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Trust your neighbour
Industrial relatedness, social capital and outsourcing

Roberto Antonietti, Maria Rosaria Ferrante, Riccardo Leoncini

Utrecht University
Urban & Regional research centre Utrecht

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Roberto Antonietti
Department of Economics and Management "Marco Fanno", University of Padova
Via del Santo 33, 35123 Padova (Italy)
Tel: +390498271508
Fax: +390498274211
roberto.antonietti@unipd.it

Maria Rosaria Ferrante
Department of Statistical Sciences "Paolo Fortunati", Alma Mater University of Bologna
via Belle Arti 41, 40126 Bologna (Italy)
maria.ferrante@unibo.it

Riccardo Leoncini
Department of Economics, Alma Mater University of Bologna
Strada Maggiore 45, 40125 Bologna (Italy)
CERIS-CNR
Via Bassini, 15 – 20133 Milan (Italy)
riccardo.leoncini@unibo.it

Abstract

Relying on a unique dataset of small, machine-tool firms located in Emilia Romagna, Italy, we estimate the separate effects of industrial relatedness and social capital on the propensity to fully or partially outsource production activities. We focus on a series of 29 production phases, for which we have information on whether they are accomplished in-house or outside the firm. After controlling for endogeneity, we find that: (i) full outsourcing is positively related to social capital, but this effect vanishes as industrial proximity with neighbouring firms increases; and (ii) firms engage in concurrent sourcing only when industrial relatedness with neighbouring firms is high. Also phase estimates show that: (iii) while social capital matters for full outsourcing of core activities, for full outsourcing of peripheral activities it is industrial relatedness that is relevant; and (iv) there is no significant effect of either industrial relatedness or social capital on the concurrent sourcing of core and peripheral activities.

JEL classification: A13, D23, L23, L24, L64, R12

Keywords: concurrent sourcing, full outsourcing, industrial relatedness, social capital, machine-tool industry

1. Introduction

Recent studies identify industry concentration as a key element determining the degree of vertical disintegration of firms. This finding dates back to Stigler's (1951) work, and rests on the idea that spatial proximity reduces transport, search and managerial costs, and reduces the scope for opportunistic behaviour by increasing mutual visibility and reciprocal trust.

Holmes (1999) provides a seminal empirical study on this topic. Using 1987 US manufacturing plant census data, he finds that the intensity of plants' input purchases is positively correlated with the level of employment in neighbouring plants in the same industry. Similar results have been found for the US (Ono, 2007), the Chinese manufacturing (Li and Lu, 2009), the Turkish textile industry (Taymaz and Kiliçaslan, 2005), the Spanish electronic industry (Rama and Calatrava, 2002; Rama *et al.*, 2003) and manufacturing (Holl, 2008), and for the Italian manufacturing (Antonietti and Cainelli, 2008, 2012; Cainelli and Iacobucci, 2009, 2012).

These studies show that, as the local concentration of employment increases, the propensity of firms to increase their purchase of materials and business service inputs from external suppliers also increases. There are two factors related to spatial agglomeration that favour the outsourcing of production and service activities: reduced transport and search costs, and reduced transaction costs due to reduced chances of opportunism. According to Love and Roper (2001, p. 319):

> Proximity between purchaser and provider of the outsourced activity may influence the outsourcing decision due to agglomeration or clustering effects. […] These may affect the outsourcing decision by impacting on the costs of the outsourced activity, influencing the governance or management costs associated with outsourcing, […] or by changing the risks associated with information asymmetries, bounded rationality and opportunism.

Spatial agglomeration allows firms to save on transportation necessary for outsourcing, to gain from specialized services provided by local suppliers, and to benefit from increased scope for outsourcing due to the presence of locally developed interpersonal networks and supply chains. From a behavioural perspective, spatial clustering facilitates personal contacts and social interactions that reduce governance and management costs through the development of reciprocal trust among partners (Goldstein and Gronberg, 1984; Glaeser and Sacerdote, 1999). Thus, ‘the potential for such proximity effects – or outsourcing economies – is likely to be greater in urbanised or metropolitan areas’ (Love and Roper, 2001, p. 319), because ‘agglomeration reduces opportunism, and so serves as a substitute for integration’ (Helsley and Strange, 2007, p. 57).

A recent strand of the regional economics literature focuses on the role of proximity in shaping the economic relations among firms. Relying on Boschma (2005), several types of distance/proximity are considered as non-geographical barriers to the formation of cooperative agreements among economic agents, at both the international and local levels. Among others, Ponds et al. (2007) examine the role of geographical proximity in shaping research collaborations among organizations. They find that geographical proximity is more important if the collaboration involves different kinds of organizations, but does not matter if the collaboration is among similar organizations. D’Este et al. (2013) show that both geographical and organizational proximity are important for driving the establishment of university-industry research partnerships, but that the spatial clustering of technologically complementary firms make proximity among university and industry partners less relevant. In a study of domestic Mergers and Acquisitions (M&A) in the Netherlands, Ellwanger and Boschma (2013) find that industrial relatedness plays a stronger role than geographical proximity in driving domestic M&A deals.

In this paper, we try to extend the literature on agglomeration and outsourcing in four directions.

First, we contribute to analyses of the role of proximity in the vertical relationships among firms and, in particular, the decision to subcontract production activities to external suppliers.

Second, we claim that, in examining the vertical relationships among firms, using a single measure of geographical concentration does not clearly distinguish among the effects of agglomeration and trust, and employing different levels of industry aggregation does not add to our understanding of the importance of the role of industrial relatedness among neighbouring firms. The decision to subcontract may depend not only on transport and *static* transaction costs but also on the alignment of providers' and suppliers' competencies and knowledge bases. A higher technological distance between the parties implies higher '*dynamic* transaction costs' (Langlois, 1992), such as the costs of persuading, negotiating, coordinating with, and teaching others. This applies particularly to small-sized firms, whose financial resources and market or bargaining power tend to be lower. However, firms with similar knowledge bases can more easily observe, imitate or differentiate from, the outsourcing behaviour of neighbours.

Third, we contribute to work on the nature of outsourcing. Drawing on transaction cost theory (Coase, 1937; Williamson, 1985), both theoretical and empirical studies of agglomeration and outsourcing typically focus on the dichotomous 'make-or-buy' choice. Recent business and organization studies (Parmigiani, 2007; Parmigiani and Mitchell, 2009; Puranam et al., 2013) highlight that, in practice, firms favour joint sourcing, and often make *and* buy the same good, which has been described as concurrent sourcing, partial outsourcing, or tapered integration (Harrigan, 1984; see Parmigiani (2007) for a finer distinction between these forms of integration). Concurrent sourcing allows the firm to maintain greater control over the outsourcing process, but incurs the costs of both coordinating internal production and searching for, monitoring and maintaining external suppliers. Since monitoring and coordination activities differ between full and partial outsourcing, spatial agglomeration can have different effects on the firm's vertical boundaries. However, a direct investigation of these effects is still lacking in the literature.

The fourth contribution is the analysis of the nature of the outsourced activity. With a few exceptions[1], the empirical literature on the local determinants of outsourcing uses dummy variables

[1] Love and Roper (2001) focus on outsourcing within the innovation process, while Cusmano et al. (2009) broadly distinguish among production, R&D, design and service activities. Mazzanti et al. (2009) distinguish among ancillary

to measure the general probability to outsource (Love and Roper, 2001; Ono, 2007; Antonietti and Cainelli, 2008; Cusmano et al., 2009), or synthetic indicators of the intensity of outsourcing, based on the costs of purchased services over total production costs (Antonietti and Cainelli, 2012) or the share of subcontracted inputs in all inputs (Taymaz and Kiliçaslan, 2005), or uses the standard Adelman index of vertical integration (Holmes, 1999; Li and Lu, 2009). Apart from roughly distinguishing between material and service activities (including knowledge-intensive services), none of these indicators clearly identifies which phase of the production process or which task is contracted out by the firm. We believe that neglecting this aspect could be problematic for studying the effects of agglomeration on outsourcing.[2] In practice, production processes are heterogeneous, as they involve simple and complex tasks, high and low routinized activities, core and peripheral phases, and innovative and mature or standardized processes. In this case, the importance of transaction costs could vary across production phases, and be particularly important in high-value added stages.

In this paper first, we distinguish between the roles of industrial relatedness and social capital for shaping the likelihood of outsourcing. Second, we distinguish between full and partial outsourcing. Third, we take account of the specific production phase being outsourced, separating the core and peripheral phases.

For the empirical analysis, we rely on a new and original dataset of small firms located in the Emilia Romagna region of Italy, and specialized in the manufacturing of machinery and equipment (ATECO 2001 code D29, NACE rev. 2 code C28). This region provides an interesting case study

(inventories management, logistics, maintenance, data processing), production supporting (design, marketing, R&D, human resource management, quality control) and production activities.

[2] This aspect is emphasized by Baldwin and Venables (2013) with respect to the offshoring case. In their opinion, the engineering details of the production process strongly influence how the different stages of production are linked and unbundled across space. In particular, Baldwin and Venables distinguish between processes where goods move sequentially from upstream to downstream stages (i.e. snakes) and processes where multiple parts are assembled into a single body (i.e. spiders).

because of its rapid post-war recovery, based on the industrial district model (Brusco, 1982) in which a strong division of labour and a high recourse to subcontracting with local specialized suppliers is mixed with close cooperation and strong competition among firms, and highly localized social learning patterns (Asheim et al., 2009). Emilia Romagna is an interesting example also of regional branching based on knowledge transfer across related sectors: 'Many successful sectors like ceramic tiles, the packaging industry and robotics emerged out of a pervasive regional knowledge base in engineering. These sectors not only built and expanded on this extensive knowledge base, they also renewed and broadened the regional economy of Emilia Romagna' (Boschma, 2009, p. 9). Also, the industrial-district based Emilia model described by Brusco (1992) and recent empirical evidence (Cusmano et al., 2009) show that outsourcing in this region occurs predominantly at the local level, particularly in the machine-tool related industries. For all these reasons, we consider Emilia Romagna to be an appropriate case to test the effects of relatedness and social capital on the local division of labour.

Our results show that industrial relatedness and social capital are important factors increasing the likelihood to subcontract production activities in the machine tool industry. We find that geographical clustering of technologically similar firms makes social capital less relevant for building trust, at least for the full outsourcing of peripheral stages, whereas for full outsourcing of core stages social capital remains highly significant. In the concurrent sourcing case, only high technological relatedness among neighbouring firms matters, with social capital never statistically significant.

The rest of the paper is organized as follows. Section 2 presents the theoretical background and the main research hypotheses: we discuss the theoretical motivation for the link between technological relatedness, social capital and the probability to fully or partially outsource production activities (2.1); and we formulate our research hypotheses at the level of each stage of production (2.2). Section 3 describes the data (3.1), and the empirical strategy and the variables used in the estimates (3.2). Section 4 presents and discusses the estimation results and Section 5 concludes.

2. Theoretical background and research hypotheses

2.1. Industrial relatedness, social capital and full versus partial outsourcing

The large literature on transaction costs thoroughly investigates the factors that push firms to subcontract material or service activities to external suppliers. Generally, recourse to the market rather than vertical integration, depends on the level of transaction costs, which, in turn, depend on the degree of contractual incompleteness affecting the economic transaction (Williamson, 1985). Asset specificity, market and technological uncertainty, information asymmetries and the risk of opportunistic behaviour all contribute to increasing hold-up problems, and discouraging firms from subcontracting goods and services.

According to Williamson (2005), the firm's vertical boundaries are determined not only by transaction attributes but also by the characteristics of the surrounding environment. To quote Windrum et al. (2009, p. 198): 'the make/buy decision is not a question of ownership but of control'. In this paper, we focus on two factors that are supposed to drive this decision, and characterize the local environment in which the firm is located in terms of industrial relatedness and social capital. Although both aspects contribute to determining the level of transaction costs, here we assume that they influence the outsourcing decision in two different ways: that is, that industrial relatedness is linked to price mechanisms, and social capital is related more to non-price factors.

The geographic concentration of activities increases the spatial proximity between clients and suppliers, thus reducing transport costs, and is also associated with greater availability of specialized suppliers, which reduces the average price of outsourcing (Ono, 2007) and increases the efficiency and quality of the client/supplier matching process, which in turn reduces search and matching costs (Duranton and Puga, 2004). In addition, a densely populated area favours better coordination among specialized tasks, thereby reducing the opportunity costs of inefficient coordination (Baumgardner, 1988).

A higher likelihood to contract out activities is driven not only by higher supplier availability but also by the degree of industrial relatedness among firms (Boschma, 2005). The higher the level of clustering of technologically similar firms, the easier it should be to monitor the service provided because firms can more easily exchange technical advice and information and better absorb, decode and master external (often tacit) knowledge from business partners (Langlois, 1992; Zander and Kogut, 1995). This holds not only from a buyer-purchaser perspective but also for the case of competing firms: if firms have a common knowledge base, they will be better able to observe each other, and to imitate or differentiate their outsourcing behaviours more easily.

Social capital is a difficult concept to define, since it encompasses different aspects of human behaviour. Here, social capital is conceived as a system of shared values and beliefs that should prevent or reduce opportunistic behaviour by favouring trust building and mutual cooperation among people.[3] This chimes with the definition in Putnam et al. (1993), according to which social capital refers to features of social organizations, such as trust, norms, and networks, that can improve the efficiency of society by facilitating coordinated actions, and with the characterization in Bowles and Gintis (2002, p. F419): '[social capital] generally refers to trust, concern for one's associates, a willingness to live by the norms of one's community and to punish those who do not'.

In recent years, the notion of social capital has been utilized extensively in several fields including economics, management, organization, sociology, psychology, political science and planning. Social capital generally is related to aspects of socio-economic life including, among others, higher economic growth (Zak and Knack, 2001), higher financial development (Guiso et al., 2004), higher levels of innovation (Akçomak and ter Weel, 2009; Crescenzi et al., 2013), less crime (Glaeser et al., 1995), higher levels of education (Coleman, 1988; OECD 2001), and higher regional development (De Blasio and Nuzzo, 2009; Tabellini, 2010).[4] Some work in organization science, labour economics and game theory focus on social capital as a determinant of governance structure and establishment

[3] This definition is similar to the one proposed by Guiso et al. (2008a) of a set of beliefs and values that facilitate cooperation among the members of a community, and overlaps with the definition in Guiso et al. (2011, p. 419) of the concept of civic capital, defined as "persistent and shared values that help a group overcome the free rider problem in the pursuit of socially valuable activities".

[4] For a critical review of the empirics of social capital see Durlauf (2002) and Durlauf and Fafchamps (2005).

size (Fukuyama, 1995; La Porta et al., 1997), through the role of increased trust or reduced opportunism in the decentralization of decisions in larger firms (Bloom et al., 2012), avoidance of shirking behaviour in teams (Ichino and Maggi, 2000), and reputation building in one-off transactions (Baker et al., 2002; for a short review see Bürker and Minerva, 2013). According to Williamson (1985), trust is a social norm that reduces the need to use hierarchy and vertically integrated structures to attenuate opportunism. Areas where social capital is higher are expected to be associated with higher levels of trust and pro-social attitudes such as altruism, preferences for reciprocal fairness, and the moral obligation not to defect or behave deviously. In such a local environment, market transactions are favoured, and outsourcing should be more manageable.

Apart from a set of firm-level characteristics, we assume that the probability that each firm will fully outsource production activities will depend on two main features of the external environment in which the firm operates: degree of sectoral contiguity between neighbouring firms, and level of social capital in the area in which the firm is located. Since full outsourcing (FO) implies that control over the outsourced activities passes entirely to the service provider, we would expect FO to be more likely in contexts of high levels of trust (i.e. social capital). However, we would also expect that firms might not choose to exploit locally available social capital if they are surrounded by technologically related providers, partners or competitors. Mutual visibility and knowledge sharing among similar firms negates the need for a highly trustworthy local environment. Also, if monitoring levels are low and in-house operations are lacking (as in the FO case), firms cannot use the threat of backward integration, and must rely more on relational norms (Heide et al., 2013).

Thus, we formulate the following hypothesis:

H1*: in the full outsourcing case (low monitoring), other things being equal, social capital becomes relevant if levels of industrial relatedness with neighbouring firms are low*.

In contrast, in engaging in concurrent sourcing (CS), firms balance higher production costs (because performance of the outsourced task is kept partly in house) with lower transaction management costs (because they are better able to monitor the quality of the service provided). This latter aspect is crucial for modelling the role of social capital and industry relatedness. Since the concurrent sourcing firm can operate more direct (or less costly) control over the outsourcing process, the need to locate in a high trustworthy environment should be lower. Also, in the CS case, the presence of an in-house operation can undermine the effects of relational norms because of the threat of backward integration (Heide et al., 2013). Instead, the CS choice may be motivated by higher technological relatedness, which further reduces monitoring and dynamic transaction costs. Therefore, other things being equal, we expect that:

H2*: in the concurrent sourcing case (high monitoring), firms do not need to compensate for lower industrial relatedness by using local social capital as a sign of reduced opportunism.*

2.2. Phase-heterogeneity in full and partial outsourcing

All the hypotheses formulated above refer to full and partial outsourcing, without distinguishing among the activities being contracted out. Our data (described in Section 3) allow us to separate the machine tool production process into a set of 29 phases, listed in Table 1 (see also Section 3.1). To our knowledge, this is the first analysis of the firm's outsourcing decision at this level of disaggregation.

[TABLE 1 AROUND HERE]

The production phases include:

- preliminary (production supporting) activities, i.e. design;
- early working activities including hot and cold-working, gear working;

- treatments (cold and hot);
- assembling;
- ancillary activities including rubber, glass and wood working or software development;
- final stages such as testing, painting and refining;
- post-production activities such as repairs, component replacement and re-working.

Table 1 shows the number of firms operating each phase, and the percentage of firms that develop them in-house or externally via FO or CS.

The organization of production across phases is quite heterogeneous. The five phases that are most frequently fully outsourced are sintering, thermal treatment, surface treatment, glass working and sandblasting; the five which are most frequently concurrently sourced are cold-working, working by shaving removal, assembling by welding, electrical assembly and installation. On average, assembly and post-production phases are more frequently internalized (i.e. relative internalization index, named RELINT, is higher than 1, on average),[5] followed by final stages. Early phases, treatments and ancillary stages are the most likely to be outsourced. Based on this evidence, we consider assembly, post-production and final phases to be *core* phases, and treatments and ancillary stages to be *peripheral* phases.[6] Note that concurrent sourcing is generally less frequent than full outsourcing, except for the case of post-production stages.

Figure 1 summarizes the phase distribution along the outsourcing process.

[FIGURE 1 ABOUT HERE]

[5] RELINT is computed as the ratio of number of firms that operate the phase in-house (nINT) to the sum of the number of firms that fully outsource (nFO) and the number of firms that concurrently source (nCS) the same phase: RELINT = nINT/(nFO+nCS).

[6] This distinction is also somewhat intuitive: assembling, installing/testing and repairing are reasonably representative of the activities that mostly characterize the machine tool industry.

At this stage in the analysis, it is difficult to predict how industrial relatedness and social capital will influence the outsourcing of individual phases. In principle, we expect that FO of core activities will be particularly open to opportunism. When firms are surrounded by technologically unrelated partners, FO of core activities may require a highly trustworthy environment in order to compensate for competence misalignment and for the high cost of phase re-integration. Also, it is more likely that a machine-tool firm outsourcing a core activity will necessarily match with a machine-tool supplier belonging to the same industry. If so, industrial relatedness is always implied by the type of activity outsourced, and only social capital is relevant for reducing the risk of opportunistic behaviour. In contrast, FO of peripheral stages may involve less technologically related partners (e.g. between a machine-tool client and a provider belonging to the rubber and plastics industry). Since monitoring is low and becomes more difficult when competencies are not aligned, firms may compensate for lower industry relatedness by 'making use' of higher local social capital.

Therefore, other things being equal, we would expect that:

H3: *higher social capital compensates for lower industrial relatedness when firms fully outsource peripheral stages where they lack specific competencies and cannot use the threat of backward integration. For full outsourcing of core stages, both industrial relatedness and social capital are relevant.*

With respect to CS, we rely on the general hypothesis that relational norms and social capital should not influence the probability to release both core and peripheral activities, because the firm maintains control over the organization and quality of the outsourcing service, and is not induced to compensate for lower industrial relatedness by 'using' more social capital. We can formulate the following testable hypothesis:

H4: *when firms have control over the outsourcing process (CS), social capital is not required to compensate for lower industrial relatedness, regardless of the phase being partially outsourced.*

3. Dataset and variables

3.1. The dataset

The data were extracted from the Sector Studies (*Studi di Settore*), developed by the Italian Fiscal Authority (*Agenzia delle Entrate*) with the aim of establishing a benchmark of relevant fiscal data and providing a detailed and objective picture of firms' fiscal positions.[7]

We obtained a dataset of about 4,500 firms belonging to the machine-tool industry (NACE code C28, ATECO 2001 code D29), located in the Emilia Romagna region in 2005, and employing less than 100 employees (i.e. annual turnover of less than €5,164,169). After cleaning the data of missing values in the variables of interest, and deleting a small and not representative set of firms with more than 50 employees, we obtained a final sample of 3,280 firms. Table 2 shows the firm distribution by industry, size and province (NUTS 3 region).

[TABLE 2 ABOUT HERE]

Table 3 presents some statistics on the representativeness of our data, based on a comparison with 2001 Census data.

[TABLE 3 ABOUT HERE]

[7] Data were obtained under a formal agreement between the University of Bologna (Department of Statistical Sciences), Emilia-Romagna Region and the Italian Statistical Institute (ISTAT).

Studying the outsourcing behaviour of small firms may not provide a representation of total outsourcing. Although in Emilia Romagna 90% of firms employ less than 50 employees, they account for almost 60% of regional value added. Also, studying small firms can provide useful insights, firstly, because the literature on outsourcing determinants does not specifically target small firms despite acknowledgement of their relevance in the current European context, and secondly, because they represent the pillars of industry clusters and their business operations are more sensitive to local conditions than those of large firms. From a policy perspective, our results apply to small firms, rather than the whole population of companies.

3.2 Empirical strategy and variables description

Our empirical strategy consists of two steps. In the first, we focus on the probability to fully or partially outsource production activities. In the second step, we consider these two probabilities separately, at the level of each individual phase (see Table 1 for the full list).

The dependent variables are defined as follows. The first is a dummy equal to 1 if the firm fully outsources its production phases (FO) and 0 otherwise. The second is a dummy equal to 1 if the firm concurrently sources its production phases (CS), and 0 otherwise. When we refer to the whole production process, FO (CS) is equal to 1 if the firm fully (partially) outsources at least one of its production activities; when we refer to a single phase a value of 1 for FO (CS) refers to the decision to fully (partially) outsource that specific phase.

Since the dependent variables are binary, we estimate two separate probit models for FO and CS:

$$(1)\ \Pr(FO_{ir}=1\mid \mathbf{X}_{ir}, Density_r, SocialCapital_r)=\Phi(\mathbf{X}_{ir}^{'}\boldsymbol{\beta}_{FO}+Density_r\gamma_{FO}+SocialCapital_r\delta_{FO})$$

$$(2)\ \Pr(CS_{ir}=1\mid \mathbf{X}_{ir}, Density_r, SocialCapital_r)=\Phi(\mathbf{X}_{ir}^{'}\boldsymbol{\beta}_{CS}+Density_r\gamma_{CS}+SocialCapital_r\delta_{CS})$$

where *i* denotes the firm and *r* denotes the province (NUTS 3 region) in which the firm is located.

To make the results more readable, we pooled the 29 phases into two groups: core and peripheral stages. We consider as *core* the group of phases with an average relative internalization index RELINT higher than 1; the remaining ones are considered *peripheral* which Table 2 shows include assembling, and final and post-production activities. The criterion for this categorization is based on the idea that a phase that is more developed in-house is likely to be more strategic for the firm. The phases that are relatively more internalized are those where the firm has built and accumulated capabilities, and built up its knowledge base and patterns of specialization.

Our regressors include firm-level controls **X**, and measures for industrial relatedness and social capital. These controls include variables capturing the internal organization of the firm and standard determinants of the outsourcing decision. Firm age is computed as 2005 minus the firm's start-up year, in log (*Age*); employment size (*Micro*), given by two dummy variables equal to 1 for firms employing 1 to 10 employees and 11 to 50 employees respectively (the latter is used as the reference); level of human capital (*HC*), or skill intensity, of the workforce, given by the (log) share of white collar workers (managers, executives and clerks); (log) labour cost per employee (*ULC*); number of products offered by the firm as a proxy for scope economies (*NPROD*); three dummies for whether the market in which the firm operates is local/regional (*Local*), national (ref.) or global (*Global*); two asset-specificity variables measuring the percentage of turnover from catalogue production (*Catalogue*) and production based on client's design (*Client design*);[8] two continuous variables (share of turnover) measuring own production (*Prod_own*) and production on behalf of a third party (*Third party*), to distinguish whether the firm is a supplier or not. We also include five three-digit industry dummies, and 29 phase dummies to control for sector-specific effects and for the structure of the production process.

[8] These two variables should capture the degree of asset specificity surrounding firm activity. Producing from catalogue design implies a standardized and, thus, more general type of production; producing from customers' design implies a more client-specific type of production.

After controlling for firm-specific attributes, we include two variables referring to the environment in which the machine-tool firms operate. Industrial relatedness refers to the province in which firm *i* is located and is calculated in density terms as: (i) (log) manufacturing (1 digit, ATECO2002 code D: manufacturing) employment (from 2001 Census data provided by ISTAT) per square kilometre (*Density_1digit*); (ii) as (log) machine-tool manufacturing (2 digit, ATECO2002 code 29: machine tool industry) employment per square kilometre (*Density_2digit*); (iii) as (log) manufacturing (3 digit, ATECO2002 codes 29.1, 29.2, 29.3, 29.4, 29.5 and 29.7) employment per square kilometre (*Density_3digit*). In addition, we also control for employment density in manufacturing industries other than the machine tool sector (*Density_other*) in order to capture potential cross-sectoral effects.

Social capital is measured by a normalized index provided by Cartocci (2007), which borrows a key elements from Putnam et al. (1993). This index is obtained by pooling four elements through principal component analysis: (i) number of newspapers circulating per 1,000 inhabitants (average between 2001 and 2002); (ii) proportion of the population participating in electoral turnouts per 100 voters (in years 1999-2001); (iii) average of the number of blood donations per 1,000 inhabitants and blood donors per 1,000 inhabitants (in 2002); (iv) average of number of sports associations per 1,000 inhabitants (in 1999) to number of sports memberships per 1,000 inhabitants (in 2001). For all the methodological details, see Cartocci (2007).

We also need to consider the issue of endogeneity. Since our data are cross-sectional, and although we measure both industrial relatedness and social capital four years before outsourcing, potential simultaneity bias may affect our probit estimates: if clustering of technologically related neighbours and social capital are persistent over time,[9] it may be that higher industry relatedness and higher social capital are the result of a higher propensity to outsource in that region. To check for exogeneity of our two main explanatory variables, we use the Smith and Blundell (1986) test for

[9] The persistence of social capital might be the result of an inter-temporal transmission of culture and values from parents to children, as modelled by Tabellini (2008).

endogeneity. Relying on Putnam et al.'s (1993) idea that social capital is the outcome of historical experiences, to instrument social capital we use number of years of past foreign rule over Italian provinces in the 700 years before the creation of a unified Italian State (Di Liberto and Sideri, 2011).[10]

The intuition behind this is that the type of foreign domination will have shaped the cultural and entrepreneurial context of these regions, favouring a process of social capital accumulation over time, and characterizing the level of institutional quality of the region. Our identification strategy is that, other things being equal, years of past domination will influence outsourcing behaviour in 2005 only through their effect on local social capital. As a robustness check, we use an index of social capital in the 1960s (following Acemoglu et al., 2009 and De Blasio and Nuzzo, 2009 for use of historical variables as instruments), developed by Arrighetti et al. (2003).[11] To instrument our three density variables we use manufacturing employment density in 1951, based on the idea that spatial agglomeration in those years occurred mainly as a phenomenon related to the post-war reconstruction process rather than to outsourcing.[12]

4. Results

Tables 4, 5 and 6 present the estimates of the probit models for the full sample; Tables 7 and 8 present the estimates of the probit models for each individual phase, and each group of phases respectively.

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[10] The foreign past rule in the case of Emilia Romagna includes the Papal state (in the provinces of Bologna, Ferrara, Forlì-Cesena and Ravenna), Bourbons (Parma and Piacenza), Venetians (Ravenna), and Austrians (Parma and Piacenza). For many years, numerous provinces were independent of any foreign domination. See Di Liberto and Sideri (2011) for details. A similar approach is adopted by Guiso et al. (2008b).

[11] The social capital index developed by Arrighetti et al. (2003) is slightly different from the one proposed by Cartocci (2007) since it considers literacy rate in the local population, and participation in electoral turnouts and important referenda. For further details, see Arrighetti et al. (2003).

[12] Unfortunately, the 3-digit industry classifications between 1951 and 2001 are not fully comparable. For this reason, we instrument our *Density_3digit* variable based on its 1971 value.

Table 4 shows that the propensity to fully outsource production activities is negatively related to employment size and positively and significantly related to labour cost and own production, while working on behalf of a third party is less significant .

For industrial relatedness and social capital, we find that the effect of social capital is statistically significant (at 5% level) only if the level of industrial relatedness is low (Column 1), and becomes zero if the outsourcing firm is located in a technologically related area (Columns 2 and 3). This result supports H1: higher social capital is used to compensate for lower industrial relatedness among neighbouring firms.[13] The results in Column 4 confirm that high industrial relatedness remains statistically significant even after controlling for employment density in non-machine tool manufacturing industries (*Density_other*).[14] Finally, note that the Smith and Blundell statistic does not lead to rejection of the null hypothesis of exogeneity of our density and social capital variables.

[TABLE 4 ABOUT HERE]

For the CS case, Table 5 presents a different picture. The decision to CS is positively related to age, size, and unit labour cost, and negatively related to the geographical scope of the final market area and to the propensity for own production. Table 5 Columns 1 to 3 show that only a high level of industrial relatedness significantly influences the likelihood to CS, while social capital is not relevant (Column 1) or turns negative and statistically significant. This result is confirmed in Column 4 where we control also for density in other manufacturing industries. Finally, as before, the Smith and Blundell test does not reject the null hypothesis of exogeneity of density and social capital.

[13] It could be argued that this result is driven by multicollinearity. Appendix Table A1 shows that the pairwise correlation between variables is low, and the results do not change if density or social capital are dropped from estimates. In addition, multicollinearity tends to inflate the standard errors, which does not apply to our case. Finally, the scatter plots (available on request) between density variables and social capital do not reveal any sign of collinearity.

[14] We also consider the employment density of the most relevant manufacturing industry related to the machine-tool sector, namely metal products, as given by national input-output tables. When using this variable instead of *Density_other*, the results remain unchanged, and *Density_3digit* turns significant at the 5% level.

[TABLE 5 ABOUT HERE]

The negative sign of the estimated coefficient of the social capital variable is unsurprising. The results in Table 6 show that higher social capital drives the choice between FO and CS, whereas close industrial relatedness affects the choice between CS and vertical integration (INT). These results confirm H2: when monitoring is higher (as in the CS case), firms do not need social capital as compensation for lower industrial relatedness.

[TABLE 6 ABOUT HERE]

We next look at the estimation results for single phases. Table 7 summarizes the results for the single phases where we have enough observations to run probit estimates. For reasons of space, Tables 6 and 7 report only the estimated coefficients of the density and social capital variables.

[TABLE 7 ABOUT HERE]

Table 7 presents a quite heterogeneous picture. Social capital (SC) seems to have a more pervasive effect on FO of assembly, and final and post-production stages, while industrial relatedness is significant for FO of treatment activities and some other phases such as hot working, assembling by welding, and sand-blasting. Interestingly, social capital is more significant if FO is compared to the choice to produce in-house (INT): in this case, higher industrial relatedness becomes relevant with respect to other early production phases (5, 6, 7) and final stages (22, 23).

With respect to the CS choice, with a few exceptions, neither density nor social capital are significant predictors. For post-production phases, the sign of social capital turns negative, but the last column of Table 7 shows that there is a negative effect for the choice between CS and INT, which turns positive for the choice between FO and INT.

Table 8 presents a somewhat clearer picture and shows the estimation results (first block) for the core and peripheral phases, according to the classification described in Section 3.2. The second block in Table 8 presents the results for the eight groups of phases identified in the survey questionnaire.[15] In line with H3, we observe that the propensity to FO core activities increases with the level of local social capital, while the effect of technological relatedness appears only at the three-digit level and is of lower magnitude. When the peripheral stages are subcontracted, industrial relatedness becomes relevant (at the 1% level) and substitutes for social capital. Finally, and partly in line with H4, neither density nor social capital predicts the CS of core and peripheral stages.

[TABLE 8 ABOUT HERE]

5. Conclusions

Relying on an original firm-level dataset of machine tool firms located in Emilia Romagna, Italy, we analysed the relationship between industrial relatedness, social capital and firms' propensity to fully or partially outsource production activities. Unlike previous studies, we do not consider just one measure of spatial agglomeration, but distinguish the effect of industrial and technological proximity from that of social proximity for reducing transaction costs and favouring the subcontracting of production activities. We distinguish also between full and partial outsourcing choices, the latter being characterized by a higher level of monitoring over the outsourcing process. Finally, we distinguish between outsourcing of core and peripheral phases of the production process.

[15] As a robustness check, we redefined the core stages as those single activities for which RELINT is higher than 1 (from Table 1 we include phase 7, 10-13, 19-21, 24, 25-29), and considered as peripheral all the remaining ones. Since the results did not change qualitatively, we retain the original classification, which provides a more comprehensible interpretative framework.

After controlling for firm-specific attributes and endogeneity, we find that industrial relatedness and social capital are important factors affecting the choice to fully outsource production activities. In particular, we observe that higher industry relatedness compensates for low social capital in reducing transaction costs and favouring full outsourcing. In contrast, the partial outsourcing choice is not affected by social capital because firms can directly monitor external suppliers and a high level of local trust becomes less important.

To our knowledge, this is the first attempt to estimate this relationship for each single phase in the production process. In analysing single activities we find that concurrent sourcing is not related to local social capital, while full outsourcing of core activities is particularly influenced by it. On the other hand, for the full outsourcing of peripheral stages, we observe that higher industrial relatedness compensates for lower social capital in building trust and reducing transaction costs.

These results have various implications. From the academic perspective, we provide additional evidence that agglomeration externalities depend on the relatedness among industries located in the region, rather than on specialization or variety (Boschma and Frenken, 2011a). In particular, we contribute to evidence on the economic role of proximity, with a particular focus on the effects of technological and social proximity on the vertical relationships among firms. In addition, our results complement those in Bürker and Minerva (2013) on the direct link between local stock of civic capital and average plant size. Bürker and Minerva found this effect to be higher for larger plants, while our findings show that small plants tend to outsource more when social capital is higher. However, we also find that the effect of social capital vanishes as the degree of local industry relatedness increases. We would suggest that there are other knowledge-based mechanisms at work in shaping the vertical boundaries of firms.

From a policy perspective, our results, although limited to small firms and to the case of Emilia Romagna, could be useful for designing an environment that would spur the local division of labour across firms and production phases. In this respect, we stress the importance of industrial relatedness as a tool to compensate for social capital in the building of trust among neighbouring firms. Thus, related variety can be useful not only for increasing regional innovation and branching, as claimed by recent studies in evolutionary economic geography (Boschma, 2009; Boschma and Frenken, 2011a, 2011b), but also for reducing transaction costs and increasing the local division of labour through outsourcing. To the extent that outsourcing generates business opportunities and entrepreneurship, this can also translate into higher local development which means that industry policy aimed at subsidizing the expansion of small firms might be frustrated by high industrial relatedness (or social capital), and might also explain the persistent presence of small-sized firms in Italian regions.

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FIGURES AND TABLES

Figure 1. Phase distribution across production organization modes

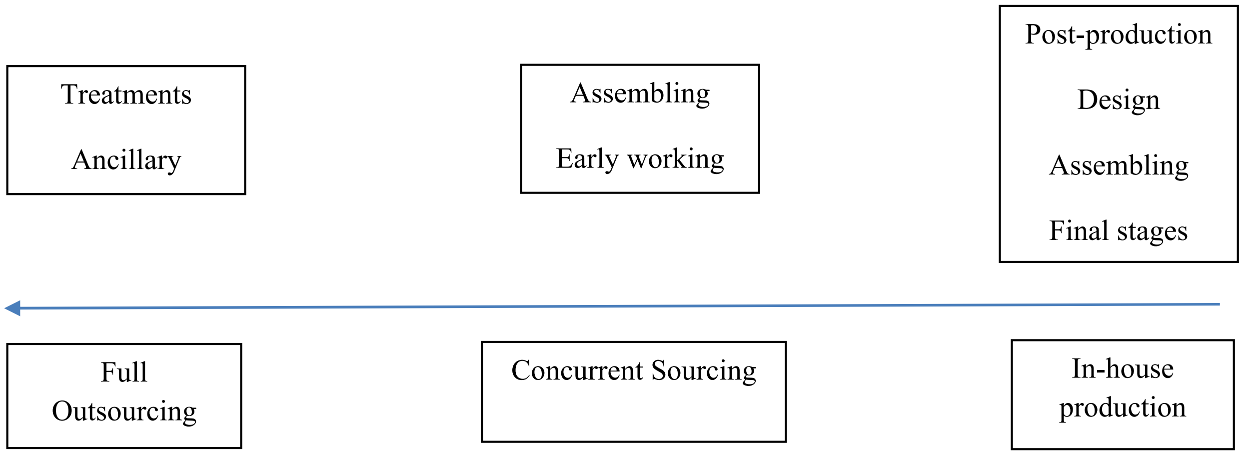

Table 1. Phase description and distributions of firms by production organization modes

			% of firms that accomplish the phase				
Group	Phase	N	INT	FO	CS	Tot	RELINT
Design	1 Design	1,276	69.83	11.76	18.41	100.0	2.31
Early working	2 Sintering	92	13.04	83.70	3.26	100.0	
	3 Hot-working	403	23.33	66.25	10.42	100.0	
	4 Cold-working	1,221	29,57	49,30	21,13	100.0	
	5 Working by shaving removal	1,253	34.48	31.92	33.60	100.0	
	6 Gear working	690	22.61	64.35	13.04	100.0	
	7 Refining	1,126	53.37	29.57	17.05	100.0	
	Average		*24.46*	*61.88*	*13.66*	100.0	0.32
Treatments	8 Thermal treatments	769	4.68	92.59	2.73	100.0	
	9 Surface treatments	905	14.59	77.35	8.07	100.0	
	Average		*9.635*	*84.97*	*5.400*	100.0	0.11
Assembling	10 Assembling by welding	1,712	50.53	26.29	23.19	100.0	
	11 Assembling by sticking	331	69.49	23.26	7.25	100.0	
	12 Assembling by riveting	586	77.30	14.16	8.53	100.0	
	13 Mechanical assembling	2,121	76.47	7.73	15.79	100.0	
	14 Electrical assembling	1,377	40.60	37.62	21.79	100.0	
	Average		*62.88*	*21.81*	*15.31*	100.0	1.69
Ancillary	15 Control software development	693	28.28	56.71	15.01	100.0	
	16 Rubber and plastics working	375	28.00	59.47	12.53	100.0	
	17 Glass working	39	5.13	92.31	2.56	100.0	
	18 Wood working	72	31.94	62.50	12.42	100.0	
	Average		*23.34*	*67.75*	*8.92*	100.0	0.30
Final	19 Testing	1,846	84.56	6.66	8.78	100.0	
	20 Packing	1,215	81.89	11.19	6.91	100.0	
	21 Washing	489	75.46	18.61	5.93	100.0	
	22 Sand-blasting	688	15.84	79.51	4.65	100.0	
	23 Painting	1,264	24.84	62.74	12.42	100.0	
	24 Installing	1,632	70.40	11.09	18.50	100.0	
	Average		*56.52*	*35.74*	*7.74*	100.0	1.30
Post-production	25 Repairing and ordinary maintenance	2,182	79.97	7.01	13.02	100.0	
	26 Repairing and scheduled maintenance	1,068	78.46	11.05	10.49	100.0	
	27 General overhaul	1,223	83.73	7.85	8.42	100.0	
	28 Component replacement	1,779	83.02	6.69	10.29	100.0	
	29 Component re-working	619	70.60	18.26	11.15	100.0	
	Average		*77.70*	*10.33*	*11.98*	100.0	3.48

Notes: nINT = number of firms that operate the phase in-house; nFO = number of firms that fully outsource the phase; nCS = number of firms that concurrently source the phase. RELINT = nINT/(nFO+nCS)

Table 2. Frequency distribution of firms by industry, size and province

Industry (3 digit)	Num. obs.	%
29.1 Manufacturing of general-purpose machinery	192	5.85
29.2 Manufacturing of other general-purpose machinery	1820	55.49
29.3 Manufacturing of agricultural and forestry machinery	286	8,72
29.4 Manufacturing of metal forming machinery and machine tools	260	7.93
29.5 Manufacturing of special-purpose machinery	689	21.01
29.7 Manufacturing of other-purpose machinery (domestic use)	33	1.01
Total	3280	100.0
Employment classes		
1-10	2319	70.70
11-50	961	29.30
Total	3280	100.0
Province (NUTS 3 region)		
Piacenza	190	5.79
Parma	529	16.13
Reggio Emilia	508	15.49
Modena	595	18.14
Bologna	747	22.77
Ferrara	155	4.73
Ravenna	211	6.43
Forlì-Cesena	143	6.16
Rimini	143	4.36
Total	3280	100.0

Table 3. Frequency distribution of firms by size: Census Vs Sector Studies data

Employment classes	Census 2001	%	Sector Studies	%
≤ 5	3795	62.7	1714	57.9
6-9	765	12.6	378	12.8
10-15	638	10.5	367	12.4
16-19	252	4.2	151	5.1
20-49	599	10.0.	351	11.8
Total	6049	100.0	3280	100.0

Table 4. Full outsourcing: probit estimates, full sample

	(1)	(2)	(3)	(4)
Age	-0.017	-0.016	-0.016	-0.016
	(0.013)	(0.013)	(0.014)	(0.013)
Micro	0.079***	0.079***	0.080***	0.080***
	(0.031)	(0.031)	(0.031)	(0.031)
HC	-0.006	-0.007	-0.007	-0.007
	(0.030)	(0.030)	(0.030)	(0.030)
ULC	0.032***	0.032***	0.030***	0.031***
	(0.008)	(0.008)	(0.008)	(0.008)
NPROD	-0.007	-0.007	-0.007	-0.007
	(0.010)	(0.010)	(0.010)	(0.010)
Local	-0.026	-0.026	-0.026	-0.027
	(0.016)	(0.017)	(0.017)	(0.017)
Global	0.013	0.013	0.012	0.012
	(0.034)	(0.034)	(0.034)	(0.034)
Catalogue	0.033	0.032	0.029	0.029
	(0.053)	(0.053)	(0.053)	(0.053)
Client design	0.010	0.010	0.009	0.009
	(0.050)	(0.050)	(0.049)	(0.049)
Prod_own	0.180***	0.180***	0.179***	0.179***
	(0.047)	(0.048)	(0.047)	(0.047)
Third party	0.078*	0.076*	0.073*	0.073*
	(0.042)	(0.043)	(0.047)	(0.043)
Density_1digit (manufacturing)	0.056**			
	(0.024)			
Density_2digit (machine tool manufacturing)		0.041**		
		(0.019)		
Density_other (non-machine tool manufacturing)				-0.003
				(0.038)
Density_3digit			0.075***	0.0077*
			(0.027)	(0.041)
Social capital	0.097**	0.080	0.078	0.076
	(0.040)	(0.048)	(0.048)	(0.049)
Industry dummies	Yes	Yes	Yes	Yes
Phase dummies	Yes	Yes	Yes	Yes
Num. Obs.	3280	3280	3280	3280
Pseudo R^2	0.47	0.47	0.47	0.47
% rate of correct class.	84.14	84.36	84.45	84.08
Smith – Blundell test χ^2	3.226	3.663	3.001	
(p-value)	(0.199)	(0.160)	(0.223)	

Notes: cluster-robust (at industry-province level) standard error are reported in parentheses.

*** significant at 1%; ** significant at 5%; * significant at 10%.

Cells report marginal effects at the mean of continuous variables and for discrete change of dummy variables from 0 to 1.

Instruments: Density_1digit = Density_1digit 1951; Density_2digit = Density_2digit 1951; Density_3digit = Density_3digit 1971, Social capital = years of past dominations.

Table 5. Concurrent sourcing: probit estimates, full sample

	(1)	(2)	(3)	(4)
Age	0.043***	0.043***	0.044***	0.044***
	(0.012)	(0.013)	(0.013)	(0.013)
Micro	-0.102***	-0.103***	-0.102***	-0.102***
	(0.031)	(0.031)	(0.031)	(0.031)
HC	0.012	0.012	0.012	0.012
	(0.018)	(0.018)	(0.018)	(0.018)
ULC	0.061***	0.061***	0.061***	0.061***
	(0.008)	(0.008)	(0.008)	(0.008)
NPROD	0.009	0.009	0.009	0.009
	(0.007)	(0.007)	(0.007)	(0.007)
Local	-0.052***	-0.052***	-0.052***	-0.052***
	(0.012)	(0.012)	(0.012)	(0.012)
Global	0.026	0.026	0.027	0.026
	(0.024)	(0.024)	(0.024)	(0.024)
Catalogue	-0.027	-0.027	-0.027	-0.031
	(0.038)	(0.038)	(0.038)	(0.038)
Client design	0.008	0.008	0.007	0.007
	(0.032)	(0.032)	(0.032)	(0.032)
Prod_own	-0.118*	-0.118*	-0.118*	-0.117*
	(0.063)	(0.063)	(0.063)	(0.063)
Third party	-0.053	-0.054	-0.055	-0.056
	(0.038)	(0.038)	(0.038)	(0.038)
Density_1digit (manufacturing)	0.029			
	(0.023)			
Density_2digit (machine tool manufacturing)		0.022		
		(0.019)		
Density_other (non-machine tool manufacturing)				-0.022
				(0.033)
Density_3digit			0.047**	0.064**
			(0.020)	(0.032)
Social capital	-0.075	-0.084*	-0.085*	-0.094**
	(0.046)	(0.045)	(0.041)	(0.039)
Industry dummies	Yes	Yes	Yes	Yes
Phase dummies	Yes	Yes	Yes	Yes
Num. Obs.	3280	3280	3280	3280
Pseudo R^2	0.23	0.23	0.23	0.23
% rate of correct class.	74.91	74.91	74.82	74.94
Smith – Blundell test χ^2		1.087	0.707	
(p-value)		(0.297)	(0.702)	

Notes: cluster-robust (at the firm level) standard error are reported in parentheses.

*** significant at 1%; ** significant at 5%; * significant at 10%.

Cells report marginal effects at the mean of continuous variables and for discrete change of dummy variables from 0 to 1.

Instruments: Density_3digit = Density_3digit 1971, Social capital = years of past dominations.

Table 6. Concurrent sourcing Vs production in-house (INT) and full outsourcing (FO): probit estimates, full sample

	Outcome variables					
Covariates	CS Vs INT	CS Vs INT	CS Vs INT	CS Vs FO	CS Vs FO	CS Vs FO
Density_1digit	0.022			0.009		
	(0.022)			(0.032)		
Density_2digit		0.022			0.004	
		(0.019)			(0.025)	
Density_3digit			0.062***			0.009
			(0.019)			(0.034)
Social capital	-0.044	-0.051	-0.048	-0.131**	-0.134**	-0.134**
	(0.039)	(0.040)	(0.037)	(0.054)	(0.057)	(0.057)
Num. Obs.	1525	1525	1525	2075	2075	2075
Pseudo R^2	0.15	0.15	0.15	0.09	0.09	0.09

Table 7. Probit estimates by single production phase

		outcome variables							
		FO		CS		FO Vs INT		CS Vs INT	
	Phase	Density	SC	Density	SC	Density	SC	Density	SC
Design	1	n.s.	n.s.	n.s. n.s. 0.043*	n.s. n.s. n.s.	n.s.	n.s.	-0.035*** -0.024** n.s.	n.s. n.s. n.s.
Early working stages	3	n.s. 0.084** 0.132**	0.222*** 0.201*** 0.193***	n.s.	n.s.	n.s. n.s. 0.131**	0.260*** 0.236** 0.220**	-	-
	4	n.s.	n.s.	n.s.	n.s.	n.s. n.s. n.s.	0.352*** 0.341*** 0.334***	n.s.	n.s.
	5	n.s.	n.s.	n.s.	n.s.	0.166*** 0.139*** 0.212***	n.s. n.s. n.s.	n.s.	n.s.
	6	n.s.	n.s.	n.s. n.s. 0.066**	n.s. n.s. n.s.	0.206*** 0.168** 0.243***	n.s. n.s. n.s.	-	-
	7	n.s. n.s. n.s.	0.199** 0.192** 0.188**	n.s.	n.s.	0.129** 0.122** 0.177***	0.378*** 0.341*** 0.321***	n.s.	n.s.
Treatments	8	0.039*** 0.030*** 0.027**	n.s. n.s. n.s.	-	-	0.001*** 0.005*** 0.012***	n.s. n.s. n.s.	-	-
	9	0.091*** 0.083*** 0.088***	0.164** 0.139** 0.122*	-0.028*** -0.021** n.s.	n.s. n.s. n.s.	0.124*** 0.125*** 0.167***	0.232** 0.182** n.s.	-	-
Assembling	10	0.072** 0.056** 0.049	0.192** 0.170* 0.162*	n.s.	n.s.	0.094*** 0.078*** 0.104***	0.243*** 0.214*** 0.210***	n.s. n.s. 0.058*	n.s. n.s. n.s.
	12	n.s. n.s. n.s.	0.174*** 0.171*** 0.162***	-	-	n.s. n.s. n.s.	0.304*** 0.301*** 0.288***	-	-
	13	n.s. n.s. n.s.	0.063** 0.065** 0.069**	n.s. n.s. 0.030*	n.s. n.s. n.s.	n.s. n.s. n.s.	n.s. 0.066* 0.067*	n.s. n.s. 0.042**	n.s. n.s. n.s.
	14	n.s.	0.149**			n.s.	0.162*	n.s.	n.s.

		n.s. n.s.	0.160** 0.161**	n.s.	n.s.	n.s. n.s.	0.175* 0.173*	n.s. 0.086*	n.s. n.s.
Ancillary	15	n.s. n.s. 0.115**	0.149** n.s. n.s.	-0.043* -0.043** -0.046**	n.s. n.s. n.s.	n.s. n.s. n.s.	0.448** 0.441** 0.427**	-	-
Final stages	19	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s. n.s. 0.006**	n.s. n.s. n.s.
	20	-0.045*** -0.041*** n.s.	0.095** 0.105** 0.121**	n.s.	n.s.	n.s. n.s. n.s.	0.128*** 0.140*** 0.141***	-	-
	21	n.s. n.s. n.s.	0.260*** 0.254*** 0.258***	-	-	n.s.	n.s.	-	-
	22	0.083*** 0.064*** 0.099***	-0.110* -0.131** -0.147**	-	-	0.062** 0.060*** 0.070**	-0.255*** -0.265*** -0.277***	-	-
	23	n.s.	n.s.	n.s.	n.s.	0.094** 0.073** 0.146***	n.s. n.s. n.s.	n.s. n.s. 0.002***	n.s. n.s. n.s.
Post-production stages	24	n.s. n.s. n.s.	0.082* 0.082* 0.084*	0.028* 0.028* 0.048**	-0.111*** -0.121*** -0.121***	n.s. n.s. n.s.	0.143*** 0.144*** 0.144***	0.041** 0.037* 0.066**	-0.090** -0.106*** -0.100***
	25	n.s. n.s. n.s.	0.053*** 0.052** 0.052**	0.036** 0.031*** 0.046***	-0.048* -0.060** -0.057**	n.s. n.s. n.s.	0.064** 0.061** 0.062**	n.s. n.s. n.s.	-0.056*** -0.061*** -0.057***
	26	0.026* n.s. n.s.	0.082*** 0.074*** 0.073***	n.s.	n.s.	0.046** 0.030* 0.047*	0.055** 0.041* 0.044*	n.s.	n.s.
	27	n.s. n.s. n.s.	0.053* 0.052** 0.053**	n.s. n.s. n.s.	-0.042** -0.043** -0.043**	n.s.	n.s.	n.s. n.s. n.s.	-0.075*** -0.072*** -0.075***
	28	n.s. n.s. n.s.	0.046*** 0.043*** 0.044**	n.s. n.s. n.s.	-0.071*** -0.073*** -0.071**	n.s. n.s. n.s.	0.050* 0.047* 0.050*	n.s. n.s. n.s.	-0.080*** -0.075*** -0.077***
	29	-0.029** -0.033** n.s.	0.121*** 0.128*** 0.134***	-	-	n.s. n.s. 0.115***	n.s. n.s. n.s.	-	-

Note: n.s. = not statistically significant

Table 8. Probit estimates by groups of production phases

		FO		CS	
Core vs Peripheral blocks of phases	Phase	Density	SC	Density	SC
Core	10-14 24-29	n.s. n.s. 0.059**	0.106*** 0.100*** 0.100***	n.s. n.s. n.s.	-0.087*** -0.090*** -0.090***
Periphery	3-9 15-18	0.094*** 0.056** 0.089***	0.179*** n.s. n.s.	n.s. n.s. n.s.	n.s. n.s. n.s.
Groups of phases (from questionnaire)					
Design	1	n.s. n.s. n.s.	n.s. n.s. n.s.	n.s. n.s. 0.043*	n.s. n.s. n.s.
Early working stages	3-7	n.s. n.s. n.s.	0.120*** 0.108*** 0.105***	n.s. n.s. 0.019**	n.s. n.s. n.s.
Treatments	8-9	0.071*** 0.058*** 0.053***	n.s. n.s. n.s.	-0.028*** -0.022*** n.s.	n.s. n.s. n.s.
Assembling	10-14	n.s. n.s. n.s.	0.118*** 0.116*** 0.115***	n.s. n.s. n.s.	n.s. n.s. n.s.
Ancillary	15-18	0.022*** 0.018*** 0.020***	0.039*** 0.033** 0.031**	-0.044* -0.043** -0.046**	n.s. n.s. n.s.
Final stages	19-23	n.s. n.s. 0.051*	n.s. n.s. n.s.	n.s. n.s. n.s.	n.s. n.s. n.s.
Post-production stages	24-29	n.s. n.s. n.s.	0.065*** 0.064*** 0.065***	0.031** 0.023** 0.042***	-0.054*** -0.064*** -0.063***

Note: n.s. = not statistically significant

Appendix

Table A1. Pairwise correlations between density, social capital and the covariates

	Density_1digit	Density_2digit	Density_3digit	Social Capital
Age	0.05	0.05	-0.06	0.03
Micro	-0.04	-0.04	0.03	0.01
HC	0.05	0.06	0.00	0.02
ULC	0.06	0.06	-0.00	0.01
NPROD	-0.02	-0.02	0.02	0.00
Local	-0.05	-0.05	0.06	0.05
Global	0.03	0.03	-0.08	-0.04
Catalogue	0.08	0.09	-0.11	-0.03
Client design	-0.00	-0.00	0.01	0.04
Prod_own	0.10	0.11	-0.09	-0.02
Third party	-0.04	-0.04	0.01	0.07
Density_1digit	1.00	0.91	0.42	-0.16
Density_2digit	0.94	1.00	0.40	-0.01
Density_3digit	0.42	0.40	1.00	0.04
Social Capital	-0.16	-0.01	0.04	1.00