



Entrepreneurship and subjective vs objective institutional performance: A decade of US hospital data

Shelby Renee Meek^{a,*}, Matthias A. Tietz^b

^a Coles College of Business, Kennesaw State University, United States of America

^b University of St. Gallen, 110 Amoy Street, #03-01, Singapore 069930, Singapore

ARTICLE INFO

Keywords:

Entrepreneurial activity
Public service institutions
Subjective performance
Entrepreneurial ecosystems
Knowledge flows
Regional development

ABSTRACT

Regional entrepreneurial activity can importantly affect the performance of local public service institutions. Yet, the literature explaining these relationships suffers from five methodological challenges: 1) inferred direction of influence; 2) unavailability of representative data; 3) blurring of objective and subjective performance; 4) a lack of longitudinal data; 5) and a lack of fine-grained regional data. This paper relies on a rich dataset from the ubiquitous institution of hospitals to explore these effects and overcome these challenges. We discriminate between objective and subjective institutional performance, suggesting that both performance categories deserve empirical attention, and may react differently to entrepreneurship. Our empirical approach applies econometric, mixed-effects regression models to a novel longitudinal dataset representing the entire hospital population in over 3000 U.S. counties between 2006 and 2018 merged with two sources of entrepreneurial activity at the county level. Interestingly, the results suggest divergent relationships: regional entrepreneurial activity positively affects objective institutional performance and also negatively affects subjective performance. Further, an institution's research designation attenuates the effect on subjective performance. These findings suggest that institutional performance is an often-overlooked byproduct of regional entrepreneurial activity and offer significant theoretical and policy implications.

1. Introduction

Entrepreneurial activity and public service institutions (e.g., government, healthcare, education) are said to be interdependent and co-develop (e.g., [Stam and van de Ven, 2021](#); [Wurth et al., 2022](#)). Yet, most empirical research to date has focused on the one-directional relationship of the impact that public service institutions can have on entrepreneurship. For instance, previous evidence suggests that, when public institutions perform well, they encourage productive entrepreneurial activity and regional development ([Baumol, 1990](#); [Estrin et al., 2013](#); [Sobel, 2008](#)). Regions that invest in their public institutions propagate productive entrepreneurial activity ([Wei, 2022](#)). When institutions emphasize innovation, entrepreneurship increases, leading to regional economic development ([Sobel and King, 2008](#)). This association is important because the value of entrepreneurship has been predicated on its crucial role in economic development ([Acs et al., 2017](#); [Rocha, 2004](#); [Schumpeter, 1934](#); [Sobel, 2008](#)). Researchers attribute between one-third ([Reynolds et al., 1999](#)) to one-half ([Zacharakis et al., 2000](#)) of the differences in economic growth between countries to

entrepreneurial activity. At a local level, entrepreneurial activity fosters job creation, which increases local wealth and connects the regional economy to the broader business world ([Bos and Stam, 2014](#); [Criscuolo et al., 2014](#); [Haltiwanger et al., 2013](#); [Henderson et al., 2002](#)).

The relationship in the opposite direction, such that entrepreneurial activity also influences the emergence and evolution of institutions, is largely empirically overlooked, thus leaving a gap in the literature ([Henrekson and Sanandaji, 2011](#)). The emphasis on entrepreneurship as a means to economic growth underappreciates its other byproducts, namely, its influence in developing the “character of a place” through its local institutions ([Feldman, 2014](#); [Feldman et al., 2005](#)). Having empirical evidence of the implications of regional entrepreneurial activity, both economic and non-economic, is crucial for decision-making by researchers, policymakers, entrepreneurs, etc.

Additionally, we contend that measuring the effects of entrepreneurship on the objective and subjective performance of public service institutions can inform their improvement. An important nuance in evaluating institutions that provide a public service is that they must be evaluated in terms of objectively verifiable criteria and users' subjective

* Corresponding author.

E-mail addresses: smeek5@kennesaw.edu (S.R. Meek), matthias.tietz@unisg.ch (M.A. Tietz).

<https://doi.org/10.1016/j.respol.2022.104652>

Received 27 November 2019; Received in revised form 29 September 2022; Accepted 2 October 2022

Available online 31 October 2022

0048-7333/© 2022 Elsevier B.V. All rights reserved.

perceptions of the service (Boulding et al., 1993; Cronin and Taylor, 1994; Djellal and Gallouj, 2005, 2007; Fornell et al., 1996; Iacobucci et al., 1995; Parasuraman et al., 1985; Sureshchandar et al., 2002).

This paper takes an advanced, complementary, empirical approach to determine whether and how entrepreneurial activity affects public service institutions, differentiating the impact on their objective versus subjective performance. Our longitudinal study examines measurable institutional performance against objective and subjective criteria over a decade. Our unique multiyear database from four distinct public and private data sources represents all (3000+) U.S. counties and provides: 1) details on regional entrepreneurial activity; 2) key regional economic cluster-level sociodemographic variables; and 3) objective and subjective hospital performance metrics. We use the entirety of U.S. hospitals as exemplary public service institutions because they are ubiquitous, serving the population in all regions, and currently experiencing unprecedented demands to innovate in response to policy changes, such as the Affordable Care Act (*Patient Protection and Affordable Care Act, 2010*), and market pressures, such as the fight against the COVID-19 pandemic. Further, hospital performance matters beyond economics; it is often literally a matter of life and death. Our longitudinal models use mixed-effects regression, and we also graph important interactions with research institutions, highlighting hospitals' dual role as generators and recipients of innovative knowledge.

The exploratory research design supports an in-depth empirical investigation without committing to specific hypotheses (similar studies include Feldman et al., 2019; Moeen and Agarwal, 2017; Petty and Gruber, 2011; Sobel, 2008). The findings diverge and suggest that regions with significant entrepreneurial activity have lower hospital mortality rates (objective performance) but also lower patient satisfaction (subjective performance). The relationship with patient satisfaction is less negative when the hospitals also conduct research. The policy implications of these results loom large. Namely, public service institutions are clearly influenced by the entrepreneurial knowledge in their communities, and would do well to understand how to increasingly absorb knowledge flows related to the customer experience. This work opens the black box that has obfuscated the interdependence of regional elements and will, we hope, inform theory development and future policymaking.

2. Roles of institutional performance and entrepreneurship in regional development

Three perspectives have dominated discussions of regional entrepreneurial development: the knowledge spillover theory, regional innovation clusters, and entrepreneurial ecosystems. We briefly review their relevant tenets and latest contributions.

The knowledge spillover theory suggests that, when organizations innovate and create new knowledge, some of the knowledge may be shared (intentionally or not) and become a source of entrepreneurial opportunity for other organizations to exploit (Acs et al., 2009; Audretsch and Keilbach, 2007; Audretsch and Lehmann, 2005; Ghio et al., 2015; Plummer and Acs, 2014). In one example, knowledge-generating organizations utilize knowledge filters, such as organizational priorities, which create a gap between the knowledge the organization creates and the knowledge the organization eventually utilizes or absorbs (Acs et al., 2009; Acs and Plummer, 2005; Audretsch and Feldman, 1996; Audretsch and Keilbach, 2007; Feldman and Audretsch, 1999; Jaffe et al., 1993; Shu et al., 2014). In a second scenario, innovative knowledge may be exploited by the creating organization, only to be followed by copycat organizations, which may have an advantage with investors dependent on the copycat's ability to exploit the knowledge (Fu and Tietz, 2019). A third scenario involves universities as an example of institutions that create knowledge spillovers (Ghio et al., 2015), which local entrepreneurs can exploit (Acs and Plummer, 2005). In other words, knowledge-generating organizations often create more new knowledge than they can completely, and solely, exploit, resulting

in knowledge spilling over the boundaries of the creating organization. Such knowledge spillovers tend to be more significant locally (Audretsch and Feldman, 1996; Jaffe et al., 1993).

The innovation cluster approach to regional development “focuses on geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions” (Porter, 1998: 197), which are spatially bound and local by definition (Enright and Roberts, 2001; Porter, 2000). Work related to clusters on regional systems of innovation tells us that innovation is a process that does not occur in isolation, relying solely on internal resources; instead, it depends on the greater cluster environment and social interactions that occur within it (Cooke et al., 1997; Doloreux, 2002; Edquist, 1997; Howells, 1999). This is because knowledge flows more easily between actors located in a cluster than outside, largely because informal networks are an important channel for knowledge diffusion (Dahl and Pedersen, 2004). Strong regional economic clusters foster entrepreneurial activity and encourage a broad variety of regional innovation (Delgado et al., 2010; Delgado et al., 2014; Feldman and Audretsch, 1999; Feser et al., 2008; Glaeser et al., 2010; Glaeser and Kerr, 2009; Kim et al., 2021; Porter, 2003). Early cluster work studying Silicon Valley found that the region's innovation success was greatly influenced by the “variety of regional institutions [...] that provide technical, financial, and networking services, which the regions' enterprises often cannot afford individually. By socializing costs and risks and pooling technical expertise, these institutions allow Silicon Valley's specialist firms to continue to innovate and react flexibly” (Saxenian, 1990: 96). And while cluster work has shown that entrepreneurship positively affects economic growth, there is a call for more empirical evidence of the impact of entrepreneurship on regional development focusing on building capabilities rather than simple output (Rocha, 2004).

Derived from the regional development literature (Acs et al., 2017), the entrepreneurial ecosystem approach has become popular. Entrepreneurial ecosystems are defined as an interconnected group of local community actors committed to supporting new ventures expected to drive productive development (Cohen, 2006; van de Ven, 1993). The literature claims to holistically consider these interconnected elements; yet, entrepreneurial activity remains the main outcome of interest, even though other elements of the ecosystem, including institutions, depend on entrepreneurs (Stam and van de Ven, 2021). In the ecosystem view, mutual interdependence sustains entrepreneurial activity. The theory and measurement of entrepreneurial ecosystems are still a work in progress (Wurth et al., 2022). Stam and van de Ven (2021) take a first step by applying a systems approach, in part because they believe that researchers must clearly define the roles of institutions in these ecosystems.

The three literatures on knowledge spillovers, regional clusters, and entrepreneurial ecosystems together suggest that “a major part of firms' competitive advantage is related to the resources found within the region rather than solely residing within the firm” (Spigel, 2017: 51). A differentiated theoretical base addressing how entrepreneurial activity might influence institutional performance is still missing, however. We find that the literature streams on regional development downplay the flow of knowledge from entrepreneurial activity to regional institutional performance. We attribute this gap, in part, to five methodological challenges.

3. Methodological challenges of regional development research

3.1. Challenge 1: directional precedent

A relatively substantial body of literature empirically demonstrates that institutional settings influence entrepreneurial activity (e.g., Estrin et al., 2013). It stems from Baumol's (1990, 1993) theory that the institutional setting determines the extent and productivity of local entrepreneurship. Stenholm et al. (2013) find empirical evidence that a

supportive regulative environment is crucial for the formation of new firms but has almost no influence on the prevalence of high-growth, innovative new ventures. Instead, high-impact new firms rely on innovative opportunities created by knowledge spillovers from the institutional environment (Acs et al., 2008; Audretsch and Keilbach, 2007; Stenholm et al., 2013). Fewer researchers, to our best knowledge, have examined the opposite direction to define how entrepreneurial activity affects institutions (for an exception relying on case studies, see Henrekson and Sanandaji, 2011).

3.2. Challenge 2: representative data

One of the biggest missing pieces in the literature is reliable, nationally representative data on the relationships between entrepreneurial activity and the performance of important institutions. The regional entrepreneurship and development index (REDI) developed by Szerb et al. (2015) “conceptualizes entrepreneurship as a trial-and-error process of knowledge spillovers and resource allocation” (p. 5). This multifaceted measure also accounts for the institutional context, which is a great step toward examining entrepreneurial ecosystems as a whole. However, in emphasizing overall relationships, it neglects specific relationships within the ecosystem (Szerb et al., 2015).

Another recent approach uses rather coarse measures. Stam and van de Ven (2021), for example, measure the presence or absence of corruption, rule of law, government effectiveness, and voice and accountability across educational, healthcare, and law enforcement institutions. Remarkably, in contrast with their expectations, the authors reveal that the quality of these public services consistently correlates negatively with other entrepreneurial ecosystem elements. Unfortunately, the authors offer no explanation for this finding.

We designed our study to bring the direction and influence of these relationships into focus by compiling relevant, healthcare-specific, nationally representative data on every hospital in the United States.

3.3. Challenge 3: differentiation between objective and subjective performance of institutions

Institutional performance has two dimensions: objective performance, which can be quantified by quality measures, and subjective performance based on user perceptions. However, studies rarely, if ever, account for both (Donabedian, 1989). Indeed, public service institutions would gain valuable knowledge and deeper appreciation of subjective perceptions of their own output quality by studying the work on service performance conducted in various industries (Oh, 1999; Parasuraman et al., 1985; Sureshchandar et al., 2002). For instance, Oh (1999) uses an integrated approach to show that perceived value sparks customer satisfaction. Further, Sureshchandar et al. (2002) emphasize that customers consider all their encounters and experiences with their local institution when evaluating its service performance. These conceptual differences suggest that institutions must work to continuously improve their objective and subjective performance (Donabedian, 1989; Sureshchandar et al., 2002); they also can be expected to perform differently depending on which they prioritize.

3.4. Challenge 4: longitudinality

Causal relationships are difficult to determine in entrepreneurial ecosystems since their elements are often interdependent and co-evolve (Stam and van de Ven, 2021). Previous empirical studies of the relationship of institutional quality and entrepreneurship have relied solely on cross-sectional data (Becker et al., 2019; Sobel, 2008; Sobel and King, 2008; Stenholm et al., 2013). Longitudinal data can help in teasing out, if not causal, then at least chronological relationships, but these data are difficult to obtain. Our data on the U.S. healthcare system spans 12 years, allowing us to study the relationship between entrepreneurial activity and hospital performance over time.

3.5. Challenge 5: regional granularity

Previous research on institutional quality examines entrepreneurial activity at the state (Sobel, 2008) and national levels (Estrin et al., 2013; Stenholm et al., 2013), often overlooking the increasing amount of “spiky” development in particular geographic regions (Stenholm et al., 2013). Because entrepreneurial clusters are not homogenous across nations or even states (Andersson and Larsson, 2016), a macro-level approach may mask an innovative cluster in an overall average. As a remedy, we use fine-grained, county-level data on entrepreneurial activity and match it with detailed objective and subjective hospital-level outcomes (Audretsch and Feldman, 1996). Institutional interactions are highly local (Marti et al., 2013); as such, regional residents attend nearby colleges and universities, seek the nearest medical care, and are influenced by local law enforcement and governments.

The regional development literature emphasizes that endogenous growth occurs when residents share knowledge and interact to encourage entrepreneurship. Whether and how entrepreneurial activity influences the performance of regional institutions remains unknown, however. Our methods, described next, are designed to answer this question empirically.

4. Research methodology

4.1. Hospitals as an important institutional context

In this paper, we examine the important institutional context of hospitals. Healthcare is currently the largest employer in the United States (employing 20 million people in 2018) and is expected to continue growing (Dowell, 2020). Additionally, recent policy changes in the U.S. healthcare sector have incentivized hospitals to leverage innovation, as they progressively transition from volume-based payment toward performance-based payment (Berwick et al., 2008; Gawande, 2012; *Patient Protection and Affordable Care Act*, 2010). Yet, despite a clear and recent policy mandate for hospitals to innovate, hospitals are prototypical institutions (Eriksson and Ujvari, 2015; Meyer and Rowan, 1977; Ruef and Scott, 1998; Yang, 2015), because they are highly regulated by public agencies (Gulbrandsen et al., 2016) and subject to the bureaucracies that make institutions notoriously difficult to change (Grazier and Metzler, 2006; Herzlinger, 2006; Shortell et al., 2001). The prototypical nature of hospitals is relevant from a research design, as it affords higher degrees of generalizability.

4.2. Data

Our empirics are based on a hand-collected county-level data set assembled from four secondary databases: the U.S. Cluster Mapping Project (USCMP), StatsAmerica (SA), Hospital Compare from the Centers for Medicare and Medicaid Services (CMS), and the American Hospital Association's (AHA) annual survey of hospitals. Table 1 provides an overview of our data sources and the variables we used. We briefly introduce each data set here.

First, USCMP provides county-level information about regional economic clusters and their business environments. Here, we use the longitudinal USCMP data from 2006 to 2014. Second, SA's Innovation 2.0 data set provides comprehensive data on innovation capacity and innovation output of counties from 2016. Third, CMS publicly reports hospital performance information on the Hospital Compare website at the hospital level. Here, we use CMS biennial data from 2008 to 2018. Finally, the AHA survey provides hospital profiles and statistics for approximately 6300 hospitals across the United States. Here, we use the biennial survey results from 2008 to 2016. We match the county-level data to hospital data in the same county using the Federal Information Processing Standard (FIPS) code.

Table 1
Data sources.

Data source	Sponsor and key notes	Timeframe of data included in analysis	Level of data analysis	Variables used in analysis
U.S. Cluster Mapping Project (USCMP)	-Sponsored by U. S. Economic Development Administration and the U.S. Department of Commerce, led by the Institute for Strategy and Competitiveness at Harvard Business School -Longitudinal panel data on regional cluster strength, business environments and regional economic performance for the 3141 counties or county-equivalents in the U.S. -Innovative data source standardized for cross-regional analysis (Feldman et al., 2012 Innovative Data Sources for Regional Economic Analysis)	2006–2014, every other year	3143 counties in the U. S.	Independent variable: cluster strength Controls: prosperity, poverty rate, college degrees (scaled to population), establishments growth rate, innovation (patents/10 k employees), population age
StatsAmerica (SA)	-Led by Indiana Business Research Center at Indiana University's Kelley School of Business -Innovative data source (Feldman et al., 2012 Innovative Data Sources for Regional Economic Analysis)	2016 (Innovation 2.0)	3143 counties in the U. S.	Independent variables: business dynamics index, business incubator spillovers Controls: economic wellbeing index, population growth
Hospital Compare (CMS)	-Centers for Medicare and Medicaid Services (CMS)	2008–2018, every other year	Hospital (e.g., 4024 hospitals in 2014 data)	Dependent variables: 30-day pneumonia mortality, % of patients rating their hospital experience a 9 or 10 Controls: Hospital competition
American Hospital Association (AHA) Annual Survey	-American Hospital Association (accessed through the Wharton database)	2008–2016	Hospital (e.g., 4024 hospitals in 2014 data)	Moderator variable: research hospitals Controls: hospital bed size, state

4.3. Methodology

4.3.1. Dependent variables: objective and subjective performance of institutions

Our two dependent variables come from the CMS Hospital Compare Dataset. First, we measure the objective performance of public service institutions based on *30-day mortality rates for pneumonia*. Mortality (or death) rates from common diagnoses, including pneumonia, were some of the first performance metrics that CMS required hospitals to report and have been publicly reported since 2007, making them one of the most standardized, well-accepted measures in the industry (CMS.gov, 2017). Specific care protocols ensure high comparability across U.S. counties. To calculate the mortality rate, CMS obtains risk-adjusted (for the severity of patient illnesses) data at the patient level, directly from hospitals about deaths in the 30 days after a patient enters the hospital for pneumonia. Lower rates equal better performance.

Our measure of subjective performance is patient satisfaction (Bjertnaes et al., 2012). Patient satisfaction is systematically and officially recorded by the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey for all hospitals accepting CMS payments; it is well regarded by hospitals because patient satisfaction is used to determine financial reimbursement for hospitals (CMS.gov, 2017). It is also the metric most patients follow when selecting a hospital for elective treatment (Wensing et al., 1998). The HCAHPS survey asks about overall patient experience and specific processes such as cleanliness, communication with caregivers, and quietness of the facilities; it then summarizes an overall experience rating of 0 (extremely negative) to 10 (extremely positive). CMS makes only data on the percentage of patients who *responded 9 or 10* in this summary measure of patient satisfaction publicly available. This measure is the industry-wide standard for subjective performance of hospitals, which hospitals also use to benchmark their own performance against that of their peers. Higher percentage values reflect higher patient satisfaction.

One reason that we rely on these specific dependent variables is because these are the objective and subjective performance measures that matter to hospitals and policymakers. For instance, CMS, the largest government payer, withholds 2 % of all hospitals' base reimbursement for Medicare patients to pay hospitals that score above the median on important metrics; further (not coincidentally), 25 % of this performance payment is determined by patient satisfaction scores, and another 25 % is determined by patient mortality rates.

4.3.2. Independent variables: entrepreneurial activity in regions

We measure entrepreneurial activity using the biennial U.S. Cluster Mapping Project (USCMP) measure of *cluster strength*, which measures the percent of traded employment in strong clusters and is an appropriate and tested empirical proxy for entrepreneurial activity in a region (Delgado et al., 2010). We also measure entrepreneurial activity with the *business dynamics index* and *business incubator spillovers* from StatsAmerica (SA). The business dynamics index is a composite measure of establishment formation (e.g., business start-ups and associated jobs), establishment dynamics (e.g., start-up births, deaths, expansions, and contractions), and venture capital measures (e.g., venture capital by high-tech industries and number of IPOs). Business incubator spillovers are measured as the concentration of business incubator resources in a region and are described as “akin to university knowledge spillovers” (Slaper et al., 2016: 22). StatsAmerica calculates a score from the number of business incubators within 50 miles, weighted by distance. Higher scores represent regions with a higher density of business incubators. Together, the U.S. Cluster Mapping Project and StatsAmerica provide innovative data for a comprehensive view of entrepreneurial activity in regional economic clusters.

4.3.3. Moderating variable: research institutions

Research institutions are public service entities that actively engage in investigation and knowledge creation. Typical examples include

universities, think tanks, innovation spaces, research institutes, and research hospitals. All of them participate and invest in research and development on innovation and process improvements. They also play a unique role as knowledge generators, which also gives them a unique relationship with knowledge absorption. Hence, we examine research institutions' moderating role on the relationships between entrepreneurial activity and objective as well as subjective institutional performance. The AHA annual survey of hospitals provides data on whether hospitals as public service institutions are characterized as a *research hospital* through the inclusion of a dedicated question: "Does your hospital have an organized hospital research program in any of the following areas: basic research, clinical research, community health research, and/or research on innovative health care delivery?" We code a "yes" as 1 and a "no" as 0 for a binary indicator variable. On average, 27 % of hospitals in a given year are designated research hospitals.

4.3.4. Control variables

We include important control variables to rule out alternative elements, including innovation output, economic well-being, hospital characteristics, and possible endogenous variables that could affect both entrepreneurial activity and the performance of public service institutions in a region. We control for technical *innovation* (from USCMP), measured as the number of utility patents per 10,000 employees. Other scholars have already established the importance of patents as a measure of regional production of new knowledge (Acs et al., 2002; Jaffe, 1989; Plummer and Acs, 2014). The United States is one of the most advanced countries in healthcare patents (Herper, 2011). Importantly, cluster strength and patented innovation measure different things. The former is a marker for entrepreneurship in the community; the latter measures predominantly technical innovation. Of course, overall economic well-being could be associated with both strong regional economic clusters and high-performance public service institutions. To control for this possibility, we include *establishments' growth rate* (from USCMP), which measures new business growth in a location as the annual percentage change (positive or negative) of registered businesses in a county.

It is also important to control for business growth (Audretsch and Feldman, 1996; Jaffe et al., 1993; Wong et al., 2005), as we wish to isolate the relationship of strong clusters with hospital performance, from general economic growth in a county. The general community satisfaction of the regional population is another consideration that may influence entrepreneurial activity and public service institutions' performance; therefore, we include two controls measures to capture this sentiment: *prosperity* (measured as the GDP per capita) and *poverty rate* (percent of population below the federal poverty level) by county (both from USCMP). Prosperity and poverty rate have a moderate correlation coefficient of -0.14 , so the risks of multicollinearity are low; thus, we include both in our model to represent the diverse economic range of regional economic clusters.

We further control for the ratio of aging *adults over 65* and *adults 45–64* (and by exclusion adults 25–44), as a proxy for population health. Obviously, we would expect that, as the age of the population increases, mortality rates also increase; further, because counties vary in their population make-up, it is important to control for this. To additionally consider differences in the general human capital between counties, we include the percentage of the population aged 25 and above who hold a *college degree* in each of our 3000 counties as a control variable. For hospital characteristics, we include *hospital beds* (from AHA), which counts the number of stationary patients a hospital can accommodate. This measure corrects for differences that are solely due to economies of scale in the healthcare sector (Berry, 1967; Goes and Park, 1997; Lynk, 1995). Hospital competition is also likely to influence hospital performance in a region (Kessler and McClellan, 2000; Plummer and Acs, 2014); therefore, we created a *hospital competition* measure based on the number of unique hospitals serving each county per the elderly population (to scale the measure for the expected demand for hospital services).

In the cross-sectional analysis, we additionally control for *population growth* (from SA), measuring the annual average growth rate for the population ages 25 to 44, and the *economic well-being index* (from SA), a composite measure of employment and poverty rates, compensation, income growth, and migration of new residents. Finally, in the cross-sectional analysis, we include a control for *state* (which mixed effects account for in the longitudinal data), because a large portion of health policy occurs at the state level, and we may expect differences between state policy environments.

4.4. Econometric models

We begin by using longitudinal data from the USCMP to run regression analysis with mixed effects for hospitals on panel data from 2006 to 2014. Investigating cluster strength using mixed-effects regression models is superior to using fixed-effects or random-effects models alone because some of the characteristics we are interested in are expected to be rather time invariant (e.g., state, research institution designation), while we also want to allow other characteristics to vary. Additionally, the fixed-effects portion of the models also controls for the average differences across hospitals in any unobservable characteristics and leaves only the within-hospital variation across time, reducing the potential for omitted variable bias.

To corroborate our longitudinal analysis with cluster strength, we re-run each hypothesis with the more direct measures of entrepreneurial activity, the business dynamics index, and business incubator spillovers (from SA) as our independent variables. We test business dynamics index and business incubator spillovers simultaneously in the regression models to explain objective and subjective hospital performance. Because both independent variables are correlated with each other ($r = 0.61$; $p = 0.000$) and still show significant results when tested together, we gain confidence that we are not overestimating their effects. In all regressions, we lag the dependent variables by two years to allow time for knowledge diffusion. Theoretically, a two-year lag is appropriate here, because it affords sufficient time for knowledge diffusion and adaptation. Conversely, a longer time lag (the next available one is a four-year time lag, given our biennial data) may be a long time for knowledge diffusion and sustainment, whereas a more concurrent entrepreneurial activity (zero-year lag) would not allow for the expected diffusion of knowledge to public service institutions, knowing how slowly these institutions typically absorb knowledge. In support of our two-year lag, early work on knowledge spillovers reveal that spillovers peaked around three years after the originating knowledge was made available to the public, and that absorbed knowledge spillovers were prevalent and on the rise in year two (Jaffe et al., 1993).

5. Results

Table 2 shows the summary statistics and correlation matrix for all variables. As expected, the mortality and patient satisfaction dependent variables are substantially ($r = 0.10$) and significantly ($p = 0.000$) correlated. On average, 71.93 % of patients rated their hospital experience as a 9 or 10 out of 10 throughout all U.S. hospitals during 2008–2018. The average hospital in our nationally representative data (and hence in the entire United States) has approximately 163 beds, although hospital size differs widely across all hospitals. The largest hospital has 2478 beds, for example. The growth rate of new establishments also varies across counties. The average growth rate across the United States in the number of new businesses was flat but ranged from -10 % to 19 %. The makeup of the county communities greatly differs across the United States with an average poverty rate of 16 % (ranging 4 %– 47 %), and an average of 25 % of the population having a college degree (ranging 8 %– 72 %). Our indicators of entrepreneurial activity were reported at the county-level and showed wide variation across the nation. A skewness/kurtosis test for the normality histogram indicated that cluster strength, one of our indicators of entrepreneurial activity, is

Table 2
Summary statistics and correlation matrix.

Variable	N	Mean	S.D.	Min	Max	Correlations	
						1	2
(1) 30-day pneumonia mortality	4024	16.4	2.09	8.7	26.8		
(2) patient satisfaction (% 9 or 10 rating)	4047	71.93	8.6	30	97	0.10***	
(3) cluster strength	4591	0.49	0.17	0	0.93	0.01	−0.02*
(4) business dynamics index	4555	70.88	27.5	9.9	159.1	−0.16***	−0.08***
(5) business incubator spillovers	4555	107.53	60.9	0	200	−0.14***	−0.12***
(6) research hospitals	3762	0.27	0.44	0	1	−0.06***	−0.02*
(7) prosperity	4571	45,549	41,125	7503	1,131,082	−0.03***	0.04***
(8) poverty rate	4591	0.16	0.06	0.04	0.47	0.10***	−0.05***
(9) adults over 65	4591	0.16	0.04	0.06	0.52	0.18***	0.05***
(10) adults 45–64	4591	0.27	0.03	0.12	0.38	0.01	0.05***
(11) hospital competition	4591	52.21	109.86	1.91	675.64	−0.15***	−0.10***
(12) college degrees	4591	0.25	0.1	0.08	0.72	−0.11***	0.05***
(13) innovation	3811	9.84	14.94	0.2	171.82	0.02	0.06***
(14) establishments growth rate	4591	0	0.02	−0.1	0.19	0.10***	−0.04***
(15) hospital bed size	4690	163.03	194.94	2	2478	−0.09***	−0.14***
(16) population growth	4555	123.53	43.49	50	200	−0.02**	0.01
(17) economic wellbeing index	4555	109.84	19.89	59.6	187.8	−0.01	0.21***

Table displays a sample of one year of data; 2014 for the longitudinal data, and 2016 for cross-sectional data.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

not normally distributed; however, non-normality in the data is not unexpected with such a large sample size; further, the kurtosis of 0.5741 is within an acceptable range (−1 to +1) (Hair et al., 2007). Histogram and quantile plots of cluster strength show graphical evidence of normality. The cluster strength variable ranges from 0 to 0.93 with a mean of 0.49. Additionally, the number of entrepreneurial resources in communities varies across the United States. From SA, the business incubator spillovers measure averages 107.53, ranging from 0, indicating no business incubators nearby, up to 200.

Table 3 shows the longitudinal and cross-sectional regression results for these variables. In the subsequent paragraphs, models with odd numbers represent longitudinal mixed-effects models based on the cluster-strength independent variable. Models with even numbers intend to corroborate their immediately preceding model with simple OLS regressions of business dynamics index and business incubator spillovers. Overall, we find divergent results in terms of objective and subjective institutional performance.

Model 1 investigates the possible effect of cluster strength on 30-day pneumonia mortality. Model 1 has a chi-squared of 636.96 and log likelihood of −19,109. We find a significant negative relationship ($\beta = -0.501$; $p = 0.020$) between the two variables, indicating that, as cluster strength increases, local hospital mortality rates from pneumonia decrease. These findings suggest that entrepreneurial activity in a region is associated with improved objective institutional performance.

In Model 2, we regress two independent variables from the cross-sectional StatsAmerica 2016 data: (1) business dynamics index and (2) business incubator spillovers on our dependent variable of 30-day pneumonia mortality to support and verify the findings from Model 1. We find corroborative evidence in a significant negative relationship between business dynamics index and pneumonia mortality ($\beta = -0.013$; $p = 0.000$). Business incubator spillovers do not have a significant relationship with mortality in this case. We also see that innovation has a positive and significant relationship with pneumonia mortality in this model.

Models 3 and 4 examine the relationship between entrepreneurial activity in a region and subjective hospital performance. Model 3 examines the relationship between cluster strength and patient satisfaction and finds a significant negative relationship ($\beta = -1.670$; $p = 0.007$). Contrarily to mortality, as cluster strength increases, the patient satisfaction decreases. Our findings show that a relatively small increase in cluster strength, e.g., from the mean of 49 % to 50 % of traded

employment, is associated with the comparatively larger change from 71.93 % to 70.26 % of patients rating their hospital experience as a 9 or 10 (out of 10).

Model 4 examines the relationship between the business dynamics index and business incubator spillovers on the patient satisfaction ratings; these results are consistent with those in the longitudinal Model 3. As expected, business incubator spillovers were significantly negatively associated with high patient satisfaction ratings ($\beta = -0.013$; $p = 0.032$). There was also a significant negative relationship between the business dynamics index and patient satisfaction ($\beta = -0.009$; $p = 0.000$). In contrast with objective performance, these findings suggest that, as entrepreneurial activity increases, subjective institutional performance decreases.

Models 5–8 investigate the possible contingencies of research hospitals. Previously, we saw a direct, positive effect of research hospitals on patient satisfaction ($\beta = 0.49$; $p = 0.015$ in Model 3; $\beta = 1.22$; $p = 0.000$ in Model 4), indicating that subjective performance is higher in research hospitals compared with that of non-research hospitals. We attribute this finding to patients having a general preference for hospitals that provide higher levels of care, as at research hospitals, regardless of whether or not they need this specialized care (Liu et al., 2018). Model 5 then tests the interaction effects of research hospitals $\times$ cluster strength on 30-day pneumonia mortality. We did not find a significant relationship here.

Model 6 tests alternative measures of entrepreneurial activity in the interaction of research hospitals $\times$ business dynamics index and research hospitals $\times$ business incubator spillovers on 30-day pneumonia mortality rates. Here, we find that the interaction with the business dynamics index is negative and significant ($\beta = -0.015$; $p = 0.000$). This finding suggests that research hospitals in areas with a high business dynamics index have even better pneumonia mortality rates than non-research hospitals. Yet, the interaction between research hospitals and business incubator spillovers is nonsignificant. Taken together, the findings from Models 5 and 6 suggest no clearly discernible pattern.

Model 7 does not show a significant relationship between the interaction of research hospitals and cluster strength on patient satisfaction.

Model 8, however, does show a positive ($b = 0.021$) and significant ($p = 0.013$) relationship between the interaction of research hospitals with the business dynamics index and patient satisfaction. Then, the interaction of research hospitals with business incubator spillovers on

Correlations													
3	4	5	6	7	8	9	10	11	12	13	14	15	16
-0.01													
-0.02**	0.61***												
-0.05***	0.38***	0.35***											
0.11***	0.30***	0.14***	0.14***										
-0.11***	-0.25***	-0.22***	-0.05***	-0.14***									
-0.05***	-0.43***	-0.41***	-0.23***	-0.14***	-0.02**								
0.04***	-0.31***	-0.18***	-0.16***	-0.11***	-0.26***	0.65***							
-0.21***	0.47***	0.41***	0.19***	0.16***	0.03***	-0.35***	-0.32***						
0.06***	0.73***	0.55***	0.37***	0.29***	-0.43***	-0.37***	-0.18***	0.27***					
0.08***	0.36***	0.21***	0.06***	0.14***	-0.27***	-0.10***	0.03***	0.02**	0.42***				
0.04***	0.25***	0.10***	0.05***	0.12***	-0.17***	-0.23***	-0.23***	0.12***	0.24***	0.11***			
-0.04***	0.41***	0.38***	0.56***	0.15***	0.01	-0.26***	-0.22***	0.22***	0.36***	0.01	0.06***		
0.04***	0.39***	0.12***	0.15***	0.15***	0.01	-0.53***	-0.61***	0.17***	0.33***	0.02**	0.35***	0.21***	
0.10***	0.06***	-0.12***	-0.11***	0.21***	-0.61***	0	0.05***	-0.17***	0.22***	0.23***	0.17***	-0.18***	0.12***

patient satisfaction is not significant ($p = 0.222$). Thus, in order to better understand the partial significance of the interactions we find in Models 5–8, we graph these results in Figs. 1 and 2 below.

Fig. 1 shows the margins plots for the interactions among (A) research hospitals and cluster strength, (B) research hospitals and business dynamics index, and (C) research hospitals and business incubator spillovers all on pneumonia mortality. The plotted relationships and associated 95 % confidence intervals represent research hospitals (dashed lines) and non-research hospitals (solid lines). Fig. 1A shows reveals a much steeper declining slope for research hospitals than for non-research hospitals, indicating that research hospitals improve their objective performance at increasing rates compared with non-research hospitals, and that this significant interaction is mostly observed at the higher levels of cluster strength (around 0.7 cluster strength out of 1). Fig. 1B shows a nonsignificant interaction, with the confidence intervals overlapping throughout. Fig. 1C again shows a differentiation between research and non-research hospitals; this time, the interaction is observed through significant differences at lower levels of business incubator spillovers. It makes sense theoretically that, when a region increases the number of business incubators from 1 to 3, for instance, this makes a greater marginal impact on the objective quality of institutions in the community than another community that increases business incubators in the region from 101 to 103.

Fig. 2 shows that, when examining the interaction between research hospitals and the different entrepreneurial activity measures on patient satisfaction, the only significant interaction we find overall is between research hospitals and the business dynamics index (as illustrated in 2B). However, interestingly, both Fig. 2A and C display portions where the interaction is significant and the two confidence intervals are not overlapping. Fig. 2B shows a strong interaction effect between research hospitals and the business dynamics index on patient satisfaction, which reverses the previously observed negative relationship between business dynamics and patient satisfaction. For research hospitals, we observe a positive relationship between the business dynamics index and patient satisfaction; for non-research hospitals, this relationship continues to be a negative one with an increasing business dynamic index. The divergence between research hospitals and non-research hospitals increasingly grows as the business dynamics index increases.

5.1. Robustness checks

We conducted numerous robustness checks to ensure consistency and confidence in our results. Our main analysis includes one dependent variable each for hospital mortality rates and for patient satisfaction

scores. There are of course other performance and patient satisfaction measures that are also important performance measures for hospitals. As further robustness checks on our results, we mirror our main analysis using alternative measures. First, to verify our results on hospital performance, we use the alternative dependent variable, *30-day heart failure mortality*, from the CMS Hospital Compare Dataset. Second, to verify our patient satisfaction results, we use a second summary metric from the HCAHPS survey by CMS as the dependent variable, the percent of patients who report they would “*definitely recommend*” the hospital to friends and family. We run the same analyses with these alternative measures: first, the longitudinal mixed-effects regressions using the *cluster strength* measure from the USCMP as the independent variable, and then cross-sectional OLS regressions using *business dynamics index* and *business incubator spillovers* from the StatsAmerica data set as independent variables. The 30-day mortality for pneumonia and the 30-day mortality for heart failure have a correlation of $r = 0.36$ ($p = 0.000$). The patient satisfaction summary metric is highly correlated with patient recommendation at $r = 0.88$ ($p = 0.000$). The results of these robustness analyses closely mirror the findings we report above and are available in Table 4. These measures provide the same results in our models in terms of direction, magnitude, and significance levels of the coefficients, providing assurance of the robustness and reliability of our findings.

Additionally, one of the concerns of conducting regression analyses on large data sets such as ours is the possibility for endogeneity in the form of omitted variables that, for instance, are related to both the demand for research hospitals and hospital performance. To account for this possibility, we replicated our models with a Heckman two-stage least-squares model. A Heckman sample selection model is appropriate because, in the first-stage equation, the coefficients associated with a research hospital can be estimated so that, in the second stage, the coefficients linking with the dependent variable of interest are estimated accounting for the fact that the same variables have already helped to explain the existence of research hospitals. In the first stage of our analysis, we use the number of hospital beds and the total number of hospital admissions to predict whether the hospital is a research hospital or a non-research hospital, because, traditionally, the largest institutions are designated research hospitals. In comparison, we find that the number of hospital admissions ($p = 0.000$) is a better predictor of research hospitals. We then use the main equation to determine the influence of entrepreneurial activity on hospital performance, having already accounted for the explanatory contribution of hospital admissions on research hospitals. We find comparable results with our original models in this analysis.

Third, we obtained data on the net domestic migration in each

Table 3
Mixed effects and OLS regression analysis results.

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	Mortality: 30-day pneumonia		Patient Satisfaction: % 9 or 10		Mortality: 30-day pneumonia		Patient Satisfaction: % 9 or 10	
Cluster strength	−0.501* (0.22)		−1.670** (0.62)		−0.149 (0.24)		−1.667* (0.72)	
Business dynamics index		−0.013*** (0.00)		−0.013* (0.01)		−0.015*** (0.00)		−0.020** (0.01)
Business incubator spillovers		−0.001 (0.00)		−0.009*** (0.00)		0.000 (0.00)		−0.011*** (0.00)
Research hospital (binary)	−0.036 (0.08)	−0.023 (0.08)	0.479* (0.20)	1.221*** (0.22)	0.592** (0.23)	0.274 (0.23)	0.484 (0.54)	−1.189 (0.66)
Research hospitals × cluster strength					−1.319** (0.44)		−0.011 (1.10)	
Research hospitals × business dynamics index						0.006 (0.00)		0.021* (0.01)
Research hospitals × business incubator spillovers						−0.006*** (0.00)		0.005 (0.00)
Controls								
Prosperity	0.000* (0.00)	0.000*** (0.00)	0.000* (0.00)	0.000 (0.00)	0.000* (0.00)	0.000*** (0.00)	0.000* (0.00)	0.000 (0.00)
Poverty rate	−0.396 (0.86)	−6.975*** (1.15)	−4.402 (2.86)	−1.490 (3.43)	−0.313 (0.86)	−6.736*** (1.16)	−4.402 (2.86)	−2.551 (3.44)
Economic wellbeing index		−0.011*** (0.00)		0.043*** (0.01)		−0.011*** (0.00)		0.041*** (0.01)
Establishments growth rate	43.235*** (3.78)	50.669*** (2.07)	34.846*** (5.01)	31.216*** (6.14)	43.137*** (3.78)	50.963*** (2.07)	34.845*** (5.00)	31.571*** (6.14)
College degrees (scaled to population)	−2.230*** (0.51)	−0.288 (0.54)	11.062*** (1.95)	15.789*** (1.57)	−2.102*** (0.51)	−0.272 (0.54)	11.063*** (1.95)	16.120*** (1.57)
Innovation (patents/10 k employees)	0.006 (0.00)	0.005* (0.00)	0.005 (0.01)	−0.001 (0.01)	0.007 (0.00)	0.005* (0.00)	0.005 (0.01)	−0.002 (0.01)
Hospital competition	−0.004*** (0.00)	−0.003*** (0.00)	−0.007*** (0.00)	−0.001 (0.00)	−0.004*** (0.00)	−0.003*** (0.00)	−0.007*** (0.00)	−0.001 (0.00)
Hospital beds	−0.001*** (0.00)	−0.000* (0.00)	−0.008*** (0.00)	−0.004*** (0.00)	−0.001*** (0.00)	−0.000* (0.00)	−0.008*** (0.00)	−0.004*** (0.00)
Adults over 65	20.747*** (1.94)	17.582*** (1.23)	29.283*** (5.36)	5.108 (3.64)	20.743*** (1.94)	17.870*** (1.23)	29.282*** (5.37)	3.871 (3.65)
Adults 45–64	−20.382*** (2.24)	−28.955*** (2.10)	−42.116*** (6.30)	−4.566 (6.18)	−20.394*** (2.25)	−28.920*** (2.10)	−42.116*** (6.30)	−5.053 (6.18)
Population growth (ages 25–44)		−0.008*** (0.00)		−0.002 (0.00)		−0.008*** (0.00)		−0.001 (0.00)
Constant	17.006*** (0.54)	24.292*** (1.17)	77.500*** (1.84)	61.225*** (3.48)	16.779*** (0.55)	24.177*** (1.18)	77.498*** (1.85)	62.695*** (3.50)
Observations	8035	8004	8116	8085	8035	8004	8116	8085
Adjusted R ²		0.1802		0.1833		0.175		0.1847
F Statistic		27.71		29.81		27.11		29.17
chi2	636.96		430.50		637.04		430.56	
LogLikelihood	−19,109	−18,823	−25,934	−27,725	−19,105	−18,816	−25,936	−27,718
df	11	63	11	63	12	65	12	65
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust standard errors in parentheses. Regression estimations of mixed effects reported in Models 1, 3, 5 and 7. Regression estimations of OLS reported in Models 2, 4, 6 and 8.

Dependent variables are lagged 2 years in all models.

*** $p < 0.001$.

** $p < 0.01$.

* $p < 0.05$.

county from the USCOMP (as a proxy for labor mobility) to check if we could find empirical evidence of the influence of labor mobility on spreading knowledge to institutions. Following [Baron and Kenny's \(1986\)](#) method for mediation, we find initial support that net domestic migration partially mediates the relationship between the business dynamics index as a measure of entrepreneurial activity and the objective performance of public service institutions. We find that the business dynamics index ($\beta = 0.00$; $p = 0.000$) and business incubator spillovers ($\beta = 0.00$; $p = 0.043$) are significantly, positively related to net domestic migration. In the final stage of the mediation, the business dynamics index and net domestic migration have negative, significant relationships with mortality, which might be interpreted such that the relationship between entrepreneurial activity and objective performance of institutions could be mediated by labor mobility. These results

offer empirical support that, in entrepreneurial areas, labor mobility helps knowledge to transfer from one organization to another. These results are available upon request.

Fourth, we empirically confirm our dependent-variable two-year time lag. We conducted our analyses with various different time lags as robustness checks, using no time lag (i.e., the IV and DV from the same wave), a two-year time lag, and a four-year time lag (based on the availability of our biennial data). Both zero- and four-year time lags result in coefficients in the same direction and similar magnitude compared with the two-year time lag, although the strongest results occur when we exploit the longitudinal nature of our data cautiously and lag our dependent variables by two years.

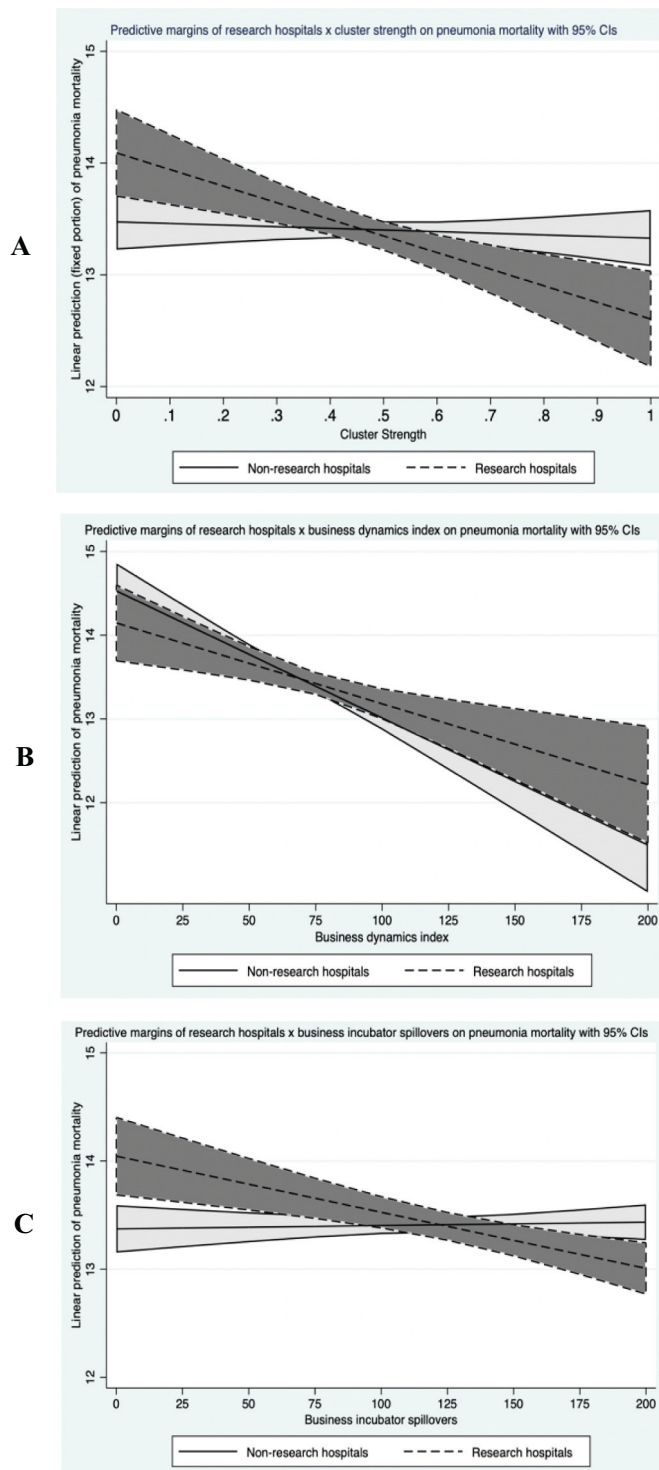


Fig. 1. Margins plots of research hospitals and entrepreneurial activity on mortality.

6. Discussion and conclusion

6.1. Entrepreneurial activity has a positive impact on objective institutional performance but reduces subjective perceptions of performance

Our analysis confirms that entrepreneurship significantly and differentially shapes the objective and subjective performance domains of local public service institutions. We present the argument that this

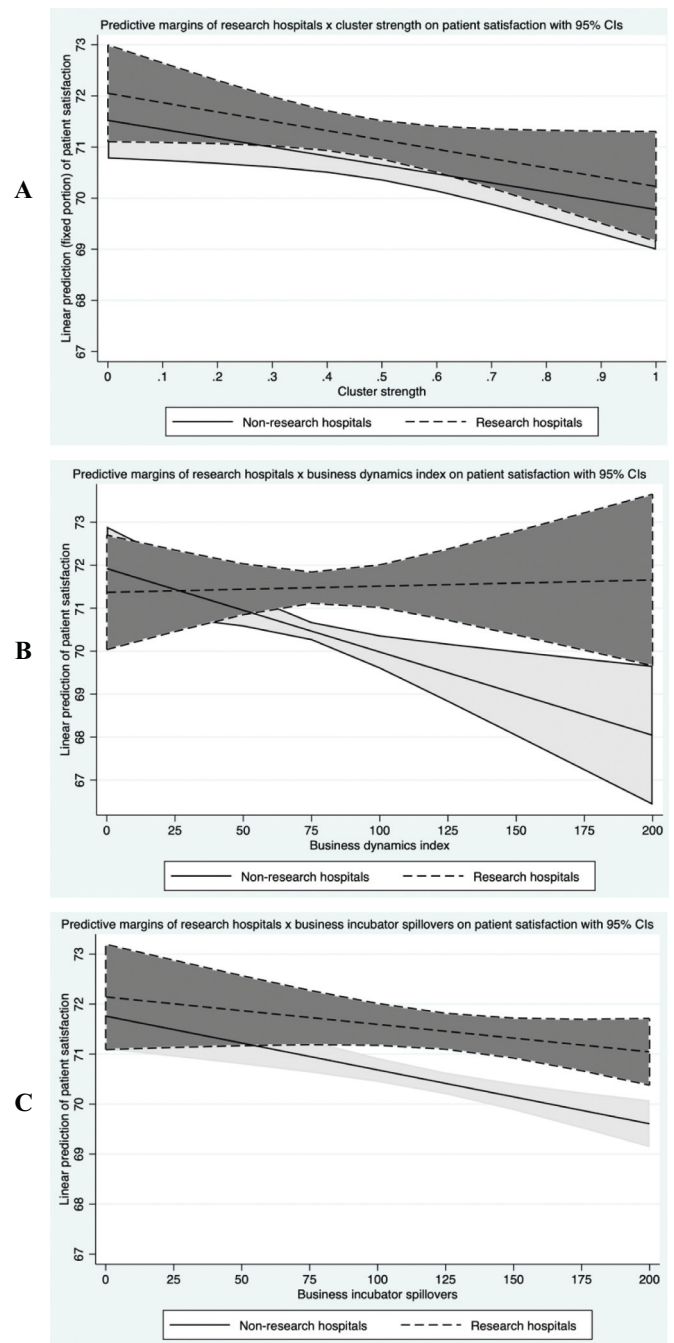


Fig. 2. Margins plots of research hospitals and entrepreneurial activity on patient satisfaction.

difference may be best explained by differential evaluative bases. Therefore, against the theoretical backdrop of literature on knowledge spillovers, clusters, and entrepreneurial ecosystems, we deduce potential theoretical contributions. Table 5 provides a summary.

On the one hand, we find entrepreneurial activity positively related to the objective performance of institutions. We consider this evidence that local institutions seeking ways to improve their technical performance absorb new knowledge generated by activity in the entrepreneurial ecosystem. Geographic proximity may promote beneficial relationships between innovative technology companies and local hospitals (Audretsch and Feldman, 1996; Feldman, 2014; Jaffe, 1989; Jaffe et al., 1993). Social relationships among employees and customers (Almeida and Kogut, 1999; Braunerhjelm et al., 2016; Ejermo and

Table 4

Mixed effect and OLS regression analysis results of robustness checks with alternative dependent variables.

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	Mortality: 30-day heart failure		PS: %Definitely recommend		Mortality: 30-day heart failure		PS: % Definitely recommend	
Cluster strength	−0.254 (0.13)		−2.436*** (0.60)		−0.064 (0.15)		−2.647*** (0.71)	
Business dynamics index		−0.005*** (0.00)		0.002 (0.01)		−0.006*** (0.00)		0.001 (0.01)
Business incubator spillovers		−0.003*** (0.00)		−0.011*** (0.00)		−0.001 (0.00)		−0.013*** (0.00)
Research hospital (binary)	0.005 (0.05)	0.009 (0.04)	0.609** (0.20)	1.942*** (0.24)	0.328* (0.14)	0.519*** (0.12)	0.242 (0.53)	0.776 (0.72)
Research hospitals × cluster strength					−0.683** (0.26)		0.782 (1.07)	
Research hospitals × business dynamics index						0.003* (0.00)		0.003 (0.01)
Research hospitals × business incubator spillovers						−0.006*** (0.00)		0.007 (0.00)
Controls								
Prosperity	−0.000 (0.00)	−0.000** (0.00)	0.000 (0.00)	−0.000 (0.00)	−0.000 (0.00)	−0.000* (0.00)	0.000 (0.00)	−0.000 (0.00)
Poverty rate	−1.060* (0.52)	−0.872 (0.65)	−7.057* (2.90)	−8.710* (3.78)	−1.018 (0.52)	−0.556 (0.65)	−7.109* (2.90)	−9.314* (3.79)
Economic wellbeing index		0.006** (0.00)		0.022* (0.01)		0.006** (0.00)		0.021 (0.01)
Establishments growth rate	6.506*** (1.09)	3.677** (1.16)	8.107 (4.47)	1.286 (6.76)	6.438*** (1.09)	3.871*** (1.16)	8.184 (4.46)	1.115 (6.77)
College degrees (scaled to population)	−0.381 (0.31)	0.663* (0.30)	21.702*** (1.97)	25.618*** (1.73)	−0.312 (0.31)	0.649* (0.30)	21.628*** (1.97)	25.718*** (1.73)
Innovation (patents/10 k employees)	0.000 (0.00)	−0.000 (0.00)	−0.005 (0.01)	−0.009 (0.01)	0.001 (0.00)	−0.000 (0.00)	−0.005 (0.01)	−0.010 (0.01)
Hospital competition	−0.003*** (0.00)	−0.003*** (0.00)	−0.006*** (0.00)	−0.001 (0.00)	−0.003*** (0.00)	−0.002*** (0.00)	−0.006*** (0.00)	−0.001 (0.00)
Hospital beds	−0.001*** (0.00)	−0.001*** (0.00)	−0.003*** (0.00)	−0.001 (0.00)	−0.001*** (0.00)	−0.001*** (0.00)	−0.003*** (0.00)	−0.001 (0.00)
Adults over 65	5.208*** (0.86)	2.980*** (0.69)	3.146 (4.82)	3.052 (4.00)	5.188*** (0.86)	3.432*** (0.69)	3.168 (4.82)	2.366 (4.02)
Adults 45–64	−7.313*** (1.14)	−3.684** (1.19)	−23.996*** (6.49)	−3.194 (6.80)	−7.294*** (1.14)	−3.642** (1.19)	−24.002*** (6.50)	−3.406 (6.81)
Population growth (ages 25–44)		0.000 (0.00)		0.009* (0.00)		0.000 (0.00)		0.010* (0.00)
Constant	14.029*** (0.33)	13.985*** (0.66)	75.013*** (1.94)	63.016*** (3.83)	13.904*** (0.33)	13.733*** (0.67)	75.148*** (1.95)	63.670*** (3.85)
Observations	7593	7562	8116	8085	7593	7562	8116	8085
Adjusted R ²		0.2061		0.1748		0.2188		0.175
F statistic		32.62		28.18		32.3		27.38
chi ²	682.10		346.35		679.92		346.16	
Log likelihood	−12,685.29	−13,084	−25,990.36	−28,503	−12,681.91	−13,056	−25,990.12	−28,501
Degrees of freedom	11.00	63.00	11.00	63.00	12.00	65.00	12.00	65.00
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

PS: Patient Satisfaction.

Robust standard errors in parentheses.

Regression estimations of mixed effects reported in Models 1, 3, 5 and 7.

Regression estimations of OLS reported in Models 2, 4, 6 and 8.

Dependent variables are lagged 2 years in all models.

*** p < 0.001.

** p < 0.01.

* p < 0.05.

Karlsson, 2006; Feldman, 2001; Kim and Marschke, 2005; Koo and Cho, 2011) may facilitate the necessary collaborations and knowledge exchange for this to happen (Agarwal et al., 2006; Dahl and Pedersen, 2004; Thursby and Thursby, 2004). Our empirical findings may therefore be understood to support the interpretation that social relationships strengthen the ability of employees to absorb and translate new knowledge into improvements at their organization (Escribano et al., 2009).

On the other hand, the subjective performance of public service institutions did not profit from local entrepreneurial activity. Consumers' subjective judgments often address the “soft” aspects of an experience, likely based on impressions of employee kindness, waiting times, and

the institution's appearance (Bjertnaes et al., 2012; Joffe et al., 2003; Vogus and McClelland, 2016; Wensing et al., 1998). Institutional performance is often not transparent or comprehensible to patients (Akao and Chaplin, 2003; Bowers et al., 1994; Lam, 1997; Levay and Waks, 2009; Ware and Snyder, 1975), chiefly because most outcomes result from (medical) team efforts that run in the background, making it nearly impossible for patients to comprehensively evaluate their service. Meanwhile, institutions tend to prioritize improving objective performance indicators at the expense of subjective performance, because they are directly measurable and within the institutional power to influence (Boudreaux and O’Hea, 2004; Gulbrandsen et al., 2016; Taylor et al., 2006; Trout et al., 2000).

Table 5

How does entrepreneurial activity influence the objective and subjective performance of institutions?

Findings	Potential theoretical mechanisms
Entrepreneurial activity is positively related to the objective performance of institutions	Geographic proximity between regional entrepreneurial activity and local institutions Co-location is important for knowledge to flow from the private sector to public institutions (Audretsch and Feldman, 1996; Jaffe, 1989; Jaffe et al., 1993) Social relationships Employee relationships (Escribano et al., 2009) Customer contact (Thursby and Thursby, 2004; von Hippel and Cann, 2021; Ali and Gittelman, 2016; Llopis and D'Este, 2016; French and Miller, 2012; Miller and French, 2016; von Hippel, 2018) Labor mobility (Braunerhjelm et al., 2016; Koo and Cho, 2011; Almeida and Kogut, 1999; Feldman, 2001; Kim and Marschke, 2005) Diverse innovation clusters Diverse economic activities across industries are conducive to innovation (Feldman and Audretsch, 1999; Battke et al., 2016; Goes and Park, 1997)
Entrepreneurial activity is negatively related to the subjective performance of institutions	Different evaluative base Customers prioritize the non-technical aspects of the user experience in evaluating institutional performance (Bjertnaes et al., 2012; Joffe et al., 2003; Vogus and McClelland, 2016; Wensing et al., 1998) Higher expectations People in entrepreneurial regions expect innovation in all service interactions (Aghion and Jaravel, 2015; Yang et al., 2010; Donthu and Yoo, 1998; Zeithaml et al., 1993) Institutions emphasize improving objective performance The greatest improvement opportunity in institutions is the customer experience, not technical innovation (Djellal and Gallouj, 2005, 2007; Lateef, 2011; Porter and Teisberg, 2007)

In addition, in regions with high entrepreneurial activity, the difference between expected and perceived service (Parasuraman et al., 1985) may be greater; then, the latter suffers. For instance, good marketing for artificial intelligence applications (e.g. Apple's Siri or Amazon's Alexa) may suggest superior performance that is not always echoed in reality ("Sorry, I didn't quite get that"). When the service is not as seamless as expected, consumers' overall perception of performance and satisfaction diminish (Kaplan and Haenlein, 2019). At a macro-level, people who live in regions where the total amount and relative rate of innovation is high (e.g., Silicon Valley, CA, or Cambridge, MA) may grow accustomed to it (Aghion and Jaravel, 2015; Donthu and Yoo, 1998; Yang et al., 2010; Zeithaml et al., 1993). These consumers (patients in the hospital example) come to expect streamlined, transparent processes (Goetz and Han, 2020). A compounding effect could be related to the recent prevalence of information-technology-related innovations. The paradox of information technology is that, while technology's intent is to improve productivity, evidence shows that productivity gains are not always realized, at least in the short term (Brynjolfsson, 1993). In hospitals, technology solutions are often not well-designed and contribute to a negative patient care experience (Jones et al., 2012), suggesting one explanation for this lag in subjective performance. Even when technology changes are well-designed, the effort to cope with the changes in the short-term, can cost on the "soft" aspects of service

delivery.

Another interesting preliminary finding from our study is the effect of research institutions. We find initial evidence that entrepreneurial activity is associated with less-negative subjective performance (and perhaps even positive subjective performance) among research institutions compared with non-research institutions. In other words, in entrepreneurial areas, the subjective performance of research institutions exceeds that of non-research institutions. We propose that one explanation for this finding is that research institutions explicitly and purposefully prioritize the ability to translate new knowledge to practice (Batalden et al., 2016; Curtis et al., 2016; Miller et al., 2012; Morris et al., 2011; Mosadeghrad, 2014). Research institutions are more prepared to appreciate and absorb novel insights from external entrepreneurial activity than counterparts in less-active regions (Escribano et al., 2009; Zahra and George, 2002). Additionally, it would make sense that the time to assimilate a smoothly provided new service and the ability to communicate the service value to patients is accelerated in research hospitals because research institutions are more experienced in integrating new knowledge into innovative services and communicating them to patients. The previous discussion regarding short-term negative effects on the customer experience following technology changes also fits well with these findings. Research institutions may find it easier to absorb and assimilate the new technology and thus its implementation sacrifices less the "soft" aspects of the service in the short term.

One might argue that this could also be the result of higher general rates of academic achievements in the population of areas home to research institutions. To address these possible market forces, we did account for the proportion of college-educated people in the population and the intensity of the local hospital competition. Supporting this argument, we find that the more educated the population, the higher the objective and subjective hospital performance. Higher local hospital competition did not have as clear of a relationship with subjective performance, but hospital competition was significantly associated with better objective hospital performance. Both the education of the population and the degree of hospital competition are highly correlated with research institutions.

Complementing the above explanations, we propose that spatial and industry proximity increases knowledge flow between entrepreneurs and research institutions (Hoang and Antoncic, 2003). Research labs are often located on hospital or university campuses, sometimes purposefully even in adjacent buildings, thus increasing the chance for social interactions and knowledge exchange, which may in time translate into better objective and subjective institutional performance. Additionally, it is not uncommon for research institutions to emphasize their dual focus on improving the technical, objective, and subjective aspects of their constituents' experience (Ali and Gittelman, 2016).

6.2. Theoretical implications

First, our results show that entrepreneurial activity does not always lead to exclusively positive outcomes. Going beyond traditional understandings of delayed adoption, slow diffusion, or learning curves with new innovation that can result in performance dips (Berwick, 2003; Guler et al., 2002), understanding possible unintended, implications of entrepreneurial activity on institutions is critical to advancing regional development (Agarwal et al., 2010; Alvedalen and Boschma, 2017; O'Mahony and Vecchi, 2009; Parker, 2010). By employing reliable, replicable, and novel measures to analyze the effects of entrepreneurship (Feldman et al., 2012), our measures and the results they afford us further strengthen the following notion. Although innovations designed for other (e.g., military) purposes can be productively translated into life-saving technologies hospitals use on a daily basis to improve their objective performance (Nelson et al., 2011), hospitals are not capitalizing on entrepreneurial activity in their surroundings to the same extent to improve their subjective performance. Indeed, such divergence is striking, especially because subjective performance in the form of

patient satisfaction is directly related to improved medical outcomes (Plewnia et al., 2016). In other words, if hospitals were to learn from local entrepreneurial activity how to improve their service experience, their patient medical outcomes could further improve. Improving patient satisfaction can literally reduce medical errors and improve patient health (Dubina et al., 2014).

Second, our study contributes to research on entrepreneurial ecosystems by providing empirical evidence that essential noneconomic ramifications have been understudied. In theory, the entrepreneurial ecosystem emphasizes the many elements that coalesce to advance regional development; yet, data showing their composition and practices are hard to come by. Significant work has established the link between knowledge and regional economic growth (Agarwal et al., 2007; Agarwal et al., 2010); yet, our findings indicate that the focus on economic output, i.e., employment, growth, and productivity (Acs, 2006; Acs et al., 2017, 2008; Braunerhjelm et al., 2016), is likely too narrow (Audretsch and Keilbach, 2007; Bloom and Canning, 2000; Ghio et al., 2015; Rocha, 2004). In agreement with Feldman (2014), we believe entrepreneurial activity is a catalyst for change within communities, and public service institutions are vital to their well-being. A more holistic and realistic model of entrepreneurship would define, collect, and test novel metrics to gain insights beyond economic performance—not just of interest to scholars but to community leaders and policymakers as well.

Third, our view of which institutions are influential in the entrepreneurial ecosystem should be expanded to include more than just university education and government. According to the “attributes of entrepreneurial ecosystems,” institutions related to public health are not currently considered part of the entrepreneurial ecosystem (Spigel, 2017). Our study shows the need to be more inclusive in considering these elements, because entrepreneurial activity can have an impact on hospital performance, e.g., the nimble creation and distribution of vaccines to treat COVID-19.

Finally, complementing recent work by Audretsch and Link (2019), who find that institutional investments encourage entrepreneurial activity, our empirical evidence makes it clear that entrepreneurial activity also influences institutional performance. Because of the difference between objective and subjective performance implications for institutions highlighted in our analysis, a more complete model of regional development must differentiate between the two when analyzing the important role of public institutions (next to private enterprise) in relation to entrepreneurial activity.

This comprehensive picture encourages regional development work, ranging in theoretical background from the knowledge spillover theory of entrepreneurship to clustering to entrepreneurial ecosystems, to invite testing of multidirectional relationships in future studies. While not a completely new view (Casper, 2013; De Clercq et al., 2008; Henrekson and Sanandaji, 2011), the bidirectional nature of relationships between entrepreneurial activity and public institutions needs to be more central to the literature both conceptually and empirically. We hope that the novel empirical evidence presented here strengthens the view that entrepreneurship and public institutions are important elements that, on a regional level, have interdependent and influential relationships with each other.

6.3. Implications for policymakers

Institutions are clearly influenced by the entrepreneurial activity occurring in the regions in which they are located. Our results suggest that institutions are better able to embed the knowledge flows regarding technical innovations that improve their objective performance more so than the customer-centric innovations that improve their subjective performance. Yet, the subjective performance of our institutions is of utmost importance. Subjective institutional performance can be a matter of life and death when discussing hospitals (Vogus and McClelland, 2016), a matter of future citizen success and disengagement when

discussing public education, and a matter of trust and distrust when discussing law enforcement. From conversations with experts in the hospital industry, we know anecdotally that hospitals tend to prefer peer learning, thus perpetuating insularity rather than capitalizing on the wider spectrum of innovation and entrepreneurial activity in a region. Policymakers can use the evidence herein to prioritize creating opportunities for knowledge flows to occur between individuals engaged in entrepreneurship and those engaged in improving customer perceptions of institutions. For instance, regular meetings between hospital leadership and community entrepreneurs might be a starting point to loosen traditional learning patterns and encourage more effective knowledge transfer.

Policymakers could also leverage research institutions to share best practices for knowledge flows and absorption. Additionally, allocating research resources across a broader range of institutions could be beneficial to allow those institutions that are functioning without slack resources the ability to translate new knowledge from entrepreneurial organizations in their region into practice.

Understanding, and coping with, the potential tension between objective and subjective performance implications from innovation might have a significant impact on the pace of technology development. In public service institutions, policy makers can decide that objective performance (e.g., saving lives) is more important than subjective performance (e.g., patients being satisfied) and thus technology development might not suffer, but customer-centricity will. In contrast, private enterprise might need to focus more on customer experience to maintain the pace of technology development. For example, although autonomous cars have the potential to save many lives through reduced accidents, their adaptation may be slowed due to customer mistrust and dissatisfaction. Thus, our results can help policymakers better understand this tension and how it might apply in different contexts.

6.4. Limitations and future research

Its contributions notwithstanding, our study has limitations. Endogeneity is a concern when studying regions using secondary data sources because the private and public sectors often develop in parallel and depend on each other. Despite careful corroboration, we cannot make unambiguous causal claims about the relationships between entrepreneurial activity and hospital performance.

Our empirical results returned significant findings in regard to two of our control variables that deserve further study: technical innovation and the establishments' growth rate. In terms of technical innovation as measured by patents, two of our cross-sectional models show that, as more patents were issued in a region (compared with the average of patent activity across counties), pneumonia mortality increased. Technical innovation is an established measure of regional knowledge flows (Acs et al., 2002; Jaffe, 1989; Plummer and Acs, 2014), but how it influences performance in an institutional setting is often unclear (Dixon-Woods et al., 2011). Since entrepreneurial activity and patents measure different aspects of innovation, as an extension of our efforts, the theoretical mechanisms explaining why and how patented innovation might influence the performance of institutions should be empirically substantiated. Also related to innovation, the timing of an innovation's adoption may differently influence performance. Our data captures entrepreneurial activity in general; therefore, we cannot know the breakdown of the types and timing of specific innovations. To fully understand regional knowledge flows, enlightening future research could discuss innovation timing in influencing institutions.

Supporting our inclusion of the establishments' growth rate as a control for general community growth, we found highly significant relationships that the more growth a county is experiencing, the higher the mortality rates and the higher the patient satisfaction. We offer an initial interpretation of these findings that, in relation to mortality, community growth might lead to growing contingents of sicker and older populations, resulting in increased mortality rates. On the flipside, in

relation to patient satisfaction, we could imagine that, in regions that are quickly growing, expectations are not growing as quickly, as residents might come from less-developed areas or are more accepting of imperfections linked to regional “growing pains.” Understanding the dynamics of community growth and its interaction with institutional performance might well deserve future study.

Finally, research hospitals, by virtue of their specialization and reputation, receive the more critical cases, which are accounted for within their stated mortality rates. Knowing this makes the significant positive effect that regional entrepreneurial activity has on reducing their mortality rates even more remarkable. Future studies should consider how research institutions influence knowledge flows and quantify how knowledge flows are absorbed. Future research could therefore integrate our results with those of [Escribano et al. \(2009\)](#) and examine the sources hospitals use for learning and incorporating new information. Similarly, we see great potential in combining our work with that of [Nohria and Gulati \(1996\)](#) to investigate the resources that hospitals have to explore, experiment with, and exchange novel insights within their region.

We hope our work contributes to a more holistic yet still parsimonious view of the outcomes of entrepreneurship, one that recognizes entrepreneurial activity as both recipient and generator of knowledge that flows into regional ecosystems and local public service institutions to improve daily life.

CRedit authorship contribution statement

Shelby Meek: Conceptualization, Methodology, Software, Formal Analysis, Data Curation, Visualization, Writing-Original Draft

Matthias Tietz: Conceptualization, Methodology, Validation, Data Curation, Writing-Reviewing and Editing

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

- Acs, Z., 2006. How is entrepreneurship good for economic growth? *Innovations* 97–107.
- Acs, Z.J., Plummer, L.A., 2005. Penetrating the “knowledge filter” in regional economies. *Ann. Reg. Sci.* 39, 439–456. <https://doi.org/10.1007/s00168-005-0245-x>.
- Acs, Z.J., Anselin, L., Varga, A., 2002. Patents and innovation counts as measures of regional production of new knowledge. *Res. Policy* 31.
- Acs, Z.J., Desai, S., Hessels, J., 2008. Entrepreneurship, economic development and institutions. *Small Bus. Econ.* 31, 219–234. <https://doi.org/10.1007/s11187-008-9135-9>.
- Acs, Z., Braunerhjelm, P., Audretsch, D., Carlsson, B., 2009. The knowledge spillover theory of entrepreneurship. *Small Bus. Econ.* 32, 15–30. <https://doi.org/10.1007/s11187-008-9157-3>.
- Acs, Z.J., Stam, E., Audretsch, D.B., O'Connor, A., 2017. The lineages of the entrepreneurial ecosystem approach. *Small Bus. Econ.* 49, 1–10. <https://doi.org/10.1007/s11187-017-9864-8>.
- Agarwal, A., Cockburn, I., Mchale, J., 2006. Gone but not forgotten: knowledge flows, labor mobility, and enduring social relationships. *J. Econ. Geogr.* 6, 571–591. <https://doi.org/10.1093/jeg/lbl016>.
- Agarwal, R., Audretsch, D., Sarkar, M., 2007. The process of creative construction: knowledge spillovers, entrepreneurship and economic growth. *Strateg. Entrep. J.* 1, 263–286. <https://doi.org/10.1177/0040571X2601207207>.
- Agarwal, R., Audretsch, D., Sarkar, M., 2010. Knowledge spillovers and strategic entrepreneurship. *Strateg. Entrep. J.* 4, 271–283. <https://doi.org/10.1002/sej>.
- Aghion, P., Jaravel, X., 2015. Knowledge spillovers, innovation and growth. *Econ. J.* 125, 533–573. <https://doi.org/10.1111/ecoj.12199>.
- Akao, Y., Chaplin, E.R., 2003. Making hospitals more transparent. *Qual. Manag. J.* 10, 25–32. <https://doi.org/10.1080/10686967.2003.11919070>.
- Ali, A., Gittelman, M., 2016. Research paradigms and useful inventions in medicine: patents and licensing by teams of clinical and basic scientists in academic medical centers. *Res. Policy* 45, 1499–1511. <https://doi.org/10.1016/j.respol.2016.03.015>.
- Almeida, P., Kogut, B., 1999. Localization of knowledge and the mobility of engineers in regional networks. *Manag. Sci.* 45, 905–917. <https://doi.org/10.1287/mnsc.45.7.905>.
- Alvedalen, J., Boschma, R., 2017. A critical review of entrepreneurial ecosystems research: towards a future research agenda. *Eur. Plan. Stud.* 25 (6), 887–903. <https://doi.org/10.1080/09654313.2017.1299694>.
- Andersson, M., Larsson, J.P., 2016. Local entrepreneurship clusters in cities. *J. Econ. Geogr.* 16 (1), 39–66. <https://doi.org/10.1093/JEG/LBU049>.
- Audretsch, D.B., Feldman, M.P., 1996. R&D spillovers and the geography of innovation and production. *Am. Econ. Rev.* 86, 630–640. <https://doi.org/10.2307/2118216>.
- Audretsch, D.B., Keilbach, M., 2007. The theory of knowledge spillover entrepreneurship. *J. Manag. Stud.* 44, 1242–1254.
- Audretsch, D.B., Lehmann, E.E., 2005. Does the knowledge spillover theory of entrepreneurship hold for regions? *Res. Policy* 34, 1191–1202. <https://doi.org/10.1016/j.respol.2005.03.012>.
- Audretsch, D.B., Link, A.N., 2019. Entrepreneurship and knowledge spillovers from the public sector. *Int. Entrep. Manag. J.* 15, 195–208.
- Baron, R.M., Kenny, D.A., 1986. The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J. Pers. Soc. Psychol.* 51 (6), 1173.
- Batalden, M., Batalden, P., Margolis, P., et al., 2016. Coproduction of healthcare service. *BMJ Qual. Saf.* 25, 509–517.
- Batke, B., Schmidt, T.S., Stollenwerk, S., Hoffmann, V.H., 2016. Internal or external spillovers – which kind of knowledge is more likely to flow within or across technologies. *Res. Policy* 45, 27–41. <https://doi.org/10.1016/j.respol.2015.06.014>.
- Baumol, W.J., 1990. Entrepreneurship: productive, unproductive, and destructive. *J. Polit. Econ.* 98 (5), 893–921.
- Baumol, W.J., 1993. Formal entrepreneurship theory in economics: existence and bounds. *J. Bus. Ventur.* 8 (3), 197–210. [https://doi.org/10.1016/0883-9026\(93\)90027-3](https://doi.org/10.1016/0883-9026(93)90027-3).
- Becker, E.R., Chahine, T., Shegog, R., 2019. Public health entrepreneurship: a novel path for training future public health professionals. *Front. Public Health* 7 (APR), 89. <https://doi.org/10.3389/fpubh.2019.00089/BIBTEX>.
- Berry, R.E., 1967. Returns to scale in the production of hospital services. *Health Serv. Res.* 123–139.
- Berwick, D.M., 2003. Disseminating innovations in health care. *J. Am. Med. Assoc.* 289, 1969–1975. <https://doi.org/10.1001/jama.289.15.1969>.
- Berwick, D.M., Nolan, T.W., Whittington, J., 2008. The triple aim: care, health, and cost. *Health Aff.* 27, 759–769. <https://doi.org/10.1377/hlthaff.27.3.759>.
- Bjertnaes, O.A., Sjetne, I.S., Iversen, H.H., 2012. Overall patient satisfaction with hospitals: effects of patient-reported experiences and fulfillment of expectations. *BMJ Qual. Saf.* 21, 39–46. <https://doi.org/10.1136/bmjqs-2011-000137>.
- Bloom, D.E., Canning, D., 2000. The health and wealth of nations. *Science* (80-) 287, 1208–1209.
- Bos, J.W.B., Stam, E., 2014. Gazelles and industry growth: a study of young high-growth firms in The Netherlands. *Ind. Corp. Chang.* 23 (1), 145–169. <https://doi.org/10.1093/icc/dtt050>.
- Boudreaux, E.D., O'Hea, E.L., 2004. Patient satisfaction in the Emergency Department: a review of the literature and implications for practice. *J. Emerg. Med.* 26, 13–26. <https://doi.org/10.1016/j.jemermed.2003.04.003>.
- Boulding, W., Kalra, A., Staelin, R., Zeithaml, V.A., 1993. A dynamic process model of service quality: from expectations to behavioral intentions. *J. Mark. Res.* 30, 7. <https://doi.org/10.2307/3172510>.
- Bowers, M., Swan, J., Koehler, W., 1994. What attributes determine quality and satisfaction with health care delivery? *Health Care Manag. Rev.* 19, 49–55.
- Braunerhjelm, P., Ding, D., Thulin, P., 2016. Labour as a knowledge carrier: how increased mobility influences entrepreneurship. *J. Technol. Transf.* 41, 1308–1326. <https://doi.org/10.1007/s10961-015-9452-5>.
- Brynjolfsson, E., 1993. The productivity paradox of information technology. *Commun. ACM* 36 (12), 66–77.
- Casper, S., 2013. The spill-over theory reversed: the impact of regional economies on the commercialization of university science. *Res. Policy* 42, 1313–1324. <https://doi.org/10.1016/j.respol.2013.04.005>.
- CMS.gov, 2017. Outcome Measures [WWW Document]. Centers Medicare Medicaid Services, 6.
- Cohen, B., 2006. Sustainable valley entrepreneurial ecosystems. *Bus. Strateg. Environ.* 15 (1), 1–14. <https://doi.org/10.1002/BSE.428>.
- Cooke, P., Uranga, M.G., Etxebarria, G., 1997. Regional innovation systems: institutional and organizational dimensions. *Res. Policy* 26 (4–5), 475–491.
- Crisuolo, C., Gal, P., Menon, C., 2014. The dynamics of employment growth: new evidence from 18 countries. In: OECD Science, Technology and Industry Policy Papers, No. 14. OECD Publishing, Paris. <https://doi.org/10.1787/5f417hj6hg6-en>.
- Cronin, J.J., Taylor, S.A., 1994. SERVPERF versus SERVQUAL: reconciling performance-based and perceptions-minus-expectations measurement of service quality. *J. Mark.* 58, 125. <https://doi.org/10.2307/1252256>.
- Curtis, K., Fry, M., Shaban, R.Z., Considine, J., 2016. Translating research findings to clinical nursing practice. *J. Clin. Nurs.* 26, 862–872. <https://doi.org/10.1111/jocn.13586>.

- Dahl, M.S., Pedersen, C.Ø.R., 2004. Knowledge flows through informal contacts in industrial clusters: myth or reality? *Res. Policy* 33, 1673–1686. <https://doi.org/10.1016/j.respol.2004.10.004>.
- De Clercq, D., Hessels, J., van Stel, A., 2008. Knowledge spillovers and new ventures' export orientation. *Small Bus. Econ.* 31, 283–303. <https://doi.org/10.1007/s11187-008-9132-z>.
- Delgado, M., Porter, M., Stern, S., 2010. Clusters and entrepreneurship. *J. Econ. Geogr.* 10, 495–518. <https://doi.org/10.3386/w19846>.
- Delgado, M., Porter, M.E., Stern, S., 2014. Clusters, convergence and economic performance. *Res. Policy* 43, 1785–1799. <https://doi.org/10.1080/10630732.2015.1090196>.
- Dixon-Woods, M., Amalberti, R., Goodman, S., et al., 2011. Problems and promises of innovation: why healthcare needs to rethink its love/hate relationship with the new. *BMJ Qual. Saf.* 20, i47–i51.
- Djellal, F., Gallouj, F., 2005. Mapping innovation dynamics in hospitals. *Res. Policy* 34, 817–835. <https://doi.org/10.1016/j.respol.2005.04.007>.
- Djellal, F., Gallouj, F., 2007. Innovation in hospitals: a survey of the literature. *Eur. J. Health Econ.* 8 (3), 181–193.
- Doloreux, D., 2002. What we should know about regional systems of innovation. *Technol. Soc.* 24 (3), 243–263.
- Donabedian, A., 1989. The quality of care: how can it be assessed? *JAMA J. Am. Med. Assoc.* 260, 1743–1748. <https://doi.org/10.1001/jama.1989.03420080065026>.
- Donthu, N., Yoo, B., 1998. Cultural influences on service quality expectations. *J. Serv. Res.* 1, 178–186.
- Dowell, E.K.P., 2020. Health care still largest U.S. employer [WWW document]. <https://www.census.gov/library/stories/2020/10/health-care-still-largest-united-states-employer.html>. (Accessed 20 December 2020).
- Dubina, M.I., O'Neill, J.L., Feldman, S.R., 2014. In: Effect of Patient Satisfaction on Outcomes of Care, 9(5), pp. 393–395. <https://doi.org/10.1586/Erp.09.45>.
- Edquist, C., 1997. Systems of Innovation: Technologies, Institutions and Organizations, 1st ed. Routledge. <https://doi.org/10.4324/9780203357620>.
- Ejermo, O., Karlsson, C., 2006. Interregional inventor networks as studied by patent coinventorships. *Res. Policy* 35, 412–430. <https://doi.org/10.1016/j.respol.2006.01.001>.
- Enright, M.J., Roberts, B.H., 2001. Regional clustering in Australia. *Aust. J. Manag.* 26, 65–85.
- Eriksson, N., Ujvari, S., 2015. Fiery Spirits in the context of institutional entrepreneurship in Swedish healthcare. *J. Health Organ. Manag.* 29, 515–531. <https://doi.org/10.1108/JHOM-09-2014-0158>.
- Escribano, A., Fosfuri, A., Tribó, J.A., 2009. Managing external knowledge flows: the moderating role of absorptive capacity. *Res. Policy* 38, 96–105. <https://doi.org/10.1016/j.respol.2008.10.022>.
- Estrin, S., Korosteleva, J., Mickiewicz, T., 2013. Which institutions encourage entrepreneurial growth aspirations? *J. Bus. Ventur.* 28 (4), 564–580. <https://doi.org/10.1016/j.jbusvent.2012.05.001>.
- Feldman, M., 2001. The entrepreneurial event revisited: firm formation in a regional context. *Ind. Corp. Chang.* 8, 861–891.
- Feldman, M.P., 2014. The character of innovative places: entrepreneurial strategy, economic development, and prosperity. *Small Bus. Econ.* 43, 9–20. <https://doi.org/10.1007/s11187-014-9574-4>.
- Feldman, M., Audretsch, D., 1999. Innovation in cities: science-based diversity, specialization and localized competition. *Eur. Econ. Rev.* 43, 409–429.
- Feldman, M.P., Francis, J., Bercovitz, J., 2005. Creating a cluster while building a firm: entrepreneurs and the formation of industrial clusters. *Reg. Stud.* 39, 129–141. <https://doi.org/10.1080/0034340052000320888>.
- Feldman, M.P., Reed, A., Lanahan, L., McLaurin, G., Nelson, K., Reamer, A., 2012. In: *Innovative Data Sources for Regional Economic Analysis*, pp. 1–14.
- Feldman, M.P., Ozcan, S., Reichstein, T., 2019. Falling not far from the tree: entrepreneurs and organizational heritage. *Organ. Sci.* 30 (2), 337–360. <https://doi.org/10.1287/ORSOC.2018.1222>.
- Feser, E., Renski, H., Goldstein, H., 2008. Clusters and economic development outcomes: an analysis of the link between clustering and industry growth. *Econ. Dev. Q.* 22, 324–344. <https://doi.org/10.1177/0891242408325419>.
- Fornell, C., Johnson, M.D., Anderson, E.W., Cha, J., Bryant, B.E., 1996. The American customer satisfaction index: nature, purpose, and findings. *J. Mark.* 7–18.
- French, M., Miller, F.A., 2012. Leveraging the “living laboratory”: on the emergence of the entrepreneurial hospital. *Soc. Sci. Med.* 75 (4), 717–724.
- Fu, Y., Tietz, M.A., 2019. When do investors prefer copycats? Conditions influencing the evaluation of innovative and imitative ventures. *Strateg. Entrep. J.* 13 (4), 529–551.
- Gawande, A., 2012. In: *Big Med.* New Yorker August, pp. 1–20.
- Ghio, N., Guerini, M., Lehmann, E.E., Rossi-Lamastra, C., 2015. The emergence of the knowledge spillover theory of entrepreneurship. *Small Bus. Econ.* 44, 1–18. <https://doi.org/10.1007/s11187-014-9588-y>.
- Glaeser, E.L., Kerr, W.R., 2009. Local industrial conditions and entrepreneurship: how much of the spatial distribution can we explain? *J. Econ. Manag. Strateg.* 18, 623–663. <https://doi.org/10.1111/j.1530-9134.2009.00225.x>.
- Glaeser, E.L., Kerr, W.R., Ponzetto, G.A.M., 2010. Clusters of entrepreneurship. *J. Urban Econ.* 67, 150–168.
- Goes, J.B., Park, S.H., 1997. Interorganizational links and innovation: the case of hospital services. *Acad. Manag. J.* 40, 673–696.
- Goetz, S., Han, Y., 2020. Latent innovation in local economies. *Res. Policy* 49.
- Grazier, K.L., Metzler, B., 2006. Health care entrepreneurship: financing innovation. *J. Health Hum. Serv. Adm.* 28, 485–503.
- Gulbrandsen, M., Hopkins, M., Thune, T., Valentin, F., 2016. Hospitals and innovation: introduction to the special section. *Res. Policy* 45, 1493–1498. <https://doi.org/10.1016/j.respol.2016.05.010>.
- Guler, I., Guillen, M.F., Muir Macpherson, J., 2002. Global competition, institutions, and the diffusion of organizational practices: the international spread of ISO 9000 quality certificates. *Adm. Sci. Q.* 47, 207–232.
- Hair, J., Black, W., Babin, B.J., Anderson, R., 2007. *Multivariate Data Analysis*, 7th edition.
- Haltiwanger, J., Jarmin, R.S., Miranda, J., 2013. Who creates jobs? Small versus large versus young. *Rev. Econ. Stat.* 95 (2), 347–361. https://doi.org/10.1162/REST_A_00288.
- Henderson, J., Dicken, P., Hess, M., Coe, N., Wai-Chung Yeung, H., 2002. In: *Global Production Networks and the Analysis of Economic Development*, 9(3), pp. 436–464. <https://doi.org/10.1080/09692290210150842>.
- Henrekson, M., Sanandaji, T., 2011. The interaction of entrepreneurship and institutions. *J. Inst. Econ.* 7 (1), 47–75. <https://doi.org/10.1017/S1744137410000342>.
- Herper, M., 2011. The Most Innovative Countries in Biology and Medicine. *Forbes Mag.*
- Herzlinger, R.E., 2006. Why innovation in health care is so hard. *Harv. Bus. Rev.* 58–66.
- Hoang, H., Antoncic, B., 2003. Network-based research in entrepreneurship: A critical review. *J. Bus. Ventur.* 18, 165–187. [https://doi.org/10.1016/S0883-9026\(02\)00081-2](https://doi.org/10.1016/S0883-9026(02)00081-2).
- Howells, J., 1999. Regional systems of innovation. In: *Innovation Policy in a Global Economy*, pp. 67–93.
- Iacobucci, D., Ostrom, A., Grayson, K., 1995. Distinguishing service quality and customer satisfaction: the voice of the consumer. *J. Consum. Psychol.* 4 (3), 277–303. https://doi.org/10.1207/S15327663JCP0403_04.
- Jaffe, A.B., 1989. Real effects of academic research. *Am. Econ. Rev.* 79, 957.
- Jaffe, A.B., Trajtenberg, M., Henderson, R., 1993. Geographic localization of knowledge spillovers as evidenced by patent citations. *Q. J. Econ.* 108, 577–598.
- Joffe, S., Manocchia, M., Weeks, J., Cleary, P., 2003. What do patients value in their hospital care? An empirical perspective on autonomy centred bioethics. *J. Med. Ethics* 29, 103–108.
- Jones, S.S., Heaton, P.S., Rudin, R.S., Schneider, E.C., 2012. Unraveling the IT productivity paradox—lessons for health care. *N. Engl. J. Med.* 366 (24), 2243–2245.
- Kaplan, A., Haenlein, M., 2019. Siri, Siri, in my hand: who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. *Bus. Horiz.* 62, 15–25. <https://doi.org/10.1016/j.bushor.2018.08.004>.
- Kessler, Daniel P., McClellan, Mark B., 2000. Is hospital competition socially wasteful? *Q. J. Econ.* 115 (2), 577–615.
- Kim, J., Marschke, G., 2005. Labor mobility of scientists, technological diffusion, and the firm's patenting decision. *RAND J. Econ.* 36, 298–317.
- Kim, J.Y.(Rose), Steensma, H.K., Heidt, R.A., 2021. Clustering and connectedness: how inventor network configurations within incumbent firms influence their assimilation and absorption of new venture technologies. *Acad. Manag. J.* 64 (5), 1527–1552. <https://doi.org/10.5465/AMJ.2018.0225/FORMAT/EPUB>.
- Koo, J., Cho, K., 2011. New firm formation and industry clusters: a case of the drugs industry in the U.S. *Growth Chang.* 42, 179–199.
- Lam, S.S.K., 1997. SERVQUAL: a tool for measuring patients' opinions of hospital service quality in Hong Kong. *Total Qual. Manag.* 8, 145–152. <https://doi.org/10.1080/09541429797587>.
- Lateef, F., 2011. Patient expectations and the paradigm shift of care in emergency medicine. *J. Emerg. Trauma Shock* 4 (2), 163.
- Levy, C., Waks, C., 2009. Professions and the pursuit of transparency in healthcare: two cases of soft autonomy. *Organ. Stud.* 30, 509–527.
- Liu, Y., Zhong, L., Yuan, S., et al., 2018. Why patients prefer high-level healthcare facilities: a qualitative study using focus groups in rural and urban China. *BMJ Glob. Health* 3, e000854.
- Llopis, O., D'Este, P., 2016. Beneficiary contact and innovation: the relation between contact with patients and medical innovation under different institutional logics. *Res. Policy* 45 (8), 1512–1523.
- Lynk, W.J., 1995. The creation of economic efficiencies in hospital mergers. *J. Health Econ.* 14, 507–530.
- Marti, I., Courpasson, D., Dubard Barbosa, S., 2013. “Living in the fishbowl”. Generating an entrepreneurial culture in a local community in Argentina. *J. Bus. Ventur.* 28 (1), 10–29. <https://doi.org/10.1016/j.jbusvent.2011.09.001>.
- Meyer, J.W., Rowan, B., 1977. Institutionalized organizations: formal structure as myth and ceremony. *Am. J. Sociol.* 83, 340–363. <https://doi.org/10.1086/226550>.
- Miller, F.A., French, M., 2016. Organizing the entrepreneurial hospital: hybridizing the logics of healthcare and innovation. *Res. Policy* 45 (8), 1534–1544.
- Miller, Alison L., et al., 2012. Partnering to translate evidence-based programs to community settings: bridging the gap between research and practice. *Health Promot. Pract.* 13 (4), 559–566.
- Moen, M., Agarwal, R., 2017. Incubation of an industry: heterogeneous knowledge bases and modes of value capture. *Strateg. Manag. J.* 38 (3), 566–587. <https://doi.org/10.1002/SMJ.2511>.
- Morris, Z.S., Wooding, S., Grant, J., 2011. The answer is 17 years, what is the question: understanding time lags in translational research. *J. R. Soc. Med.* 104, 510–520.
- Mosadeghrad, Ali Mohammad, 2014. Factors influencing healthcare service quality. *Int. J. Health Policy Manag.* 3 (2), 77.
- Nelson, R.R., Buterbaugh, K., Perl, M., Gelijns, A., 2011. How medical know-how progresses. *Res. Policy* 40, 1339–1344. <https://doi.org/10.1016/j.respol.2011.06.014>.
- Nohria, N., Gulati, R., 1996. Is slack good or bad for innovation? *Acad. Manag. J.* 39 (5), 1245–1264.
- O'Mahony, M., Vecchi, M., 2009. R & D, knowledge spillovers and company productivity performance. *Res. Policy* 38 (1), 35–44.
- Oh, H., 1999. Service quality, customer satisfaction, and customer value: a holistic perspective. *Hosp. Manag.* 18, 67–82.

- Parasuraman, A., Zeithaml, V.A., Berry, L.L., 1985. A conceptual model of service quality and its implications for future research. *J. Mark.* 49, 41. <https://doi.org/10.2307/1251430>.
- Parker, S., 2010. A predator-prey model of knowledge spillovers and entrepreneurship. *Strateg. Entrep. J.* 4, 307–322. <https://doi.org/10.1002/sej>.
- Petty, J.S., Gruber, M., 2011. “In pursuit of the real deal” A longitudinal study of VC decision making. *J. Bus. Ventur.* 26, 172–188. <https://doi.org/10.1016/j.jbusvent.2009.07.002>.
- Plewania, A., Bengel, J., Körner, M., 2016. Patient-centeredness and its impact on patient satisfaction and treatment outcomes in medical rehabilitation. *Patient Educ. Couns.* 99 (12), 2063–2070. <https://doi.org/10.1016/j.pec.2016.07.018>.
- Plummer, L.A., Acs, Z.J., 2014. Localized competition in the knowledge spillover theory of entrepreneurship. *J. Bus. Ventur.* 29, 121–136. <https://doi.org/10.1016/j.jbusvent.2012.10.003>.
- Porter, M.E., 1998. In: *Clusters and the New Economics of Competition*, 76. Harvard Business Review, Boston, pp. 77–90, 6.
- Porter, M., 2000. Location, competition and economic development: local clusters in a global economy. *Econ. Dev. Q.* 14, 15–34.
- Porter, M.E., 2003. The economic performance of regions. *Reg. Stud.* 37, 549–578. <https://doi.org/10.1080/0034340032000108688>.
- Porter, M.E., Teisberg, E.O., 2007. How physicians can change the future of health care. *Jama* 297 (10), 1103–1111.
- Patient Protection and Affordable Care Act, 2010, Patient Protection and Affordable Care Act 2010.
- Reynolds, P.D., Hay, M., Camp, S.M., 1999. Global Entrepreneurship Monitor. May 30. Kauffman Center for Entrepreneurial Leadership, Kansas City, Missouri (DiscussionPaper# CFE-2015-021).
- Rocha, H.O., 2004. Entrepreneurship and development: the role of clusters. *Small Bus. Econ.* 23, 363–400.
- Ruef, M., Scott, W.R., 1998. A multidimensional model of organizational legitimacy: hospital survival in changing institutional environments. *Adm. Sci. Q.* 43, 877–904.
- Saxenian, A., 1990. Regional networks and the resurgence of Silicon Valley. *Calif. Manag. Rev.* 33 (1), 89–112.
- Schumpeter, J.A., 1934. *The Theory of Economic Development: An Inquiry Into Profits, Capital, Credit, Interest, and the Business Cycle*. Harvard University Press, Cambridge, MA.
- Shortell, S.M., Zazzali, J.L., Burns, L.R., Alexander, J.A., Gillies, R.R., Budetti, P.P., Waters, T.M., Zuckerman, H.S., 2001. Implementing evidence-based medicine: the role of market pressures, compensation incentives, and culture in physician organizations. *Med. Care* 39, 162–178.
- Shu, C., Liu, C., Gao, S., Shanley, M., 2014. The knowledge spillover theory of entrepreneurship in alliances. *Enterp. Theory Pract.* 38 (4), 913–940. <https://doi.org/10.1111/etap.12024>.
- Slaper, T., van der Does, T., Egan, P., Ortuzar, G., Strange, R., 2016. *Driving Regional Innovation: The Innovation Index 2.0*. Indiana Business Research Center.
- Sobel, R.S., 2008. Testing Baumol: institutional quality and the productivity of entrepreneurship. *J. Bus. Ventur.* 23, 641–655. <https://doi.org/10.1016/j.jbusvent.2008.01.004>.
- Sobel, R.S., King, K.A., 2008. Does school choice increase the rate of youth entrepreneurship? *Econ. Educ. Rev.* 27, 429–438. <https://doi.org/10.1016/j.econedurev.2007.01.005>.
- Spigel, B., 2017. The relational organization of entrepreneurial ecosystems. *Enterp. Theory Pract.* 49–72. <https://doi.org/10.1111/etap.12167>. January.
- Stam, E., van de Ven, A., 2021. Entrepreneurial ecosystem elements. *Small Bus. Econ.* 56 (2), 809–832. <https://doi.org/10.1007/S11187-019-00270-6>, 2019 56:2.
- Stenholm, P., Acs, Z.J., Wuebker, R., 2013. Exploring country-level institutional arrangements on the rate and type of entrepreneurial activity. *J. Bus. Ventur.* 28 (1), 176–193. <https://doi.org/10.1016/J.JBUSVENT.2011.11.002>.
- Sureshchandar, G.S., Rajendran, C., Anantharaman, R.N., 2002. The relationship between service quality and customer satisfaction – a factor specific approach. *J. Serv. Mark.* 16 (4), 363–379. <https://doi.org/10.1108/08876040210433248>.
- Szerb, L., Acs, Z.J., Ortega-Argilés, R., Komlosi, E., 2015. Measuring Entrepreneurial Ecosystems: The Regional Entrepreneurship and Development Index (redi). May 30. Henley Centre for Entrepreneurship. <https://doi.org/10.2139/SSRN.2642514> (DiscussionPaper# CFE-2015-021).
- Taylor, D., Kennedy, M.P., Virtue, E., McDonald, G., 2006. A multifaceted intervention improves patient satisfaction and perceptions of emergency department care. *Int. J. Qual. Health Care* 18, 238–245. <https://doi.org/10.1093/intqhc/mzl002>.
- Thursby, J., Thursby, M., 2004. Are faculty critical? Their role in university-industry licensing. *Contemp. Econ. Policy* 22, 162–178. <https://doi.org/10.1017/CBO9781107415324.004>.
- Trout, A., Magnusson, A.R., Hedges, J.R., 2000. Patient satisfaction investigations and the emergency department: what does the literature say? *Acad. Emerg. Med.* 7, 695–709. <https://doi.org/10.1111/j.1553-2712.2000.tb02050.x>.
- van de Ven, H., 1993. The development of an infrastructure for entrepreneurship. *J. Bus. Ventur.* 8 (3), 211–230. [https://doi.org/10.1016/0883-9026\(93\)90028-4](https://doi.org/10.1016/0883-9026(93)90028-4).
- Vogus, T.J., McClelland, L.E., 2016. When the customer is the patient: lessons from healthcare research on patient satisfaction and service quality ratings. *Hum. Resour. Manag. Rev.* 26, 37–49. <https://doi.org/10.1016/j.hrmr.2015.09.005>.
- Von Hippel, C., 2018. A next generation assets-based public health intervention development model: the public as innovators. *Front. Public Health* 6, 248.
- von Hippel, C.D., Cann, A.B., 2021. Behavioral innovation: pilot study and new big data analysis approach in household sector user innovation. *Res. Policy* 50 (8), 103992.
- Ware, J., Snyder, M., 1975. Dimensions of patient attitudes regarding doctors and medical care services. *Med. Care* 13, 669–682.
- Wei, Y., 2022. Regional governments and opportunity entrepreneurship in underdeveloped institutional environments: an entrepreneurial ecosystem perspective. *Res. Policy* 51 (1), 104380. <https://doi.org/10.1016/j.respol.2021.104380>.
- Wensing, M., Jung, H.P., Mainz, J.A.N., Olesen, F., Grol, R., 1998. A Systematic review of the literature on patient priorities for general practice care. Part 1: description of the research domain. *Soc. Sci. Med.* 47, 1573–1588.
- Wong, P.K., Ho, Y.P., Autio, E., 2005. Entrepreneurship, innovation and economic growth: evidence from GEM data. *Small Bus. Econ.* 24, 335–350. <https://doi.org/10.1007/s11187-005-2000-1>.
- Wurth, B., Stam, E., Spigel, B., 2022. Toward an entrepreneurial ecosystem research program. *Enterp. Theory Pract.* 46 (3), 729–778. <https://doi.org/10.1177/1042258721998948>. March.
- Yang, C., 2015. Implementing hospital innovation in Taiwan: the perspectives of institutional theory and social capital. *Int. J. Health Plann. Manag.* 30, 403–425.
- Yang, H., Phelps, C., Steensma, H.K., 2010. Learning from what others have learned from you: the effects of knowledge spillovers on originating firms. *Acad. Manag. J.* 53, 371–389. <https://doi.org/10.5465/amj.2010.49389018>.
- Zacharakis, A., Bygrave, W.D., Shepherd, D.A., 2000. *Global Entrepreneurship Monitor: National Entrepreneurship Assessment, United States of America: 2000 Executive Report*. Kauffman Center for Entrepreneurial Leadership at the Ewing Marion Kauffman Foundation.
- Zahra, S., George, G., 2002. International entrepreneurship: the current status of the field and future research agenda. In: *Strategic Entrepreneurship: Creating a New Mindset*, pp. 255–288. <https://doi.org/10.1017/CBO9781107415324.004>.
- Zeithaml, V.A., Berry, L.L., Parasuraman, A., 1993. The nature and determinants of consumer expectations of service. *J. Acad. Mark. Sci.* 1–12.