

The role of relatedness in firm interrelationships

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Abstract

Purpose – This paper analyses how firm births and deaths are influenced by previous firm births and deaths in related and unrelated sectors. Competition and multiplier effects are used as the theoretical lens for this analysis.

Design/methodology/approach – This paper uses 2008–2016 Irish business demography data pertaining to 568 NACE 4-digit sectors within 20 NACE 1-digit industries across 34 Irish county and sub-county regions within 8 NUTS3 regions. A three-stage least squares (3SLS) estimation is used to analyse the impact of past firm deaths (births) on future firm births (deaths). The effect of relatedness on firm interrelationships is explicitly modelled and captured.

Findings – Findings indicate that the multiplier effect operates mostly through related sectors, while the competition effect operates mostly through unrelated sectors.

Research limitations/implications – This paper's findings show that firm interrelationships are significantly influenced by the degree of relatedness between firms. The raw data used to calculate firm birth and death rates in this analysis are count data. Each new firm is measured the same as another regardless of differing features like size. Some research has shown that smaller firms have a greater propensity to create entrepreneurs (Parker, 2009). Thus, it is possible that the death of differently sized firms may contribute differently to multiplier effects where births induce further births. Future research could seek to examine this.

Practical implications – These findings have implications for policy initiatives concerned with increasing entrepreneurship. Some express concerns that public investment into entrepreneurship can lead to “crowding out” effects (Cumming and Johan, 2019), meaning that public investment into entrepreneurship could displace or reduce private investment into entrepreneurship (Audretsch and Fiedler, 2023; Zikou *et al.*, 2017). This study's findings indicate that using public investment to increase firm births could increase future firm births in related and unrelated sectors. However, more negative “crowding out” effects may also occur in unrelated sectors, meaning that public investment which stimulates firm births in a certain sector could induce firm deaths and crowd out entrepreneurship in unrelated sectors.

Originality/value – This paper is the first in the literature to explicitly account for the role of relatedness in firm interrelationships.

Keywords Relatedness, Firm births, Firm deaths, Firm interrelationships, Three-stage least squares

Paper type Research paper

1. Introduction

Firm interrelationships are instances where firm births/deaths influence future rates of firm births/deaths, see Calá *et al.* (2016) and Carree *et al.* (2011). Johnson and Parker (1994) provide a substantive theoretical framework through which these firm interrelationships can be viewed by examining the existence of multiplier and competition effects. When firm births induce future firm births (and reduce firm deaths) or when firm deaths induce future firm deaths (and reduce firm births), multiplier effects are present (Lu *et al.*, 2008; Resende *et al.*, 2015). Whereas, when firm births induce future firm deaths (and reduce firm births) or when firm deaths induce future firm births (and reduce firm deaths), competition effects are present

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(Carree *et al.*, 2011; Pe'er and Vertinsky, 2008) [1]. The objective of this paper is to build on existing firm interrelationship work by analysing how competition and multiplier effects are influenced by firm births and deaths from related and unrelated sectors.

Little evidence exists regarding the role which relatedness plays in influencing firm interrelationships. However, economic theory suggests relatedness could influence both the competition and multiplier effect. Beginning with the competition effect, this stipulates that firm births can increase future firm deaths via competitive pressures (Gajewski and Kutun, 2018). The level of similarity between firms is considered a key factor in determining rivalry (Dejardin, 2004). Therefore, firm births from related sectors may increase future firm deaths through competitive pressure due to increased rivalry. However, non-related firms can also compete for versatile resources (Markman *et al.*, 2009). As a result, firm births from unrelated sectors could also increase future firm deaths. This effect could also occur when firm deaths increase future firm births (Lu *et al.*, 2008). For example, when firm deaths increase the available “market room” in a given industry, this could incentivise future firm births (Carree and Dejardin, 2020). Logic would dictate that a firm death in a certain industry would free up market room in that same industry. Therefore, firm deaths from related sectors may increase future firm births. Multiplier effects could also be influenced by relatedness. Firm births (or deaths) can increase future firm births (or deaths) via demonstration effects where the birth or death of a firm signals the value/difficulty associated with owning a firm (Dejardin, 2004). Meaning firm births could incentivise individuals to start businesses of their own (Nyström, 2007) and firm deaths could incentivise business owners to exit the market (Bartoloni *et al.*, 2020). These demonstration effects are clearly dependent on relatedness because the economic value (or lack thereof) communicated by a firm being born (or dying) is obviously most applicable to other related firms.

Most studies of firm interrelationships, such as Arcuri *et al.* (2019), Gajewski and Kutun (2018) and Carreira and Teixeira (2011) do not consider the role of similarity/relatedness between firms. They analyse the degree to which firm births (deaths) impact future firm deaths (births) for the economy as a whole or for a specific sector. Dejardin (2004) and Carree *et al.* (2011) are two rare exceptions. They analyse how lagged firm births/deaths affect future firm births/deaths in the same and other sectors. For example, Dejardin (2004) examines how firm births in NACE sector 501 (trade of motor vehicles) are influenced by lagged births and deaths in that sector as well as in other sectors (which may be related or unrelated). While this approach accounts for firm sector, it doesn't account for relatedness between sectors. Carree *et al.* (2011) adopt a similar method examining how firm deaths in one industry (e.g. textiles) are influenced by lagged births and deaths in the same industry and in other industries. This approach also doesn't account for degrees of relatedness. Dejardin (2004) calls for future research to focus on designing a more detailed analytical framework to account for complementarities between economic activities. This is echoed by Guo *et al.* (2016) who assert that few entrepreneurial studies accurately measure technological relatedness despite relatedness between firms influencing complementary or competitive effects. This paper significantly contributes to the existing literature by examining whether the degree of relatedness between firms influences future firm births/deaths.

This is done by developing and explicitly accounting for related firm birth and death rate variables which can indicate how firm births/deaths in related sectors (same NACE-1 industry) and unrelated sectors (different NACE-1 industry) influence future firm births/deaths. Thus, our analysis significantly builds on previous examinations of firm interrelationships between sectors by Dejardin (2004) and Carree *et al.* (2011) and provides extremely novel results which have never been produced in the literature previously. The results of this analysis can provide important implications for the direction of investments in industrial policy supports for start-ups by development agencies organisations. To conduct the analysis a three stage least squares (3SLS) estimation is performed using the Central Statistics Office (CSO) of Ireland's business demography dataset from years 2008–2016. This

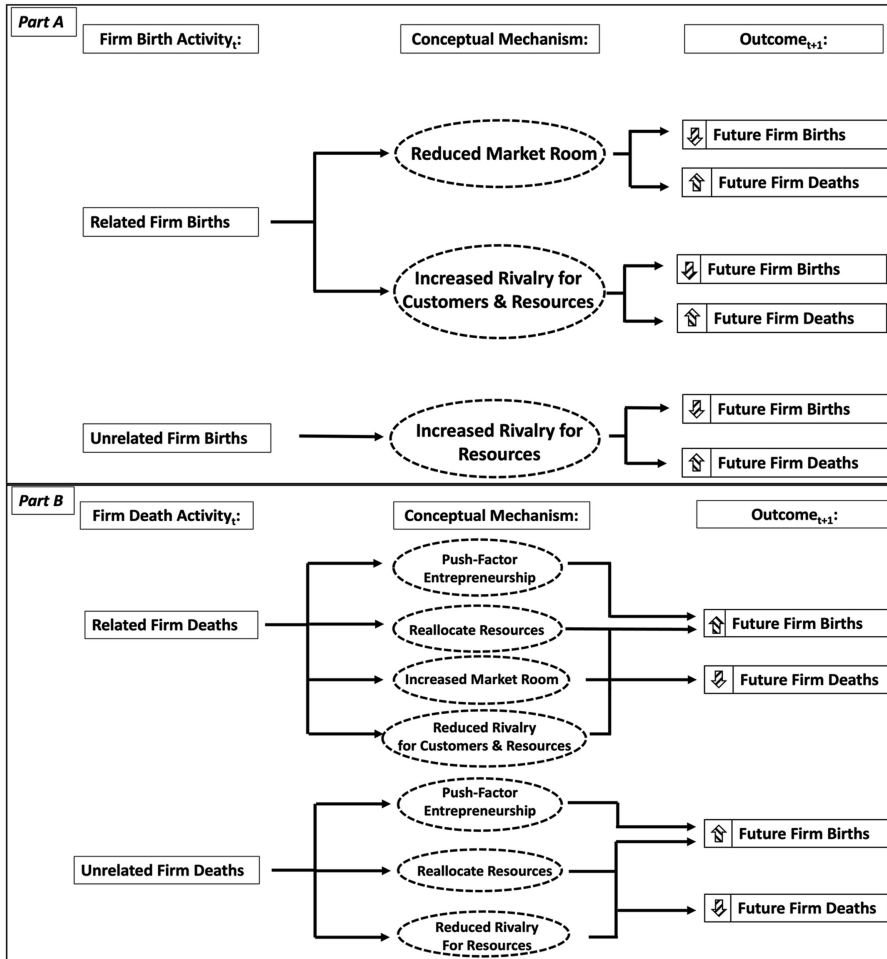
2. Literature review

The two key effects which will be examined in this analysis are the competition and multiplier effects originally set forth by Johnson and Parker (1994). This literature review will provide conceptual reasoning for why relatedness between firms would impact the mechanisms underpinning the competition and multiplier effects. We refer to relatedness here in the same way Frenken *et al.* (2007) refer to it in their related and unrelated variety framework. Meaning relatedness refers to cognitive proximity in a firm's operations (Crowley *et al.*, 2021). Cognitive proximity refers to the level of similarity between firms in terms of their knowledge bases and economic interests (O'Connor *et al.*, 2021; Criscuolo *et al.*, 2018; Boschma, 2005). Firms which are cognitively approximate to each other may find it easier to learn from and interact with one another (Molina-Morales *et al.*, 2014; Boschma, 2005) [2].

2.1 Competition effects and relatedness

We summarise the conceptual arguments made for relatedness influencing competitions effects in Figure 1. As per the definition of the competition effect, firm births should increase future firm deaths and decrease future firm births (Johnson and Parker, 1994). Conceptually, this can occur when firm births increase rivalry and the demand for valuable inputs which increases future firm deaths and decreases future births (Brixy, 2014; Cainelli *et al.*, 2014). This competitive mechanism is dependent on rivalry existing between firms, so it would be expected that firm births in related industries would increase competition and induce future firm deaths. However, rivalry can also occur between unrelated firms because firms can compete with each other at various points in the supply chain due to versatile resources (Nason and Wiklund, 2018; Porter, 2011). Some resources are idiosyncratic to certain firms (Miller, 2003), but others like administrative infrastructure and human capital can be used by unrelated firms (Markman *et al.*, 2009). Thus, it could be expected that firm births in unrelated industries increase competition which induces future firm deaths. Both processes are demonstrated in Figure 1 (Part A) by relating increased rivalry for resources and customers to increased future firm births and decreased future firm deaths.

Additionally, the competition effect should see firm deaths increase future firm births and decrease future firm deaths (Johnson and Parker, 1994). This can occur via four different mechanisms which include changes to market room, reduced rivalry, the reallocating of resources, and necessity-based entrepreneurship. As is shown in Figure 1 (Part B) firm deaths in related industries should increase "market room" which could increase future firm births and decrease future firm deaths (Carree and Dejardin, 2020). Conceptually, this process should operate via related industries. The industry in which the firms deaths took place is the industry where the "room" has been increased. Regarding the influence of reduced rivalry, firm deaths should decrease competition and demand for key inputs which should reduce future firm deaths (Cainelli *et al.*, 2014; Dejardin, 2004). As has already been discussed, rivalry for resources can exist between related and unrelated firms (Markman *et al.*, 2009; Porter, 2011). Thus, as is illustrated in Figure 1 (Part B) firm deaths in related or unrelated industries could reduce competition for resources and decrease future firm deaths and increase future firm births. Firm deaths also reallocate resources back into the economy where they can be used by others to start firms (Brown *et al.*, 2013; Nyström, 2007). The versatility of resources could mean that, as is illustrated in Figure 1 (Part B), firm deaths in related or unrelated industries could reallocate resources which could result in increased future firm births and



Note(s): Figure 1 above relates to hypotheses concerning the competition effect (hypotheses H1a, H1b, and H1c)

Source(s): Author’s own work

Figure 1.
The role of relatedness in the competition effect

decreased future firm deaths. Finally, firm deaths can induce unemployment which motivates individuals to pursue necessity-based entrepreneurship which increases firm births (Block *et al.*, 2015; O’Leary, 2022). Some entrepreneurs will look to start firms in industries that are related to their employment experience (Cooper and Dunkelberg, 1986; Feeser, 1987), but others may not (Astebro and Thompson, 2011), meaning that, as is shown in Figure 1 (Part B), firm deaths in related or unrelated industries could induce push-factor entrepreneurship leading to an increase in future firm births. Given the above theoretical arguments, we propose the following three hypotheses:

H1a. Firm births (deaths) should increase future firm deaths (births) and decrease firm births (deaths).

- H1b. Related firm births (deaths) should increase future firm deaths (births) and decrease future firm births (deaths).
- H1c. Unrelated firm births (deaths) should increase future firm deaths (births) and decrease future firm births (deaths).

2.2 Multiplier effects and relatedness

We summarise the conceptual arguments made for relatedness influencing multiplier effects in Figure 2. According to the multiplier effect, firm births should increase future firm births (and decrease future firm deaths); and firm deaths should increase future firm

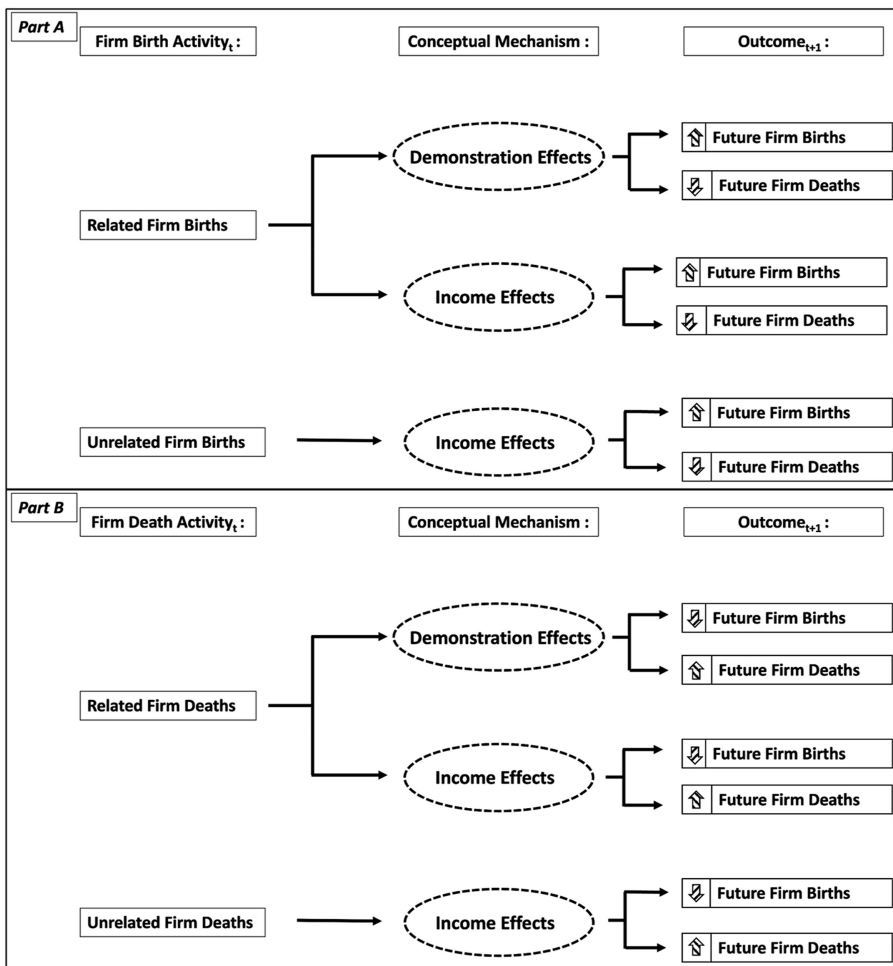


Figure 2.
The role of relatedness
in the multiplier effect

Note(s): Figure 2 above relates to hypotheses concerning the multiplier effect (hypotheses H2a, H2b, and H2c)

Source(s): Author's own work

deaths (and decrease future firm births) (Johnson and Parker, 1994). These results can occur via two mechanisms; demonstration/signalling effects (Dejardin, 2004) and income effects (Gajewski and Kutan, 2018). Signalling/demonstration effects occur when firm births signal the value associated with a firm and incentivise more firm births and disincentivise firm deaths (Nyström, 2007). Conversely, firm deaths could signal a lack of value which may incentivise business owners to exit the market (Bartoloni *et al.*, 2020) and disincentivise others from entering the market (Dejardin, 2004). Demonstration effects are dependent on relatedness because the economic value (or difficulty) communicated by a firm being born (or dying) is most applicable to other related firms. This is illustrated in Figure 2 (Parts A & B) where only firm births and deaths in related industries are shown to induce demonstration effects.

However, income effects provide a conceptual argument for multiplier effects occurring across any industry. Income effects occur when firm births increase levels of income/demand and thus increase future firm births (and decrease future firm deaths) to meet this new level of demand (Gajewski and Kutan, 2018; Sutaria and Hicks, 2004). The same process can increase future firm deaths (and decrease future firm births) as a result of firm deaths lowering income/demand. Individuals spend their incomes on a wide variety of goods and services (Chai *et al.*, 2015) which means income from one sector could theoretically influence the income of any other sector (Conrad, 1955). This is illustrated in Figure 2 (Parts A & B) where both related and unrelated firm births and deaths are shown to induce income effects. Therefore, we investigate the following three hypotheses:

- H2a.* Firm births (deaths) should increase future firm births (deaths) and decrease future firm deaths (births).
- H2b.* Related firm births (deaths) should increase future firm births (deaths) and decrease future firm deaths (births).
- H2c.* Unrelated firm births (deaths) should increase future firm births (deaths) and decrease future firm deaths (births).

3. Data and methods

The data for this study is business demography (2008–2016) data from the Central Statistics Office (CSO) of Ireland. We examine firm births and deaths across 568 NACE 4-digit sectors embedded in 20 different NACE 1-digit sectors pertaining to 34 regions embedded within 8 NUTS3 regions [3]. We produce fixed effects for the aggregated NUTS 3 regions to provide informative geographical results.

3.1 Constructed variables

The firm birth (death) variable is constructed by dividing the count of firm births (deaths) in year t by the total stock of businesses in year $t-1$. A firm is considered born if it engages in a combination of production factors, e.g. generating revenue, employing people or investing in capital [4]. A firm death occurs given the dissolution of these production factors (CSO, 2022). The firm birth and death variables are calculated in the same manner as Nyström (2007), Carree *et al.* (2011), and Resende *et al.* (2015) to capture the intertemporal elements of firm interrelationships. The notation for the construction of these two variables can be seen below in equations (1) and (2).

$$Firm\ Births_{sjt} = \frac{BirthCount_{sjt}}{Stock_{sjt-1}} \quad (1)$$

$$FirmDeaths_{sjt} = \frac{DeathCount_{sjt}}{Stock_{sjt-1}} \quad (2)$$

Where $FirmBirths_{sjt}$ is the count of firm births in NACE 4-digit sector s in region j in year t divided by the total count of firms (i.e. stock) in sector s in region j in year $t-1$. $DeathCount_{sjt}/Stock_{sjt-1}$ is the count of firm deaths in NACE 4-digit sector s in region j in year t divided by the total count of firms (i.e. stock) in sector s in region j in year $t-1$. We also construct variables which measure firm births and deaths in related or unrelated sectors. The first of these can both be seen below in [equation \(3\)](#) and [\(4\)](#).

$$FirmBirths_{skjt} = \frac{BirthCount_{skjt}}{Stock_{skjt-1}} \quad (3)$$

$$FirmDeaths_{skjt} = \frac{DeathCount_{skjt}}{Stock_{skjt-1}} \quad (4)$$

Where $FirmBirths_{skjt}$ is the firm births in NACE 1-digit sector sk in region j in year t divided by the total count of firms (i.e. stock) in sector sk in region j in year $t-1$. Sector sk is number of firm births which occurred in the remaining NACE 4-digit sectors within a NACE 1 digit sector. $FirmDeaths_{skjt}$ is the count of firm deaths in NACE 1-digit sector sk in region j in year t divided by the total count of firms (i.e. stock) in sector sk in region j in year $t-1$. The value of sk is the sum of firm births (or deaths) in related sectors. In addition to the related sector firm birth and firm death rate measures, we also develop unrelated variety-based ones as seen below in [equations \(5\)](#) and [\(6\)](#).

$$FirmBirths_{s-skjt} = \frac{BirthCount_{s-skjt}}{Stock_{s-skjt-1}} \quad (5)$$

$$FirmDeaths_{s-skjt} = \frac{DeathCount_{s-skjt}}{Stock_{s-skjt-1}} \quad (6)$$

Where $FirmBirths_{s-skjt}$ is the count of firm births in the remaining sectors of the economy after the firm births in the NACE 1-digit sector sk are subtracted from the total firm births in all sectors in region j in year t divided by the total count of firms (i.e. stock) in these sectors ($s-sk$) in region j in year $t-1$. The value of $s-sk$ is the sum of firm births in unrelated sectors. $FirmDeaths_{s-skjt}$ is notated similarly but for the case of firm deaths.

To measure industrial concentration and specialisation, we use the Herfindahl index and location quotient (LQ) variable respectively using standard measurements consistent with [Power et al. \(2019\)](#) and [Antonietti and Cainelli \(2011\)](#). Additionally, to indicate levels of industrial diversification related and unrelated variety variables are calculated in line with [Frenken et al. \(2007\)](#). Precise discussion around these variables and their calculations are provided in [Appendix 4](#). Summary statistics for this study can be viewed in [Table 1](#) below. [Appendix 5](#) presents the correlation matrix between our variables.

3.2 Method of estimation

We use the three stages least squares (3SLS) methodology to estimate a system of firm birth and death equations while mitigating against potential endogeneity issues ([Abdallah et al., 2015](#)). Our use of lagged dependent variables as explanatory variables raises concerns of endogeneity where an independent variable may be influenced by a dependent variable ([Abdallah et al., 2015](#)). Specifically, this analysis may be vulnerable to simultaneity endogeneity ([Wooldridge, 2010](#)). Simultaneity can render the estimation of the impact of the

Variable	N	Mean	Std. dev	Min	Max
Firm Birth Rate _t	82,383	0.11	0.22	0.00	7.00
Firm Death Rate _t	82,383	0.08	0.24	0.00	4.00
Firm Birth Rate _{t-1}	82,383	0.11	0.24	0.00	6.33
Firm Death Rate _{t-1}	82,383	0.08	0.14	0.00	3.00
Related Firm Birth Rate _{t-1}	82,383	0.10	0.06	0.00	5.00
Related Firm Death Rate _{t-1}	82,383	0.09	0.03	0.00	1.00
Unrelated Firm Birth Rate _{t-1}	82,383	0.10	0.03	0.04	0.22
Unrelated Firm Death Rate _{t-1}	82,383	0.09	0.01	0.06	0.14
Log of Population Density	82,383	4.73	1.65	3.05	8.42
HHI	82,383	119.17	73.34	2.00	253.23
RV	82,383	0.14	0.20	0.00	0.75
UV	82,383	-9.80	2.95	-16.72	-2.32
Log of Average Firm Size	82,383	1.18	1.25	-3.36	9.22
Log of Income per person	82,383	10.10	0.13	9.81	10.42
LQ	82,383	1.69	4.76	0.00	124.48

Note(s): Further discussion on the defining of these variables and their calculations are provided in [Section 3](#) and in [Appendix 4](#)

Source(s): Author's own work

Table 1. Summary statistics for variables in estimations

independent variable (X) on the dependent variable (Y) biased because there is a reciprocal relationship between X and Y ([Hill et al., 2021](#)). Given the conceptual basis for firm interrelationships is that firm births or deaths can influence other firm births or deaths ([Nyström, 2007](#); [Johnson and Parker, 1994](#)), it could be assumed that there is a simultaneous relationship between the X and Y in this paper's analysis. If endogeneity of this form is present, single equation methods such as two stage least squares (2SLS) can be considered preferable to OLS estimation ([Bollen et al., 2007](#)). However, 2SLS does not correct for correlation between the error terms in a structural equations system because each equation is estimated individually ([Kaplan, 1988](#)). Given that this paper analyses how firm interrelationships determine both firm births and deaths, a full system estimation method like 3SLS estimation is more appropriate because it corrects for endogeneity and estimates all the parameters jointly ([Abdallah et al., 2015](#); [Zellner and Theil, 1992](#)). Endogeneity can be accounted for via the use of instrumental variables in a 3SLS estimation. We construct synthetic instrumental variables for all the firm birth and firm death rate variables via Bartlett's three group method ([Bartlett, 1949](#)). This method takes the endogenous variable and creates an instrumental variable which is coded as either "-1", "0" or "1" depending on whether the value of the endogenous variable falls in the lower (-1), middle (0) or upper (1) third of the variable's distribution. This produces a suitable instrumental variable as per the criterion mentioned by [Le Gallo and Pérez \(2013\)](#). Meaning the instrument is still somewhat correlated with the endogenous variable (allowing it to function well as an estimator) but is less correlated with the endogenous variable (thus mitigating endogeneity issues). This technique was originally used to account for omitted variable bias ([Hanushek et al., 1996](#)), but has become a widely used method for dealing with endogeneity – see [Bahlous-Boldi \(2021\)](#), [Doran and Fingleton \(2016\)](#) and [Angeriz et al. \(2008\)](#).

We specify three sets of simultaneous equations systems to test our hypotheses. Each system models firm births (deaths) as a function of lagged firm births and deaths. Firstly, we estimate a model similar to the models used by [Arcuri et al. \(2019\)](#) and [Gajewski and Kutan \(2018\)](#) examining how future firm birth/death activity (t) is determined by past firm birth or death activity ($t-1$) with no emphasises on relatedness/unrelatedness. This model is estimated below in [equations \(7\) and \(8\)](#).

$$FirmBirths_{s_{jt}} = \alpha_1 FirmBirths_{s_{jt-1}} + \alpha_2 FirmDeaths_{s_{jt-1}} + \alpha_3 X_{s_{jt}} + \varepsilon_t \quad (7)$$

$$FirmDeaths_{s_{jt}} = \beta_1 FirmBirths_{s_{jt-1}} + \beta_2 FirmDeaths_{s_{jt-1}} + \beta_3 X_{s_{jt}} + \varepsilon_t \quad (8)$$

These represent the first of our firm births and deaths models. Where $FirmBirths_{s_{jt}}$ and $FirmDeaths_{s_{jt}}$ are the firm birth and death rate respectively in sector s , year t and region j . $X_{s_{jt}}$ represents a matrix of control variables including industrial factors and socioeconomic controls. ε represents the error term. Secondly, we build upon this models (7) and (8) where we look to see how future firm births and deaths in a given sector (notated $FirmBirths_{s_{jt}}$, $FirmDeaths_{s_{jt}}$) are determined by lagged firm births and deaths in related sectors (sk) (notated $FirmBirths_{skjt-1}$; $FirmDeaths_{skjt-1}$) as well as the sector specific lagged firm birth and death rate variables (notated $FirmBirths_{s_{jt-1}}$; $FirmDeaths_{s_{jt-1}}$) from equations (7) and (8). This model can be seen below in equations (9) and (10).

$$FirmBirths_{s_{jt}} = \alpha_1 FirmBirths_{s_{jt-1}} + \alpha_2 FirmDeaths_{s_{jt-1}} + \alpha_3 FirmBirths_{skjt-1} + \alpha_4 FirmDeaths_{skjt-1} + \alpha_5 X_{s_{jt}} + \varepsilon_t \quad (9)$$

$$FirmDeaths_{s_{jt}} = \beta_1 FirmBirths_{s_{jt-1}} + \beta_2 FirmDeaths_{s_{jt-1}} + \beta_3 FirmBirths_{skjt-1} + \beta_4 FirmDeaths_{skjt-1} + \beta_5 X_{s_{jt}} + \varepsilon_t \quad (10)$$

Finally, we build on models (9) and (10) by adding in lagged firm birth and death rates of firms which are in unrelated sectors $s-sk$. $FirmBirths_{s-skjt}$ and $FirmDeaths_{s-skjt}$ represent the firm birth and death rates respectively in unrelated sectors to the NACE 1-digit sectors. Equations (11) and (12) also include all variables from models (9) and (10).

$$FirmBirths_{s_{jt}} = \alpha_1 FirmBirths_{s_{jt-1}} + \alpha_2 FirmDeaths_{s_{jt-1}} + \alpha_3 FirmBirths_{skjt-1} + \alpha_4 FirmDeaths_{skjt-1} + \alpha_5 FirmBirths_{s-skjt-1} + \alpha_6 FirmDeaths_{s-skjt-1} + \alpha_7 X_{jt} + \varepsilon_t \quad (11)$$

$$FirmDeaths_{s_{jt}} = \beta_1 FirmBirths_{s_{jt-1}} + \beta_2 FirmDeaths_{s_{jt-1}} + \beta_3 FirmBirths_{skjt-1} + \beta_4 FirmDeaths_{skjt-1} + \beta_5 FirmBirths_{s-skjt-1} + \beta_6 FirmDeaths_{s-skjt-1} + \beta_7 X_{jt} + \varepsilon_t \quad (12)$$

4. Results

The estimates of equations (7) and (8) are shown in the columns labelled I and II in Table 2 and show that both the multiplier and competition effect appear to influence firm births. Specifically, firm births are increased by both lagged firm births and deaths. This provides some support for both H1a and H2a. Conceptually, the multiplier effect could be attributable to income or demonstration effects (Dejardin, 2004; Gajewski and Kutan, 2018). Meanwhile the competition effect could be attributable to push-factor entrepreneurship or increased market room (O'Leary, 2022; Saridakis et al., 2016). Regarding firm deaths, the results support the competition effect. Firm deaths are increased by lagged firm births and decreased by lagged firm deaths. This provides support for H1a. This could be attributable to firm births increasing competitive pressures and inducing firm deaths as is suggested by Cefis et al. (2020) and Audretsch (1995) when referring to the displacement effect and firm deaths alleviating these same competitive pressures. These results match the results of Calá et al.

Variables	I Firm births (Eqn. 7)	II Firm deaths (Eqn. 8)	III Firm births (Eqn. 9)	IV Firm deaths (Eqn. 10)	V Firm births (Eqn. 11)	VI Firm deaths (Eqn. 12)
Firm Birth Rate _{t-1}	0.0873*** (0.0033)	0.0337*** (0.0025)	0.0869*** (0.0033)	0.0336*** (0.0025)	0.0851*** (0.0033)	0.0332*** (0.0025)
Firm Death Rate _{t-1}	0.0315*** (0.0055)	-0.0421*** (0.0041)	0.0315*** (0.0055)	-0.0421*** (0.0041)	0.0309*** (0.0054)	-0.0422*** (0.0041)
Related Firm Birth Rate _{t-1}			0.0494*** (0.0143)	0.0083 (0.0107)	0.0114 (0.0146)	0.0006 (0.0109)
Related Firm Death Rate _{t-1}			-0.0397 (0.0275)	0.0079 (0.0205)	-0.0577** (0.0275)	0.0043 (0.0206)
Unrelated Firm Birth Rate _{t-1}					0.5822*** (0.0551)	0.1199*** (0.0412)
Unrelated Firm Death Rate _{t-1}					0.3013** (0.1405)	0.0498 (0.1051)
Log of Population Density	0.0056*** (0.0007)	0.0041*** (0.0005)	0.0055*** (0.0007)	0.0040*** (0.0005)	0.0021*** (0.0008)	0.0033*** (0.0006)
HHI	-0.0000 (0.0000)	0.0000 (0.0000)	-0.0000 (0.0000)	0.0000 (0.0000)	-0.0000 (0.0000)	0.0000 (0.0000)
LQ	0.0008*** (0.0002)	0.0001 (0.0001)	0.0008*** (0.0002)	0.0001 (0.0001)	0.0007*** (0.0002)	0.0001 (0.0001)
RV	-0.0196*** (0.0071)	0.0059 (0.0053)	-0.0197*** (0.0071)	0.0059 (0.0053)	-0.0197*** (0.0071)	0.0059 (0.0053)
UV	-0.0001 (0.0004)	-0.0006* (0.0003)	-0.0002 (0.0004)	-0.0006** (0.0003)	-0.0012*** (0.0004)	-0.0008*** (0.0003)
Log of Income per person	-0.0266* (0.0148)	0.0007 (0.0111)	-0.0263* (0.0148)	0.0007 (0.0111)	-0.0182 (0.0149)	0.0024 (0.0112)
Log of Average Firm Size	-0.0246*** (0.0007)	-0.0192*** (0.0005)	-0.0246*** (0.0007)	-0.0192*** (0.0005)	-0.0242*** (0.0007)	-0.0191*** (0.0005)
B- Mining and Quarrying (Reference Category)	0.0303*** (0.0081)	0.0101* (0.0061)	0.0304*** (0.0081)	0.0101* (0.0061)	0.0282*** (0.0081)	0.0096 (0.0061)
C- Manufacturing						

(continued)

Table 2.
3SLS estimation
results

Variables	I Firm births (Eqn. 7)	II Firm deaths (Eqn. 8)	III Firm births (Eqn. 9)	IV Firm deaths (Eqn. 10)	V Firm births (Eqn. 11)	VI Firm deaths (Eqn. 12)
D – Electricity, Gas, Steam and Air Conditioning Supply	0.0477*** (0.0135)	0.0029 (0.0100)	0.0427*** (0.0135)	0.0020 (0.0101)	0.0460*** (0.0135)	0.0026 (0.0101)
E – Water Supply, Sewerage, Waste management and Remediation Activities	0.0478*** (0.0100)	0.0204*** (0.0074)	0.0471*** (0.0100)	0.0200*** (0.0075)	0.0467*** (0.0100)	0.0199*** (0.0075)
F – Construction	0.0327*** (0.0089)	0.0186*** (0.0067)	0.0336*** (0.0090)	0.0183*** (0.0067)	0.0317*** (0.0090)	0.0179*** (0.0067)
G – Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	0.0445*** (0.0087)	0.0200*** (0.0065)	0.0449*** (0.0087)	0.0199*** (0.0065)	0.0409*** (0.0087)	0.0191*** (0.0065)
H – Transport and Storage	0.0323*** (0.0089)	0.0112* (0.0067)	0.0335*** (0.0089)	0.0113* (0.0067)	0.0277*** (0.0089)	0.0102 (0.0067)
I – Accommodation and Food Service Activities	0.0711*** (0.0095)	0.0401*** (0.0071)	0.0713*** (0.0096)	0.0397*** (0.0071)	0.0710*** (0.0096)	0.0396*** (0.0071)
J – Information and Communication	0.0737*** (0.0087)	0.0328*** (0.0065)	0.0722*** (0.0088)	0.0319*** (0.0066)	0.0749*** (0.0088)	0.0324*** (0.0066)
K – Financial and Insurance Activities	0.0281*** (0.0089)	0.0248*** (0.0067)	0.0267*** (0.0090)	0.0240*** (0.0067)	0.0288*** (0.0090)	0.0244*** (0.0067)
L – Real Estate Activities	0.0258** (0.0108)	0.0158* (0.0081)	0.0246** (0.0108)	0.0151* (0.0081)	0.0266** (0.0108)	0.0155* (0.0081)
M – Professional, Scientific and Technical Activities	0.0498*** (0.0087)	0.0272*** (0.0065)	0.0492*** (0.0087)	0.0268*** (0.0065)	0.0494*** (0.0087)	0.0268*** (0.0065)
N – Administrative and Support Service Activities	0.0569*** (0.0085)	0.0310*** (0.0063)	0.0568*** (0.0085)	0.0307*** (0.0063)	0.0556*** (0.0085)	0.0305*** (0.0063)
O – Public Administration and Defence; Compulsory Social Security	0.1132*** (0.0106)	0.0504*** (0.0079)	0.1088*** (0.0107)	0.0495*** (0.0080)	0.1102*** (0.0107)	0.0498*** (0.0080)
P – Education	0.0671*** (0.0091)	0.0144** (0.0068)	0.0659*** (0.0091)	0.0144** (0.0068)	0.0640*** (0.0091)	0.0140** (0.0068)

(continued)

Variables	I Firm births (Eqn. 7)	II Firm deaths (Eqn. 8)	III Firm births (Eqn. 9)	IV Firm deaths (Eqn. 10)	V Firm births (Eqn. 11)	VI Firm deaths (Eqn. 12)
Q – Human Health and Social Work Activities	0.0430*** (0.0091)	0.0151** (0.0068)	0.0423*** (0.0091)	0.0150** (0.0068)	0.0396*** (0.0090)	0.0145** (0.0068)
R – Arts, Entertainment and Recreation	0.0446*** (0.0089)	0.0131** (0.0067)	0.0432*** (0.0089)	0.0127* (0.0067)	0.0433*** (0.0089)	0.0127* (0.0067)
S – Other Service Activities	0.0478*** (0.0087)	0.0106 (0.0065)	0.0466*** (0.0088)	0.0103 (0.0065)	0.0464*** (0.0087)	0.0102 (0.0065)
T – Activities of Households as Employers; Undifferentiated Goods and Services Producing Activities of Households for Own Use	0.1345*** (0.0161)	0.1387*** (0.0120)	0.1356*** (0.0162)	0.1399*** (0.0121)	0.1299*** (0.0162)	0.1388*** (0.0121)
U – Activities of Extraterritorial Organisations and Bodies	0.1070*** (0.0161)	0.0519*** (0.0120)	0.1082*** (0.0162)	0.0532*** (0.0121)	0.1045*** (0.0162)	0.0525*** (0.0121)
IE041 (Reference Category) (Donegal, Sligo, Leitrim, Cavan and Monaghan)	0.0028 (0.0032)	0.0036 (0.0024)	0.0029 (0.0032)	0.0036 (0.0024)	0.0018 (0.0032)	0.0034 (0.0024)
IE042 (Galway, Mayo and Roscommon)	0.0095** (0.0042)	0.0041 (0.0031)	0.0092** (0.0042)	0.0040 (0.0031)	0.0029 (0.0042)	0.0027 (0.0032)
IE051 (Clare, Tipperary and Limerick)	0.0051 (0.0047)	0.0047 (0.0035)	0.0049 (0.0047)	0.0045 (0.0035)	0.0003 (0.0047)	0.0036 (0.0035)
IE052 (Waterford, Kilkenny, Carlow and Wexford)	0.0076* (0.0045)	0.0026 (0.0034)	0.0072 (0.0045)	0.0025 (0.0034)	0.0053 (0.0046)	0.0021 (0.0034)
IE053 (Cork and Kerry)	0.0201*** (0.0076)	0.0171*** (0.0057)	0.0198*** (0.0076)	0.0170*** (0.0057)	0.0082 (0.0077)	0.0146** (0.0057)
IE061 (Dublin)	0.0100* (0.0054)	0.0091** (0.0041)	0.0099* (0.0055)	0.0089** (0.0041)	-0.0003 (0.0055)	0.0069* (0.0041)
IE062 (Wicklow, Kildare, Meath and Louth)	0.0003 (0.0052)	0.0078** (0.0039)	0.0002 (0.0052)	0.0076* (0.0039)	-0.0056 (0.0053)	0.0065* (0.0039)
IE063 (Longford, Westmeath, Offaly and Laois)	0.0095*** (0.0029)	-0.0061*** (0.0021)	0.0105*** (0.0029)	-0.0058*** (0.0022)	0.0369*** (0.0038)	-0.0006 (0.0029)
2010 (Reference Category) 2011						

(continued)

Table 2.

Table 2.

Variables	I Firm births (Eqn. 7)	II Firm deaths (Eqn. 8)	III Firm births (Eqn. 9)	IV Firm deaths (Eqn. 10)	V Firm births (Eqn. 11)	VI Firm deaths (Eqn. 12)
2012	0.0185*** (0.0028)	0.0017 (0.0021)	0.0190*** (0.0029)	0.0021 (0.0022)	0.0415*** (0.0043)	0.0064** (0.0032)
2013	-0.0250*** (0.0029)	0.0098*** (0.0021)	-0.0243*** (0.0029)	0.0100*** (0.0022)	-0.0031 (0.0038)	0.0142*** (0.0028)
2014	0.0224*** (0.0029)	0.0036* (0.0022)	0.0243*** (0.0030)	0.0039* (0.0022)	0.0524*** (0.0037)	0.0096*** (0.0028)
2015	0.0295*** (0.0029)	0.0041* (0.0022)	0.0298*** (0.0029)	0.0044** (0.0022)	0.0463*** (0.0041)	0.0075** (0.0030)
2016	0.0326*** (0.0030)	0.0128*** (0.0022)	0.0326*** (0.0030)	0.0129*** (0.0022)	0.0446*** (0.0039)	0.0152*** (0.0029)
Constant	0.3053** (0.1502)	0.0478 (0.1122)	0.3008** (0.1502)	0.0468 (0.1122)	0.1330 (0.1508)	0.0124 (0.1127)
Observations	82,383	82,383	82,383	82,383	82,383	82,383
R-squared	0.0463	0.0322	0.0465	0.0322	0.0483	0.0324
χ^2	4003.14	2742.97	4016.09	2743.97	4182.84	2755.95
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note(s): Standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Eqn. means Equation
Source(s): Author's own work

(2016) and Pe'er and Vertinsky (2008) who find evidence of the presence of the multiplier effect in the case of firm deaths and Arcuri *et al.* (2019) and Resende *et al.* (2015) who find evidence of the competition effect in the case of firm deaths.

4.1 Intersectoral firm interrelationships

In columns labelled III through VI in Table 2 we produce extremely novel results which detail the role of relatedness of firm sector in explaining firm interrelationships through estimates of equations (9)–(12) respectively. Firm births are increased by previous firm births in related sectors (multiplier effect), providing partial support for hypothesis H2b. This could be explained by demonstration/signalling effects (O'Leary *et al.*, 2023; Nyström, 2007). Meaning firm births communicate economic value which incentivises more related firm births. Alternatively, firm births could increase consumer demand through income effects resulting in more firm births (Gajewski and Kutun, 2018; Sutaria and Hicks, 2004). Future firm births are reduced by previous firm deaths in related sectors (multiplier effect) providing partial support for H2c. This could be conceptually attributable to demonstration/signalling effects discussed by Nyström (2007). Meaning firm deaths may disincentivise people setting up other related firms.

Firm births are increased by previous firm births and deaths in unrelated sectors (multiplier and competition effect) providing partial support for H1c and H2c. The multiplier effect could again be attributable to income effects mentioned above. Considering that the income of a given sector is a function of the income of all sectors (Conrad, 1955), it's likely the increased income would result in higher consumer demand in a variety of different sectors. Therefore, firm births from unrelated sectors could increase future firm births. The competition effect is potentially attributable to firm deaths leading to the reallocation of versatile resources which are discussed by Nason and Wiklund (2018). These resources could be seized upon by alert entrepreneurs (Adomako *et al.*, 2018) and increase firm births.

Finally, firm deaths are increased by lagged firm births from unrelated sectors (competition effects). This finds some support for H1c and could be attributable to competitive pressures whereby new firms displace old ones (Brixy, 2014). Competition can occur between unrelated firms as rivalry is not solely determined by similarity (Markman *et al.*, 2009). Therefore, firm deaths in unrelated sectors could increase future firm deaths.

5. Conclusions

This paper's findings show that firm interrelationships are significantly influenced by the degree of relatedness between firms. Results suggest that future firm births are increased by past firm births from related and unrelated sectors via multiplier effects. However, firm deaths are also stimulated by previous firm births from unrelated sectors via competition effects. These results are helpful in answering the call of Dejardin (2004) to establish a more detailed framework in examining firm interrelationships which accounts for complementarities between economic activities. Overall, the findings show that competition effects explain firm interrelationships between unrelated sectors. By contrast, multiplier effects explain firm interrelationships between related sectors.

These findings have implications for policy initiatives concerned with increasing entrepreneurship. Some express concerns that public investment into entrepreneurship can lead to "crowding out" effects (Cumming and Johan, 2019), meaning that public investment into entrepreneurship could displace or reduce private investment into entrepreneurship (Audretsch and Fiedler, 2023; Zikou *et al.*, 2017). Our findings indicate that using public

investment to increase firm births could increase future firm births in related and unrelated sectors. However, more negative “crowding out” effects may also occur in unrelated sectors, meaning that public investment which stimulates firm births in a certain sector could induce firm deaths and crowd out entrepreneurship in unrelated sectors.

This paper also creates avenues for future research. The raw data used to calculate firm birth and death rates in this analysis are count data. Each new firm is measured the same as another regardless of differing features like size. Some research has shown that smaller firms have a greater propensity to create new firm start-ups (Parker, 2009). Thus, it is possible that the death of differently sized firms may have a varying influence on competition effects where firm deaths induce future births. Future research could examine this.

Notes

1. See Appendix 1 for the expected signs associated with multiplier and competition effects.
2. From a measurement perspective, firms can be considered related to each other if they operate in the same NACE 1-digit industry and unrelated if they don't.
3. See Appendixes 2 and 3 for a percentage breakdown of regions and NACE sectors in the model respectively.
4. If a dormant unit is reactivated within two years, this event is not considered to be a birth.

References

- Abdallah, W., Goergen, M. and O'Sullivan, N. (2015), “Endogeneity: how failure to correct for it can cause wrong inferences and some remedies”, *British Journal of Management*, Vol. 26, pp. 791-804, doi: [10.1111/1467-8551.12113](https://doi.org/10.1111/1467-8551.12113).
- Adomako, S., Danso, A., Boso, N. and Narteh, B. (2018), “Entrepreneurial alertness and new venture performance: facilitating roles of networking capability”, *International Small Business Journal*, Vol. 36, pp. 453-472, doi: [10.1177/0266242617747667](https://doi.org/10.1177/0266242617747667).
- Angeriz, A., McCombie, J. and Roberts, M. (2008), “New estimates of returns to scale and spatial spillovers for EU Regional manufacturing, 1986—2002”, *International Regional Science Review*, Vol. 31, pp. 62-87, doi: [10.1177/0160017607306750](https://doi.org/10.1177/0160017607306750).
- Antonietti, R. and Cainelli, G. (2011), “The role of spatial agglomeration in a structural model of innovation, productivity and export: a firm-level analysis”, *The Annals of Regional Science*, Vol. 46, pp. 577-600, doi: [10.1007/s00168-009-0359-7](https://doi.org/10.1007/s00168-009-0359-7).
- Arcuri, G., Brunetto, M. and Levratto, N. (2019), “Spatial patterns and determinants of firm exit: an empirical analysis on France”, *The Annals of Regional Science*, Vol. 62, pp. 99-118, doi: [10.1007/s00168-018-0887-0](https://doi.org/10.1007/s00168-018-0887-0).
- Åstebro, T. and Thompson, P. (2011), “Entrepreneurs, jacks of all trades or hobos?”, *Research Policy*, Vol. 40, pp. 637-649, doi: [10.1016/j.respol.2011.01.010](https://doi.org/10.1016/j.respol.2011.01.010).
- Audretsch, D.B. (1995), *Innovation and Industry Evolution*, MIT Press, Cambridge, Massachusetts.
- Audretsch, D.B. and Fiedler, A. (2023), “Does the entrepreneurial state crowd out entrepreneurship?”, *Small Business Economics*, Vol. 60, pp. 573-589, doi: [10.1007/s11187-022-00604-x](https://doi.org/10.1007/s11187-022-00604-x).
- Bahlous-Boldi, M. (2021), “Agency costs and credit availability: an international study”, *European Journal of Management and Business Economics*, Vol. 31, pp. 285-304, doi: [10.1108/EJMBE-06-2020-0175](https://doi.org/10.1108/EJMBE-06-2020-0175).
- Bartlett, M. (1949), “Some evolutionary stochastic processes”, *Journal of the Royal Statistical Society. Series B (Methodological)*, Vol. 11, pp. 211-229, doi: [10.1111/j.2517-6161.1949.tb00031.x](https://doi.org/10.1111/j.2517-6161.1949.tb00031.x).
- Bartoloni, E., Arrighetti, A. and Landini, F. (2020), “Recession and firm survival: is selection based on cleansing or skill accumulation?”, *Small Business Economics*, Vol. 57 No. 1, pp. 1-22, doi: [10.1016/j.inteco.2017.07.002](https://doi.org/10.1016/j.inteco.2017.07.002).

- Block, J.H., Kohn, K., Miller, D. and Ullrich, K. (2015), "Necessity entrepreneurship and competitive strategy", *Small Business Economics*, Vol. 44, pp. 37-54, doi: [10.1007/s11187-014-9589-x](https://doi.org/10.1007/s11187-014-9589-x).
- Bollen, K.A., Kirby, J.B., Curran, P.J., Paxton, P.M. and Chen, F. (2007), "Latent variable models under misspecification: two-stage least squares (2SLS) and maximum likelihood (ML) estimators", *Sociological Methods and Research*, Vol. 36, pp. 48-86, doi: [10.1177/0049124107301947](https://doi.org/10.1177/0049124107301947).
- Boschma, R. (2005), "Role of proximity in interaction and performance: conceptual and empirical challenges", *Regional Studies*, Vol. 39, pp. 41-45, doi: [10.1080/0034340052000320878](https://doi.org/10.1080/0034340052000320878).
- Brixy, U. (2014), "The significance of entry and exit for regional productivity growth", *Regional Studies*, Vol. 48, pp. 1051-1070.
- Brown, J.P., Lambert, D.M. and Florax, R.J. (2013), "The birth, death, and persistence of firms: creative destruction and the spatial distribution of US manufacturing establishments, 2000–2006", *Economic Geography*, Vol. 89, pp. 203-226, doi: [10.1111/ecge.12014](https://doi.org/10.1111/ecge.12014).
- Cainelli, G., Montresor, S. and Marzetti, G.V. (2014), "Spatial agglomeration and firm exit: a spatial dynamic analysis for Italian provinces", *Small Business Economics*, Vol. 43, pp. 213-228, doi: [10.1007/s11187-013-9532-6](https://doi.org/10.1007/s11187-013-9532-6).
- Calá, C.D., Manjón-Antolín, M. and Arauzo-Carod, J.M. (2016), "Regional determinants of firm entry in a developing country", *Papers in Regional Science*, Vol. 95, pp. 259-279, doi: [10.1111/pirs.12128](https://doi.org/10.1111/pirs.12128).
- Carree, M. and Dejardin, M. (2020), "Firm entry and exit in local markets: 'Market Pull' or 'Unemployment Push' Effects, or both?", *International Review of Entrepreneurship*, Vol. 18, pp. 371-386, available at: <https://halshs.archives-ouvertes.fr/halshs-03220690>
- Carree, M.A., Verheul, I. and Santarelli, E. (2011), "Sectoral patterns of firm exit in Italian provinces", *Journal of Evolutionary Economics*, Vol. 21, pp. 499-517, doi: [10.1007/s00191-010-0191-3](https://doi.org/10.1007/s00191-010-0191-3).
- Carreira, C. and Teixeira, P. (2011), "Entry and exit as a source of aggregate productivity growth in two alternative technological regimes", *Structural Change and Economic Dynamics*, Vol. 22, pp. 135-150, doi: [10.1016/j.strueco.2011.01.001](https://doi.org/10.1016/j.strueco.2011.01.001).
- Cefis, E., Malerba, F., Marsili, O. and Orsenigo, L. (2020), "Time to exit: 'revolving door effect' or 'Schumpeterian gale of creative destruction'", *Journal of Evolutionary Economics*, Vol. 31 No. 1, pp. 1-30, doi: [10.1007/s00191-020-00701-8](https://doi.org/10.1007/s00191-020-00701-8).
- Chai, A., Rohde, N. and Silber, J. (2015), "Measuring the diversity of household spending patterns", *Journal of Economic Surveys*, Vol. 29, pp. 423-440, doi: [10.1111/joes.12066](https://doi.org/10.1111/joes.12066).
- Conrad, A.H. (1955), "The multiplier effects of redistributive public budgets", *The Review of Economics and Statistics*, Vol. 37, pp. 160-173, available at: <https://www.jstor.org/stable/1925747>
- Cooper, A.C. and Dunkelberg, W.C. (1986), "Entrepreneurship and paths to business ownership", *Strategic Management Journal*, Vol. 7, pp. 53-68, available at: <https://www.jstor.org/stable/2485967>
- Crisuolo, P., Laursen, K., Reichstein, T. and Salter, A. (2018), "Winning combinations: search strategies and innovativeness in the UK", *Industry and Innovation*, Vol. 25, pp. 115-143, doi: [10.1080/13662716.2017.1286462](https://doi.org/10.1080/13662716.2017.1286462).
- Crowley, F., Doran, J. and McCann, P. (2021), "The vulnerability of European regional labour markets to job automation: the role of agglomeration externalities", *Regional Studies*, Vol. 55, pp. 1711-1723, doi: [10.1080/00343404.2021.1928041](https://doi.org/10.1080/00343404.2021.1928041).
- CSO (2022), *Business Demography*, Central statistics Office (CSO) of Ireland, available at: <https://www.cso.ie/en/methods/multisectoral/businessdemography/>
- Cumming, D. and Johan, S. (2019), "Government venture capital research: fake science and bad public policy", *Venture Capital*, Vol. 21, pp. 121-131, doi: [10.1080/13691066.2018.1558508](https://doi.org/10.1080/13691066.2018.1558508).
- Dejardin, M. (2004), "Sectoral and cross-sectoral effects of retailing firm demographies", *The Annals of Regional Science*, Vol. 38, pp. 311-334, available at: <https://link.springer.com/content/pdf/10.1007/s00168-004-0197-6.pdf>

- Doran, J. and Fingleton, B. (2016), "Employment resilience in Europe and the 2008 economic crisis: insights from micro-level data", *Regional Studies*, Vol. 50, pp. 644-656, doi: [10.1080/00343404.2015.1088642](https://doi.org/10.1080/00343404.2015.1088642).
- Feeser, H.R. (1987), *Incubators, Entrepreneurs, Strategy and Performance: A Comparison of High and Low Growth High Tech Firms*, Purdue University, West Lafayette, Indiana.
- Frenken, K., Van Oort, F. and Verburg, T. (2007), "Related variety, unrelated variety and regional economic growth", *Regional Studies*, Vol. 41, pp. 685-697, doi: [10.1080/00343400601120296](https://doi.org/10.1080/00343400601120296).
- Gajewski, P. and Kutan, A.M. (2018), "Determinants and economic effects of new firm creation: evidence from polish regions", *Eastern European Economics*, Vol. 56, pp. 201-222, doi: [10.1080/00128775.2018.1442226](https://doi.org/10.1080/00128775.2018.1442226).
- Guo, Q., He, C. and Li, D. (2016), "Entrepreneurship in China: the role of localisation and urbanisation economies", *Urban Studies*, Vol. 53, pp. 2584-2606, doi: [10.1177/0042098015595598](https://doi.org/10.1177/0042098015595598).
- Hanushek, E.A., Rivkin, S.G. and Taylor, L.L. (1996), "Aggregation and the estimated effects of school resources", *The Review of Economics and Statistics*, Vol. 78, pp. 611-627, doi: [10.2307/2109949](https://doi.org/10.2307/2109949).
- Hill, A.D., Johnson, S.G., Greco, L.M., O'Boyle, E.H. and Walter, S.L. (2021), "Endogeneity: a review and agenda for the methodology-practice divide affecting micro and macro research", *Journal of Management*, Vol. 47, pp. 105-143, doi: [10.1177/0149206320960533](https://doi.org/10.1177/0149206320960533).
- Johnson, P. and Parker, S. (1994), "The interrelationships between births and deaths", *Small Business Economics*, Vol. 6, pp. 283-290, doi: [10.1007/BF01108395](https://doi.org/10.1007/BF01108395).
- Kaplan, D. (1988), "The impact of specification error on the estimation, testing, and improvement of structural equation models", *Multivariate Behavioral Research*, Vol. 23, pp. 69-86, doi: [10.1207/s15327906mbr2301_4](https://doi.org/10.1207/s15327906mbr2301_4).
- Le Gallo, J. and Páez, A. (2013), "Using synthetic variables in instrumental variable estimation of spatial series models", *Environment and Planning A*, Vol. 45, pp. 2227-2242, doi: [10.1068/a45443](https://doi.org/10.1068/a45443).
- Lu, W.-C., Chen, J.-R. and Huang, Y.-T. (2008), "Dynamic interrelation of births and deaths: evidence from plant level data", *Economics Bulletin*, Vol. 12, pp. 1-7, available at: <http://economicsbulletin.vanderbilt.edu/2008/volume12/EB-07L00018A.pdf>
- Markman, G.D., Gianiodis, P.T. and Buchholtz, A.K. (2009), "Factor-market rivalry", *Academy of Management Review*, Vol. 34, pp. 423-441, doi: [10.5465/amr.2009.40632072](https://doi.org/10.5465/amr.2009.40632072).
- Miller, D. (2003), "An asymmetry-based view of advantage: towards an attainable sustainability", *Strategic Management Journal*, Vol. 24, pp. 961-976, doi: [10.1002/smj.316](https://doi.org/10.1002/smj.316).
- Molina-Morales, F.X., García-Villaverde, P.M. and Parra-Requena, G. (2014), "Geographical and cognitive proximity effects on innovation performance in SMEs: a way through knowledge acquisition", *International Entrepreneurship and Management Journal*, Vol. 10, pp. 231-251, doi: [10.1007/s11365-011-0214-z](https://doi.org/10.1007/s11365-011-0214-z).
- Nason, R.S. and Wiklund, J. (2018), "An assessment of resource-based theorizing on firm growth and suggestions for the future", *Journal of Management*, Vol. 44, pp. 32-60, doi: [10.1177/0149206315610635](https://doi.org/10.1177/0149206315610635).
- Nyström, K. (2007), "Interdependencies in the dynamics of firm entry and exit", *Journal of Industry, Competition and Trade*, Vol. 7, pp. 113-130, doi: [10.1007/s10842-006-0027-x](https://doi.org/10.1007/s10842-006-0027-x).
- O'Connor, M., Doran, J. and McCarthy, N. (2021), "Cognitive proximity and innovation performance: are collaborators equal?", *European Journal of Innovation Management*, Vol. 24, pp. 637-654, doi: [10.1108/EJIM-11-2019-0347](https://doi.org/10.1108/EJIM-11-2019-0347).
- O'Leary, D. (2022), "Unemployment and entrepreneurship across high-, middle- and low-performing European regions", *Regional Studies, Regional Science*, Vol. 9, pp. 571-580, doi: [10.1080/21681376.2022.2118072](https://doi.org/10.1080/21681376.2022.2118072).
- O'Leary, D., Doran, J. and Power, B. (2023), "Urbanisation, concentration and diversification as determinants of firm births and deaths", *Regional Studies, Regional Science*, Vol. 10, pp. 506-528, doi: [10.1080/21681376.2023.2204143](https://doi.org/10.1080/21681376.2023.2204143).

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- Parker, S.C. (2009), "Why do small firms produce the entrepreneurs?", *The Journal of Socio-Economics*, Vol. 38, pp. 484-494, doi: [10.1016/j.socec.2008.07.013](https://doi.org/10.1016/j.socec.2008.07.013).
- Pe'er, A. and Vertinsky, I. (2008), "Firm exits as a determinant of new entry: is there evidence of local creative destruction?", *Journal of Business Venturing*, Vol. 23, pp. 280-306, doi: [10.1016/j.jbusvent.2007.02.002](https://doi.org/10.1016/j.jbusvent.2007.02.002).
- Porter, M.E. (2011), *Competitive Advantage of Nations: Creating and Sustaining Superior Performance*, Simon & Schuster, New York.
- Power, B., Doran, J. and Ryan, G. (2019), "The effect of agglomeration economies on firm deaths: a comparison of firm and regional based approaches", *Urban Studies*, Vol. 56, pp. 3358-3374, doi: [10.1177/0042098018817428](https://doi.org/10.1177/0042098018817428).
- Resende, M., Ribeiro, E.P. and Zeidan, R. (2015), "Dynamic entry and exit linkages in the Brazilian manufacturing industry: an econometric investigation", *International Journal of the Economics of Business*, Vol. 22, pp. 379-392, doi: [10.1080/13571516.2015.1009684](https://doi.org/10.1080/13571516.2015.1009684).
- Saridakis, G., Mendoza, M.A., Torres, R.I.M. and Glover, J. (2016), "The relationship between self-employment and unemployment in the long-run: a panel cointegration approach allowing for breaks", *Journal of Economic Studies*, Vol. 43 No. 3, pp. 358-379, doi: [10.1108/JES-11-2013-0169](https://doi.org/10.1108/JES-11-2013-0169).
- Sutaria, V. and Hicks, D.A. (2004), "New firm formation: dynamics and determinants", *The Annals of Regional Science*, Vol. 38, pp. 241-262, doi: [10.1007/s00168-004-0194-9](https://doi.org/10.1007/s00168-004-0194-9).
- van Egeraat, C., Morgenroth, E., Kroes, R., Curran, D. and Gleeson, J. (2018), "A measure for identifying substantial geographic concentrations", *Papers in Regional Science*, Vol. 97, pp. 281-300, doi: [10.1111/pirs.12241](https://doi.org/10.1111/pirs.12241).
- Wooldridge, J.M. (2010), *Econometric Analysis of Cross Section and Panel Data*, MIT Press, Cambridge, Massachusetts.
- Zellner, A. and Theil, H. (1992), *Three-stage Least Squares: Simultaneous Estimation of Simultaneous Equations*, Springer, Dordrecht.
- Zikou, E., Varsakelis, N. and Sarri, A.K. (2017), "Does public sector crowd out entrepreneurship? Evidence from the EU regions", *International Journal of Entrepreneurial Behavior & Research*, Vol. 24, pp. 866-881, doi: [10.1108/IJEBR-03-2017-0100](https://doi.org/10.1108/IJEBR-03-2017-0100).

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Appendix 1

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Table A1.
Expected coefficient
signs for multiplier and
competition effects

	Multiplier	Competition
$\Delta FB_t / \delta FB_{t-1}$	+	-
$\Delta FD_t / \delta FD_{t-1}$	+	-
$\Delta FB_t / \delta FD_{t-1}$	-	+
$\Delta FD_t / \delta FB_{t-1}$	-	+

Note(s): Where Δ represents change in firm births (FB) and firm deaths (FD) and t is a given time period (a year) and NA is not applicable

Source(s): Table is based on work from [Johnson and Parker \(1994\)](#)

Appendix 2

Table A2.
Regions
representatives

Region	%	Region	%
Carlow	2.58%	Cork County	3.75%
Dublin City	3.85%	Kerry	3.16%
South Dublin	3.57%	Limerick City	2.88%
Dublin Fingal	3.18%	Limerick County	2.96%
Dun Laoghaire-Rathdown	2.99%	North Tipperary	2.79%
Kildare	3.32%	South Tipperary	2.61%
Kilkenny	2.85%	Waterford City	2.57%
Laois	2.53%	Waterford County	2.62%
Longford	2.27%	Galway City	2.79%
Louth	3.09%	Galway County	3.29%
Meath	3.31%	Leitrim	2.19%
Offaly	2.63%	Mayo	3.07%
Westmeath	2.89%	Roscommon	2.54%
Wexford	3.07%	Sligo	2.65%
Wicklow	3.21%	Cavan	2.64%
Clare	3.18%	Donegal	3.23%
Cork City	3.27%	Monaghan	2.47%

Source(s): Author's own work

NACE 1-digit industries	%
B- Mining and Quarrying (Reference Category)	1.05%
C – Manufacturing	26.43%
D – Electricity, Gas, Steam and Air Conditioning Supply	0.63%
E – Water Supply; Sewerage, Waste management and Remediation Activities	1.63%
F – Construction	5.08%
G – Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	21.97%
H – Transport and Storage	3.71%
I – Accommodation and Food Service Activities	2.01%
J – Information and Communication	5.05%
K – Financial and Insurance Activities	3.63%
L – Real Estate Activities	1.04%
M – Professional, Scientific and Technical Activities	4.68%
N – Administrative and Support Service Activities	7.57%
O – Public Administration and Defence; Compulsory Social Security	1.25%
P – Education	2.86%
Q – Human Health and Social Work Activities	3.07%
R – Arts, Entertainment and Recreation	3.46%
S – Other Service Activities	4.34%
T – Activities of Households as Employers; Undifferentiated Goods and Services Producing Activities of Households for Own Use	0.27%
U – Activities of Extraterritorial Organisations and Bodies	0.27%
Source(s): Author's own work	

Table A3.
NACE 1-digit sectors
representatives

Variable	Description	Calculation
Herfindahl index	The Herfindahl index measures concentration in a particular industry. A higher value indicates higher industrial concentration in a region, while a lower value indicates a lower level of industrial concentration in the region (van Egeraat <i>et al.</i> , 2018). The index of HHI_i measures the degree of industrial concentration. Using standard measurements consistent with Power <i>et al.</i> (2019) and Antonietti and Cainelli (2011) a measurement for sectoral concentration within regions is developed	$HHI_{i,2017} = \sum_j^N \left(\frac{y_{ij}}{y_i} \right)^2$ <p>Where HHI_i is the Herfindahl index for region i; y_{ij} is the number of firms in region i in NACE four-digit industry j; and y_i is the number of firms in region i</p>
The location quotient (LQ) variable	The LQ variable compares the concentration of employment in a sector in a region with the concentration of the same sector nationally	$LQ_{s,r} = \frac{E_{s,r}/E_r}{E_{s,n}/E_n}$ <p>Where $LQ_{s,r}$ is the concentration of firms in a sector s and region r and E is the share of firms in sector s and region r while F_n is the firms nationally</p>
Related variety (RV) and unrelated variety (UV)	RV and UV are variables which proxy levels of industrial diversification within regions. Higher values of these indices indicate higher levels of unrelated variety or higher levels of related variety. These calculations of these variables are consistent with those used by Frenken <i>et al.</i> (2007)	$RV_i = \sum_j P_{ji} \left(\sum_{h \in (j)} \frac{P_{hi}}{P_{ji}} \log_2 \left(\frac{1}{P_{hi}/P_{ji}} \right) \right)$ $UV_i = \sum_j P_{ji} \log_2 \left(\frac{1}{P_{ji}} \right)$ <p>Where RV_i is the measure for related variety and UV_i is the measure for unrelated variety. The 4-digit NACE classification h falls exclusively falls under the 1-digit NACE classification j in region i. Where P_{ji} is the number of firms in region i and P_{hi} is total number of firms in all regions in industry j. And where $P_{ji} = \sum_{h \in (j)} P_{hi}$ indicates the 1-digit shares</p>
Population Density	The density is measured via persons per squared km	Persons per km ²
Log of Average Firm Size	Log of average firm size acts as a control variable for the scale of businesses within the sub-county regions	The natural log of average firm size within sub-county regions
Log of Income per person	Log of income per person acts as an economic control variable	The natural log of income per person within sub-county regions

Table A4.
Variable definitions
and descriptions

Source(s): Author's own work

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1 FB Rate	1																						
2 FD Rate	0.22	1																					
3 FB	0.12	0.06	1																				
4 FD	0.12	0.06	1	1																			
Rate _{t-1}																							
5 Rate _{t-1}	0.01	0.01	0.12																				
RFB																							
6 Rate _{t-1}	0.06	0.00	0.25	1																			
RFD																							
7 Rate _{t-1}	0.08	0.06	0.13	0.10																			
UFB																							
8 Rate _{t-1}	0.04	0.02	0.08	0.03	1																		
UFD																							
9 Rate _{t-1}	0.53	0.12	0.52	0.11	0.05																		
IVFB																							
10 IVFB	0.01	0.02	0.03	0.04	0.34	1																	
11 IVRFB	0.11	0.64	0.09	0.05	0.03	0.04																	
12 IVRFD	0.06	0.04	0.10	0.05	0.33	0.18	1																
13 FB Rate	NA	0.23	0.12	0.07	0.01	-0.01	0.08																
14 FD Rate	0.03	0.02	0.04	0.06	0.17	0.26	0.52	1															
15 FB	0.54	0.14	0.15	0.11	0.06	0.04	0.10	0.07	1														
Rate _{t-1}																							
16 FD	0.10	0.59	0.08	0.06	0.03	0.05	0.07	0.05	0.30	1													
Rate _{t-1}																							
17 RFB	0.11	0.66	0.08	0.05	0.03	0.04	0.06	0.04	0.27	0.89	1												
Rate _{t-1}																							
18 RFD	0.11	0.66	0.08	0.05	0.03	0.04	0.06	0.04	0.27	0.89	1	1											
Rate _{t-1}																							
19 UFB	0.10	0.59	0.08	0.06	0.03	0.05	0.07	0.05	0.30	1	0.89	0.89	1										
Rate _{t-1}																							
20 UFD	0.10	0.59	0.08	0.06	0.03	0.05	0.07	0.05	0.30	1	0.89	0.89	1	1									
Rate _{t-1}																							
21 Log of PD	0.04	0.03	0.04	0.05	0.19	0.21	0.49	0.50	0.10	0.08	0.07	0.07	0.08	0.08	1								
22 HHI	-0.03	-0.02	-0.03	-0.04	-0.14	-0.16	-0.38	-0.43	-0.10	-0.08	-0.06	-0.06	-0.08	-0.08	-0.43	1							
23 LQ	-0.05	-0.06	-0.05	-0.07	-0.02	-0.04	-0.01	-0.01	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.04	0.02	1						

(continued)

Table A5. Correlation matrix

Table A5.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
24 RV	-0.02	0.01	-0.03	0.03	-0.12	0.00	0.01	-0.01	0.05	0.10	0.08	0.08	0.1	0.10	-0.05	0.04	-0.07	1						
25 UV	0.04	0.03	0.03	0.03	0.16	0.15	0.42	0.31	0.09	0.07	0.06	0.06	0.07	0.07	0.53	-0.34	-0.03	-0.08	1					
26 Log of Inc	0.04	0.03	0.04	0.04	0.20	0.18	0.52	0.44	0.12	0.10	0.08	0.08	0.10	0.10	0.70	-0.59	-0.03	-0.07	0.67	1				
27 Log Av size	-0.14	-0.14	-0.12	-0.08	0.01	-0.01	0.06	0.08	-0.12	-0.11	-0.11	-0.11	-0.11	-0.11	0.15	-0.09	0.37	-0.04	0.07	0.13	1			
28 Region	0.01	0.00	0.01	-0.01	0.02	0.01	0.04	-0.01	-0.03	-0.03	-0.02	-0.02	-0.03	-0.03	-0.21	0.12	0.01	0.02	-0.04	-0.12	-0.06	1		
29 Year	0.04	0.02	-0.01	0.00	0.00	-0.04	0.01	-0.26	0.05	0.02	0.02	0.02	0.02	0.02	0.00	0.02	0.00	-0.02	0.27	0.15	0.02	0.00	1	

Note(s): "FB" and "FD" can be read as "Firm Birth" and "Firm Death", respectively
 "RFB" and "RFD" can be read as "Related Firm Birth" and "Unrelated Firm Birth"
 "RFBD" and "RFDD" can be read as "Related Firm Death" and "Unrelated Firm Death"
 "IV" can be read as "Instrumental Variable" meaning "IVFB", for example, refers to the instrumental variable created for the Firm Birth Rate variable. The instrumental variables were created using Bartlett's three group method
Source(s): Author's own work