Green and Digital Entrepreneurship in Smart Cities

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Abstract

This paper investigates the relationship between the implementation of smart city initiatives and the number of new firms, paying special attention to the rates of green and digital entrepreneurship as smart cities tend to follow sustainable and/or digital orientations. We find evidence of a positive (causal) relation between smart city initiatives and entrepreneurship rates in a sample of Belgian municipalities, particularly when these initiatives follow a bottom-up approach and/or the level of implementation is high. In contrast, having sustainable and/or digital orientations in smart city initiatives does not generally make any difference in the rates of entrepreneurship, the exception being the digital rates in large municipalities. These results suggest that the smart city initiatives may be acting as a local entrepreneurship-supporting policy. They also support the view that smart cities are mainly (but not only) associated with technological developments (in large cities).

Keywords: entrepreneurship, digital and green industries, smart city

JEL Codes: L26, R11

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1. Introduction

Cities all over the world are becoming "smart", i.e., they are launching initiatives associated with the mobility of citizens and vehicles, the role of big data and technology, the long-term sustainability of the urban environment and/or the increase of citizens' engagement in local matters (Manville *et al.* 2014, Angelidou 2017, Anthopoulos 2017). This is illustrated by the presence of representatives from nearly 700 cities and 150 countries in the 2018 and 2019 (pre-pandemic) editions of the Smart City Expo World Congress in Barcelona. It is also interesting to note that smart city projects implemented in the EU over the period 2005 to 2016 had, on average, an estimated cost of nearly €16 million (Collins *et al.* 2017). Lastly, according to a recent report by the consulting firm *Markets and Markets* ("Smart Cities Market - Global Forecast to 2025"), the global smart cities market is expected to grow from USD 410.8 billion in 2020 to USD 820.7 billion by 2025. There is therefore a substantial amount of public and private resources dedicated to the "smart city" (SC hereafter).[1]

At the heart of SC initiatives lies the ambition of enhancing city performance and citizens' wellbeing (Albino *et al.* 2015, Ben Letaifa 2015). However, empirical evidence on whether territories implementing SC initiatives perform better in certain socio-economic outcomes is scarce. Caragliu and Del Bo (2018), for example, found that a causal relationship exists between smart city policies and economic growth in a sample of metropolitan areas in the EU and, in related work, Caragliu and Del Bo (2019) show that these metropolitan areas have a statistically higher number of patents filed —which they argue may explain the higher rates of growth found by Caragliu and Del Bo (2018). This paper contributes to this meagre body of literature by investigating the link between SC initiatives and entrepreneurship. In their seminal work on smart cities, Giffinger *et al.* (2007) suggested that entrepreneurship is one of the expected outcomes of developing SC initiatives (see also Kummitha 2019). To our knowledge, however, there is no empirical evidence supporting this tenet.[2]

Since one of the main purposes behind SC initiatives is to foster entrepreneurship, and the number of new businesses registered is one of the main indicators of the "competitiveness dimension" of the smart cities (Giffinger *et al.* 2007), we may intuitively expect to observe higher rates of entrepreneurship in the territories that launch SC initiatives (Richter *et al.* 2015, Montgomery 2018).

[1] Although some smart city studies focus on large cities and/or metropolitan areas (e.g., Caragliu and Del Bo 2018, 2019), in this paper we largely follow the literature (e.g., Giffinger *et al*. 2007 and Estevez *et al*. 2016) in using the term "smart cities" to refer generically to local administrative units that develop SC initiatives (notably municipalities, but also counties and regions). In particular, our empirical analyses concern Belgian municipalities, i.e., level 2 Local Administrative Units in the Eurostat nomenclature of territorial units.

[2] In a sample of 44 large Spanish municipalities, Barba-Sánchez *et al*. (2019) found a positive correlation between the level of smartness (as measured by an index constructed by the consulting firm IDC that considers, among other factors, a number of economic indicators) and the number of enterprises. However, the statistical significance of this effect vanished when they controlled for the number of companies in the information and communication technologies sector.

However, since the SC concept may be developed along several dimensions (other than competitiveness and its associated outcomes), its relation to entrepreneurship may be weak (Kraus *et al.* 2015) or even non-existent, for it is not guaranteed that the potential opportunities for entrepreneurship that SC initiatives raise will eventually materialise (Stephens 2020). It is therefore an empirical question to determine whether a (causal) relationship exists between SC initiatives and entrepreneurship. In particular, this paper analyses whether there are statistically significant differences in the rates of (green and digital) entrepreneurship in local administrative units that develop SC initiatives (following a sustainable and/or technological orientation).

Our focus on green and digital entrepreneurship is motivated by the fact that SC initiatives mainly follow sustainable and/or technological orientations (Caragliu *et al.* 2011, Nam and Pardo 2011a). In this vein, smart cities are meant to become sustainable urban environments (e.g., Chourabi *et al.* 2012) where there is a wide use of information and communication technologies (e.g., Washburn and Sindhu 2010). As such, smart city initiatives may provide a favourable climate for green and/or digital entrepreneurs, i.e., new ventures "that foster resource efficiency and benefit the environment" (Shapira *et al.* 2014: 95; see also Kraus *et al.* 2018 for the broader concept of sustainable entrepreneurship) and/or "in technology-intensive environments" (Nambisan 2017: 1030, Department for Culture, Media and Sport 2015, Office for National Statistics 2015). This suggests that a link between SC initiatives following a sustainable and/or technological orientation and green and digital entrepreneurship exist, respectively (Sarma and Surmy 2017). However, this may not be case if the way in which smart cities effectively orient their initiatives does not fully account for the sustainable and technological domains (Estevez *et al.* 2016, Angelidou 2017).

To empirically investigate these issues, we used "business creation", measured as the number of new firms created in a territory over a certain period of time, as a measure of entrepreneurship (Barreneche-García 2014: 79). We thus follow a number of recent papers that used an analogous approach to analyse the determinants of green (e.g., Colombelli and Quatraro 2019 and Giudici *et al.* 2019) and digital (e.g., Lasch *et al.* 2013) entrepreneurship. Still, in our case this is mostly motivated by the aim of analysing the link between a local event (the launch of SC initiatives and their orientation) and the creation of new firms in the local administrative units.[3] Further, we used survey data from Belgian municipalities to construct measures of SC initiatives and orientations (Bounazef *et al.* 2018). The Belgian case is interesting because, in recent years, several SC initiatives have been launched at different administrative levels. We can mention, among others, "Digital Belgium" at the federal level; "Smart Flanders" and "Digital Wallonia" at the regional level; and the smart city projects of Antwerp, Brussels and Namur at the local level. Lastly, we used count data models and a set of

[3] In essence, this is the argument used in the "local knowledge spillovers" literature to justify this empirical approach (see e.g. Audretsch and Lehmann 2005, Audretsch and Keilbach 2007).

control variables largely used in the literature (e.g., Stenholm *et al.* 2013 and Breitenecker *et al.* 2017) to find that SC initiatives pay off in terms of higher rates of entrepreneurship.[4]

The rest of the paper is organised as follows. In Section 2 we develop our theoretical framework and derive the hypotheses to be empirically tested. In Section 3 we present the empirical analysis. Section 4 concludes.

2. Entrepreneurship in smart cities

Some SC initiatives are intended to foster entrepreneurship. Amsterdam and San Francisco, for example, offer "Startup in Residence" programmes, and in Medellin the government-funded innovation centre "Ruta N" currently hosts around 80 companies in their premises and has supported more than 500 innovation projects since its creation in 2009. These examples illustrate that some SC initiatives focus directly on entrepreneurship promotion. However, SC initiatives may also promote entrepreneurship as an indirect effect through the development of a favourable climate for entrepreneurial activity. In Kansas City, for example, "[t]the KCSource Link Web site lists over 200 not-for-profit, economic development, and entrepreneur-related support groups", and the "smart city ambition" programme of Brussels specifically mentions the creation of an "ecosystem that will bring economic opportunities to our entrepreneurs".

The question we seek to address in this paper is to what extent these examples are indicative of a more general (causal) relationship. To this end, in this section we first review the appropriate SC and entrepreneurship literature to hypothesise a link between SC initiatives and entrepreneurship, then introduce the fine-tuning role of the levels of implementation, and finally hypothesise a link between SC orientation and entrepreneurship. We conclude with a discussion on how to empirically test the proposed hypotheses (using Belgian municipality data).

The hypotheses are formulated in a positive way because anecdotal evidence and case studies point in that direction. That is, the null states that a positive correlation between entrepreneurship and (the level and orientation of) SC initiatives exists (Angelidou 2017). It is important to note, however, that the alternative that this relationship is not supported by the data is also possible (Barba-Sánchez

[4] Our results raise the question of what the sources of this positive effect are. Although an empirical analysis of this question is beyond the scope of this paper, it is interesting to note that, as Barba-Sánchez *et al*. (2019: 1) and Kummitha (2019) argue, SC initiatives may act "as a vehicle to attract investments and entice entrepreneurs and high-qualified workforce" by providing facilities (e.g., incubators and accelerators), promoting public-private partnerships and introducing regulatory changes (e.g., in the field of open data, as illustrated in Snow *et al*. 2016). Particularly in the case of bottom-up initiatives led by local governments (the most common case according to Estevez *et al*. 2016), they may also be a source of funding (Visnjic *et al*. 2016), provide fiscal incentives and lobby for changes in regulations at regional and national levels (Dovey-Fishman and Flynn 2018).

et al. 2019, Stephens 2020). Also, given that sustainability and technology are pillars of the SC concept, the second part of the hypotheses concerning the implementation of SC initiatives (Hypotheses 1 and 2) are formulated specifically in relation to green and digital entrepreneurship and, by the same token, the hypothesis relative to the orientation of SC initiatives (Hypothesis 3) focuses on green and digital entrepreneurship (Kraus *et al.* 2015, Richter *et al.* 2015, Sarma and Surmy 2017, Montgomery 2018). Lastly, it is understood that the hypotheses are constructed under the usual *ceteris paribus* clause, which means that they hold after controlling for other factors shaping the relationship between SC initiatives and entrepreneurship.

2.1 Smart city initiatives and entrepreneurship

The term "smart city" seems to have emerged in the 1990s as part of the so-called "smart growth movement" in US urban planning (Albino *et al.* 2015). In particular, the concept of the SC was initially associated with the application of information and communication technologies to urban development projects. In fact, technology was seen to be critical to facilitate bottom-up approaches and increase citizens' participation (Nam and Pardo 2011b). It is also interesting to note that, because of its close historical link to technology, the SC has often been seen as an artefact used by (technological) corporations lobbying for a market for their products (Hollands 2008, 2015; Dowling *et al.* 2019). However, as Kummitha (2019: 2-3) has recently stressed, this "neoliberal critique" tends to omit the fact that the efforts made by these corporations to promote the SC may actually act as a driver of entrepreneurship. This may happen directly through the creation of new firms by these same corporations (i.e., corporate entrepreneurship), "[a] classical example [being] IBM's smart city venturing" and the "urban service and consulting ventures" launched by IBM, Cisco, and Accenture, among others. But the activities of these corporations may also create opportunities for new business, either in their supply chains or in new and/or unserved market niches (Carvalho 2015). What is more, the knowledge generated around these entrepreneurial activities may spill over to other entrepreneurs and firms and thus become the source of additional business opportunities and start-ups (Audretsch and Keilbach 2007, Barba-Sánchez *et al.* 2019).

However, this technological view of the SC has gradually evolved to embrace other elements that may impinge upon a city's performance and/or citizens' wellbeing (Ben Letaifa 2015, Caragliu and Del Bo 2015). Notably, environmental sustainability and human capital have become cornerstones of the SC concept (Caragliu *et al.* 2011, Nam and Pardo 2011a). Interestingly, these aspects are highly valued by the entrepreneurs of the German smart cities of Berlin, Cologne and Düsseldorf interviewed by Kraus *et al.* (2015). Also, as Giudici *et al.* (2019) show, both human capital (local availability of scientific and technological knowledge) and local environmental awareness are important determinants of the creation of new "cleantech" firms in Italy. More generally, McLaren and Agyeman (2015) provide numerous examples of collaborative start-ups in cities like San Francisco and

Amsterdam that aim to provide goods and services following the "sharing paradigm" (of which Uber and Airbnb are prominent examples).

Conceptually, however, no general consensus has emerged on what a SC is. Today many different definitions coexist and, although technological, sustainable and human capital elements tend to always be present, they differ in the importance given to each element. Also, the debate extends to whether additional elements need to be considered (e.g., infrastructures and social capital) and what their importance might be. This makes it difficult to identify those territories that are indeed "smart" (Neirotti *et al.* 2014, Kummitha and Crutzen 2017).

To address this issue, Giffinger *et al.* (2007) proposed a three-level structure of analysis. First, at the top level they set six "characteristics" in which smart cities should perform well: economy-competitiveness, social and human capital, governance-participation, transport-ICT, environment, and quality of life. Then, to make it operative, in the second level each characteristic has a number of associated factors and in the third level each factor is described by a number of indicators. To illustrate, the characteristic "economy-competitiveness" includes "entrepreneurship" as one of its associated factors, and the "entrepreneurship" factor is measured using two indicators: "self-employment rate" and "new businesses registered". In doing so, this is the first study that (to our knowledge) suggests a link between entrepreneurship and the SC.[5]

This suggests the following hypothesis on the relationship between entrepreneurship and the implementation of SC initiatives (irrespective of their level and orientation):

<u>Hypothesis 1</u>. SC initiatives are positively correlated with entrepreneurial initiatives. In particular, those territories that have launched SC initiatives should have higher rates of green and/or digital entrepreneurship (in general, higher rates of entrepreneurship).

The indicators proposed by Giffinger *et al.* (2007) have become, to a large extent, the standard to assess a meant-to-be SC. As Kourtit *et al.* (2012: 233) point out, "[t]o qualify as a smart city, it is necessary to comply with various quantitative indicators that can provide an informed picture of the performance of the cities under consideration" (see also Nam and Pardo 2011a and Lombardi *et al.* 2012). However, as Estevez *et al.* (2016) and Angelidou (2017) have recently shown, most smart cities

[5] Anecdotal evidence also suggests that there is a link between entrepreneurship and smart cites (Barba-Sánchez *et al*. 2019, Kummitha 2019). For example, "local municipalities within the Kansas City metropolitan area paved the way for a rapid Google Fiber infrastructure deployment" (Harrington 2017: 1010; see also Sarma and Sunny 2017). In Vietnam, Vu and Hartley (2015) argue that the implementation of smart city initiatives is a key element for the development of an ICT sector in that country. Lastly, a number of successful EU regional entrepreneurship policies developed under the Small Business Act rely on smart city initiatives (see the report of the European Entrepreneurial Region, 2015).

tend to be qualified as such despite being "smart" with varying intensities ("maturity level") and only with respect to some of the indicators generally claimed to characterise smart cities. This means that, in practice, each territory differs in the way it implements the SC concept, either in the level of implementation of the SC initiatives or in the dimensions under consideration within the SC framework (what we may call the "SC orientation"). Next we discuss how these differences can shape the relationship between SC and entrepreneurship.

2.2 SC implementation and entrepreneurship

Territories vary in their level of implementation of SC initiatives. That is, we may have territories that not only have launched SC initiatives but have also largely succeeded in their implementation (e.g., a mobility programme). However, we may also have territories that, despite having launched SC initiatives, still have a low level of implementation of such initiatives (Becker *et al.* 2009, Coletta *et al.* 2018). This would make the relationship between entrepreneurship and SC initiatives statistically weak or non-existent and, as a consequence, we may reject Hypothesis 1. Previous research has shown that entrepreneurship policies may have failed to succeed because of their lack of appropriate implementation (Arshed *et al.* 2016). Addressing this issue can therefore be critical to assess the results obtained when testing Hypothesis 1.

In this paper we follow Manville *et al.* (2014) in measuring the level of implementation of SC initiatives by distinguishing between bottom-up and top-down initiatives. Bottom-up initiatives are launched by local stakeholders and non-governmental parties (e.g., businesses and public organisations), but without a clear involvement of the city council and lacking an elaborated plan. Typically, there is no formal organisation behind these efforts. In contrast, top-down initiatives are structured, planned and government-driven. Typically, an SC strategy is elaborated and implemented by the government and a SC manager is often hired to coordinate the implementation of related initiatives and projects. Further, within these alternative approaches to the participation of citizens and relevant stakeholders in the SC (i.e., bottom-up and top-down approaches), the higher the level of implementation of SC initiatives, the more the potential entrants will benefit from these initiatives. This leads us to formulate the following hypothesis:

Hypothesis 2. The level of SC implementation, for both top-down and bottom-up smart city initiatives, is positively correlated with entrepreneurial initiatives. In particular, those territories with higher levels of SC implementation (top-down and bottom-up) should have higher rates of green and/or digital entrepreneurship (in general, higher rates of entrepreneurship).

2.3 SC orientation and digital and green entrepreneurship

Our analyses so far suggest a link between entrepreneurship and SC initiatives. However, the analysis also shows that many SC initiatives revolve around issues that do not have a clear association with the creation of new firms in the territory (e.g., citizens' well-being and participation). In general, territories involved in SC initiatives tend to favour specific dimensions of the SC concept that are seen as necessary to their context, and thus may leave out other key SC dimensions (Estevez *et al.* 2016, Angelidou 2017). Yet Hypotheses 1 and 2 do not account for the impact that the differences in the SC orientation of the territories may have on the relationship between SC initiatives and entrepreneurship (Kraus *et al.* 2015).

Ultimately, these differences arise because the stakeholders involved in launching SC initiatives (regardless of whether they follow a bottom-up or a top-down approach) differ in the way they conceptualise the SC (Lombardi *et al.* 2012, Ching and Ferreira 2015). As a result, each territory "interprets" the SC concept differently: while for some SC initiatives must be exclusively technological and hardware-oriented (e.g., Washburn and Sindhu 2010), others prioritise sustainable development (e.g., Chourabi *et al.* 2012), and yet others adopt a more "holistic view" (Kummitha and Crutzen, 2017). In this paper, we pay particular attention to the sustainable and digital orientations of SC initiatives because they are both the most common (Manville *et al.* 2014, Estevez *et al.* 2016, Desdemoustier *et al.* 2019) and naturally linked to green and digital entrepreneurship (Lasch *et al.* 2013, Colombelli and Quatraro 2019 and Giudici *et al.* 2019; in contrast, see Cohen and Winn 2007, Kraus *et al.* 2019). Consequently, we hypothesise a relationship between sustainable and/or digital SC orientations and the rates of green and digital entrepreneurship.

Still, Neirotti *et al.* (2014) argue that differences in the SC orientation are not the result of a discrepancy in the understanding of the SC concept but of a deliberate aim arising from contextual factors (Nam and Pardo 2011b). Territories with a high demographic density, for example, are more likely to orient their SC initiatives towards the transport and mobility domains, whereas in territories with higher levels of income it is the economy and/or sustainability domains that drive SC initiatives (Desdemoustier *et al.* 2019). Notice that if that was the case, no statistical relation between (green and digital) SC orientation and the rates of (green and digital) entrepreneurship should be observed once we control for such contextual factors.[6] This leads us to formulate the following hypothesis:

<u>Hypothesis 3</u>. SC initiatives with a sustainable and digital orientation are positively correlated with green and digital entrepreneurial initiatives, respectively. In particular, those territories launching

[6] Neirotti *et al*. (2014) propose using geographical and socio-economic characteristics of the territories (e.g., transport and mobility, living, government, and economy and people) to control for contextual factors. We use a set of variables related to the human capital, transport infrastructures, agglomeration economies, market size and the institutional setting (see Section 3 for details).

SC initiatives with a sustainable and/or digital orientation should have higher rates of green and/or digital entrepreneurship (in general, higher rates of entrepreneurship).

2.4 Testing the hypotheses

Our review of the SC and entrepreneurship literature suggests a link between entrepreneurship and SC initiatives. This may happen directly, through both bottom-up (e.g., entrepreneurship programmes of large companies) and top-down (e.g., "Startup in Residence" and funding programmes) approaches, as well as indirectly through the development of a favourable context for the entrepreneurial activity (e.g., providing physical and technological infrastructures), typically following a top-down approach. However, the analysis also shows that many SC initiatives revolve around issues that do not have a clear association with the creation of new firms in the territory (e.g., citizens' well-being and participation). Further, it is argued that not all the territories develop SC initiatives with the same intensity and purpose (i.e., there are differences in the level of implementation and orientation). Lastly, these efforts to foster entrepreneurship in smart cities may simply not succeed, as the cases of Songdo in South Korea, Yujiapu and Lingang in China, and Dholera in India show (Stephens 2020).

In Belgium, for example, most SC initiatives tend to be organised around regional programmes involving information and communication technologies (Desdemoustier *et al.* 2019). This is the case of the "smart city ambition" programme of the Brussels-Capital Region, which seeks to create an "ecosystem that will bring economic opportunities to our entrepreneurs, start-ups and SMEs (..) by increasing public financing for research and creation of digital companies, by accelerating digitalisation of companies and introducing a cluster centred on coding and computer programming skills". But, on the other hand, the Smart City strategy of Brussels stresses that "the main objective of a Smart City is to improve the quality of life of citizens and businesses" and that "technologies are not an end in themselves, but rather a tool in the design of the smart city". Similarly, the smart city programme of the Flanders region ("Smart Flanders Programma") covers 13 of its 308 municipalities, with a particular focus on the use of open data and the aim of stimulating the "collaboration between cities and actors from the quadruple helix". At the same time, however, some municipalities in the Flemish province of Limburg are pursuing a sustainable approach in their smart city projects that seeks to attract green energy firms to the area through collaborations with the R&D innovation hub Energyville. Lastly, the strategy of the Wallonian government, coordinated by the "Digital Wallonia" platform and largely following the technological view of the SC, includes an investment fund (W.IN.G.) that has financed nearly 60 start-ups in the digital sector since 2016 (of which only a few did not succeed). Still, as Desdemoustier *et al.* (2019: 133) point out, many municipalities in Wallonia tend to "reject the concept" of the smart city, many more than in Brussels and Flanders.

Consistent with what the literature suggests, these examples of SC initiatives in Belgium illustrate that while some may foster (green and digital) entrepreneurship in different degrees and forms, others intend to pursue other objectives (or just fail). In general, it is not certain that a positive (causal) relationship exists between (green and digital) entrepreneurship and (the level and orientation of) SC initiatives. It is then an empirical question to ascertain whether this is the case. This paper addresses this question by means of three hypotheses that, following the literature, capture the potential relationship between the rates of entrepreneurship and the implementation (Hypothesis 1), the level of implementation (Hypothesis 2) and the orientation of the SC initiatives (Hypothesis 3).

Since these hypotheses link a local event (the launch of SC initiatives and their orientation) with the creation of new firms in the territory (conditional on other determinants of the rates of entrepreneurship), we propose using data on municipalities and count data models to test them (Audretsch and Lehmann 2005, Audretsch and Keilbach 2007).[7] Although the evidence from case studies provides interesting insights on the relationship between SC and entrepreneurship (e.g., Vu and Hartley 2015, Harrington 2017, Sarma and Sunny 2017), the availability of measures of SC initiatives and orientations for a large sample of municipalities is critical to empirically test the proposed hypotheses and provide findings that can be applied more generally. This is one of the reasons for analysing the Belgian case (Bounazef *et al.* 2018). Notice also that we have constructed our hypotheses on the grounds of correlation analyses and let the data determine the existence of a relation of causality. This is because our data consists of a cross-section of municipalities whose sampling is given by a survey addressed to all the Belgian municipalities (no error bias and a response rate of around one out of five), which raises some econometric issues that may preclude a causal interpretation (notably, the role of unobserved heterogeneity). Thus, we initially test the proposed hypotheses by analysing the statistical significance of the coefficients associated with the SC initiatives and orientation explanatory variables in the proposed count data models under the assumption of exogenous sample and covariates. Later we address the sampling and endogeneity concerns to assess the robustness of our initial conclusions and identify a causal relation between entrepreneurship and the SC phenomenon (List *et al.* 2003, Cameron and Trivedi 2013, Solon *et al.* 2015).

3. Empirical analysis

In this section we first describe the data used to empirically test the hypotheses previously discussed. We then analyse the estimates we obtained on the relationship between the rate of entrepreneurship

[7] See also List *et al*. (2003), Colombelli and Quatraro (2019) and Giudici *et al*. (2019); Stenholm *et al*. (2013) and Breitenecker *et al*. (2017) provide alternative empirical approaches using analogous dependent variables.

and the SC initiatives and orientation (and discuss the outcomes of some robustness tests). In particular, we provide results from negative binomial regression models (the so-called NB2 model) because we generally find evidence of overdispersion in our data (Cameron and Trivedi 2013). We also report results from a control function and instrumental variable (IV) methods that, under certain conditions, have a causal interpretation (Angrist and Pischke 2009, Wooldridge 2010). Lastly, note that the geographical unit of analysis is the municipality, which is the smallest administrative and political unit in Belgium (LAU2 units in the Eurostat nomenclature).

3.1 Data

We used three sources of data to construct our database. First, the dependent variables (new businesses registered within a certain period of time) rely on information provided by Bel-first (Bureau van Dijk).[8] Second, the explanatory variables of interest (measures of SC initiatives and orientation) were constructed from a survey of the Belgian municipalities conducted by the Smart City Institute of the University of Liège (Bounazef *et al.* 2018). Third, the set of control variables used in all the estimated models were obtained from a Belgian municipalities' dataset constructed by Belfius from various statistical sources (Belfius 2007, 2017) and public data on inter-city trains from the National Railway Company of Belgium (NMBS/SNCB). Next, we provide detailed definitions of these three groups of variables, whose summary statistics are reported in Table 1.

[Insert Table 1 about here]

3.1.1 Dependent variables

We used three dependent variables to perform the empirical tests of the hypotheses: one that is a proxy for the rate of entrepreneurial activity (# new firms), one that is a proxy for the rate of green entrepreneurship (# new green firms) and one that is a proxy for the rate of digital entrepreneurship (# new digital firms). More precisely, each variable contains the number of new business registrations over the period 2013 to mid-2018, in each Belgian municipality and in a specific group of industries. That is, the variable "# new firms" corresponds to the registrations in any industry, "# new green firms" corresponds to the registrations in the green industries (as defined below) and "# new digital firms" corresponds to the registrations in the digital industries (as defined below). Notice that we restrict the counts to companies that report an active legal status.

[8] Since this data source only considers companies for which it is compulsory to register balance sheets (see Kalemli-Özcan *et al*. 2019 for details on the coverage), our data may underestimate the importance of micro-firms in "business creation" (Bajgar *et al*. 2020, Barreneche-García 2014: 79). Still, comparative studies show that the data is largely representative of the whole population of Belgian firms (Bajgar *et al*. 2020) and that, by using cumulative values over a number of years, as we do here, such underestimation is largely mitigated (Kalemli-Özcan *et al*. 2019).

The period used to construct the dependent variables is motivated by the fact that: *i)* to our knowledge the oldest plan for a Belgian municipality that integrates SC initiatives dates from 2013 and *ii)* the information on the SC initiatives and orientations was obtained during the first half of the year 2018. This means that in our regression analyses we are initially assuming that SC initiatives and orientations are exogenous to the rate of entrepreneurial activity. Yet we cannot completely rule out the possibility that these variables are correlated with an unobservable characteristic of the municipalities, which would bias our estimates (and preclude a causal interpretation). We assess this issue below as part of our robustness tests.

Other aspects worth considering in the construction of our dependent variables are the heterogeneity of businesses we may be picking up and the definition of the green and digital industries. With regard to the former, it is important to note that business registrations that appear in the Bel-first dataset include mostly commercial enterprises (around 60% of # new firms), but also the self-employed (39% of # new firms) and a fringe of associations, public organisations and foreign companies (the remaining 1% of # new firms). To address this heterogeneity and assess the potential bias towards larger firms that this data source may produce (Kalemli-Özcan *et al.* 2019, Bajgar *et al.* 2020), we provide results only for the self-employed as part of our robustness tests. For the definition of the green industries, following Shapira *et al.* (2014) we selected those companies that contained "green terms" in their SIC code (NACE-BEL) and the "general overview" of the company, both provided by Bel-first. However, as a robustness test we also explored a more restrictive definition that only included some of the terms initially used.[9] Lastly, our definition of the digital industries follows the practice of the UK Department for Digital, Culture, Media and Sport. This means defining digital industries in terms of SIC codes (see Department for Culture, Media and Sport 2015 for details). However, as a robustness test we also defined the digital industries using the OECD definition —see e.g. the report of the Office for National Statistics (2015) for details on the different definitions.[10]

We report descriptive statistics for the dependent variables and their restricted versions in Table 1, thus showing the differences that arise between the considered definitions. These are mostly relevant for the rate of entrepreneurial activity, since the self-employed roughly represent a third of the new

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[9] Specifically, the terms initially employed for the search were: "sustainab* or (green good*) or (green technolog*) or (green innov*) or (eco*innov*) or (green manufac*) or (green prod*) or pollut* or (ecolabel) or (environ* product declarat*) or (EPD AND environ*) or (environ* prefer* product*) or (environ* label*)", the asterisk * indicating a wild card and the terms in brackets a single expression (see Shapira *et al*. 2014 for details). The restrictive version uses the same terms except for "green technolog*", since this term may *a priori* include companies in digital industries and so distort our results.

[10] Our approach to the definition of green and digital entrepreneurship is similar to that used by other papers analysing the determinants of green (e.g., Giudici *et al*. 2019) and digital (e.g., Lasch *et al*. 2013) entrepreneurship at the local level. Notice also that our definitions do not differ much either from the ones generally used in the green and digital entrepreneurship literature (Nambisan 2017, Kraus *et al*. 2018), which in essence are contextual (Nambisan 2017) and process-driven (Kraus *et al*. 2018) definitions.

firms. In contrast, the differences in the initial and restricted versions of the green and digital rates are small. It is also interesting that none of the dependent variables considered have zero values, i.e., all the municipalities of the sample show positive rates of entrepreneurship.

With this in mind, Figure 1 shows the spatial distribution of # new firms, # new green firms and # new digital firms across the Belgian municipalities (using the initial definitions of these variables). New venture creation is clearly more important in the north of the country, which roughly corresponds to the regions of Brussels and Flanders. This is where we find a larger number of municipalities in the upper side of the distribution of the variables. In particular, there are more business registrations in the more-populated areas, such as Antwerp, Ghent, Charleroi, Liège and Brussels. However, the weight of the southern municipalities in the green industries is worth noting. Although most municipalities in the upper side of the distribution of the variables are in the north of the country, there are more southern (and particularly eastern) municipalities above the median in the green than in the digital industries.[11]

[Insert Figure 1 about here]

3.1.2 Sample and variables of interest

Moving on to the explanatory variables of interest, we constructed proxies for the implementation of SC initiatives (Hypothesis 1), for the level of implementation of the SC initiatives (Hypothesis 2), and for the SC orientation (Hypothesis 3). In particular, these variables rely on information gathered in a survey of the Belgian municipalities conducted by the Smart City Institute of the University of Liège during the first half of 2018. Although all the Belgian municipalities were targeted, only 123 responded, which implies a response rate of nearly 21%.

Figure 2 shows the geographical distribution of the sample, which is statistically representative of Belgian territorial and institutional realities (Bounazef *et al.* 2018, Desdemoustier *et al.* 2019). This means that, on one hand, Chi-Square adjustment tests cannot reject the null hypothesis that the sample matches the Belgian municipalities' population in terms of degree of urbanisation (urban *vs* rural, using the OECD's threshold of 150 inhabitants per km^2) and political organisation (provinces and regions). On the other hand, the test rejects the null hypothesis with respect to the size of the municipalities. This is because the sample overrepresents larger municipalities (see also Manville *et*

[11] In the regression analyses we control for market size using total firms and population (see e.g. Audretsch and Lehmann 2005 and Barreneche-García 2014) instead of using these variables to scale the dependent variables. This scaling is known as the "ecological" and "labour market" approach, respectively. While e.g. Lasch *et al*. (2013) follows the ecological approach, Audretsch and Keilbach (2007), Arin *et al*. (2015), Stenholm *et al*. (2013) and Breitenecker *et al*. (2017) are examples of the labour market approach.

al. 2014), since those with more than 50,000 inhabitants represent about 16% of the initial sample although they are only about 5% of the Belgian municipalities.

This oversampling of large municipalities may raise concerns about the representativeness of our results and the presence of a selection bias (Solon *et al.* 2015). We assessed the importance of these concerns by weighting our regressions using the inverse of the population between 20 and 60 years old in 2017 (using 2007 data provided essentially the same results). In addition, we assessed the role of the larger municipalities in shaping the relation between entrepreneurship and SC initiatives by considering an alternative specification that includes the product of the variables of interest (SC initiatives, SC implementation and SC orientations) with a dummy variable indicating those municipalities with more than 50,000 people between 20 and 60 years old in 2017. These results are discussed below as part of our robustness tests.

[Insert Figure 2 about here]

Our first measure of the implementation of SC initiatives is a binary outcome (denoted "SC Initiatives") that takes the value 1 if there are SC initiatives in the municipality (79 municipalities of the sample) and 0 otherwise (26 municipalities). In particular, a municipality was judged to have launched SC initiatives if it answered yes to the survey question "Have you formalised any SC objectives in your municipality", yes to the survey question "Are the SC projects formalised according to a plan?" and/or a strictly positive number to the survey question "How many SC projects have you developed in your municipality". Conversely, a municipality was judged not to have launched SC initiatives if the answers to these questions were "no", "no" and "zero", respectively. Lastly, the 18 municipalities omitting answers and/or providing ambiguous answers (for example, answering with a question mark) were dropped from the sample. This restricts the final sample of our study to 105 municipalities.

In summary, those municipalities identified as having launched SC initiatives have clear objectives, implemented a plan and carried out some projects, whereas those identified as not having launched SC initiatives do not have clear objectives, have not implemented a plan and have not carried out any projects. Yet an important drawback of this binary definition is that it does not account for the "maturity level" of the SC initiatives (Becker *et al.* 2009, Estevez *et al.* 2014, Arshed *et al.* 2016). To address this issue, we followed the report commissioned by the European Parliament's Committee on Industry, Research and Energy on Smart Cities in the EU (Manville *et al.* 2014, p. 77) and proposed the use of five categories of implementation of SC initiatives depending on the direction and level of "the participation of citizens and relevant stakeholders in the Smart City". In particular, we empirically defined these five categories by using dummy variables that account for different levels of maturity of the SC initiatives within the two directions of participation: a “bottom-up approach” where citizens, enterprises and other stakeholders trigger and monitor the initiatives and a “top-down approach” where the city council and the public authorities trigger and monitor the initiatives. Table 2 summarises the way we implemented this using the same survey questions we used to construct the SC initiatives dummy variable.[12]

[Insert Table 2 about here]

In the bottom-up approach, SC initiatives are launched (i.e., some SC projects are developed) without clear objectives or plans (low level of implementation) to later formalise the goals in a plan (high level of implementation). Thus, the lower bottom-up level in our sample corresponds to the 23 municipalities (identified with the indicator variable “SC Implementation Bottom-up Low”) that answered no to the survey question “Have you formalised any SC objectives in your municipality” and no to the survey question “Are the SC projects formalised according to a plan?”, whereas the top level corresponds to the 18 municipalities (identified with the indicator variable “SC Implementation Bottom-up High”) that answered no to the first question and yes to the second. Notice, however, that all these 41 municipalities answered with a strictly positive number for the question “How many SC projects have you developed in your municipality” and that the residual category corresponds to the remaining 64 municipalities with no bottom-up initiatives.

In the top-down approach, the implementation of the SC initiatives goes the other way around; that is, the starting point is the definition of the goals (i.e., objectives are clearly set) to progressively construct plans and develop projects. In this vein, the low level of implementation corresponds to SC initiatives that have developed projects (to reach certain pre-defined objectives) but without a clear plan, the higher level of implementation corresponds to SC initiatives that have developed projects following a plan (with the aim of reaching certain objectives), and the intermediate level of implementation corresponds to SC initiatives that have a plan to follow but have not developed associated projects (despite having defined objectives). Thus, the lower top-down level in our sample corresponds to the 3 municipalities (identified with the indicator variable “SC Implementation Top-down Low”) that answered yes to the survey question “Have you formalised any SC objectives in your municipality”, no to the survey question “Are the SC projects formalised according to a plan?”, and a strictly positive number to the survey question “How many SC projects have you developed in your municipality”. For the intermediate level, this corresponds to the 10 municipalities (identified with the indicator variable “SC Implementation Top-down Intermediate”) that answered yes to the first question, yes to the second question and zero to the third question. Lastly, the higher level

[12] Case studies discussed by e.g. Angelidou (2017), Anthopoulos (2017), Coletta *et al*. (2018), Dowling *et al*. (2019), Komninos *et al*. (2019) provide examples of the categories considered in Table 2.

corresponds to the 25 municipalities (identified with the indicator variable "SC Implementation Top-down High") that answered yes to the first question, yes to the second question and a strictly positive number to the third question. The residual category corresponds to the remaining 67 municipalities that did not implement SC initiatives following a top-down approach.

For the SC orientation (Hypothesis 3), we started by excluding those municipalities that did not provide useful information on the launch of SC initiatives. This was made for the sake of consistency, since it seemed difficult to analyse the SC orientation of those municipalities that we were uncertain about whether or not they had launched SC initiatives. This left us with 105 municipalities, since all of them answered the question used to construct our measure of SC orientation, namely "What are the elements that your municipality associates with the SC?". In particular, the digital/sustainable non-excluding answers were used to construct four indicator variables of the SC orientation: sustainable (11 municipalities), digital (19), sustainable and digital (62), and neither sustainable nor digital (13). Thus, each of these indicators ("SC Orientation Sustainable", "SC Orientation Digital" and "SC Orientation Sustainable & Digital", being neither sustainable nor digital the residual category) takes the value 1 for the corresponding answer and 0 otherwise.

3.1.3 Control variables

Lastly, our set of control variables largely covers what the literature has found to be the most important determinants of the rate of entrepreneurship: human capital, transport infrastructures, agglomeration economies, market size and the institutional setting.[13] Specifically, we proxied the various aspects of the human capital using variables related to the education (rate of population with a degree from an "Haute École" and a university degree in 2011), income (the log of the median income in 2007) and its square, unemployment (the unemployment rate in 2007) and migrant population (rate of population from EU countries and from other countries other than the EU in 2017). For the transport infrastructures, we considered the number of kilometres of motorways in the municipality (in thousands, 2015 and 2017 data) and a dummy variable that indicates whether inter-city trains stop at the municipality's train station (data retrieved from the webpage of the NMBS/SNCB in 2018). Agglomeration economies are proxied by the density of population in 2015 and its square (to control for potential diseconomies), as well as the number of firms in green and/or digital industries and their square (location (dis)economies). Also, the total number of firms in the 2013 to mid-2018 period and the population between 20 and 60 years old in 2007 are our proxies for market size. Finally, the institutional setting is proxied by dummy variables indicating the province in which the municipality is located (NUTS2 units in the Eurostat nomenclature, with Flemish Brabant being the residual category), the percentage of males in the population in 2007, and an inequality

[13] See e.g. List *et al*. (2003), Lasch *et al*. (2013), Barreneche-García (2014), Arin *et al*. (2015), Breitenecker *et al*. (2017), Colombelli and Quatraro (2019) and Giudici *et al*. (2019) and the references therein.

measure (the log of the difference between the third and first quartile, i.e., the interquartile range of the income distribution in 2007).

We explored alternative sets of controls, such as using additional levels of education (e.g., population with a secondary degree and/or a post-secondary education), alternative definitions for the location economies (number of firms in green and/or digital industries over total number of firms), and the inclusion of the square of some variables (e.g., motorways and the inequality measure). However, we obtained essentially the same results (available upon request) and the variables eventually selected generally provided the best fit (in terms of Akaike's information criterion). It is also interesting to note that, for some of the control variables, data was available for a different year than the one used to obtain our basic estimates. In particular, we had information on income in 2015, unemployment in 2016, the population between 20 and 60 years old in 2017, the percentage of males in 2017, and the inequality measure in 2015. As a final robustness test on our results, we re-estimated the model using these data from alternative years. However, our results largely coincide with those reported below and are consequently omitted to save space (they are available upon request).[14]

3.2 Basic Estimates

Table 3 reports our basic estimates. These are negative binomial estimates obtained for each of the initially-defined dependent variables (# new firms, # new green firms and # new digital firms), assuming exogenous explanatory variables, and using the reference years initially proposed for the set of control variables. In particular, for each dependent variable we report estimates for each set of variables of interest: the SC initiatives dummy (SC Initiatives), the dummies distinguishing bottom-up and top-down approaches to the implementation of SC initiatives (SC Implementation Bottom-up Low, SC Implementation Bottom-up High, SC Implementation Top-down Low, SC Implementation Top-down Intermediate and SC Implementation Top-down High), and the sustainable/digital orientation dummies (SC Orientation Sustainable, SC Orientation Digital and SC Orientation Sustainable & Digital). These combinations allowed us to empirically test the hypotheses put forward in the previous section.[15]

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[14] We also explored the existence of spatial effects in the relationship between entrepreneurship and SC initiatives by log-transforming the dependent variable (# new firms, # new green firms and # new digital firms) and estimating a linear spatial autoregressive model using a spatial contiguity matrix, the SC initiatives dummy variable and the set of controls previously described. We found that the spatial autoregressive term was not statistically significant in any of the considered specifications (results available upon request).

[15] Notice that, because of the way we had constructed the dummy variables measuring the level and direction of the implementation of SC initiatives, a Wald test on the sum of the coefficients of the levels of implementation dummies for each direction of participation (SC Implementation Bottom-up Low plus SC Implementation Top-down Low and SC Implementation Bottom-up High plus SC Implementation Top-down High) provides the impact of each level of implementation considered (low and high, respectively), whereas a Wald test on the sum of the coefficients of the direction of participation dummies for each level of implementation (SC Implementation Bottom-up Low plus SC Implementation Bottom-up High and SC Implementation Top-down Low plus SC Implementation Top-down High) provides the impact of the direction of participation considered (bottom-up and top-down, respectively). Results from

[Insert Table 3 about here]

The first thing to notice is that our results are largely consistent with previous findings in the literature (Arin *et al.* 2015, Breitenecker *et al.* 2017). This means that the sign and statistical significance of the control variables are in line with the results of related studies (e.g., List *et al.* 2003, Greembaum and Tita 2004, Barreneche-García 2014, Arin *et al.* 2015). Notice, however, that not all the control variables impact the different entrepreneurship measures we considered in the same way (Audretsch and Lehmann 2005, Audretsch and Keilbach 2007). In particular, the statistical significance of the variables that are proxies for the human capital (except for education), agglomeration economies, market size and the institutional setting vary across the three dependent variables (# new firms, # new green firms and # new digital firms). In contrast, the effect of the transport infrastructures (and education) is practically the same across the different entrepreneurial rates. Also, notice that although the fit of the models is similar for the different SC implementation and orientation measures (in terms of Akaike's information criterion), the best fit was obtained when using the variable "SC Initiatives".

More precisely, we find that municipalities with more educated people (as measured by the rate of population holding a university degree), with a higher median income (but not too high, otherwise the non-linear term may overcome the effect), better transportation infrastructure (at least in terms of access to inter-city trains and possibly too in terms of motorways, since the coefficients in columns 3 and 4 of Table 3 are close to significance) and lower percentage of males tend to have a higher rate of entrepreneurial activity. It is also interesting to note that (dis)agglomeration economies arise mainly from the presence of green firms. Lastly, while the provinces of Antwerpen and Limburg have statistically significantly higher rates of entrepreneurship, the provinces of Brabant-Wallon, Hainaut and Luxembourg have the lowest (after controlling for the other factors). This means that, at the regional level, entrepreneurial activity is generally higher in Flanders than in Wallonia and even the Brussels region.

We also find that the entry of green and digital firms in the Belgian municipalities are driven by essentially these same factors. However, some differences are worth noting. First, the level of income and its square, the rate of unemployment and the (dis)agglomeration economies arising from the population density are drivers of the creation of firms in the digital industries but do not make a difference for the green industries. Second, while facing a potentially larger market (as measured by

these tests are reported at the bottom of Table 3 as "Wald test Imp. Low", "Wald test Imp. High", "Wald test Imp. Bottom-up", "Wald test Imp. Top-down", respectively.

the total number of firms) spurs digital entrepreneurship, it deters green entrepreneurship. Third, while the rate of green entrepreneurship is statistically significantly higher in the province of Limburg (Belgium's most important fruit-producing territory), the Wallonian provinces and Brussels show statistically significantly lower levels of digital entrepreneurship. To a large extent, these results are consistent with those found by other studies on the determinants of green and digital entrepreneurship (Lasch *et al.* 2013, Colombelli and Quatraro 2019 and Giudici et al. 2019).

For the variables associated with the smart city phenomenon, we find that the implementation of SC initiatives shows a positive effect on the creation of new firms. However, it is only statistically significant for # new firms and # digital firms. In addition, high levels of implementation and/or bottom-up approaches spur the entry of new firms, whereas bottom-up approaches only spur the entry of green firms if the level of implementation of the SC initiatives is high. Digital entry increases with SC initiatives in general, i.e., regardless of the level of implementation and direction of participation. On the other hand, the SC orientation variables are never statistically significant, i.e., having a sustainable and/or digital orientation does not seem to have any effect on any of the rates of entrepreneurship considered. Therefore, in terms of the hypotheses put forward in the previous section, these results *i)* support Hypothesis 1 with respect to the rates of total and digital entrepreneurship, *ii)* support Hypothesis 2 with respect to the rates of total and digital entrepreneurship, and generally for bottom-up approaches as long as the level of implementation is high, and *iii)* do not support Hypothesis 3. Next, we assess whether these conclusions hold when we consider alternative definitions of the dependent variables and address the sampling and endogeneity concerns previously mentioned.

3.3 Robustness tests

Table 4 reports results from three of the robustness tests we performed on our basic estimates. First we considered the case of the self-employed (to assess the heterogeneity and potential bias towards larger firms that our data source may produce) and alternative definitions for the green and digital industries (to assess to what extent our results are driven by the definitions employed). Second, we considered an alternative model specification in which we included as additional regressors the products of the SC initiatives, implementation and orientation variables with a dummy variable identifying municipalities with more than 50,000 people between 20 and 60 (to assess the role of the larger municipalities in shaping the relationship between entrepreneurship and SC initiatives). These regressions were weighted using the inverse of the population because (unreported) results from the basic specification showed that such weighting regressions yielded similar estimates with generally smaller standard errors. This supports the use of this procedure to account for the oversampling of large municipalities (Solon *et al.* 2015). Third, we assessed the impact of the potential endogeneity of the SC initiatives by using two instrumental variables methods (Angrist and Pischke 2009, Wooldridge 2010). In particular, the instruments used are third- and fourth-degree polynomials of indicators of the SC characteristics proposed by Giffinger *et al.* (2007). Namely, share of parks and gardens in 2007 as an indicator of the "environment", share of sport areas in 2007 as an indicator of "quality of life", and number of parties elected in the 2012 local elections as an indicator of "governance-participation". Notice that, in principle, these (lagged) variables are exogenous to the (current) entrepreneurship measures. Also, they are relevant instruments to the extent that they are correlated with smart city initiatives (Neirotti *et al.* 2014). In fact, results show that these polynomials are jointly statistically significant variables in our first stage regressions.[16]

[Insert Table 4 about here]

Estimates of the variables of interest obtained in each of these robustness tests are reported in Panels A, B and C of Table 4, respectively. They largely replicate those reported in Table 3 in that the signs and statistical significance of the coefficients remain largely the same (and, in Panels A and B, even the values of most of the coefficients are similar). This means that the (lack of) empirical support for the hypotheses proposed in Section 2 is largely robust to sampling and endogeneity concerns, as well as the use of different definitions for the rates of entrepreneurship (and different reference years in some of the control variables). Still, results reported in Panels B and C reveal certain issues in the relationship between SC initiatives and entrepreneurship that are worth noting.[17]

Panel B in Table 4 reports, for each dependent variable (# new firms, # new green firms and # new digital firms), the direct effects of the variables of interest and the differential effects of these variables in municipalities with more than 50,000 people, i.e., the coefficient estimates of the product of the SC initiatives, implementation and orientation variables with the corresponding dummy variable. However, these differential effects in large municipalities are not statistically significant for the # new firms and # new green firms. Consistent with this, the coefficient estimates of the direct effects of the

16 Specifically, we instrumented the SC initiatives dummy variable using a polynomial of degree two of the share of parks and gardens, the share of sport areas, and the number of parties (without the squared terms, i.e., only including cross-products of the three variables), the number of parties squared times the share of sport areas, the share of sport areas squared times the share of parks and gardens, and the product of the share of parks and gardens, the share of sport areas, and the number of parties, whereas we instrumented the level of implementation dummies using the same third-degree polynomial used for the SC initiatives dummy plus the share of sport areas squared times the number of parties. Similarly, we instrument the SC orientation dummies using the polynomial of degree three of the share of parks and gardens, the share of sport areas, and the number of parties but without including either squared terms or the product of the share of parks and gardens and the share of sport areas, nor the variables to the power of three (i.e., only including cross-products of the three variables).

17 Unreported results from the Wald tests on the level of implementation and direction of participation also provided analogous results to the ones reported in Table 3, the only noticeable difference being that while high levels of implementation and bottom-up approaches spur the entry of digital firms in smaller municipalities, digital entry increases with SC initiatives in general (i.e., regardless of the level of implementation and direction of participation) only in larger municipalities.

variables of interest in the first and second column of Panel B in Table 4 are similar to those reported in Table 3. In contrast, the fact that SC initiatives are developed in larger municipalities (with more than 50,000 people) makes an important difference in their impact on the creation of new firms in the digital industries. Namely, the effects of launching SC initiatives are larger, statistically significant for both bottom-up and top-down initiatives with low levels of implementation, and for all the SC orientations considered (albeit larger for the digital orientation).

Panel C in Table 4 reports results from the two approaches we used to address the potential endogeneity of the SC initiatives. In the first column we report IV negative binomial estimates using a control function approach that, under certain conditions, can have a causal interpretation (Angrist and Pischke 2009, Wooldridge 2010). Specifically, this is a two-stage estimator with bootstrapped standard errors that uses a linear model in the first stage and the first-stage residual(s) to control for endogeneity in the second stage. In the second column we report estimates from an exponential conditional mean model with multiplicative errors estimated by GMM and weighted by the inverse of the population that produces consistent estimators without requiring that the dependent variable follows a conditional negative binomial distribution (Wooldridge 2010). Thus, this provides estimates that are more robust to misspecification issues than the IV negative binomial estimates. Notice also that the fact that the estimates obtained from both approaches are very similar suggests that our conclusions are not driven by the weighting scheme we used in one approach. In addition, the penultimate row of Panel C in Table 4 reports Hansen J-tests that do not reject the validity of the moment conditions constructed with the proposed set of instruments. Lastly, the ultimate row presents endogeneity tests rejecting the exogeneity of the SC initiatives variable and, for # new firms and # new digital firms, also that of the implementation variables (i.e., in these cases the residuals from the first-stage regression of the control function approach are statistically significant in the second-stage negative binomial model). This supports a causal interpretation of the results and shows that assuming exogeneity may result in underestimation of the impact of SC initiatives on entrepreneurship (as in List *et al.* 2003).

Thus, we find evidence of a positive causal relation between smart city initiatives and all the entrepreneurship rates (# new firms, # new green firms and # new digital firms), particularly when these initiatives follow a bottom-up approach and/or the level of implementation is high. In the digital industries, entrepreneurship rates are also higher when the SC initiatives follow a top-down approach and the level of implementation is high. In contrast, SC orientation variables do not generally make a difference in the rates of entrepreneurship considered. Therefore, we conclude that our results fully support Hypothesis 1 (not partially, as previously concluded), largely support Hypothesis 2 (which holds for all entries and entries in the digital industries, and with respect to bottom-up approaches) and fail to support Hypothesis 3 (except possibly for the digital industries in larger municipalities).

3.4 Discussion of results

Our results provide interesting insights for the urban management and policy of municipalities engaged or considering engaging in SC initiatives. Notably, these initiatives may pay off for local governments seeking to increase entrepreneurship in their areas. However, such local governments should be aware that these positive effects are not likely to arise in the short term, because they will only arise when the SC initiatives are in an advanced stage of development. Furthermore, for these initiatives to succeed in terms of firm creation, they seem to require an active participation of local stakeholders and non-governmental parties. SC initiatives led by local governments may still spur digital entrepreneurship, but only if they have reached an advanced stage of development.

Also, if the main goal of an SC initiative is indeed to attract new firms, then the stakeholders involved do not need to be highly concerned about which dimensions of the SC concept are to be prioritised. Regardless of whether they go for a technological, sustainable or holistic orientation, the effects on the entrepreneurship rates are likely to be meagre. This is not the case, however, if the municipality is large and aims to attract firms in the digital industries. In fact, the creation of new firms in the digital industries benefits from practically any effort made by larger municipalities towards the advance of SC initiatives, i.e., in that case the holistic view to the SC pays off. Larger municipalities are thus in a better position to achieve these higher rates of (digital) entrepreneurship associated with the SC initiatives.

All in all, our results suggest that smart cities may be acting as a local entrepreneurship-supporting policy. However, these results can also be analysed in relation to the way we interpret the SC phenomenon. Historically, the concept of the SC was linked to the application of information and communication technologies to urban development projects (Washburn and Sindhu 2010, Nam and Pardo 2011b). From this point of view, our findings suggest that this view of the smart cities as "digital hubs" is still in place, particularly in larger municipalities following a digital orientation (Komninos *et al.* 2019). However, in recent years a broader view of the smart cities, which includes sustainability and citizens' wellbeing, seems to have emerged (Ben Letaifa 2015, Caragliu and Del Bo 2015). To the extent that the creation of new firms in the green industries and the role of bottom-up (i.e., community-driven) approaches reflect this view, our results provide support to the idea that SC initiatives aim to transform urban environments into sustainable areas that widely use information and communication technologies to improve citizens' wellbeing.

4. Conclusions

The smart city phenomenon is growing. Cities all over the world are seeking to develop "smart" initiatives, i.e., projects associated with the mobility of citizens and vehicles, the role of big data and its technologies, the long-term sustainability of the urban environment, and the increase of citizen's political participation. These projects are not cheap and usually involve substantial amounts of resources, yet empirical assessments of the economic effects of these initiatives are scarce. In this paper we argue that smart city initiatives may be associated with higher rates of entrepreneurship. We then empirically analysed the link between (green and digital) entrepreneurship and the SC implementation and orientation using data from Belgian municipalities.

Our main finding is that the creation of new firms is greater in municipalities engaged in SC initiatives, particularly when they are in more advanced stages of development and/or involve local stakeholders and non-governmental parties. This suggests that smart cities may be acting as a local entrepreneurship-supporting policy that is not necessarily limited to initiatives emanating from the local government but from the whole local community. We also find that government-driven initiatives (top-down approach) spur the entry of digital firms when the level of implementation of the initiatives is high and, in large municipalities, regardless of their level of implementation and mostly when they follow a digital orientation. This is consistent with the view that (large) smart cities are essentially "digital hubs" that stand mostly on technological developments. However, the role of bottom-up approaches and the positive effects on the entry of green firms support a broader view of smart cities that stands not only on technology but also on sustainability and stakeholders' participation. In any case, our results are largely robust to sampling and endogeneity concerns, the use of different definitions for the rates of entrepreneurship, and the use of different reference years in some of the control variables.

To conclude, it is interesting to mention what we see as future avenues for research in this area. First, additional empirical evidence from longitudinal and/or natural-experimental studies is required. In particular, an analysis of the dynamics of the (causal) relationship between SC initiatives and entrepreneurship may provide interesting insights about the impact that these local initiatives have on the short- and long-term evolution of new business ventures. Second, if SC initiatives attract new firms, this opens the door to the possibility that they attract potential entrepreneurs and existing firms from nearby, possibly "non-smart" locations. Empirical research on this issue (e.g., how important are these effects and/or which territories are more affected) may help to address policy concerns about what actions (if any) should be taken by the local governments involved.

More generally, our results raise the question of where the link between SC initiatives and entrepreneurship may come from. Does it come from the territories, the entrepreneurs, or is it a combination of both? Specifically, what kind of entrepreneurs choose "smart cities" to start their ventures? Are they different from the entrepreneurs in "non-smart cities"? Also, what makes territories involved in SC initiatives more performant in terms of entrepreneurships rates (beyond the set of controlling factors that we have included in our regressions)? Do they provide a more entrepreneurship-supportive environment and, if that is the case, how do they do it? Addressing these questions is critical to understanding the role that the SC phenomenon may play in fuelling entrepreneurship as well as in designing appropriate (local) policies. For if the key roles are the characteristics of the territory (e.g., the existence of a powerful entrepreneurship ecosystem), then local programmes oriented towards improving such characteristics should be implemented (programmes specifically oriented towards entrepreneurship or, perhaps, of a general nature if the empirical evidence shows that they perform well). However, if the higher rates of entrepreneurship in smart territories actually have their origins in the entrepreneurs' characteristics (e.g., a strong background in STEM disciplines), then the policy recommendation would be to promote their acquisition by the local population of potential entrepreneurs.

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Figure 1: Spatial distribution of the rates of entrepreneurial activity.

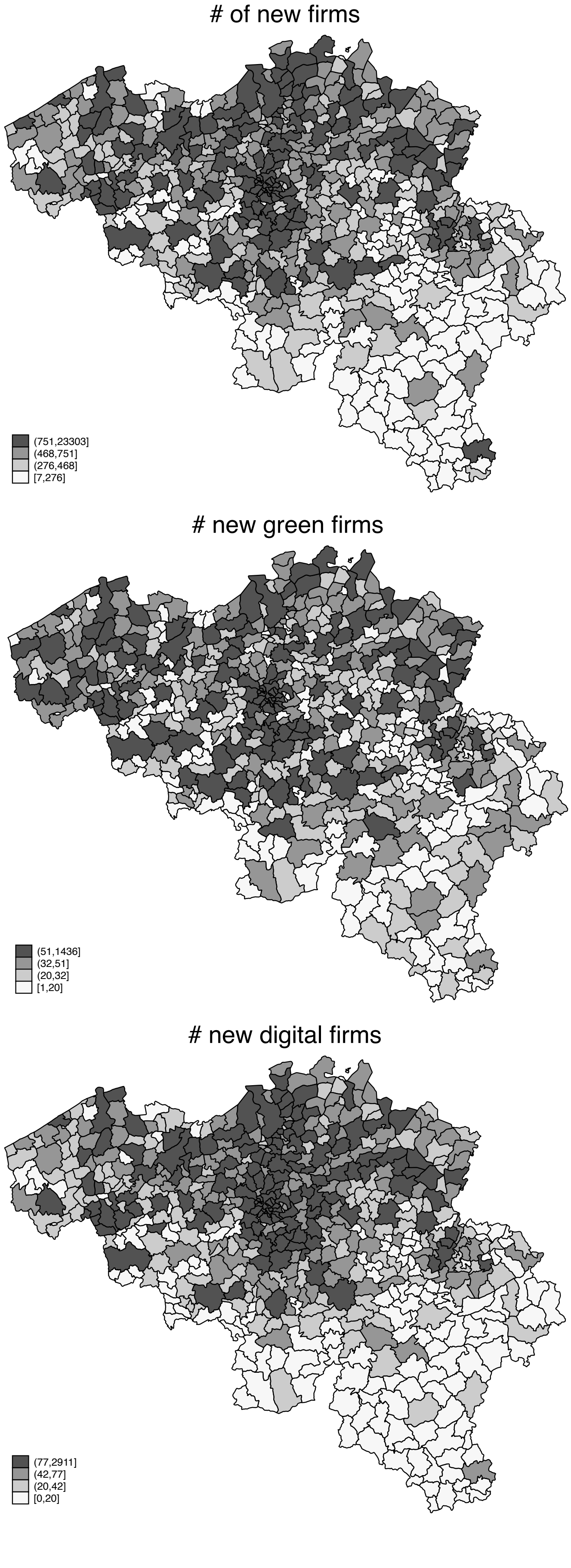

Figure 2: Sample of municipalities.

Note: The dots on the map indicate the municipalities in the sample.

Table 1: Summary statistics

Variables	*Mean*	*St. Dev.*	*Min.*	*Max.*
# new firms	1,524.93	2,998.22	77	23,303
# new firms (self-employed)	523.92	918.25	32	6,951
# new green firms	152.63	273.96	7	2,115
# new green firms (restricted version)	152.48	273.60	7	2,112
# new digital firms	169.17	380.59	4	2,911
# new green firms (OECD)	183.58	414.85	3	3,099
SC Initiatives	0.75	0.43	0.00	1.00
SC Imp. Bottom-up Low	0.22	0.42	0.00	1.00
SC Imp. Bottom-up High	0.17	0.38	0.00	1.00
SC Imp. Top-down Low	0.03	0.17	0.00	1.00
SC Imp. Top-down Intermediate	0.10	0.29	0.00	1.00
SC Imp. Top-down High	0.24	0.43	0.00	1.00
SC Orientation Sustainable	0.10	0.31	0.00	1.00
SC Orientation Digital	0.18	0.39	0.00	1.00
SC Orientation Sustainable & Digital	0.59	0.49	0.00	1.00
Pop. w. an “Haute École” degree	0.18	0.04	0.10	0.26
Pop. w. a university degree	0.07	0.04	0.02	0.21
Income	4.28	0.05	4.15	4.37
Unemployment	0.08	0.05	0.02	0.23
Pop. from EU countries	0.03	0.04	0.00	0.25
Pop. from non-EU countries	0.03	0.03	0.00	0.14
# km. of motorways	0.02	0.02	0.00	0.13
Inter-city trains	0.36	0.48	0.00	1.00
Density	0.85	1.73	0.04	14.85
# green firms	499.55	763.93	37	6,156
# digital firms	263.72	519.83	7	3,837
# firms	4,629.19	8,367.78	281	61,867
Pop. between 20 and 60	0.59	0.02	0.55	0.67
% Males in the population	0.49	0.01	0.46	0.51
Interquartile range of income (log)	4.31	0.08	4.12	4.51

Note: 105 observations. Detailed definitions of the variables can be found in Section 3.

Table 2: Level of implementation variables

	Bottom-up approaches		*Top-down approaches*		
	Low	*High*	*Low*	*Intermediate*	*High*
SC Objectives	no	no	yes	yes	yes
SC Plan	no	yes	no	yes	yes
SC Projects	1 or more	1 or more	1 or more	0	1 or more

Table 3: Basic Estimates

	# new firms			# new green firms			# new digital firms		
SC Initiatives	0.1740**			0.0365			0.3200***		
	(0.0739)			(0.0786)			(0.0985)		
SC Imp. Bottom-up Low		0.1512*			0.0109			0.2887**	
		(0.0837)			(0.0845)			(0.1128)	
SC Imp. Bottom-up High		0.2914***			0.1650*			0.4106***	
		(0.0859)			(0.0916)			(0.1021)	
SC Imp. Top-down Low		0.0236			0.0041			0.4484	
		(0.1427)			(0.1360)			(0.3290)	
SC Imp. Top-down Int.		-0.0262			-0.1111			0.1114	
		(0.1232)			(0.1184)			(0.1998)	
SC Imp. Top-down High		0.1595			-0.0052			0.3417**	
		(0.1071)			(0.1023)			(0.14511)	
SC Orientation Sust.			0.0850			-0.0049			0.0035
			(0.1291)			(0.1295)			(0.1968)
SC Orientation Dig.			0.0871			0.0647			0.1512
			(0.1324)			(0.1045)			(0.1918)
SC Orient. Sust. & Dig.			0.1363			0.0641			0.1343
			(0.1239)			(0.0988)			(0.1894)
Pop. w. HE deg.	-1.5077	-0.4839	-0.8439	-1.8307	-1.4645	-1.2383	-0.5035	-0.3085	0.7267
	(2.1191)	(2.1505)	(2.3087)	(2.1312)	(2.1815)	(2.0558)	(3.1632)	(3.3639)	(3.7213)
Pop. w. univ. deg.	4.7450**	4.8767**	3.4805**	3.7372**	4.2128**	3.6347**	3.6339**	4.5813**	2.3633
	(1.4191)	(1.4940)	(1.6483)	(1.2592)	(1.2931)	(1.2673)	(1.8169)	(2.1197)	(2.3793)
Income	257.19*	351.05**	262.67*	158.01	221.96	161.63	390.83**	471.53**	428.45**
	(131.48)	(132.74)	(139.81)	(138.57)	(149.03)	(141.544)	(172.39)	(185.19)	(186.93)
Income²	-29.94*	-40.88**	-30.65*	-18.59	-26.01	-19.01	-45.63**	-55.02**	-50.06**
	(15.42)	(15.55)	(16.38)	(16.21)	(17.42)	(16.55)	(20.18)	(21.65)	(21.88)
Unemployment	2.5283	3.1998	3.4147	-0.4351	0.1826	-0.3948	5.3665*	5.5804*	7.5295**
	(2.5893)	(2.8041)	(2.6632)	(2.6974)	(2.8397)	(2.6814)	(3.1028)	(3.2871)	(3.0806)
Pop. from EU countries	1.9249	2.3331	2.1998	0.8790	1.3304	1.1164	-2.3420	-2.1134	-2.0544
	(1.4712)	(1.4995)	(1.6117)	(1.5934)	(1.6203)	(1.5842)	(1.7915)	(1.8061)	(1.9701)
_____ non-EU countries	2.2400	2.6318	2.2714	4.2309	4.3462	4.5313	-0.6338	-0.4979	-2.2822
	(2.5399)	(2.6923)	(2.9482)	(3.0417)	(3.1404)	(3.0505)	(3.3428)	(3.6919)	(3.9401)
Motorways	3.0883*	2.6271	2.6175	4.1743**	4.0307**	3.9312**	5.9046**	5.4953**	5.9232**
	(1.6612)	(1.6175)	(1.7219)	(1.5891)	(1.6111)	(1.5918)	(2.4598)	(2.4594)	(2.8503)
Trains	0.2781***	0.2493***	0.2854***	0.2857***	0.2706***	0.2786***	0.3084***	0.3067***	0.3310***
	(0.0674)	(0.0720)	(0.7307)	(0.0777)	(0.0814)	(0.0773)	(0.0974)	(0.0977)	(0.1065)
Density	0.1835	0.2243*	0.1873	0.0024	0.0260	-0.0015	0.3279**	0.3296**	0.3414**
	(0.1296)	(0.1225)	(0.1333)	(0.1414)	(0.1380)	(0.1399)	(0.1483)	(0.1525)	(0.1495)
Density²	-0.0108	-0.0135*	-0.0110	0.0005	-0.0009	0.0005	-0.0169**	-0.0171**	-0.0177**
	(0.0073)	(0.0065)	(0.0075)	(0.0081)	(0.0079)	(0.00796)	(0.0084)	(0.0086)	(0.0085)
# Green Firms	0.0021***	0.0021***	0.0022***	0.0025***	0.0025***	0.0026***			
	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0003)			
# Green Firms²	-2.03×10^{-7}*	-1.80×10^{-7}*	-1.96×10^{-7}*	-2.20×10^{-7}***	-2.11×10^{-7}***	-2.21×10^{-7}***			
	(1.07×10^{-7})	(1.08×10^{-7})	(1.03×10^{-7})	(2.10×10^{-8})	(2.12×10^{-8})	(2.01×10^{-8})			
# Digital Firms	0.0001	0.0002	0.0004				0.0012**	0.0011*	0.0016***
	(0.0006)	(0.0006)	(0.0006)				(0.0005)	(0.0006)	(0.0006)
# Digital Firms²	-4.86×10^{-8}	-8.67×10^{-8}	-9.25×10^{-8}				-4.91×10^{-7}***	-4.66×10^{-7}***	-5.36×10^{-7}***
	(3.04×10^{-7})	(3.08×10^{-7})	(2.91×10^{-7})				(7.99×10^{-8})	(8.21×10^{-8})	(8.31×10^{-8})
# Firms	-3.35×10^{-5}	-4.23×10^{-5}	-5.69×10^{-5}*	-0.0001***	-0.0001***	-0.0001***	0.0001***	0.0001***	0.0001**
	(3.15×10^{-5})	(3.27×10^{-5})	(3.23×10^{-5})	(2.35×10^{-5})	(2.54×10^{-5})	(2.39×10^{-5})	(3.12×10^{-5})	(3.33×10^{-5})	(3.29×10^{-5})
Pop. 20-60	0.9440	0.2355	0.7010	-2.5372	-3.3542	-2.6525	3.7462	2.9852	2.3962
	(2.6334)	(2.5387)	(2.8790)	(2.6291)	(2.5422)	(2.6749)	(3.3758)	(3.4836)	(3.7474)
% Males	-19.62***	-18.91***	-19.29***	-9.45*	-9.26*	-8.95*	-27.93***	-27.88***	-28.64***
	(5.76)	(5.56)	(5.65)	(5.35)	(5.20)	(5.32)	(6.77)	(6.70)	(6.72)
Int. range of income	-0.1600	-0.6437	0.5833	-0.0827	-0.4861	-0.2610	1.2554	0.7463	1.8194
	(1.439)	(1.3850)	(1.4541)	(1.5146)	(1.4457)	(1.5758)	(1.9302)	(2.0203)	(2.1269)
LR-Test (α)	5165.58***	4936.55***	5135.38***	332.55***	306.57***	315.31***	403.18***	378.86***	485.13***
Wald test Imp. Low		0.96			0.01			4.07**	
Wald test Imp. High		7.35***			0.92			11.98***	
Wald test Imp. Bottom-up		9.50***			1.31			14.03***	
Wald test Imp. Top-down		0.81			0.01			4.62**	
AIC	1461.92	1463.66	1471.67	1013.40	1015.95	1016.94	1007.26	1011.29	1019.97

Note: The reported estimates were obtained from a negative binomial model estimated by maximum likelihood using 105 observations (Belgian municipalities). # new firms, # new green firms and # new digital firms are the dependent variables. Provincial dummy variables included but not reported. Robust standard errors in parentheses. The asterisks denote statistically significant coefficients at the 1% level (***), 5% level (**) and 10% level (*). LR-Test reports the likelihood ratio statistic of the null hypothesis that the overdispersion parameter of the negative binomial model (α) is zero. AIC reports the value of the Akaike's information criterion score. See footnote 15 for a description of the Wald tests reported. The number of observations is 105 (Belgian municipalities). Detailed definitions of the variables can be found in Section 3.

Table 4: Robustness tests

Panel A. Alternative definitions of the rates of entrepreneurship			
	Self-employed	# new green firms (Restricted)	# new digital firms (OECD)
SC Initiatives	0.1297*	0.0362	0.3297***
	(0.0665)	(0.0786)	(0.0988)
SC Imp. Bottom-up Low	0.1132	0.0097	0.2893**
	(0.0779)	(0.0876)	(0.1119)
SC Imp. Bottom-up High	0.2227***	0.1651*	0.4311***
	(0.0801)	(0.0916)	(0.1071)
SC Imp. Top-down Low	-0.0215	0.0045	0.4592*
	(0.1247)	(0.1360)	(0.3321)
SC Imp. Top-down Int.	0.0059	-0.1109	0.1093
	(0.1172)	(0.1183)	(0.1959)
SC Imp. Top-down High	0.0979	-0.0047	0.3676***
	(0.0941)	(0.1023)	(0.1481)
SC Orientation Sustainable	0.1001	-0.0050	0.0548
	(0.1183)	(0.1295)	(0.1958)
SC Orientation Digital	0.0497	0.0651	0.1862
	(0.1133)	(0.1046)	(0.1898)
SC Orientation Sust. & Dig.	0.0951	0.0645	0.1871
	(0.1114)	(0.0989)	(0.1886)

Panel B. Weighted estimates (inverse of population)						
	# new firms		# new green firms		# new digital firms	
	Direct Effect	×Pop. Dummy	Direct Effect	×Pop. Dummy	Direct Effect	×Pop. Dummy
SC Initiatives	0.1705**	-0.0197	0.0370	-0.0086	0.2820***	0.3713***
	(0.0742)	(0.1540)	(0.0806)	(0.1693)	(0.1025)	(0.1327)
SC Imp. Bottom-up Low	0.1165	0.1645	-0.0392	0.2236	0.2294*	0.4139*
	(0.0885)	(0.2039)	(0.0877)	(0.1891)	(0.1232)	(0.2152)
SC Imp. Bottom-up High	0.3265***	-0.1118	0.2125**	-0.2810	0.4421***	0.0740
	(0.0912)	(0.2547)	(0.0927)	(0.2745)	(0.1104)	(0.2449)
SC Imp. Top-down Low	-0.1515	0.4876	-0.0569	0.1781	-0.3160*	1.4261***
	(0.1794)	(0.3276)	(0.1637)	(0.3466)	(0.1811)	(0.2464)
SC Imp. Top-down Int.	-0.0886	0.2174	-0.1321	0.0175	-0.1141	0.5657
	(0.1308)	(0.2794)	(0.1319)	(0.2280)	(0.2405)	(0.3718)
SC Imp. Top-down High	0.1979*	-0.1272	0.0110	-0.0287	0.3161*	0.2860
	(0.1193)	(0.1966)	(0.1131)	(0.2443)	(0.1640)	(0.1841)
SC Orientation Sustainable	0.1343	-0.0949	-0.0129	0.0802	-0.0926	0.4968**
	(0.1328)	(0.2296)	(0.1393)	(0.2291)	(0.1942)	(0.2388)
SC Orientation Digital	0.0753	0.2219	0.0549	0.0602	0.1211	0.7942***
	(0.1332)	(0.2862)	(0.1051)	(0.2787)	(0.1959)	(0.2675)
SC Orientation Sust. & Dig.	0.1345	0.0452	0.0470	0.1170	0.1677	0.3066*
	(0.1374)	(0.1929)	(0.1054)	(0.1731)	(0.2104)	(0.1834)

Panel C. Endogeneity of the SC initiatives						
	# new firms		# new green firms		# new digital firms	
	CF	GMM	CF	GMM	CF	GMM
SC Initiatives	0.8033***	0.8264***	0.5585***	0.6383**	1.0903***	1.2287***
	(0.1890)	(0.2715)	(0.2009)	(0.2861)	(0.2790)	(0.3435)
SC Implementation Bottom-up Low	0.2806	0.2941	0.5625	0.3725	0.2360	0.5633
	(0.4853)	(0.4537)	(0.3619)	(0.5095)	(0.4888)	(0.4900)
SC Implementation Bottom-up High	3.0120*	1.5574**	0.6511*	1.0530	4.4149**	1.7772**
	(1.5688)	(0.8054)	(0.3734)	(0.7090)	(1.8654)	(0.7775)
SC Implementation Top-down Low	1.3150	1.1537	-0.1852	0.5829	1.4712	1.9639
	(2.1991)	(5.0356)	(0.8009)	-13.370	(1.0471)	(4.4221)
SC Implementation Top-down Intermediate	22.013	1.1805	0.3285	0.6099	2.0956*	1.4120
	(1.3792)	(0.9249)	(0.4295)	(0.7712)	(1.2011)	(0.9495)
SC Implementation Top-down High	0.6250	0.4120	-0.0819	0.2394	0.7145	0.8274*
	(0.5645)	(0.4802)	(0.3583)	(0.3725)	(0.4723)	(0.4633)
SC Orientation Sustainable	0.4281	0.2236	-0.3409	-0.2455	0.1270	-0.1283
	(0.5909)	(0.4917)	(0.5507)	(0.5428)	(0.5851)	(0.7029)
SC Orientation Digital	5.6900	1.4616	3.0169	1.1525	20.70	1.0634
	(12.45)	(1.0906)	(3.0510)	(0.9340)	(16.70)	(1.3029)
SC Orientation Sustainable & Digital	1.7693**	1.0179	0.9625	0.4361	1.2235*	0.5402
	(0.7665)	(0.6963)	(0.7644)	(0.8405)	(0.7445)	(0.8886)
Hansen J-test	7.10, 3.89, 4.11		12.44, 6.71, 9.01		9.22, 1.70, 6.01	
Endogeneity test	2.68**, 12.28**, 2.68		-2.45**, 6.00, 3.60		3.12***, 9.48*, 1.03	

Note: Estimates reported in Panel A were obtained from a negative binomial model estimated by maximum likelihood (robust standard errors in parentheses). Estimates reported in Panel B were obtained from a negative binomial model estimated by maximum likelihood weighted using the inverse of the population of the municipality (robust standard errors in parentheses). Estimates reported in Panel C were obtained from a negative binomial model estimated using a control function approach (columns CF, with bootstrapped standard errors and 250 replications) and an exponential conditional mean model with multiplicative errors weighted using the inverse of the population of the municipality and estimated by GMM (columns GMM, robust standard errors in parentheses), being the instruments polynomials of share of parks and gardens, the share of sport areas, and the number of parties (see footnote 14 for details). The endogeneity test corresponds to the null significance test of the residuals of the first-stage regression: a *t*-test for the SC initiatives dummy (first reported value) and Wald tests for level of implementation (second value) and orientation dummies (third value). The asterisks denote statistically significant values at the 1% level (***), 5% level (**) and 10% level (*). The number of observations is 105 (Belgian municipalities). Detailed definitions of the variables can be found in Section 3.