

Do network's externalities improve economic performance? An empirical analysis at NUTS-3 level

Luca Bettarelli and Laura Resmini

University of Milan-Bicocca
Department of Sociology

Bolzano, 17-09-2018

Objective and motivations

- Understanding whether and to what extent local economies benefit from being internationally connected;
- MNCs integrate different nations and subnational territories into Global Production Networks (GPNs) which are by far the dominant way of production worldwide (OECD, 2013).

Objective and motivations

- This paper combines two strands of literature:
 - the one focusing on GVCs, which is still silent on the nature and the magnitude of the potential benefits accruing to host economies (Dunning, 1977; Crescenzi et al., 2014);
 - the one investigating the determinants of regional growth, with a specific focus on the composition of the production base [agglomeration theories, related/unrelated variety (Jacobs, 1969; Krugman, 1991, Feser, 2002...)].

Theoretical background: MNEs

- MNCs cross national borders to save on transaction and trading costs and/or to exploit the value-added chain;
- MNCs may improve the efficiency and the productivity of host regions (Dunning, 1977);
- Productivity spillovers are determined by spatial proximity, i.e. they materialize thanks to the presence of foreign affiliates that interact directly or indirectly with local firms (Crespo and Fontoura, 2007).

Theoretical background: GPNs

- Recent regional economics literature has emphasized the need to place the idea of localization into the wider context of economic globalization, so as to account for the whole spectrum of externalities deriving from the interaction between local and non-local agents (Crescenzi and Iammarino, 2017).
- GPNs not only integrate firms into structures that blur traditional organizational boundaries, but also integrate locations throughout the World in a complex and variegated manner, thus extensively affecting local economic conditions and development paths (Crescenzi et al., 2014).

Theoretical background: Network

- Networks facilitate exchanges both within (local networks) and between agglomerations (the nodes) (Johansson, Quigley, 2004);
- Networks may act as a substitute for proximity in the process of knowledge diffusion/production where “complementarity” gains importance as the spatial distance increases (Capello and Caragliu, 2016);
- However, lack of empirical evidence (Pain et al., 2016; Neil et al., 2016).

This paper ...

... by exploring several network characteristics - such as intensity, spatial dispersion, sector diversification -, addresses the following research questions:

- Does network participation affect the economic performance at local level?
- Are there differences between inward and outward networks?
- Is the network complementary/synergetic to local specialization?

Data

- 110 Italian provinces (NUTS-3 classification);
- **Inward network**: foreign global ultimate owners (GUOs) located throughout the World (7 macro-regions, no Italy) which own at least a subsidiary in Italy;
- **Outward network**: Italian GUOs which own at least a subsidiary abroad (7 macro-regions);
- Definition of GUO: min. path of 25.01% leading to the GUO.
Source: Orbis/Amadeus.

Provinces' connectedness is split according to the following 5 NACE-categories (550 observations):

Nace-category	2-digit sectors
Agriculture, forestry and fishing, mining (AGR)	01 02 03 04 05 06 07 08 09
Construction and public utilities (CONPU)	35 36 37 38 39 41 42 43
Capital intensive services (KIS)	50 51 58 59 60 61 62 63 64 65 66 69 70 71 72 73 74 75 78 80 84 85 86 87 88 90 91 92 93
Low capital intensive services (LKIS)	45 46 47 49 52 53 55 56 68 77 79 81 82 94 95 96 97 98 99
Manufacturing (MANIF)	21 26 27 28 29 30 10 11 12 13 14 15 16 17 18 31 32 19 22 23 24 25 33

KIS outward network is composed of subsidiaries operating into KIS 2-digit sectors, regardless of the GUO sector.

Methodology

- We estimate the following FE regressions:

$$Y_{i,t,s} = \alpha + \beta Int_{i,s,t_0} + \delta SectDiv_{i,s,t_0} + \gamma GeoDisp_{i,s,t_0} + \theta NetComp_{i,s,t_0} + \rho X_{i,s,t_0} + \sigma_i + \tau_s + \varepsilon_{i,s}$$

- Y is the percentage change of Gross Value Added and Productivity between 2007-2015, 2007-2011, 2012-2015;
- Int , $SectDiv$, $GeoDisp$ and $NetComp$ characterize provinces' connectedness;
- X is a vector of controls at province/nace-category level (specialization, island, Y_{t_0});
- σ and τ are province and nace-category fixed effects, respectively.

Provinces' connectedness indices (*Int*): Intensity

At network level:

- **Network Intensity (IntNet):** $I = \sum_{i,s} EF_{i,s} / \max EF_s \in [0, 1]$

Number of EFs by province/sector over the maximum number of EFs by sector, where EF indicates external firms with respect to the province i (thus, EF is a subsidiary or a guo for outward and inward network, respectively);

At province level:

- **Local Intensity (IntLoc):** number of local firms by province-sector, over the maximum number of local firms by sector. Local firms are GUOs or subsidiaries for outward and inward networks, respectively.

Network sector diversification (*SectDiv*) indices 4-digit NACE

At network level: We compute Unrelated Variety at 2-digit nace level, while Related Variety is defined as the weighted sum of diversification at the 4-digit level within each 2-digit class.

- **Unrelated variety** (in terms of number of EFs):

$$UV = \sum_{g=1}^G P_g \ln\left(\frac{1}{P_g}\right)$$

where P_g represents the share of EFs in the 2-digit class g , over the total number of EFs.

- **Related variety:** weighted sum of diversification within each NACE 2-digit class (in terms of number of EFs):

$$RV = \sum_{g=1}^G P_g H_g$$

where:

$$H_g = \sum_{i \in S_g} \frac{p_i}{P_g} \ln\left(\frac{1}{p_i/P_g}\right)$$

where S_g is a 2-digit class, P_g is a 2-digit class share over the entire set of 2-digit classes (the number of which is G), and p_i is the 4-digit share.

Network sector diversification: Intuitions

- *Unrelated variety* indicates that network provides diversified competencies and/or protect a province from asymmetric shocks by differentiating the composition of the production base (Haug, 2004);
- *Related variety* indicates that networks composed of firms operating within complementary sectors positively impact on the economic performance, thanks to knowledge spillovers (Van Oort, 2004).

Geo dispersion of the network

Geo macro-areas (INTER)	N. countries (INTRA-in)	N. countries (INTRA-out)	% subs (out)	% guos (in)
EU-28 (28)	28	28	65	68
North America (2)	2	2	7	17.5
South-Centre America (35)	10	12	16.5	3
Africa (54)	7	10	2.5	0.5
Oceania (14)	2	2	1	0.5
Middle East (14)	9	6	1	1.5
Far East (34)	12	10	7	9
Total number			12807	14651

Network geo dispersion (*GeoDisp*)

At network level: We define r as one macro-region, where m is the total number of macro-regions, and c a country within a macro-region r .

- **INTER**-regional dispersion across macro-regions (in terms of number of EFs):

$$INTER = \sum_{r=1}^m P_i^r \ln\left(\frac{1}{P_i^r}\right)$$

where P_i^r is the proportion of the r_{th} region to the province i 's total number of EFs in all regions.

- **INTRA**-regional dispersion within macro-regions (in terms of number of EFs).

Two steps: i) EFs within each macro-region; ii) EFs in all regions, by adding each of them:

$$i) INTRA_{rc} = \sum_{c \in r} P_{cr}^r \ln\left(\frac{1}{P_{cr}^r}\right)$$

where P_{cr}^r is the proportion of EFs in the c_{th} country to the total number of EFs of the r_{th} macro-region.

$$ii) INTRA_m = \sum_{r=1}^m P_{rm}^m \times INTRA_{rc}$$

where $INTRA_m$ is the weighted average of $INTRA_{rm}$, the weight being equal to P_{rm}^m .

Network geo dispersion: Intuitions

- INTRA indicates that the optimal strategy is to take advantage of spatial-proximity and locally bounded country-specific specializations, without running into high fix costs in terms of, e.g., knowledge of institutions, markets, entry modes, legal procedures (Contractor, 2007; Nachum et al., 2008);
- INTER advantages include access to diversified resources and capabilities that may be internationally spread. Therefore, it may operate as a risk-diversification tool against shocks that hit international areas in a different way (Wan and Hoskisson, 2003).

- **NetComp** indicates whether the network is complementary to the province's specialization;

Define $Lqprov$ as the province's location quotient in terms of employment (by province i /nace-category s):

$$Lqprov_{is} = \frac{empl_{is}/empl_i}{empl_s/empl}$$

and $Lqnet$ as the network's location quotient in terms of number of EFs (by province i /nace-category s)

$$Lqnet_{is} = \frac{EF_{is}/EF_i}{EF_s/EF}$$

Then, we have specialization if $Lqprov, Lqnet > 1$

- **NetComp** is a dummy equal to one if $Lqprov > 1$ and $Lqnet \leq 1$ or viceversa (within each nace-category), zero otherwise.

	Mean	SD	NorthE	NorthW	Centre	South	Islands
Network outward							
IntNet	3.73	12.2	5.14	8.36	3.31	0.28	0.21
IntLoc	0.67	1.76	1.05	1.47	0.51	0.10	0.06
RV	0.34	0.43	0.71	0.48	0.31	0.07	0.04
UV	1.23	1.00	2.04	1.75	1.35	0.38	0.33
INTRA	0.80	0.76	0.97	1.13	0.87	0.20	0.18
INTER	0.58	0.48	0.97	0.70	0.66	0.21	1.18
Network inward							
IntNet	3.76	13.0	4.19	9.33	2.89	0.58	0.56
IntLoc	6.17	24.2	6.36	15.4	5.03	1.09	0.76
RV	0.29	0.25	0.45	0.37	0.33	1.41	0.09
UV	1.98	0.89	2.66	2.48	2.14	1.25	1.02
INTRA	1.19	0.54	1.55	1.48	1.27	0.82	0.61
INTER	0.64	0.37	0.84	0.75	0.76	0.39	0.37

Network complementarity: the share of individual networks created by GUO-SUB which operate in different NACE-categories.

	network out	network in
AGR	96.8	83
CONPU	67	45
KIS	52	60
LKIS	76	46
MANIF	41	59
TOT	61.4	57

Outward Network					
Tot	Agr	Conpu	Kis	Lkis	Manif
Milano	Roma	Roma	Milano	Milano	Milano
Roma	Milano	Milano	Roma	Roma	Bologna
Torino	Alessandria	Genova	Torino	Treviso	Torino
Bologna	Torino	Forlì	Genova	Torino	Roma
Treviso	Forlì	Ravenna	Bologna	Bologna	Treviso

Inward Network					
Tot	Agr	Conpu	Kis	Lkis	Manif
Milano	Milano	Milano	Milano	Milano	Milano
Roma	Roma	Roma	Roma	Roma	Torino
Torino	Siena	Bolzano	Treviso	Torino	Roma
Bologna	Venezia	Torino	Bolzano	Monza	Brescia
Treviso	Firenze	Bologna	Bologna	Bolzano	Bergamo

Dep.Var.	GVA(07-15)		GVA(07-11)		GVA(12-15)	
	(1)	(2)	(3)	(4)	(5)	(6)
IntNet	0.21*** (0.07)	0.20*** (0.07)	0.05 (0.05)	0.01 (0.09)	0.19*** (0.05)	0.18*** (0.04)
IntLoc	0.05* (0.03)	0.05* (0.03)	0.08*** (0.02)	0.08*** (0.02)	0.06** (0.03)	0.02** (0.01)
RV	0.03 (0.03)		-0.06* (0.03)		-0.01 (0.02)	
UV	0.05*** (0.02)		0.03* (0.01)		0.07** (0.02)	
Intra		0.02 (0.02)		-0.02 (0.03)		0.02 (0.02)
Inter		0.08*** (0.02)		0.04* (0.02)		0.12*** (0.01)
Spec	0.12*** (0.03)	0.07*** (0.03)	0.04** (0.02)	0.05** (0.03)	0.08*** (0.01)	0.09*** (0.02)
Netcomp	0.04*** (0.01)	0.04*** (0.01)	0.01 (0.01)	0.01 (0.01)	0.03*** (0.01)	0.03*** (0.01)
Isl	-0.05** (0.02)	-0.04** (0.01)	0.01 (0.02)	-0.01 (0.02)	-0.04** (0.01)	-0.02** (0.00)
Gva _{to}	-0.09*** (0.03)	-0.09*** (0.03)	0.03 (0.02)	0.03 (0.03)	-0.08*** (0.00)	-0.09*** (0.02)

Dep.Var.	Prody(07-15)		Prody(07-11)		Prody(12-15)	
	(1)	(2)	(3)	(4)	(5)	(6)
IntNet	0.41*** (0.17)	0.35*** (0.09)	-0.12 (0.25)	-0.15 (0.25)	0.41*** (0.06)	0.45* (0.09)
IntLoc	0.12* (0.07)	0.08* (0.5)	0.21*** (0.04)	0.28*** (0.04)	0.11** (0.05)	0.17* (0.08)
RV	0.22*** (0.03)		0.06 (0.04)		0.32*** (0.09)	
UV	-0.03 (0.03)		0.05* (0.03)		-0.02 (0.04)	
Intra		0.15** (0.06)		-0.05 (0.04)		0.17** (0.07)
Inter		-0.06 (0.08)		0.06* (0.03)		-0.05 (0.06)
Spec	0.31*** (0.06)	0.31*** (0.06)	0.13 (0.11)	0.08 (0.06)	0.40*** (0.06)	0.42*** (0.06)
Netcomp	0.14*** (0.05)	0.15*** (0.06)	-0.04 (0.05)	-0.05 (0.05)	0.19*** (0.04)	0.19*** (0.06)
Isl	-0.04** (0.01)	-0.04* (0.02)	-0.02 (0.03)	-0.02 (0.03)	-0.05* (0.02)	-0.03* (0.01)
Prody _{to}	-0.02*** (0.00)	-0.03*** (0.00)	0.01 (0.01)	0.01 (0.01)	-0.04*** (0.00)	-0.02*** (0.00)

Dep.Var.	GVA(07-15)		GVA(07-11)		GVA(12-15)	
	(1)	(2)	(3)	(4)	(5)	(6)
IntNet	-0.22 (0.14)	-0.16 (0.21)	-0.03 (0.03)	-0.02 (0.03)	-0.21* (0.14)	-0.15 (0.12)
IntLoc	0.26** (0.12)	0.21** (0.16)	0.15 (0.13)	0.19 (0.18)	0.41*** (0.08)	0.38*** (0.6)
RV	-0.03 (0.03)		-0.01 (0.02)		-0.01 (0.02)	
UV	0.04** (0.02)		0.02** (0.01)		0.04** (0.02)	
Intra		0.02 (0.02)		-0.02* (0.01)		0.02 (0.03)
Inter		0.10*** (0.03)		0.01 (0.02)		0.11*** (0.03)
Spec	0.13*** (0.03)	0.12*** (0.03)	0.04** (0.02)	0.04** (0.02)	0.08*** (0.01)	0.06*** (0.02)
Netcomp	-0.04* (0.02)	-0.03** (0.01)	0.01 (0.01)	0.01 (0.03)	-0.04** (0.01)	-0.04** (0.02)
Isl	-0.03 (0.04)	-0.02 (0.04)	-0.02 (0.02)	-0.02 (0.02)	-0.08 (0.08)	-0.06 (0.05)
Gva _{LO}	-0.08*** (0.03)	-0.09*** (0.03)	0.01*** (0.00)	-0.05*** (0.02)	-0.06*** (0.02)	-0.07*** (0.01)

Dep.Var.	Prody(07-15)		Prody(07-11)		Prody(12-15)	
	(1)	(2)	(3)	(4)	(5)	(6)
IntNet	-0.08 (0.51)	-0.12 (0.62)	0.01 (0.12)	-0.05 (0.14)	-0.11 (0.48)	-0.22 (0.32)
IntLoc	0.12 (0.09)	0.21 (0.28)	0.42 (0.36)	0.33 (0.29)	0.19 (0.21)	0.23 (0.20)
RV	0.21** (0.09)		0.01 (0.03)		0.20** (0.09)	
UV	-0.08 (0.05)		0.04* (0.02)		-0.14** (0.06)	
Intra		0.11** (0.06)		0.01 (0.02)		0.13** (0.06)
Inter		0.04 (0.05)		0.02* (0.01)		-0.08** (0.03)
Spec	0.41*** (0.03)	0.39*** (0.04)	0.02 (0.02)	0.03 (0.02)	0.48*** (0.03)	0.46*** (0.03)
Netcomp	0.02 (0.04)	0.04 (0.04)	0.01 (0.02)	0.01 (0.02)	0.03 (0.04)	0.03 (0.04)
Isl	-0.01 (0.04)	-0.01 (0.04)	-0.01 (0.02)	-0.02 (0.02)	-0.06 (0.07)	-0.08 (0.08)
Prody _{to}	-0.02*** (0.00)	-0.02*** (0.00)	-0.02*** (0.00)	-0.01*** (0.00)	-0.03*** (0.00)	-0.02*** (0.00)

Results

- VIF always around 2.3, correlation under 0.4;
- Provinces' connectedness improves economic performance;
- GVA benefits from unrelated competences, while productivity from related ones;
- Outward network provides additional benefits with respect to local specialisation;
- During crisis, the impact of provinces' connectedness partially decreases, even though unrelated indices seem to mitigate negative effects.

Future ...

- Quantile regression;
- Spatial analysis: to investigate cross-provinces spillovers;
- Suggestions?

Thank you!