Kiel

Working Papers

Kiel Institute for the World Economy

Offshoring, Domestic Outsourcing, and Productivity: Evidence for a Number of European countries

by Tillmann Schwörer

No. 1786| July 2012

Web: www.ifw-kiel.de

Kiel Working Paper No. 1786 | July 2012

Offshoring, Domestic Outsourcing, and Productivity: Evidence for a Number of European Countries*

Tillmann Schwörer

Abstract:
The economic effects of offshoring have been subject to extensive empirical analysis in the past, but many studies have not accurately distinguished between offshoring, domestic outsourcing, and the substitution of domestic by foreign suppliers. In this study I provide stylized facts on offshoring in Europe between 1995 and 2008 taking into account this distinction. I show that service inputs have been offshored and domestically outsourced, whereas material inputs have been either offshored or moved from domestic to foreign suppliers. The strong overall decline in the share of internal production evokes the question whether this has led to productivity gains within firms. I address this question by combining industry-level data on offshoring and domestic outsourcing with a firm panel. I find that offshoring of non-core activities has led to productivity gains whereas offshoring of core activities and domestic outsourcing have had no such effects. The estimated productivity gains are in particular driven by offshoring to low-wage countries and by the gains of multinational firms.

Keywords: offshoring, domestic outsourcing, productivity

JEL classification: F23, D24, L24, L60

Tillmann Schwörer
Kiel Institute for the World Economy
24100 Kiel, Germany
Telephone: +49 431 8814573
E-mail: tillmann.schwoerer@ifw-kiel.de

* Research for this paper was supported through the European Commission, Research Directorate General as part of the 7th Framework Programme, Theme 8: Socio-Economic Sciences and Humanities, Grant Agreement no: 244552. I am grateful to Holger Görg, to participants of the Aarhus-Kiel-Workshop 2010, the Göttingen Workshop 2011, and the ISGEP Workshop 2011 in Lüneburg for helpful comments and discussions.

1. Introduction

Offshoring, or the sourcing of inputs from abroad, is one of the most debated features of economic globalisation. Firms split up their value chains and relocate those activities which they perform with less efficiency to foreign affiliates or to external foreign suppliers. Numerous studies have documented the rapid growth in offshoring over the last decades (see e.g. Hummels, Ishii, and Yi, 2001 or Amiti and Wei, 2005). While offshoring has for a long time been limited to material inputs, the last decade has also witnessed an increase in offshoring of services, a trend that has been triggered by the revolution in information and communication technologies (Blinder, 2006).

In the public perception offshoring is often associated with layoffs, wage reductions, and a rise in wage inequality. These fears have even led Germany to elect outsourcing in 1996 as "unword of the year". Indeed there is evidence of at least some adverse labour market effects. In particular, offshoring is blamed to penalise low skilled workers since their jobs often involve routine activities which are more easily offshorable than the activities of high skilled workers (Feenstra and Hanson, 1996; Geishecker and Görg, 2008). Blinder (2006, 2009) has caused alarm with estimates of about 25 per cent of American Jobs that are potentially exposed to offshoring.

In light of the anxiety about job losses and wage reductions, research has been mostly focused on the labour market effects of offshoring, while there is only a small literature on the productivity effects of offshoring. I argue that the importance of this aspect has been overlooked. First, productivity is an important driver of economic growth and hence interesting in its own right. Second, recent theoretical studies show that there are positive feedback effects on the labour markets provided that offshoring raises productivity: According to Grossman and Rossi-Hansberg (2008) the wages of unskilled workers may rise despite their vulnerability to offshoring if the productivity effect induced by offshoring is sufficiently large; Mitra and Ranyan (2010) show that due to the presence of productivity effects offshoring may decrease unemployment and increase wages; Kohler and Wrona (2010) identify conditions under which job creation dominates job destruction in the presence of productivity effects. Hence, analysing the offshoring-productivity link is important to better understand the feedback effects on the labour markets.

The existing literature on this topic provides some evidence that offshoring can increase productivity, but the identified effects are quite heterogeneous depending on the analysed country, the type of firms (e.g. exporters versus non-exporters) or the type of offshored inputs (materials or services):[1] Görg and Hanley (2005) find that material offshoring has contributed to an increase in the productivity of exporters with low export intensities in the Irish electronics sector. Egger and Egger (2006) find that offshoring lowers the productivity of low-skilled workers in the short run, but raises their productivity in the long run. Görg, Hanley, and Strobl (2008) find that service offshoring enhances the productivity of exporting firms in the Irish manufacturing sector. Hijzen, Inui, and Todo (2008) show for Japanese firms that offshoring to foreign affiliates raises productivity, while offshoring to external suppliers has no such effect. Amiti and Wei (2009) find that offshoring increases productivity, with service offshoring accounting for 10% and material offshoring accounting for 5% of the productivity growth in the United States. Winkler (2010) finds that service offshoring increases the productivity of German manufacturing industries, when controlling for domestic outsourcing. Wagner (2011) finds some evidence for positive productivity effects for German firms using a matching approach.

A criticism which applies to most studies in this literature is that the interpretation of the central offshoring measure is ambiguous. Offshoring is widely defined as the share of imported inputs in total inputs and is measured at the industry-level through a combination of input-output tables and import data (Feenstra and Hanson, 1996). The offshoring measure per se does not allow distinguishing whether internal production is moved out to foreign suppliers (offshoring) or to domestic suppliers (domestic outsourcing), or whether domestic suppliers are replaced by foreign suppliers (supplier change). See Castellani, de Benedictis, and Horgos (2011) for a detailed analysis of this problem.

In the present study I provide stylized facts on offshoring in Western Europe taking into account this important distinction. I show that services which were previously done internally have been offshored and outsourced domestically. For material inputs, by contrast, I find also evidence of a systematic replacement of domestic by foreign suppliers. Overall the share of internal production has gone down by 4.5 percentage points between 1995 and 2008, which raises the question whether firms achieved productivity gains through this specialisation effort. I address this question by combining industry offshoring data with a firm panel. Using fixed effects regressions and an instrumental variable approach I find that offshoring of non-core activities has led to productivity gains whereas offshoring of core activities and domestic outsourcing have had no such effects. The estimated productivity gains are in particular driven by offshoring to low-wage countries and by the gains of multinational firms.

[1] See Olsen (2006) for a detailed survey of the offshoring-productivity literature.

The remainder of this study is structured as follows. Section 2 discusses possible channels for productivity effects, section 3 illustrates how offshoring is measured and provides stylized facts on offshoring in Western Europe, section 4 describes the empirical model, section 5 presents the regression results, and section 6 concludes.

2. Channels for productivity effects

To motivate the analysis of productivity effects I discuss in the following different channels through which offshoring can affect productivity:[2] *First*, a static efficiency gain may arise when firms focus on their core competencies and offshore their less productive activities to foreign suppliers. Offshoring should be therefore all the more beneficial the less productively the activity is done internally. For instance, one may expect that business services offshoring by a manufacturer bears a greater potential for productivity gains than offshoring of its core production activities. *Second*, offshoring may also come along with restructuring measures which reduce inefficiencies. For instance, offshoring may induce firms to reorganize the way in which tasks are bundled or to improve the communication and reporting system between departments. *Third*, offshoring firms may benefit from learning externalities which arise due to the interaction with foreign suppliers. For instance, workers may learn about new software packages or gain knowledge about technologies used by the foreign supplier. *Fourth*, offshoring may raise productivity if the imported input varieties are of higher quality or better match with the specific needs of the firm. *Fifth*, in Glass and Saggi (2001) offshoring to low wage countries lowers the marginal production costs and raises profits, which creates resources for additional R&D investments. Thus, offshoring may indirectly raise productivities through an increase in innovation activities. Görg and Hanley (2011) provide empirical support for this hypothesis on the basis of Irish plant-level data. *Sixth*, offshoring may induce general equilibrium effects if realised productivity gains spill over to other firms, or if offshoring induces tougher competition and selection effects in their markets.

Note that the relevance of individual productivity channels cannot be evaluated in this study. In particular, effects for offshoring firms cannot be isolated from general equilibrium effects on competitors or upstream and downstream firms, because offshoring is not observed at the firm level. Yet, this study can provide an indication of heterogeneous effects for different types of firms by combining the industry-level offshoring data with a firm panel.

[2] See Amiti and Wei (2009) for a similar summary of channels for productivity effects.

3. Offshoring and domestic outsourcing

3.1 Measurement and data

I define offshoring as the share of inputs, imported from affiliates or from external supplliers, in output. Similarly, I define domestic outsourcing as the share of inputs from domestic affiliates or external suppliers in output. Based on these definitions I create different variables on offshoring and domestic outsourcing, differeing with respect to the types of inputs and groups of supplier countries. These variables are measured for an industry *j* in country *c* and year *t*. We can write:

$$Offshoring_{jct} = \frac{\sum_k (Imported\ inputs\ from\ industry\ k\ by\ industry\ j)_{ct}}{(Output\ of\ industry\ j)_{ct}} \quad (1)$$

$$Domestic\ sourcing_{jct} = \frac{\sum_k (Domestic\ inputs\ from\ industry\ k\ by\ industry\ j)_{ct}}{(Output\ of\ industry\ j)_{ct}} \quad (2)$$

In a first step I distinguish three offshoring variables by restricting the numerator of equation (1) to specific supplier industries *k*. *Offshoring of core activities* captures inputs from the buyer's own industry (k=j). *Offshoring of non-core activities* captures inputs from all manufacturing industries except the buyer's industry (k≠j, manufacturing). The two variables can be subsumed under the term material offshoring. *Service offshoring* captures inputs from six services industries, including post and telecommunication services, financial services, computer services, R&D, and other business services, as in Amiti and Wei (2009) (k≠j, services). In the same way I distinguish three domestic outsourcing variables for core activities, non-core activities, and services.[3]

Note that the material offshoring variables are equivalent to the well-known narrow offshoring measure (for core activities) and difference offshoring measure (for non-core activities) in Feenstra and Hanson (1999)[4]. I prefer the new terms, though, to better illuminate the economic content. In the literature the difference measure is widely treated as a residual that exists only with reference to the broad and narrow offshoring measure, and it is usually ignored in econometric analyses. Yet, in my view offshoring of non-core activities may have even larger productivity effects than offshoring of core activities, because firms should generally be less productive in the former type of activities and thus the potential for productivity gains should be larger.

[3] To keep the explanations short I will refer in the following only to offshoring, but equivalent arguments apply for domestic outsourcing unless otherwise noted.

[4] The only difference is in the denominator. In Feenstra and Hanson (1999) offshoring is scaled by non-energy inputs, while in this study I use output.

In a second step I further distinguish the offshoring variables according to the countries that are supplying the inputs to country c. The first group of supplier countries comprises Austria, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, and United Kingdom. Note that these are precisely the countries which are analysed as receiving (or offshoring) countries in this study. The second group comprises 14 high-income OECD countries, not including the countries of the first group.[5] The third group comprises the rest of the world, consisting mainly of low-income countries.

The data come from the World Input Output Database (WIOD)[6]. This database provides information on input-output relations between industries in 40 countries between 1995 and 2009. Different from standard input-output tables, WIOD contains a breakdown of input-output relations by supplier country. That is, WIOD allows identifying where the inputs of a specific industry are sourced. The denominator of offshoring, industry output, can be directly taken from WIOD. The numerators can be calculated on the basis of the world input-output table building the column sums over groups of supplier industries *k* and over groups of supplier countries. WIOD has several unique features compared to standard input-output tables which help resolving measurement limitations that have been present in the offshoring literature:[7]

First, the world input-output table contains annual data on domestic inputs and on foreign inputs, which enables me to distinguish between offshoring, domestic outsourcing and supplier changes. Castellani, de Benedictis, and Horgos (2011) show that standard offshoring measures fail to account for this distinction and as a consequence tend to overestimate the importance of business service offshoring. For my analysis this distinction is of particular relevance since offshoring, domestic outsourcing and supplier changes could have different effects on productivity.

Second, the supply and use tables underlying the world input-output table are more frequently available than input-output tables from EUROSTAT or the OECD. For the nine Western European countries considered in this study the time coverage is almost complete (Timmer et al., 2012, p.69). This reduces considerably the measurement bias arising from the imputation of missing data.

---

[5] Australia, Belgium, Canada, Czech Republic, Denmark, Estonia, Greece, Hungary, Ireland, Japan, Republic of Korean, Luxembourg, Slovak Republic, United States.

[6] Downloadable at http://www.wiod.org/database/index.htm. See Timmer et al. (2012) for detailed information on the methods applied in the construction of the world input-output table. All information on WIOD presented in the following is taken from this background document.

[7] See Winkler and Milberg (2009) and Castellani, de Benedictis, and Horgos (2011) and Feenstra and Jensen (2012) for detailed information on measurement problems in offshoring measures.

A related issue is the choice of the variable in the denominator. The literature has used non-energy inputs (e.g. Feenstra and Hanson, 1999; Amiti and Wei, 2009), value added (Hijzen et al. 2005), or output (Geishecker and Görg, 2008). However, offshoring variables scaled with non-energy inputs or with value added are hard to interpret because both variables are affected by changes from internal production to domestic outsourcing (Geishecker, 2007). To resolve these ambiguities I choose output as the denominator.

Third, the distinction between domestic and foreign inputs is achieved in WIOD through an imputation method which dispenses with the traditional type of proportionality assumption, which is present in standard input-output tables of imports. According to the proportionality assumption every industry imports a specific input in the same proportion as the whole economy. It is well known that this assumption is quite restrictive (Winkler and Milberg, 2009; Feenstra and Jensen, 2012). WIOD is based on a weaker type of proportionality assumption which allows import shares to differ between the three use categories intermediates, final consumption, and investment.

3.2 Patterns of offshoring and domestic outsourcing

The following part provides an overview of offshoring patterns in Western Europe's manufacturing industries between 1995 and 2008. To account for differences in the size of industries all observations are generally weighted by industry output.

Table 1 decomposes output into three components: internal production, domestic outsourcing, and offshoring.[8] The table shows that in 2008 about 29% of the firms' output originates from internal production, 28% are due to domestically outsourced inputs, and 17% are due to offshored inputs. Domestic outsourcing is further distinguished into core activities (10.0%), non-core activities (9.6%) and services (7.9%). Offshoring is distinguished into core activities (8.9%), non-core activities (7.1%) and services (1.1%). A first stylized fact is, thus, that material inputs are offshored and domestically outsourced to a similar degree, whereas services are predominantly outsourced domestically. This can be regarded as evidence that many services are not yet tradable over longer distances. In particular, this may be due to services that require regular face-to-face contact with customers, or due to services that involve non-routine activities (Blinder, 2009).

Furthermore, table 1 shows that between 1995 and 2008 offshoring of core activities has increased by 2.5 percentage points (pp) and offshoring of non-core activities has increased

[8] Note that the shares of these components in output would sum to 100% if inputs from the primary sector and the remaining service industries (e.g. transport services) were included in the offshoring measures and the domestic outsourcing measures.

by 1.8 pp. This increase in material offshoring has coincided with a decrease in internal production but also with a decrease in the domestic outsourcing measure. This suggests that two quite different phenomena have occurred at the same time: First, internal production of materials has been partly moved out to foreign suppliers (genuine offshoring). Second, domestic suppliers have been partly replaced by foreign suppliers (supplier change). For services the patterns are somewhat different. Service offshoring has increased by 0.4 pp, domestic service outsourcing has increased by 0.6 pp, and internal value added has decreased. This suggests that internal services have been moved out both to domestic suppliers (genuine domestic outsourcing) and to foreign suppliers (genuine offshoring).[9]

Table 2 shows country-level changes in the composition of output between 1995 and 2008, and table 3 shows the corresponding industry-level changes. The numbers are in percentage points. Overall, tables 2 and 3 show that the general offshoring patterns identified above hold for most of the countries and industries individually. One of the few exceptions is the United Kingdom, where internal production has remained constant and domestic material outsourcing has fallen sharply. Here the rise in the material offshoring variables seems to be predominantly the result of supplier changes rather than genuine offshoring.

Table 4 compares Western Europe with the United States. To make the two regions better comparable in terms of economic size I treat Western Europe as a single market. This implies that domestic outsourcing comprises all inputs supplied by Western European countries, and offshoring comprises all inputs supplied by countries outside Western Europe. The table shows that the share of internal production has been similar for the two markets in 1995 (each about 33%), but has decreased considerably faster in Western Europe compared to the US (-4.5 versus -1.2 pp). The numbers suggest that in both markets internal services have been moved out to domestic suppliers and to foreign suppliers. However, with respect to material inputs, the numbers suggest that Western Europe has moved out internal production to foreign suppliers whereas the United States has mainly realized supplier changes.

The tables 5 and 6 show offshoring trends in terms of supplier countries. Table 5 shows offshoring intensities for three groups of supplier countries – Western Europe, other high-income OECD countries, and the rest of the world (ROW). Table 6 shows the relative share of each of these groups in total offshoring. A stylized fact is that material and service offshoring have increased for all three supplier regions. This suggests that offshoring costs must have generally fallen. Another stylized fact is that offshoring from ROW has gained

[9] Note that the increase in service offshoring and domestic service outsourcing could be also due to newly created services. It is not possible to verify this possibility with input-output data as the composition of internal production (i.e. the share of internally provide services, core activities, and non-core activities) is unknown.

relative importance. For instance, service offshoring from ROW represented one fifth of total service offshoring in 1995 and already one third of total service offshoring in 2008. Since ROW comprises predominantly low wage countries, this indicates that labour cost differentials may have been an important driver of firms' offshoring decisions. A final stylized fact is that the relative importance of Western Europe as a supplier of services differs considerably from its relative importance as a supplier of materials. Europe's share in total material offshoring has strongly decreased, whereas its share in total service offshoring has slightly increased.

To sum up I highlight some key stylized facts: a) Offshoring has increased throughout virtually all countries and industries in Western Europe between 1995 and 2008, and it has increased with respect to high-wage and low-wage supplier countries. b) The observed increase in material offshoring reflects genuine offshoring as well as supplier changes. This increase has occurred for core activities and non-core activities. c) With respect to services we observe genuine domestic outsourcing and genuine offshoring, while there is no evidence of systematic supplier changes. d) The importance of domestic outsourcing relative to offshoring is considerably higher for services than for materials, suggesting that many services are still less tradeable over longer distances. e) Overall, the share of internal production has gone down by 4.5 percentage points. This raises in particular the question whether firms achieved productivity gains through this specialisation effort.

4. Empirical strategy

For the empirical analysis I combine the offshoring data with a firm panel spanning the period 1996 to 2008. In this setup an increase in offshoring captures an aggregate offshoring trend, which does not imply that all firms within a country-industry cell are involved in offshoring. Hence, the regressions capture average productivity effects comprising the effects for offshoring firms and the effects for their competitors. To capture some of the heterogeneity present within country-industry cells, I introduce an additional firm-level variable and interact this variable with offshoring. In particular, I estimate in this way whether productivity effects differ between multinationals and non-multinationals.

4.1 TFP model

In the first step I estimate standard Cobb-Douglas production functions:

$$VA_{it} = \alpha + \beta_K^j K_{it} + \beta_L^j L_{it} + TFP_{it} \qquad (3)$$

where VA, K, L are the logarithms of value added, capital, and labour, and where i and t are indices for firms and years. The parameters β_K and β_L are capital and labour intensities. To allow for differences in technologies across industries, the production functions are estimated separately for 98 three-digit manufacturing industries j. The residuals are extracted and used in the following as the measure of total factor productivity (TFP). See the appendix for the TFP regression results and summary statistics.[10]

The firm-level data comes from Amadeus, a commercial database provided by Bureau van Dijk. Amadeus contains information on the balance sheet, profit and loss account, industrial activity, and ownership structure of more than two million firms in 41 European countries. The data is gathered by different national institutions and finally compiled and harmonised by Bureau van Dijk. I extract data of the manufacturing sector in Austria, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, and the United Kingdom between 1996 and 2008. NACE industries 23 and 37 are dropped due to insufficient observations. Monetary values for Sweden and United Kingdom are converted into Euros based on exchange rates from EUROSTAT. To account for price changes nominal values are deflated by industry-specific deflators from EU KLEMS and the STAN database. Labour and capital inputs are given by the number of employees and tangible fixed assets. The sample is restricted to firms with more than five employees, value added larger than 100,000 Euro, and tangible capital larger than 5,000 Euros. To avoid outlier problems I drop the 2% of the observations with the largest (absolute) residuals in the TFP regressions, and then re-estimate the TFPs.

Note that the dataset is not representative because reporting requirements vary across countries, as can be seen from table 11. Spain and Italy are overrepresented in the data, and also the average firm characteristics such as the capital stock or the number of employees vary considerably across countries. These are certainly limitations of the data. Yet, the cross-country differences should play a minor role for the econometric analysis, as the fixed effects regressions use only the within-firm variation in TFP. Also, I conduct robustness checks on subsamples, for instance by excluding Spain and Italy.

[10] The TFP estimations were also conducted with the Levinsohn-Petrin method to account for a possible simultaneity bias. Yet, this caused partly implausible point estimates for some of the industries, such as negative coefficients for capital. For this reason the following analysis is based on simple OLS estimates of TFP. Furthermore, I conduct robustness checks with an alternative TFP measure derived from OLS regressions of model (4) plus additional firm fixed effects.

4.2 Offshoring model

In the second step I combine this firm panel at the industry (i) - country (c) - year (t) level with the data on offshoring and domestic outsourcing and estimate the following fixed effects model:

$$TFP_{it} = \alpha + \boldsymbol{\beta_O}\, \mathbf{Off}_{jct} + \boldsymbol{\beta_D}\, \mathbf{Dom}_{jct} + \gamma\, R\&D_{jct} + \mu_i + \mu_t + \varepsilon_{it} \qquad (4)$$

I regress total factor productivity (*TFP*) on offshoring (***Off***) and domestic outsourcing ***(Dom)***, where offshoring and domestic outsourcing are captured through the corresponding variables for core activities, non-core activities, and services. The research and development intensity (*R&D*) is included as a control variable to account for the fact that technological change may be correlated with productivity and with offshoring. R&D is measured as share of R&D expenditures in output based on industry-country level data from ANBERD. μ_i are firm-fixed effects that capture all time-invariant characteristics of the firm, including the time-invariant characteristics of the firm's industry (μ_j) and country (μ_c). μ_t are year-fixed effects that account for business cycles common for all countries and industries. The idiosyncratic error ε_{it} allows for clustering at the industry-country-level. This clustering is required since the offshoring variables are measured at this higher level of aggregation (Moulton, 1990). The coefficient vectors $\boldsymbol{\beta_O}$ and $\boldsymbol{\beta_D}$ represent the marginal effects of offshoring and domestic outsourcing.

Note that the existing literature has widely used either the offshoring measure for core activities (usually refered to as narrow offshoring) or the measure for all manufacturing activities (broad offshoring) in similar regression setups. Against this background I include offshoring measures for core and non-core activities simultaneously. In this way I allow for different effects of these variables. I expect that productivity gains are higher for offshoring of non-core activities because such type of offshoring could free up resources in relatively unproductive activities.

To capture some of the heterogeneity present within industry-country cells I include in the third step a dummy variable that is equal to one if the firm is part of a multinational enterprise (*MNE*), and I interact this variable with offshoring. The empirical model then becomes:

$$TFP_{it} = \alpha + \boldsymbol{\beta_O}\, \mathbf{Off}_{jct} + \beta_M\, MNE_{it} + \boldsymbol{\beta_{MO}}\, \mathbf{MNE\_Off}_{it} + \boldsymbol{\beta_D}\, \mathbf{Dom}_{jct} + \gamma\, R\&D_{jct} + \mu_i + \mu_t + \varepsilon_{it} \; (4)$$

Note some particular features of the multinationality dummy: *MNE* is one either if a firm owns one or more foreign subsidiaries or if the firm is itself owned by a foreign firm.

Ownership is defined in terms of a benchmark of 50 per cent of the firms' shares, and it includes direct as well as indirect ownership. Note further that the information on shareholders and subsidiaries is only observable for the most recent period in the data.[11] Therefore I assume that the MNE status does not change over time, which implies for the fixed effects regressions that the main effect of multinationality (β_M) is fully cancelled out by the firm-fixed effects (μ_i). The interaction effects between multinationality and offshoring, which are of primary interest in this context, are not affected, though. The coefficient vector $\boldsymbol{\beta_{MO}}$ thus captures additional productivity effects for multinational firms vis-à-vis non-multinationals.

Possible endogeneity problems are addressed in the following way: First, I reduce the potential for omitted variable bias by controlling for domestic outsourcing. In this way I avoid confounding offshoring with domestic outsourcing or with supplier changes.[12] This is important because I expect that genuine offshoring has the largest productivity effects. In particular, I expect that offshoring firms focus themselves on a reduced set of (core) activities and may thus benefit from increased specialisation. Most of the existing offshoring literature using input-output data does not control for domestic outsourcing, and may thus have problems of omitted variable bias. [13]

Second, in the full specifications of the regression I account for country-specific productivity trends by including country-year interaction dummies rather than simple year fixed effects. This should further reduce omitted variable potential problems.

Third, I address potential reverse causality problems through an instrumental variable strategy. A reverse causality bias could arise due to selection effects in offshoring as suggested by e.g. Antràs and Helpman (2004) and Wagner (2011). In this strand of the literature highly productive firms have been found to be more likely to engage in offshoring than less productive firms. In the context of this study the reverse causality problem is attenuated by the fact that the independent variables are measured at a higher level of aggregation than the dependent variable, as in Geishecker and Görg (2008). Still, I make use

[11] In order to trace ownership changes over time, an attempt was made to use ownership information from past editions of the Amadeus database, where each of these editions would provide the ownership information at the current point in time. However, this strategy was discarded after careful inspection of the data, since Amadeus does not regularly update the ownership information and since the coverage for these variables is small in the earlier editions.

[12] An increase in offshoring implies by construction a decrease in the internal production if domestic outsourcing is held constant.

[13] Notable exceptions are Munch and Skaksen (2009), Geishecker and Görg (2008), and Winkler (2010) using Danish respectively German input-output tables. Note that there are also studies on different topics that distinguish between offshoring and domestic outsourcing *at the firm level* (e.g. Görg and Hanley, 2011; Fariñas and Martín-Marcos, 2010; Kohler and Smolka, 2011).

of an instrumental variable estimation. As instruments I use world offshoring measures for core, non-core, and service activities, and their interaction with the MNE dummy variable. These world offshoring measures are constructed as output-weighted averages of offshoring in all countries covered by WIOD. Changes in world offshoring reflect changes in offshoring costs around the world. Hence, I expect the instruments to be correlated with offshoring in a given country. Moreover, I expect the instruments to be exogenous because it is unlikely that firms' productivities affect world offshoring.[14]

5. Regression results

Table 7 shows the results from the fixed effects regressions. In the first specification total factor productivity is regressed only on the offshoring variables and time dummies. The coefficient for offshoring of non-core activities is positive and statistically significant at the 1% level. The corresponding coefficients for core activities and services are statistically insignificant. In the second specification I replace the time dummies through country-year interaction dummies to account for country-specific productivity trends that are not due to offshoring. The results remain qualitatively the same as before but the adjusted R-squared is higher than before. Hence, I keep the country-year dummies in the further specifications.

In the third specification I control additionally for domestic outsourcing. The coefficient for offshoring of non-core activities remains positive and statistically significant at the 5% level. Additionally, service offshoring is positive and significant at the 5% level and domestic outsourcing of services is negative and significant at the 10% level. Hence, this shows that controlling for domestic outsourcing has consequences for the way we do interpret the productivity effects of offshoring.

In specification four I interact offshoring with a dummy variable for multinational firms. Offshoring of non-core activities and service offshoring remain positive and significant and the coefficient of domestic service outsourcing remains negative. Additionally, the coefficients of the interaction terms for non-core activities and services are positive and significant. This suggests that there is an additional gain for multinational firms compared to non-multinationals.

In specification five and six I use instrumental variables fixed effects regression. Specification five includes year fixed effects, and specification six includes country-year fixed effects. The used instruments are the lagged and contemporaneous values of world offshoring

[14] It is possible, though, that industry specific shocks jointly determine firm productivities and world offshoring, in which case the instruments may become invalid. For instance, one may think of a technological invention which raises firm productivity and offshoring simultaneously. While I cannot address this problem in a general way, I am able to rule out biases related to technology by controlling for R&D intensities.

(core, non-core, and service offshoring), which are obtained by taking the output-weighted average of offshoring in all 40 countries covered by the WIOD data. The tests for underidentification (Kleibergen-Paap LM test: significant at 1%) and weak identification (Kleibergen-Paap Wald test: F-statistic >> 10) are rejected. This confirms that the instruments are sufficiently correlated with offshoring. The test for the validity of overidentifying restrictions (Hansen J statistic) cannot be rejected at the 5% level. As to the results, the IV fixed effects regressions support the previous results in two respects. First, the coefficient of offshoring of core activities is positive and highly significant. Second, the interaction term for service offshoring is positive and also significant (with varying levels of statistical significance in the two specifications).

Overall, I interpret the results as follows. Offshoring of non-core activities and service offshoring appear to have contributed to an increase in productivity, while there is no productivity effect due to offshoring of core activities. This result is consistent with the interpretation that productivity effects arise due to an induced specialisation. Manufacturing firms that move out services or non-core production activities to foreign suppliers benefit from the termination of their relatively unproductive activities, which allows them to specialise more on their relatively productive core activities.

Furthermore, we also see additional productivity effects for multinational firms in some of the specifications. In the IV regressions there is an additional effect from service offshoring and in the simple fixed effects regressions there is also an additional effect from offshoring of non-core activities. This may be due to the fact that the MNE dummy is correlated with firm-level offshoring. Such a correlation is likely to exist because multinationals have been shown to possess more and better information about foreign markets and may therefore face lower sunk costs of offshoring (see e.g. Görg, Hanley, and Strobl 2008). In the extreme case that this correlation was 100% the interaction term would pick up the additional productivity gains for offshoring firms vis-à-vis non-offshoring firms. Still, there may be alternative explanations for this effect. For instance, MNEs could have systematically higher management skills, which allow them to adjust faster to changes in the general sourcing patterns.

In table 8 I check the robustness of the results with respect to several adjustments: First, I use alternative productivity measures as dependent variable: *Labour productivity* is measured as value added per employee. *TFP-FE* is a measure of total factor productivity, where firm fixed effects are included in the first stage TFP estimations. The results from both specifications are qualitatively similar as before. Second, I estimate the fixed effects model for different subsamples. Sample split regressions show that the productivity effects for MNEs and non-MNEs are similar though slightly larger for MNEs. Excluding Spain and Italy from the sample causes a negative coefficient for offshoring of core activities, while the remaining coefficients are consistent with previous results. Excluding the years 1996 to 2000 from the regressions causes no qualitative changes as compared to the full sample estimations. These findings confirm that the initial results are not driven by single countries or particular years that are overrepresented in the data.

In table 9 I split up the offshoring variables with respect to two groups of supplier countries and reestimate the main specifications. Motivated by the stylized facts presented in section 3 I distinguish between offshoring to high-wage countries and offshoring to low-wage countries. The group of high-wage countries is given by the nine Western European countries analysed in this study and by additionally by 14 high-wage OECD countries. The results show positive and statistically significant coefficients for service offshoring and offshoring of non-core activities in the case of low-wage supplier countries. The coefficients for high-wage supplier countries are statistically insignificant. This indicates that the the previous findings on positive productivity effects are in particular driven by offshoring to low-wage countries. A possible explanation for the differential effect is that offshoring to low-wage countries might be particularly driven by cost reduction motives, while offshoring to high-wage countries might be driven by other factors, such as the location of suitable suppliers or the firms' market access strategies.

6. Conclusion

The standard Feenstra/Hanson-type offshoring measures have been criticised because, by construction, offshoring cannot be accurately distinguished from domestic outsourcing and supplier changes (Castellani et al., 2011). Using data from the World Input Output Database (WIOD) this study analyses these variables systematically, and provides stylized facts on offshoring and domestic outsourcing in nine European countries between 1995 and 2008. Furthermore, I combine the offshoring data with a manufacturing firm panel and estimate the productivity effects of service and material offshoring, while controlling for domestic outsourcing and supplier changes.

The main stylized facts are as follows: Offshoring has increased throughout virtually all countries and industries in Western Europe and it has increased with respect to different types of supplier countries, though strongest for low-wage supplier countries. The observed increase in material offshoring measures reflects genuine offshoring as well as a substitution of domestic by foreign suppliers. With respect to services inputs there is evidence for domestic outsourcing and offshoring. Overall, the share of internal production has fallen by 4.5 percentage points between 1995 and 2008, thus evoking the question whether firms achieved productivity gains through this specialisation effort.

This question has been adressed through estimations based on combined industry and firm-level data. The main results are as follows: Offshoring of services and non-core manufacturing activities have contributed to an increase in productivity, while offshoring of core activities and domestic outsourcing have had no such effects. This suggests that offshoring raises productivity by allowing firms to further specialise on their core activities. The estimated productivity gains are in particular driven by offshoring to low-wage countries, and by the gains of multinational firms. For future research it would be desirable to use detailed firm level data on offshoring and domestic outsourcing and analyse the reasons behind the heterogeneous effects observed in this study.

References:

Amiti, M. and S. J. Wei (2005). Fear of Service Outsourcing: Is It Justified? *Economic Policy*, 20 (42), 308–347.

Amiti, M. and S. J. Wei (2009). Service Offshoring and Productivity: Evidence from the US. *World Economy*, 32 (2), 203–220.

Antràs, P. and E. Helpman (2004). Global Sourcing. *Journal of Political Economy*, 112 (3), 552–580.

Blinder, A. S. (2006). Offshoring: The Next Industrial Revolution? *Foreign Affairs*, 85 (2), 113–128.

Blinder, A. S. (2009). How Many US Jobs Might Be Offshorable? *World Economics*, 10 (2), 41–78.

Castellani, D., L. de Benedictis, and D. Horgos (2011). Can We Really Trust Offshoring Indices?," Working Paper 114/2011, Helmut Schmidt University, Hamburg.

Egger, H. and P. Egger (2006). International Outsourcing and the Productivity of Low-Skilled Labor in the EU. *Economic Inquiry*, 44 (1), 98–108.

Fariñas, J. C. and A. Martín-Marcos (2010). "Foreign Sourcing and Productivity: Evidence at the Firm Level", *World Economy*, 33(3), 482–506.

Feenstra, R. C. and G. H. Hanson (1996). Globalization, Outsourcing, and Wage Inequality. The *American Economic Review*, 86 (2), 240–245.

Feenstra, R. C. and G. H. Hanson (1999). The Impact of Outsourcing and High-Technology Capital on Wages: Estimates for the United States, 1979-1990. *The Quarterly Journal of Economics*, 114 (3), 907–940.

Feenstra, R. C. and J. B. Jensen (2012). Evaluating Estimates of Materials Offshoring from U.S. Manufacturing. NBER working paper 17916, March 2012.

Geishecker, I. (2007). Assessing the Extent and Development of International Outsourcing in the Euro Area. Working Paper.

Geishecker, I. and H. Görg (2008). Winners and Losers: a Micro-Level Analysis of International Outsourcing and Wages. *Canadian Journal of Economics*, 41 (1), 243–270.

Glass, A. J. and K. Saggi (2001). Innovation and Wage Effects of International Outsourcing. *European Economic Review*, 45 (1), 67 – 86.

Görg, H. and A. Hanley (2005). International Outsourcing and Productivity: Evidence from the Irish Electronics Industry. *The North American Journal of Economics and Finance*, 16 (2), 255–269.

Görg, H. and A. Hanley (2011). Services Outsourcing and Innovation: An Empirical Investigation. *Economic Inquiry*, 49 (2), 321–333.

Görg, H., A. Hanley, and E. Strobl (2008). Productivity Effects of International Outsourcing: Evidence from Plant-Level Data. *Canadian Journal of Economics*, 41 (2), 670–688.

Grossman, G. M. and E. Rossi-Hansberg (2008). Trading Tasks: A Simple Theory of Offshoring. *American Economic Review*, 98 (5), 1978–1997.

Hijzen, A., H. Görg, and R. C. Hine (2005). International Outsourcing and the Skill Structure of Labour Demand in the United Kingdom. *The Economic Journal*, 115 (506), 860–878.

Hijzen, A., T. Inui, and Y. Todo (2008). Does Offshoring Pay? Firm-Level Evidence from Japan. *Economic Inquiry*.

Hummels, D., J. Ishii, and K.-M. Yi (2001). The Nature and Growth of Vertical Specialization in World Trade. *Journal of International Economics*, 54 (1), 75–96.

Kohler, W. K. and J. Wrona (2010). Offshoring Tasks, Yet Creating Jobs? Working paper.

Kohler, W. K. and M. Smolka (2011). Sourcing Premia with Incomplete Contracts: Theory and Evidence. *The B.E. Journal of Economic Analysis and Policy*, 11(1), art. 10.

Mitra, D. and P. Ranjan (2010). Offshoring and Unemployment: The Role of Search Frictions Labor Mobility. *Journal of International Economics*, 81 (2), 219–229.

Munch, J. R. and J. R. Skaksen (2009). Specialization, Outsourcing and Wages. *Review of World Economics*, 145 (1), 57-73.

Moulton, B. R. (1990). An Illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Units. *The Review of Economics and Statist*ics, 72 (2), 334–338.

Olsen, K. B. (2006). Productivity Impacts of Offshoring and Outsourcing: A Review. OECD Science, Technology and Industry Working Papers 2006/1, OECD Publishing.

Timmer, M. et al. **(2012)**. The World Input-Output Database (WIOD): Contents, Sources and Methods. WIOD Background document available at www.wiod.org.

Wagner, J. (2011). Offshoring and Firm Performance: Self-Selection, Effects on Performance, or Both? *Review of World Economics*, 147, 217–247.

Winkler, D. and W. Milberg (2009). Errors from the “Proportionality Assumption” in the Measurement of Offshoring: Application to German Labor Demand," SCEPA Working Papers 2009-12, Schwartz Center for Economic Policy Analysis.

Winkler, D. (2010). Services Offshoring and its Impact on Productivity and Employment: Evidence from Germany. 1995-2006. *The World Economy*. 33 (12). 1672-1701.

Table 1: Output composition – internal production, domestic outsourcing, and offshoring

		1995	2008	Δ pp
Internal production	All activities	33.50	28.97	-4.53
Domestic outsourcing	Core activities	11.23	10.08	-1.15
	Non-core activities	10.92	9.62	-1.30
	Services	7.36	7.96	0.60
Offshoring	Core activities	6.41	8.94	2.53
	Non-core activities	5.27	7.12	1.85
	Services	0.64	1.07	0.43

Sources: WIOD, own calculations.
Notes: This table shows the average output composition of manufacturing industries in 1995 and in 2008 (in %), and the corresponding changes (in percentage points). Output is composed of internal production, domestically outsourced inputs, and offshored inputs. All observations are weighted by industry output.

Table 2: Output composition by country

	Internal production	Domestic outsourcing			Offshoring		
	All activities	Core	Non-core	Services	Core	Non-core	Services
Austria	-4.38	-1.78	-2.68	-0.35	5.97	2.21	-0.58
Germany	-6.19	-0.43	-2.90	-0.04	4.05	2.78	0.36
Spain	-3.93	-0.19	-0.33	0.37	1.67	1.01	0.79
Finland	-4.23	-2.05	-1.56	0.12	0.95	0.55	2.09
France	-3.85	-1.13	-0.15	1.58	1.89	1.81	0.22
United Kingdom	0.06	-4.17	-4.67	0.65	1.31	1.31	0.37
Italy	-3.48	-1.20	-1.53	1.59	1.17	0.67	0.29
Netherlands	-4.04	-0.55	-0.85	0.67	1.76	0.10	0.37
Sweden	-6.24	-2.35	-1.06	1.83	2.33	1.94	1.36

Sources: WIOD, own calculations.
This table shows country-level changes (in percentage points) in the output composition of manufacturing industries between 1995 and 2008. Output is composed of internal production, domestically outsourced inputs, and offshored inputs. All observations are weighted by industry output.

Table 3: Output composition by industry

	Internal production	Domestic sourcing			Offshoring		
	All activities	Core	Non-core	Services	Core	Non-core	Services
15-16 Food & tobacco	-1.39	-0.42	-0.33	2.03	0.84	0.68	0.44
17-18 Textiles & clothing	-3.23	-3.22	-0.84	1.98	-1.00	1.03	0.39
19 Leather	0.55	-2.37	-1.77	1.11	0.49	0.48	0.31
20 Wood	-3.81	-0.46	-0.50	-0.06	0.73	1.84	0.18
21-22 Paper & publishing	-3.06	-4.39	-0.55	1.58	-0.12	0.80	0.44
24 Chemicals	-5.35	-3.36	-1.28	0.64	3.72	1.43	0.51
25 Rubber, plastics	-4.96	-0.28	-4.21	0.84	1.03	3.19	0.37
26 Glass, ceramics	-6.20	0.94	-0.84	0.14	0.51	1.19	0.34
27-28 Metals	-5.27	-1.98	-1.08	-0.10	5.35	0.92	0.17
29 Machinery	-3.74	-0.34	-2.91	0.47	2.08	2.70	0.31
30-33 Electrical & medical	-2.48	-3.07	-1.51	0.80	1.71	2.20	1.03
34-35 Transport equipment	-7.45	1.55	-4.52	0.36	4.53	2.53	0.37
36-37 Manufacturing, nec	-2.88	1.05	-2.89	-0.26	0.38	2.17	0.20

Sources: WIOD, own calculations.

This table shows industry-level changes (in percentage points) in the output composition of manufacturing industries between 1995 and 2008. Output is composed of internal production, domestically outsourced inputs, and offshored inputs. All observations are weighted by industry output.

Table 4: United States and Western Europe

		United States			Western Europe		
		1995	2008	Δ pp	1995	2008	Δ pp
Internal production	All activities	33.14	31.89	-1.25	33.50	28.97	-4.53
Domestic outsourcing	Core activities	17.90	15.45	-2.45	14.92	14.39	-0.53
	Non-core activities	16.47	13.94	-2.53	13.89	13.00	-0.89
	Services	8.50	9.80	1.30	7.55	8.29	0.74
Offshoring	Core activities	3.34	4.61	1.27	2.72	4.63	1.91
	Non-core activities	2.92	4.20	1.28	2.30	3.74	1.44
	Services	0.45	0.60	0.15	0.45	0.74	0.29

Sources: WIOD, own calculations.
Notes: This table shows the average output composition of manufacturing industries in the United States and Western Europe in 1995 and 2008 (in %), and the corresponding changes (in percentage points). Western Europe is treated as a single market. Hence, domestic outsourcing comprises all inputs from Western European suppliers. All observations are weighted by industry output.

Table 5: Offshoring by supplier region

	Core activities		Non-core activities		Services	
	1995	2008	1995	2008	1995	2008
Western Europe	3.69	4.31	2.96	3.38	0.19	0.33
High income OECD countries	1.55	1.91	1.32	1.59	0.29	0.33
Rest of the world	1.17	2.72	0.99	2.15	0.16	0.41

Sources: WIOD, own calculations.
Notes: This table shows average offshoring intensities (in %) in 1995 and 2008, by group of supplier countries. Western European countries are excluded from the group of high-income OECD countries. Statistics are weighted by industry output.

Table 6: Share of supplier regions in total offshoring

	Core activities		Non-core activities		Services	
	1995	2008	1995	2008	1995	2008
Western Europe	57.06	47.15	56.55	48.43	31.13	32.65
High income OECD countries	22.83	19.70	24.87	21.76	48.86	32.39
Rest of the world	20.11	33.15	18.58	29.81	20.00	34.96
Sum	100.00	100.00	100.00	100.00	100.00	100.00

Sources: WIOD, own calculations.
Notes: This table shows the share of single groups of supplier countries in total offshoring (in %) in 1995 and 2008. Western European countries are excluded from the group of high-income OECD countries. Statistics are weighted by industry output.

Table7: Regression results

	Fixed effects regression				IV-FE regression	
	(1)	(2)	(3)	(4)	(5)	(6)
OffCore	0.006	0.002	-0.004	-0.004	0.011	0.008
	(0.006)	(0.004)	(0.006)	(0.006)	(0.018)	(0.015)
OffNoncore	0.034***	0.030***	0.025**	0.021*	0.070**	0.061**
	(0.011)	(0.009)	(0.011)	(0.011)	(0.030)	(0.025)
OffService	-0.022	0.034	0.051**	0.046**	0.134	0.173
	(0.069)	(0.035)	(0.020)	(0.021)	(0.229)	(0.227)
DomCore			-0.003	-0.003	-0.002	0.002
			(0.004)	(0.004)	(0.012)	(0.009)
DomNoncore			-0.009	-0.009	-0.003	-0.007
			(0.009)	(0.008)	(0.013)	(0.013)
DomService			-0.024*	-0.024*	-0.041	-0.035
			(0.012)	(0.012)	(0.053)	(0.066)
MNE_OffCore				0.000	0.013	0.021
				(0.004)	(0.012)	(0.014)
MNE_OffNoncore				0.019***	0.010	0.012
				(0.005)	(0.013)	(0.012)
MNE_OffService				0.016*	0.231***	0.123*
				(0.009)	(0.088)	(0.071)
R&D	0.023	0.022	0.021	0.021	0.009	0.012
	(0.022)	(0.019)	(0.018)	(0.018)	(0.021)	(0.017)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	–	Yes	Yes	Yes	–	Yes
Year FE	Yes	–	–	–	Yes	–
Kleibergen-Paap LM test: p-val					0.000	0.000
Kleibergen-Paap Wald test: F					60.027	97.970
Hansen J: p-val					0.093	0.095
Observations	783,827	783,827	783,827	595,685	595,685	595,685
Clusters	116	116	116	116	116	116
Adj R2	0.044	0.092	0.093	0.094	0.040	0.075

Standard errors clustered at the country-industry level in parentheses. Instrumental variables are 1) the weighted average of world offshoring in t and t-1 for each of the offshoring variables, and 2) each of these instruments interacted with the dummy for multinational activity. *** (**; *) denote significance at the one (five; ten) per cent level.

Table 8: Regression results: robustness checks

	Dependent variable:		Subsample regressions			
	Labour Productivity	TFP-FE	Non-MNEs	MNEs	Excl. ES/IT	2001-2008
OffCore	-0.002	-0.003	-0.003	-0.009	-0.018*	-0.006
	(-0.006)	(0.006)	(-0.006)	(-0.006)	(-0.01)	(-0.005)
OffNoncore	0.020*	0.022**	0.024**	0.025**	0.018	0.028**
	(-0.012)	(0.011)	(-0.011)	(-0.011)	(-0.015)	(-0.012)
OffService	0.044**	0.048**	0.048**	0.059***	0.045***	0.041**
	(-0.021)	(0.023)	(-0.023)	(-0.015)	(-0.017)	(-0.02)
DomCore	-0.002	-0.002	-0.003	-0.005	-0.012	-0.009*
	(-0.005)	(0.005)	(-0.005)	(-0.004)	(-0.007)	(-0.005)
DomNoncore	-0.007	-0.008	-0.009	-0.009	-0.012	-0.014
	(-0.009)	(0.008)	(-0.009)	(-0.008)	(-0.014)	(-0.011)
DomService	-0.021*	-0.024*	-0.025*	-0.018	-0.027	-0.035***
	(-0.013)	(0.012)	(-0.013)	(-0.012)	(-0.016)	(-0.011)
MNE_OffCore	-0.001	-0.003			0.001	0.000
	(-0.004)	(0.003)			(-0.003)	(-0.005)
MNE_OffNoncore	0.017***	0.011***			0.013**	0.018***
	(-0.005)	(0.004)			(-0.005)	(-0.005)
MNE_OffService	0.011	0.007			0.015	0.015
	(-0.009)	(0.009)			(-0.009)	(-0.01)
R&D	0.021	0.019	0.022	0.021	0.028	-0.001
	(-0.018)	(0.017)	(-0.019)	(-0.018)	(-0.021)	(-0.011)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	783,827	776,544	650,534	133,293	260,387	626,428
Clusters	116	116	116	115	90	116
Adj R2	0.091	0.115	0.093	0.102	0.188	0.098

The dependent variable labour productivity in column (1) is defined as value added per employee. The dependent variable TFP-FE in column (2) is a measure of total factor productivity derived from first-stage TFP regressions that include firm fixed effects. In column (3) to (6) the empirical model is estimated on different subsamples: the group of non-multinational firms (column 3), the group of multinational firms (column 4), firms in all countries except for Spain and Italy (column 5), and all firmyears between 2001 and 2008 (column 6). Standard errors clustered at the country-industry level in parentheses.. *** (**; *) denote significance at the one (five; ten) per cent level.

Table 9: Regression results: offshoring by supplier regions

	TFP	
	(1)	(2)
HighCore	-0.008	-0.007
	(0.007)	(0.007)
HighNoncore	0.003	0.001
	(0.005)	(0.005)
HighService	-0.006	-0.010
	(0.016)	(0.018)
LowCore	0.018	0.015
	(0.011)	(0.011)
LowNoncore	0.061***	0.060***
	(0.023)	(0.023)
LowService	0.091***	0.092***
	(0.017)	(0.018)
DomCore	-0.001	-0.001
	(0.003)	(0.003)
DomNoncore	-0.006	-0.006
	(0.009)	(0.009)
DomService	-0.012	-0.011
	(0.012)	(0.012)
MNE_HighCore		-0.004
		(0.004)
MNE_HighNoncore		0.011**
		(0.004)
MNE_HighService		0.010
		(0.010)
MNE_LowCore		0.022**
		(0.009)
MNE_LowNoncore		0.000
		(0.014)
MNE_LowService		-0.013
		(0.013)
R&D	0.020	0.019
	(0.018)	(0.017)
Firm FE	Yes	Yes
Country-Year FE	Yes	Yes
Observations	750,516	750,516
Clusters	104	104
Adj R2	0.095	0.096

Offshoring is distinguished into offshoring from high-wage countries (HighCore, HighNoncore, HighService) and offshoring from low-wage countries (LowCore, LowNoncore, LowService). The group of high-wage countries comprises the nine European countries under analysis in this study, as well as further European and non-European high-wage countries. Standard errors clustered at the country-industry level in parentheses.. *** (**; *) denote significance at the one (five; ten) per cent level.

Appendix 1

Table 10: Total factor productivity estimations

NACE Code	Industry	Labour		Capital		Obs	R2
		β	SE	β	SE		
151	Production, processing, preserving of meat and meat products	0.801***	(0.003)	0.175***	(0.003)	22,839	0.89
152	Processing and preserving of fish and fish products	0.721***	(0.009)	0.196***	(0.007)	4,143	0.85
153	Processing and preserving of fruit and vegetables	0.674***	(0.008)	0.257***	(0.007)	7,755	0.86
154	Vegetable and animal oils and fats	0.878***	(0.012)	0.212***	(0.01)	3,247	0.83
155	Dairy products	0.811***	(0.006)	0.199***	(0.005)	9,062	0.92
156	Grain mill products, starches and starch products	0.812***	(0.009)	0.221***	(0.006)	4,837	0.89
157	Prepared animal feeds	0.861***	(0.008)	0.162***	(0.006)	6,778	0.89
158	Other food products	0.733***	(0.004)	0.253***	(0.003)	30,095	0.88
159	Beverages	0.856***	(0.006)	0.198***	(0.005)	15,245	0.86
160	Tobacco products	0.816***	(0.049)	0.364***	(0.037)	379	0.88
171	Preparation and spinning of textile fibres	0.777***	(0.008)	0.120***	(0.005)	7,063	0.86
172	Textile weaving	0.793***	(0.007)	0.107***	(0.005)	8,393	0.85
173	Finishing of textiles	0.764***	(0.012)	0.146***	(0.006)	5,211	0.83
174	Made-up textile articles, except apparel	0.785***	(0.009)	0.100***	(0.006)	4,202	0.84
175	Other textiles	0.832***	(0.008)	0.147***	(0.005)	6,664	0.86
176	Knitted and crocheted fabrics	0.757***	(0.017)	0.124***	(0.012)	1,475	0.78
177	Knitted and crocheted articles	0.758***	(0.009)	0.124***	(0.006)	4,680	0.85
181	Leather clothes	0.816***	(0.023)	0.098***	(0.016)	661	0.82
182	Other wearing apparel and accessories	0.746***	(0.004)	0.161***	(0.003)	21,617	0.78
183	Dressing and dyeing of fur; articles of fur	0.663***	(0.034)	0.089***	(0.02)	527	0.62
191	Tanning and dressing of leather	0.768***	(0.009)	0.119***	(0.005)	4,888	0.85
192	Luggage, handbags and the like, saddler	0.740***	(0.011)	0.160***	(0.007)	3,098	0.82
193	Footwear	0.736***	(0.006)	0.212***	(0.003)	11,000	0.83
201	Sawmilling and planing of wood; impregnation of wood	0.779***	(0.006)	0.175***	(0.004)	10,843	0.83
202	Veneer sheets; panels and boards	0.843***	(0.011)	0.190***	(0.006)	3,068	0.90
203	Builders, carpentry and joinery	0.874***	(0.006)	0.107***	(0.004)	12,282	0.86
204	Wooden containers	0.862***	(0.01)	0.086***	(0.006)	5,500	0.77
205	Other products of wood, cork, straw and plaiting materials	0.755***	(0.009)	0.163***	(0.006)	5,386	0.83
211	Pulp, paper and paperboard	0.819***	(0.01)	0.231***	(0.007)	4,980	0.93
212	Articles of paper and paperboard	0.846***	(0.005)	0.142***	(0.003)	16,957	0.90
221	Publishing	0.870***	(0.005)	0.101***	(0.003)	19,919	0.83
222	Printing and service activities related to printing	0.863***	(0.004)	0.120***	(0.002)	33,389	0.87
223	Reproduction of recorded media	0.812***	(0.033)	0.117***	(0.022)	470	0.81
241	Basic chemicals	0.833***	(0.007)	0.190***	(0.005)	13,717	0.89
242	Pesticides and other agro-chemical products	1.086***	(0.027)	0.052***	(0.017)	849	0.91
243	Paints, varnishes and similar coatings	0.920***	(0.009)	0.112***	(0.006)	6,495	0.89
244	Pharmaceuticals, medicinal chemicals and botanical products	0.999***	(0.008)	0.040***	(0.006)	8,054	0.88
245	Soap and detergents, cleaning, perfumes and toilet preparations	0.899***	(0.009)	0.139***	(0.006)	7,429	0.88
246	Other chemical products	0.841***	(0.008)	0.158***	(0.005)	9,142	0.88
247	Man-made fibers	0.771***	(0.032)	0.189***	(0.023)	659	0.89
251	Rubber products	0.850***	(0.007)	0.132***	(0.005)	7,344	0.91
252	Plastic products	0.843***	(0.003)	0.139***	(0.002)	45,457	0.88
261	Glass and glass products	0.823***	(0.008)	0.206***	(0.005)	7,397	0.92
262	Non-refractory ceramic goods	0.785***	(0.01)	0.192***	(0.007)	4,152	0.89
263	Ceramic tiles and flags	0.800***	(0.017)	0.196***	(0.011)	2,153	0.92
264	Bricks, tiles and construction products, in baked clay	0.808***	(0.012)	0.204***	(0.008)	4,489	0.86
265	Cement, lime and plaster	0.773***	(0.02)	0.334***	(0.012)	2,242	0.90
266	Articles of concrete, plaster and cement	0.763***	(0.005)	0.196***	(0.003)	22,291	0.84
267	Ornamental and building stone	0.716***	(0.008)	0.173***	(0.004)	8,013	0.78
268	Other non-metallic mineral products	0.672***	(0.008)	0.235***	(0.006)	3,528	0.88

NACE Code	Industry	Labour β	Labour SE	Capital β	Capital SE	Obs	R2
271	Basic iron and steel and of ferro-alloys	0.782***	(0.012)	0.220***	(0.008)	4,093	0.92
272	Tubes	0.853***	(0.012)	0.131***	(0.008)	2,789	0.91
273	Other first processing of iron and steel	0.836***	(0.01)	0.164***	(0.007)	3,570	0.90
274	Basic precious and non-ferrous metals	0.801***	(0.012)	0.177***	(0.008)	5,151	0.90
275	Casting of metals	0.834***	(0.006)	0.139***	(0.004)	8,117	0.92
281	Structural metal products	0.859***	(0.003)	0.138***	(0.002)	47,397	0.83
282	Tanks, reservoirs and containers of metal	0.838***	(0.009)	0.144***	(0.005)	5,078	0.87
283	Steam generators, except central heating hot water boilers	0.979***	(0.03)	0.0268	(0.018)	346	0.93
284	Forging, pressing, stamping and roll forming of metal	0.806***	(0.005)	0.160***	(0.003)	12,777	0.89
285	Treatment metals; general mechanical engineering	0.837***	(0.003)	0.115***	(0.002)	52,991	0.87
286	Cutlery, tools and general hardware	0.860***	(0.006)	0.119***	(0.004)	10,624	0.89
287	Other fabricated metal products	0.848***	(0.004)	0.141***	(0.002)	30,356	0.89
291	Machinery for mechanical power	0.905***	(0.005)	0.094***	(0.003)	16,495	0.92
292	Other general purpose machinery	0.900***	(0.003)	0.0773***	(0.002)	50,723	0.88
293	Agricultural and forestry machinery	0.892***	(0.008)	0.111***	(0.005)	6,464	0.89
294	Machine-tools	0.870***	(0.006)	0.099***	(0.004)	10,165	0.89
295	Other special purpose machinery	0.896***	(0.004)	0.094***	(0.002)	28,363	0.89
296	Weapons and ammunition	0.983***	(0.024)	0.085***	(0.016)	710	0.93
297	Domestic appliances n.e.c.	0.891***	(0.012)	0.097***	(0.008)	3,617	0.91
300	Office machinery and computers	0.947***	(0.012)	0.079***	(0.009)	4,105	0.81
311	Electric motors, generators and transformers	0.876***	(0.01)	0.110***	(0.007)	5,760	0.85
312	Electricity distribution and control apparatus	0.860***	(0.01)	0.107***	(0.007)	5,808	0.85
313	Insulated wire and cable	0.893***	(0.015)	0.105***	(0.011)	2,443	0.87
314	Accumulators, primary cells and primary batteries	0.856***	(0.03)	0.119***	(0.021)	411	0.93
315	Lighting equipment and electric lamps	0.810***	(0.012)	0.131***	(0.008)	4,660	0.82
316	Electrical equipment n.e.c.	0.834***	(0.006)	0.126***	(0.004)	15,548	0.86
321	Electronic valves and tubes; other electronic components	0.917***	(0.01)	0.085***	(0.007)	6,793	0.81
322	Television and radio transmitters; apparatus for telephony	0.934***	(0.013)	0.074***	(0.009)	4,279	0.83
323	Television and radio receivers, sound or video recording	0.971***	(0.025)	-0.011	(0.016)	1,354	0.77
331	Medical and surgical equipment	0.831***	(0.008)	0.138***	(0.005)	8,238	0.87
332	Instruments for measuring, checking, testing, navigating	0.934***	(0.006)	0.066***	(0.004)	9,118	0.90
333	Industrial process control equipment	0.890***	(0.015)	0.091***	(0.009)	1,567	0.86
334	Optical instruments and photographic equipment	0.909***	(0.015)	0.064***	(0.011)	2,013	0.88
335	Watches and clocks	0.825***	(0.033)	0.060***	(0.018)	491	0.84
341	Motor vehicles	0.859***	(0.015)	0.150***	(0.011)	2,447	0.96
342	Bodies for motor vehicles; trailers and semi-trailers	0.850***	(0.008)	0.126***	(0.005)	6,810	0.87
343	Parts and accessories for motor vehicles and engines	0.815***	(0.006)	0.152***	(0.005)	9,980	0.91
351	Building and repairing of ships and boats	0.816***	(0.007)	0.156***	(0.005)	6,774	0.87
352	Railway and tramway locomotives and rolling stock	0.900***	(0.021)	0.089***	(0.014)	1,313	0.91
353	Aircraft and spacecraft	0.991***	(0.012)	0.061***	(0.009)	2,117	0.94
354	Motorcycles and bicycles	0.816***	(0.015)	0.132***	(0.011)	1,649	0.90
355	Other transport equipment n.e.c.	0.952***	(0.021)	0.076***	(0.013)	845	0.89
361	Furniture	0.827***	(0.004)	0.125***	(0.002)	34,876	0.86
362	Jewellery and related articles	0.832***	(0.01)	0.101***	(0.006)	4,423	0.82
363	Musical instruments	0.811***	(0.041)	0.103***	(0.019)	410	0.81
364	Sports goods	0.837***	(0.017)	0.117***	(0.011)	1,605	0.86
365	Games and toys	0.766***	(0.019)	0.155***	(0.012)	1,529	0.81
366	Miscellaneous manufacturing n.e.c.	0.812***	(0.006)	0.136***	(0.004)	10,612	0.88

Source: Amadeus, own calculations.

Notes: This table shows the results from the TFP regressions, according to equation 3. NACE industries 23 and 37 are excluded due to lack of observations. Robust standard errors in parentheses. *** denotes significance at the one per cent level.

Table 11: Average performance by country

Country	TFP	VA/L	L	K (th. €)	VA (th. €)	Obs
Austria	9.7	82,751	356	21,439	28,145	573
Germany	9.8	68,359	414	16,935	39,059	26,674
Spain	9.0	41,262	57	2,707	2,862	205,811
Finland	9.5	55,475	68	4,633	4,833	26,179
France	9.6	58,051	128	4,416	8,813	110,152
United Kingdom	9.5	53,628	56	2,589	3,169	311,267
Italy	9.7	77,023	137	10,424	12,774	5,725
Netherlands	9.6	55,904	50	2,669	3,333	51,635
Sweden	9.6	64,961	301	18,348	22,213	29,687

Source: Amadeus, own calculations.
Notes: This table shows the average performance of firms by country.

Table 12: Performance statistics by industry

Nace	Industry	TFP	VA / L	L	K (th. €)	VA (th. €)	Obs
15-16	Food & tobacco	8.4	50,972	88	5,144	5,275	87,694
17-18	Textiles & clothing	9.6	44,705	59	1,566	2,501	51,468
19	Leather	9.0	38,252	42	858	1,559	16,887
20	Wood	9.3	43,927	43	1,979	1,948	31,707
21-22	Paper & publishing	9.6	58,095	80	4,891	5,774	63,650
24	Chemicals	9.5	76,387	152	12,846	16,125	38,678
25	Rubber, plastics	9.4	51,840	83	3,246	4,552	44,055
26	Glass, ceramics	8.7	54,451	75	4,575	4,804	48,569
27-28	Metals	9.4	47,193	63	2,550	3,387	154,724
29	Machinery	10.0	53,811	79	2,050	4,706	98,785
30-33	Electrical & medical	10.0	64,368	139	4,499	12,691	61,655
34-35	Transport equipment	9.5	51,809	346	16,941	24,473	27,645
36-37	Manufacturing, nec	9.5	41,473	48	1,228	1,964	42,186

Source: Amadeus, own calculations.
Notes: This table shows the average performance of firms by industry.

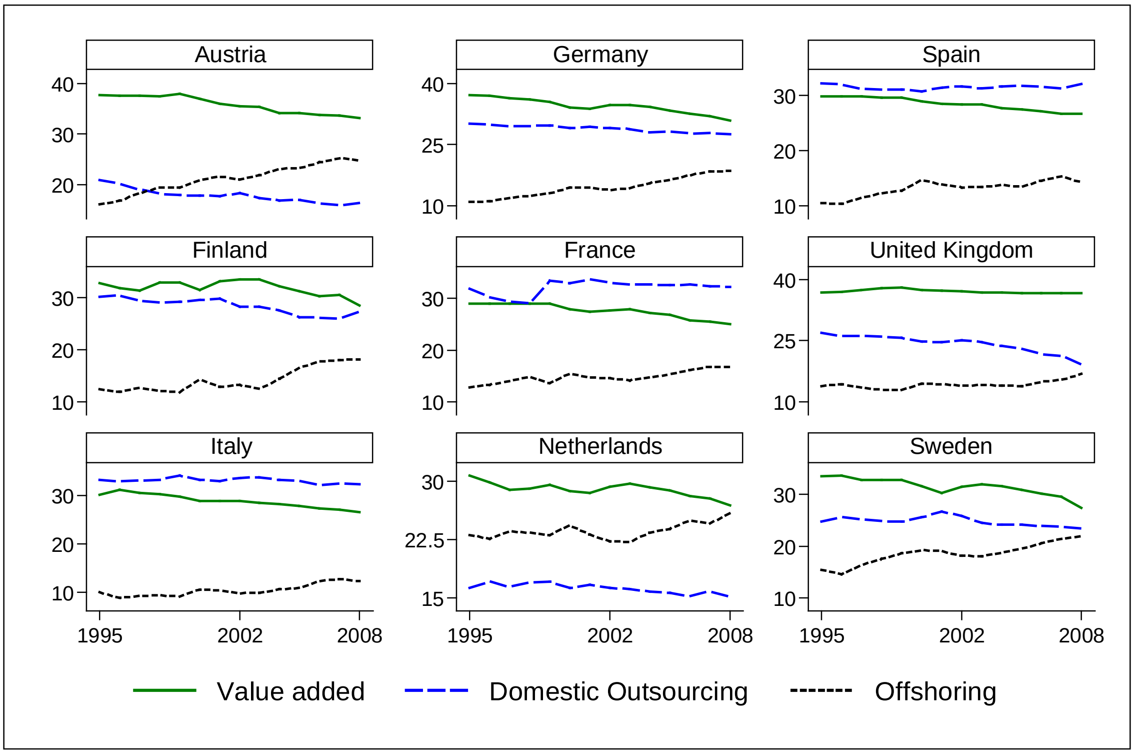
Table 13: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Domestic outsourcing of core activities	1,638	8.3685	6.0138	0.0000	27.5141
Domestic outsourcing of non-core activities	1,638	9.7234	5.9132	1.6447	33.2059
Domestic outsourcing of services	1,638	6.9131	2.4848	1.8647	18.5390
Offshoring of core activities	1,638	7.0806	5.2949	0.4293	30.2627
Offshoring of non-core activities	1,638	7.1008	4.3804	1.2870	27.8508
Offshoring of services	1,638	1.3590	1.3478	0.1547	12.0276
Value added	783,827	14.1159	1.3387	11.5129	24.1152
Employees	783,827	3.4074	1.2369	1.6094	12.4783
Tangible capital	783,827	13.2296	1.8413	8.5171	22.9413
Total factor productivity	783,827	9.3979	0.7324	2.7403	13.3466
MNE dummy	783,827	0.1701	0.3757	0	1

Sources: WIOD, Amadeus, own calculations.

Appendix 2

Figure 1: Output composition by country



Sources: WIOD, own calculations.

Figure 2: Material offshoring by country

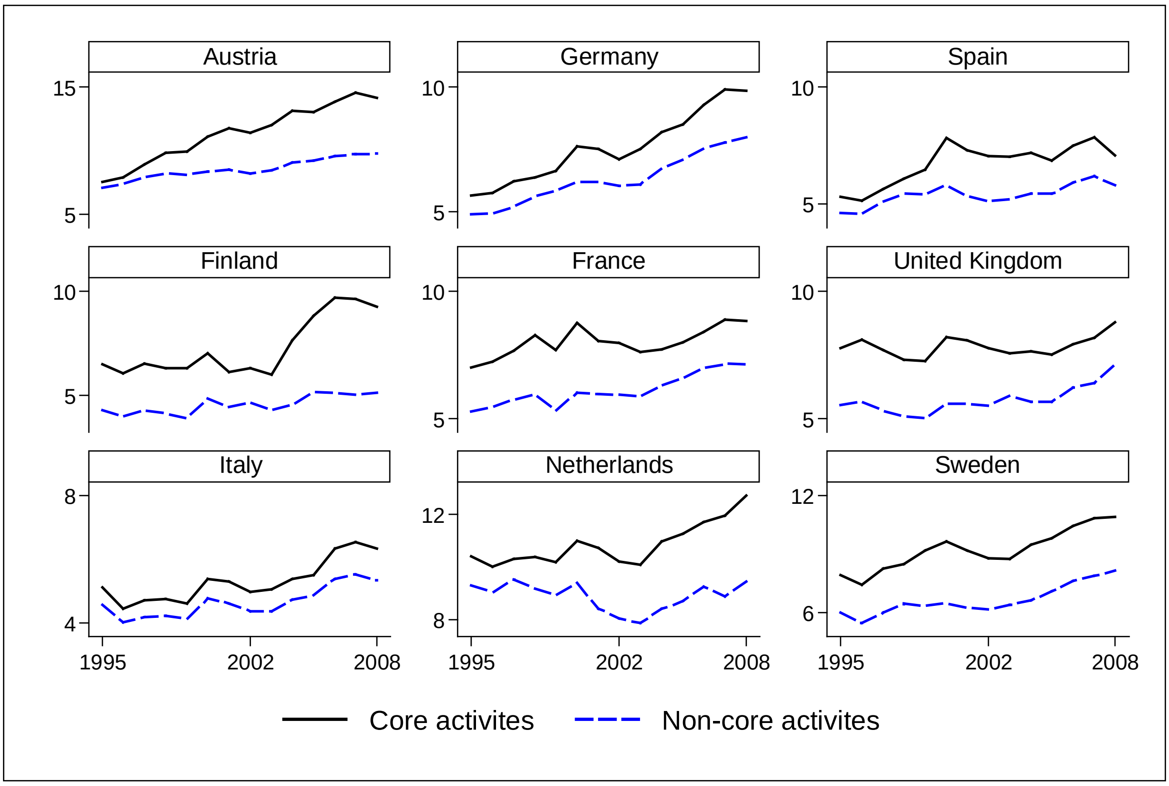


Figure 3: Service offshoring by country

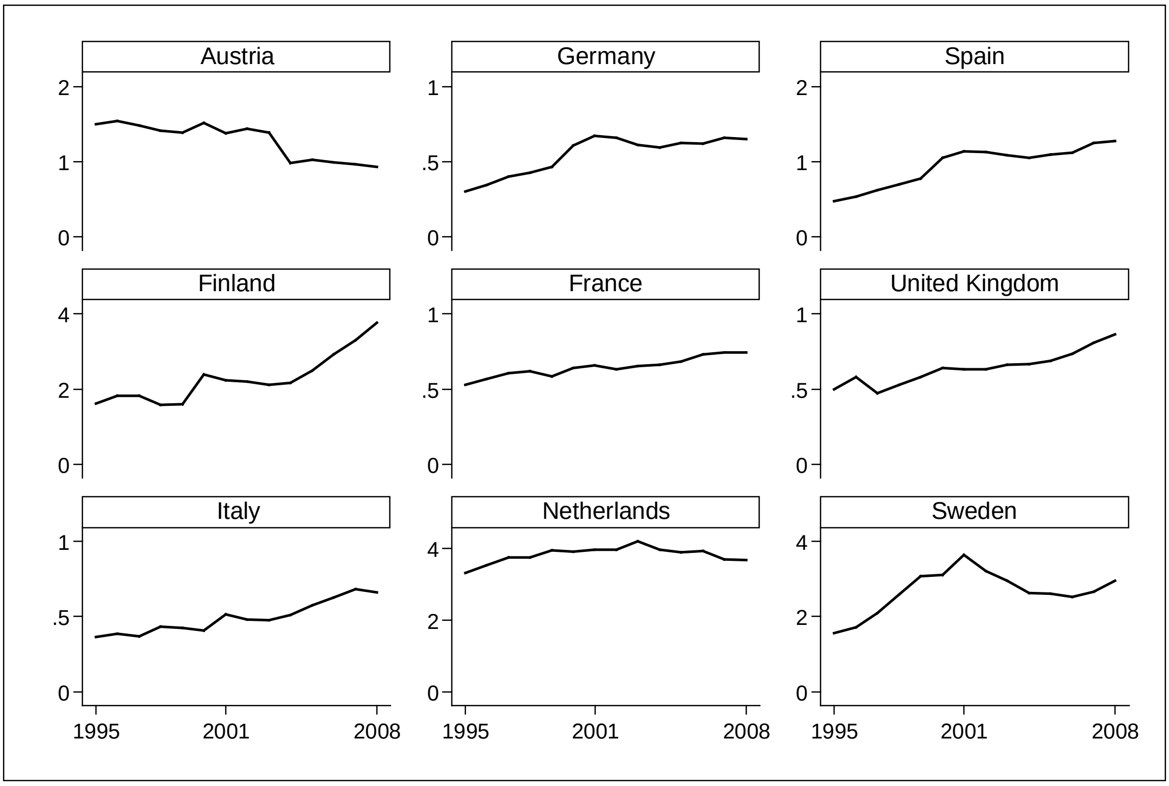
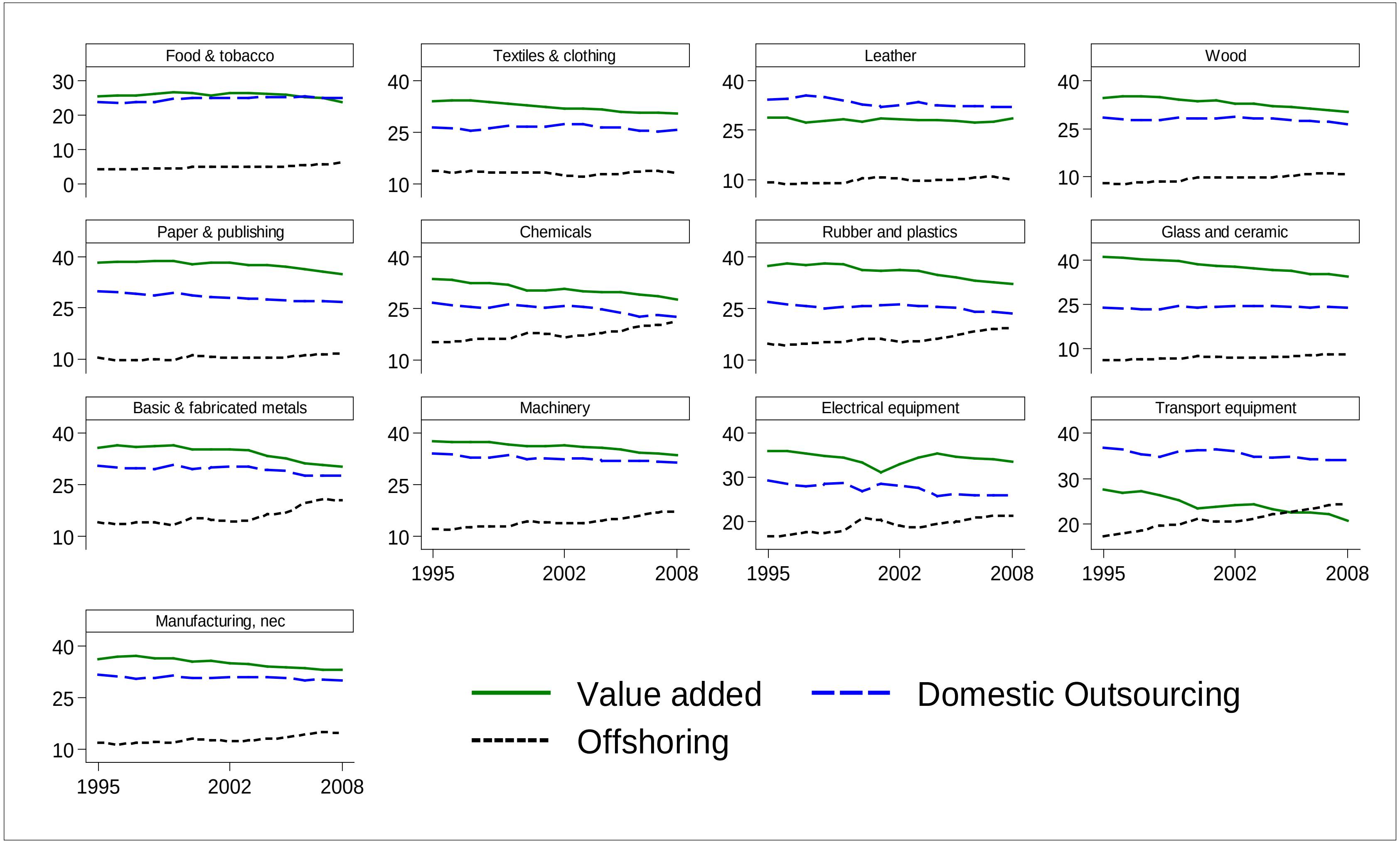


Figure 4: Output composition by industry



Sources: WIOD, own calculations.

Appendix 3: Data sources

Table 13: Data sources

Variable	Data source
Offshoring	World Input Output Database
R&D expenditures	ANBERD
Firm-level variables	Amadeus
Price deflators	EU KLEMS; STAN
Exchange rates	EUROSTAT