3.0	63.8	18.2	-2.3	-0.5	-0.1	2.0	0.8	6.1	3.2	1.5	-3.2	2.4	1.4
Transport equipment	18.1	5.3	1.0	3.6	72.0	24.8	-1.8	-0.1	-0.1	0.9	1.0	6.0	3.4	0.3	-2.4	2.1	1.2
Other manufacturing; repair and installation of machinery and equipment	32.3	7.1	1.1	2.0	57.4	14.6	-1.0	0.6	0.2	0.7	-0.4	3.1	3.1	2.2	-3.0	2.8	1.5
Electricity, gas and water supply	15.4	27.4	1.6	0.9	54.7	11.5	-2.4	-2.8	-0.0	-0.5	5.8	2.2	2.8	1.3	-3.8	1.5	3.0
Construction	32.9	7.7	0.4	0.1	58.9	9.9	0.5	-0.7	0.0	-0.0	0.2	2.0	2.9	0.8	-3.6	2.1	2.2
Wholesale and retail trade and repair of motor vehicles and motorcycles	40.2	12.1	1.1	0.1	46.5	10.9	1.2	0.2	-0.1	0.0	-1.3	2.0	3.7	1.3	-2.5	4.2	1.7
Wholesale trade, except motor vehicles and motorcycles	36.0	16.3	3.3	1.0	43.4	6.3	-2.1	1.7	0.2	0.3	-0.1	1.7	3.0	3.6	-2.0	4.3	1.8
Retail trade, except motor vehicles and motorcycles	48.1	14.3	2.5	0.1	35.1	3.9	-4.3	-0.3	-0.4	0.0	5.0	1.3	3.1	2.1	-3.4	3.4	1.8
Transport and storage	30.8	14.3	1.6	0.1	53.2	12.3	-3.7	-1.4	-0.7	-0.0	5.7	3.8	3.0	1.0	-3.8	1.6	2.2
Postal and courier activities	53.3	5.5	2.0	0.3	38.9	4.7	-10.4	-0.9	-0.6	0.1	11.8	3.4	3.5	2.1	-0.9	1.9	0.8
Accommodation and food service activities	37.3	12.4	0.8	0.0	49.4	4.6	1.6	-1.6	-0.2	-0.0	0.2	1.7	2.5	0.8	-4.7	0.3	2.0
Publishing, audiovisual and broadcasting activities	26.6	10.1	4.9	0.8	53.4	6.4	1.4	-1.2	0.7	0.6	-1.2	0.9	2.5	-0.4	-3.5	0.9	1.2
Telecommunications	18.6	18.5	10.2	1.2	51.4	7.7	-2.5	-0.2	-0.5	0.6	2.6	2.7	3.0	0.1	-3.2	1.6	-0.6
IT and other information services	45.0	3.1	6.8	1.4	43.6	5.9	-2.5	0.9	0.8	0.8	-0.0	1.7	2.9	2.5	-2.0	4.2	1.0
Financial and insurance activities	32.2	15.5	5.8	0.4	46.0	3.5	-2.8	1.4	0.6	0.7	0.0	0.4	3.0	4.1	-2.1	3.8	1.1
Real estate activities	5.1	67.9	0.2	0.0	26.8	1.8	-0.2	-1.7	0.1	-0.0	1.8	0.1	2.3	1.8	-4.3	0.9	2.6
Professional, scientific, technical, administrative and support service activities	40.3	9.4	3.3	2.8	44.2	5.8	3.0	-2.0	-0.9	-0.1	0.1	1.3	2.6	-1.4	-5.4	0.2	1.5
Public administration and defence; compulsory social security	50.3	13.2	2.0	1.4	33.0	4.8	-2.4	0.7	-0.3	0.0	2.0	-0.2	3.2	0.4	-4.1	1.9	1.9
Education	68.3	4.2	1.2	4.6	21.7	1.8	-1.5	-0.3	-0.1	0.2	1.6	0.5	2.7	0.9	-4.5	1.5	2.0
Health and social work	59.5	8.2	0.9	0.7	30.8	4.4	-2.4	-0.5	-0.0	-0.1	3.0	1.9	2.7	1.1	-4.3	2.2	1.6
Arts, entertainment and recreation	40.0	12.0	1.9	1.0	43.8	4.6	-0.7	-0.5	-0.5	-0.1	1.9	0.9	2.4	0.7	-4.8	1.8	1.9
Other service activities	49.1	10.8	1.6	0.5	38.0	4.5	4.5	-3.2	-0.6	-0.1	-0.6	0.8	3.2	-1.4	-5.0	-0.6	1.6

Notes: Sector values are unweighted averages across countries.

On the capital side, non-ICT capital makes up the largest share in capital compensation, followed by ICT and R&D capital. The share of non-ICT capital in total costs was 15.3% on average in 2000, while it stood at 1.9% and 1.7% for ICT and R&D capital, respectively. Overall, there was a tendency to reduce non-ICT and to increase R&D capital relative to the remaining input factors, with no clear tendency observable for ICT capital. Turning to price developments, ICT capital became, on average, less expensive over time (-4.1% per year), while prices for non-ICT and R&D capital increased slightly (+0.8% and +1.6% per year, respectively).

Figure 2: Median user costs of capital (in % of replacement costs in 2010)



(a) Ex post user costs

(b) Ex ante user costs

As indicated above, estimates of the user costs of capital are subject to uncertainty. Figure 2 compares the median price developments of non-ICT, ICT, and R&D capital from the baseline (ex post) and an alternative (ex ante) approach.[14] Overall, differences in estimated user costs as a fraction of replacement costs are rather small, and estimates are similar from a qualitative and, in general, also from a quantitative point of view. The user costs of ICT capital show a clear downward trend from above 120% (of replacement costs in 2010) at the beginning of the sample to below 40% in 2014. While the user costs for non-ICT capital remained broadly unchanged over time at around 20%, the user costs for R&D capital showed a moderate upward trend in the baseline version from below 20% at the beginning of the sample period to around 30% in 2014. In the alternative version, however, the user costs for R&D capital changed only very little.

4 Results

4.1 Baseline results

This section presents the results from estimating the factor share equations given by Equation (2). We estimate the system of share equations jointly using a seemingly unrelated regression (SUR) estimator, which yields more efficient results compared to equation-by-equation estimations when the error terms are correlated across equations (Zellner,

[14]These ex ante user costs are based on time-varying sector-specific rates of return and expectations were obtained using out-of-sample forecasts from $AR(1)$-models (Section 2.2).

1962).[15] In most of the variants presented below, year and country × sector fixed effects are controlled for and standard errors are clustered at the country-sector level. The baseline results are based on a variable cost function with one labour and one intermediate input along with capital disaggregated into ICT, non-ICT, and R&D categories.

Table 3: Baseline specification

	s_L	s_{nonICT}	s_{ICT}	$s_{R\&D}$	s_M
p_L	0.069***	-0.025***	-0.006***	-0.001	-0.036***
	(0.009)	(0.003)	(0.002)	(0.001)	(0.009)
p_{nonICT}	-0.025***	0.040***	0.004***	0.003**	-0.021***
	(0.003)	(0.004)	(0.001)	(0.001)	(0.003)
p_{ICT}	-0.006***	0.004***	0.004***	0.000	-0.002
	(0.002)	(0.001)	(0.001)	(0.000)	(0.003)
$p_{R\&D}$	-0.001	0.003**	0.000	0.001	-0.003**
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
p_M	-0.036***	-0.021***	-0.002	-0.003**	0.062***
	(0.009)	(0.003)	(0.003)	(0.001)	(0.010)
Y	-0.043***	-0.018**	-0.010***	0.001	0.069***
	(0.007)	(0.008)	(0.004)	(0.003)	(0.012)
O	-0.144***	-0.145***	0.002	-0.028***	0.314***
	(0.029)	(0.028)	(0.009)	(0.010)	(0.048)
Obs	5634				

Notes: Standard errors in parentheses are clustered at the country-sector level. Year and country × sector fixed effects are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

The results from our baseline estimation are presented in Table 3.[16] p_L denotes the wage, p_M denotes the price of intermediate inputs, and p_i with $i \in \{nonICT, ICT, R\&D\}$ denotes the user costs of capital of the respective asset class. As we are primarily interested in the relationship between offshoring and factor demand, the sign and statistical significance of the estimated coefficients on offshoring are of main interest. In line with the previous literature, we find that offshoring has a negative effect on the demand for labour and a positive effect on the demand for intermediate inputs (Foster-McGregor et al., 2013; Hijzen et al., 2005). A positive coefficient of offshoring on the demand for intermediate inputs implies that offshoring does not simply substitute domestic intermediates one-to-one. However, the fact that the coefficient differs from one suggests that the offshoring measure captures both the reduction in sectoral value added as well as changes from domestic to international suppliers. Turning to the demand for capital by asset

[15] As the variable cost shares add up to unity by construction, i.e. $\sum_{n=1}^{N} S_n = 1$, one equation has to be dropped in order to avoid the singularity of the disturbance covariance matrix. The system of share equations is estimated with an iterative Zellner efficient procedure such that the choice of the equation that is dropped is arbitrary. In all tables, the coefficients of the corresponding share equation were recovered by making use of the cross-equation adding-up constraints.

[16] The estimated translog cost function (or equivalently the estimated share equations) should be consistent with economic theory. The results suggest that our estimates are in line with economic theory in the sense that the own-price elasticities are negative and statistically significant for all variable input factors (Allen, 1938; Uzawa, 1962). It should be noted that negative own-price elasticities constitute a necessary condition for concavity of a cost function in input prices.

class, we find that offshoring significantly reduces the demand for non-ICT capital. An increase in the share of imported intermediates by 1 percentage point is associated with a decrease in the non-ICT capital share by 0.15 percentage point. Furthermore, offshoring also has a statistically significant negative impact on R&D capital. However, the effect is quantitatively small. The offshoring coefficient for non-ICT capital is roughly five times larger in absolute terms than the offshoring coefficient on R&D capital. Interestingly, offshoring does not seem to impact ICT capital in a statistically significant way. These results suggest that offshoring changes the composition of the demand for capital. While non-ICT capital has been squeezed by offshoring in the recent past, the relative demand for R&D and ICT capital has been affected much less or not at all by the restructuring of the domestic production process. In line with the terminology used for compositional effects on labour demand for different skill levels, we refer to this phenomenon as the polarisation of the demand for capital.[17]

Table 4: Specification with nine input factors

	s_L	s_{TraEq}	s_{OMach}	s_{Build}	s_{IT}	s_{CT}	s_{Soft}	$s_{R\&D}$	s_M
p_L	0.068***	-0.004***	-0.016***	-0.011***	-0.004***	-0.003***	-0.000	-0.000	-0.030***
	(0.009)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.000)	(0.009)
p_{TraEq}	-0.004***	0.006***	-0.001	-0.001**	-0.000	0.000***	0.001*	0.000	-0.001
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
p_{OMach}	-0.016***	-0.001	0.024***	-0.001	0.000	-0.001	0.001	0.001*	-0.007***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)
p_{Build}	-0.011***	-0.001**	-0.001	0.022***	0.000	0.000	0.000	0.002***	-0.012***
	(0.001)	(0.000)	(0.001)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
p_{IT}	-0.004***	-0.000	0.000	0.000	0.002***	-0.001**	0.000	0.000	0.001
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
p_{CT}	-0.003***	0.000***	-0.001	0.000	-0.001**	0.002**	-0.000	0.000	0.002*
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
p_{Soft}	-0.000	0.001*	0.001	0.000	0.000	-0.000	0.008***	0.000	-0.011***
	(0.002)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.002)
$p_{R\&D}$	-0.000	0.000	0.001*	0.002***	0.000	0.000	0.000	0.001	-0.004**
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
p_M	-0.030***	-0.001	-0.007***	-0.012***	0.001	0.002*	-0.011***	-0.004**	0.061***
	(0.009)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.010)
Y	-0.045***	-0.002**	-0.005	-0.017**	-0.004***	-0.009**	0.002	0.001	0.078***
	(0.006)	(0.001)	(0.003)	(0.008)	(0.001)	(0.004)	(0.002)	(0.003)	(0.012)
O	-0.151***	0.001	-0.082***	-0.081***	0.005	-0.005	0.010*	-0.026**	0.327***
	(0.030)	(0.005)	(0.016)	(0.023)	(0.003)	(0.006)	(0.005)	(0.011)	(0.052)
Obs	5129								

Notes: Standard errors in parentheses are clustered at the country-sector level. Year and country × sector fixed effects are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

The data allows us to further disaggregate the capital input. Non-ICT capital is

[17] The offshoring elasticities (e.g. Foster-McGregor et al., 2013) corresponding to the results in Table 3 are: non-ICT (-1.108^{***}), ICT (0.105), and R&D (-1.600^{***}). *** indicates significance at the 1% level. Note that the elasticity for R&D capital is comparatively large given its small average share in total factor compensation (Table 1). However, the absolute and not the relative response of the demand for capital by asset class to changes in offshoring is the relevant measure for the polarisation result.

split into its subcomponents transport equipment ($TraEq$), other machinery equipment ($OMach$), and the umbrella category buildings ($Build$), which subsumes cultivated assets, dwellings, other buildings and structures as well as a residual. For ICT capital, we differentiate between computer hardware (IT), telecommunications equipment (CT), and computer software and databases ($Soft$). The R&D capital input, however, cannot be further subdivided. The results from estimating the factor share equations of the corresponding cost function with nine input factors are shown in Table 4.[18] Overall, the estimated coefficients are in line with our baseline results. An increase in offshoring significantly reduces the demand for the non-ICT capital components other machinery equipment and buildings, while the offshoring coefficient on transport equipment turns out not to be statistically significant. As before, we observe a small negative offshoring coefficient for R&D capital. For the subcategories of ICT capital, only computer software and databases show a weakly significant positive association with offshoring.

Comparing our results to the previous literature is somewhat complicated, not least for the following reason. While prior work has generally focused on the relationship between offshoring and R&D or ICT investment, we estimate the effect of offshoring on different capital asset classes by employing relative factor demand equations. The latter gauge the composition effect of offshoring on different input factors. However, studies focusing on investment additionally include scale effects of offshoring on output resulting from productivity gains associated with the reorganisation of production (Grossman and Rossi-Hansberg, 2008; Amiti and Wei, 2009). Hence, were we to take into account these scale effects, the net impact on ICT and R&D investment associated with our estimation results may well be positive, given that the corresponding offshoring coefficients are close to zero.

Overall, we draw the conclusion that offshoring has a polarising effect on the demand for capital. This main result is robust to a variety of different user cost estimates and methodological choices. Details on the extensive robustness analyses are provided in Section 4.2 and in the appendix.

4.2 Robustness

4.2.1 Alternative user costs of capital

In contrast to wages, user costs of capital are not easy to obtain and their calculation relies on a particular economic model (Section 2.2). Given the presence of methodological choices in their derivation, user cost estimates will naturally be subject to some uncertainty. Our baseline results rely on ex post user costs that were calculated in line with the EU KLEMS methodology. From a practical point of view, the ex post method has the advantage that its computation is comparatively straightforward and transparent since the ex post measure can be directly obtained from national accounts data without involving additional estimation steps. However, the ex ante approach is theoretically more appealing given that investment decisions are based on expected rather than realised outcomes

[18] p_i with $i \in \{TraEq, OMach, Build, IT, CT, Soft, R\&D\}$ denote the user costs of capital of the respective asset class. For details on the disaggregation of the capital input, see Figure 1. The own-price elasticities are negative and statistically significant for all variable input factors except for the own-price elasticity of $Soft$, which turns out to be statistically insignificant. This, again, suggests that the underlying cost function is well-behaved.

as assumed in the ex post approach. To test the robustness of our main results to the methodology used for estimating user costs, we compute different variants using the ex ante approach. Results from our preferred ex ante specification based on time-varying sector-specific rates of return and expectation formation using $AR(1)$-models are shown in Table 5.

Table 5: Ex ante user costs of capital

	s_L	s_{nonICT}	s_{ICT}	$s_{R\&D}$	s_M
p_L	0.069***	-0.024***	-0.005**	0.001	-0.040***
	(0.009)	(0.004)	(0.002)	(0.003)	(0.008)
p_{nonICT}	-0.024***	0.032***	0.003***	0.001	-0.012***
	(0.004)	(0.004)	(0.001)	(0.002)	(0.004)
p_{ICT}	-0.005**	0.003***	0.003**	0.001	-0.001
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
$p_{R\&D}$	0.001	0.001	0.001	0.006**	-0.007***
	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)
p_M	-0.040***	-0.012***	-0.001	-0.007***	0.061***
	(0.008)	(0.004)	(0.002)	(0.002)	(0.009)
Y	-0.048***	-0.009	-0.007**	0.000	0.063***
	(0.006)	(0.008)	(0.004)	(0.003)	(0.011)
O	-0.101***	-0.204***	-0.004	-0.030***	0.339***
	(0.026)	(0.033)	(0.006)	(0.010)	(0.048)
Obs	5386				

Notes: Ex ante user costs of capital were estimated based on time-varying sector-specific rates of return and expectations were obtained using out-of-sample forecasts from $AR(1)$-models (Section 2.2). Standard errors in parentheses are clustered at the country-sector level. Year and country × sector fixed effects are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

As before, we find that offshoring has a negative effect on the demand for labour and a positive effect on the demand for intermediate inputs. Similarly, the results suggest that offshoring significantly reduces the demand for non-ICT capital, while R&D capital is only mildly and ICT capital not significantly affected. Results in Table A.4 in the appendix are based on an additional specification in which expectations for the capital compensation shares as well as the expected real rates of return and asset-specific expected price gains are modelled using $AR(2)$-processes. In addition, we also calculate expectations using exponential smoothing, which mimics the concept of adaptive expectations. The expectation formation process for the expected real rate, r_t^e, is then given by

$$r_t^e = \beta r_{t-1}^e + (1-\beta) r_t,$$

where $0 \leq \beta \leq 1$ is the smoothing parameter (Table A.5).[19] For all ex ante variants of the user cost of capital, the effect of offshoring on the demand for capital by asset class remains qualitatively unchanged. We therefore conclude that our main results are robust to using different approaches for calculating user costs of capital.

[19]The initial values for this process are chosen to be the mean values of the realised counterparts between 1996 and 2014, and $\beta = 0.8$. The results are, however, not sensitive to these specific choices.

4.2.2 Sluggish adjustment of input factors

The analyses so far assume that all variable inputs can immediately adjust to their respective cost-minimising or long-run levels conditional on the level of output. Or, put differently, the observed time series used for the estimation can be thought of as representing the equilibrium paths of the variables of interest. Given that an instantaneous adjustment to long-run equilibrium might be a rather strong assumption, this section explores the robustness of our results by resorting to a data-driven approach for dynamic adjustment that allows for long-run (i.e. equilibrium) and short-run (i.e. off-equilibrium deviations) dynamics of the factor inputs.

The observed input quantities may depart from their equilibrium values for a variety of reasons such as regulatory restrictions or costs of adjustment. In what follows, we are agnostic regarding the specific factors for off-equilibrium behaviour in the short run and let the data pin down the dynamics without imposing overly strong restrictions on the nature of the adjustment process ex ante. As far as the capital stock is concerned, for instance, it is quite common to model capital adjustment costs (Chirinko, 1993). Note that in contrast to our approach, capital adjustment costs only capture one factor that prevents firms from instantaneously adjusting their capital stocks to the desired levels.

In the most general form, the system of long-run (static) share equations for a generic country can be expressed in matrix notation as

$$M_t = BX_t, \tag{4}$$

where $M_t = (S_{1,t}, ..., S_{N,t})'$, $X_t = (1, p_{1,Q}, ..., p_{N,Q}, Z_1, ..., Z_z, Y_t)'$, and B is a $N \times N + z + 2$ coefficient matrix. According to Anderson and Blundell (1982), a first-order dynamic version of (4) is then given by

$$\Delta M_t = A\Delta \tilde{X}_t - C[M_{t-1} - BX_{t-1}] + \epsilon_t, \tag{5}$$

where ϵ_t denotes a vector of error terms. A, B, and C are coefficient matrices conformable with the dimensions of M_t, X_t, and $\tilde{X}_t$. Note that $\tilde{X}_t$ is identical to X_t except for the constant term which is excluded in $\tilde{X}_t$. This and similar dynamic models have sometimes been applied in empirical research in the context of factor share analyses (e.g. Friesen, 1992; Holly and Smith, 1989). While the short-run adjustment process is governed by the coefficient matrices A and C, the long-run coefficient matrix is given by B. As in the static case, the system of dynamic share equations is singular as the column sum of M_t equals unity by construction. One equation has thus to be deleted in order to obtain an estimable form of Equation (5), which is equivalent to deleting one element in M_t and the rows corresponding to the deleted element in B and C. An estimable form then reads

$$\Delta M_t^* = A^*\Delta \tilde{X}_t - C^*[M_{t-1}^* - B^*X_{t-1}] + \epsilon_t^*, \tag{6}$$

where asterisks denote vectors (matrices) with one element (row) deleted. The coefficients governing the short-run adjustment cannot be recovered (Anderson and Blundell, 1982). The long-run (static) coefficients in B – which we are interested in – are, however, identified. Due to the curse of dimensionality and data limitations, we estimate a first-order process as was done in previous applied work.

The choice of the specific econometric estimator used in such a dynamic setting is not obvious. When a static translog function is considered as in Section 4.1, pooled and mean group estimators are both consistent and yield unbiased estimates of the coefficient means (see Zellner, 1969, among others).[20] This rests on the assumptions that the regressors are strictly exogenous and that the coefficients differ randomly and are also distributed independently of the regressors across groups. In the dynamic case that is considered here, however, a pooled estimator can yield biased results as highlighted by Pesaran and Smith (1995).[21] Therefore, we consider the mean group estimator – which is consistent even in dynamic settings – for the analyses using the dynamic translog function. The mean group estimator involves, first, estimating individual regressions for each country and, second, averaging the estimated coefficients across countries.

Table 6: Dynamic translog

	s_L	s_{nonICT}	s_{ICT}	$s_{R\&D}$	s_M
p_L	0.063***	-0.012	-0.005	0.028**	-0.075**
	(0.022)	(0.022)	(0.009)	(0.013)	(0.033)
p_{nonICT}	0.009	0.051***	-0.005	-0.001	-0.055***
	(0.014)	(0.009)	(0.004)	(0.005)	(0.017)
p_{ICT}	-0.020*	0.029***	0.015***	0.000	-0.026**
	(0.011)	(0.009)	(0.004)	(0.004)	(0.013)
$p_{R\&D}$	-0.020	-0.003	0.009	0.012	0.003
	(0.023)	(0.014)	(0.006)	(0.008)	(0.025)
p_M	-0.036**	-0.018	0.001	-0.006	0.054**
	(0.018)	(0.014)	(0.004)	(0.006)	(0.022)
Y	-0.044***	-0.015*	-0.010***	-0.008	0.078***
	(0.013)	(0.008)	(0.003)	(0.005)	(0.016)
O	-0.051	-0.162***	0.003	-0.054*	0.276***
	(0.075)	(0.060)	(0.018)	(0.032)	(0.102)
Obs	5303				

Notes: The table presents mean group estimates in line with Pesaran and Smith (1995). Unweighted averages of the long-run coefficient estimates (i.e. the elements of the matrix B obtained using country-specific regressions) are shown. Standard errors in parentheses correspond to the linear combination of the individual coefficient estimates and are clustered at the sector level. Year and sector fixed effects are controlled for at the country level, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

The unweighted averages of the long-run parameter estimates from B are shown in Table 6.[22] As before, offshoring has a positive impact on the demand for intermediates, while the offshoring coefficient for labour is still negative, but no longer statistically significant. More importantly, offshoring still has a negative effect on the demand for non-ICT capital inputs, a weakly negative impact on R&D capital, and no significant effect on ICT capital. Overall, we conclude that the main result concerning offshoring and its polar-

[20] As expected, our baseline results in Section 4.1 are qualitatively and, in general, quantitatively the same when a mean group estimator (Pesaran and Smith, 1995) is applied.

[21] The authors conclude that "(t)he lesson for applied work is that when large T panels are available, the individual micro-relations should be estimated separately and the averages of the estimated micro-parameters and their standard errors calculated explicitly" (p. 102).

[22] Estimated coefficients in A^* and C^* are omitted for brevity. Results stem from a translog variable cost function without imposing symmetry and homogeneity.

ising effect on the demand for capital remains unchanged when allowing for a sluggish adjustment of the input factors to their long-run levels.

4.2.3 Endogeneity concerns

Drawing conclusions about a causal relationship between offshoring, O, and factor demand, s_i, can be challenging as time-varying shocks to technology or productivity within a certain sector can potentially affect both the relative demand for input factors and the returns to offshoring (and thus the extent of offshoring itself).[23] Hence, the simultaneity of offshoring and factor demand decisions might be a source of endogeneity. To address this issue, an instrument is needed that is correlated with offshoring decisions, but uncorrelated with the regression error term (i.e only indirectly associated with factor demand via offshoring). In this section, we exploit the exogenous variation of the world export supply of intermediate inputs as predictors for changes in offshoring, a variant of which was proposed by Hummels et al. (2014). More specifically, for any country c that purchases intermediate inputs from foreign suppliers, the world export supply, wes^c_{ijt}, is defined as country i's exports of sector j to the world market (excluding exports to country c) in period t, EX^c_{ijt}, relative to the exports from all countries (excluding country c):

$$wes^c_{ijt} = \frac{EX^c_{ijt}}{\sum_{i \neq c}^{C} EX^c_{ijt}}.$$

Consequently, wes^c_{ijt} is a measure of world export market shares capturing changes in the comparative advantage of a particular supplier, for example, related to changes in prices, quality, or technology. To obtain an instrument with country-sector-time variation for sector s in country c, I_{cst}, we aggregate wes^c_{ijt} using the pre-sample (i.e. 1995) share of imported intermediates, ϕ_{csij}, sourced from sector j in country i in total imported intermediates:

$$I_{cst} = \sum_{i \neq c}^{C} \sum_{j}^{S} \phi_{csij} wes^c_{ijt}.$$

The regional and industrial sourcing structure of a given sector is fairly constant over time, allowing us to use fixed pre-sample weights of the imported intermediates in constructing our instrument. As a result, our estimates are unaffected by shocks that may affect both import composition and subsequent offshoring decisions. The resulting instrument is exogenous to the domestic sectors in our dataset, while it contains rich variation across offshoring destinations and sectors given the existing differences in their sourcing structure.

The results from a two-stage least squares (2SLS) instrumental variable estimation of our baseline specification are shown in Table 7. The F-statistic on excluded instruments in the first stage is well above 10, suggesting that our instrument is sufficiently strongly correlated with offshoring and that the 2SLS estimation does not suffer from weak instruments (Stock, Wright, and Yogo, 2002). Similar to the results in Section 4.1, offshoring has a negative impact on labour demand and a positive impact on the demand

[23] For example, investment in ICT capital is thought to reduce communication costs and hence increase offshoring (Abramovsky and Griffith, 2006; Baldwin, 2016).

Table 7: Instrumental variable approach

	s_L	s_{nonICT}	s_{ICT}	$s_{R\&D}$	s_M
p_L	0.093***	-0.017	0.006	0.012**	-0.093***
	(0.015)	(0.018)	(0.005)	(0.006)	(0.022)
p_{nonICT}	-0.032***	0.032***	0.004**	0.005**	-0.011
	(0.006)	(0.007)	(0.002)	(0.002)	(0.007)
p_{ICT}	-0.008**	0.002	0.004***	0.000	0.002
	(0.004)	(0.004)	(0.001)	(0.001)	(0.005)
$p_{R\&D}$	-0.001	0.002	0.000	0.001	-0.002
	(0.002)	(0.002)	(0.000)	(0.001)	(0.002)
p_M	0.021	0.037	0.004	-0.021**	-0.038
	(0.026)	(0.034)	(0.010)	(0.010)	(0.040)
Y	-0.038***	-0.013	-0.009***	-0.001	0.060***
	(0.008)	(0.009)	(0.003)	(0.003)	(0.014)
O	-0.674**	-0.717**	-0.019	0.112	1.273***
	(0.281)	(0.360)	(0.098)	(0.102)	(0.428)
Obs	5634				
F-statistic	14.385				

Notes: The table presents estimates from a two-stage least squares (2SLS) regression in which world export supply is used as an instrument for offshoring. The F-statistic refers to the test for significance of the coefficients on the instrument in the first-stage regression. Standard errors in parentheses are clustered at the country-sector level. Year and country × sector fixed effects are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

for intermediates, as expected. Furthermore, offshoring reduces the demand for non-ICT capital, while ICT capital is not affected in a statistically significant way. In contrast to the baseline results, we find no statistically significant effect of offshoring on the demand for R&D capital. While the size of the coefficients is larger than in the baseline specification, the 2SLS estimates are economically plausible. An exogenous increase in the offshoring measure, O, by 1 percentage point is associated with a decrease in value added over gross output by around 1 percentage point and a corresponding increase in the intermediate share of production by the same magnitude.[24] This is what one would expect if the increase in imported intermediates derived exclusively from offshoring value added of a given sector, while leaving the share of intermediates sourced from domestic suppliers unaffected.

For the instrument to satisfy the exclusion restriction, unobservable technology and productivity shocks in trade partners used to construct the world export supply variable should not be correlated with shocks in the offshoring countries in our dataset. To evaluate the robustness of our results to the potential presence of, for instance, regional shocks, we exclude certain countries when calculating wes_{ijt}^c and I_{cst} for an additional instrumental variable estimation. Specifically, we exclude all countries belonging to the European Union for Austria, Denmark, Finland, France, Germany, Italy, the Netherlands, Spain, Sweden, and the United Kingdom, while we exclude Canada and Mexico for the United States.[25]

[24] The offshoring effect on value added over gross output corresponds to the sum of the offshoring coefficients for s_L, s_{nonICT}, s_{ICT}, and $s_{R\&D}$. The resulting coefficient and the offshoring coefficient on s_M are statistically indistinguishable from -1 and 1, respectively.

[25] This is similar to the identification strategy used by Autor, Dorn, and Hanson (2013), who instrument

The results from this additional 2SLS regression are shown in Table A.6. The use of the restricted instrument group leaves the 2SLS results by and large unaffected, suggesting that the effect of correlated shocks across countries appears to be negligible.

Overall, instrumenting for offshoring using variations in the comparative advantage of offshoring destinations confirms our main results on the offshoring-induced polarisation of the demand for capital by asset class. The 2SLS estimates qualify the results on the offshoring coefficient on R&D capital, which is not statistically different from zero once endogeneity concerns are addressed. All things considered, endogeneity issues do not seem to be of major concern for the main conclusions of our empirical analysis.

4.2.4 Further robustness analyses

In addition, we assess the robustness of our main result by estimating a range of different specifications and using alternative measures of offshoring. First, one concern is that offshoring and the year fixed effects included in our baseline specification do not fully capture the effects of technological change, such that our results would suffer from an omitted variable bias. To control for this, we additionally include three commonly used proxies for technological change: R&D intensity[26], country-sector time trends (Foster-McGregor et al., 2013), and a Solow residual[27] (Table A.7–A.9). Second, estimating the system of equations given by Equation (2) in a panel setting assumes that the same cost function applies across sectors. In order to allow for sectoral heterogeneity, we estimate two separate regressions for the manufacturing and services sectors, respectively (Table A.10). Third, as an additional robustness test we also estimate a specification that excludes mining and quarrying, real estate activities, and sectors dominated by non-market activities due to their idiosyncratic characteristics (Table A.10). Fourth, it has been argued that the expansion of cross-border production networks may have slowed since the onset of the global financial crisis (Hoekman, 2015). To assess whether our main effect varies over time, we perform a sample split and run separate regressions for pre- and post-crisis samples (Table A.10). Fifth, previous studies have sometimes estimated the system of share equations in first differences (Foster-McGregor et al., 2013), or even in long differences to smooth out measurement error (Michaels et al., 2014). Accordingly, we provide coefficients from estimates in annual differences (Table A.11) and differences between values in 2014 and 2000 (Table A.12). Sixth, Feenstra and Hanson (1999) distinguish between narrow and broad offshoring, with the former referring to the share of imported intermediates originating from the same sector as the offshoring sector, and the latter to the share of imported intermediates originating from all sectors other than the offshoring sector (Table A.13). In addition, some studies (e.g. Hijzen et al., 2005) define offshoring as the share of imported intermediates relative to value added instead of gross output (Table A.13). Tables A.7–A.13 show that all alternative specifications leave the coefficients on offshoring by and large unchanged in terms of significance and

US imports from China by Chinese exports to other high-income countries. See also Dauth, Findeisen, and Suedekum (2014) and Bloom, Draca, and Van Reenen (2016).

[26]R&D intensity is defined as the nominal gross fixed capital formation for research and development over gross output and varies over time at the country-sector level (Machin and Van Reenen, 1998; Hijzen et al., 2005).

[27]The Solow residual is derived using country-sector production functions with time-varying capital and labour shares corresponding to their empirical values.

sign. Although the size of the coefficients varies slightly, we maintain a highly significant and negative effect of offshoring on the demand for non-ICT capital, while offshoring has no statistically significant effect on the demand for ICT and only a rather small negative impact on the demand for R&D capital.

5 Theoretical channels

In the previous section, we presented robust evidence that – similar to the demand for labour by skill type – offshoring has a polarising effect on the demand for capital by asset class. Empirically, offshoring reduces the domestic demand for non-ICT capital relative to ICT and R&D capital, although the extent to which this occurs appears to be somewhat inconclusive for R&D capital.[28] In the following, we briefly sketch two channels that may rationalise the offshoring-induced polarisation of the demand for capital: (i) the direct offshoring of capital-intensive stages of production and (ii) capital-labour complementaries. To focus the discussion, we consider both channels in the context of simple variants of the trade-in-tasks model by Grossman and Rossi-Hansberg (2008). Fully analysing these models is a useful direction for future research, but goes beyond the scope of this paper.

First, the offshoring-induced reduction in the relative demand for non-ICT capital may reflect differences in the cost of non-ICT capital goods across countries. In general, factor price differences for labour are commonly considered the major factor behind offshoring decisions (Trefler, 1993; Blau and Kahn, 1996). Hence, the relocation of capital-intensive stages of production abroad is typically not the focus of the offshoring literature, which abstracts from potential efficiency gains deriving from cross-country differences in the cost of capital. Whether or not the marginal product of capital is equalised across countries, however, has been a matter of some debate (e.g. Banerjee and Duflo, 2005; Caselli and Feyrer, 2007). Credit frictions on international capital markets, for example, are one of the reasons that may hamper an efficient cross-country allocation of capital (e.g. Reinhart and Rogoff, 2004; Portes and Rey, 2005; Stulz, 2005).

In the model of Grossman and Rossi-Hansberg (2008), the production of a unit of a final good requires a continuum of two distinct tasks. While some tasks can be performed by workers with little education (so-called L-tasks), other tasks require more skills (H-tasks). Offshoring is likely to take place if the resulting efficiency gains and cost savings outweigh the coordination and trade costs associated with the additional fragmentation of the production process (Feenstra and Hanson, 1997; Kohler, 2004; Grossman and Rossi-Hansberg, 2008). Lower foreign wages for both types of tasks then rationalise the relocation of the corresponding tasks up to the point where the cost of offshoring exactly equals the associated gains.[29] For our case, consider a variant of this model, in which two types of tasks are performed by an aggregate labour input and a (non-ICT) capital input. It then follows that lower wages and lower rental rates for non-ICT capital abroad

[28] The results on the relation between offshoring and ICT are broadly in line with the empirical literature (Abramovsky and Griffith, 2006; Rasel, 2017), while the predictions from theoretical models on the relation between offshoring and R&D are ambiguous (Glass and Saggi, 2001; Marjit and Mukherjee, 2008; Beladi et al., 2012).

[29] Grossman and Rossi-Hansberg (2008) mainly focus on differences in the wages of low-skilled labour, but also present an extension of their baseline model, in which trade in both low- and high-skill tasks is examined.

account for offshoring of both labour-intensive as well as non-ICT capital-intensive stages of production.

Second, capital-labour complementaries[30] may be an explanation for the negative effect on non-ICT capital even if the marginal product of capital is equalised across countries such that there are no incentives for firms to offshore capital-intensive stages of production. In this case, offshoring of labour-intensive stages of production may bring about adjustments on the capital side due to input factor complementaries. Consider a variant of the baseline model of Grossman and Rossi-Hansberg (2008) augmented by two types of capital inputs.[31] Assume that there are two countries and three factors of production. Output, Y, is produced under perfect competition using labour, L, ICT capital, C, and non-ICT capital, K, using a CES production technology[32] given by

$$Y_{i,t} = [\mu C_{i,t}^{\frac{\rho-1}{\rho}} + (1-\mu)(K_{i,t}^{\eta} L_{i,t}^{1-\eta})^{\frac{\rho-1}{\rho}}]^{\frac{\rho}{\rho-1}}, \tag{7}$$

where $0 < \mu < 1$ and $0 < \eta < 1$, t denotes time and ρ the elasticity of substitution of $C_{i,t}$ with the Cobb-Douglas aggregate.[33] Without loss of generality, let a denote the home (or offshoring) country and b the foreign country (or offshoring destination). Assume that the wage in country a is strictly higher than in country b, $p_{L,t}^a > p_{L,t}^b$, and that a unit of the labour input consists of a continuum of tasks with measure one. Labour tasks can be offshored from country a to country b in order to capitalise on the wage differential. The relocation of tasks abroad, however, is costly to the firms, which is captured in this variant by multiplicative offshoring costs. It is assumed that the firm has to pay the wage $p_{L,t}^a$ for performing the task i in country a, whereas the costs for performing the same task in country b are given by $\beta t(i) p_{L,t}^b$ with shift parameter $\beta > 0$. Firms thus offshore tasks up until the marginal task, $I \in [0, 1]$, for which the costs of offshoring exactly equal the associated gains.

Let $\alpha_{L,t}$, $\alpha_{C,t}$, and $\alpha_{K,t}$ denote the units of the respective domestic input factor needed in order to produce one unit of output in the absence of offshoring. The unit cost of production is then the sum of the wage paid to domestic labour, the wage paid to labour abroad including offshoring costs, and the compensation for ICT and non-ICT capital used in the production process. When tasks are offshored up to the marginal task I, the unit cost of production, p_t^a, is given by

$$p_t^a = p_{L,t}^a \alpha_{L,t}(1-I) + p_{L,t}^b \alpha_{L,t} \beta \int_0^I t(i)di + p_{C,t}\alpha_{C,t} + p_{K,t}\alpha_{K,t}.$$

Given factor prices, offshoring costs, and the shift parameter, cost minimisation with respect to the input factor requirements determines the factor shares. The ratio between non-ICT and ICT capital decreases in response to a decline in the cost of offshoring if the elasticity of substitution between labour and non-ICT capital is smaller than the elasticity of substitution between labour and ICT capital. By construction, the elasticity

[30] Originally, the literature on capital-skill complementarity goes back to Griliches (1969).

[31] Note that we abstract from R&D capital for parsimonious exposition. Alternatively, ICT capital can be thought of as encompassing R&D capital.

[32] The particular functional form of the production technology is not crucial for obtaining a capital-labour complementarity, but was chosen for simplicity.

[33] Schwellnus, Pak, Pionnier, and Crivellaro (2018) analyse a similar model considering a production technology with routine labour, non-routine labour, and a single capital input.

of substitution between labour and non-ICT capital is unity in the model as both input factors form a Cobb-Douglas aggregate in Equation (7). Consequently, if the elasticity of substitution between labour and ICT capital is larger than unity (i.e. $\rho > 1$), offshoring of labour-intensive stages of production renders parts of the non-ICT capital stock redundant domestically.[34] Hence, the offshoring-induced reduction in the relative demand for non-ICT capital observed in the data may reflect an adjustment on the capital side to a changing labour intensity of domestic production.

6 Concluding remarks

In this paper, we examine the effect of offshoring on the demand for capital by asset class using a rich dataset spanning information on 11 advanced economies and 32 sectors across 20 years. Our paper differs from the existing literature by providing a comprehensive analysis of the offshoring-induced effects on the capital side, while previous work has focused on the impact of offshoring on the skill structure of labour demand. Estimating a system of factor demand equations, we document that offshoring has a polarising effect on the demand for capital. While non-ICT capital is squeezed by offshoring, this is less or not the case for R&D and ICT capital. These results are robust against a wide range of different specifications and methodological choices including an instrumental variable approach to address endogeneity concerns. Hence, offshoring is – along with technological change – one factor behind the structural change in the composition of the demand for capital observed in advanced economies (Colecchia and Schreyer, 2002; Corrado et al., 2009). Potential explanations for the polarising effect of offshoring on the demand for capital by asset class include (i) the direct offshoring of capital-intensive stages of production and (ii) capital-labour complementaries. While we highlight two conceivable channels for the heterogeneous effect of offshoring on the demand for different asset classes, more work in this area appears to be a useful direction for future research.

[34] Note that offshoring may also decrease the ICT capital share. In order for the model to explain the polarisation of the demand for capital, it is sufficient that the non-ICT capital share goes down by more than the ICT capital share.

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A Appendix

Table A.1: Sectors in EU KLEMS

Code	Sector	Type
A	Agriculture, forestry and fishing	*M*
B	Mining and quarrying	*M*
10-12	Food products, beverages and tobacco	*M*
13-15	Textiles, wearing apparel, leather and related products	*M*
16-18	Wood and paper products; printing and reproduction of recorded media	*M*
19	Coke and refined petroleum products	*M*
20-21	Chemicals and chemical products	*M*
22-23	Rubber and plastics products, and other non-metallic mineral products	*M*
24-25	Basic metals and fabricated metal products, except machinery and equipment	*M*
26-27	Electrical and optical equipment	*M*
28	Machinery and equipment n.e.c.	*M*
29-30	Transport equipment	*M*
31-33	Other manufacturing; repair and installation of machinery and equipment	*M*
D-E	Electricity, gas and water supply	*S*
F	Construction	*S*
45	Wholesale and retail trade and repair of motor vehicles and motorcycles	*S*
46	Wholesale trade, except motor vehicles and motorcycles	*S*
47	Retail trade, except motor vehicles and motorcycles	*S*
49-52	Transport and storage	*S*
53	Postal and courier activities	*S*
I	Accommodation and food service activities	*S*
58-60	Publishing, audiovisual and broadcasting activities	*S*
61	Telecommunications	*S*
62-63	IT and other information services	*S*
K	Financial and insurance activities	*S*
L	Real estate activities	*S*
M-N	Professional, scientific, technical, administrative and support service activities	*S*
O	Public administration and defence; compulsory social security	*S*
P	Education	*S*
Q	Health and social work	*S*
R	Arts, entertainment and recreation	*S*
S	Other service activities	*S*

Notes: Manufacturing (M) and services (S).

Table A.2: Correspondence between sectors in WIOD (release 2016) and EU KLEMS

WIOD		EUKLEMS	
Code	Sector	Code	Sector
A01	Crop and animal production, hunting and related service activities	A	Agriculture, forestry and fishing
A02	Forestry and logging	A	Agriculture, forestry and fishing
A03	Fishing and aquaculture	A	Agriculture, forestry and fishing
B	Mining and quarrying	B	Mining and quarrying
C10-C12	Manufacture of food products, beverages and tobacco products	10-12	Food products, beverages and tobacco
C13-C15	Manufacture of textiles, wearing apparel and leather products	13-15	Textiles, wearing apparel, leather and related products
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	16-18	Wood and paper products; printing and reproduction of recorded media
C17	Manufacture of paper and paper products	16-18	Wood and paper products; printing and reproduction of recorded media
C18	Printing and reproduction of recorded media	16-18	Wood and paper products; printing and reproduction of recorded media
C19	Manufacture of coke and refined petroleum products	19	Coke and refined petroleum products
C20	Manufacture of chemicals and chemical products	20-21	Chemicals and chemical products
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	20-21	Chemicals and chemical products
C22	Manufacture of rubber and plastic products	22-23	Rubber and plastics products, and other non-metallic mineral products
C23	Manufacture of other non-metallic mineral products	22-23	Rubber and plastics products, and other non-metallic mineral products
C24	Manufacture of basic metals	24-25	Basic metals and fabricated metal products, except machinery and equipment
C25	Manufacture of fabricated metal products, except machinery and equipment	24-25	Basic metals and fabricated metal products, except machinery and equipment
C26	Manufacture of computer, electronic and optical products	26-27	Electrical and optical equipment
C27	Manufacture of electrical equipment	26-27	Electrical and optical equipment
C28	Manufacture of machinery and equipment n.e.c.	28	Machinery and equipment n.e.c.
C29	Manufacture of motor vehicles, trailers and semi-trailers	29-30	Transport equipment
C30	Manufacture of other transport equipment	29-30	Transport equipment
C31-C32	Manufacture of furniture; other manufacturing	31-33	Other manufacturing; repair and installation of machinery and equipment
C33	Repair and installation of machinery and equipment	31-33	Other manufacturing; repair and installation of machinery and equipment
D35	Electricity, gas, steam and air conditioning supply	D-E	Electricity, gas and water supply
E36	Water collection, treatment and supply	D-E	Electricity, gas and water supply
E37-E39	Sewage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services	D-E	Electricity, gas and water supply
F	Construction	F	Construction
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles	45	Wholesale and retail trade and repair of motor vehicles and motorcycles
G46	Wholesale trade, except motor vehicles and motorcycles	46	Wholesale trade, except motor vehicles and motorcycles
G47	Retail trade, except motor vehicles and motorcycles	47	Retail trade, except motor vehicles and motorcycles
H49	Land transport and transport via pipelines	49-52	Transport and storage
H50	Water transport	49-52	Transport and storage
H51	Air transport	49-52	Transport and storage
H52	Warehousing and support activities for transportation	49-52	Transport and storage
H53	Postal and courier activities	53	Postal and courier activities
I	Accommodation and food service activities	I	Accommodation and food service activities
J58	Publishing activities	58-60	Publishing, audiovisual and broadcasting activities
J59-J60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities	58-60	Publishing, audiovisual and broadcasting activities
J61	Telecommunications	61	Telecommunications
J62-J63	Computer programming, consultancy and related activities; information service activities	62-63	IT and other information services
K64	Financial service activities, except insurance and pension funding	K	Financial and insurance activities
K65	Insurance, reinsurance and pension funding, except compulsory social security	K	Financial and insurance activities
K66	Activities auxiliary to financial services and insurance activities	K	Financial and insurance activities
L68	Real estate activities	L	Real estate activities
M69-M70	Legal and accounting activities; activities of head offices; management consultancy activities	M-N	Professional, scientific, technical, administrative and support service activities
M71	Architectural and engineering activities; technical testing and analysis	M-N	Professional, scientific, technical, administrative and support service activities
M72	Scientific research and development	M-N	Professional, scientific, technical, administrative and support service activities
M73	Advertising and market research	M-N	Professional, scientific, technical, administrative and support service activities
M74-M75	Other professional, scientific and technical activities; veterinary activities	M-N	Professional, scientific, technical, administrative and support service activities
N	Administrative and support service activities	M-N	Professional, scientific, technical, administrative and support service activities
O64	Public administration and defence; compulsory social security	O	Public administration and defence; compulsory social security
P85	Education	P	Education
Q	Human health and social work activities	Q	Health and social work
R-S	Other service activities	R	Arts, entertainment and recreation
R-S	Other service activities	S	Other service activities

Notes: In case of multiple correspondences, the data was either (a) aggregated across WIOD subsectors to match those of EU KLEMS or (b) the same values for WIOD variables were imputed in EU KLEMS subsectors.

Table A.3: Correspondence between sectors in WIOD (release 2013) and EU KLEMS

WIOD		EUKLEMS	
Code	Sector	Code	Sector
AtB	Agriculture, hunting, forestry and fishing	A	Agriculture, forestry and fishing
C	Mining and quarrying	B	Mining and quarrying
15t16	Food, beverages and tobacco	10-12	Food products, beverages and tobacco
17t18	Textiles and textile products	13-15	Textiles, wearing apparel, leather and related products
19	Leather, leather and footwear	13-15	Textiles, wearing apparel, leather and related products
20	Wood and products of wood and cork	16-18	Wood and paper products; printing and reproduction of recorded media
21t22	Pulp, paper, paper, printing and publishing	16-18	Wood and paper products; printing and reproduction of recorded media
23	Coke, refined petroleum and nuclear fuel	19	Coke and refined petroleum products
24	Chemicals and chemical products	20-21	Chemicals and chemical products
25	Rubber and plastics	22-23	Rubber and plastics products, and other non-metallic mineral products
26	Other non-metallic mineral	22-23	Rubber and plastics products, and other non-metallic mineral products
27t28	Basic metals and fabricated metal	24-25	Basic metals and fabricated metal products, except machinery and equipment
30t33	Electrical and optical equipment	26-27	Electrical and optical equipment
29	Machinery, n.e.c.	28	Machinery and equipment n.e.c.
34t35	Transport equipment	29-30	Transport equipment
36t37	Manufacturing, n.e.c.; recycling	31-33	Other manufacturing; repair and installation of machinery and equipment
E	Electricity, gas and water supply	D-E	Electricity, gas and water supply
F	Construction	F	Construction
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel	45	Wholesale and retail trade and repair of motor vehicles and motorcycles
51	Wholesale trade and commission trade, except motor vehicles and motorcycles	46	Wholesale trade, except motor vehicles and motorcycles
52	Retail trade, except motor vehicles and motorcycles; repair of household goods	47	Retail trade, except motor vehicles and motorcycles
60	Inland transport	49-52	Transport and storage
61	Water transport	49-52	Transport and storage
62	Air transport	49-52	Transport and storage
63	Other supporting and auxiliary transport activities; activities of travel agencies	49-52	Transport and storage
64	Post and telecommunications	53	Postal and courier activities
H	Hotels and restaurants	I	Accommodation and food service activities
64	Post and telecommunications	58-60	Publishing, audiovisual and broadcasting activities
64	Post and telecommunications	61	Telecommunications
64	Post and telecommunications	62-63	IT and other information services
J	Financial intermediation	K	Financial and insurance activities
70	Real estate activities	L	Real estate activities
71t74	Renting of M&Eq and other business activities	L	Real estate activities
O	Other community, social and personal services	M-N	Professional, scientific, technical, administrative and support service activities
L	Public admin and defence; compulsory social security	O	Public administration and defence; compulsory social security
M	Education	P	Education
N	Health and social work	Q	Health and social work
O	Other community, social and personal services	R	Arts, entertainment and recreation
O	Other community, social and personal services	S	Other service activities

Notes: In case of multiple correspondences, the data was either (a) aggregated across WIOD subsectors to match those of EU KLEMS or (b) the same values for WIOD variables were imputed in EU KLEMS subsectors.

Table A.4: Ex ante user costs of capital: $AR(2)$-models

	s_L	s_{nonICT}	s_{ICT}	$s_{R\&D}$	s_M
p_L	0.067***	-0.016***	-0.005**	-0.004	-0.042***
	(0.009)	(0.004)	(0.002)	(0.003)	(0.008)
p_{nonICT}	-0.016***	0.026***	0.003**	0.000	-0.013***
	(0.004)	(0.004)	(0.001)	(0.001)	(0.004)
p_{ICT}	-0.005**	0.003**	0.002**	0.001	-0.001
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
$p_{R\&D}$	-0.004	0.000	0.001	0.008***	-0.005*
	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)
p_M	-0.042***	-0.013***	-0.001	-0.005*	0.061***
	(0.008)	(0.004)	(0.002)	(0.003)	(0.009)
Y	-0.047***	-0.006	-0.007*	0.000	0.059***
	(0.006)	(0.008)	(0.004)	(0.003)	(0.011)
O	-0.094***	-0.207***	-0.004	-0.033***	0.338***
	(0.025)	(0.035)	(0.006)	(0.010)	(0.048)
Obs	5220				

Notes: Ex ante user costs of capital were estimated based on time-varying sector-specific rates of return and expectations were obtained from out-of-sample forecasts using $AR(2)$-models. Standard errors in parentheses are clustered at the country-sector level. Year and country × sector fixed effects are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table A.5: Ex ante user costs of capital: Adaptive expectations

	s_L	s_{nonICT}	s_{ICT}	$s_{R\&D}$	s_M
p_L	0.071***	-0.025***	-0.005**	-0.002	-0.040***
	(0.009)	(0.005)	(0.002)	(0.003)	(0.008)
p_{nonICT}	-0.025***	0.030***	0.003**	-0.000	-0.007
	(0.005)	(0.006)	(0.001)	(0.002)	(0.005)
p_{ICT}	-0.005**	0.003**	0.002*	0.001	-0.001
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
$p_{R\&D}$	-0.002	-0.000	0.001	0.008***	-0.007***
	(0.003)	(0.002)	(0.001)	(0.003)	(0.003)
p_M	-0.040***	-0.007	-0.001	-0.007***	0.055***
	(0.008)	(0.005)	(0.002)	(0.003)	(0.010)
Y	-0.050***	-0.005	-0.006*	0.000	0.061***
	(0.007)	(0.008)	(0.004)	(0.003)	(0.011)
O	-0.092***	-0.222***	-0.006	-0.032***	0.352***
	(0.027)	(0.036)	(0.006)	(0.010)	(0.049)
Obs	5392				

Notes: Ex ante user costs of capital were estimated based on time-varying sector-specific rates of return and expectations were obtained using exponential smoothing (smoothing parameter $\beta = 0.8$). Standard errors in parentheses are clustered at the country-sector level. Year and country × sector fixed effects are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table A.6: Instrumental variable approach with restricted instrument group

	s_L	s_{nonICT}	s_{ICT}	$s_{R\&D}$	s_M
p_L	0.093***	-0.016	0.006	0.012**	-0.093***
	(0.015)	(0.017)	(0.005)	(0.006)	(0.021)
p_{nonICT}	-0.032***	0.033***	0.005***	0.006***	-0.012**
	(0.005)	(0.006)	(0.002)	(0.002)	(0.006)
p_{ICT}	-0.008**	0.002	0.004***	0.001	0.002
	(0.004)	(0.003)	(0.001)	(0.001)	(0.005)
$p_{R\&D}$	-0.001	0.002	0.000	0.001	-0.002
	(0.002)	(0.002)	(0.000)	(0.001)	(0.002)
p_M	0.026	0.031	0.001	-0.025**	-0.031
	(0.024)	(0.028)	(0.007)	(0.010)	(0.036)
Y	-0.037***	-0.013	-0.009***	-0.001	0.061***
	(0.008)	(0.009)	(0.004)	(0.003)	(0.014)
O	-0.723***	-0.651**	0.007	0.155	1.197***
	(0.225)	(0.272)	(0.078)	(0.113)	(0.323)
Obs	5634				
F-statistic	27.085				

Notes: The table presents estimates from a two-stage least squares (2SLS) regression in which world export supply is used as an instrument for offshoring. The F-statistic refers to the test for significance of the coefficients on the instrument in the first-stage regression. Standard errors in parentheses are clustered at the country-sector level. Year and country × sector fixed effects are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table A.7: Controlling for technological change: R&D intensity

	s_L	s_{nonICT}	s_{ICT}	$s_{R\&D}$	s_M
p_L	0.066***	-0.025***	-0.007***	-0.001	-0.033***
	(0.009)	(0.003)	(0.002)	(0.001)	(0.009)
p_{nonICT}	-0.025***	0.039***	0.004***	0.004**	-0.022***
	(0.003)	(0.004)	(0.001)	(0.001)	(0.003)
p_{ICT}	-0.007***	0.004***	0.004***	0.000	-0.002
	(0.002)	(0.001)	(0.001)	(0.000)	(0.003)
$p_{R\&D}$	-0.001	0.004**	0.000	0.001	-0.003***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
p_M	-0.033***	-0.022***	-0.002	-0.003***	0.060***
	(0.009)	(0.003)	(0.003)	(0.001)	(0.010)
Y	-0.043***	-0.018**	-0.010***	0.001	0.069***
	(0.006)	(0.008)	(0.004)	(0.002)	(0.011)
O	-0.145***	-0.144***	0.002	-0.016*	0.302***
	(0.029)	(0.028)	(0.009)	(0.008)	(0.048)
$R\&D$	0.124	-0.037	0.016	0.739***	-0.831***
	(0.106)	(0.136)	(0.058)	(0.073)	(0.212)
Obs	5634				

Notes: Standard errors in parentheses are clustered at the country-sector level. Year and country × sector fixed effects are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. $R\&D$ refers to the R&D intensity defined as the nominal gross fixed capital formation for research and development over gross output.

Table A.8: Controlling for technological change: Country-sector time trends

	s_L	s_{nonICT}	s_{ICT}	$s_{R\&D}$	s_M
p_L	0.091***	-0.024**	0.001	0.000	-0.067***
	(0.009)	(0.010)	(0.003)	(0.003)	(0.013)
p_{nonICT}	-0.012***	0.033***	0.003***	0.003	-0.027***
	(0.002)	(0.004)	(0.001)	(0.002)	(0.004)
p_{ICT}	-0.007***	0.014***	0.005***	0.002**	-0.013***
	(0.002)	(0.003)	(0.001)	(0.001)	(0.003)
$p_{R\&D}$	-0.001	0.002	0.000	0.001	-0.002
	(0.001)	(0.002)	(0.000)	(0.001)	(0.002)
p_M	-0.043***	-0.046**	-0.007***	-0.005	0.101***
	(0.010)	(0.019)	(0.002)	(0.005)	(0.019)
Y	-0.089***	-0.011	-0.006*	-0.001	0.107***
	(0.006)	(0.010)	(0.003)	(0.005)	(0.012)
O	-0.076***	-0.130***	-0.014	-0.047***	0.267***
	(0.017)	(0.033)	(0.011)	(0.017)	(0.045)
Obs	5634				

Notes: Standard errors in parentheses are clustered at the country-sector level. Country × sector fixed effects, country-sector time trends as well as a linear time trend are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. For computational reasons, homogeneity and symmetry constraints are not imposed in this specification.

Table A.9: Controlling for technological change: Solow residual

	s_L	s_{nonICT}	s_{ICT}	$s_{R\&D}$	s_M
p_L	0.062***	-0.019***	-0.005**	-0.000	-0.037***
	(0.008)	(0.003)	(0.002)	(0.001)	(0.008)
p_{nonICT}	-0.019***	0.035***	0.003***	0.002*	-0.021***
	(0.003)	(0.005)	(0.001)	(0.001)	(0.004)
p_{ICT}	-0.005**	0.003***	0.004***	0.000	-0.001
	(0.002)	(0.001)	(0.001)	(0.000)	(0.003)
$p_{R\&D}$	-0.000	0.002*	0.000	0.001	-0.003**
	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)
p_M	-0.037***	-0.021***	-0.001	-0.003**	0.063***
	(0.008)	(0.004)	(0.003)	(0.002)	(0.010)
Y	-0.044***	-0.018**	-0.010***	0.001	0.070***
	(0.007)	(0.008)	(0.004)	(0.003)	(0.012)
O	-0.133***	-0.153***	0.000	-0.029***	0.314***
	(0.029)	(0.028)	(0.009)	(0.010)	(0.049)
SR	-0.104***	0.077**	0.019***	0.008	-0.002
	(0.023)	(0.035)	(0.005)	(0.007)	(0.034)
Obs	5634				

Notes: Standard errors in parentheses are clustered at the country-sector level. Year and country × sector fixed effects are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. The Solow residual, SR, is derived using country-sector production functions with time-varying capital and labour shares corresponding to their empirical values.

Table A.10: Estimation for sub-samples

	Manufacturing	Services	Selection	1995-2008	2009-2014
δ_L	-0.037	-0.281***	-0.135***	-0.178***	-0.075***
	(0.025)	(0.070)	(0.029)	(0.043)	(0.018)
δ_{nonICT}	-0.111***	-0.470***	-0.112***	-0.185***	-0.111***
	(0.030)	(0.122)	(0.023)	(0.046)	(0.028)
δ_{ICT}	0.001	-0.058	0.006	-0.018	0.002
	(0.003)	(0.044)	(0.010)	(0.019)	(0.004)
$\delta_{R\&D}$	-0.045***	-0.029	-0.022**	-0.030**	-0.019*
	(0.016)	(0.027)	(0.010)	(0.013)	(0.011)
δ_M	0.191***	0.840***	0.263***	0.413***	0.205***
	(0.047)	(0.181)	(0.044)	(0.077)	(0.039)
Obs	2531	3103	4363	3764	1870

Notes: Standard errors in parentheses are clustered at the country-sector level. Year and country × sector fixed effects are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. δ_i refers to the coefficient of offshoring in the share equation of factor i. Column 3 (Selection) excludes sectors with the codes B, L, O, P, Q, R and S.

Table A.11: Estimation in first differences ($\Delta_{t,t-1}$)

	Δs_L	Δs_{nonICT}	Δs_{ICT}	$\Delta s_{R\&D}$	Δs_M
Δp_L	0.074***	-0.008***	-0.005***	-0.005***	-0.056***
	(0.009)	(0.001)	(0.001)	(0.001)	(0.008)
Δp_{nonICT}	-0.008***	0.030***	0.001	-0.001	-0.022***
	(0.001)	(0.004)	(0.001)	(0.003)	(0.004)
Δp_{ICT}	-0.005***	0.001	0.013***	0.002*	-0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
$\Delta p_{R\&D}$	-0.005***	-0.001	0.002*	0.010***	-0.005***
	(0.001)	(0.003)	(0.001)	(0.004)	(0.001)
Δp_M	-0.056***	-0.022***	-0.009***	-0.005***	0.092***
	(0.008)	(0.004)	(0.002)	(0.001)	(0.008)
ΔY	-0.103***	0.009	-0.015***	-0.006**	0.116***
	(0.005)	(0.011)	(0.003)	(0.003)	(0.012)
ΔO	-0.037***	-0.205***	0.003	-0.023*	0.262***
	(0.014)	(0.036)	(0.005)	(0.012)	(0.043)
Obs	5303				

Notes: Standard errors in parentheses are clustered at the country-sector level. Year and country × sector fixed effects are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table A.12: Estimation in long differences ($\Delta_{2014,2000}$)

	Δs_L	Δs_{nonICT}	Δs_{ICT}	$\Delta s_{R\&D}$	Δs_M
Δp_L	0.085***	-0.013	-0.001	-0.016***	-0.056***
	(0.015)	(0.008)	(0.005)	(0.006)	(0.018)
Δp_{nonICT}	-0.013	0.046***	0.003***	-0.014**	-0.022***
	(0.008)	(0.009)	(0.001)	(0.007)	(0.007)
Δp_{ICT}	-0.001	0.003***	0.009***	-0.001	-0.011**
	(0.005)	(0.001)	(0.003)	(0.002)	(0.005)
$\Delta p_{R\&D}$	-0.016***	-0.014**	-0.001	0.027***	0.004
	(0.006)	(0.007)	(0.002)	(0.010)	(0.006)
Δp_M	-0.056***	-0.022***	-0.011**	0.004	0.084***
	(0.018)	(0.007)	(0.005)	(0.006)	(0.019)
ΔY	-0.048***	0.004	-0.001	0.009*	0.035
	(0.012)	(0.022)	(0.003)	(0.005)	(0.026)
ΔO	-0.120***	-0.137**	0.004	-0.119**	0.368***
	(0.036)	(0.058)	(0.009)	(0.059)	(0.095)
Obs	304				

Notes: Standard errors in parentheses are clustered at the sector level. Country and sector fixed effects are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table A.13: Alternative offshoring measures

	Y	Y narrow	Y broad	VA	VA narrow	VA broad
δ_L	-0.144***	-0.167***	-0.146***	-0.077***	-0.115***	-0.114***
	(0.029)	(0.037)	(0.041)	(0.008)	(0.020)	(0.013)
δ_{nonICT}	-0.145***	-0.049	-0.191***	-0.072***	-0.065***	-0.129***
	(0.028)	(0.042)	(0.038)	(0.012)	(0.019)	(0.019)
δ_{ICT}	0.002	0.006	-0.001	-0.002	-0.001	-0.003
	(0.009)	(0.010)	(0.011)	(0.003)	(0.007)	(0.005)
$\delta_{R\&D}$	-0.028***	-0.036*	-0.027**	-0.018***	-0.027**	-0.025***
	(0.010)	(0.021)	(0.011)	(0.006)	(0.012)	(0.009)
δ_M	0.314***	0.244***	0.364***	0.169***	0.207***	0.271***
	(0.048)	(0.065)	(0.073)	(0.015)	(0.029)	(0.022)
Obs	5634	5634	5634	5634	5634	5634

Notes: Standard errors in parentheses are clustered at the country-sector level. Year and country × sector fixed effects are controlled for, but are not shown for brevity. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. δ_i refers to the coefficient of offshoring in the share equation of factor i. Y (VA) corresponds to the share of imported intermediates relative to gross output (value added). Narrow (broad) refers to the share of imported intermediates originating from the same sector as (all sectors other than) the offshoring sector. The data for VA is winsorised at the 5th and 95th percentile to limit the effect of outliers resulting from sectors with very low levels of value added (Foster-McGregor et al., 2013).