E C O N O M I C S   B U L L E T I N

Service offshoring and productivity in Western Europe

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Abstract

Using comparable data for nine Western European countries, this paper finds that service offshoring exerts positive and economically large effects on domestic productivity. A one percentage point increase in service offshoring is found to raise Total Factor Productivity by 0.5-0.6 percent.

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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 large debate has developed over the possible consequences of this phenomenon, known as *service offshoring*.[1] A growing number of empirical studies have contributed to this debate, by analyzing the effects of service offshoring on the level of domestic productivity. Consistent with theoretical predictions, the studies on the U.S. have shown that these effects are positive and economically large (Mann, 2003; Amiti and Wei, 2006).[2] The studies on WE, on the other hand, have insofar produced inconsistent results, mostly due to the use of very different data, methodologies and proxies for service offshoring.[3] In this paper, I aim to improve upon the existing empirical literature on WE, by exploiting recently released data allowing to construct comparable measures of service offshoring, as well as of other variables needed in the analysis, for nine economies that account for about 75% of the EU-25 population.

I use the EUKLEMS data set to retrieve, for each country, information on output and inputs in twenty industries between 1990 and 2004. I match these data with a proxy for service offshoring at the industry-level, which is defined as the share of imported private services in total non-energy input purchases and is constructed from the Eurostat Import Matrices.[4] Using these data, I estimate a Cobb-Douglas production function allowing service offshoring to affect Total Factor Productivity (TFP). I find that service offshoring exerts positive effects on TFP in WE, and that these effects are economically relevant: in particular, a one percentage point increase in service offshoring raises TFP by 0.5-0.6 percent.

During the analysis, I address a number of issues that may affect the reliability of my estimates. Specifically, I control for other variables that are correlated with service offshoring and TFP, and may thus spuriously drive the results. I also check the robustness of the estimates when relaxing 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 all of these sensitivity tests.

The remainder of the paper is organized as follows: Section 2 presents the data and the empirical model; Section 3 discusses the results; Section 4 briefly concludes.

[1] For a summary of the debate, see Bhagwati *et al*. (2004), Samuelson (2004), Blinder (2006) and Mankiw and Swagel (2006).

[2] In theory, there are four channels through which service offshoring may affect domestic productivity (Amiti and Wei, 2006). 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, service offshoring may enlarge the number of varieties of service inputs available to the firms. Fourth, service offshoring may induce a learning process, known as "learning-by-offshoring", whereby firms develop more efficient ways of producing services by looking at how they are produced abroad.

[3] See, among others, Gorg and Hanley (2005), Daveri and Jona-Lasinio (2008) and Gorg *et al*. (2008), as well as Olsen (2006) for a survey.

[4] This proxy has first been 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 Crinò (2008) for a recent survey.

2. Data and Empirical Model

I use a panel of twenty manufacturing and service industries for nine Western European countries between 1990 and 2004.[5] 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 with other inputs (Amiti and Wei, 2006). To construct *SOS*, I use two sources of data: 1) the Eurostat Import Matrices for the years 1995 and 2000, which contain detailed information on service imports for all industries in all countries; 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.[6] Exploiting the Import Matrices, 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:

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

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

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.

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)) only comes from the economy-wide service imports. The second is due to the use of non-energy inputs as a normalization,

[5] 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, n.e.c. (29); Electrical and optical equipment (30-33); Transportation equipment (34-35); Manufacturing, n.e.c. (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).

[6] These data include both affiliated and unaffiliated transactions.

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) will increase by the same amount.[7] I will test the robustness of my results by using alternative indicators that overcome these limitations.

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

$$\ln Y_{c,i,t} = \ln A_{c,i,t} + \beta_K \ln K_{c,i,t} + \beta_M \ln M_{c,i,t} + \beta_L \ln L_{c,i,t} \quad (2)$$

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

$$\ln A_{c,i,t} = \beta_{c,i} + \beta_{SOS} SOS_{c,i,t} + \beta' \Omega_{c,i,t} + u_{c,i,t} \quad (3)$$

with $\beta_{c,i}$ being a country-industry fixed-effect, Ω a vector of control variables and u a white-noise disturbance.[8] Substituting (3) into (2) yields the following estimating equation:

$$\ln Y_{c,i,t} = \beta_{c,i} + \beta_K \ln K_{c,i,t} + \beta_M \ln M_{c,i,t} + \beta_L \ln L_{c,i,t} + \beta_{SOS} SOS_{c,i,t} + \beta' \Omega_{c,i,t} + u_{c,i,t} \quad (4)$$

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 decrease in size as compared to the previous specification.

These estimates may be spuriously driven by other factors that are correlated 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 (see footnote 2). 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 add a proxy for material offshoring (*MOS*) and a proxy for technical progress (*ICT*). *MOS* is the share of imported intermediate inputs in total non-energy input purchases (Feenstra and Hanson, 1999), 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

[7] See Horgos (2007) for a deeper discussion of measurement issues.
[8] *SOS* is not in logarithms because it is already expressed in percentages.

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). The point estimate implies that a one percentage point increase in service offshoring raises TFP by 0.6 percent. Hence, the baseline results suggest that the productivity effects of service offshoring in WE are positive and economically large.

Table 1 - Baseline Results

Dependent Variable: Log of Real Output (*ln Y*)

	Baseline	*Adding time dummies*	*Adding other controls*
	(1)	(2)	(3)
ln L	0.068***	0.101***	0.106***
	[0.011]	[0.014]	[0.013]
ln K	0.058***	0.049***	0.068***
	[0.005]	[0.005]	[0.006]
ln M	0.738***	0.681***	0.674***
	[0.011]	[0.015]	[0.014]
SOS	**0.801*** **	**0.665*** **	**0.602*** **
	[0.130]	**[0.119]**	**[0.112]**
MOS			0.053*
			[0.028]
ICT			0.267***
			[0.039]
Time dummies	NO	YES	YES
Obs.	2318	2318	2318
R^2	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 technologies in total capital compensation).

Yet, a number of concerns may raise doubts about the reliability and robustness of these estimates. I now turn to address the most relevant of these concerns. I start by relaxing the two most restrictive assumptions underlying *SOS*. In column (1) of Table 2, I use gross output as the denominator of (1), in order to mitigate the underestimation of service offshoring implied by the use of non-energy inputs as a normalization.[9] The main results are virtually unaffected. In fact, the input coefficients remain positive and highly significant, like those on material offshoring and technical progress. More importantly, the coefficient on *SOS* is still positive and very precisely estimated, and is also remarkably close in size to the estimate reported in column (3) of Table 1.

In column (2), I instead replace the numerator of (1) with the official data on industry-level service imports available only for 1995 and 2000 in the Import Matrices. By doing so, I check the robustness of my 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.

[9] See, in particular, Hijzen *et al*. (2005) for the use of this alternative normalization.

Nevertheless, the evidence on service offshoring is preserved. Overall, this suggests that my findings are not driven by the main issues involved in the construction of *SOS*.

A second potential drawback of my results is that OLS estimates may be upward biased, due to the endogeneity of service offshoring in specifications like (4): in fact, more productive firms may be better able to coordinate their overseas activities and may thus resort more heavily to service offshoring. 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 (see, e.g., Daveri and Jona Lasinio, 2008). I follow this approach and use the first three lags of *SOS* as instruments.

Table 2 - Robustness Checks

Dependent Variable: Log of Real Output (*ln Y*)

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

Column (3) of Table 2 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 column (3) of Table 1, the point estimate is slightly lower, confirming that OLS results are 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. The point estimates obtained with 2SLS imply that a one percentage point increase in service offshoring raises TFP by about 0.5 percent, a value slightly lower than those obtained with OLS, but still substantial.

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.

Table 3 - Country Heterogeneity

Dependent Variable: Log of Real Output (*ln Y*)

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

I close by dealing with a third potential drawback of my 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 (4) by excluding one country at the time. The coefficient on *SOS* is always positive and precisely estimated, suggesting that the previous results are not driven by any specific country in the sample. In panel b), I instead re-estimate (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 seem to be widespread across the economies analyzed.[10]

[10] 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; I have estimated the production function with value added, rather than output, as the dependent variable (omitting intermediate inputs from the regressors); I have included linear and quadratic time trends in the specification, to account for uneven productivity growth across industries and countries; I have used the number of employees instead of the number of worked hours as a proxy for labor; I have distinguished labor in three skill

4. Conclusion

Using comparable data for nine Western European countries, I found that service offshoring exerts positive and large effects on domestic productivity: a one percentage point increase in my proxy is found to raise TFP by 0.5-0.6 percent. 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 productivity in WE.

5. Appendix

Table A1 - Descriptive Statistics on Service Offshoring

Country	*Obs.*	*Mean*	*Std. Dev.*	*Change 1990-2004*	*Country*	*Obs.*	*Mean*	*Std. Dev.*	*Change 1990-2004*
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.

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groups, and intermediate inputs in materials, services and energy; I have proxied capital with its total stock, rather than its compensation; finally, I have controlled for outliers. The main results have always proven robust.

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