Online Appendix

Productivity estimation

The Cobb-Douglas production function has the following form:

$$Y_{it} = A_{it} K_{it}^{\beta 1} L_{it}^{\beta 2} \quad (1)$$

where Y_{it} denotes the output of firm *i* at time *t,* K_{it} denotes capital, L_{it} labour, and A_{it} is a measure of TFP, which is to be estimated and used as the outcome variable. TFP (A_{it}) is Hicks neutral, which implies that technological changes affect A_{it}, thereby raising the marginal productivity of both labour and capital in such a manner that the relative marginal productivity of the two factor inputs remains the same (Hicks, 1963). β_1 and β_2 represent the output elasticity of capital and labour. The production function (1) is assumed to be homogenous.[1] After taking logs, the baseline equation becomes:

$$y_{it} = \alpha + \beta_1 k_{it} + \beta_2 l_{it} + w_{it} + \varepsilon_{it} \quad (2)$$
$$\ln(A_{it}) = \alpha + w_{it} + \varepsilon_{it} \quad (3)$$

Lower-case y, *k,* and *l* refer to the logarithmic forms of *Y*, *K*, and *L*; α is the average productivity in the base period (Eberhardt and Helmers, 2010), while $w_{it} + \varepsilon_{it}$ represents the composite error term η_{it} ($\eta_{it} = w_{it} + \varepsilon_{it}$). w_{it} represents an anticipated productivity shock, i.e. managerial ability, or other internally known factor (by firm) of productivity. ε_{it} are idiosyncratic, unanticipated productivity shocks, independently distributed *(iid)*, and not observed by a firm in its decisions on inputs.

The chosen outcome variable in the Cobb-Douglas production function is value added, expressed in thousands of euros (nominal values). Following the relevant literature, capital is proxied by tangible fixed assets (Resmini and Nicolini, 2007; Abraham et al., 2010; Du et al., 2011), labour by the number of employees, and material by material costs. All variables are in logarithmic form (k_{it}, l_{it}, m_{it}). Hence, negative values of value added (when operating revenue is lower than material costs) are lost with logarithmic transformation.

All values are in nominal terms (except for employment) and have been deflated. The official currency in Slovenia is the euro, since Slovenia entered the European Monetary Union (EMU) in 2007, while it is the kuna in Croatia. Since all the values in the Amadeus database are expressed in euros, they are converted to kuna using the annual exchange rate (the twelve-month period average), while Slovenian values are left unchanged. The values denominated in the Croatian domestic currency were deflated and then converted back into euros using the 2009 exchange rate to attenuate the effects of exchange rate fluctuations on cross-country comparisons over the years. Capital and operating revenue were deflated by the 2-digit industry price index.[2] Material costs were also deflated by the PPI index (in the absence of an

[1] If inputs increase *n* times, output will increase t^n times, if the Cobb Douglas production function is homogenous at level *t*.

[2] The Statistical Office of Slovenia has a PPI index that covers all 2-digit manufacturing and service industries, except for industries 12, 56, 58, 65-69, 73, and 75, for which the PPI index for similar industries is used. The Croatian Bureau of Statistics does not report PPI indexes for most of the service industries. A PPI index is only reported for electricity, gas, steam, and air conditioning supply, as well as for water supply, sewerage, waste management, and remediation activities. For the remaining industries in the Croatian service sector, the total PPI index is used.

intermediate goods price index). Value added was then calculated as the difference between the deflated operating revenue and the deflated material cost.

The productivity estimation should be obtained as the difference between the actual output y_{it} and its estimated counterpart $\widehat{y_t}$. However, this calculation is impeded by the endogeneity issue caused by the fact that decisions on inputs are made based on the productivity shock w_t observed only by the firm. A firm demands more labour as its productivity increases, which causes an upward bias in the labour estimates. Equation (2) and its residual, TFP, cannot be consistently estimated if the correlation between employment l_{it} and the composite error term η_{it} (simultaneity bias) is not dealt with.

Wooldridge (2009) suggests a one-step GMM estimator, which estimates capital and labour simultaneously with robust standard errors. The approach has the additional advantage of the Sargan-Hansen test for over-identifying restrictions (instrument validity), which is necessary because the method offers a greater set of instruments for a single unobservable productivity ω_{it} (Van Beveren, 2012). Based on some derivations and assumptions, Wooldridge derives two equations that differ in the set of instruments used, or more precisely, in different instrumentation for productivity ω_{it}. The first equation is derived from Equation (2) directly, considering that productivity can be expressed as a function of capital and material ($w_{it} = g(m_{it}, k_{it})$):

$$y_{it} = \alpha + \beta_1 k_{it} + \beta_2 l_{it} + g(m_{it}, k_{it}) + \varepsilon_{it} \quad (3)$$

According to Wooldridge, *g()* can be approximated in the estimation by a third-degree polynomial.[3] Wooldridge derives the second equation based on the assumption that productivity follows a first-order Markov process. This means that productivity builds on its own previous level, which differs only by the level of productivity innovation ξ_{it}. Productivity can be then expressed as $\omega_{it} = E[\omega_{it}|\omega_{it-1}] + \xi_{it}$, where the remaining part, ξ_{it}, represents productivity innovation. In sum, productivity can be expressed as follows: $\omega_{it} = g(m_{it}, k_{it}) = f[g(m_{it-1}, k_{it-1})] + \xi_{it}$. The second equation under the Wooldridge approach thus has the form:

$$y_{it} = \alpha + \beta_1 k_{it} + \beta_2 l_{it} + f[g(m_{it-1}, k_{it-1})] + u_{it} \quad (4)$$

where the u_{it} idiosyncratic part consist of productivity innovation, and the remaining error term $u_{it} = \xi_{it} + \varepsilon_{it}$. *f()* can be approximated by the polynomial in the estimation.[4] Equations (3) and (4) are estimated with GMM. The endogenous current level of labour l_{it} is instrumented with the first lag of labour, l_{it-1}, which is exogenous.

TFP is estimated as the difference between the actual and predicted output ($\hat{y}_{it}$). Considering that all the terms in the Cobb-Douglas function equation are in logarithmic form, so too is the TFP. The results of the TFP estimation (using Stata **ivreg2** command) are presented below.

Table 1A TFP estimation, diagnostics, and test - Croatia (stata command: ivreg2)

[3] This implies that the function *g()* is expressed in terms of $m^p k^s$, where $p+s< 3$ needs to hold. Wooldridge also assumes that the *g()* function contains *m* and *k*, separately.

[4] $f(\omega)=\kappa_0+k_1\omega+..k_n\omega^n$

Ind	ln(L)	ln(K)	Constant returns to scale test (p-value):	Kleibergen-Paap LM test (H0: model is underidentified) (p-value)	Ho: Weak IV	Endogen. test of regressor (p-value)	Weak IV robust test AR: H0: beta=b0 and H0:E(Zu)=0 Wald: beta=b0 (p-value)
10	.617	.061	0.000	0.000	rejected	0.026	0.000
11	.503	.023	0.000	0.000	rejected	0.084	0.000
13	.639	.141	0.000	0.000	rejected	0.001	0.000
14	.748	.088	0.000	0.000	rejected	0.1175	0.000
15	.724	.008	0.000	0.000	rejected	0.632	0.000
16	.651	.061	0.000	0.000	rejected	0.876	0.000
17	.546	.020	0.000	0.000	rejected	0.742	0.000
18	.594	.057	0.000	0.000	rejected	0.408	0.000
20	.593	.080	0.000	0.000	rejected	0.563	0.000
22	.591	.076	0.000	0.000	rejected	0.718	0.000
23	.594	.099	0.000	0.000	rejected	0.573	0.000
24	.764	-.053	0.000	0.000	rejected	0.422	0.000
25	.775	.090	0.000	0.000	rejected	0.061	0.000
26	.727	.109	0.000	0.000	rejected	0.501	0.000
27	.495	.086	0.000	0.000	rejected	0.667	0.000
28	.654	.097	0.000	0.000	rejected	0.187	0.000
30	.781	.039	0.008	0.000	rejected	0.465	0.000
31	.597	.126	0.000	0.000	rejected	0.291	0.000
32	.528	.106	0.000	0.000	rejected	0.698	0.000
33	.822	.028	0.000	0.000	rejected	0.203	0.000
45	.655	.087	0.000	0.000	rejected	0.972	0.000
46	.556	.068	0.000	0.000	rejected	0.000	0.000
47	.624	.076	0.000	0.000	rejected	0.160	0.000
49	.633	.111	0.000	0.000	rejected	0.920	0.000
50	.772	.062	0.120	0.000	rejected	0.231	0.000
52	.837	.043	0.002	0.000	rejected	0.028	0.000
55	.427	.060	0.000	0.000	rejected	0.093	0.000
56	.530	.076	0.000	0.000	rejected	0.607	0.000
58	.708	.046	0.000	0.000	rejected	0.428	0.000
59	.541	.138	0.000	0.000	rejected	0.379	0.000
60	.671	.011	0.000	0.000	rejected	0.128	0.000
61	.691	.039	0.000	0.000	rejected	0.107	0.000
62	.982	.075	0.017	0.000	rejected	0.001	0.000
63	.782	.109	0.133	0.000	rejected	0.092	0.000
66	.667	020	0.000	0.000	rejected	0.593	0.000
68	.563	.048	0.000	0.000	rejected	0.581	0.000
69	.985	.021	0.778	0.000	rejected	0.000	0.000
70	.731	.078	0.000	0.000	rejected	0.074	0.000
72	.860	.002	0.137	0.000	rejected	0.649	0.000
73	.661	.111	0.000	0.000	rejected	0.508	0.000

Table 2A TFP estimation, diagnostics, and test- Slovenia (stata command: ivreg2)

Ind	ln(L)	ln(K)	Constant returns to scale test (p-value):	Kleibergen-Paap LM test (H0: model is underidentified) (p-value)	Ho: Weak IV	Endogen. test of regressor (p-value)	Weak IV robust test AR: H0:beta=b0 and H0:E(Zu)=0 Wald: beta=b0 (p-value)
10	.551	.105	0.0000	0.000	rejected	0.1873	0.0000

13	.566	.047	0.000	0.000	rejected	0.3856	0.000
16	.554	.208	0.0051	0.000	rejected	0.5145	0.000
18	.362	.089	0.0000	0.000	rejected	0.9498	0.000
20	.5512	-.006	0.0000	0.000	rejected	0.2460	0.000
22	.5187	.133	0.0000	0.000	rejected	0.0179	0.000
23	.378	.229	0.000	0.000	rejected	0.0090	0.0012 0.0000
25	.5162	.1615 7	0.000	0.000	rejected	0.0001	0.000
26	.332	.156	0.0000	0.000	rejected	0.0114	0.0035 0.0009
27	.4309	.1011	0.000	0.000	rejected	0.5569	0.0015 0.0000
28	.512	.175	0.0000	0.000	rejected	0.0000	0.0000
29	.6054	.0883	0.0009	0.000	rejected	0.2200	0.0040 0.0000
31	.532	.1329	0.0001	0.000	rejected	0.1719	0.0012 0.0000
32	.7157	.1354	0.0609	0.000	rejected	0.0028	0.0000
45	.6118	.0064	0.0000	0.000	rejected	0.0031	0.0000
46	.648	-.010	0.000	0.000	rejected	0.0002	0.000
47	.7114	.0686	0.0005	0.000	rejected	0.4603	0.0000
49	.6279	.1463	0.0135	0.000	rejected	0.0369	0.0000
52	.7171	.2061	0.6062	0.000	rejected	0.3329	0.000
56	.6367	.0853	0.0003	0.000	rejected	0.8311	0.000
58	.7262	.1163	0.1631	0.000	rejected	0.8464	0.0000
62	1.122	.0313	0.0222	0.000	rejected	0.7983	0.0000
64	.5348	.0744	0.0305	0.000	rejected	0.3305	0.0117 0.0009
71	.759	.1346	0.0758	0.000	rejected	0.1026	0.0000
73	.8162	.0735	0.5035	0.000	rejected	0.5453	0.000

For both countries, the diagnostic tests justify the validity of the model. The Kleibergen-Paap LM test is for the rank condition: whether the instrument (l_{it-1}) contributes to the independent variation of l_{it}. The null hypothesis is that the equation in the first stage is underidentified. The Kleibergen-Paap (2006) LM test rejects this null hypothesis, thus suggesting that the instrument is valid.

Stock and Yogo (2005) define an instrument to be weak if the bias of the IV estimator, relative to the bias of the OLS, exceeds a certain threshold, usually 10%. The hypothesis of a weak instrument is rejected, since the first stage Kleibergen-Papp Wald F statistics is greater than the Stock and Yogo (2005) critical values for all industries in the two countries. Additionally, Staiger and Stock (1997) suggest that, if the F statistics of the first stage is greater than 10, it indicates the presence of a non-weak instrument. Surprisingly, for most industries in both countries, the endogeneity test is negative, implying that the proclaimed endogenous variable (logarithm of employees) can be treated as exogenous. For all but four industries in both countries, the test for constant returns to scale is negative.

The TFP descriptive statistics (in logarithmic form) for foreign and domestic firms are provided in Table 3A.

Table 3A. Foreign and domestic firms' weighted average TFP in manufacturing and services in Croatia and Slovenia (2006-2014)

MANUFACTURING	CROATIA	SLOVENIA
TFP_FOREIGN	0.111	0.134
TFP_DOMESTIC	0.011	0.043

SERVICES	CROATIA	SLOVENIA
TFP_FOREIGN	0.025	0.041
TFP_DOMESTIC	0.003	0.025

Note: Following Van Beveren (2012), the summary statistics take into account the firm size proxied by the employment level. Hence, the statistics below represent the mean of the weighted TFP of foreign and domestic firms (separately) in two-digit industries, where weights are the firm employment shares in total (two-digit) industry employment.

Variables and descriptive statistics

Table 4A. Definition of variables and descriptive statistics, manufacturing, 2006-2014 period average

Croatia (Number of firms=3855)				
Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
TFP (ln)	3.542	0.835	-1.823	8.922
Horizontal spillover	0.119	0.152	0	0.902
Backward spillover	0.132	0.049	0.025	0.266
Forward spillover	0.124	0.043	0.030	0.195
Industry concentration (HH index - sum of squared market shares of all firms in each 3 digit industry)	0.142	0.154	0.021	0.982
Human capital (Ln cost of employees over total number of firm's employees)	2.208	0.449	-3.056	7.223
Intangible assets ratio (Ln)	-7.887	3.394	-16.551	0.000
Size (Ln of assets)	7.205	1.530	2.079	13.315
Age (log lf years since establishment)	2.589	0.874	-0.693	5.75
Leverage (Ln of the ratio of total liabilities to total assets)	-1.053	0.733	-5.979	2.691
Slovenia (Number of firms =2171)				
TFP (ln)	4.488	0.790	0.881	9.100
Horizontal spillover	0.125	0.142	0	0.965
Backward spillover	0.115	0.066	0.011	0.333
Forward spillover	0.125	0.058	0.015	0.336
Industry concentration (HH index - sum of squared market shares of all firms in each 3 digit industry)	0.159	0.155	0.024	0.980
Human capital (Ln cost of employees over total number of firm's employees)	2.993	0.293	0.661	7.240
Intangible assets ratio (Ln)	-6.645	3.442	-15.164	-0.009
Size (Ln of number of employees)	7.860	1.404	3.296	14.264
Age (log lf years since establishment)	2.56	0.77	-0.69	4.22
Leverage (Ln of the ratio of total liabilities to total assets)	-1.121	0.656	-6.477	2.620

Note: industry, region and year dummies are not included

Table 5A. Definition of variables and descriptive statistics, services, 2006-2014 period average

Services - Croatia (Number of firms=1558)				
Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
TFP (ln)	3.723	0.849	-3.005	8.344
Horizontal spillover	0.128	0.107	0.000	0.833
Backward spillover	0.113	0.039	0.000	0.833
Forward spillover	0.109	0.028	0.037	0.163

Industry concentration (HH index - sum of squared market shares of all firms in each 3 digit industry)	.088	.141	.010	.984
Human capital (Ln cost of employees over total number of firm's employees)	2.331	0.503	-6.242	6.297
Intangible assets ratio (log)	-7.178	3.679	-17.703	0.000
Size (Ln of number of employees)	7.147	1.558	1.792	14.914
Age (log lf years since establishment)	2.53	.77	-.69	5.06
Leverage (Ln the ratio of total liabilities to total assets)	-0.970	0.854	-7.328	3.399
Services - Slovenia (Number of firms=2273)				
TFP (ln)	4.529	0.829	-0.573	9.458
Horizontal spillover	0.155	0.130	0	0.958
Backward spillover	0.134	0.046	0.004	0.234
Forward spillover	0.115	0.031	0.029	0.227
Industry concentration (HH index - sum of squared market shares at 3 digit industry)	0.101	0.131	0.007	1
Human capital (Ln cost of employees over total number of firm's employees)	3.093	0.387	0.405	4.842
Log(Intangible assets ratio)	-6.567	3.636	-16.376	-0.004
Size (log of employees)	7.715	1.446	2.890	15.597
Age (log lf years since establishment)	2.580	.691	-.693	4.060
Leverage (Ln the ratio of total liabilities to total assets)	-1.055	0.707	-5.341	2.288

Note: region and industry dummies are not included.

Margins plot – leverage and leverage squared

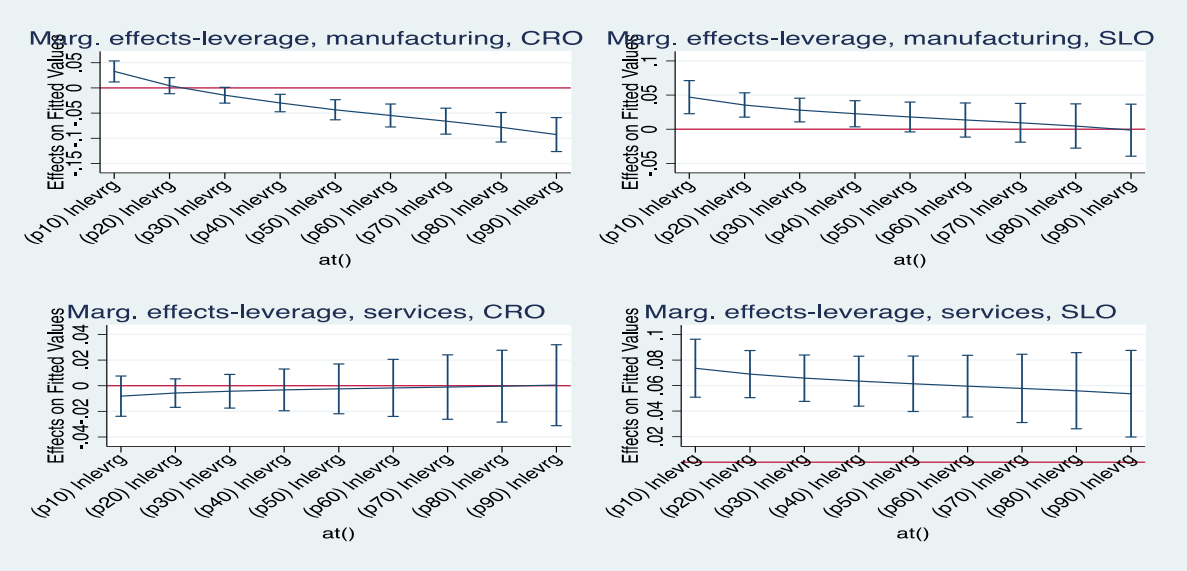

Figure 1A Croatia, manufacturing, and services: average marginal effects of leverage on TFP with 90% CI

Figure 1B Slovenia, manufacturing, and services: average marginal effects of leverage on TFP, with 90% CI

Note: The figure show marginal effects of leverage (y-axis) across different leverage levels ranging from its 10th to 90th percentile values (x-axis). Point estimate of the effect above (below) the red line represents positive (negative) marginal effects. The effect is insignificant if the zero line is within the confidence interval.

Results of the regression augmented with interactions

Table 6A Year interaction terms (horizontal and vertical spillovers)

	Manufacturing Croatia	Service Croatia	Manufacturing Slovenia	Service Slovenia

L.TFP	0.413***	0.554***	0.735***	0.717***
	(0.0361)	(0.0251)	(0.0346)	(0.0600)
L2.TFP	0.150***	0.0983***	0.0542**	
	(0.0252)	(0.0168)	(0.0225)	
lhorizontal	0.321***	0.0497	-0.319*	-0.175
	(0.0828)	(0.0840)	(0.181)	(0.152)
lbackward	0.0609	-3.098***	0.605***	1.325*
	(0.515)	(0.587)	(0.142)	(0.699)
lforward	0.0442	-0.860	2.003***	-1.206**
	(0.624)	(1.199)	(0.575)	(0.544)
2006.year#~l	0	0	0	0
	(.)	(.)	(.)	(.)
2007.year#~l	0	0	0	0
	(.)	(.)	(.)	(.)
2008.year#~l	-0.155*	0.157	0.168	0.225
	(0.0831)	(0.122)	(0.179)	(0.143)
2009.year#~l	0	0.0135	0	0.0404
	(.)	(0.106)	(.)	(0.160)
2010.year#~l	-0.0787	0	0.295	0.104
	(0.0809)	(.)	(0.196)	(0.158)
2011.year#~l	-0.149*	-0.0717	0.349*	0.269*
	(0.0827)	(0.105)	(0.191)	(0.158)
2012.year#~l	-0.125	-0.244**	0.328*	0.0171
	(0.0819)	(0.103)	(0.194)	(0.157)
2013.year#~l	-0.330***	-0.478***	0.402**	0.132
	(0.0931)	(0.104)	(0.191)	(0.155)
2014.year#~l	-0.316***	-0.155	0.277	0.124
	(0.108)	(0.103)	(0.186)	(0.157)
2006.year#~d	0	0	0	0
	(.)	(.)	(.)	(.)
2007.year#~d	0	0	0	-0.781
	(.)	(.)	(.)	(0.665)
2008.year#~d	-0.430	3.610***	-0.504**	-0.855
	(0.630)	(0.851)	(0.212)	(0.780)
2009.year#~d	0	3.561***	0.127	-0.256
	(.)	(0.868)	(0.201)	(0.773)
2010.year#~d	-1.098	4.905***	-0.236*	0
	(0.743)	(0.842)	(0.143)	(.)
2011.year#~d	-0.320	2.845***	-0.446***	0.232
	(0.576)	(0.673)	(0.137)	(0.597)
2012.year#~d	-0.990*	1.587**	-0.425***	0.146
	(0.532)	(0.702)	(0.138)	(0.584)
2013.year#~d	-0.536	0	-0.199	-0.331
	(0.553)	(.)	(0.161)	(0.588)
2014.year#~d	-0.531	2.842***	0	-0.849
	(0.563)	(0.673)	(.)	(0.610)
2006.year#~d	0	0	0	0
	(.)	(.)	(.)	(.)
2007.year#~d	0	0	0	4.063***
	(.)	(.)	(.)	(0.944)
2008.year#~d	0	4.324**	0	4.071***
	(.)	(1.728)	(.)	(0.911)
2009.year#~d	-1.740***	1.930	-1.601**	1.865**
	(0.604)	(1.565)	(0.799)	(0.822)
2010.year#~d	-0.524	0	-1.693***	1.625***
	(0.665)	(.)	(0.556)	(0.623)
2011.year#~d	-0.305	2.915**	-2.105***	1.375***
	(0.625)	(1.372)	(0.578)	(0.524)
2012.year#~d	-0.0662	4.220***	-2.327***	1.262**
	(0.565)	(1.273)	(0.568)	(0.520)
2013.year#~d	-0.238	5.567***	-2.092***	1.064*
	(0.599)	(1.292)	(0.576)	(0.628)
2014.year#~d	-0.106	2.832**	-2.256***	0
	(0.594)	(1.290)	(0.565)	(.)
lnhc	0.478***	0.329***	0.304***	0.326***
	(0.0404)	(0.0237)	(0.0337)	(0.0450)
lnintang	0.00568***	0.00275***	0.00309***	0.00264**
	(0.00153)	(0.000941)	(0.00115)	(0.00108)
lnage	-0.0457***	-0.0606***	-0.0240***	-0.0602***
	(0.00885)	(0.00706)	(0.00698)	(0.00707)
HH_3d	-0.0452	0.0920***	0.0897**	0.0497
	(0.0478)	(0.0303)	(0.0398)	(0.0360)
lnlevrg	-0.114***	-0.0222*	-0.0103	0.0270
	(0.0205)	(0.0130)	(0.0222)	(0.0208)
lnlevrg2	-0.0356***	-0.00157	-0.0141*	-0.00717
	(0.00635)	(0.00374)	(0.00765)	(0.00579)
size	0.0898***	0.0749***	0.0593***	0.0624***

	(0.0137)	(0.00941)	(0.0128)	(0.0135)
high_tech	-0.0408		0.0971***	
	(0.0342)		(0.0310)	
med_high	-0.0306		0.00214	
	(0.0247)		(0.0142)	
med_low	-0.125***		-0.0574***	
	(0.0204)		(0.0129)	
reg1	0.0382*	-0.0342**	0.0243***	0.00137
	(0.0200)	(0.0142)	(0.00738)	(0.00782)
reg2	0.0427**	-0.00969		
	(0.0169)	(0.0104)		
reg3	0.0190	-0.0179		
	(0.0217)	(0.0139)		
reg4	0.0374	-0.0206		
	(0.0269)	(0.0189)		
yr3	-0.0469	-0.323***	-0.423***	-0.154**
	(0.0882)	(0.106)	(0.0659)	(0.0627)
yr4	0.146*	-0.0176	-0.485***	-0.0843
	(0.0778)	(0.103)	(0.0691)	(0.0659)
yr5	0.0917	0.0388	-0.402***	-0.143*
	(0.0750)	(0.0705)	(0.0695)	(0.0802)
yr6	-0.0580	-0.0786	-0.360***	-0.176***
	(0.0802)	(0.0605)	(0.0674)	(0.0639)
yr7	0.102	0.0302	-0.360***	-0.152***
	(0.0814)	(0.0531)	(0.0659)	(0.0580)
yr8	0.0742	0.0673	-0.426***	-0.0449
	(0.0842)	(0.0582)	(0.0673)	(0.0631)
yr9	0.0630	0.00170	-0.370***	0.166*
	(0.0820)	(0.0571)	(0.0707)	(0.100)
high_ser		-0.182***		-0.261***
		(0.0190)		(0.0498)
yr2				-0.0666
				(0.0638)
_cons	0	0	0	0
	(.)	(.)	(.)	(.)
ar1p	2.88e-42	1.45e-63	1.59e-22	6.10e-19
ar2p	0.883	0.669	0.163	0.690
hansenp	0.433	1.42e-08	0.481	0.142
No. of observations	12339	20852	8256	12313
Number of firms	2226	3799	1548	2170
Number of groups	5.543	5.489	5.333	5.674
Number of IVs	80	90	89	68

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 7A Horizontal spillovers, leverage and firm size (competition) interactions, Croatia

	MANUFACTURING		SERVICES	
	Horizontal# Leverage#size	Horizontal# Leverage#HH	Horizontal# Leverage#size	Horizontal# Leverage#HH
L.TFP	0.411***	0.418***	0.854***	1.302***
	(0.0358)	(0.0359)	(0.206)	(0.308)
L2.TFP	0.148***	0.149***	0.131	-0.252
	(0.0249)	(0.0251)	(0.174)	(0.256)
lhorizontal2	0.157***	0.345***	0.116	-0.170***
	(0.0474)	(0.0719)	(0.186)	(0.0453)
size2	0.0906***	0.0886***	0.00303	
	(0.0133)	(0.0135)	(0.0230)	
c.lhorizon~2	-0.0117		0.0298	
	(0.0294)		(0.0736)	
leverage	-0.117***	-0.00863	0.0176	0.00898
	(0.0209)	(0.00856)	(0.0122)	(0.0202)
c.lhorizon~e	0.0206	-0.0191	-0.0272	0.124*
	(0.0465)	(0.0726)	(0.102)	(0.0626)
c.size2#c.~e	-0.00592		-0.00773	
	(0.00503)		(0.00497)	
c.lhorizon~e	-0.0157		-0.0621	
	(0.0290)		(0.0627)	
lbackward	-0.484*	-0.446	-0.213	-1.911**
	(0.242)	(0.242)	(0.787)	(0.584)

lforward	-0.529	-0.502	-4.587	2.652**
	(0.365)	(0.366)	(3.819)	(0.838)
lnhc	0.479***	0.477***	0.156***	0.175***
	(0.0401)	(0.0407)	(0.0443)	(0.0405)
lnintang	0.00570***	0.00531***	0.00218	-0.0000429
	(0.00152)	(0.00151)	(0.00184)	(0.00148)
lnlevrg2	-0.0374***			0.00372
	(0.00660)			(0.00631)
lnage	-0.0456***	-0.0404***	-0.0745*	0.00450
	(0.00895)	(0.00864)	(0.0365)	(0.0293)
HH_3d	-0.0515		-3.153	
	(0.0476)		(2.277)	
high_tech	-0.0314	-0.0421		
	(0.0339)	(0.0339)		
med_high	-0.0203	-0.0382		
	(0.0241)	(0.0242)		
med_low	-0.120***	-0.124***		
	(0.0204)	(0.0204)		
reg1	0.0364	0.0428*	0.0367	0.0271
	(0.0201)	(0.0199)	(0.0352)	(0.0155)
reg2	0.0428*	0.0437**	-0.00892	-0.0301***
	(0.0169)	(0.0168)	(0.0237)	(0.00779)
reg3	0.0181	0.0209	0.00600	-0.0277**
	(0.0218)	(0.0213)	(0.0349)	(0.00887)
reg4	0.0375	0.0294	0.0164	-0.0315**
	(0.0272)	(0.0269)	(0.0475)	(0.0104)
yr3	-0.0735***	-0.0677***	-0.135***	-0.159***
	(0.0122)	(0.0122)	(0.0256)	(0.0325)
yr4	-0.0272*	-0.0237*	-0.0730***	-0.0913***
	(0.0119)	(0.0120)	(0.0208)	(0.0202)
yr5	-0.0660***	-0.0590***	-0.161***	-0.127***
	(0.0119)	(0.0120)	(0.0432)	(0.0287)
yr6	-0.101***	-0.0965***	-0.192***	-0.102***
	(0.0108)	(0.0109)	(0.0536)	(0.0143)
yr8	-0.00698	-0.0102	-0.0258	-0.0562
	(0.0134)	(0.0135)	(0.0146)	(0.0322)
yr9	0.000595	-0.00244		-0.0129
	(0.0117)	(0.0118)		(0.0243)
HH2		-0.00102		0.00258
		(0.0500)		(0.0257)
c.lhorizon~2		-0.779***		0.638***
		(0.205)		(0.191)
c.HH2#c.le~e		-0.0237		-0.0795
		(0.0680)		(0.0472)
c.lhorizon~e		0.145		-0.272
		(0.229)		(0.217)
high_ser			-0.000340	-0.0377
			(0.0682)	(0.0422)
yr7			-0.0883	
			(0.0481)	
size				-0.0329
				(0.0212)
_cons	0.875***	0.772***	0.769	-0.373**
	(0.157)	(0.154)	(0.696)	(0.137)
ar1p	2.10e-42	1.99e-42	0.00720	0.00408
ar2p	0.841	0.852	0.849	0.165
hansenp	0.788	0.719	0.274	0.674
No. of observations	12339	12339	20855	20730
Number of firms	2226	2226	3799	3782
Number of groups	5.543	5.543	5.490	5.481
Number of IVs	66	65	30	32

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 8A Horizontal spillovers, leverage and firm size (competition) interactions, Slovenia-

	MANUFACTURING		SERVICES	
	Horizontal# Leverage#size	Horizontal# Leverage#HH	Horizontal# Leverage#size	Horizontal# Leverage#HH
L.TFP	0.741***	0.771***	0.587***	1.029***
	(0.0313)	(0.0262)	(0.0491)	(0.0455)

L2.TFP	0.0762***	0.0861***		
	(0.0198)	(0.0186)		
lhorizontal2	-0.0163	0.00365	-0.243***	0.0142
	(0.0351)	(0.0368)	(0.0471)	(0.0339)
size2	0.0525***		0.0863***	
	(0.0115)		(0.0114)	
c.lhorizon~2	-0.0143		0.123***	
	(0.0159)		(0.0314)	
leverage	-0.00710	-0.0203	0.0503*	-0.0135
	(0.0233)	(0.0253)	(0.0211)	(0.0185)
c.lhorizon~e	0.000892	-0.0540	0.103*	-0.0418
	(0.0381)	(0.0511)	(0.0519)	(0.0341)
c.size2#c.~e	-0.00662		0.0111	
	(0.00552)		(0.00716)	
c.lhorizon~e	-0.0143		-0.0677*	
	(0.0249)		(0.0330)	
lbackward	0.309***	0.307***	1.215***	-0.299
	(0.0906)	(0.0903)	(0.344)	(0.235)
lforward	0.113	0.0944	0.905***	-0.546*
	(0.135)	(0.140)	(0.248)	(0.223)
lnhc	0.291***	0.318***	0.427***	0.107*
	(0.0310)	(0.0347)	(0.0393)	(0.0470)
lnintang	0.00285**	0.00475***	0.00432***	-0.000313
	(0.00109)	(0.00129)	(0.00129)	(0.00106)
lnlevrg2	-0.0141	-0.0156	-0.0000640	-0.00834
	(0.00793)	(0.00891)	(0.00642)	(0.00557)
lnage	-0.0241***	-0.00230	-0.0634***	-0.0581***
	(0.00634)	(0.00672)	(0.00887)	(0.00829)
HH_3d	0.0860*		0.0297	
	(0.0378)		(0.0540)	
high_tech	0.0860**	0.0529*		
	(0.0269)	(0.0240)		
med_high	-0.00280	-0.00202		
	(0.0126)	(0.0125)		
med_low	-0.0488***	-0.0492***		
	(0.0116)	(0.0112)		
reg1	0.0260***	0.0275***	-0.00268	0.0277***
	(0.00698)	(0.00714)	(0.0109)	(0.00662)
yr3	0.0994***	0.110***	0.202***	0.000161
	(0.0150)	(0.0160)	(0.0336)	(0.0312)
yr4	-0.0230	-0.0144	0.127***	-0.0862**
	(0.0156)	(0.0164)	(0.0337)	(0.0298)
yr5	0.0696***	0.0788***	0.0378***	0.0500***
	(0.00877)	(0.00900)	(0.00803)	(0.00911)
yr6	0.0341***	0.0406***	0.0421***	0.0420***
	(0.00821)	(0.00836)	(0.00573)	(0.00740)
yr8	0.00946	0.00878	0.0342***	0.0310***
	(0.00816)	(0.00826)	(0.00571)	(0.00728)
yr9	0.0467***	0.0435***	0.00842	0.0489***
	(0.00821)	(0.00849)	(0.00985)	(0.00982)
HH2		0.119**		0.0265
		(0.0433)		(0.0314)
c.lhorizon~2		-0.0897		0.450*
		(0.0952)		(0.220)
c.HH2#c.le~e		0.00286		-0.0255
		(0.0490)		(0.0426)
c.lhorizon~e		0.149		-0.215
		(0.186)		(0.303)
high_ser			-0.359***	-0.0179
			(0.0434)	(0.0424)
yr2			0.260***	0.0295
			(0.0377)	(0.0356)
_cons	-0.105	-0.353***	0.460***	-0.211***
	(0.104)	(0.0659)	(0.0990)	(0.0543)
ar1p	1.46e-23	7.21e-24	1.83e-25	8.92e-24
ar2p	0.306	0.362	0.801	0.833
hansenp	0.669	0.757	0.377	0.277
No. of observations	8256	8256	12313	12313
Number of firms	1548	1548	2170	2170
Number of groups	5.333	5.333	5.674	5.674
Number of IVs	63	62	59	43

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

A note on the sensitivity of estimates

Various specifications of the model were estimated for both manufacturing and services to ensure its robustness. First, for a further inspection of the time dimension of spillovers, the spillovers were lagged twice. The results for both sectors in Slovenia remained unchanged. Backward spillovers in both sectors in Croatia turned insignificant, indicating that vertical spillovers lost their effect after two years. The negative backward spillovers found previously in Croatian manufacturing could reflect short term market adjustments to new foreign customers and/or loss of market share due to foreign firm entry in the downstream industry. Positive forward spillovers in the Croatian service sector also disappeared in the second year, as the second lagged spillovers lost significance.

Second, a different definition of spillovers, the proportion of output (rather than employment), of a 3-digit industry produced by foreign owned firms was used. The measure of spillovers used in the main model captured the absorption of knowledge mainly via labour mobility. The measure used in the robustness check captured the absorption of spillovers via the effect of demonstration and imitation of foreign firm's technology through observation of its output. This is because output (sales) instead of employment was used for the calculation of spillover measures. This different measure of spillovers revealed different mechanisms for the transmission of the spillovers in manufacturing and services. The results showed differences in the significance of the spillover estimates in both sectors and countries. The estimates of the vertical spillovers in manufacturing in Croatia in the baseline model were larger and more significant than the previous measures. The forward spillovers turned positive and significant, the backward spillovers gained further negative significance, while the horizontal spillovers remained unchanged. In Slovenia, the backward spillovers turned positive and significant for manufacturing. This robustness check reveals that, in manufacturing, the positive and negative effects of the transmission of spillovers are better captured via a different measure of spillovers. Considering the greater significance of estimates obtained with the new spillover measure, the results suggest that foreign knowledge in manufacturing is transmitted more effectively through observation of foreign firms' products than through labour mobility, which the earlier measure accounts for.

In services in both countries, the estimated size of the coefficients of the spillovers decreases: the forward spillovers in both countries lose their positive significance, while the negative horizontal spillovers in Slovenia lose their significance too. This finding suggests that the spillovers in services occur mainly through labour mobility, as mentioned earlier (Kloosterman, 2008). Therefore, the previous measure of spillovers may capture the effects of the spillovers in services better. The results are not surprising. Manufacturing is characterised by tangible products that are easily observed and learnt from, while services require face-to-face interaction between individuals for knowledge transmission to occur (Bekkers et al., 2017). The results suggest that different measures of spillovers may account for different mechanisms of knowledge transmission. Printouts of these estimations are available upon request.