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INVESTIGATING THE REGIONAL EMPLOYMENT EFFECTS OF SOLO SELF-EMPLOYED FORMATION

MASTER THESIS

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Abstract

The solo self-employed pool has increased amongst various European countries during the last two decades and became a considerable large source of income. Although recent empirical research suggests that solo self-employed entries may bring flexible services to incumbent firms, the exact economic impact of the solo self-employed group remains rather unclear. In this study, the overall contribution of the solo self-employed is followed over a period of ten years in which immediate and indirect effects are separated through an Almon polynomial distributed lag model. The results imply that solo self-employed stimulate the competition among incumbent firms rather than offer flexibility to the market. Furthermore, it was found that regional dissimilarities of the employment change induced by solo self-employed entrants could for a large part be clarified by respective differences of the indirect effects. Hence, the way solo self-employed interact with their regional environment plays a crucial role for explaining their influence on regional development. The results indicate that the indirect effects of solo self-employed entrants are more pronounced in agglomerations and the knowledge intensive sector.

Keywords: Solo self-employed, regional development, regional employment, immediate and indirect effects, flexibility.

1. Introduction

One of the most persistent economic trends in Europe is the increase of the solo self-employed group at the national workforce. This growth is seen in Greece, Romania, the United Kingdom, the Netherlands and among many other European nations (Van Stel et al., 2014; CBS, 2020). Figure 1 shows the annual growth of the solo self-employed in the Netherlands as total percentage relatively to the Dutch workforce from 2003 to 2018. There are two remarkable observations embedded in this solo self-employed trend: (1) Over a period of fifteen years, solo self-employers took a share of approximately 12,1% in the workforce. This resembles the employment opportunities created through individuals becoming solo self-employed; (2) The economic crisis of 2008 is unnoticeable, as the increase of the solo self-employed group as total percentage of the workforce continued during this period. From 2015 onwards, however, the trend seems to stagnate.

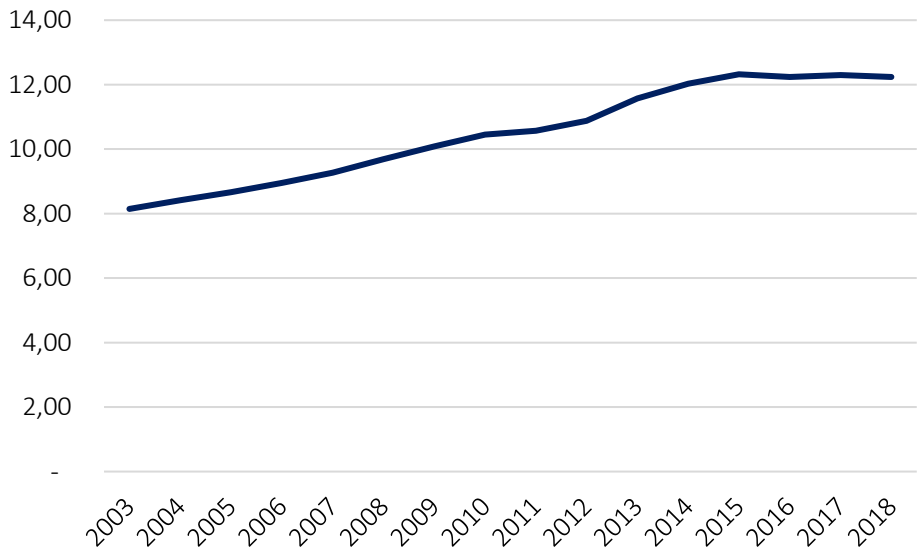

Figure 1: Annual share of solo self-employed as total percentage of the Dutch workforce from 2003 to 2018 (source: CBS, 2020).

Although more people became solo self-employed within the last two decades, knowledge regarding the economic impacts of the solo self-employed group remains rather unclear. Van Stel and De Vries (2015) explain that solo self-employed may offer flexible services to the labour market as they facilitate job dynamics. This 'peel of flexibility' is often used by large firms hiring solo self-employers for temporary projects. However, in terms of capital, solo self-employed are expected to contribute relatively less than the incumbent firms. The solo self-employed are pinned down by their size which disallows them to grow and utilize the same economies of scale (Van Stel et al., 2014; Sorgner et al., 2014). Another perspective addressed to the economic contribution of the solo self-employed is the innovativeness that solo self-employed may bring to regional economic structures (Van Stel and De Vries, 2015). De Vries and Koster (2013) compared levels of innovativeness amongst Dutch small and medium sized enterprises (SMEs) and solo self-employers through a questionnaire. Particularly, De Vries and Koster

(2013) found that two out of four solo self-employed had engaged in a certain form of process innovation, whilst one out of four solo self-employers were involved in some form of product innovation over the last three years. The former was even slightly higher when compared to process innovation for SMEs. However, analysing the exact economic contribution of the solo self-employed has appeared to be rather difficult as the solo self-employed differ in terms of motivation, ambition and their level of skills (Wennekers et al., 2010). Despite this affects the possibility to allocate a particular degree of innovativeness to the solo self-employed group in general, the innovation level induced by solo self-employed often depends on their start-up motivation. De Vries et al. (2013) explain that one out of four solo self-employers initiates their business out of necessity, such as unemployment. In most cases this 'necessity' segment is expected to contribute relatively less to market innovations.

According to Birch (1981), Van Stel and Suddle (2008) and Harisson et al. (2014), entrepreneurship and new firm formation is increasingly being aligned to economic growth at both the national and regional level. Start-ups bring fresh ideas towards current market structures which in turn increases opportunities for the creation of jobs (Fritsch and Noseleit, 2013). When elaborating on the periodic growth of regional employment, Frisch and Noseleit (2013) argue that new business formation tends to induce an immediate effect and an indirect effect on employment change. New business formation immediately contributes to regional employment growth, i.e. the direct effect, as the start of a business automatically reduces unemployment. Over time, competition provokes a negative displacement effect where all firms at the particular market are challenged by the new entries to improve their performance. Eventually, after a period of approximately six years, so-called 'indirect supply-side effects' emerge as a result of the enhanced business models (Fritsch and Mueller, 2004). This process is associated with a higher productivity level allowing for accrued employment levels (Fritsch and Mueller, 2004; Koster et al., 2012). The regional economic impact through the indirect effect is usually considerably larger compared to the immediate effect (Fritsch and Noseleit, 2013). The indirect effects are therefore the most predominant reason to expect that new business formation positively influences regional employment levels.

The critical remark here is that current research has not yet been directed towards investigating the magnitude of the solo self-employed effects on the larger economy. Given that start-ups usually commence as solo self-employed firms, it is implied that solo self-employed could also influence regional innovation levels in the same way as start-ups (Van Stel et al., 2014). Research addressing the economic contribution of new business formation may then also show similar economic patterns when applying equal research methods for measuring the regional employment effects of the solo self-employed. This study will therefore examine if solo self-employed are indeed challenging the current market to improve their business performance or whether they amplify the efficiency of the incumbents by offering flexibility instead. The main research question is as follows: "*What are the regional employment effects of solo self-employed in the Netherlands?*"

In order to answer the main research question, two aspects will have to be clarified. First, the differences between the immediate effect and the indirect effect of solo self-employed on regional employment change will be examined. The initial analysis, as described here, is accomplished following the Almon lag procedure. This allowed to answer the first two sub-questions beneath:

- *To what level are Dutch solo self-employed contributing to the regional indirect employment effects?*
- *In which way differentiate the directly created solo self-employed effects from the indirect employment effects?*

Second, the mechanisms behind the regional employment effects may explain why these effects are strongly present amongst certain environments. It is widely acknowledged within empirical research that solo self-employed are active in many different sectors and are therefore observed to be a heterogeneous group (Blanchflower, 2000; Bosch and Van Vuuren, 2010). As a result of the heterogeneity, demarcating characteristics of solo self-employed becomes a highly complex task. However, the demographic characteristics and the start-up motivations of the solo self-employed offer two dimensions along which the solo self-employed group could be categorized (Van Stel and De Vries, 2015). First, despite there are different reasons to start a business, in the end, start-ups are either being established out of necessity to fight unemployment or an opportunity to find the gap in the market. Roughly one out of four solo self-employers initiates their business out of necessity (De Vries et al., 2013). Second, the demographic characteristics of the solo self-employed resemble both individual skills and company details, such as the area in which a firm operates (Van Stel and De Vries, 2015). These characteristics could explain why solo self-employers in a particular environment enhance regional employment levels whilst solo self-employers in other circumstances do not seem to trigger any effects (Rapelli, 2012). Urban areas, for instance, often strengthen competition amongst firms which results in higher innovation levels (Feldman and Audretsch, 1999). Consequently, survival chances for solo self-employed are different within dense cities compared to stretched rural areas. This argumentation may also apply for industries where start-up motivations differ amongst the sectors; In particular industries solo self-employed could mainly feel a necessity to start a business while in other sectors the solo self-employed are more inclined to anticipate on new ideas and opportunities. These environmental mechanisms therefore resulted in sub-question three and four:

- *To what extent influences the level of urbanity regional job creations through solo self-employed?*
- *In which sectors are regional job creations through solo self-employed predominantly tangible?*

The term ‘solo self-employed’ is often discussed within empirical research resulting in the existence of different definitions. In general, a solo self-employer is seen as an entrepreneur working and registered on his or her own account (Van Stel and De Vries, 2015). Several solo self-employers, however, start to hire employers over time whilst holding on to their legal form as solo self-employer. This way of solo self-employment is in contrast with the former definition as hiring employers over time will shape a different layer within the creation of direct regional employment effects. The establishment of extra jobs through solo self-employers at their own firms then affects the analyses as the person behind the solo self-employed firm is from this point onwards not working as an autonomous operator. At the time solo self-employed change their legal form and start hiring other employees, the analyses will intertwine with the growth of start-ups as it will in turn capture the effects of all new business formation as well. Furthermore, hiring other employees indicates that new firm formation has led to economic growth at the individual level (Fritsch and Mueller, 2004). As such a process takes time, it could be stated that newly created jobs at the individual level are not immediately established, but rather an indirect effect (Fritsch and Noseleit, 2013).

This research will provide a quantitative analyses through various regression models. Both the immediate effect and indirect effect of solo self-employed on regional employment are analysed based on Almon polynomial distributed lag structures. The analysis captures the extent to which solo self-employed contribute to immediate creation of employment at their own firms and the indirectly established jobs at incumbent firms. After the general effects are explored, the impact of the solo self-employed is demounted for different urbanity degrees and the role of industries. Regional environments are then used to capture the employment effects of the solo self-employed more clearly and may provide a more stable answer to the main research question.

2. The relationship between solo self-employers and regional employment levels

The theoretical framework embedded in this chapter will mainly address in which way and under which circumstances solo self-employed could influence regional employment levels. This paper particularly emphasizes on the immediate and indirect effects of new solo self-employed entrants on employment change. Additionally, the entrepreneurial characteristics of the solo self-employed are often reflected by the sectors and the urbanity degrees in which they operate. These climates could therefore define the magnitude of their impact. The conceptual model at the end of this section highlights the approach that is used for the analyses in section 3 and 4.

The immediate and indirect effects on regional employment

Following the theory that new business formations often commence as a solo self-employed firm, solo self-employed are expected to generate, to a certain extent, the same regional employment effects as start-ups (Van Stel et al., 2014). There is, however, limited empirical evidence on the economic contribution of solo self-employed (Van Stel et al., 2014; Van Stel and De Vries, 2015). On the one hand, solo self-employed could bring flexible services to the firms that hire them reducing financial restrictions and enabling de-risking strategies (Burke, 2011). On the other hand, solo self-employers are often constrained by their legal form which disallows them to exploit economies of scale (Van Stel et al., 2014). It is then the question which regional employment effects solo self-employed may induce despite their small size.

As mentioned earlier, Fritsch and Noseleit (2013) separate regional employment effects through new business formation into immediate effects and indirect (supply-side) effects. The immediate effect of newly created employment is given by the evolution of newcomers and their employees. A positive employment impact for start-ups within the current period may therefore be understood as the additional jobs that are established in the newly founded businesses at the time of inception (Fritsch and Mueller, 2004; Fritsch and Noseleit, 2013). This immediate employment effect however, is only a part of the economic development brought by new market entries. Start-ups have shown that new business formations may challenge incumbents in similar regional areas to innovate either their products or production processes (Schumpeter, 1942; Fritsch and Mueller, 2004; Koster et al., 2012). Incumbents thus become subject to competition and market selection, allowing only for a fraction of the start-ups to survive for a longer period of time. This fraction of succeeding start-ups may then displace incumbents or sustain alongside them given that market selection works accordingly to a 'survival of the fittest' scenario; Firms with relatively low productivity will exit the market or reduce their output, whilst firms with relatively high productivity will claim a market place by increasing their competitive position (Fritsch and Noseleit, 2013). This market selection process ensures that fewer resources are needed in order to produce a given amount of services and goods. Hence, at a constant output level, enhanced efficiency results in declining employment rates within the first few years. The positive impact of start-ups on the regional employment

level arises after this period, potentially as a result of the increased competition amongst the regional suppliers (Fritsch and Mueller, 2004). New business formation therefore tends to increase regional employment rates with a certain amount of delay. This process is eventually leads to the creation of the indirect supply-side effect altering overall employment through: (1) A greater variety of products and problem solutions; (2) stimulated or secured efficiency increase that affects the market position of firms; (3) an acceleration of structural change due to a turnover of economic units; (4) amplify innovation with particularly the establishment of new markets (Fritsch, 2008; Fritsch and Noseleit, 2013).

This literature will typically exploit the Almon lag structure to measure the effects as described above. So-called Almon polynomial distributed lags could be used to clarify the direct and indirect regional employment effects by estimating the phases as highlighted in figure 2. Phase l 'New capacities' shows the immediate created employment in year t=0 when new businesses enter the market. From years t-2 to t-5, phase ll 'Exiting capacities' starts when incumbent firms are forced to exit the market and regional employment levels diminish. The effect is negative with a minimum in annual period t-3. This process follows Schumpeter's (1942) 'creative destruction' theory, where new firms with innovative ideas tend to generate high productivity levels and therefore turn into a threat to incumbents; When current firms fail to yield similar productivity levels, they may lose (parts of) their market shares. Creative destruction then eventually sketches a situation where overall productivity increases. Empirically, Fritsch and Mueller (2004) indicate that the net effect of growing new start-up entries and those that are forced to leave the market is zero around one or two years. This finding resembles that the immediate or direct effect only mirrors a short-term impact as the effect evaporates after one or two years.

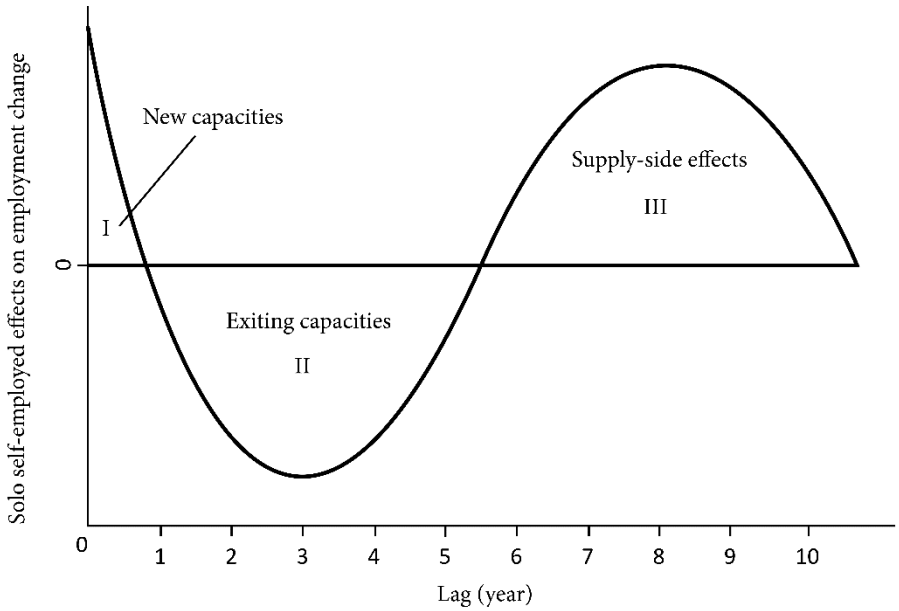

Figure 2: The Almon lag curve showing the annual impact of new business formation on employment rates (source: Fritsch and Mueller, 2004).

Phase lll 'Supply-side effects' highlights the period in which the indirect effects between years t-6 to t-9 are generated. This reflects a new market where regional employment rates are able to increase, with a positive relationship found with a maximum from years t-7 and t-8. The magnitude of the supply side effects decreases after year t-9 and becomes slightly negative in year t-10 (Fritsch and Noseleit, 2013). The above described employment effects resulting from new business formation, as shown by the Almon lag structure, has been validated within a number of empirical studies amongst Germany, Portugal, Spain and the Netherlands (Fritsch and Mueller, 2004; Baptista et al., 2007; Arauzo-Carod et al., 2008; Van Stel and Suddle, 2008; Fritsch and Noseleit, 2013). The Almon lag structure therefore provides a suitable method to acquire information regarding the economic contribution of solo self-employed. Estimating both the direct and indirect employment effects through the solo self-employed could clarify a large chunk of the innovation or flexibility that solo self-employed may bring into economies. When comparing the solo self-employed pool with the group of start-ups, it is expected that start-ups are more involved in innovative activities than the solo self-employed. Start-ups are generally known for their innovative character and less frequently commence their business out of a necessity motive (De Vries et al., 2013). Furthermore, solo self-employed are constrained by their legal form, whereas start-ups have the possibility to expand in terms of size following their economic progress (Bosma et al., 2008). The Almon lag structure of the solo self-employed then probably mirrors weaker effects on employment change than those of the start-ups.

Despite this research explains the economic contribution of the solo self-employed group through the effects on employment change, the Almon lag structure could also be applied for clarifying economic benefits based on a change in regional income or added value (Greene, 2003). Ascertaining the impact of solo self-employed on income change could provide insights to the economic development at local markets and how the local consumer demand condition is affected. The critical point here is that new entrepreneurs will not solely spend their capital on business related activities, but purchase regional products for their daily lives as well (Bosma et al., 2008). Additionally, income growth may induce improved access to capital for potential entries whilst also generate negative effects by increasing regional wage rates (Reynolds, 1994; Van Stel and Storey, 2004). The welfare maximizing individual theoretically chooses between utility in solo self-employment and utility in in paid employment for which wages are taken. As a consequence, rises in wage would result in a higher demand for wage-employment whilst a decrease in wage becomes more attractive to operate autonomously (Van Stel and Storey, 2004; Bosma et al., 2008). Although modifications in income then greatly seem to influence the economic development of regions, the possible opposite effects of the changing wage rates remain indeterminate from theory (Van Stel and Storey, 2004). This suggests that the ongoing fluctuations in regional wage would only add another complex aspect to the analysis rather than improving it. A second potential variable for investigating the economic contribution of solo self-employed is reflected by the added value. The added value may be measured in a number of ways and could impact upon all areas of the firm's activities. Nevertheless, the most

important areas of added value typically interface with the business strategy, the financial performances, and, for most big incumbents, the investor group' decisions (Gillmore et al., 1999; Politis, 2008). The added value then closely resembles the competitive advantage of a firm. This implies that using added value as indicator for economic contribution mirrors another suitable option. However, there are several reasons why employment numbers are more fitting for this type of analyses. First, in a practical manner, employment numbers are generally better accessible compared to the individual data addressed to the financial developments at the concerning firms. Second, earlier studies on start-ups have shown that economic development through time could be estimated following the Almon lag structure (Fritsch and Mueller, 2004). Given the possibility that added value may be indicated in various ways, analysing the solo self-employed effects on a change in the added value could lead to serious difficulties in the interpretation of the results. Finally, employment growth is widely acknowledged amongst academic literature to be a pertinent estimator of both the added value created at incumbents and for measuring the economic contribution of new entries (Carree and Thurik, 2010; Koster et al., 2012).

Urban vs. rural

As mentioned earlier, the solo self-employed pool appears to be a heterogeneous group where individuals operate in different sectors and areas, whilst simultaneously bringing their individual skills to their firm and their personal network (Blanchflower, 2000; Bosch and Van Vuuren, 2010; Wennekers et al., 2010). Entrepreneurship is often considered to arise from an individual's capability to exploit and identify opportunities for new ways to establish a profitable business (Shane and Venkataraman, 2000). The survival changes of entrepreneurs then lie within the different abilities to discover, value and explore opportunities (Storey, 1994; Krueger, 2003; Knoben et al., 2011). Various empirical studies at the aggregate level of countries, regions and sectors, however, imply the individual capabilities to be constant and examine the influence of the diverse contexts on entrepreneurship. According to Beugelsdijk and Noorderhaven (2004) regional climates are therefore crucial for the entrepreneurial opportunities influencing the differences in rates of new business formation. Their research explains that mainly the differences in recognizable and available environmental opportunities could explain the success rate of start-ups. Hence, studies with regional dimensions follow the theory where differences in entrepreneurial opportunities are explained through the regional environment. The main purpose of such analyses is to inquire to what extent regional differences in entrepreneurship opportunities relate to the possible sources of these chances rather than individual capabilities of the entrepreneurs (Knoben et al., 2011). The nature of these particular theories aligns with this particular study, where regional economic effects of solo self-employed are being related to the urbanity degrees of areas and sectorial differences.

So, the contrast amongst regional environments is partially embedded in the urbanity degree of regions (Audretsch and Fritsch, 1994; Bosma et al., 2008). Agglomerated economies contain many advantages for firms due to a concentration of their activities (Knoben et al., 2011). These

economies of scale typically hold a limited spatial reach constricted by transaction costs of geographical distance, for instance transportation, communication and commuting costs (Baranes and Tropeano, 2003; Van Wee et al., 2013). Although agglomerated economies may be categorized in various ways, empirical studies mainly divide between urbanization economies (Jacobs' externalities) and localization economies (Marshall externalities) (Van Oort, 2004). Urbanization economies refer to the effect of a concentration of firms from different sectors in the same region known as 'relatedness', whereas localization economies address the effect of a concentration of firms from a single sector in the same region known as 'increased competition'. A concentration of firms from various industries, i.e. urbanization economies, generally derives from urban related advantages such as a large consumer base and a robust physical infrastructure network (Knoben et al., 2011). Densely populated regions may therefore display a higher variety of demand enforcing the survival chances for start-ups (Acs and Armington, 2004; Van Stel and Suddle, 2008). The concentration of firms of a similar industry, i.e. localization economies, may be beneficial for a regional economy due to the presence of a specialized labour market containing specialized suppliers. This process is known as the network (or relatedness) effect shaping opportunities for highly specialized new businesses to enter the market (Audretsch and Fritsch, 1994; Van Oort, 2004).

Despite agglomerations often trigger competition and innovation amongst firms, several theories also highlight some downsides of being located within a high concentration of establishments. When an agglomeration of activities occurs, competition for space will drive up land costs whilst congestion effects will increase due to increased usage of the physical infrastructure (Flyer and Shaver, 2003). Besides, new businesses increasingly have to compete for qualified labour and other inputs creating a situation in which new establishments struggle to obtain a foothold in the area (Sohn, 2004). Such a development could possibly decrease regional start-up rates (Knoben et al., 2011). Although potential downsides of agglomeration effects appear, empirical literature tends to show more positive effects; Overall new business formation increases when being located in agglomerated regions compared to areas with less-densely concentrations of firms (Reynolds et al., 1994; Knoben et al., 2011).

Fritsch and Noseleit (2013) separated the impact of new business formation on the direct and indirect regional employment rates for rural areas, moderately congested regions and agglomerations. Direct employment effects are rather similar in the three types of areas, whilst the aggregate indirect employment effects of new business formations differ greatly. The amplitude of the Almon lag wave is more pronounced in the agglomerations than the moderately congested regions and the rural areas due to a stronger presence of the indirect supply-side effects. This finding coincides with the agglomeration effect; The situation reflects a higher level of interaction amongst firms resulting from a close localized concentration (Audretsch and Fritsch, 1994; Bosma et al., 2008; Knoben et al., 2011). Intensive competition then arises which leads to higher exit rates during the 'exiting capacities' phase and accrued regional employment rates when the supply-side effect emerges. Another predominant

difference between rural areas, on the one hand, and agglomerations and moderately congested areas, on the other hand, is addressed when analysing the directions of the indirect employment effects in the first annual periods. In urban areas and moderately congested regions, the positive effect on employment at the starting year suggests that the demand-side effects of the resources purchased by the new entries in their region are much stronger than the displacement effects. For the rural areas, the first indirect effects are significantly negative implying that the demand for peripheral products becomes largely effective in other areas over time (Fritsch and Noseleit, 2013). The critical remark here is that the immediate effects on employment are of more importance to the rural economies whilst for agglomerations the indirect supply-side effects tend to outgrow the direct effects. The empirical study from Fritsch and Noseleit (2013) therefore suggests that urban areas contain advantages regarding the regional employment effects of new business formation compared to rural regions. These advantages are predominantly related to increased competition amongst firms resulting in higher overall productivity (Knoben et al., 2011). Due to relatedness within a network of high entrepreneurial activity, positive indirect effects on employment will highly pronounce themselves at these places, whilst the direct employment effects seem to be decisive for the less densely-populated areas. The latter regions are confronted with relatively low competition or a widespread concentrations of firms resulting in a weaker impact of the creative destruction process.

When applying the empirical studies from Fritsch and Noseleit (2013) and Knoben et al. (2011) to the solo self-employed group, it is suggested that rural economies mainly benefit from the immediate solo self-employed effects. The low concentration of firms in the peripheral areas probably decreases the creative destruction process leading to a less overall innovative character of the regional economy (Knoben et al. 2011). A larger share of the rural solo self-employed then started their business out of a necessity motive when compared to solo self-employed in urban areas (Van Stel and de Vries, 2015). The highly competitive markets that are found in agglomerations typically allow only the innovative solo self-employed to survive the market (Unger et al. 2011). These solo self-employed may in turn offer their flexible services to the incumbent firms (i.e. induce Jacobs' externalities) or increase the overall innovativeness of the market by challenging the incumbents instead (i.e. driven by Marshall externalities). In both scenarios the indirect solo self-employed effects are expected to be more pronounced in agglomerated regions, increasing the employment rates at incumbent firms over time.

The influence of sectors

Recent governmental strategies attempt to persuade new firms to locate within their boundaries by offering business estates and space for their activities (Siegel et al., 2003). As discussed earlier, new business formation is increasingly being related to economic development at the domestic and regional level as newly created businesses often induce employment growth (Birch, 1979; Birch, 1981; Audretsch and Keilbach, 2004; Van Stel and Suddle, 2008; Harisson et al, 2014). Current local policies anticipate on this process by

stimulating start-up formation that could trigger new economic activity in their region (Gustavsen et al., 2007; Knoben et al., 2011). Mack and Mayer (2016) argue that the implementation of these policies may actually enforce positive effects on regional economic structures. Not only tax breaks and investments in public funds could enhance start-up rates, but especially the liberation of the bureaucratic process and governmental restrictions. Entrepreneurs are then provided with an open market predominantly shaped by Schumpeter's (1942) creative destruction process. However, in most cases, new firms in their early stage may only appoint a restricted amount of employers and are constrained by limited financial resources (Knoben et al., 2011). This implies that new firms, including solo self-employed entrants, are more sensitive to changes in policy compared to incumbents.

Despite cultural and political climates may be used to account for differences in entrepreneurial attitudes and the success of new business formation, they mainly disseminate on the national level and do not necessarily play a crucial role for municipalities or regions (Beugelsdijk and Noorderhaven, 2004; Bosma and Schutjens, 2007). The dissimilarities of the skills and motivation among the solo self-employed are more likely to be raised across industries where spatial proximity predominantly defines opportunities for new entries to grow. In general, firms in manufacturing typically operate in more dispersed markets relatively to firms in the service sector. The latter industry tends to be geographically constrained as the firms here hold a greater dependency on regional demand factors (Knoben et al, 2011). In addition to this phenomenon, newly created firms at manufacturing are expected to provoke different indirect effects than in the service sector (Fritsch and Noseleit, 2013). Koster et al. (2012) for example, encountered that start-ups operating in the service sector may induce relatively less broadening of the entire market, whilst Audretsch and Fritsch (1994) and Andersson et al. (2012) argue that overall productivity brought by new firm formation at the service sector is higher than for industrial start-ups.

When solo self-employed start a business out of necessity, they are expected to induce relatively less innovation compared to start-ups. What could also present itself is that particular solo self-employed cherished the opportunity to work autonomously and attempt to supplement the current market by offering unique services or products. Such start-ups tend to contribute to the creative destruction process as they challenge incumbents to become subject to market selection. The heterogeneousness amongst the solo self-employed group could then explain why the innovation levels of solo self-employed are very diverse (Van Stel et al., 2014). Solo self-employed are typically active in different sectors and differ in terms of motivation, level of skills, and both in the degree of autonomy and ambition (Wennekers et al., 2010). Besides, empirical studies have shown that solo self-employed in certain sectors are sometimes provided with so-called 'freelancer opportunities'; When solo self-employed offer their services to incumbent firms they are able to reduce financial risks, financial constraints and fulfil short-term projects (Burke, 2011; Van Stel and De Vries, 2015). Freelancers are then usually active in markets relatively more open to innovative ideas like the service sector, construction, real

estate and the self-crafted products industry (Eurostat, 2020). The study of Audretsch et al. (2020) corroborates earlier findings addressed to the freelancer opportunities as they argue that microfirms, firms with less than ten employees including start-ups and solo self-employed, predominantly contribute to innovation at the knowledge intensive services (KIS) where overall entry barriers are relatively lower. This indicates that the creative destruction process elapses differently in contrast to the manufacturing sector. On the one hand, microfirms in the KIS sector have similar abilities to the incumbent firms to react upon new products or processes (Konon et al., 2018). On the other hand, microfirms in manufacturing are often constrained by their size, meaning that incumbents are provided with the opportunity to perform larger projects and hold a prerequisite for having a considerable amount of economic capability (Audretsch et al., 2020). In this case, only the manufacturing start-ups that perceive serious business opportunities are able to enter the market. These high barriers may cause a preliminary selection effect which in turn improves the innovation standard (Koster et al., 2012). The creative destruction process is then influenced by a higher average quality of new firms resulting in accrued competition among the incumbents. Despite the entry barriers at the service sector are relatively lower than for manufacturing, overall innovation levels still turn out to be higher (Audretsch et al., 2020). However, the innovation process at the service sector mainly derives from a network effect where the solo self-employed improve the local economic conditions by their provision of flexibility to the incumbent firms (Koster et al., 2012). In this case, solo self-employed operating in the KIS sector will not lead to competition effects but rather contribute to the complementation of the respective industry. The empirical studies of Koster et al. (2012) and Audretsch et al. (2020) therefore imply that solo self-employed entrants are influenced by differences in entry barriers and may induce different ways of innovation when decomposing their effects at manufacturing and the service sector.

Municipalities as regional indicator and the presence of spatial spillovers

As described earlier, the inclusion of urbanity degrees and industries is crucial for the analyses as this reflects the differences between the motivations and skills of the solo self-employed. There are multiple empirical studies arguing which regional degree should be used in order to measure the economic environment. On the one hand, Dutch municipalities are a close resemblance to the cities and rural areas within them (Knoben et al., 2011). On the other hand, the regional dimension could be displayed at the NUTS-III spatial aggregation level[1]. This regional scale is commonly applied in Dutch economic research as it resembles 40 labour market regions that indicate the regional-sector level (Bosma et al., 2011; Koster and Van Stel, 2014). However, the NUTS-III classification fails to properly decompose urban, intermediate and rural areas due to the potential error in which a labour market contains multiple urbanity degrees at once. The regions addressed in the NUTS-III division could then display commuting areas where inhabitants of sparse rural areas are possibly working at the nearest city (Warren et al., 2014). Due to this problem, it makes sense to analyse the regional employment effects

[1] This regional division is similar to the Dutch COROP classification.

on a municipal scalar level as municipalities provide a pertinent indicator for the different urbanity degrees.

However, the use of municipalities may in turn provoke a presence of spatial autocorrelation as this potentially creates an overlap amongst the labour markets. So-called spatial spillovers are widely recognized as source of externality reflecting the locally bounded interactions amongst establishments, actors and regional economies (Capello, 2009; Kotikova 2018). The main reason for the presence of spatial autocorrelation is that regional units are administrative in nature rather than a reflection of their regional economies (Frenken et al., 2007). There is sizeable literature concerning the relationship between spatial spillovers and economic development. First, a spatial overlap could be perceived when human capital shaped by firms or institutions does not solely remain at the concerning enterprise (Capello, 2009). These knowledge spillovers could therefore contribute to the creation of capital at other establishments in the respective area (Audretsch and Lehmann, 2005; Capello, 2009). Although knowledge spillovers mainly occur among regional markets, knowledge spillovers may also be linked to the presence of universities. It is suggested that the regions that contain a university are usually provided with higher outputs of entrepreneurial activity (Audretsch and Lehmann, 2005). In this case, however, it could be argued that the presence of a university in the area does not necessarily trigger the establishments of solo self-employed that may in turn induce knowledge spillovers through institutions, but rather apply solely to start-ups. Solo self-employed with a vocational or tertiary degree (i.e., higher education) generally earn less compared to paid employees with the same degree, whereas solo self-employed with a university entrance degree (similar to a high school diploma) have relatively higher incomes than employees with similar degrees (Sorgner et al., 2014). Non-pecuniary motivations, for instance autonomy on the job, are then likely to play a major role for highly educated individuals when becoming a solo self-employer (Van Stel and De Vries, 2015). Despite leaving out the presence of universities as control variable, the potential knowledge spillovers, industrial spillovers and growth spillovers are included for the analyses following a spatial lagged variable of the solo self-employed. Industrial spillovers refer to a situation in which production processes of a firm, usually an incumbent, are modified, enforcing other firms in the surrounding regions to alter their in- or output linkages. Growth spillovers occur based on a change in the local economy, influencing economic development of the neighbouring local economies through market relationships and trade linkages (Capello, 2009).

Conceptual model

An important finding within several studies that address the impact of new firm formation on the economic development of regions is that new businesses bring an immediate effect and an indirect effect (Fritsch and Mueller, 2004). The immediate effect, in terms of employment, typically reflects the additional labour established at the new entries. In order to initiate solo self-employed firms, a part of the solo self-employers is drawn from the initial labour market. Although in effect this only leads to a reshuffling of the working class, it could also occur that

employees are drawn from the pool of people that were unemployed or inactive at the current labour market. Subsequently, new jobs are realized and a positive immediate effect emerges automatically (Koster and Van Stel, 2014). The indirect effects are shaped in two possible ways: (1) The solo self-employed induce a creative destruction process in which incumbent firms are challenged by the solo self-employed entries to improve their performance. If the incumbents fail to redevelop their business case, they are forced to downsize or even exit the market; (2) The process entails a network effect where solo self-employed offer their flexible services to the incumbent firms. Those that cooperate with the solo self-employed may reduce the risk of worker downtime and hire specialist workers whose skills are required only during parts of the year or for one-off projects (Burke, 2011). Due to this collaboration, the incumbent firms could advance their market position.

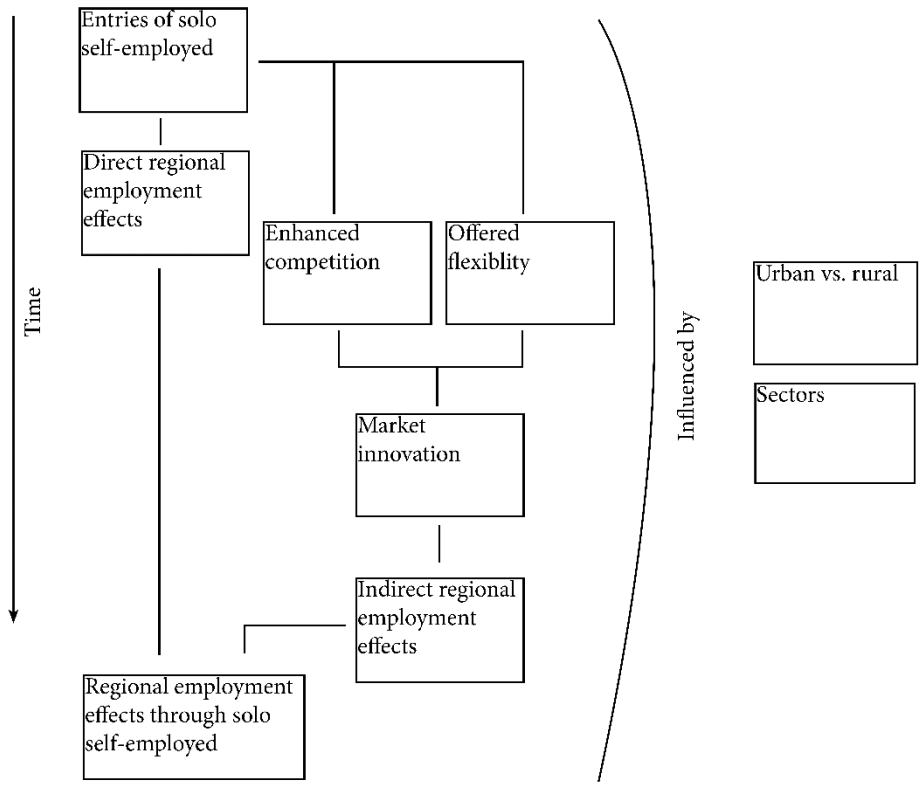

Figure 3: Conceptual model.

The atop line of argumentation was brought together in a conceptual model as highlighted in figure 3. The conceptual model is used to provide an answer to the main research question: "*What are the regional employment effects of solo self-employed in the Netherlands?".* The summary described above explains that solo self-employed entries lead to an ever changing composition of the firm population in regional economies, where the average quality of the overall market continuoulsy improves as a result of the interaction between the new entrants and the current incumbents. It is suggested that the indirect effects are therefore more tangible

than the immediate effects. The strength of the the solo self-employed impact on employment change relies on the differences in urbanity degrees and industries. Decomposing the regional climates may then reflect the competitiveness of the concerning market and the motivation and skills behind the solo self-employed operating within these different climates. This particular study could therefore elucidate some of the heterogeniety amongst the solo self-employed and their influence on employment change. The expectation of this research is as follows:

"Within the Netherlands, the indirect regional employment effects through solo self-employed are of greater influence to employment change compared to the immediate effects. Indirect regional employment effects are subject to 'creative destruction', where innovation over time leads to higher employment rates. The regional entrepreneurial climates define the exact impact of the direct and indirect regional employment effects as solo self-employed are constrained by markets with high or low competition and dense or widespread networks amongst firms. First, it is expected that due to a higher concentration of firms urban areas tend to stimulate the competition process or better facilitate networks among firms, whereas solo self-employment in rural regions is more often used as a solution to fight unemployment. The direct effects will then be greater in rural areas while the indirect effects on employment change are more tangible within agglomerations. Second, solo self-employed in the knowledge intensive service sector presumably bring higher innovation levels than in manufacturing as solo self-employed operating in the knowledge intensive sector tend to engage more frequently in new processes and innovative activities".

3. Methodology

This empirical study aims to capture the immediate and indirect solo self-employment effects on regional employment change and to what extent these effects are intensified by regional urbanity levels and sectors. In order to measure such effects, the analyses examine the relationship between the regional growth rates of solo self-employed and the change in the amount of jobs in similar areas over time. The main method of this research is drawn upon Almon polynomial distributed lag (APDL) models to inquire both short-run and long-run relationships, along with the presence of nonlinearity. The Almon lag structure, initiated by Shirley Almon (1965), generates time lags for both the dependent and explanatory variables based on either an ordinary least squares regression or a generalized least squares regression when applying spatial lags to the model (Greene, 2003). Such a method allows for measuring the correlation between the annual rates of solo self-employed in earlier years and the development in regional employment at the current annual period. Once time lags are included, the 'creative destruction' process and formation of the supply-side effects resulting from an increase in solo self-employed entries in the region may then come forward.

The data used for the analysis is derived from the establishment file of the 'Landelijk Informatie Systeem van Arbeidsplaatsen' (from here: LISA), which stands for the 'National Information System of Jobs'. Typically, the LISA database contains yearly data of Dutch firms from 1996 to 2018 including SBI codes, geographical locations on the zip code level, the number of employees and the legal forms of all businesses. Employment development could then be visualized at any geographical degree and for each economic activity on an annual basis. The overall database adjusted for this empirical research represents all job locations in the Netherlands form 1996 to 2018, including 147.168 incumbent businesses and 133.158 solo self-employed firms. Here all firms managed by one autonomous person are being classified as the solo self-employed pool. The LISA dataset thus allows for a region-specific analysis over time which is needed for the implementation of the APDL models.

The immediate and indirect employment effects of solo self-employed are calculated based on net annual cohorts. The yearly growth of solo self-employed in a particular area is followed over time and compared with the employment development at the incumbent businesses in the same regional areas. In the next APDL regressions, the employment effects are explored for each sector and regional urbanity degree. The following formula was applied in order to calculate the direct employment effects through solo self-employed:

$$\Delta\, Emp\ SSE = \frac{Emp\ SSE\ t = n - Emp\ SSE\ t = n - 1}{Emp\ total\ t = n - 1} * 100$$

The change in *Emp SSE* denotes the development rate of the direct solo self-employed contribution on overall regional employment. This development rate is measured by the annual

growth or decline in year *t=n* relatively to year *t=n-1* divided by the total employment level of *t=n-1*.

Another way of measuring the direct impact of new business formation on regional employment is to compare the employment share in total employment in period t=0 with the change in individual employment share in the subsequent cohorts. Although the direct effect of new businesses within period t=1 is positive by definition, it could become negative in following the cohorts when new entries are forced to leave the market due to a highly competitive reaction of other firms (Schumpeter, 1942; Fritsch and Mueller, 2004; Fritsch and Noseleit, 2013). Using cohort data of individual firms may, however, affect the influence of solo self-employed on regional employment rates; Many start-ups commence as a solo self-employed firm, but as soon these firms are given the opportunity to enlarge their business they could change their legal forms alongside with their growth. Due to this potential error, the direct effects of solo self-employed on regional employment change are calculated based on net annual cohorts. The interpretation of the data then becomes slightly different, as the yearly growth rate of solo self-employed as percentage of the total employment rate indicates the direct employment effects. Despite individual firms may not be followed over time, the overall effects of solo self-employed could still be shown through the Almon lag structure. New jobs created through solo self-employed entries then represent the direct effects, whereas newly created employment at incumbent firms, as a result of an increase in solo self-employed, represents the indirect effects.

In order to capture the indirect employment effects of solo self-employed entries, the employment development at incumbents needs to be followed over time as well. To execute the analyses, the LISA dataset has been divided between solo self-employed firms on the one hand, and all remaining firms representing a different legal form, on the other hand. Again, the yearly change in employment is calculated according to the net annual rates. This method thus allocates all new registered employment either to the solo self-employed or to the incumbent firms; The annual employment change percentages in both groups are weighted based on their respective share in total employment which may be explained by the following example: If the share of solo self-employed in total employment is 20 percent and the employment change in this group is 10 percent, the respective employment change for solo self-employed is 20 * 0.1 = 2.0 percent. The share of the incumbents in employment change then becomes 80 percent. If the employment change within these businesses is 2 percent, the weighted employment change of the incumbent firms is 2 * 0.80 = 1.6 percent. Summing up the weighted employment change of solo self-employed and the employing firms leads to 2.0 + 1.6 = 3.6 percent, which translates into the overall (regional) employment change. The contribution of solo self-employed to regional employment change conclusively becomes (2.0 / 3.6) * 100 = 55,5 percent, whereas the share of the incumbents covers (1.6 / 3.6) * 100 = 45,5 percent. The weighted employment change *ΔEmp rbu* is calculated using the formulas highlighted in table 1. A two-year average for the employing firms is applied due to possible disturbances by short-term fluctuations. The annual development in total employment and the incumbents is then

displayed as the average change between the periods t+2 and t+0. To clarify the aggregate change in regional employment, the solo self-employed development rates of the year t=0 are regressed with each of the preceding annual periods from year t-1 to t-10 on the weighted employment change in incumbent firms between year t+0 and t+2.

Table 1: calculation method for the indirect employment effects.

Employment change in remaining businesses: $$Emp\ INC\ t = 0 = Emp\ total\ t = 0 - Emp\ SSE\ t = 0\ to\ t - 10$$ $$Emp\ INC\ t = 2 = Emp\ total\ t + 2 - Emp\ SSE\ t + 2\ to\ t - 10$$
Regional two-year employment change of the indirect effects: $$\Delta\ Emp\ INC = \frac{Emp\ INC\ t = n - Emp\ INC\ t = n - 2}{Emp\ total\ t = n - 2} * 100$$ Regional share of employees in incumbent firms of total employment in period t=0 to t+2: $$\Delta\ Emp\ INC = \frac{Emp\ INC\ t = 2 - Emp\ INC\ t = 0}{emp\ total\ t = 0} * 100$$

The first model in the analyses regresses the solo self-employed development rates on employment change at incumbent firms. This unrestricted regression, however, may generate two possible ways of pronounced multicollinearity. First, the annual solo self-employed rates may be highly correlated over time; The start-rate of solo self-employers in year t=0 could become slightly different in subsequent years, but more or less still indicate the same results. Second, employment growth at the other businesses could also stimulate an increase in solo self-employment, for instance when there is a rising demand from incumbents for flexible one-man-job assignments. It then becomes unclear whether the trend in employment growth is derived from the solo self-employed entries or the increased economic activities at the other businesses. The Almon polynomial lag structure re-formulates the model prior to its own estimation from which the values of the regression coefficients are converted by a polynomial order of 'P'. This operation establishes Z-vectors for the concerning independent variable(s) and every periodic combination through time. After choosing an optimal lag-length, i.e. the time lags in which the effects may occur, it is possible to effectively impose exact linear restrictions on the original coefficients. The created Z-vectors ensure that the presence of multicollinearity is highly unlikely. A second model will therefore show statistically improved regressions using different orders of Almon polynomial lags to provide well-fitted solutions.
In order to control for time invariant heterogeneity across municipalities the final regressions deal with spatial autocorrelation by the inclusion of spatial lags. In addition, a control variable for regional population numbers was added as population numbers account for several

environmental aspects such as the number of businesses, density of local markets, house prices and the degree of local knowledge spillovers (Fritsch and Mueller, 2004; Fritsch and Noseleit, 2013). The municipal population numbers are derived from the CBS and included for the years 2002 to 2018. The development rates between cohorts 1996 to 2001 have therefore been excluded from the analyses. Table 2 indicates the descriptive statistics for the time lagged solo self-employed rates over a period of ten years, the time lagged rates for the incumbent firms and the control variables. The statistics clearly show the effect of time lags as each preceding year results in less observations. Besides, both the mean of the solo self-employed rates and the mean of the incumbent rates fluctuate somewhere between 0.5 and 2.2. The annual change in employment (either at the solo self-employed or at the incumbents) is divided by the total amount of jobs at the beginning of the year. When a change at the solo self-employed pool tremendously contributes to a rise in employment at the incumbent firms, it means that the rate becomes automatically larger than if there is a small change in employment. The possible range of the rates is therefore infinite, where rates may also adopt a negative outcome. The latter possibility resembles a situation in which either the solo self-employed number or the pool of incumbents declines during the concerning annual period.

Table 2: Descriptive statistics for the general model

Variable	*N*	*Mean*	*Std. Dev.*	*Min*	*Max*
SSE rate					
L0.	5,680	.5874584	.7586863	-1.49592	8.391973
L1.	5,325	.5824173	.7775148	-1.49592	8.391973
L2.	4,970	.5962403	.7987918	-1.49592	8.391973
L3.	4,615	.5984918	.8066334	-1.49592	8.391973
L4.	4,260	.6154243	.8322799	-1.49592	8.391973
L5.	3,905	.6458183	.8525251	-1.383105	8.391973
L6.	3,550	.6836364	.8781411	-1.383105	8.391973
L7.	3,195	.7121473	.9047222	-1.383105	8.391973
L8.	2,840	.7203029	.9434458	-1.383105	8.391973
L9.	2,485	.6854337	.8785397	-1.383105	8.391973
L10.	2,130	.4596753	.4216767	-1.383105	2.961276
INC rate					
L0.	5,325	1.263045	4.02166	-19.70016	34.24974
L1.	4,970	1.13853	4.064333	-19.70016	34.24974
L2.	4,615	1.057154	4.10987	-19.70016	34.24974
L3.	4,260	1.046116	4.172072	-17.95527	34.24974
L4.	3,905	1.187558	4.252608	-17.95527	34.24974
L5.	3,550	1.479985	4.2585	-16.98431	34.24974
L6.	3,195	1.779016	4.266946	-16.0784	34.24974
L7.	2,840	1.959693	4.356955	-16.0784	34.24974
L8.	2,485	2.034108	4.311376	-16.0784	34.24974
L9.	2,130	2.142408	4.174763	-16.0784	26.68622
L10.	1,775	2.004156	4.318805	-16.0784	21.78432
Regional population	6,035	46636.76	66586.61	919	854047
W_SSE rate L0.	5,680	.5874584	.4247125	.1842898	2.045433

When the overall regional employment effects of either new business formation or solo self-employed are added up, the outcome shows an overview of the average impact. Previous studies, however, have shown that the employment effects resulting from start-ups are different for certain types of regions or industries.[2] Decomposing the regional characteristics of areas may then clarify some of the heterogeneity amongst the solo self-employed pool. For assessing the aggregate effects of solo self-employed in different environments or markets, the same Almon lag regression model was used but included with dummies for the classifications that interact with the solo self-employed rates. The most influential characteristics of regional environments on economic development, as highlighted in section two, are expected to be the different types of urbanity degrees and the division between knowledge intensive sectors and manufacturing. The LISA register contains these categorizations allowing to analyse the effects of regional environments in a proper manner. LISA uses the following classifications: 'Not urbanized', 'slightly urbanized', 'moderately urbanized', 'strongly urbanized'; 'very highly urbanized'.

Table 3: Descriptive statistics for the urbanity degrees

	Agglomerations			*Moderately urbanized areas*			*Rural regions*		
Variable	*N*	*Mean*	*Std. Dev.*	*N*	*Mean*	*Std. Dev.*	*N*	*Mean*	*Std. Dev.*
SSE rate									
L0.	1,520	.502957	.6231695	3,264	.5966337	.727299	896	.6973848	1.019917
L1.	1,425	.4897332	.6345168	3,060	.5920114	.7448506	840	.7046996	1.048849
L2.	1,330	.4908209	.6533861	2,856	.6080351	.7645739	784	.7321097	1.074841
L3.	1,235	.4719542	.6316906	2,652	.6119476	.7733625	728	.7641361	1.10268
L4.	1,140	.4793323	.6515844	2,448	.6292522	.7972634	672	.7959218	1.137185
L5.	1,045	.4969952	.6673657	2,244	.6613888	.8135776	616	.8415645	1.169043
L6.	950	.5185569	.689243	2,040	.6994518	.8364008	560	.9060684	1.200326
L7.	855	.5202237	.7062017	1,836	.7303868	.8598672	504	.9712882	1.233846
L8.	760	.5141379	.7357911	1,632	.7417013	.8938556	448	.9920956	1.292531
L9.	665	.3949036	.4080679	1,428	.723741	.8347388	392	1.038749	1.342959
L10.	570	.3373468	.3695653	1,224	.4840451	.4071389	336	.5784214	.50112
INC rate									
L0.	1,425	1.241418	4.249064	3,060	1.347129	4.012771	840	.9934318	3.630585
L1.	1,330	1.140335	4.337894	2,856	1.223284	4.039114	784	.8267237	3.644343
L2.	1,235	1.062754	4.416378	2,652	1.134801	4.064269	728	.7647968	3.708533
L3.	1,140	1.054489	4.509967	2,448	1.124072	4.105316	672	.7479335	3.792378
L4.	1,045	1.213538	4.618579	2,244	1.267527	4.172223	616	.8521699	3.868468
L5.	950	1.520225	4.66245	2,040	1.563937	4.149711	560	1.105899	3.905097
L6.	855	1.834882	4.717663	1,836	1.85857	4.140842	504	1.394443	3.885256
L7.	760	2.041844	4.829975	1,632	2.007889	4.235134	448	1.64476	3.922884
L8.	665	1.982961	4.779416	1,428	2.109649	4.180143	392	1.84569	3.932375
L9.	570	1.883106	4.55477	1,224	2.31956	4.03509	336	1.936955	3.976576
L10.	475	1.698184	4.641354	1,020	2.236571	4.194356	280	1.676559	4.156999
Population proxy	1,615	95188.93	112158.2	3,468	30324.48	17446.45	952	23694.79	13130.2

[2] See for example Koster et al. (2012), Fritsch and Noseleit (2013) or Audretsch et al. (2020).

W_SSE rate L0.	1,520	.5876971	.4255236	3,264	.5874325	.4246899	896	.5871479	.4238905

Grouping of urbanity degrees is, however, discussed in various empirical research. Warren et al. (2014) show that the definition of rurality differentiates between countries, especially when comparing the rural areas of the United States with the peripheral areas of European countries. The Netherlands for instance, are mainly covered with highly urbanized areas and most inhabitants are living in cities or suburban cores. Subsequently, it may be argued that remoted rural areas do not present themselves in the Netherlands, which is why rural regions are often being classified as 'not urbanized' (Hart et al., 2005). For the analysis, the 'not urbanized' category is being classified as the 'rural regions', the 'slightly urbanized' and 'moderately urbanized' regions are changed into the 'moderately urbanized areas', whereas the 'strongly urbanized' and 'very highly urbanized' municipalities will represent the 'agglomerations. This extra division is made both in order to create sufficient distinction between the categories and to provide adequate cases for each urbanity degree. Previous studies on start-ups have also used similar classifications for the urbanity levels of areas.[3] Table 3 contains similar descriptive statistics compared to table 2, but now shows the number of observations, mean and standard deviation for the agglomerations, moderately urbanized areas and rural regions. What could be observed is that the mean of the solo self-employed rates for the agglomerations is relatively lower compared to the other urbanity degrees, whereas the rates at the incumbents are somewhat higher in the agglomerations and moderately urbanized areas than for the rural regions. This is mainly caused by the calculation procedure; The rates represent the annual change indicated as percentage of the total number of jobs for each region at the beginning of the period. New entries of solo self-employed, logically, are then less represented in cities whilst more pronounced in the thinner employment population at rural areas.

When addressing the sectorial data, LISA classifies industries following the standard business format developed by the CBS (Kruiskamp, 2008). These different industries are divided according to the theory initiated by Audretsch et al (2020)[4]; The businesses operating within knowledge intensive sectors tend to trigger higher levels of innovation and are therefore more likely to contribute to increased indirect employment effects. An extra division in the total employment numbers was applied to create four groups: The solo self-employed jobs in the knowledge intensive sector, the solo self-employed jobs in manufacturing, the remaining jobs in other businesses in the knowledge intensive sector and the remaining jobs in other

[3] See Fritsch and Noseleit (2013) for a corresponding approach.

[4] The following industries are subdivided amongst manufacturing: Agriculture, forestry and fishing; Extraction of minerals; Manufacturing; Production and distribution of electricity, natural gas, steam and cooled air trade; Extraction and distribution of water, waste and wastewater management and remediation; Construction; Wholesale and retail trade, Transportation and storage; Lodging, meals and drinks; Culture, sports and recreation. The remaining industries are then classified as knowledge intensive sectors, which are: Information and communication; Financial institutions; Rental and trade in real estate; Consulting, research and other specialists services; Rental of movable property and other business services; Public administration, government services and compulsory social insurance; Education; Health and Wellness care; Extraterritorial organization; Remaining services.

businesses in manufacturing. Again, the same Almon lag structure was used to execute regressions for the different types of industry. Table 4 shows the descriptive statistics for the knowledge intensive sector and manufacturing. The number of observations is equal for both sectors as these observations are derived from either the solo self-employed rates or the rates for the remaining businesses at a certain municipality and sector. It is therefore not the number of businesses that represent the observations, but the change in employment at each municipality. The statistics imply that firms in manufacturing are changing relatively more quickly as the means of the rates are higher than for the knowledge intensive sector. This suggests that the creative destruction process could be more tangible here.

Table 4: Descriptive statistics for the knowledge intensive sectors and manufacturing

	Knowledge intensive sector					*Manufacturing*				
Variable	*N*	*Mean*	*Std. Dev.*	*Min*	*Max*	*N*	*Mean*	*Std. Dev.*	*Min*	*Max*
SSE rate										
L0.	5,325	.44656	1.097887	-4.301075	17.56026	5,325	.874826	.8780642	-2.232796	11.08765
L1.	4,615	.4832462	1.162909	-4.301075	17.56026	4,615	.8585659	.8838915	-2.232796	11.08765
L2.	4,260	.4964583	1.204631	-4.301075	17.56026	4,260	.8499691	.9208523	-2.232796	11.08765
L3.	3,905	.4966274	1.224639	-4.301075	17.56026	3,905	.8043531	.7290277	-2.232796	6.160382
L4.	3,550	.2741602	.5595033	-4.301075	8.536585	3,550	.8729215	.9534227	-2.232796	11.08765
L5.	3,195	.577044	1.3609	-1.801802	17.56026	3,195	.9195087	.9772217	-1.374093	11.08765
L6.	3,195	.5633609	1.361319	-4.301075	17.56026	3,195	.9234154	.9776456	-1.374093	11.08765
L7.	2,840	.6510074	1.419422	-4.301075	17.56026	2,840	.9454281	.9682036	-1.374093	11.08765
L8.	2,485	.7130994	1.491449	-4.301075	17.56026	2,485	.9310747	.9966311	-1.374093	11.08765
L9.	2,130	.7991808	1.548309	-4.301075	17.56026	2,130	.8595326	.6717931	-1.259446	5.023548
L10.	1,775	.3574804	.4874624	-4.301075	8.536585	1,775	.7885461	.6715961	-1.374093	6.160382
INC rate										
L0.	4,970	1.711425	6.366651	-27.58621	56.65317	4,970	3.103542	6.038557	-28.37901	71.74515
L1.	4,260	1.797827	6.661671	-27.58621	56.65317	4,260	3.221589	6.223335	-28.37901	71.74515
L2.	3,905	1.688298	6.794555	-27.58621	56.65317	3,905	3.158326	6.277778	-28.37901	71.74515
L3.	3,550	.9921515	6.260062	-27.58621	56.65317	3,550	3.277805	6.249834	-28.37901	71.74515
L4.	3,195	.8392669	6.218292	-27.58621	53.31263	3,195	3.678178	6.468124	-28.37901	71.74515
L5.	2,840	1.840078	7.460952	-27.58621	56.65317	2,840	4.103356	6.438406	-22.2449	71.74515
L6.	2,840	1.95781	7.45907	-27.58621	56.65317	2,840	4.205708	6.449871	-22.2449	71.74515
L7.	2,485	2.775433	7.752386	-27.58621	56.65317	2,485	4.853309	6.470523	-22.2449	71.74515
L8.	2,130	3.648646	7.827095	-27.58621	56.65317	2,130	5.124679	6.397572	-22.2449	71.74515
L9.	1,775	3.130986	7.08006	-21.61431	56.65317	1,775	4.913651	6.176544	-19.02326	44.37608
L10.	1,775	.879233	5.350206	-27.58621	20.85594	1,775	4.557697	6.43344	-22.2449	71.74515
Population proxy	5,680	46605.23	66500.36	919	854047	5,680	46605.23	66500.36	919	854047
W_SSE rate L0.	5,325	.44656	.6845393	.0449306	2.958091	5,325	.874826	.3241981	.3554717	1.675099

4. Empirical results

As described in earlier sections, the innovation levels of the overall solo self-employed group is potentially lower than that of start-ups. The overall solo self-employed effects are expectedly brought down both by those operating in less innovative markets and the ones that started their business out of necessity circumstances. In order to estimate the regional employment effects, various regressions are implemented showing step-by-step results that lead to a final model. The final model implies to estimate the real-world phenomena, i.e. the impact of solo self-employed entries on regional employment, as best as possible. The heterogeneity amongst the solo self-employed group, however, yields certain problems to analyse their effects; It becomes less straightforward to grasp or define the concept of an individual solo self-employer. As a first step, this empirical study highlights the regional employment effects of solo self-employers from a general point of view. These effects show both direct and indirect impacts of the solo self-employed on regional economies and may indicate whether solo self-employed as a whole contribute to regional innovation levels. Subsequently, new regressions are performed for each urbanity degree and sector. Such regressions allow for comparisons between different backgrounds of solo self-employed and may therefore provide new insights to the effects of subgroups within this heterogeneous pool.

Descriptive analysis

In order to shed light on the solo self-employed effects on regional employment change, few descriptive statistics are generated that show the current development of the solo self-employed in the Netherlands. Figure 3 illustrates the periodic SSE share denoted as the average amount of solo self-employed during the designated period divided by the total municipal population number at the starting year. For the analyses, the municipal borders of 2019 are used as base layer. In case municipal borders have changed over time, e.g. through a merge or a change of name, previous employment numbers are included for the new municipality. It is clearly indicated that the presence of the solo self-employed has become more tangible when comparing the periodic shares. For the period between 2002 and 2004, solo self-employed shares higher than 20 percent are only observed for a few municipalities in the Randstad (Bergen, Landsmeer, Waterland and Zandvoort) and for Mook en Middelaar in the province of Limburg. When exploring the period from 2016 to 2018, however, the solo self-employed shares seemingly grow amongst different Dutch municipalities. For instance, two out out five Wadden Islands, the whole province of Friesland (expect for Leeuwarden, Heerenveen and Harlingen) and the municipalities of Hollands kroon, Drechterland, Koggenland, Langedijk, Bergen, Heilo, Castricum, Beemster, Womerland, Oostzaan, Landsmeer, Waterland, Bloemendaal and Heemstede within the province of Noord-Holland contained a solo self-employed share higher than 20 percent during this period. During the period of 2016 to 2018, the region of Sluis appears to be the only municipality containing a solo self-employed share of less than 10 percent. This trend corroborates the finding that the solo self-employed are increasingly participating in the market as reflected in the introduction (see figure 1).

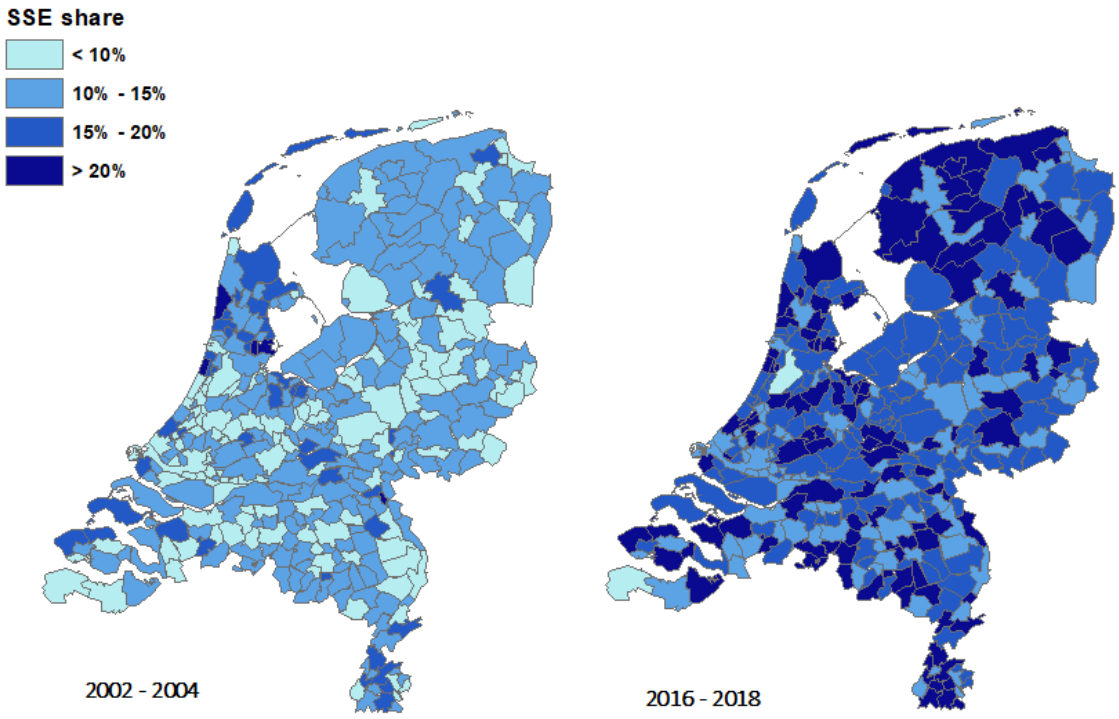

Figure 3: The average solo self-employed share over a period of three years as percentage of the regional employment at the starting year.

Whilst figure 3 indicates the solo self-employed share, figure 4 contains the periodic growth rate of the solo self-employed. The solo self-employed development is measured according to an increase or decrease of the solo self-employed as share of the regional employment. Again a period of three years is used to compare different cohorts in time. The periodic growth indicator typically tends to be more vulnerable to short-term fluctuations than the solo self-employed share, but may clearly highlight the current regional development at the solo self-employed pool. For the years between 2002 and 2004, the solo self-employed were especially growing amongst the municipalities of Reimerswaal, Kapelle, Tholen and Veere (Zeeland), Bergeijk (Noord-Brabant), Rozendaal (Gelderland), Midden-Delfland and Peijnacker Nootdorp (Zuid-Holland), whilst periodic decline remarkably occurred among the same provinces that contained municipalities with a growth higher than 2 percent as well; The biggest solo self-employed decreases are observed in a large part of Noord-Holland and Zuid-Holland, whereas several municipalities in Zeeland, Noord-Brabant (clustered around the region of Bergeijk) and the municipalities of Losser, Almelo, Hof van Twente, Voorst and Elburg also indicate a declining solo self-employed group. Although the solo self-employed development from 2002 to 2004 seems to be scattered throughout the country, the trends become less randomly divided during the period from 2016 to 2018. From a domestic perspective, the solo self-employed growth rate became higher for almost every municipality. A slight decline was found

only for the municipalities of Delfzijl, Loppersum, Borne and Voerendaal, whilst solo self-employed growth rates above 2 percent appeared around Someren, Boekel, Grave, Mill en Sint Hubert, Bernheze, Haaren, Heusden, Alphen Chaam, Maassluis, Bloemendaal, Zandvoort, Westervoort, Weesp, Voorschoten, Oudewater, Landsmeer, Hillegom, Eemnes en Blaricum. The municipalities experiencing a declining solo self-employed pool are predominantly rural areas. This carefully suggests that solo self-employed either perceive less opportunities in rural areas or that dispersed regions decrease potential supplementation of current networks. However, it is difficult to draw strong conclusions based on the insights given by the maps as shown in figure 3 and 4, particularly when the positive growth rates are disproportionally located among the municipalities.

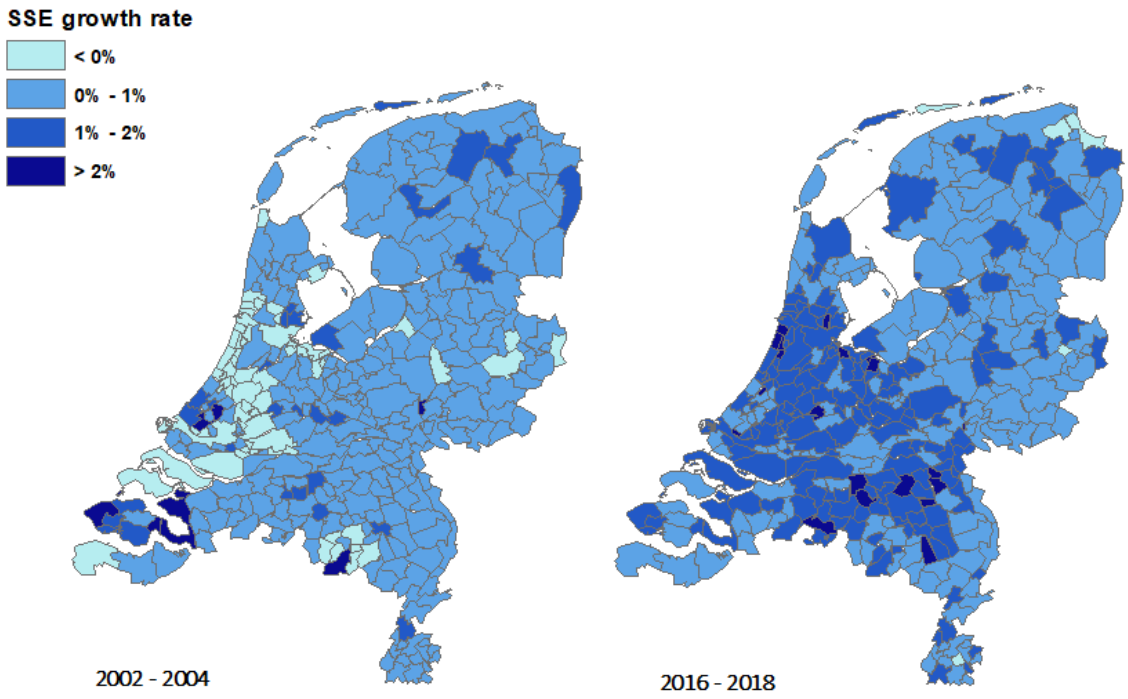

Figure 4: The periodic development percentage of the solo self-employed as share of the regional employment.

All in all, however, it appears that solo self-employed tend to present themselves in clusters; The increase of solo self-employed in the Randstad and the province of Noord-Brabant shows that the highest growth rates amongst for instance Bloemendaal and Zandvoort or Heusden and Haaren are followed by a slightly smaller increase between 1 and 2 percent at the surrounding municipalities. These observations show the importance to add spatial lags when regressing the solo self-employed effects on regional employment change in the next chapter. Further regressions will also focus on regional aspects that reflect the motivations and skills of the solo self-employed. This may then clarify whether the highest solo self-employed shares and growth rates are predominantly clarified at, for instance, the urban municipalities.

Standard time-lagged regression model

In order to define the solo self-employed effects on regional employment, a first model was estimated including the solo self-employed development rates at the beginning of the inspected period of employment change, i.e. the current year, and each consecutive solo self-employed development rates of the ten preceding years. It is assumed that the effect on regional employment change through solo self-employed entries develops over a period of ten years.[5] Figure 5 shows that, when including all solo self-employed development rates in one model, the negative impacts for solo self-employed are found for the years t-2, t-5, t-6 and t-7. The solo self-employed development rates of the yearly cohorts t=0, t-1, t-3, t-8 and t-10 hold a positive impact on regional employment change.

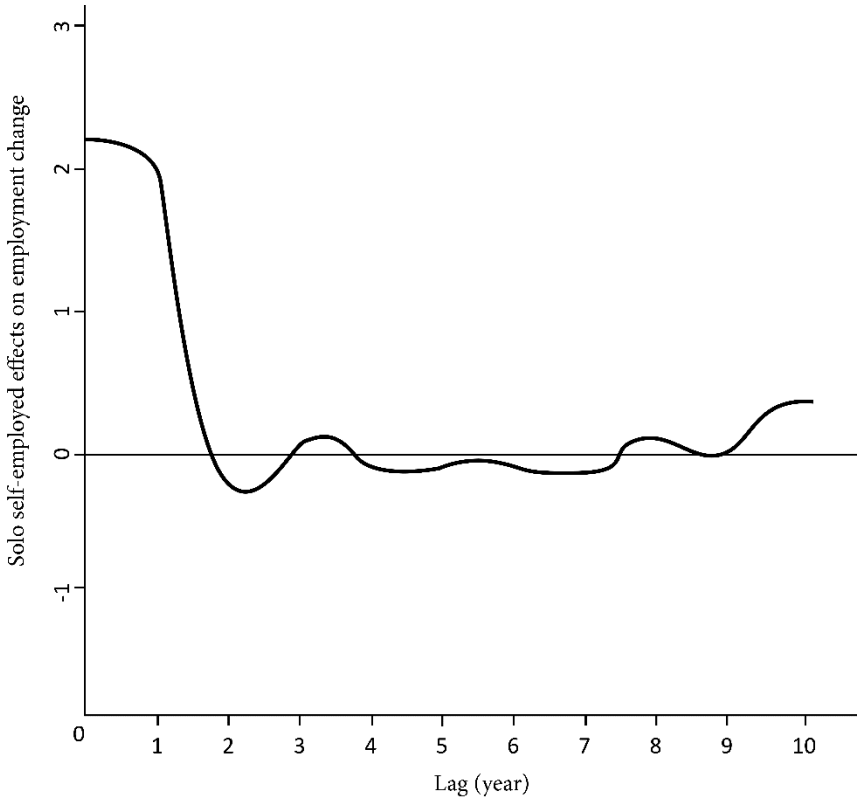

Figure 5: The regression coefficient structure of the solo self-employed effects on regional employment following a standard time-lagged regression that accounts for entry rates over ten years.

The regression results including all solo self-employed development rates between t-1 and t-10 thus implies both a negative and positive relationship between solo self-employed activity and employment growth. Table 5 indicates the regression output containing four different

[5] Ten lags were chosen due to earlier studies performing similar regressions on employment change for start-up rates (See Fritsch and Mueller, 2004; Van Stel and Storey, 2004; Fritsch and Noseleit, 2013). The strongest solo self-employed effects on regional employment are found during the years t-5 and t-8, but seem to flatten after t-10. When running models with eleven or twelve periods, the regression coefficients become less statistically significant.

models. The first model solely regresses the solo self-employed development rates on the regional employment change in the remaining businesses.

Table 5: The impact of lagged solo self-employed development rates on regional employment change

Standard (OLS) time-lagged regression

Model	*(1)*	*(2)*	*(3)*	*(4)*
Constant	-1.66***	-1.78***	-1.97***	-4.802 ***
	(-7.10)	(-7.20)	(-6.90)	(-13.09)
SSE-rate current year t=0	2.083***	2.072***	2.081***	1.572***
	(13.79)	(13.70)	(13.70)	(10.29)
SSE-rate year t-1	1.893***	1.883***	1.888***	2.073***
	(13.30)	(13.22)	(13.23)	(14.95)
SSE-rate year t-2	-.084	-.092	-.09	-.142
	(-0.63)	-(0.68)	(-0.67)	(-1.10)
SSE-rate year t-3	-.066	-.066	-.069	.083
	(-0.70)	-(0.69)	(-0.73)	(0.89)
SSE-rate year t-4	-.202***	-.194***	-.206***	-.008
	(-3.18)	-(3.06)	(-3.14)	(-0.13)
SSE-rate year t-5	-.319***	-.313***	-.323***	-.132**
	(-5.20)	-(5.11)	(-5.16)	(-2.10)
SSE-rate year t-6	-.167***	-.161**	-.17***	-.105*
	(-2.65)	-(2.55)	(-2.64)	(-1.68)
SSE-rate year t-7	.118*	.125*	.115*	-.087
	(1.81)	(1.92)	(1.73)	(1.31)
SSE-rate year t-8	.253***	.26***	.25***	.284***
	(3.74)	(3.84)	(3.61)	(4.22)
SSE-rate year t-9	.594***	.605***	.588***	.08
	(7.82)	(7.93)	(7.39)	(0.91)
SSE-rate year t-10	.834***	.839***	.819***	.53***
	(4.93)	(4.96)	(4.81)	(3.19)
Regional population proxy		0	0*	0*
		(1.52)	(1.90)	(1.95)
Urban areas (1) (base)	-	-	-	-
Moderately urbanized areas (2)			.31	.504**
			(1.31)	(2.15)
Rural regions (3)			.231	.547*
			(0.70)	(1.67)
W_SSE-rate_t=0				7.178***
				(12.10)
R^2	0.3280	0.3282	0.3281	0.3720
Wald Chi^2	915.62	918.96	919.92	1135.59
Prob > Chi^2	0.0000	0.0000	0.0000	0.0000

*Notes: T-values in parentheses; *** statistically significant at the 1% level; ** statistically at significant at the 5% level; * statistically significant at the 10% level.N = 2130.*

For the consecutive regressions, anew (proxy) variable was added to the model resulting in the structure of solo self-employed effects on regional employment change as shown in figure 5[6].

[6] Several population numbers of modified municipalities are (partly) not included in the analyses due to missing values within the CBS dataset: Waadhoeke was not included for Menameradiel. Boarnsterhim was divided amongst four other municipalities by the year of 2014, which complicates redistribution of the populations numbers. The same counts for Maasdonk (allocated between Oss and Den Bosch in 2015), Littenseradeel

Table 5 implies that there is a clear positive immediate effect on regional employment change in years t=0 and t-1. Although the immediate setting-up of new capacities is positive by definition, the creative destruction process soon arises during year t-2 and becomes statistically significant by the year t-5. During year t-8 and t-10, increased competitiveness provokes rising markets and economic growth induced by the indirect supply-side effects. Model (4) indicates the relevance of spatial autocorrelation; The R-squared becomes much larger than within the other models. The regressions accounted for spatial autocorrelation using a spatial weighting matrix. Spatial autoregressive (SAR) models specifies spatial lags for both the dependent and independent variables. Model (4) was given a nearest neighbour matrix in order to add spatial lags for the solo self-employed development rates. Municipal clusters of increased solo self-employed activity are then attenuated as solo self-employed may take on jobs in surrounding regions, allowing other businesses to develop there as well. Though the regressions estimated in table 5 nearly capture the solo self-employment impact on regional employment, a high correlation amongst solo self-employed development rates for subsequent years was observed. The regression coefficients for each year may not necessarily reflect the effects of solo self-employed activity solely in the concerning year but also in other annual periods. The current model fails to take these impacts into account generating possible pronounced multicollinearity as a result. Interpretation of the regression coefficients then becomes highly problematic. In order to deal with this issue, Almon polynomial lags are implemented.[7] Generally, the Almon lag procedure reduces the effect of multicollinearity in distributed lags by transforming the lag coefficient according to a polynomial function of a finite degree.

The Shirley Almon polynomial distributed lag model

When applying the Almon lag structure instead of a standard time-lagged model, the type of polynomial assumed becomes a rather critical issue. Table 6 indicates an overview of the robust regressions for the solo self-employed development rates but this time with applied Almon lags of second-, third-, fourth-, and fifth-order polynomials. Figure 6 represents the lag structures resulting from the different types of polynomials assumed. This graphical display implies that a second-order polynomials results in a U-shaped structure for the effects of solo self-employed on regional employment change. The results show that though solo self-employed entries in years t=0, t-1, t-2 and t-3 have a positive impact on employment change, their influence turns negative in t-4 to t-7. After t-8 the positive effects are yielded again for the last three years. When applying a third-order polynomial, the regression becomes a quite different type of lag structure, which may also be found for a fifth-order polynomial.[8] The third-order polynomial suggests that solo self-employed entries in t=0 hold a positive impact on regional innovation. For cohorts t-3 to t-6 the effect turns negative with a minimum peak in year t-4. The solo self-employed formations are then able to regenerate positive effects with a maximum between cohort t-8 and t-9. In the last year the intensity of the impact drops approximately to zero

(redistributed amongst several municipalities) and Meerlo-Wassum (split amongst Venray and Horst aan de Maas)

[7] See Fritsch and Mueller (2004) and Fritsch and Noseleit (2013) for a corresponding approach.

[8] The model containing the fifth-order polynomial lag holds a comparatively lower statistical significance level.

indicating that regional employment returns to the same level as in the beginning period. A fourth-order polynomial of the solo self-employed development rates shows a different but comparative pattern to the third- and fifth-order polynomials; Though the cohorts from t=0 to t-9 fluctuate following a similar structure, the positive trend of the third- and fifth-order polynomial lags flatten during year t-10 whilst the curve of the fourth-order polynomial seems to prolong even further.

Table 6: The regression coefficient structures of the solo self-employed effects on regional employment

Shirley Almon Polynomial Distributed Lag Model (GLS) Generalized least squares

Polynomial degree	^2	^3	^4	^5
Constant	-.204	-.023	-.008	-.078
	(-0.77)	(-0.09)	(-0.03)	(-0.29)
SSE-rate current year t=0	1.450***	1.873***	2.003***	2.223***
	(12.99)	(14.80)	(13.93)	(12.89)
SSE-rate year t-1	.947***	.827***	.736***	.544***
	(12.24)	(10.57)	(8.09)	(4.41)
SSE-rate year t-2	.507***	.177**	.062	-.142
	(9.90)	(2.55)	(0.67)	(-0.40)
SSE-rate year t-3	.176***	-.155 **	-.209***	-.165**
	(4.52)	(-2.53)	(-3.08)	(-2.35)
SSE-rate year t-4	-.046	-.244***	-.230***	-.154***
	(-1.22)	(-5.15)	(-4.80)	(-2.67)
SSE-rate year t-5	. -.158***	-.167***	-.124***	-.120***
	(-4.00)	(-4.23)	(-2.77)	(-2.68)
SSE-rate year t-6	-.160***	.001	.018***	-.049
	(-4.07)	(0.03)	(0.39)	(-0.90)
SSE-rate year t-7	-.052	.183***	.140**	.104*
	(-1.38)	(3.63)	(2.55)	(1.83)
SSE-rate year t-8	.165***	.303***	.216***	.328***
	(3.94)	(6.63)	(3.44)	(4.13)
SSE-rate year t-9	.493***	.284***	.256***	.461***
	(8.45)	(4.39)	(3.87)	(4.16)
SSE-rate year t-10	.930***	.051	.299	.100
	(10.57)	(0.33)	(1.51)	(0.46)
Regional population	.00002	.0001	.0001	.0001
	(0.60)	(0.73)	(0.97)	(0.405)
R^2	0.1497	0.1781	0.1805	0.1836
Wald Test	248.75	305.70	310.32	316.36
P-Value > Chi^2	0.0000	0.0000	0.0000	0.0000
F-Test	41.46	38.21	31.03	26.36
P-Value > F	0.0000	0.0000	0.0000	0.0000

*Notes: T-values in parentheses; *** statistically significant at the 1% level; ** statistically at significant at the 5% level; * statistically significant at the 10% level. N=1420*

The Almon Lag structure thus solves the possible presence of multicollinearity amongst the lags of the solo self-employed development rates, only creates ambiguity when it comes to picking between the different types of polynomial orders. F-values are however decisive for the predictive capability of the regressions as the F-test verifies to what extent all of the regression coefficients are equal to zero. Despite all of the models are statistically significant, the relatively high F-value for the estimates based on a third-order polynomial indicates that this structure fits the data quite well.

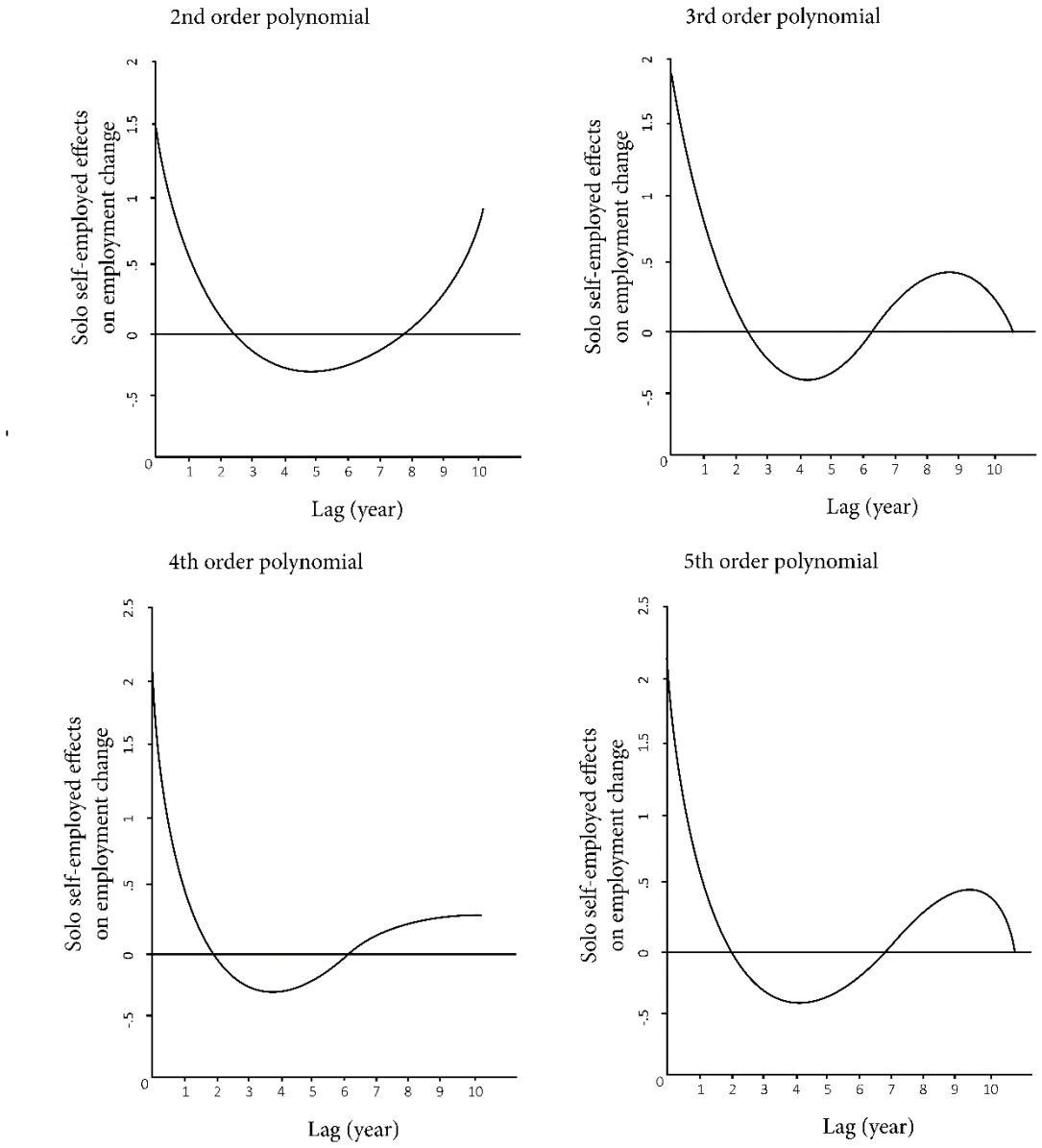

Figure 6: The regression coefficient structures of the solo self-employed effects on regional employment following different polynomials according to the Almon lag structure.

The F-value for estimates containing a second-order polynomial is more or less the same, suggesting that this assumption of polynomial may provide a well-fitted model as well. The discovered pattern for the lag distribution of the solo self-employed effect on regional employment change seems to follow a particular time sequence similar to that of start-ups as described by Fritsch and Mueller (2004). Figure 7 resembles the regional employment growth due to solo self-employed entries according to the third-order polynomial estimations. The positive employment impacts brought by solo self-employed entries in year t-1 could be observed as the additional jobs that are generated due to the increase of solo self-employed pool at the time of inception. The immediate employment effect is indicated following 'phase I'. As new entries arrive within the regional markets all participants become subject to market

selection leading to a different distribution of market shares. It is then assumed that the creative destruction process, as shown in 'phase II' results in the negative effects of the solo self-employed development rates in the cohorts t-3 to t-6. The next positive impact in 'phase III' in years t-7, t-8 and t-9 is expected to derive from a dominance of indirect supply-side effects; Improved competitiveness of the regional suppliers opened up new markets and increased efficiency providing more space to hire new employers. After ten years the regional employment effects created through solo self-employed entries fades away slowly. Logically, as solo self-employed are a sub-group of new business formation, similar effects are found within studies for the impacts of start-ups (Fritsch and Mueller, 2004; Koster et al., 2012; Fritsch and Noseleit; 2013). The lag structure indicated with a second-order polynomial then appears to be highly implausible after year t-8. The structure of this polynomial shows that the indirect supply-side effects become increasingly stronger without decreasing again in the last annual periods.

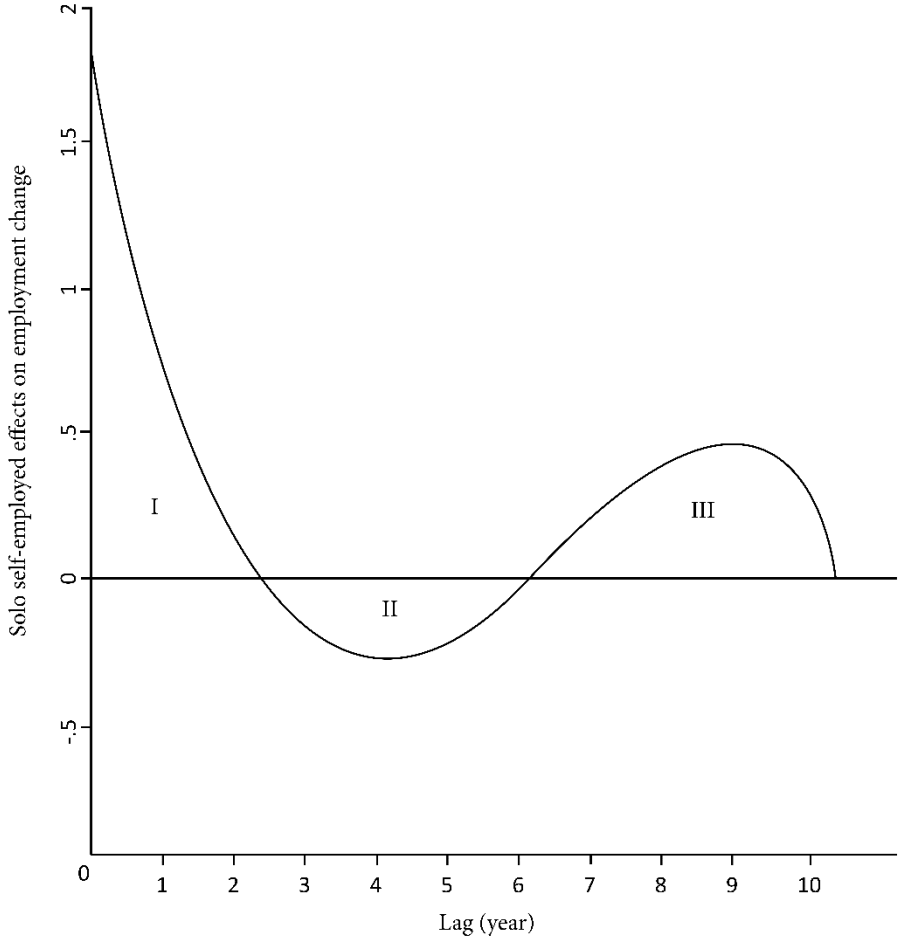

Figure 7: The regression coefficient structures of the solo self-employed effects on regional employment following an Almon polynomial distributed lag of the third-order.

Assuming that the interpretation of the Almon distributive lag model is correct, both the second- and third-order polynomial suggest that the indirect employment effects are of greater

impact than the initial creation of solo self-employment. Mainly the curve that follows the estimated regression coefficients indicates that 'phase lll' representing the indirect supply-side effect is somewhat larger compared to the area containing the direct effects in 'phase I'. This conclusion becomes more tangible when the net effects of new entries are subtracted from the overall exiting capacities that is yielded by 'phase I' minus 'phase II' in figure 7. Similar to start-ups, the indirect (supply-side) effects may thus resemble the most influential impact of solo self-employed entries on regional economic development.

Solo self-employed effects for different urbanity degrees

The different urbanity levels, i.e. agglomerations, moderately urbanized areas and rural regions, are used in order to explain some of the regional differences on the solo self-employed effects on employment change.

Table 7: The impact of lagged solo self-employed development rates on regional employment change for urban areas, moderately urbanized areas and rural areas

Shirley Almon Polynomial Distributed Lag Model (GLS) Generalized Least Squares

Polynomial degree	Urban areas	Moderately urbanized areas	Rural areas
Constant	-.703*	.047	1.968***
	(-1.69)	(0.11)	(2.72)
SSE-rate current year t=0	1.470***	1.942***	1.617***
	(6.57)	(10.39)	(5.54)
SSE-rate year t-1	.533***	.900***	.490***
	(3.32)	(8.04)	(2.77)
SSE-rate year t-2	.008	.177**	-.177
	(0.06)	(2.46)	(-1.18)
SSE-rate year t-3	-.195*	-.118	-.479***
	(-1.70)	(-1.37)	(-3.62)
SSE-rate year t-4	-.165*	-.235***	-.512***
	(-1.90)	(-3.50)	(-4.93)
SSE-rate year t-5	.011	-.186***	-.371***
	(0.13)	(-3.22)	(-4.31)
SSE-rate year t-6	.243**	-.041	-.151
	(2.28)	(-0.61)	(-1.57)
SSE-rate year t-7	.442***	.129*	.053
	(3.67)	(1.69)	(0.50)
SSE-rate year t-8	.519***	.254***	.146
	(4.57)	(3.54)	(1.54)
SSE-rate year t-9	.387***	.262***	.032
	(2.69)	(2.72)	(0.26)
SSE-rate year t-10	-.0439611	.083	-.386
	(-0.14)	(0.38)	(-1.27)
Regional population	-9.21e-06	.0004**	.0018**
	(0.922)	(2.31)	(2.23)
R^2	0.2475	0.1629	0.3077
Wald Test	122.25	157.01	95.55
P-Value > Chi^2	0.0000	0.0000	0.0000
F-Test	15.25	19.63	11.94
P-Value > F	0.0000	0.0000	0.0000

*Notes: T-values in parentheses; *** statistically significant at the 1% level; ** statistically at significant at the 5% level; * statistically significant at the 10% level. N agglomerations = 380; N moderately urbanized areas = 816; N rural regions = 224.*

Table 7 indicates three models included with dummies for the type of regions that were interacted with the solo self-employed development rates following an Almon polynomial model of the third-order. The lag structures for each category are summarized within figure 8, showing that the immediate employment effects are rather identical for the three types of urbanity levels. In year t=0, the direct employment effect is slightly higher in the moderately urbanized areas which either implies that solo self-employment serves a means to resolve unemployment or that more people in the moderately congested regions perceive higher opportunities for starting their own business. Although the basic S-shaped figure of the curves for the aggregate effect looks similar for each urbanity degree, the resulting lag structures of the indirect solo self-employed effects on regional employment differ considerably amongst the types of regions. The amplitudes of the waves indicate that particularly agglomerations provide a higher intensity of the indirect supply-side effects from the years t-5 to t-9.

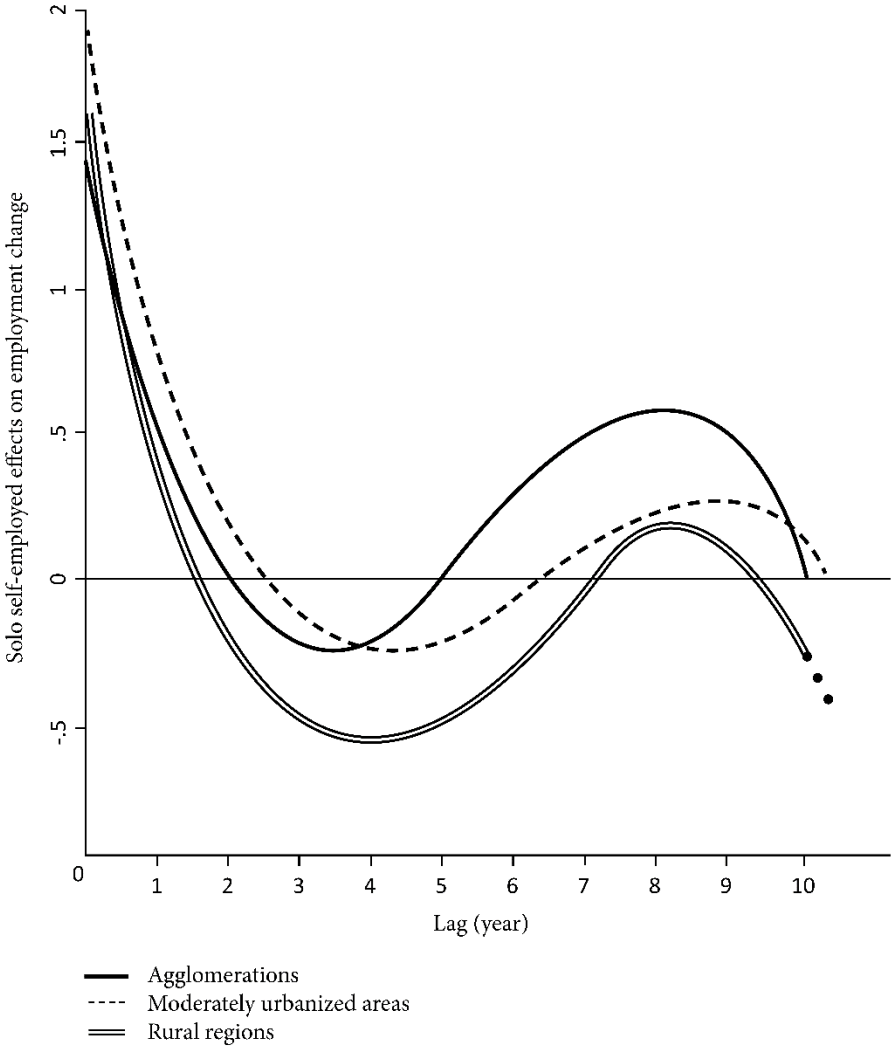

Figure 8: The regression coefficient structures of the solo self-employed effects on regional employment following an Almon polynomial distributed lag of the third-order including dummies for agglomerations, moderately urbanized areas and rural regions.

The relatively higher competition within agglomerations may therefore declare the more pronounced positive indirect effects on employment change that dominate the last phase of the S-curve. In contrast to this, the displacement process of phase two in rural regions seems to persist for a longer period of time up to year t-7. Solo self-employed operating in rural areas may then, presumably due to their less innovative character, experience difficulties conquering their market share. The positive regression coefficients during period t-8 and t-9 lack statistical significance indicating that the possible indirect supply-side effects of solo self-employed entries in rural regions are negligible. All in all, given the rather similar immediate effects, it may be concluded that the regional differences between the three types of urbanity degrees are caused by the indirect effects. This again represents that the interaction of solo self-employment with their regional-characterized environment brings out the difference in the overall effect.

Solo self-employed effects for knowledge intensive sectors and manufacturing sectors

Estimating the models for solo self-employed development rates in the manufacturing and the service sector independently indicates much larger effects of new entries for the knowledge intensive sector (table 8). It is highly unusual that the regression coefficients of the aggregate indirect effects in the knowledge intensive sectors do not flatten in the last years. Although it seems that the indirect supply-side effects of solo self-employed entries, indicated in figure 9, increase infinitely further, the unrestricted coefficients for the solo self-employed development rates in later periods never prove to be statistically significant when more time lags were added to the model. The magnitude of the effects may therefore still decrease after ten years. Negative employment effects resulting from a creative destruction process commences earlier in the knowledge intensive sector than in manufacturing. This observation is compatible with earlier studies explaining that there is a relatively high competitiveness amongst new service firms in the first years of their existence (Fritsch and Weyh, 2004; Fritsch, Audretsch et al., 2020). The amplitudes of the waves show that the supply-side effects in manufacturing are present for a smaller amount of time and less intense when being compared to the knowledge intensive sector. This finding corresponds to the fact that manufacturing firms tend to be less spatially bounded to their start-up region as they are able to export their products and services to other areas more easily. Another remarkable observation is the low presence of statistically significant regression coefficients in periods after t-3 for manufacturing. This finding has been observed in several other studies that used Almon restrictions to estimate the a lag structure for the industrial sectors (see for example Fritsch and Mueller, 2004; Baptista et al., 2007). The reason is that if industries follow a life cycle, the number of start-ups will be relatively high in the early stages of the life cycle when the industry is growing whilst be relatively low in the latter stages in which the concerning sector economically declines (Fritsch, 1996; Fritsch and Mueller, 2004).

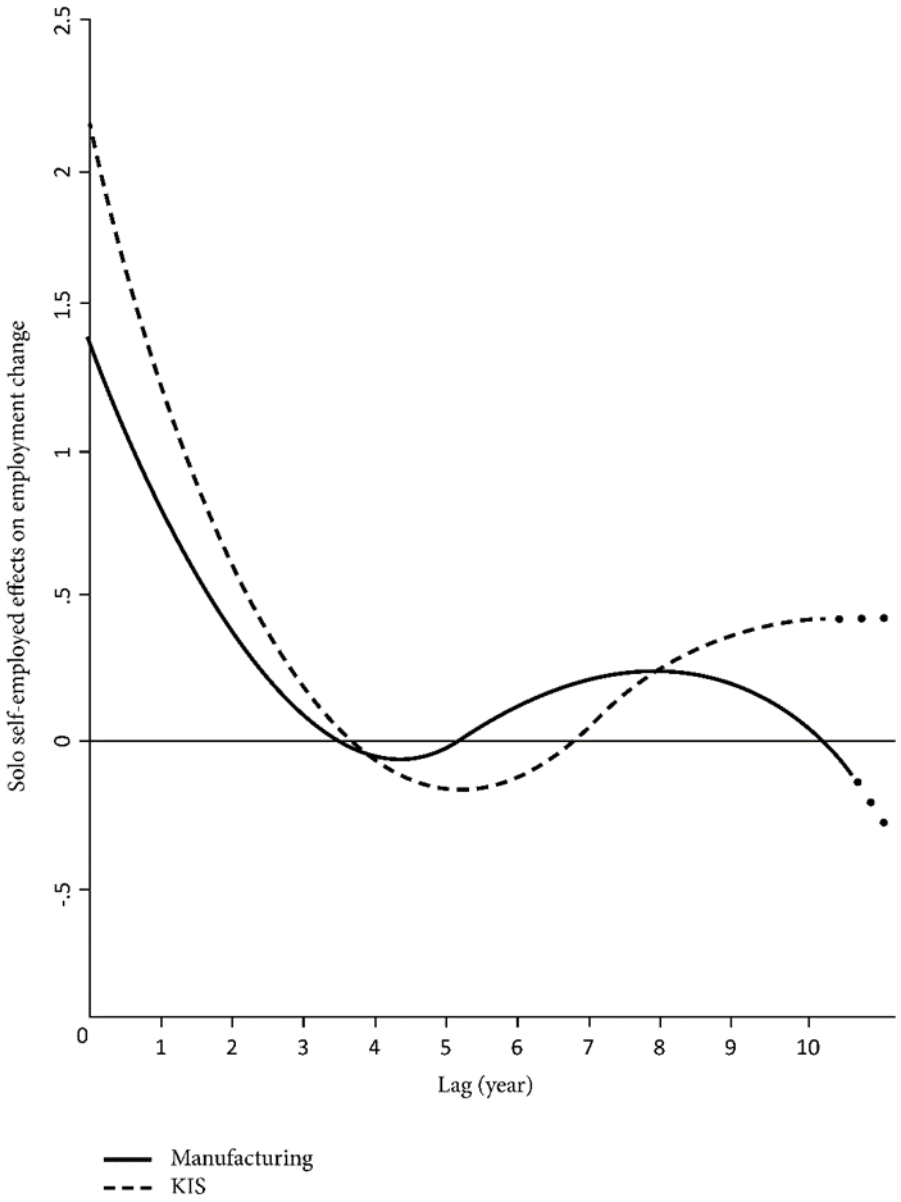

Figure 9: The regression coefficient structures of the solo self-employed effects on regional employment following an Almon polynomial distributed lag of the third-order including an extra division on knowledge intensive sectors and manufacturing.

Given that the resulting positive correlation between new entries and the development of the employment at the concerning industry in following periods could for a large part be established by the industry life cycle rather than the effect of the entrants on development itself (Klepper, 1996), entirely different results are found when the relationship between new solo self-employed entrants and employment change is analysed based on a regional scalar level instead of the level of sectors. When new capacities of firms are estimated in both an individual sector and for all sectors as a whole, the immediate and indirect effects tend to be larger in regressions aiming to explore employment change in the respective sector. Both the negative magnitude of the displacement process and the positive supply-side effects are

therefore less pronounced for the models that make use of a respective division amongst the industries. Still, the estimated structure shows similar short- and long-term effects to the general model highlighted in figure 7. The less pronounced S-curve for the types of industry then asks for a different interpretation of the estimations, implying that the solo self-employed effects are not strictly bound to the respective sectors.

Table 8: The impact of lagged solo self-employed development rates on regional employment change for knowledge intensive sectors and manufacturing

Shirley Almon Polynomial Distributed Lag Model (GLS) Generalized Least Squares

Polynomial degree	KIS	Manufacturing
Constant	1.635***	-.498
	(5.70)	(-1.18)
SSE-rate current year t=0	2.207***	1.321***
	(10.17)	(8.56)
SSE-rate year t-1	1.266***	.831***
	(10.01)	(9.35)
SSE-rate year t-2	.608***	.469**
	(6.44)	(6.22)
SSE-rate year t-3	.190**	.218
	(2.34)	(3.23)
SSE-rate year t-4	-.031	.059
	(-0.49)	(1.05)
SSE-rate year t-5	-.096**	-.025
	(-2.15)	(-0.44)
SSE-rate year t-6	-.048	-.054
	(-1.21)	(-0.76)
SSE-rate year t-7	.071	-.044
	(1.50)	(-0.56)
SSE-rate year t-8	.219***	-.013
	(3.86)	(-0.19)
SSE-rate year t-9	.354***	.019
	(3.83)	(0.24)
SSE-rate year t-10	.434**	.036*
	(3.31)	(0.20)
Regional population	.0000	.0000
	(0.91)	(0.59)
R^2	0.1110	0.1086
Wald Test	131.84	128.63
P-Value > Chi^2	0.0000	0.0000
F-Test	16.48	16.08
P-Value > F	0.0000	0.0000

*Notes: T-values in parentheses; *** statistically significant at the 1% level; ** statistically at significant at the 5% level; * statistically significant at the 10% level. N = 1065.*

Although the industry life cycle interferes the relationship between the solo self-employed entries on the employment development at industries, a part of the interpretation difficulties may be still be clarified. Figure 9 highlights that the negative displacement effect for manufacturing is less pronounced than at the knowledge intensive sector. This finding corroborates earlier studies in which the effect of new firm formation among the industry sector appeared to be weak (Fritsch and Mueller, 2004; Koster and De Vries, 2014). Potentially,

the manufacturing start-ups enter markets due to perceived business opportunities based on precise estimates of their resources aligning their probability of success. Entry barriers, such as high transaction costs, could provoke a prior market selection which results in a higher average quality of the new firm formation relative to other sectors (Koster et al., 2012). This suggests that negative displacement effects at manufacturing, as indicated in figure 9, are indeed lower than the general model as shown in figure 7. The start-ups are then expected to intensify the competition among incumbents leading to higher positive indirect effects, whilst this was not found in the analysis. A potential explanation is that the competition between manufacturing firms in the Netherlands seems to take place at the national level rather than in regional economies (Koster and De Vries, 2014). In the service sector, by contrast, new firm formation are perceived to be market followers reacting to the development at incumbents. Start-ups at the knowledge intensive sector are therefore expected to increase the scope of the markets rather than amplifying the competition. This finding supplements the ongoing positive indirect effect highlighted in figure 9, where the large pool of solo self-employed may offer a provision of flexibility to the current networks from which the incumbent firms in turn could also benefit. It is, however, highly likely that the improvement of the market would be sector-specific as the increased efficiency is perceived solely to the more narrowly defined markets.

5. Conclusion

The theoretical literature addressed in this research argues that the solo self-employed impact on employment change could be decomposed into an immediate effect and a long-term indirect effect. The direct effect mirrors the newly created jobs initiated by the new solo self-employed entrants. The indirect effect could either reflect a process of creative destruction where incumbents become subject to market selection or a situation in which solo self-employed supplement the current market with a provision of flexibility. The predominant purpose of this research was to clarify the change in regional employment through solo self-employed entries. In the analysis, the annual employment change at the municipal level is explained through the regional development at the solo self-employed group and the growth in employment at the incumbent firms. This was primarily done by imposing Almon vectors on the coefficients on a set of lagged solo self-employed rates which allows to measure the competitive reshuffling process amongst incumbents over a longer period of time. The finding that the overall indirect effect clearly provides higher productivity rates and employment benefits for the concerning regional economy than the immediate effect does not mean that the new entrants are of minor importance. Even those solo self-employed entries who fail to compete with the other businesses may contribute to a positive impact on employment as the indirect effects would not present themselves without the solo self-employed challenging the incumbents. It is therefore not the survival rate that counts, but the adaptability of the market.

The results following the Almon lag procedure suggest that the positive trend for the indirect employment effects, i.e. the supply-side effects, of solo self-employed entries takes several years to arise. Though the employment gains due to the new solo self-employed entries are rather high in the starting annual period, the immediate effects are compensated by exiting firms in the subsequent years due to failing newcomers and displacement effects. As a result, the net impact of solo self-employed entries on employment change may well be negative during the first six years. Solo self-employed formation then leads to higher employment levels after seven to nine years. This indicates that the concerning market benefits considerably more from the competition induced by the creative destruction process rather than the provision of flexibility. In case solo self-employed would better facilitate job dynamics, it is expected that the negative effects on employment would be of less impact of not appear at all.

The magnitude of the solo self-employed effects varies following the respective urbanity degree or industry. In this analysis, the regional environments are used to clarify a part of the heterogeneity among the solo self-employed population. First, the results clearly imply that solo self-employed operating in agglomerations contribute relatively more to indirect employment growth than those solo self-employed at the moderately urbanized areas and, particularly, the rural regions. The higher intensity of the indirect effect suggests a higher level of interaction among urban areas which often directly results from spatial proximity, clusters and spillovers. Second, in contrast to this, the negative displacement effects at the rural regions are bigger than for the agglomerations. This implies that solo self-employed are unable to claim

their market share or complement the regional economic structure with their services. The solo self-employed in rural areas are then more often expected to be constrained with a necessity motive for commencing their business rather than being provided with the opportunity to operate autonomously. Finally, direct employment effects seem to be high for the moderately urbanized areas. This relationship deserves to be further investigated as it remains unclear which characteristics separate the solo self-employed in these areas from the solo self-employed across the other peripheral and highly urbanized regions.

The solo self-employed effects also vary between sectors which are decomposed by manufacturing and the knowledge intensive sector. The solo self-employed generally constitute a greater challenge to the incumbents in manufacturing as a result of the higher negative displacement effects. Although the entry barriers for the KIS sector are relatively lower, the overall innovation level at the KIS sector is often perceived to be higher than for manufacturing. This finding explains the more pronounced positive indirect effects at the knowledge intensive sector. Given that the indirect impact also reflects an ongoing increase at the regional employment level, it is likely that the solo self-employed entrants do not generate accrued competition among the incumbents but rather apply their provision of flexible services to the regional economy. As the lagged solo self-employed rates become less statistically significant after the immediate effects fade away for both industries, it is expected that the employment effects may become clearer when adding a lower sectoral aggregation level. Despite this division affects the results of the estimations following the Almon lag structure as the regressors will become automatically larger, further research could be done on computing market mobility rates. Market mobility indicators measure the extent to which the economic performance ranking of a population of firms changes over time and may clarify the relationship between solo self-employed entrants and the reshuffling of the employment at incumbents among more narrowly defined markets.

The findings in the analyses corroborate earlier empirical studies on start-ups in which the indirect effect is more important to the increase of overall employment than the immediate effect. The slightly different calculations regarding the regression coefficients, however, obstruct the possibility to compare the results of this research with earlier studies on new business formation. As described earlier, the solo self-employed development is analysed based on the net annual effect preventing the potential disturbance where solo self-employed modify their legal form over time. The use of net-annual cohorts then thwarts the possibility to follow the individual growth among the solo self-employed pool which disallowed performing a well-structured comparison between the solo self-employed effects on regional employment and the impact of start-ups. Additional studies could investigate whether following individual cases indeed results in the above expectation. If not, the regional employment effects of solo self-employed could be compared to those of start-ups. It is then expected that new firm formation in general brings larger indirect effects than the solo self-employed pool, mainly due to the growing potential of the start-ups.

This literature strengthens that assessing the contribution of the solo self-employed pool on economic development should be established in a longitudinal setting. Regional policy should therefore address the mechanisms behind the creation of the indirect effect, for instance the provoked competition amongst the incumbent firms. As the solo self-employed are relatively small in terms of capital and size, it may seem as if the solo self-employed do not participate in the changing regional economy whilst their innovative ideas could actually provide an improvement to employment growth.

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