

Cariolle, Joël; Le Goff, Maëlan

Working Paper

Spatial internet spillovers in manufacturing

FERDI Working Paper, No. P288

Provided in Cooperation with:

Fondation pour les études et recherches sur le développement international (FERDI),
Clermont-Ferrand

Suggested Citation: Cariolle, Joël; Le Goff, Maëlan (2021) : Spatial internet spillovers in manufacturing, FERDI Working Paper, No. P288, Fondation pour les études et recherches sur le développement international (FERDI), Clermont-Ferrand

This Version is available at:

<https://hdl.handle.net/10419/269568>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

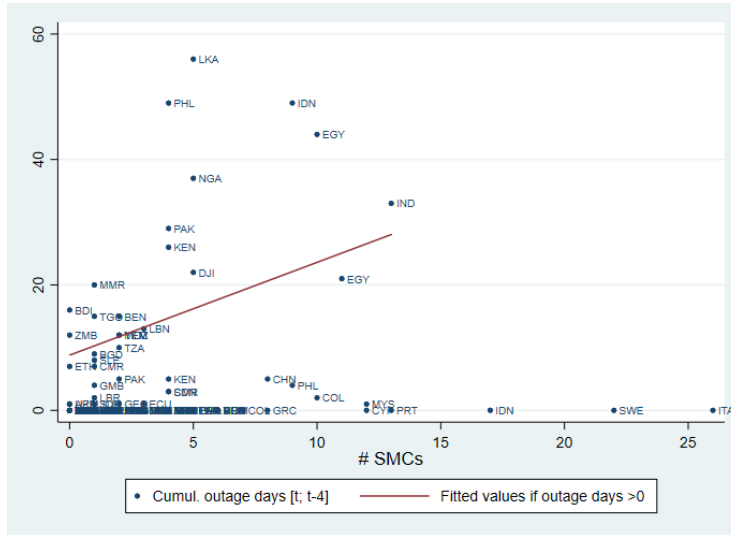
If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Spatial internet spillovers in manufacturing

Online Appendix

Appendix A. Instrumental Variable setting.

Appendix A.1. SMC number versus cumulative outage days



Appendix A.2. Instrument set calibrations.

Dep. Var: Total sales (ln, USD)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	First stage estimates							Reduced form estimations		
	Baseline sample					Excl. East-Asia & Pac	Unrestricted IVs	Baseline sample		
IV1	0.03584***	0.183***	.1853***	0.1902***			0.1903***	0.5159***		-0.0273
	(0.0021)	(0.0576)	(0.0577)	(0.0582)			(.0583)	(0.0338)		(0.231)
IV2 -- calibrations ($\tau_1 = 0; \tau_2 = 2$)		-0.0078***								
		(0.0030)								
($\tau_1 = 0; \tau_2 = 3$)			-0.0105***							
			(0.0040)							
($\tau_1 = 0; \tau_2 = 4$)				-0.0137***	0.0019***	-0.0712***	-0.0137***		0.0460***	0.0482**
				(0.0050)	(0.000158)	(0.02698)	(0.0050)		(0.00351)	(0.0216)
Control variables:										
Email adoption	-0.0052**	-0.0056***	-0.0056***	-0.0056***	-0.0048*	-0.0041***	-0.0054***	-	-	-
	(0.0024)	(0.0021)	(0.0021)	(0.0021)	(0.0026)	(0.0008)	(0.0023)	-	-	-
Website adoption	0.0015***	0.0016***	0.00156***	0.0016***	0.0014***	0.00098**	0.0018***	-	-	-
	(0.0003)	(0.0003)	(0.00036)	(0.00036)	(0.0004)	(0.00045)	(0.0004)	-	-	-
Exports	0.0000	-0.0000	-0.0000	-0.0000	0.0000	-0.0000	0.0000	-	-	-
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	-	-	-
Initial # perm. FT employees	-0.00015	-0.00006	0.0000	-0.00006	-0.00014	-0.00016	-0.00006	-	-	-
	(0.00012)	(0.0001)	(0.0001)	(0.00016)	(0.00012)	(0.00023)	(0.00015)	-	-	-
% non-production workers	-0.0068**	-0.0059**	-0.0058**	-0.0058**	-0.0063**	-0.0011	-0.0041**	-	-	-
	(0.0035)	(0.0027)	(0.0027)	(0.0027)	(0.00318)	(0.0007)	(0.0020)	-	-	-
% skilled workers	0.0042	0.0042	0.00424	0.0043	0.0042	0.0005*	0.0060	-	-	-
	(0.0037)	(0.0037)	(0.0037)	(0.00374)	(0.0037)	(0.0003)	(0.00398)	-	-	-
Manager exp	-0.0019	-0.0019	-0.0019	-0.0019	-0.0023	0.00008	-0.0018	-	-	-
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0017)	(0.00032)	(0.0014)	-	-	-
Firm's age	0.0020	0.0018	0.0018	0.0017	0.00219	-0.00037	0.00165	-	-	-
	(0.0016)	(0.0013)	(0.0013)	(0.0013)	(0.0017)	(0.0003)	(0.00128)	-	-	-
% of foreign ownership	-0.0000	-0.0000	-0.0000	-0.0000	0.0000	0.00002**	-7.92E-06	-	-	-
	(0.0000)	(0.0000)	(0.0000)	(0.00001)	(0.0000)	(0.00001)	(0.00001)	-	-	-
% of state ownership	-0.00001*	-0.00001**	-0.00001*	-0.00001**	-0.000013*	-0.00006***	-0.00003**	-	-	-
	(0.000006)	(0.0000)	(0.0000)	(0.0000)	(0.000007)	(0.00002)	(0.00001)	-	-	-
Bank loan (0 or 1)	0.0019	0.0017*	0.0017*	0.0017*	0.0019	0.00057**	0.0019	-	-	-
	(0.0012)	(0.00099)	(0.00099)	(0.00099)	(0.0012)	(0.0002)	(0.0012)	-	-	-
Electricity obstacle	0.00115	0.0009	0.0009	0.0009	0.0011	-0.0003**	0.00080	-	-	-
	(0.00096)	(0.00076)	(0.00076)	(0.00075)	(0.0009)	(0.00012)	(0.00068)	-	-	-
Distance to connectivity infra	0.0095***	0.0468***	0.0472***	0.0484***	0.00059	0.0010	0.0495	-	-	-
	(0.0019)	(0.0148)	(0.0148)	(0.0149)	0.00202	(0.0021)	(0.0159)	-	-	-

	Second-stage estimates									
<i>Internet</i>	14.397***	3.868***	3.805***	3.620***	24.07***	8.944***	3.596***	-	-	-
	(1.385)	(0.734)	(0.728)	(0.712)	(1.564)	(1.924)	(0.711)	-	-	-
Email adoption	0.695***	0.648***	0.648***	0.647***	0.738***	0.732***	0.661***	0.620***	0.622***	0.622***
	(0.0774)	(0.0982)	(0.0983)	(0.0987)	(0.0651)	(0.0882)	(0.0946)	(0.1026)	(0.103)	(0.103)
Website adoption	0.640***	0.655***	0.655***	0.655***	0.627***	0.701***	0.665***	0.6623***	0.662***	0.662***
	(0.0589)	(0.0562)	(0.0562)	(0.0562)	(0.0620)	(0.0557)	(0.0554)	(0.0565)	(0.0566)	(0.0565)
Exports (% sales)	0.00615***	0.0063***	0.0063***	0.0063***	0.0060***	0.00863***	0.00661***	0.0062***	0.00620***	0.00620***
	(0.00152)	(0.00151)	(0.00151)	(0.00151)	(0.00153)	(0.00106)	(0.00160)	(0.0015)	(0.0015)	(0.0015)
Initial # perm. FT employees	0.655***	0.653***	0.653***	0.653***	0.656***	0.552***	0.651***	0.6526***	0.652***	0.652***
	(0.0373)	(0.0375)	(0.0375)	(0.0375)	(0.0370)	(0.0454)	(0.0375)	(0.0375)	(0.0375)	(0.0374)
% non-production workers	0.268	0.213	0.213	0.212	0.318	0.177	0.210	0.1696	0.166	0.166
	(0.176)	(0.155)	(0.155)	(0.154)	(0.194)	(0.188)	(0.144)	(0.138)	(0.137)	(0.136)
% skilled workers	-0.554***	-0.510***	-0.510***	-0.509***	-0.595***	-0.480***	-0.500***	-0.4933***	-0.493***	-0.493***
	(0.0718)	(0.0455)	(0.0454)	(0.0452)	(0.101)	(0.0839)	(0.0446)	(0.0416)	(0.0414)	(0.0414)
Manager exp	0.0625	0.0328	0.0327	0.0321	0.0897	0.0399	0.0352	0.0350	0.0350	0.0349
	(0.0558)	(0.0547)	(0.0547)	(0.0548)	(0.0640)	(0.0339)	(0.0498)	(0.0562)	(0.0563)	(0.0563)
Firm's age	0.166***	0.192***	0.192***	0.192***	0.143**	0.298***	0.152***	0.1950***	0.196***	0.196***
	(0.0535)	(0.0485)	(0.0485)	(0.0485)	(0.0622)	(0.0465)	(0.0472)	(0.0479)	(0.0479)	(0.0480)
% of foreign ownership	0.00786***	0.00774***	0.00774***	0.00774***	0.00797***	0.00829***	0.0072***	0.0078***	0.0078***	0.0078***
	(0.000943)	(0.00095)	(0.00095)	(0.00095)	(0.00096)	(0.00185)	(0.000992)	(0.0009)	(0.0009)	(0.0009)
% of state ownership	0.00533***	0.00516***	0.00516***	0.00516***	0.00549***	-0.00114	0.00517***	0.0052***	0.0052***	0.0052***
	(0.000817)	(0.00086)	(0.00086)	(0.00086)	(0.00079)	(0.00454)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Bank loan	0.529***	0.547***	0.548***	0.548***	0.511***	0.568***	0.545***	0.5559***	0.557***	0.557***
	(0.0546)	(0.0484)	(0.0483)	(0.0482)	(0.0604)	(0.0768)	(0.0478)	(0.0464)	(0.0462)	(0.0461)
Electricity obstacle	0.0316	0.0407	0.0408	0.0410	0.0232	0.0281*	0.0294	0.0481*	0.0488*	0.0489*
	(0.0313)	(0.0280)	(0.0280)	(0.0279)	(0.0353)	(0.0163)	(0.0280)	(0.0269)	(0.0269)	(0.0269)
Distance to connectivity infra	-0.0646**	-0.0565***	-0.0564***	-0.0563***	-0.0720	-0.0679**	-0.0560***	0.0721***	-0.0579***	-0.0648
	(0.0329)	(0.0208)	(0.0208)	(0.0207)	(0.0500)	(0.0267)	(0.0207)	(0.0231)	(0.0202)	(0.0650)
Control variables (X_{it}) & FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kleibergen-Paap Wald F stat	281.55	118.33	119.40	125.62	146.01	6.97	125.91	-	-	-
LM stat	1.995	8.377**	8.416**	8.595**	1.685	1.769	8.629**	-	-	-
Hansen J test (P-val.)	-	0.19	0.20	0.20	-	-	0.19	-	-	-
<i>N</i>	40,154	40,154	40,154	40,154	40,154	33,820	42,245	40,154	40,154	40,154

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates of 1st-stage equation not reported. Standard errors are presented in parentheses, and are robust to heteroscedasticity and clustered by country-year of survey. In column (7), we consider internet outages induced by natural hazards and government interventions in IV2 computation.

Appendix A.3. IV1 decomposition and identification restrictions.

	(1)	(2)	(3)	(4)		
IV1's fixed component:	Ln distance infrastructure			Connectivity shocks		
<i>Internet</i>	14.05***	21.66***	3.135***	2.411	-5.508***	0.472
	(0.827)	(1.353)	(0.459)	(2.781)	(0.627)	(2.157)
	1st stage estimates					
IV1	0.018***		0.1291***	0.0631***		0.0654***
	(0.0008)		(0.03081)	(0.0313)		(0.0315)
IV2 [†]		0.00036***	-0.0032***		-0.0156***	-0.0174***
		0.00003	(0.0009)		(0.00097)	(0.0014)
X _{it} & FEs (<i>d_{jt}</i> , <i>d_l</i> , <i>d_k</i>)	Yes	Yes	Yes	Yes	Yes	Yes
KP Wald F stat	514.037	198.905	775.608	4.043	259.67	128.99
Hansen J test (P-val.)	-	-	0.20	-	-	0.14
N	40,154	40,154	40,154	40,154	40,154	40,154
R ²	0.339	0.293	0.369	0.370	0.363	0.370

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates not reported. Standard errors, presented in parentheses, are robust to heteroscedasticity and clustered by country-year of survey. In columns (1)-(2), the IV weighting factor (distance to infrastructure) is set to its value at the first survey wave, while in columns (3)-(4), the number of SMCs is set to its value at the first survey wave.

[†] In order to be able to fix IV2's components, we had to make IV2's calculation differing slightly from equation (4), since here, we weight the sum of outage days over (t; t-4) with the location distance to infrastructure (km, ln) measured at the year of survey. As reminder, IV2 is the 5-year average of the product between lagged values of outages days and location distance to infrastructure.

Appendix B. Robustness checks

Appendix B.1. Controlling for unobserved local economic performance, pre-trend, and non-random exposure to shocks.

	(1)	(2)	(3)	(4)	(5)
Dep var: total sales	Local econ. activity		Pre-trend[†]		Non-random exposure
Internet spillovers	3.131***	2.765***	-2.943	-	3.145***
	(0.845)	(0.840)	(2.083)	-	(1.060)
Epsilon _{Y_i}	-0.118**	-0.127**	-	-	-
	(0.0576)	(0.054)	-	-	-
	First stage estimations				
IV1	0.1933**	0.1988***	0.1948***	-0.6745	
	(0.0765)	(0.065)	(0.0603)	(0.7094)	
IV2 - calibration (t;t-4)	-0.0140**	-0.0147**	-0.0140***	0.0791	
	(0.0069)	(0.0061)	(0.0053)	(0.0612)	
Recentered IV1					0.2054***
					(0.0605)
Recentered IV2					-0.0148***
					(0.0053)
X _{it} + FEs (<i>d_{jt}</i> , <i>d_l</i> , <i>d_k</i>)	Yes	Yes	Yes	Yes	Yes
Epsilon_OLS _{Y_i}	Yes	No	-	-	-
Epsilon_IV _{Y_i}	No	Yes	-	-	-
KP Wald F-stat	109.58	70.39	120.79	-	249.266
Hansen J test (P-val.)	0.19	0.19	0.30	-	0.19
N	40,154	40,154	40,861	38,321	40,154

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates not reported. Standard errors, presented in parentheses, are robust to heteroscedasticity and clustered by country-year of survey.

[†] In columns (3) and (4) the dependent variable is the 3-year lagged total sales. In column (4), a reduced form of our model is estimated, consisting in estimating the direct effect of IV1 and IV2 on the 3-year lagged total sales. In column (5), we generate counterfactual SMC-number (IV1) and outage-days (IV2) shocks from a normal distribution with mean and standard deviation equal to the corresponding moments of these variables' historic distribution.

Appendix B.2. Controlling for unobserved inter-industry linkages and output characteristics.

Dep var: total sales (Ln, USD)	(1)	(2)	(3)	(4)
	Inter-industry FE		ISIC product FE	
(A) $\overline{Internet}$	3.434*** (0.638)		3.443*** (0.655)	
(B) $\overline{Internet_inter}$		-15.895*** (3.136)		-15.174*** (2.044)
(C) $\overline{Internet_intra}$		22.951*** (3.130)		21.962*** (2.796)
1st-stage statistics				
Weak-id SW F-stat :				
(A)	125.58***		132.93***	
(B)		21.09***		22.64***
(C)		51.94***		50.92***
Under-id Chi-2 stat:				
(A)	256.74***		272.71***	
(B)		21.56***		23.22***
(C)		53.10***		52.24***
Controls	Yes	Yes	Yes	Yes
Country-year FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	No	No
Location FE	Yes	Yes	Yes	Yes
Industry-pair FE	Yes	Yes	No	No
4-digit ISIC product FE	No	No	Yes	Yes
N	40,154	39,673	39,975	39,503

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates not reported. Standard errors, presented in parentheses, are robust to heteroscedasticity and clustered by country-year of survey.

Appendix B.3. Excluding landlocked countries.

Dep var (Ln, USD):	(1)	(2)	(3)	(4)
	Total sales		Sales per worker	
(A) $\overline{Internet}$	2.953*** (0.508)		3.500*** (0.524)	
(B) $\overline{Internet_inter}$		-15.824*** (3.1047)		-13.073*** (2.009)
(C) $\overline{Internet_intra}$		23.236*** (3.132)		20.286*** (1.768)
1st-stage statistics				
Weak-id SW F-stat :				
(A)	137.63		137.63	
(B)		18.67		18.67
(C)		48.44		48.44
Under-id Chi-2 stat:				
(A)	281.83		281.83	
(B)		19.12		19.12
(C)		49.61		49.61
$X_{it} + FEs (d_{jt}, d_l, d_k)$	Yes	Yes	Yes	Yes
Hansen test p-val.	0.19	-	0.21	-
N	34,662	34,344	34,662	34,344

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates not reported. Standard errors, presented in parentheses, are robust to heteroscedasticity and clustered by country-year of survey.

Appendix B.4. Internet spillovers for inward-oriented SMEs.

	(1)	(2)	(3)	(4)
Dep var (Ln, USD):	Total sales		Sales per worker	
(A) <i>Internet</i>	1.061** (0.548)		1.358** (0.585)	
(B) <i>Internet_inter</i>		-7.727*** (0.885)		-5.949*** (1.159)
(C) <i>Internet_intra</i>		10.01*** (0.787)		8.087*** (0.933)
	1st-stage statistics			
Weak-id SW F-stat :				
(A)	123.97		123.97	
(B)		71.35		71.35
(C)		174.14		174.14
Under-id Chi-2 stat:				
(A)	256.63		256.63	
(B)		73.86		73.86
(C)		180.27		180.27
$X_{it} + \text{FEs } (d_{jt}, d_l, d_k)$	Yes	Yes	Yes	Yes
Hansen test p-val.	0.23	-	0.26	-
<i>N</i>	22,040	21,761	22,040	21,761

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates not reported. Standard errors, presented in parentheses, are robust to heteroscedasticity and clustered by country-year of survey.

Appendix B.5. Internet spillovers in locations with $N \geq 50$ observations.

	(1)	(2)	(3)	(4)
Dep var (Ln, USD):	Total sales		Sales per worker	
(A) <i>Internet</i>	3.466*** (0.508)		3.694*** (0.514)	
(B) <i>Internet_inter</i>		-16.298*** (3.485)		-14.934*** (2.878)
(C) <i>Internet_intra</i>		21.947*** (2.447)		20.371*** (1.648)
	1st-stage statistics			
Weak-id SW F-stat :				
(A)	115.44		115.44	
(B)		29.21		29.21
(C)		73.65		73.65
Under-id Chi-2 stat:				
(A)	235.57		235.57	
(B)		29.81		29.81
(C)		75.15		75.15
$X_{it} + \text{FEs } (d_{jt}, d_l, d_k)$	Yes	Yes	Yes	Yes
Hansen test p-val.	0.20	-	0.21	-
<i>N</i>	38,622	38,326	38,622	38,326

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates not reported. Standard errors, presented in parentheses, are robust to heteroscedasticity and clustered by country-year of survey.

Appendix C. Additional estimations.

Appendix C.1. Intra and inter-industry internet spillovers, with alternative industry grouping.

Dep var (Ln, USD): total sales	(1)	(2)	(3)
(A) $\overline{Internet_inter}$	-13.073*** (1.855)	-26.050*** (3.479)	
(B) $\overline{Internet_intra}$	18.970*** (1.606)		188.30 (207.62)
(C) $\overline{Internet_inter}^2$		28.770*** (2.565)	
(C) $\overline{Internet_intra}^2$			-163.27 (196.45)
$\overline{Internet_intra}$		0.821*** (0.3098)	
$\overline{Internet_inter}$			-6.456 (6.807)
Weak-id SW F-stat :			
(A)	30.90	81.91	3.75
(B)	124.37		
(C)		151.31	3.50
Under-id Chi-2 stat:			
(A)	31.59	83.75	3.83
(B)	127.16		
(C)		154.70	3.58
$X_{it} + FEs (d_{jt}, d_l, d_k)$	Yes	Yes	Yes
Lind & Melhum U-shape T-test (threshold)	-	7,49*** (0.45)	0.75 (0.58)
N	39,516	39,673	39,673

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates not reported. Standard errors, presented in parentheses, are robust to heteroscedasticity and clustered by country-year of survey. Compared to Table 5, i) firms operating in “manufactures of rubber and plastic products” and “manufactures-sales-maintenance of motor vehicles” sectors have been dropped from the “manufacture of vehicle, machinery and equipment” industry, and considered as separate industries; ii) firms (91) operating in “mining” and “manufacture of petroleum products” sectors have been dropped from the “Manufacture of extracted resource” industry. See Appendix B.4.

Appendix C.2. Internet spillovers and outward orientation.

Var. dep.: Total sales (Ln, USD)	(2)	(3)	(4)
(A) $\overline{Internet_inter}$	-5.487 (5.082)	-5.430 (3.533)	2.546 (2.861)
(B):			
$\overline{Internet_inter}$ x dir. & indir. exports	1.323*** (0.301)		
$\overline{Internet_inter}$ x foreign own.		80.50*** (16.53)	
$\overline{Internet_inter}$ x multi-plant.			51.48*** (4.919)
$\overline{Internet_inter}$ x inward. orient.			
$\overline{Internet_inter}$ x website adopt.			
Interaction var.	-0.858*** (0.217)	-52.35*** (10.97)	-33.55*** (2.854)
Weak-id SW F-stat :			
(A)	5.06	5.06	94.36
(B)	18.03	37.57	96.48
Under-id Chi-2 stat:			
(A)	5.18	5.17	76.70
(B)	18.43	38.41	96.48
$X_{it} + FEs (d_{jt}, d_l, d_k)$	Yes	Yes	Yes

N
40,154
39,280
40,154

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates not reported. Standard errors are presented in parentheses, and are robust to heteroscedasticity and clustered by country-year of survey.

Appendix C.3. Internet spillovers and workforce composition.

	(2)	(3)	(4)	(5)
Var. dep.: Employment variables (Ln, #)	# FT perm. workers	FT temp. workers	FT perm. non prod. work.	FT perm. prod. workers
<i>Internet</i>	-1.019*** (0.293)	0.129 (0.476)	-1.482*** (0.334)	-1.207*** (0.290)
IV1	0.01902*** (0.0582)	0.19105*** (0.0581)	0.01902*** (0.0582)	0.1902*** (0.0582)
IV2	-0.0137*** (0.0050)	-0.0137*** (0.0050)	-0.0137*** (0.0050)	-0.0137*** (0.0587)
Controls + FEs	Yes	Yes	Yes	Yes
Total sales (ln, USD))	Yes	Yes	Yes	Yes
F-stat	124.58	125.72	124.58	124.58
Hansen J test (P-val.)	0.23	0.14	0.21	0.20
X_{it} + FEs (d_{jt} , d_l , d_k)	Yes	Yes	Yes	Yes
N	40,154	39,280	40,154	40,154

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates not reported. Standard errors are presented in parentheses, and are robust to heteroscedasticity and clustered by country-year of survey.