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Articles

Servitization and territorial self reinforcing mechanisms: a new approach to regional competitiveness

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ABSTRACT:

The present paper discusses a theoretical model to explain the link between servitization and territorial competitiveness based on the situation in Italy. A key assumption of the model is that once the link between manufacturing and KIBS is established within a TES, there is a positive feedback between the increasing productivity (competitiveness) and the link between firms and KIBS, which becomes stronger and stronger triggering a self-reinforcing dynamic. This means that every evolutionary step of the system influences the next and thus the evolution of the entire system, so generating *path dependence*. Such a system has a high number of asymptotic states, and the initial state (time zero), unforeseen shocks, or other kinds of fluctuations, can lead the system into any of the different domains of the asymptotic states (1). In other words, both the theoretical assumptions and the empirical model outlined in this paper demonstrate that when a functional relationship between manufacturing and services is established (servitization), economic performance is positive or very positive.

KEYWORDS: Servitization; Self-Reinforcing Mechanism; Regional Policies.
JEL CLASSIFICATION: R11; R12; O31.

Servitización y mecanismos de autorrefuerzo territorial: un nuevo enfoque a la competitividad regional

RESUMEN:

El presente artículo analiza un modelo teórico para explicar el vínculo entre servitización y competitividad territorial basado en estudio empírico de tal relación en Italia.

Un supuesto clave es que, una vez que se establece el vínculo entre la manufactura y KIBS dentro de un TES, hay una retroalimentación positiva entre el aumento de la productividad (competitividad) y el vínculo entre las empresas productoras y los KIBS se genera una dinámica de retroalimentación positiva que conduce a un aumento de la productividad (competitividad). Esto implica que cada paso evolutivo del sistema influye en el siguiente y, por lo tanto, en la evolución de todo el sistema, se generan interdependencias (generando así dependencia del camino). Tal sistema tiene un alto número de estados asintóticos, y durante el estado inicial (tiempo cero), choques imprevistos u otros tipos de fluctuaciones, pueden llevar al sistema a cualquiera de los diferentes dominios de los estados asintóticos (1). En otras palabras, tanto los supuestos teóricos como el modelo empírico esbozado en este trabajo demuestran que cuando se establece una relación funcional entre manufactura y servicios (servitización), el desempeño económico es positivo o muy positivo.

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Palabras clave: Servitización; Mecanismo de autorrefuerzo; Política Regional.
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1. Introduction

The connections between firms and manufacturing and knowledge-intensive business services KIBS) are important in explaining the differences in competitiveness at local level. There is, however, very little literature on the subject. Therefore, the papers (2) (4), (5), (10); (11) ares very important as it shows how the growth of employment in a specific territory interacts strongly with Servitization and how this functional link can generate virtuous cycles.

A comprehensive survey of the literature on Servitization can be found in (10). In this paper, the authors build an interesting taxonomy of the key contributions on Servitization, by dividing the different approaches into four quadrants, where the relationship between internal analysis and external analysis is shown on the horizontal axis, and the relationship between mainstream and alternative approaches is shown on the vertical axis. Quadrant IV, focusing on the KIBS, is of particular interest and is where the present paper is ideally positioned, albeit with a different approach.

The present paper puts forward a theoretical model to explain the link between Servitization and territorial competitiveness based on the situation in Italy. We estimated the contribution of Servitization to the performance of Territorial Economic Systems (TESs) in Italy. A key assumption of the model is that once the link between manufacturing and KIBS is established within a TES, there is a positive feedback between the increasing productivity (competitiveness) and the link between firms and KIBS, which becomes stronger and stronger triggering a self-reinforcing dynamic. This means that every evolutionary step of the system influences the next and thus the evolution of the entire system, so generating *path dependence.* Such a system has a high number of asymptotic states, and the initial state (time zero), unforeseen shocks, or other kinds of fluctuations, can lead the system into any of the different domains of the asymptotic states (1).

In other words, both the theoretical assumptions and the empirical model outlined in this paper demonstrate that when a functional relationship between manufacturing and services is established (Servitization), economic performance is positive or very positive.

However, promoting development in lagging regions by relying on "traditional" policies may not be a good policy choice. Indeed, the paper shows that, due to path dependence and poor response function, in weak TESs, traditional regional policies that focus on compensating the scarce factors of production (for example capital to stimulate production investment) risk creating a Dutch disease effect, because the TES is unable to effectively absorb the additional (traditional) factor of production. Consequently, "compensatory" or "additional" regional policies end up accentuating the differences between regions due to the different response functions and which are manifested in multiple, resilient equilibriums (similar to fitness landscapes). Instead of fostering convergence, the traditional policies create underdevelopment traps (the lowest points in the fitness landscape) from which TESs struggle to escape.

We found a high and positive correlation between the specialisation of a given TES in knowledge-intensive business service (KIBS) and productivity, measured as per capita value added. We also found that path dependence strongly influences the capacity of manufacturing firms located in a given TES to diversify their products in order to embed a service component.

2. Theoretical Background

The TES is the physical space in which economic agents interact; the equilibrium properties of this system depend on its structure and, if the space is complex, on the particular attraction basin in which the

system stays. The increasing returns, the multiple equilibria, the history dependence can found a meaning in the complex space (3).

By introducing the notion of Territorial Economic System (TES) as unit of analysis, it is possible to move towards the increase of interpretative capability when a synthesis among production system, technological knowledge at territorial level and local institution is searched. A TES then consist of interconnection among production system, technological knowledge and *social capabilities*. Each of these dimensions encompasses some factors which determine the performance of the TES (see Table. 1) (6).

TABLE 1.
Elements of the TES

	EXTRA TERRITORIAL LEVEL (ETL)	TERRITORIAL LEVEL (TL)
***Access* to:** - Contextual and codified knowledge - Local and regional - infrastructure networks	Codified knowledge: technological, organisational and communication codes	***Intangible elements:*** Available knowledge and social capabilities
Receptiveness: - Size - Organisational structure - Constitutive structure - Innovative experiences - Business networks		***Physical elements:*** - Available infrastructure - Production system - Material resources

TES is a multidimensional concept that encompasses economic and social dimensions. Whereas the production system has a mainly material connotation, technical knowledge and social capability have a mainly immaterial nature (6), (7). It is important for a description of the TES to define two dimensions: the proximity and the resiliency. Each territory shows first of all a different degree of proximity which does not necessarily mean contiguity, but can have a functional meaning. There is, in fact, an industrial organization, cultural and temporal proximity.

The resiliency shows the problem of the spatial evolution in the forms of the production, which leads to the question of the historic dynamics and the evolutive trajectories of each TES. It is the capability of the system in the self-organization and in the metabolizing of the change in the external environment. Proximity and resiliency are a way to express the concepts of local interaction and self-organization. Within TESs economic dynamic takes the form of a *self-reinforcing mechanism*: a positive (or negative) feedback that characterizes the evolution of a dynamic system.

TES are characterised by a high degree of complexity that select development trajectories stochastically, but then follows a given trajectory based on a self-reinforcing mechanism. The concept of self-reinforcing mechanism can be expressed as a dynamic system, with path dependence and a positive feedback, which tends to a large variety of asymptotic states. Every evolutionary step of the system influences the next one and then the evolution of the entire system, thus generating *path dependence*.

This system has a high number of asymptotic states, and the initial state (Time zero), unpredicted shocks, or other kind of fluctuations, can all conduct the system in any of the different domains of the asymptotic states (1).

Furthermore, the system selects the state in which placing itself. Such dynamics are well known in physics, in chemistry as well as in biology and the final asymptotic state it is called the *emergent structure*. The concept of positive feedback in fact is relatively new for the economic science. The latter generally

deals with problems of optimal allocation of scarce/insufficient resources; thus, the feedback is usually considered to be negative (decreasing utility and decreasing productivity).

Self-reinforcing mechanism dynamic can be used to assess many different economic problems with different origins: from those related to the international dimension, to those typical of the industrial economy, as well as problems related to regional economics.

Many scholars have assessed multiple equilibria and their inefficiency. Multiple equilibria depend on the existence of increasing returns to scale. If the mechanism of self-reinforcing is not counterbalanced by any opposite force, the output is a local positive feedback. The latter, in turn, amplifies the deviation from some states. Since these states derive from a local positive feedback, they are unstable by definition, so multiple equilibria exist and are efficient.

I the *vector field* related to a given dynamic system is regular and its critical points follow some particular rules, then the existence of other critical points or of stable cycles (also called *attractors*) turns out (6), (7). The multi-attractors systems have some particular properties that are very useful for our research. Strict path dependence is therefore manifested, and the final state of the system will depend on the particular trail it has been covering during its dynamic evolution from an (instable) equilibrium towards another (instable) equilibrium, and so on. Accordingly, the system's dynamic is a non-ergodic one.

Description of the evolution of spatialised economies emphasizes the role of a new economic paradigm. The latter is based on a series of different features. For instance, new productive factors seem to have replaced land, work and physical capital. Natural and environmental resources, human resources (skills and human capital) and technology are beginning to get the upper hand following the "technological revolution". Another feature is that co-operation within businesses and between businesses and business systems takes place on a vertical and horizontal scale in which the local dimension and the territorial variables constitute the catalyst for processes of development. In addition, technological expertise and social capabilities (3) are the basic elements capable of explaining the different levels of development seen in different territorial contexts. Bellandi & Santini (2), introduce a framework for the interpretation of changes in local productive configurations and the assessment of territorial servitization trajectories. It includes three main variables: multiplicity of know-hows, transaction costs and the entrepreneurial drive. Lafuente., Vaillant & Vendrell-Herrero (5). by adopting a multidisciplinary perspective that combine a variety of frameworks (organizational, place-based, economic geography), explain the mechanics and relationships underlying territorial servitization as well as its territorial economic repercussions. Wyrwich (11) suggests that strengthening the industrial base in peripheral regions could induce knowledge-intensive start-up activity.

Territorial variables, in other words, are decisive factors in explaining development differentials, especially when they are associated with the idea of the market conceived as a social construction. This new market requires rules that will guarantee its smooth running given that access rights, exchange mechanisms and opportunities for distribution of the wealth generated not only do not re-assemble uniformly and autonomously in time and space (8), (9), but almost always require outside intervention to achieve the objectives set for development policies. Re-equilibrium policies thus appear necessary to guarantee a more equitable development process. Within the market it is necessary to define collective rules ensuring that positive dynamics (increasing returns) can develop through the interaction of the agents operating in it. Therefore, the territorial dimension and the systemic nature of the production process are fundamental elements to understanding and governing development processes.

3. Methodology and Findings

The collective properties of a given TES in relation to the link existing between productivity growth and information could be represented in terms of response function.

It is possible to create a generalised function – an interpretative model – to describe the propagation mechanism of economic policy in a situation of complexity. The description of the transmission mechanism logically completes the previous observations regarding objectives and instruments. Single economic policy decisions, aimed at achieving the *j-th* objective through the use of the *i-th* instrument, can be represented as an outside stimulus which superimposes itself on interactions between agents.

Agents in this approach are thought of as being spatially distributed and linked to each other by local mutual interactions (of a nearest neighbour type). We use H to indicate the effect of the economic policy. We can thus define an effective *Heff* stimulus which includes both outside stimulus and agent interaction.[1] Obviously, without agent interaction *H* and *Heff* are equal. *Heff* therefore assumes the form:

$$Heff = H + \int dr' c(r-r')\delta\gamma(r') \tag{1}$$

Where $c(r-r')$ is a function of correlation between agents which can constitute an acceptable means of modelling the concept of proximity, $\delta\gamma(r')$ is a variation in the behaviour of agents induced by the policy applied, the integral can be linked to the concept of resilience. This type of behaviour arises in the area of a linear response model for systems with collective properties. The effect of an economic policy on a complex system made up of many agents interacting with each other can therefore be described in this way and modelled by means of the response properties of the system itself. Therefore, in the area of linear response theory we have a cause-effect relationship of the type:

$$E(X) = G(X) \otimes H(X) \tag{2}$$

where $E(X)$ represents the generalized effect, $G(X)$ the response function, and $H(X)$ the generalized cause. Therefore, it is possible to study the generalised transmission mechanism of economic policy by describing the response function as a sort of susceptivity which comes to depend on the distribution of agents within the market. Obviously, the type of response depends not only on distribution, but also on the type of interaction between agents.

The relationship between competitiveness, servitization and development can be examined econometrically through a 2SLS regression model. The basic idea analysed is that there is a relationship between added value, intensity of capital accumulation and the capacity for business services development. The equation that must be calculated, therefore, is expressed as follows:

$$VA_t = VA_{t-1} + \text{intaccap} + \text{capsviser} \tag{3}$$

It was decided to use a 2SLS regression model to avoid the impact of the autocorrelations which exist between the variables to be estimated. 2SLS regression models succeed in doing this through instrumental variables. The database used to estimate and define the variables used, both predictive and instrumental, is shown in the appendix. The model not only serves to highlight the link between the variables; being based on territorialised data, it also takes regional differentials into account. In short, if the coefficients are significant, this model will not only highlight a link between added value, capital accumulation and the capacity to develop business services, but it will also explain the territorial differentials.

The model was populated with data from Italian regions. The tables with the values of the variables are given in the appendix. The results of the model are outlined in the following tables:

[1] Heff represents the actual output of the implemented policy.

TABLE 2.
Model Description

		Type of Variable
Equation 1	vapercapita2014	dependent
	vapercapita2009	predictor
	Intensity of capital accumulation	predictor
	Ability to develop business services	predictor
	Perceived risk of crime	instrumental
	Work regularity rate	instrumental
	Wealth index	instrumental
	Share of employees in high-intensity knowledge sectors	instrumental
	VA rate of change	instrumental
	Share of technical and scientific degree	instrumental

TABLE 3.
2SLS Regression

		Unstandardized Coefficients		Beta	t	Sig.	
		B	Std. Error				
	(Constant)	-89.064	42.304		-2.105	.051	*
	vapercapita2009	.762	.152	.738	5.000	.000	***
	Intensity of capital accumulation	.428	.195	.331	2.197	.043	**
	Ability to develop business services	.696	.398	.289	1.749	.099	*
					F di Fisher	60.575	***
					Adjusted R Square	.904	

4. DISCUSSION

As can be seen from the data, the regression has a good level of significance, both overall with a high F value, and for the individual coefficients which have very good Student's T-values. The sign of the coefficients correlates an incremental contribution of the individual variables to added value at time t and highlights a relationship between added value at time t and the "delayed" added value (of the previous period) and two fundamental variables in regional development theory, namely capital accumulation intensity and business services development capacity.

These results are perfectly in line with the theoretical analyses previously developed in defining the territorial economic system. In particular, the link between business services development capacity, which is an excellent proxy for the concept of servitization and added value at time t, highlights the active role of servitization in regional development processes, also in relation to territorial differences. In particular, the model identifies the three variables 'delayed added value', 'capital accumulation' and 'business services

development capacity' as the incremental factors determining territorial differences in added value at time t.

By using the data of the Italian regions, a very strong relationship can be established between the 'business services development capacity' variable, which is a proxy for servitization, and 'added value per capita' at time t, taking delayed value added per capita as the baseline.

The territorial value differentials in value added per capita are determined by the initial value added per capita, by servitization and by the intensity of capital accumulation which is an investment-linked variable. Thus, by using the TES as a key to interpretation, it is possible to identify the Territorial Level (TL) in servitization and the Firm Level (FL) in the intensity of capital accumulation. These two dimensions explain most of the differentials in regional development expressed in terms of value added per capita. Both the theoretical assumptions and the empirical model developed in this paper demonstrate, on the one hand, that the functional relationship between manufacturing and services is the basis of positive or very positive economic performance. On the other hand, it is also demonstrated that the weak regions are not equipped to respond in a positive manner (with endogenous growth) to the stimulus represented by "traditional" regional policy, which attempts to compensate for the lack of factors of production, for example by injecting capital to stimulate production investment.

5. Some concluding remarks

An initial consideration concerns the path dependence which characterises regional development trends. A given tool (e.g. regional policy) deployed to promote development in a specific TES, which is characterized by a given response function, may actually create development traps. This traditional approach risks creating a Dutch disease effect because the TES fails to effectively absorb the additional (traditional) factor of production. It is like trying to fit a piece that does not fit into a puzzle.

This type of "compensatory" or "add-on" regional development policy ends up accentuating the differences between regions, which are due to the different response functions and are manifested in multiple, resilient equilibriums (similar to fitness landscapes). Instead of fostering convergence, traditional policies create underdevelopment traps (the lowest points in the fitness landscape) from which the TES struggle to escape.

Peripheral regions are the ones most exposed to loss of competitiveness since the rules governing the economic system promote the aggregation of factors and "classic" regional policy is unable to counter this trend, despite generous financial compensation.

An effective regional policy should work on two levels: modify the response function of a TES and also provide an investment able to generate a vector (defined as a "generalised cause"). Moreover, interventions should be minimal and aimed at creating stronger connections between economic agents and, in particular, combining production activities with services, to foster the servitization that probably influences "soft" factors inside the TES.

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Appendix

Indicators for Italian regions used for 2SLS Model - Standardized and Normalized data (Italy=100)[2]

	Share of employees in high-intensity knowledge sectors	Share of technical and scientific degree	Intensity of capital accumulation	Ability to develop business services	VA per capita 2014	VA per capita 2009	VA Rate of Change	Perceived risk of crime	Work regularity rate	Wealth index
Piemonte	105.65	133.47	126.44	103.72	106.75	104.02	2.62	97.86	99.92	171.67
Valle dAosta	82.35	6.14	139.85	87.99	126.83	128.72	-1.47	43.08	106.38	160.94
Lombardia	118.74	123.55	96.99	115.85	132.69	130.05	2.03	119.31	168.32	257.50
Trentino Alto Adige	75.34	73.48	147.89	84.70	139.82	131.79	6.09	31.10	158.06	271.05
Veneto	80.70	90.76	100.39	95.09	114.04	125.84	-9.37	102.27	137.17	228.89
Friuli Venezia Giulia	90.69	142.17	108.08	109.99	107.77	104.58	3.05	55.25	107.22	130.38
Liguria	123.86	115.00	91.24	100.45	112.55	111.73	0.73	77.13	101.23	132.05
Emilia Romagna	87.63	141.97	100.92	102.94	124.09	119.01	4.27	104.74	143.00	245.24
Toscana	90.00	125.93	90.12	100.63	108.88	107.02	1.74	85.20	128.24	201.96
Umbria	79.99	92.65	100.21	94.90	87.76	92.05	-4.66	118.76	97.35	128.75
Marche	80.45	124.00	97.17	92.82	96.03	97.73	-1.74	88.98	113.56	104.04
Lazio	144.79	136.25	93.61	112.62	114.50	125.77	-8.96	131.76	123.61	177.59
Abruzzo	80.15	74.47	144.40	88.67	89.33	85.14	4.93	81.83	91.13	81.10
Molise	75.51	26.58	124.58	84.75	69.85	78.32	-10.81	30.53	47.54	53.37
Campania	88.68	84.72	82.80	82.99	63.55	67.10	-5.28	116.55	71.32	53.09
Puglia	79.18	50.80	90.67	81.62	63.47	63.43	0.07	107.63	69.32	50.24
Basilicata	77.06	35.58	116.65	91.31	72.00	70.14	2.66	46.16	53.31	40.39
Calabria	79.95	78.16	113.93	80.52	60.89	63.36	-3.90	69.76	41.57	38.29
Sicilia	85.60	60.87	81.79	82.82	63.11	68.87	-8.36	88.31	62.60	40.87
Sardegna	80.85	59.97	95.87	87.90	71.38	66.70	7.02	43.08	54.81	68.21

Source: Our elaboration from ISTAT data.

[2] Except variable VA rate of change.