

# **Service Offshoring and Productivity in Western Europe**

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## **Abstract**

Using comparable industry-level data for nine Western European countries, this paper finds that the international relocation of service activities (service offshoring) exerts positive and economically large effects on domestic productivity. A one percentage point increase in the proxy for service offshoring (i.e., the share of imported private services in total non-energy input purchases) is found to raise Total Factor Productivity by about 0.5%.

**JEL Codes:** F1.

**Keywords:** Service Offshoring; Total Factor Productivity.

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## 1. Introduction

The recent improvements in information and communication technologies have eased the tradability of services across national borders and offered firms the opportunity to relocate an increasing number of service tasks in foreign countries (Freund and Weinhold, 2002; Unctad, 2004). In both the U.S. and Western Europe (WE), a vivacious debate has developed over the possible consequences of this phenomenon (known as *service offshoring*) for the domestic economy.<sup>1</sup> A growing number of empirical studies have contributed to this debate, by analyzing the effects of service offshoring on the level and growth of domestic productivity. These studies generally show that the effects are positive and potentially large.<sup>2</sup> However, the analyses on WE have insofar focused on a small number of countries and used very different data, methodologies and proxies for service offshoring. As a consequence, it may be difficult to assess whether their results extend to the region as a whole, as well as to draw definite conclusions on the strength of the effects of service offshoring. In this paper, I attempt to move in that direction, by using comparable data to study the impact of service offshoring on the productivity levels of nine Western European economies, which account for about 75% of the EU25 population.

I match the EUKLEMS data on output and inputs for twenty industries with a proxy for service offshoring, defined as the share of imported private services in total non-energy input purchases.<sup>3</sup> Then, I estimate a production function allowing service offshoring to affect Total Factor Productivity (TFP). I find that service offshoring exerts positive effects on TFP, and that these effects are economically relevant: in particular, a one percentage point increase in the proxy for service offshoring raises TFP by about 0.5 percent.

During the analysis, I attempt to address a number of issues that may affect the reliability of my estimates. Specifically, I control that the results are not spuriously driven by other factors that correlate with service offshoring and TFP. I also check that the estimates are robust to the relaxation of some of the most restrictive assumptions underlying my proxy for service offshoring. Moreover, I use Instrumental Variables (IV) to account for the possible endogeneity of service offshoring, and finally, I control for persistency in the dependent variable of my empirical model (real output), by means of a GMM estimator for dynamic panel data. Results are robust with respect to any of these sensitivity tests.

I interpret my findings as reflecting four channels through which service offshoring affects domestic productivity (Amiti and Wei, 2006), and which I am not able to distinguish with the data at hand. First, service offshoring may trigger a positive change in the composition of activities, whereby the least efficient tasks are transferred to third countries, while the most efficient ones are kept domestically. Second, service offshoring may allow firms to restructure and rationalize their production processes. Third, it may enlarge the number of varieties of service inputs available to the firms. Fourth, it may trigger a learning process (“learning-by-offshoring”) whereby firms develop more efficient ways of producing services by looking at how they are produced abroad.

## **2. Data and Empirical Model**

I use a panel of twenty manufacturing and service industries for nine Western European countries between 1990 and 2004.<sup>4</sup> From the EUKLEMS data set (Timmer *et al.*, 2007), I retrieve comparable data on gross output ( $Y$ ), intermediate inputs ( $M$ ), number of

worked hours ( $L$ ) and capital compensation ( $K$ ). I also retrieve country-industry-specific deflators for all nominal variables, and PPP exchange rates.

I match these data with a proxy for service offshoring, defined as the share of imported private services in total non-energy input purchases ( $SOS$ ). The idea underlying this measure is that the input share of imported services should be higher the more intense is service offshoring, because the service activities relocated abroad have to be imported back in WE to enter the production process together with other inputs. To construct  $SOS$ , I use two sources of data: 1) the Eurostat Import Matrixes for the years 1995 and 2000, which contain detailed information on service (and material) imports for each industry in each country; 2) the Eurostat data on economy-wide imports of six categories of private services: communication, insurance, finance, computer and information, royalties and license fees, other business services.<sup>5</sup> Exploiting the Import Matrixes, I attribute to each industry in any given country a constant share of the total imports of these six service categories. Denoting services by  $s$ , countries by  $c$ , industries by  $i$  and years by  $t$ , the expression for  $SOS$  is:

$$SOS_{c,i,t} = \frac{\sum_{s=1}^6 \bar{\theta}_{c,i,s} * M_{c,s,t}}{NE_{c,i,t}} \quad (1.1)$$

where  $\bar{\theta} \equiv (\theta^{95} + \theta^{00})/2$  is the average share of each industry in the economy-wide imports of each service (denoted by  $M$ ), and  $NE$  is total (i.e., domestic plus foreign) purchases of non-energy inputs. Because the Import Matrixes are all based on the ESA-95 System of Accounts, the values of  $SOS$  are comparable across countries.

This indicator may suffer from two limitations. The first is due to the assumption that the time variability of service imports at the industry-level (i.e., the numerator of (1.1)) only comes from that of the economy-wide service imports. The second is due to the use of non-energy inputs at the denominator of the formula, which may lead to an underestimation of the change in service offshoring when the industry substitutes its own service production with foreign purchases: in this case, in fact, both the numerator and the denominator of (1.1) will increase by the same amount, and their ratio will not change.<sup>6</sup> I will test the robustness of my results by using alternative indicators that overcome these limitations.

Descriptive statistics on *SOS* are reported in Appendix Table A1. The indicator averages at 3% over the whole sample and has increased by 0.4 percentage points between 1990 and 2004 (from 2.8% to 3.2%). Across the nine countries, the average value of *SOS* ranges from 0.9% (France) to 15% (Austria) and has increased everywhere except in Austria and Finland.

Turning to the empirical model, I assume that the representative firm in each country and industry has the following Cobb-Douglas production function:

$$\ln Y_{c,i,t} = \ln A_{c,i,t} + \beta_K \ln K_{c,i,t} + \beta_M \ln M_{c,i,t} + \beta_L \ln L_{c,i,t} \quad (1.2)$$

where  $A$ , the technology parameter or TFP, has the following expression:

$$\ln A_{c,i,t} = \beta_{c,i} + \beta_{SOS} SOS_{c,i,t} + \beta' \Omega_{c,i,t} + u_{c,i,t} \quad (1.3)$$

with  $\beta_{c,i}$  being a country-industry fixed-effect,  $\Omega$  a vector of control variables and  $u$  a white-noise disturbance.<sup>7</sup> Substituting (1.3) into (1.2) yields the following estimating equation:

$$\ln Y_{c,i,t} = \beta_{c,i} + \beta_K \ln K_{c,i,t} + \beta_M \ln M_{c,i,t} + \beta_L \ln L_{c,i,t} + \beta_{SOS} SOS_{c,i,t} + \beta' \Omega_{c,i,t} + u_{c,i,t} \quad (1.4)$$

If  $\beta_{SOS} > 0$ , service offshoring exerts positive effects on TFP.

### 3. Results

Table 1 reports the baseline results. Starting from column (1), the input coefficients are all positive and very precisely estimated. More importantly, the coefficient on *SOS* is positive, large and statistically significant at the 1% level. The same picture emerges from column (2), where I add a full set of time dummies to account for macroeconomic shocks that are constant across countries and industries. Notice that the coefficient on *SOS* remains positive, highly significant and large, despite a slight reduction as compared to the previous specification.

These results are consistent with the existence of positive productivity effects from service offshoring in WE, but may be spuriously driven by other factors that correlate with *SOS* and TFP. Among them, the existing literature usually cites technical progress and the offshoring of intermediate inputs (*material offshoring*). Material offshoring may raise productivity for essentially the same reasons as those applying to service offshoring. Technical progress may instead free up firms from a large number of low value-added activities and allow them to concentrate their inputs on the other tasks, thereby boosting TFP. At the same time, both factors may be correlated with service offshoring, because better technologies ease the coordination of service activities across national borders, while the local presence in foreign countries can be exploited to source services and intermediates jointly.

In column (3), I therefore control for a proxy of material offshoring (*MOS*) and for a proxy of technical progress (*ICT*). *MOS* is the share of imported intermediate inputs in total non-energy input purchases, and is constructed like *SOS* using the economy-wide data on commodity imports from STAN (OECD). *ICT* is the share of information and communication technologies in total capital compensation (Berman *et al.*, 1994) and is drawn from EUKLEMS. The coefficients on *MOS* and *ICT* have the expected positive sign and are both statistically significant at conventional levels. Notice, however, that the inclusion of these variables does not alter the main evidence on service offshoring. In fact, the coefficient on *SOS* remains positive and highly significant, and shows very little change in its absolute size as compared to column (2).<sup>8</sup>

Overall, the baseline results provide *prima facie* evidence that service offshoring exerts positive effects on productivity in WE. However, a number of drawbacks may raise concerns about the reliability and robustness of these estimates. I now turn to address some of these issues.

I start by checking that my findings are not driven by the two restrictive assumptions underlying *SOS*. In column (1) of Table 2, I use real output at the denominator of (1.1), in order to mitigate the underestimation of service offshoring implied by the use of non-energy inputs.<sup>9</sup> The main results are virtually unaffected. In fact, the input coefficients remain positive and highly significant, likewise those on material offshoring and technical progress. More importantly, the coefficient on *SOS* is still positive and very precisely estimated; it is also remarkably close in size to the estimate reported in column (3) of Table 1.

In column (2), I replace the numerator of (1.1) with the official data on industry-level service imports, available only for 1995 and 2000 in the Import Matrixes. By doing so, I check the robustness of results with respect to the second assumption underlying *SOS*, namely that each industry always accounts for a constant share of the economy-wide service imports. The number of observations drops substantially, so that some of the coefficients are less precisely estimated. Nevertheless, the evidence on service offshoring is preserved. Overall, this suggests that my findings are not entirely driven by the main issues involved in the construction of *SOS*.

I now deal with the second major drawback of my baseline results. It is well understood that OLS estimates may be upward biased, due to the potential endogeneity of service offshoring in specifications like (1.4). In fact, more productive firms may be better able to coordinate their overseas activities and may thus resort more heavily to service offshoring, thereby leading to an upward bias in the coefficient on *SOS*. To account for this issue, I use an IV approach. Finding exogenous instruments for *SOS* has very often proven a hard task, and therefore most of the previous literature has used predetermined variables to this purpose. I follow this approach and use the first three lags of *SOS* as instruments.

Column (3) reports the Two-Stage Least Squares (2SLS) results. The high  $p$ -value of the Hansen  $J$ -statistic points against the endogeneity of my instruments, while the high values of the Cragg-Donald and  $F$  statistics suggest that my instruments are also relevant. The main pattern of results is unchanged. In particular, notice that the coefficient on *SOS* remains positive and highly significant. As compared to Table 1 (column (3)), the point estimate is slightly lower, suggesting that OLS results are indeed upward biased. A very similar picture emerges from column (4) of Table 2, where I instrument all of the



explanatory variables with their first three lags, in order to account also for the possible endogeneity of material offshoring and technical progress, and more importantly, for the bias of the input coefficients induced by the simultaneity between input and output choices.

Finally, in column (5) I allow for some persistency in the dependent variable of my model, by using the two-step GMM estimator for dynamic panel data developed by Arellano and Bond (1991). My instruments include the second to fifth lags of the dependent variable and the first three lags of all the regressors. The  $p$ -values of the Hansen  $J$ -statistic for over-identifying restrictions and of the test for second-order residuals autocorrelation are both high. As expected, the coefficient on lagged real output is positive and significant, while the input coefficients substantially drop, and some of them are no longer precisely estimated; similarly, the coefficient on *ICT* becomes now insignificant. Remarkably, however, the main evidence on service offshoring is preserved.

I close by dealing with the third drawback of the baseline results, namely the fact that they do not allow for cross-country heterogeneity in the productivity effects of service offshoring. I relax this restriction in Table 3. In panel a), I re-estimate equation (1.4) by excluding one country at the time. The coefficient on *SOS* is always positive and precisely estimated, suggesting that the baseline results are not driven by any specific country in my sample. In panel b), I instead re-estimate (1.4) separately on each country. I find that the coefficient on *SOS* is always positive, and is statistically significant in seven out of nine cases. Hence, the positive productivity effects of service offshoring are widespread across all of the economies analyzed.<sup>10</sup>

#### **4. Conclusion**

Using comparable data for nine Western European countries, I found that service offshoring exerts positive and robust effects on domestic productivity. According to the IV estimates reported in Table 2, a one percentage point increase in my proxy for service offshoring raises TFP by about 0.5%: hence, the effects are also economically relevant. It is therefore reasonable to expect that, if service offshoring continues to rise in the near future (as it seems to be the case, given the ongoing improvements in information and communication technologies), it will give an important boost to domestic productivity in WE.

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## Endnotes

<sup>1</sup> For a summary, see Bhagwati *et al.* (2004), Samuelson (2004), Blinder (2006) and Mankiw and Swagel (2006).

<sup>2</sup> See, among others, Mann (2003), Gorg and Hanley (2005), Amiti and Wei (2006), Daveri and Jona-Lasinio (2008) and Gorg *et al.* (2008), as well as Olsen (2006) for an updated survey.

<sup>3</sup> This proxy has been first introduced by Amiti and Wei (2006), who extended to services the indicator developed by Feenstra and Hanson (1999) to measure the offshoring of intermediate inputs. Nowadays, these indicators are extensively used in empirical applications; see, for instance, Minondo and Rubert (2006), as well as Crinò (2008) for a recent survey.

<sup>4</sup> The countries are: Austria, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, UK. The industries are: Food, beverages and tobacco (NACE 15-16); Textile, leather and footwear (17-19); Wood and cork (20); Pulp, paper, printing and publishing (21-22); Coke, refined petroleum and nuclear fuel (23); Chemicals (24); Rubber and plastics (25); Other non-metallic mineral products (26); Basic metals and fabricated metal products (27-28); Machinery, nec (29); Electrical and optical equipment (30-33); Transportation equipment (34-35); Manufacturing, nec (36-37); Wholesale and retail, motor vehicles (50); Wholesale, except motor vehicles (51); Retail, except motor vehicles (52); Transportation and storage (60-62); Post and telecommunication (64); Real estate (70); Other business activities (71-74). The choice of industries is imposed by the matching between the proxy for service offshoring and the other variables; the coverage of the sample is however high, as these 20 industries account for more than 75% of private sector employment in each country (Crinò, 2007).

<sup>5</sup> These data include both affiliated and unaffiliated transactions.

<sup>6</sup> See Horgos (2007) for a deeper discussion of measurement issues.

<sup>7</sup> *SOS* is not in logarithms because it is already expressed in percentages.

<sup>8</sup> There may be other factors correlated with service offshoring and TFP. One is import penetration, usually proxied by the ratio of imports and industry output. Unfortunately, I cannot control for its effects, because import data are generally unavailable for the service industries included in my sample. However, Amiti and Wei (2006) find that adding this variable to the specification has typically no effect on the coefficient on service offshoring.

<sup>9</sup> See, in particular, Hijzen *et al.* (2005) for the use of this alternative normalization.

<sup>10</sup> I have performed other sensitivity tests, which are available upon request. In particular, I have: computed *SOS* separately for each of the six private service categories, to account for possible heterogeneity in the effects of service offshoring depending on the type of activities relocated abroad; estimated the production function with value added, rather than output, as the dependent variable (omitting intermediate inputs from the regressors); included linear and quadratic time trends in the specification, to account for uneven productivity growth across industries and countries; used the number of employees instead of the number of worked hours as a proxy for labor; distinguished labor in three skill groups, and intermediate inputs in materials, services and energy; proxied capital with its total stock, rather than its compensation; controlled for outliers. The main results have always proven robust.

**Table 1 - Baseline Results**Dependent Variable: Log of Real Output (*ln Y*)

	<i>Baseline</i>	<i>Adding time dummies</i>	<i>Adding other controls</i>
	(1)	(2)	(3)
<i>ln L</i>	0.068*** [0.011]	0.101*** [0.014]	0.106*** [0.013]
<i>ln K</i>	0.058*** [0.005]	0.049*** [0.005]	0.068*** [0.006]
<i>ln M</i>	0.738*** [0.011]	0.681*** [0.015]	0.674*** [0.014]
<b>SOS</b>	<b>0.801***</b> <b>[0.130]</b>	<b>0.665***</b> <b>[0.119]</b>	<b>0.602***</b> <b>[0.112]</b>
<i>MOS</i>			0.053* [0.028]
<i>ICT</i>			0.267*** [0.039]
Time dummies	NO	YES	YES
Obs.	2318	2318	2318
R <sup>2</sup>	0.93	0.93	0.94

Fixed-effects (within) regressions with variables in deviations from country-industry group means. Standard errors corrected for clustering within groups are reported in brackets. \*\*\*, \*\*, \* = significant at 1, 5 and 10 percent level, respectively. Legend: *L*, labor (number of worked hours); *K*, capital (capital compensation); *M*, materials (purchases of intermediate inputs); *SOS*, service offshoring (share of imported private services in total non-energy input purchases); *MOS*, material offshoring (share of imported intermediates in total non-energy input purchases); *ICT*, technical progress (share of information and communication technology in total capital compensation).

**Table 2 - Robustness Checks**Dependent Variable: Log of Real Output (*lnY*)

	<i>Offshoring normalized by gross output</i>	<i>Offshoring based on official data</i>	<i>2SLS - Instrumenting SOS</i>	<i>2SLS - Instrumenting all explanatory variables</i>	<i>Arellano-Bond</i>
	(1)	(2)	(3)	(4)	(5)
<i>ln Y<sub>t-1</sub></i>					0.259*** [0.051]
<i>ln L</i>	0.119*** [0.014]	0.105** [0.050]	0.094*** [0.016]	0.099*** [0.019]	0.033 [0.042]
<i>ln K</i>	0.069*** [0.006]	0.052** [0.023]	0.062*** [0.007]	0.084*** [0.012]	0.034*** [0.010]
<i>ln M</i>	0.663*** [0.016]	0.743*** [0.057]	0.686*** [0.017]	0.704*** [0.020]	0.530*** [0.059]
<b>SOS</b>	<b>0.592***</b> <b>[0.199]</b>	<b>1.474*</b> <b>[0.892]</b>	<b>0.500***</b> <b>[0.123]</b>	<b>0.496***</b> <b>[0.122]</b>	<b>0.441***</b> <b>[0.141]</b>
<i>MOS</i>	0.088*** [0.032]	0.026 [0.114]	0.056** [0.027]	0.078** [0.031]	0.160* [0.090]
<i>ICT</i>	0.279*** [0.040]	0.333** [0.157]	0.274*** [0.047]	0.428*** [0.070]	0.022 [0.064]
Time dummies	YES	YES	YES	YES	YES
Obs.	2318	324	1830	1819	2150
R <sup>2</sup>	0.93	0.96	0.95	0.94	
<i>F</i> -stat. for excl. instrum. (min - max)			34.1	(13.2-198.5)	
Cragg-Donald stat.			422.6	22.4	
<i>P</i> -value Hansen <i>J</i> -stat.			0.25	0.15	1.00
<i>P</i> -value AR(2) test					0.11

Fixed-effects, 2SLS and GMM regressions with robust standard errors in brackets. \*\*\*, \*\*, \* = significant at 1, 5 and 10 percent level, respectively. In columns (1)-(4), all variables are in deviations from country-industry group means. In column (3), instruments are the first three lags of SOS, in column (4) they also include the first three lags of the other regressors, and in column (5) also the second to fifth lags of real output.

**Table 3 - Country Heterogeneity**Dependent Variable: Log of Real Output (*ln Y*)

	<i>Austria</i> (1)	<i>Finland</i> (2)	<i>France</i> (3)	<i>Germany</i> (4)	<i>Italy</i> (5)	<i>Netherlands</i> (6)	<i>Spain</i> (7)	<i>Sweden</i> (8)	<i>U.K.</i> (9)
<i>a) Excluding One Country at the Time</i>									
SOS	0.715*** [0.222]	0.298** [0.123]	0.581*** [0.114]	0.264** [0.129]	0.239* [0.124]	0.239* [0.123]	0.292** [0.123]	0.232* [0.121]	0.264** [0.114]
Obs.	2181	2027	2033	2032	2018	2022	2033	2177	2021
<i>b) Estimating the Production Function Separately on Each Country</i>									
SOS	0.568** [0.221]	0.420* [0.240]	6.698*** [1.734]	1.162*** [0.358]	2.758** [1.244]	0.517* [0.290]	0.559 [0.388]	2.363** [1.100]	1.474 [1.033]
Obs.	137	291	285	286	300	296	285	141	297

Fixed-effects (within) regressions with variables in deviations from country-industry group means (Panel a)) or industry group means (Panel b)). Standard errors corrected for clustering within groups are reported in brackets. \*\*\*, \*\*, \* = significant at 1, 5 and 10 percent level, respectively. All regressions include the same set of explanatory variables as in column (3) of Table 1.

**Table A1 - Descriptive Statistics on Service Offshoring**

<i>Country</i>	<i>Obs.</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Change</i> <i>1990-2004</i>	<i>Country</i>	<i>Obs.</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Change</i> <i>1990-2004</i>
Austria	167	15.0	11.1	-5.9	Netherlands	297	4.2	4.9	3.3
Finland	295	2.7	2.3	-0.4	Spain	300	1.9	2.1	1.4
France	300	0.9	0.7	0.1	Sweden	152	2.6	2.0	2.4
Germany	298	1.7	3.2	1.2	U.K.	298	1.5	1.1	1.1
Italy	300	2.0	2.2	0.0	Whole sample	2407	3.1	5.2	0.4

Author's calculations based on EUKLEMS and Eurostat. Service offshoring is proxied by the share of imported private services in total non-energy input purchases. The change between 1990 and 2004 is expressed in percentage points.