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Job Creation: the Case of Portugal**

by

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Abstract: This paper investigates whether a high level of new business formation in a region stimulates employment in that region. The study looks at the lag structure of these effects, using a data set covering a fairly large time span (1982-2002). The indirect supply-side effects of new firm births, whether due to greater competition, efficiency or innovation, seem to be at least as important as the direct effects associated with employment creation by the new entrants. However, such supply-side effects only occur after a time lag of about eight years, leading to a pattern of lagged effects that is somewhat u-shaped. This finding suggests that new entrants bring about improvements to overall regional competitiveness, but that such improvements only become significant after some time.

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1. Introduction

In recent years, the relationship between new firm formation, business ownership (or self-employment) and economic progress has received considerable attention from scientists and policy makers. In Western Europe, persistently high unemployment rates coupled with limited economic growth have triggered policy makers into giving greater importance to entrepreneurship and self-employment as ways to foster economic progress and reduce unemployment.

Europe and other industrialized regions of the globe have experienced considerable industrial re-structuring in the last three decades, changing from traditional manufacturing industries towards new and more complex technologies such as electronics, software and biotechnology. In this context, entrepreneurship and small firms play a particularly important role for two main reasons:

- i. the use of new technologies has reduced the importance of scale economies in many sectors (Piore and Sabel, 1984 and Carlsson, 1989);
- ii. the increasing pace of innovation and the shortening of product and technology life cycles seem to favor new entrants and small firms, which have greater flexibility to deal with radical change than large corporations (Christensen and Rosenbloom, 1995).

Under such circumstances, it would be expected that high levels of new firm formation should stimulate economic development and employment growth. Audretsch and Thurik (2001) argue that the role of new firms in technological development has been enhanced by a reduced importance of scale economies and an increasing degree of uncertainty in the world economy, creating more room for innovative entry. It can also be argued, following Audretsch and Fritsch (2002), that such effects should be stronger within strongly “entrepreneurial” regions. This implies that positive supply-side spillovers generated by high levels of new firm formation should have a stronger impact on the regions where such formation has occurred.

The present paper tests whether there is a significant relationship between increased new firm start-up rates and subsequent employment growth at the regional level. Results

from recent research (Audretsch *et al.*, 2001; Audretsch and Fritsch, 2002; Van Stel and Storey, 2004; and Fritsch and Mueller, 2004) suggest that the ambiguous evidence on the relationship between new firm formation and both economic growth and net employment change (as reported by, among others, Storey, 1991 and Fritsch, 1996) may be due to the long time lags required for the main effects of new entry to occur. Following Fritsch and Mueller (2004), this paper investigates whether there are significant time lags for the effects of new firm entry on regional employment, using the Almon lag model to examine the structure and extent of such time lags.

Section 2 of the paper presents the main theoretical underpinnings and reviews the existing empirical evidence regarding two main propositions:

- i. high levels of new firm formation stimulate employment growth;
- ii. positive effects of high levels of new firm formation are stronger within the regions where such new firm formation has occurred.

Section 3 of the paper discusses data and measurement issues and lays out the empirical approach used to examine the structure of lag effects of new firm formation on regional employment. Section 4 reports the results while Section 5 presents some concluding remarks.

2. Effects of New Firm Formation on Regional Employment Growth

2.1. Theoretical Foundations

The economies of developed countries are in a transition from a state in which mass-production was the mainstay of business to an economy in which knowledge intensive industries form the cornerstone of economic activity. Audretsch and Thurik (2000, 2001) refer to this process as the transition from the managed to the entrepreneurial economy.

In the managed economy technological trajectories were relatively well defined and firms were subject to relatively low market uncertainty. In the developed economies of the West, the pervasiveness of transaction costs meant that the economic structure most conducive to growth favored the dominance of large firms. However, a turning point occurred during the 1980s as these economies experienced decreasing levels of vertical

and horizontal concentration of businesses. Carree (2002) finds that the extent to which this process of structural change has occurred varies across countries and sectors; technologically advanced industries that have experienced relatively low levels of downsizing and de-concentration when compared with the international average are shown to experience less subsequent growth.

The first contribution of new firm formation to employment growth is, naturally, the number of jobs directly created as successful new firms enter the market and grow. Comprehensive compilations of studies relating firm size to growth such as Sutton (1997) have produced what Geroski (1995) terms the stylized fact that (successful) smaller firms have higher growth rates than their larger counterparts. A central finding of this literature is that firm growth is negatively related to firm size and age. These findings have been confirmed in most subsequent studies despite differences in country, industry, time period, and methodology used (see Audretsch *et al.*, 2004 for a review). More specifically, the evidence has been especially strong for the very young and very small firms to outperform their older and larger counterparts in terms of employment formation even when corrected for their higher probabilities of exit.

However, net job formation by new firms might not be positive. As Van Stel and Storey (2004) point out, while new firms directly contribute only a very small proportion of the stock of jobs in the economy, most new firms merely displace existing firms. Moreover, new businesses have a greater probability of failure than old businesses. According to Geroski (1995), the survival of most entrants is low and even successful entrants may take more than a decade to achieve a size comparable to the average incumbent. Moreover, in many cases the “crowding-out” of incumbents by successful entrants leads to declining market shares or market exit for these incumbents, with the ensuing reduction of the stock of jobs in the economy.

It is therefore necessary to look at the positive indirect supply-side effects (spillovers) that new firm entry may generate. Fritsch and Mueller (2004) provide a survey of such effects:

- i. Efficiency effects: by initiating or intensifying competition by contesting established market positions, factual or potential new entrants provide a strong incentive for incumbents to behave efficiently (Baumol *et al.* 1988);
- ii. Acceleration of structural change: high turnover of firms tends to speed up the adoption of new technologies and organizational innovations by the industry, increasing productivity (Schumpeter, 1934);
- iii. Amplified innovation: new firms have a greater probability of introducing radical innovations (Acs and Audretsch, 1990; Christensen and Rosenbloom, 1995) that impact all over the economy;
- iv. Greater product variety and quality: if new entrants introduce significant product or process innovations, the probability of finding a better match for customers' preferences increases, thus increasing general welfare and providing the basis for further, cumulative, innovations.

The supply-side effects of new firm formation may lead to significant improvements in the competitiveness of a country, region or industry, thereby stimulating economic growth and employment. However, the net effect of new entry in terms of employment generation depends on whether new entrants bring about market growth. If new entry processes result only in selection mechanisms working through increased competition and “survival of the fittest” while the overall market volume remains constant, then the net effect of entry is unlikely to be significantly positive. Hence, the magnitude of positive supply-side spillovers from new firm entry depends on the “quality” of new entrants with regard to innovation and efficiency. While structural rigidities (such as, for instance, employment security legislation and government protection of unsuccessful incumbents) may allow for temporarily positive net effects from new entry on employment, these are unlikely to last too long.

New firms provide a vehicle for the introduction of new ideas and innovation to an economy, which has been shown to be a key source for long term economic growth (Romer 1986). Even though, as pointed out by Van Stel and Storey (2004), innovation in new firms seems not to be as frequent as expected, it is likely to be one of the main conduits through which new firm formation may impart positive supply-side spillovers on

the economy. Authors such as Lucas (1988), Feldman (1994) and Baptista (1999) have argued that spillovers associated with innovation are stronger within relatively circumscribed geographical regions due to agglomeration externalities that increase the capacity of firms to tap into the local pool of new ideas. Glaeser *et al.* (1992) and Jaffe *et al.* (1993) found evidence of such spillovers for firm growth and innovative (patenting) activity. Based on these arguments, it is possible to claim that any positive spillovers generated by new firm entry should occur primarily within the region where such entry occurred, thus making the regional effects of new firm entry particularly worthy of appraisal.

An important feature of this process which is stressed by Fritsch and Mueller (2004) is that the emergence of positive supply-side effects from new firm formation does not require that newcomers are successful. As long as entry produces spillovers that induce improvements on the side of incumbents, generating growth in overall market volumes, it will generate positive spillovers even if entrants fail and exit soon after entering. It should be pointed out, however, that a high probability of failure could dissuade potential entrants thus lowering the potential for positive supply-side spillovers. Moreover, barring those new ventures that are rapidly acquired by larger incumbents, positive effects from exiting new small businesses on incumbents are likely to come solely from increased competitive pressure, and not from any innovative features.

2.2. Empirical Evidence on the Effects of New Business Formation

Studies of the relationship between new firm formation and job creation have found very diverse results, frequently because of the variety of approaches used. An important analysis is provided by the Global Entrepreneurship Monitor (GEM, 2000), which analyses the relationship across 21 countries between Total Entrepreneurial Activity and per cent growth in GDP finding that, amongst nations with similar economic structure, the correlation between entrepreneurship and economic growth is high and very significant. Johnson and Parker (1996) find evidence that growth in firms births and reduction in firm deaths significantly lowers unemployment. Taking the period 1981-89,

Ashcroft and Love (1996) find new firm formation to be strongly associated with net employment change in Great Britain.

Davidsson *et al.* (1994) find a positive impact of new firm formation on a complex economic indicator of well-being for Sweden. Aghion *et al.* (2004) focus on the effect of new entry on productivity growth showing that more entry, measured by a higher share of industry employment in foreign firms, has led to faster total factor productivity growth in British manufacturing establishments during the period 1980-93.

At the regional level, a clear positive impact of new firm formation on employment has been found by Reynolds (1994, 1999), and Acs and Armington (2004). However, the magnitude of such relationship seems to vary over time. Foelster (2000) has found a positive effect of increased self-employment rates on regional employment for Sweden. Similar evidence was found by Brixy and Grotz (2004).

Other studies, however, have found less clear evidence or even opposite results. Fritsch (1996), found a positive statistical relationship between entry rates and employment change for manufacturing in Germany, but a negative relationship for the service sector and the whole economy. Audretsch *et al.* (2001) investigated the impact of changes in self-employment on unemployment rates for 23 OECD countries, finding overall positive effects that, however, do not hold for all the countries in the sample – such is the case of Portugal, as reported by Baptista and Thurik (2005).

Audretsch and Fritsch (2002) provide results for Germany at the regional level, confirming Fritsch's (1996) findings that start-up rates in the 1980s are unrelated to employment change, while in the 1990s, those regions with higher start-up rates experience higher employment growth. Principally, regions with high start-up rates in the 1980s had high employment growth in the 1990s. This latter finding leads the authors to suggest that the lack of clarity with regard to the impacts of new firm formation on employment growth may be attributed to the relatively long time lags that are required for these impacts to become visible.

Van Stel and Storey (2004), in their analysis of the effects of new firm births on employment for the regions of Great Britain, investigated the relevance of time lags, finding that rates of growth of regional employment are positively shaped by entry

occurring in several earlier years. According to their results, the magnitude of such effects over time takes an “inverse u” shape, peaking on the effect on employment growth in the current period of start-up activity occurring five years ago, while no significant effects are identified after ten years.

Fritsch and Mueller (2004) use Almon lags to model the structure and extension of the effects of new firm entry on regional employment, finding that net employment effects of new firm formation are small in the year of entry and become negative over the first six years. Positive effects only occur after that, tending to peak around the eighth year and fading away after the tenth year. The authors argue that the negative effects in the first years result from the exit of existing capacities, as an outcome of market selection through the failure of new businesses and the crowding-out of incumbents, while the positive effect that occurs after that is probably due to a dominance of supply-side effects.

3. Data and Empirical Methodology

3.1. Data and Measurement Issues

Data on regional entry and employment come from the Longitudinal Matched Employer-Employee Microdata set – LMEEM (Escária and Madrugá 2002) – based on information gathered by the Portuguese Ministry of Labor and Solidarity covering all business units with at least one wage-earner in the Portuguese economy and includes extensive information on firms, establishments and workers, for 1982 to 2002 inclusive. Probably the main strength of the data set concerns the amount of information it reports and the number of units considered in the analysis as it covers most of the private sector of the economy.

The information gathered in the data set is organized in three different levels – firms, establishments and workers – each one covering specific information. The three levels are matched, giving this data set its linked employer-employee nature. At the firm level there is information reported for address of the firm; postcode; year of constitution; tax

number; location; industry¹; employment, including wage earners and unpaid workers engaged in the firm during the last week of March², including those on temporary leave; number of establishments; legal setting; equity capital and share of private, public or foreign capital; and sales volume.

The specific form in which the data set was built enables us to distinguish between entry and birth of the business units, which is very important to separate true start-ups from other processes. New firm formation is then measured by yearly regional start-up rates. Start-ups in the agricultural sector are excluded.

In order to control for differences in the size of regions, entry rates should be measured relative to regional dimension. According to Ashcroft *et al.* (1991), the regional size denominator should both control for the different absolute sizes of the regions concerned and represent the source from which start-ups are most likely to come. The two variables more commonly used as denominators are the stock of existing firms, and the size of the regional workforce. These are called the Business Stock approach and the Labor Market approach, respectively. The Business Stock approach assumes new firms arise from existing ones, whereas the Labor Market approach assumes that new firms arise from workers. The choice of measure can be highly significant as the same number of new firms in a given region may yield completely different results in terms of these two indicators of entrepreneurship.

Garofoli (1994) argues that the Labor Market approach has advantages over the Business Stock approach as the latter is misleading in regions with small numbers of large firms. In such case, small numbers of new firms would provide an artificially high birth rate, primarily because of the small denominator. Audretsch and Fritsch (1994) show that, in West Germany, the statistical relationship between unemployment and start-up activity crucially depends on the Business Stock or Labor Market methods used to measure start-up rates. Fritsch and Mueller (2004) use the Labor Market approach to examine effects of new entry on employment for West Germany. In the present study,

¹ Firms are classified according to main activity (*i.e.* the activity yielding the highest sales or involving more workers).

² Changed to October in 1994.

both approaches will be used for estimation, even though the discussion of results will focus mainly on estimations based on the Labor Market approach.

In addition to differing considerably across regions, the relative importance of incumbents and start-ups also varies systematically across industries – for example, start-up rates are systematically higher in services than in manufacturing. Regions with a high share of some industries in the local economy are more likely to have higher birth rates than other regions, possibly because of lower entry barriers, but that does not necessarily mean that these regions are more entrepreneurial. This means that entrepreneurship activity could be systematically overestimated in regions with a high share of industries where start-ups play an important role, while the role of new firm formation in regions with a high share of industries where start-ups are relatively few would be underestimated.

To account for the different industry structures and the different relative importance of start-ups and incumbents in different industries a shift-share procedure (see Ashcroft *et al.*, 1991; Audretsch and Fritsch, 2002; and Van Stel and Storey, 2004) is applied to derive a measure of sector-adjusted start-up activity. The sector-adjusted number of start-ups is defined as the number of new firms in a region that can be expected to be observed if the composition of industries was identical across all regions. Thus, the measure adjusts the raw data by imposing the same industry composition in each region.

The regional unit used in the present paper is the NUTS3 which, in the case of Portugal, yields 30 regions. These regional units are relatively larger in size than the ones used by Fritsch and Mueller (2004)³. While the use of smaller spatial units would have the advantage of providing a higher number of cross-section observations in the panel, the fact that counties may include only parts of larger urban agglomerations. This means that positive agglomeration externalities which prove to be relevant for larger regions than a county would not be picked up in the analysis. Although Portugal is a relatively small country when compared to Germany (or even West Germany), it has considerably large urban agglomerations, both in terms of land area and population, thus making the

³ Fritsch and Mueller (2004) use data for 326 West German counties (*kreise*).

use of a relatively larger spatial unit advantageous. Figures 1 and 2 present start-up rates using the Business Stock and Labor Market approaches.

Following Fritsch and Mueller (2004), we used as indicator of regional development the relative change over a two-year period of employment in the private sector. Using changes over a two-year period attempts to avoid disturbances due to short-run fluctuations. Van Stel and Storey (2004) argue that different regional industry structures will have different impacts on employment changes, and thus apply the shift-share procedure mentioned above to obtain an industry-adjusted rate of employment change. Fritsch and Mueller (2004) choose not to apply the shift-share procedure to the dependent variable, possibly since it is expected that effects on employment associated with each region's specific industrial structure will be corrected for via the estimation of regional fixed effects. The present study presents estimates for the effect of new firm formation on employment change for both measures of regional employment. Regional fixed effects estimation is discussed in the sub-section below.

3.2. Empirical Approach

The basic relationship to be modeled has the following form:

$$dEMP_t = [a_0.BIR_t + a_1.BIR_{t-1} + \dots + a_n.BIR_{t-n}] \cdot X_t.b \quad (1)$$

where: $dEMP_t$ – change in regional employment; BIR_{t-i} – firm birth rates at start of period $t-i$, with $i=0, \dots, n$ being the lag periods considered; and X_t – control variables. Alternatively, one can also estimate the effect of new firm formation rates in each year separately, giving rise to $n+1$ distinct models. For the analysis of the impact of new firm formation on regional employment growth, the yearly start-up rates at the beginning of the current employment change period and for the ten preceding years are included.

Estimation uses panel data regression techniques that allow us to account for unobserved region-specific factors. Application of the Huber/White/Sandwich procedure provides robust estimates of the standard errors. As an alternative method, panel data estimation of fixed effects was also conducted. Regional fixed effects should play a

significant role in determining regional employment change. Differences between regions may arise principally due to the following types of factors:

- i. differences in regional industrial composition – different industries typically face different product life cycles and may face different overall business cycles – as specified in the previous sub-section, using sector-adjusted employment growth rates should eliminate this kind of regional fixed effect;
- ii. differences in local labor market conditions, house prices and the extent of knowledge/innovation spillovers;
- iii. different regional cultural attitudes towards entrepreneurship: regions may differ in how they favor entrepreneurial activity and how they react to business failure – this is dubbed the “Upas Tree” effect by Van Stel and Storey (2004), who argue that this effect typically interacts with public policy effects;

Estimation of region-specific fixed effects is expected capture the kinds of regional differences pointed out above. However, in order to check on the effectiveness of the fixed effects estimator, a control variable is included in estimation. This variable is “economic size” of the region, measured as the product of population density and GDP per capita, *i.e.* income per square kilometer. The ultimate aim of this variable is to capture any agglomeration externalities arising from regional size, taken as a combination of density and wealth. However, the control variable was found not to be statistically significant in most regressions⁴.

Even though, as specified the previous sub-section, the use of NUTS3 is likely to avoid missing some of the positive agglomeration externalities which prove to be relevant for larger regional units of analysis than small counties, spatial autocorrelation could still affect results. To cope with the problem of spatial autocorrelation, following Anselin (1988) and Anselin and Florax (1995), an average of the residuals in the adjacent regions is included in the estimation. Such residuals provide an indication of unobserved influences that affect larger geographical entities than NUTS3 and that are not entirely

⁴ Estimations were carried out using each of the two variables – population density and per capita GDP – individually, reaching similar results.

reflected in the explanatory variables. Fritsch and Mueller (2004) find this approach to be the best suited to account for spatial autocorrelation.

Correlation between start-up rates of subsequent years are presented in Table I. Correlations between start-up rates are mostly significant, though not as strong as those reported by Fritsch and Mueller (2004). Such correlation leads to multicollinearity that makes interpretation of coefficients in the models difficult. In order to cope with this correlation, the Almon polynomial lags procedure is applied for the estimation of lag structures for the effect of regional start-up rates on regional employment growth (see Van Stel and Storey, 2004 for a description of the procedure).

The Almon lag procedure reduces the effects of multicollinearity in distributed lag settings by imposing a particular structure on the lag coefficients (see, for instance, Greene, 2003). In the Almon method, parameter restrictions are imposed in such away that the coefficients of the lagged variables are a polynomial function of the lag. In this way, the start-up rate coefficients are re-parameterized ‘smoothly’.

4. Results

Tables 3 through 18 present the estimation results for the all the different model specifications discussed in the section above. All estimations were conducted using both the Business Stock and the Labor Market approaches. Moreover, estimations are presented using regional employment change and sector-adjusted regional employment change (using the same shift-share approach as employed for business formation rates). Results are presented for the effects on employment change of business formation rates for the current period and up to period $t-10$, including start-up rates for all periods in one model and also estimating the effects of yearly start-up rates individually, using the Huber/White/Sandwich robust estimator and the panel data fixed effects estimator.

Estimation of Almon polynomial lags was also conducted for both the Business Stock and Labor Market approaches, using regional employment change and sector-adjusted regional employment change. Following Fritsch and Mueller, the present study estimated

Almon polynomials up to the 5th order. Again, estimations were carried out using the Huber/White/Sandwich robust estimator and the panel data fixed effects estimator.

In order to simplify the analysis and to be able to better compare the outcomes of the present study with those by Fritsch and Mueller (2004), and Van Stel and Storey (2004), it is convenient to concentrate on a single model specification which seems to better encompass all the data measurement and estimation concerns stated at length in the previous section. Therefore, the discussion of results will focus on estimation of the effect of start-up rates measured using the Labor Market approach on sector-adjusted employment change using the Huber/White/Sandwich robust estimation procedure, and accounting for spatial autocorrelation. While the Labor Market approach seems to have advantages which are corroborated by both Audretsch and Fritsch (1994) and Fritsch and Mueller (2004), results obtained from fixed effects and Huber/White/Sandwich robust estimation procedures are not very different. These specifications are reported by the two benchmark studies mentioned previously. While Fritsch and Mueller (2004) use regional employment change as the dependent variable without adjusting for industry differences, Van Stel and Storey (2004) use a sector-adjusted measure of employment change. The present focuses on the latter specification since it provides a greater chance of dealing properly with fixed effects arising from different regional industry structures.

4.1. Distribution of Time Lags: Unrestricted Model

Results for the unrestricted model (*i.e.* where no restrictions are imposed on the form of time lags, such as Almon polynomial forms) for the effects of Labor Market weighted start-up rates on sector-adjusted regional employment change using the Huber/White/Sandwich robust estimation procedure are presented in Table 14.

An exploratory approach to observing the lag structure of the effect of new business formation on regional employment change, is to estimate a model that includes the start-up rate at the beginning of the inspected period of employment change (current year) and all start-up rates of the preceding ten years. Given the reasonably high level of correlation between the start-up rates of subsequent years, results also include the separate impact of each start-up rate taken individually.

When including all start-up rates in one model, the highest positive impacts on employment change are found for the current year and, remarkably, for the earliest period ($t-10$), suggesting that the more significant positive effects of new firm formation on economic growth may occur only after a considerable period of time. Although not all individual effects are significant, likely due to multicollinearity, the pattern of the lagged effects shown on Figure 3 suggests that positive effects occurring in the first couple of years after start-up fade away and, with the exception of $t-4$, do not become clearly positive until $t-9$. However, it should be noted that only the positive effects recorded for the current year and the earliest years, as well as for $t-4$, are statistically significant. The separate regressions with the single start-up rates again show the strongest impacts for the current and earliest year, as well as for $t-4$.

The pattern of the results is not too different from the one found by Fritsch and Mueller (2004) for the same analysis. However, the magnitude of the significant effects is considerably larger – on average, Portuguese coefficients about double those of West Germany for the same years.

The variable accounting for “economic size” is not significant for the model including all start-up rates, suggesting that agglomeration externalities arising from regional size, as measured by a combination of population density and per capita GDP, is not a significant source of spillovers once fixed effects are accounted for by model estimation. This result contradicts the one found by Fritsch and Mueller (2004) for West Germany. The effect of the residuals of adjacent regions is positive but only significant at the 10% level. This suggesting that using NUTS3 spatial units reduces the significance of spatial autocorrelation. It is expected that the significance of this effect should increase if smaller regional units were used.

The analysis of the unrestricted model is seriously hampered by multicollinearity of yearly start-up rates. Due to this correlation, the regression coefficient for a certain year is likely to reflect the impact of start-up activity in that specific year and in other years as well. Moreover, in the present model, multicollinearity leads to lack of significance of coefficients that are not clearly positive, further confusing the interpretation of results.

Estimation using the Almon polynomial lag procedure, reported in the following subsection, attempts to deal with this problem.

4.2. Distribution of Time Lags: Almon Polynomials

Estimation of the Almon polynomial lag model assumes that the effect of changes in yearly start-up rates is distributed over eleven periods. Estimation results for the effects of Labor Market weighted start-up rates on sector-adjusted regional employment change using the Huber/White/Sandwich robust estimation procedure are presented in Table 18. Lag effects are estimated for the second through to the fifth orders, accounting for spatial autocorrelation through the inclusion of the residuals of adjacent regions in the model, which are found to have a significant and positive effect. The economic size variable is also included but its effect is again not significant.

Figure 4 presents the lag structures of the effects of new firm formation rates on employment growth for each of the lag orders estimated. The second and third order polynomials result in rather similar u-shaped structures in which the effect of start-up rates on employment change is positive and decreasing for the first couple of years following start-up, becoming negative after that. Positive effects return around the eight year and are strongest for the final period ($t-10$). This pattern is similar to that found by Fritsch and Mueller (2004) for the second order polynomial in their estimation for West German counties.

Assuming a fifth order polynomial leads to a different pattern of results in which new firm formation has a relatively low positive impact on employment growth for the years up to $t-3$ and then switches to an equally low negative impact that dominates until year $t-8$. From $t-9$ onwards a positive effect is observed which is strongest for the final period ($t-10$). This pattern is somewhat similar to that found by Fritsch and Mueller (2004) for West German counties in estimations of Almon polynomials of the third order or higher. However, the magnitude of the effects for the years up to $t-8$ is smaller.

The pattern of results for the fourth order polynomial is more undefined, resembling some kind of transition between the u-shape observed for the second and third order

polynomials and the pattern observed for the fifth order polynomial. Positive effects of new business formation on employment growth occur for the current period and for $t-1$, and again for $t-9$ onwards, with the strongest impacts occurring in the current and the last periods. The negative impacts occurring between $t-2$ and $t-8$ register relatively stable coefficients, making the pattern of results less u-shaped than for the second and third order polynomial estimations.

The fourth order polynomial estimation has the highest F-value of all, followed by the second and third order polynomials, while the F-value for the fifth order polynomial estimation is clearly the lowest. This suggests that the lag structure for the present analysis is closer to a u-shape than to the pattern found by Fritsch and Mueller (2004) for West Germany. The lag distribution of the impact of new firm formation on employment change estimated through the fourth order Almon polynomial suggests a certain time sequence for the effects presented in sub-section 2.1. Using either the second or the third order polynomials the interpretation of results is very similar.

The positive impact of start-ups in the current period and in $t-1$ can be interpreted as corresponding to the additional jobs that are created as a result of the establishment of the new businesses. This direct effect can be depicted by area I in Figure 5. Studies of the evolution of new businesses such as Boeri and Cramer (1992) for Germany, and Mata *et al.* (1995) for Portugal find that employment in entry cohorts tends to stagnate or even decline from the second or the third year on, thus corroborating the decline in the positive effect of new business formation on employment after the first year.

As soon as new businesses face market selection there should be a negative impact on employment resulting from the decline and exit of incumbents or from the failure of new entrants. This negative effect seems to dominate in the Portuguese case from about the second year to the eighth year after entry, corresponding to area II in Figure 5. The duration of this period of negative effects is larger for Portugal than for West Germany where, according to Fritsch and Mueller (2004), effects of new business formation on employment growth become positive again from about the sixth or seventh year after start-up and then fade away again after the ninth or tenth year.

Positive effects of new business start-ups on employment growth eventually dominate again, albeit later than in the West German case. Such positive effect is likely due to a dominance of indirect supply-side effects that spill over from new entrants leading to increased competitiveness of firms within the region, and corresponds to area III in Figure 5. In the Portuguese case, effects of new firm formation on employment growth become positive after the ninth year and show no sign of receding afterwards – a larger time span would be needed to determine whether such positive effects do indeed fade away, although it seems logical that this should happen (hence the question mark at the right tail of the curve in figure 5). Given the present time span of analysis, one can only speculate that the lag structure of the effects of new business start-ups on employment growth should eventually assume a similar shape to that reported by Fritsch and Mueller (2004) for West Germany, albeit with longer duration for the second and, possibly, the third of the stages identified. If this is true, it could be due to greater structural rigidity of product and factor markets in Portugal.

5. Concluding Remarks

The present paper has looked at the effect of new business formation in a region on employment growth in that region. The study investigates the lag structure of these effects, using a data set for the Portuguese economy covering a fairly large time span (1982-2002). The indirect supply-side effects of new firm births, whether due to greater competition, efficiency or innovation, seem to be at least as important as the direct effects associated with employment creation by the new entrants. However, such supply-side effects only occur only after a time lag of about eight years, leading to a pattern of lagged effects that is somewhat u-shaped. Stable negative effects dominate during the period between the first year after start-up and the eighth or ninth year, suggesting a relatively long market selection period.

The findings of this study confirm that new business formation contributes to economic growth not just directly through the jobs created by start-ups, but also by bringing about improvements to overall regional competitiveness. Such improvements

may occur either on the side of newcomers or on the side of incumbents reacting to the competition from new entrants.

This paper also finds that the positive indirect supply side effects of new business formation on employment growth take time to occur. Direct effects of new business formation on employment through the creation of new jobs may be offset in the medium run by negative effects resulting from the exit of newcomers or incumbents due to market selection. Hence, the net effect of new business formation on employment in the first seven or eight years after start-up may well be negative. Positive indirect effects arise from supply-side spillovers, increasing competitiveness and fostering growth and employment, but only in the longer run, after nine or ten years. Obviously, the lag time for positive effects to ensue will vary according to the type of entrant – not all entrants are equally innovative – and with the type of industry depending, for instance, on the life cycle of products and on the technological regime that dominates the industry and the region, as suggested by Audretsch (1995).

Further research should focus on the effects of different types of entry – considering, for example, initial size or the existence of foreign investment as factors differentiating between new entrants. Studies such as *Mata et al.* (1995) have found that initial size is a good indicator of the probability of survival, while several authors have argued that foreign direct investment is an important conduit for supply-side spillovers (see Blomström and Kokko, 1998 for a survey).

Further research should also focus on in-depth studies of the different effects of entry on market processes in different types of industries. In particular, it is important to determine which factors influence the size of positive indirect supply-side effects and the time lag for those to occur.

Finally, the sources of regional fixed effects should also be explored. In particular, it is important to determine whether positive indirect supply-side spillovers are more likely to arise from entry into more diverse or concentrated industries, *i.e.* whether supply-side externalities are more likely to assume a Marshall-Arrow-Romer form or a Jacobs-Lucas form (see Glaeser et al., 1992 for a review of these concepts). The role and sources of

spatial autocorrelation also deserves a deeper analysis which may require estimating the effect of new business formation on employment for different regional units.

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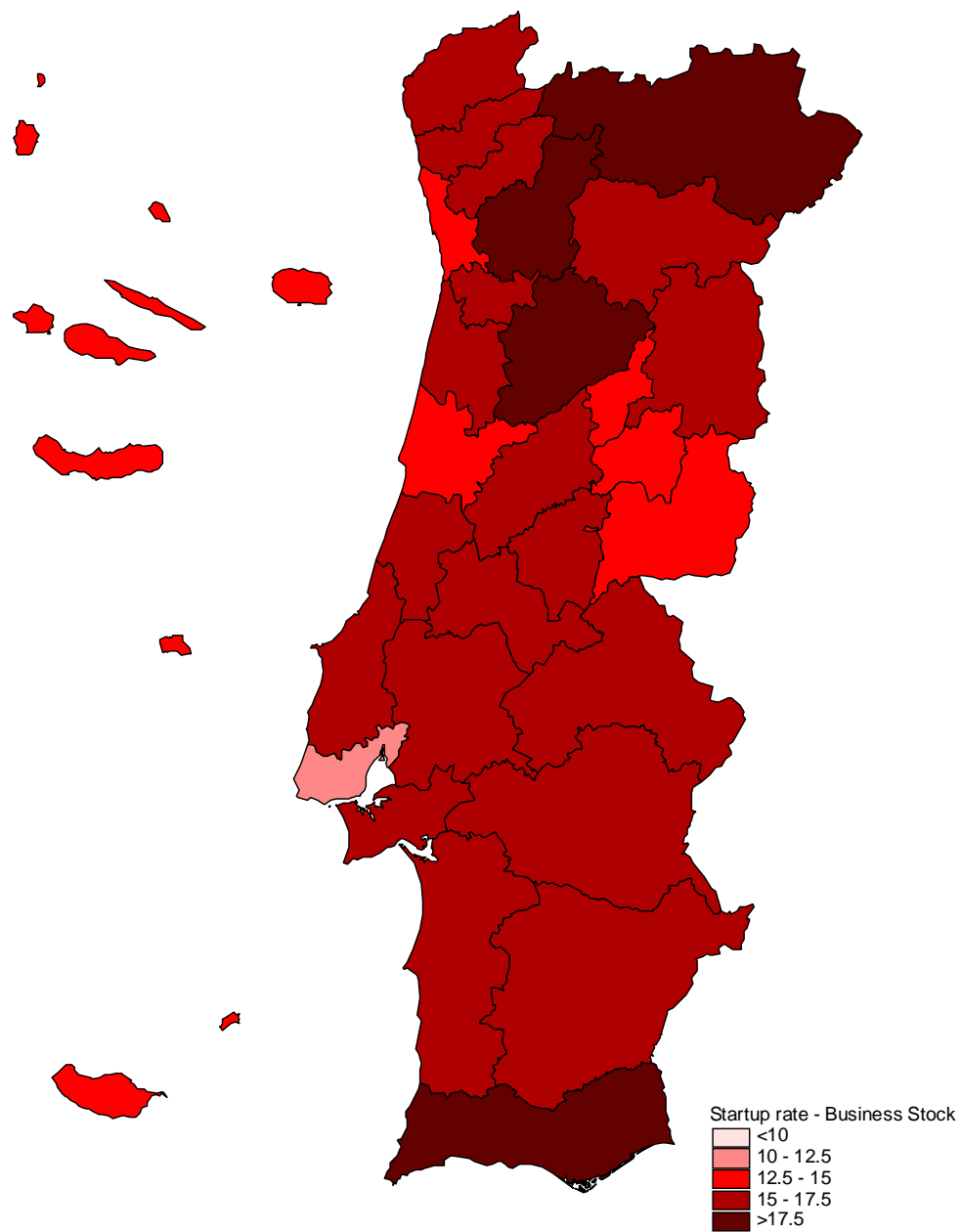
Figure 1: Average startup rate 1982-2002 by NUT3 – Business stock approach

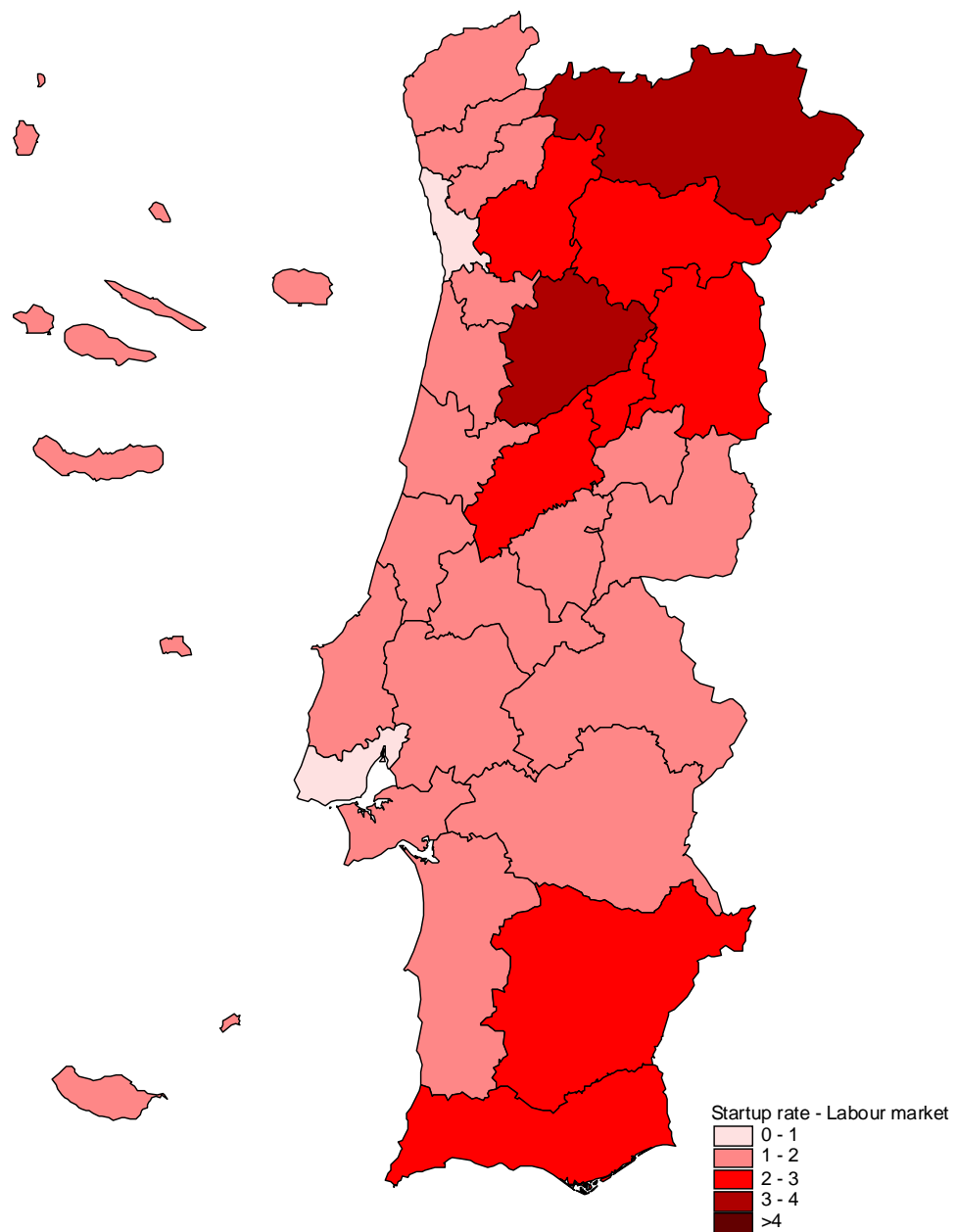
Figure 2: Average startup rate 1982-2002 by NUT3 – Labor market approach

Table 1: Correlation matrix of sector adjusted start-up rates for subsequent time periods – Business stock approach

	Year t	Year t-1	Year t-2	Year t-3	Year t-4	Year t-5	Year t-6	Year t-7	Year t-8	Year t-9	Year t-10
Year t	1.000	*0.629	*0.316	*0.159	*0.142	*0.350	*0.482	*0.389	*0.289	*0.255	*0.259
Year t-1		1.000	*0.647	*0.334	*0.180	*0.175	*0.389	*0.481	*0.423	*0.336	*0.279
Year t-2			1.000	*0.639	*0.310	*0.150	*0.140	*0.395	*0.465	*0.411	*0.326
Year t-3				1.000	*0.628	*0.288	*0.118	*0.139	*0.375	*0.452	*0.397
Year t-4					1.000	*0.613	*0.249	*0.118	0.094	*0.350	*0.441
Year t-5						1.000	*0.588	*0.263	0.063	0.040	*0.340
Year t-6							1.000	*0.611	*0.222	0.014	-0.003
Year t-7								1.000	*0.644	*0.256	0.025
Year t-8									1.000	*0.648	*0.235
Year t-9										1.000	*0.645
Year t-10											1.000

Notes: * statistically significant at 5% level

Table 2: Correlation matrix of sector adjusted start-up rates for subsequent time periods – Labor market approach

	Year t	Year t-1	Year t-2	Year t-3	Year t-4	Year t-5	Year t-6	Year t-7	Year t-8	Year t-9	Year t-10
Year t	1.000	*0.474	*0.468	*0.510	*0.505	*0.529	*0.555	*0.499	*0.477	*0.499	*0.516
Year t-1		1.000	*0.473	*0.461	*0.502	*0.514	*0.531	*0.532	*0.500	*0.486	*0.503
Year t-2			1.000	*0.469	*0.455	*0.497	*0.506	*0.531	*0.524	*0.495	*0.475
Year t-3				1.000	*0.456	*0.453	*0.492	*0.494	*0.525	*0.515	*0.486
Year t-4					1.000	*0.453	*0.445	*0.476	*0.481	*0.521	*0.505
Year t-5						1.000	*0.445	*0.443	*0.469	*0.474	*0.514
Year t-6							1.000	*0.435	*0.432	*0.462	*0.463
Year t-7								1.000	*0.428	*0.428	*0.459
Year t-8									1.000	*0.419	*0.415
Year t-9										1.000	*0.408
Year t-10											1.000

Notes: * statistically significant at 5% level

Table 3: The impact of lagged start-up rates on regional employment change: Business Stock approach – Fixed effects estimates

Dependent variable: Two-year regional employment change												
Start-up rate current year	*11.540 (0.030)	*9.749 (0.000)										
Start-up rate year t-1	5.295 (0.129)		*5.322 (0.000)									
Start-up rate year t-2	-0.950 (0.833)			3.560 (0.103)								
Start-up rate year t-3	*-9.382 (0.015)				*3.528 (0.033)							
Start-up rate year t-4	7.229 (0.178)					*5.796 (0.020)						
Start-up rate year t-5	*-8.508 (0.046)						4.709 (0.115)					
Start-up rate year t-6	0.486 (0.869)							2.924 (0.113)				
Start-up rate year t-7	-2.214 (0.524)								*1.674 (- 0.875)			
Start-up rate year t-8	-1.757 (0.332)									1.913 (0.132)		
Start-up rate year t-9	2.169 (0.161)										*4.721 (0.000)	
Start-up rate year t-10	*9.295 (0.019)											*9.815 (0.001)
Economic size	0.000 (0.634)	*0.000 (0.049)	*0.000 (0.006)	*0.000 (0.006)	*0.000 (0.005)	*0.000 (0.017)	*0.000 (0.019)	*0.000 (0.007)	*0.000 (0.004)	*0.000 (0.003)	*0.000 (0.004)	0.000 (0.218)
Spatial Autocorrelation	0.419 (0.072)	0.442 (0.053)	0.354 (0.138)	0.301 (0.231)	0.285 (0.271)	0.241 (0.379)	0.246 (0.371)	0.301 (0.296)	0.225 (0.299)	0.298 (0.174)	0.351 (0.098)	0.427 (0.066)
Constant	-8.209 (0.161)	-2.479 (0.305)	*6.657 (0.030)	*10.895 (0.020)	*11.564 (0.005)	7.705 (0.135)	9.827 (0.110)	*12.097 (0.010)	*11.821 (0.005)	*12.939 (0.000)	*8.128 (0.000)	-0.374 (0.941)
R ²	0.238	0.158	0.082	0.059	0.056	0.076	0.066	0.062	0.046	0.050	0.079	0.188
F-value	50.990	38.690	19.440	9.070	11.290	14.020	10.110	10.480	10.230	9.000	18.780	17.090
N. Observations (No. Obs. Per NUT)	270(9)	570(19)	540(18)	510(17)	480(16)	450(15)	420(14)	390(13)	360(12)	330(11)	300(10)	270(9)

Notes: P-values in parentheses; * statistically significant at 5% level

Table 4: The impact of lagged start-up rates on regional employment change: Business Stock approach – Robust Huber-White estimates

Dependent variable: Two-year regional employment change												
Start-up rate current year	-0.593 (0.142)	*-0.316 (0.000)										
Start-up rate year t-1	-0.065 (0.719)		-0.239 (0.079)									
Start-up rate year t-2	-0.012 (0.973)			-0.229 (0.140)								
Start-up rate year t-3	*-0.635 (0.000)				-0.022 (0.824)							
Start-up rate year t-4	0.103 (0.610)					*0.443 (0.000)						
Start-up rate year t-5	*0.330 (0.030)						*0.453 (0.000)					
Start-up rate year t-6	0.094 (0.560)							*0.266 (0.001)				
Start-up rate year t-7	*0.473 (0.002)								0.142 (0.110)			
Start-up rate year t-8	*0.375 (0.009)									-0.015 (0.859)		
Start-up rate year t-9	0.193 (0.184)										-0.110 (0.347)	
Start-up rate year t-10	*-0.332 (0.014)											-0.204 (0.084)
Economic size	0.000 (0.084)	*0.000 (0.001)	*0.000 (0.001)	*0.000 (0.002)	*0.000 (0.003)	*0.000 (0.042)	0.000 (0.060)	*0.000 (0.020)	*0.000 (0.009)	*0.000 (0.004)	*0.000 (0.002)	*0.000 (0.002)
Spatial Autocorrelation	0.298 (0.094)	*0.748 (0.000)	*0.709 (0.000)	*0.686 (0.000)	*0.727 (0.000)	*0.751 (0.000)	*0.756 (0.000)	*0.735 (0.000)	*0.736 (0.000)	*0.735 (0.000)	*0.718 (0.000)	*0.647 (0.000)
Constant	7.786 (0.131)	*11.346 (0.000)	*10.588 (0.000)	*10.939 (0.000)	*7.827 (0.000)	0.285 (0.835)	-0.146 (0.911)	2.353 (0.058)	*4.222 (0.010)	*7.115 (0.000)	*8.918 (0.000)	*11.260 (0.000)
R ²	0.260	0.313	0.276	0.260	0.278	0.333	0.345	0.296	0.283	0.281	0.259	0.214
F-value	15.540	61.770	52.570	52.560	54.530	55.400	51.760	41.040	45.820	45.240	45.250	32.260
N. Observations (No. Obs. Per NUT)	270(9)	570(19)	540(18)	510(17)	480(16)	450(15)	420(14)	390(13)	360(12)	330(11)	300(10)	270(9)

Notes: P-values in parentheses; * statistically significant at 5% level

Table 5: The impact of lagged start-up rates on (sector adjusted) regional employment change: Business Stock approach – Fixed effects estimates

Dependent variable: Sector adjusted Two-year regional employment change												
Start-up rate current year	-0.291 (0.753)	*-0.739 (0.008)										
Start-up rate year t-1	1.131 (0.204)		*-0.847 (0.002)									
Start-up rate year t-2	-1.170 (0.182)			*-1.091 (0.000)								
Start-up rate year t-3	*-1.680 (0.037)				*-0.828 (0.006)							
Start-up rate year t-4	1.015 (0.214)					0.466 (0.139)						
Start-up rate year t-5	-0.980 (0.269)						0.495 (0.152)					
Start-up rate year t-6	0.732 (0.423)							*0.730 (0.027)				
Start-up rate year t-7	1.549 (0.098)								0.402 (0.212)			
Start-up rate year t-8	0.824 (0.364)									-0.501 (0.129)		
Start-up rate year t-9	-1.040 (0.147)										*-0.779 (0.027)	
Start-up rate year t-10	0.498 (0.372)											-0.562 (0.131)
Economic size	0.000 (0.852)	0.000 (0.900)	0.000 (0.983)	0.000 (0.762)	0.000 (0.795)	0.000 (0.752)	0.000 (0.747)	0.000 (0.504)	0.000 (0.368)	0.000 (0.610)	0.000 (0.671)	0.000 (0.717)
Spatial Autocorrelation	-0.076 (0.646)	*0.281 (0.001)	*0.254 (0.003)	*0.210 (0.021)	*0.222 (0.018)	*0.205 (0.035)	0.164 (0.122)	*0.230 (0.038)	0.209 (0.078)	0.210 (0.100)	0.153 (0.267)	0.134 (0.359)
Constant	5.799 (0.882)	*26.559 (0.000)	*28.907 (0.000)	*34.074 (0.000)	*30.478 (0.000)	8.899 (0.120)	8.308 (0.195)	2.572 (0.683)	6.435 (0.310)	*22.437 (0.001)	*27.787 (0.000)	*25.025 (0.003)
R ²	0.085	0.037	0.037	0.039	0.028	0.017	0.015	0.030	0.015	0.021	0.027	0.015
F-value	1.630	6.800	6.410	6.500	4.260	2.390	1.900	3.620	1.680	2.080	2.460	1.230
N. Observations (No. Obs. Per NUT)	270(9)	570(19)	540(18)	510(17)	480(16)	450(15)	420(14)	390(13)	360(12)	330(11)	300(10)	270(9)

Notes: P-values in parentheses; * statistically significant at 5% level

Table 6: The impact of lagged start-up rates on (sector adjusted) regional employment change: Business Stock approach – Robust Huber-White estimates

Dependent variable: Sector adjusted Two-year regional employment change												
Start-up rate current year	-0.090 (0.907)	-0.336 (0.142)										
Start-up rate year t-1	1.332 (0.363)		-0.431 (0.056)									
Start-up rate year t-2	-1.156 (0.200)			-0.648 (0.156)								
Start-up rate year t-3	-1.718 (0.061)				-0.425 (0.339)							
Start-up rate year t-4	1.168 (0.199)					0.642 (0.093)						
Start-up rate year t-5	-0.617 (0.356)						*0.636 (0.035)					
Start-up rate year t-6	0.998 (0.325)							*0.868 (0.007)				
Start-up rate year t-7	*1.817 (0.025)								*0.634 (0.016)			
Start-up rate year t-8	1.133 (0.117)									-0.065 (0.737)		
Start-up rate year t-9	-0.867 (0.236)										-0.299 (0.276)	
Start-up rate year t-10	0.408 (0.293)											-0.153 (0.656)
Economic size	0.000 (0.169)	*0.000 (0.001)	*0.000 (0.001)	*0.000 (0.001)	*0.000 (0.001)	*0.000 (0.004)	*0.000 (0.003)	*0.000 (0.004)	*0.000 (0.003)	*0.000 (0.001)	*0.000 (0.002)	*0.000 (0.003)
Spatial Autocorrelation	0.041 (0.898)	0.359 (0.129)	0.325 (0.174)	0.270 (0.262)	0.271 (0.271)	0.261 (0.349)	0.224 (0.456)	0.290 (0.341)	0.280 (0.184)	0.291 (0.200)	0.240 (0.347)	0.213 (0.405)
Constant	-20.500 (0.379)	*21.348 (0.000)	*23.574 (0.000)	*28.240 (0.001)	*25.232 (0.003)	7.598 (0.228)	7.704 (0.155)	2.372 (0.619)	5.364 (0.197)	*17.631 (0.000)	*22.362 (0.001)	*20.840 (0.005)
R ²	0.127	0.056	0.053	0.051	0.046	0.052	0.049	0.067	0.051	0.044	0.041	0.036
F-value	5.800	5.790	5.740	4.910	4.950	6.830	8.430	8.420	8.230	5.620	5.470	4.910
N. Observations (No. Obs. Per NUT)	270(9)	570(19)	540(18)	510(17)	480(16)	450(15)	420(14)	390(13)	360(12)	330(11)	300(10)	270(9)

Notes: P-values in parentheses; * statistically significant at 5% level

**Table 7: The impact of lagged start-up rates on regional employment change -
Almon Method: Business Stock approach – Fixed effects estimates**

	Dependent variable: Two-year regional employment change			
	Almon Method assuming a polynomial of			
	2 nd order	3 rd order	4 th order	5 th order
Start-up rate current year	-1.211	-1.402	-1.467	-1.182
Start-up rate year t-1	-0.851	-0.887	-0.792	-0.876
Start-up rate year t-2	-0.551	-0.510	-0.413	-0.603
Start-up rate year t-3	-0.311	-0.253	-0.225	-0.372
Start-up rate year t-4	-0.131	-0.098	-0.145	-0.195
Start-up rate year t-5	-0.011	-0.027	-0.115	-0.083
Start-up rate year t-6	0.049	-0.021	-0.102	-0.041
Start-up rate year t-7	0.049	-0.062	-0.093	-0.061
Start-up rate year t-8	-0.011	-0.132	-0.103	-0.115
Start-up rate year t-9	-0.131	-0.213	-0.168	-0.152
Start-up rate year t-10	-0.311	-0.286	-0.350	-0.090
Economic size	0.000	0.000	0.000	0.000
Spatial Autocorrelation	0.016	0.009	-0.006	0.040
Constant	56.527	63.549	65.141	59.830
R ²	0.381	0.387	0.391	0.380
F-value	28.980	24.590	21.340	17.790
N. Observations (No. Obs. Per NUT)	270(9)	270(9)	270(9)	270(9)

Table 8: The impact of lagged start-up rates on regional employment change - Almon Method: Business Stock approach – Robust Huber-White estimates

	Dependent variable: Two-year regional employment change			
	Almon Method assuming a polynomial of			
	2 nd order	3 rd order	4 th order	5 th order
Start-up rate current year	-0.759	-0.490	-0.536	-0.453
Start-up rate year t-1	-0.434	-0.421	-0.351	-0.331
Start-up rate year t-2	-0.169	-0.286	-0.214	-0.166
Start-up rate year t-3	0.037	-0.114	-0.091	0.021
Start-up rate year t-4	0.183	0.066	0.037	0.208
Start-up rate year t-5	0.270	0.227	0.170	0.367
Start-up rate year t-6	0.297	0.339	0.292	0.469
Start-up rate year t-7	0.265	0.374	0.366	0.477
Start-up rate year t-8	0.174	0.303	0.340	0.347
Start-up rate year t-9	0.023	0.099	0.144	0.028
Start-up rate year t-10	-0.187	-0.267	-0.311	-0.540
Economic size	0.000	0.000	0.000	0.000
Spatial Autocorrelation	0.436	0.366	0.371	0.358
Constant	10.705	8.895	8.838	3.351
R ²	0.230	0.235	0.237	0.255
F-value	17.760	17.390	14.510	19.330
N. Observations (No. Obs. Per NUT)	270(9)	270(9)	270(9)	270(9)

Table 9: The impact of lagged start-up rates on (sector adjusted) regional employment change - Almon Method: Business Stock approach – Fixed effects estimates

Dependent variable: Sector adjusted Two-year regional employment change				
Almon Method assuming a polynomial of				
	2 nd order	3 rd order	4 th order	5 th order
Start-up rate current year	-0.849	-0.351	-0.250	-0.358
Start-up rate year t-1	-0.553	-0.460	-0.639	-0.272
Start-up rate year t-2	-0.314	-0.420	-0.597	-0.119
Start-up rate year t-3	-0.129	-0.280	-0.329	0.062
Start-up rate year t-4	0.000	-0.087	0.001	0.232
Start-up rate year t-5	0.073	0.113	0.276	0.350
Start-up rate year t-6	0.092	0.271	0.418	0.381
Start-up rate year t-7	0.054	0.341	0.395	0.295
Start-up rate year t-8	-0.038	0.275	0.218	0.070
Start-up rate year t-9	-0.186	0.026	-0.060	-0.304
Start-up rate year t-10	-0.389	-0.454	-0.342	-0.827
Economic size	0.000	0.000	0.000	0.000
Spatial Autocorrelation	0.063	0.078	0.059	0.050
Constant	48.852	30.730	28.379	28.216
R ²	0.022	0.025	0.026	0.031
F-value	1.060	1.010	0.890	0.930
N. Observations (No. Obs. Per NUT)	270(9)	270(9)	270(9)	270(9)

Table 10: The impact of lagged start-up rates on (sector adjusted) regional employment change - Almon Method: Business Stock approach – Robust Huber-White estimates

	Dependent variable: Sector adjusted Two-year regional employment change			
	Almon Method assuming a polynomial of			
	2 nd order	3 rd order	4 th order	5 th order
Start-up rate current year	-0.905	0.052	0.187	-0.374
Start-up rate year t-1	-0.403	-0.304	-0.544	-0.216
Start-up rate year t-2	0.002	-0.348	-0.587	-0.158
Start-up rate year t-3	0.308	-0.172	-0.246	-0.140
Start-up rate year t-4	0.516	0.132	0.233	-0.105
Start-up rate year t-5	0.626	0.471	0.661	-0.012
Start-up rate year t-6	0.637	0.755	0.912	0.150
Start-up rate year t-7	0.551	0.890	0.915	0.354
Start-up rate year t-8	0.366	0.785	0.661	0.520
Start-up rate year t-9	0.083	0.348	0.199	0.505
Start-up rate year t-10	-0.298	-0.513	-0.364	0.088
Economic size	0.000	0.000	0.000	0.000
Spatial Autocorrelation	0.186	0.172	0.149	0.167
Constant	-6.825	-15.594	-15.180	-1.166
R ²	0.0666	0.078	0.079	0.080
F-value	4.99	4.250	3.960	4.320
N. Observations (No. Obs. Per NUT)	270(9)	270(9)	270(9)	270(9)

Table 11: The impact of lagged start-up rates on regional employment change: Labor market approach – Fixed effects estimates

Dependent variable: Two-year regional employment change												
Start-up rate current year	-0.357 (0.788)	-0.558 (0.152)										
Start-up rate year t-1	0.486 (0.743)		*-1.051 (0.008)									
Start-up rate year t-2	1.751 (0.233)			*-0.953 (0.017)								
Start-up rate year t-3	0.086 (0.953)				-0.157 (0.698)							
Start-up rate year t-4	2.133 (0.123)					0.647 (0.121)						
Start-up rate year t-5	1.821 (0.150)						*0.846 (0.042)					
Start-up rate year t-6	1.275 (0.245)							0.246 (0.555)				
Start-up rate year t-7	-0.204 (0.732)								-0.604 (0.166)			
Start-up rate year t-8	0.264 (0.651)									-0.331 (0.461)		
Start-up rate year t-9	0.791 (0.159)										0.465 (0.334)	
Start-up rate year t-10	-0.195 (0.718)											-0.414 (0.417)
Economic size	0.000 (0.174)	0.000 (0.565)	0.000 (0.381)	0.000 (0.483)	0.000 (0.669)	0.000 (0.726)	0.000 (0.848)	0.000 (0.560)	0.000 (0.200)	0.000 (0.139)	0.000 (0.148)	0.000 (0.178)
Spatial Autocorrelation	*0.667 (0.000)	*0.830 (0.000)	*0.804 (0.000)	*0.778 (0.000)	*0.772 (0.000)	*0.771 (0.000)	*0.807 (0.000)	*0.764 (0.000)	*0.769 (0.000)	*0.755 (0.000)	*0.761 (0.000)	*0.700 (0.000)
Constant	-7.954 (0.329)	*6.872 (0.000)	*8.143 (0.000)	*8.431 (0.000)	*7.306 (0.000)	*6.115 (0.000)	*5.676 (0.000)	*5.965 (0.000)	*6.693 (0.000)	*6.093 (0.000)	*4.626 (0.000)	*6.644 (0.000)
R ²	0.243	0.408	0.379	0.349	0.344	0.341	0.379	0.326	0.315	0.316	0.314	0.268
F-value	5.590	123.420	103.090	85.170	78.190	72.010	78.590	57.590	50.120	45.670	40.800	28.850
N. Observations (No. Obs. Per NUT)	270(9)	570(19)	540(18)	510(17)	480(16)	450(15)	420(14)	390(13)	360(12)	330(11)	300(10)	270(9)

Notes: P-values in parentheses; * statistically significant at 5% level

Table 12: The impact of lagged start-up rates on regional employment change: Labor market approach – Robust Huber-White estimates

Dependent variable: Two-year regional employment change												
Start-up rate current year	-0.559 (0.602)	0.322 (0.545)										
Start-up rate year t-1	-0.004 (0.997)		0.142 (0.815)									
Start-up rate year t-2	1.164 (0.489)			0.251 (0.674)								
Start-up rate year t-3	-0.386 (0.597)				0.636 (0.277)							
Start-up rate year t-4	1.426 (0.119)					1.043 (0.155)						
Start-up rate year t-5	0.976 (0.438)						*0.510 (0.023)					
Start-up rate year t-6	0.168 (0.803)							0.635 (0.220)				
Start-up rate year t-7	-0.493 (0.052)								0.173 (0.673)			
Start-up rate year t-8	-0.031 (0.908)									*0.390 (-0.461)		
Start-up rate year t-9	0.645 (0.051)										*0.802 (0.040)	
Start-up rate year t-10	-0.290 (0.511)											0.348 (0.164)
Economic size	0.000 (0.066)	*0.000 (0.003)	*0.000 (0.003)	*0.000 (0.004)	*0.000 (0.006)	*0.000 (0.009)	*0.000 (0.004)	*0.000 (0.004)	*0.000 (0.002)	*0.000 (0.002)	*0.000 (0.004)	*0.000 (0.005)
Spatial Autocorrelation	*0.700 (0.000)	*0.793 (0.000)	*0.757 (0.000)	*0.728 (0.000)	*0.730 (0.000)	*0.731 (0.000)	*0.769 (0.000)	*0.726 (0.000)	*0.734 (0.000)	*0.734 (0.000)	*0.750 (0.000)	*0.707 (0.000)
Constant	2.761 (0.095)	*5.656 (0.000)	*6.480 (0.000)	*6.742 (0.000)	*6.308 (0.000)	*5.820 (0.000)	*5.638 (0.000)	*5.821 (0.000)	*6.384 (0.000)	*6.243 (0.000)	*5.465 (0.000)	*6.923 (0.000)
R ²	0.256	0.355	0.311	0.283	0.292	0.302	0.337	0.285	0.276	0.285	0.299	0.251
F-value	14.950	68.660	63.490	58.960	55.310	53.020	47.680	40.640	44.800	43.810	42.260	35.310
N. Observations (No. Obs. Per NUT)	270(9)	570(19)	540(18)	510(17)	480(16)	450(15)	420(14)	390(13)	360(12)	330(11)	300(10)	270(9)

Notes: P-values in parentheses; * statistically significant at 5% level

Table 13: The impact of lagged start-up rates on (sector adjusted) regional employment change: Labor market approach – Fixed effects estimates

Dependent variable: Sector adjusted Two-year regional employment change												
Start-up rate current year	*11.099 (0.019)	*8.666 (0.000)										
Start-up rate year t-1	4.092 (0.436)		0.143 (0.932)									
Start-up rate year t-2	-2.188 (0.667)			*-3.416 (0.048)								
Start-up rate year t-3	*-12.023 (0.019)				-3.398 (0.059)							
Start-up rate year t-4	5.910 (0.225)					1.807 (0.324)						
Start-up rate year t-5	*-9.422 (0.037)						0.568 (0.766)					
Start-up rate year t-6	0.667 (0.865)							-1.322 (0.467)				
Start-up rate year t-7	-2.706 (0.192)								-1.898 (0.287)			
Start-up rate year t-8	-2.190 (0.289)									-3.243 (0.068)		
Start-up rate year t-9	1.822 (0.362)										1.024 (0.591)	
Start-up rate year t-10	*9.172 (0.000)											*9.789 (0.000)
Economic size	0.000 (0.428)	0.000 (0.915)	0.000 (0.713)	0.000 (0.737)	0.000 (0.824)	0.000 (0.945)	0.000 (0.918)	0.000 (0.708)	0.000 (0.498)	0.000 (0.450)	0.000 (0.434)	0.000 (0.476)
Spatial Autocorrelation	*0.378 (0.009)	*0.422 (0.000)	*0.309 (0.000)	*0.247 (0.005)	*0.225 (0.016)	*0.225 (0.019)	*0.232 (0.021)	*0.334 (0.002)	0.219 (0.064)	*0.263 (0.034)	*0.264 (0.046)	*0.395 (0.004)
Constant	4.937 (0.862)	-0.801 (0.797)	*14.854 (0.000)	*22.000 (0.000)	*22.516 (0.000)	*13.715 (0.000)	*15.936 (0.000)	*17.856 (0.000)	*17.006 (0.000)	*18.871 (0.000)	*11.389 (0.014)	-2.973 (0.551)
R ²	0.179	0.089	0.027	0.025	0.022	0.016	0.014	0.028	0.015	0.028	0.018	0.116
F-value	3.820	17.420	4.730	4.070	3.330	2.240	1.890	3.410	1.650	2.850	1.600	10.380
N. Observations (No. Obs. Per NUT)	270(9)	570(19)	540(18)	510(17)	480(16)	450(15)	420(14)	390(13)	360(12)	330(11)	300(10)	270(9)

Notes: P-values in parentheses; * statistically significant at 5% level

Table 14: The impact of lagged start-up rates on (sector adjusted) regional employment change: Labor market approach – Robust Huber-White estimates

Dependent variable: Sector adjusted Two-year regional employment change												
Start-up rate current year	*11.540 (0.030)	*9.749 (0.000)										
Start-up rate year t-1	5.295 (0.129)		*5.322 (0.000)									
Start-up rate year t-2	-0.950 (0.833)			3.560 (0.103)								
Start-up rate year t-3	*-9.382 (0.015)				*3.528 (0.033)							
Start-up rate year t-4	7.229 (0.178)					*5.796 (0.020)						
Start-up rate year t-5	*-8.508 (0.046)						4.709 (0.115)					
Start-up rate year t-6	0.486 (0.869)							2.924 (0.113)				
Start-up rate year t-7	-2.214 (0.524)								*1.674 (0.875)			
Start-up rate year t-8	-1.757 (0.332)									1.913 (0.132)		
Start-up rate year t-9	2.169 (0.161)										*4.721 (0.000)	
Start-up rate year t-10	*9.295 (0.019)											*9.815 (0.001)
Economic size	0.000 (0.634)	*0.000 (0.049)	*0.000 (0.006)	*0.000 (0.006)	*0.000 (0.005)	*0.000 (0.017)	*0.000 (0.019)	*0.000 (0.007)	*0.000 (0.004)	*0.000 (0.003)	*0.000 (0.004)	0.000 (0.218)
Spatial Autocorrelation	0.419 (0.072)	0.442 (0.053)	0.354 (0.138)	0.301 (0.231)	0.285 (0.271)	0.241 (0.379)	0.246 (0.371)	0.301 (0.296)	0.225 (0.299)	0.298 (0.174)	0.351 (0.098)	0.427 (0.066)
Constant	-8.209 (0.161)	-2.479 (0.305)	*6.657 (0.030)	*10.895 (0.020)	*11.564 (0.005)	7.705 (0.135)	9.827 (0.110)	*12.097 (0.010)	*11.821 (0.005)	*12.939 (0.000)	*8.128 (0.000)	-0.374 (0.941)
R ²	0.238	0.158	0.082	0.059	0.056	0.076	0.066	0.062	0.046	0.050	0.079	0.188
F-value	50.990	38.690	19.440	9.070	11.290	14.020	10.110	10.480	10.230	9.000	18.780	17.090
N. Observations (No. Obs. Per NUT)	270(9)	570(19)	540(18)	510(17)	480(16)	450(15)	420(14)	390(13)	360(12)	330(11)	300(10)	270(9)

Notes: P-values in parentheses; * statistically significant at 5% level

**Table 15: The impact of lagged start-up rates on regional employment change -
Almon Method: Labor market approach – Fixed effects estimates**

	Dependent variable: Two-year regional employment change			
	Almon Method assuming a polynomial of			
	2 nd order	3 rd order	4 th order	5 th order
Start-up rate current year	0.638	-0.043	-0.345	-0.562
Start-up rate year t-1	0.772	0.710	1.113	-0.518
Start-up rate year t-2	0.856	1.141	1.655	-0.423
Start-up rate year t-3	0.890	1.310	1.638	-0.304
Start-up rate year t-4	0.875	1.273	1.341	-0.188
Start-up rate year t-5	0.811	1.088	0.969	-0.099
Start-up rate year t-6	0.698	0.815	0.653	-0.056
Start-up rate year t-7	0.535	0.509	0.447	-0.067
Start-up rate year t-8	0.322	0.230	0.332	-0.132
Start-up rate year t-9	0.060	0.035	0.213	-0.236
Start-up rate year t-10	-0.251	-0.018	-0.080	-0.348
Economic size	0.000	0.000	0.000	0.000
Spatial Autocorrelation	0.656	0.646	0.646	0.324
Constant	-5.222	-6.681	-8.213	51.723
R ²	0.238	0.234	0.232	0.341
F-value	14.670	11.910	10.040	15.000
N. Observations (No. Obs. Per NUT)	270(9)	270(9)	270(9)	270(9)

**Table 16: The impact of lagged start-up rates on regional employment change -
Almon Method: Labor market approach – Robust Huber-White estimates**

	Dependent variable: Two-year regional employment change			
	Almon Method assuming a polynomial of			
	2 nd order	3 rd order	4 th order	5 th order
Start-up rate current year	0.291	-0.229	-0.754	-0.162
Start-up rate year t-1	0.359	0.260	0.587	-0.147
Start-up rate year t-2	0.401	0.534	0.999	-0.043
Start-up rate year t-3	0.417	0.636	0.886	0.128
Start-up rate year t-4	0.407	0.606	0.559	0.344
Start-up rate year t-5	0.370	0.485	0.236	0.578
Start-up rate year t-6	0.307	0.314	0.043	0.784
Start-up rate year t-7	0.218	0.134	0.014	0.895
Start-up rate year t-8	0.102	-0.014	0.090	0.811
Start-up rate year t-9	-0.040	-0.089	0.120	0.396
Start-up rate year t-10	-0.209	-0.051	-0.140	-0.538
Economic size	0.000	0.000	0.000	0.000
Spatial Autocorrelation	0.681	0.679	0.684	0.452
Constant	2.671	2.760	2.695	0.406
R ²	0.248	0.2478	0.250	0.260
F-value	20.180	20.35	17.910	20.780
N. Observations (No. Obs. Per NUT)	270(9)	270(9)	270(9)	270(9)

Table 17: The impact of lagged start-up rates on (sector adjusted) regional employment change - Almon Method: Labor market approach – Fixed effects estimates

Dependent variable: Sector adjusted Two-year regional employment change				
Almon Method assuming a polynomial of				
	2 nd order	3 rd order	4 th order	5 th order
Start-up rate current year	10.354	9.622	11.903	-0.070
Start-up rate year t-1	5.055	5.082	1.307	-0.154
Start-up rate year t-2	0.887	1.323	-3.121	-0.043
Start-up rate year t-3	-2.150	-1.577	-4.093	-0.004
Start-up rate year t-4	-4.055	-3.542	-3.599	-0.271
Start-up rate year t-5	-4.830	-4.497	-2.911	-0.936
Start-up rate year t-6	-4.474	-4.364	-2.583	-1.843
Start-up rate year t-7	-2.987	-3.068	-2.445	-2.472
Start-up rate year t-8	-0.368	-0.531	-1.612	-1.833
Start-up rate year t-9	3.381	3.321	1.522	1.645
Start-up rate year t-10	8.261	8.567	9.284	10.223
Economic size	0.000	0.000	0.000	0.000
Spatial Autocorrelation	0.448	0.450	0.459	0.209
Constant	-3.640	-5.831	5.835	23.623
R ²	0.148	0.148	0.162	0.198
F-value	8.150	6.790	6.440	7.140
N. Observations (No. Obs. Per NUT)	270(9)	270(9)	270(9)	270(9)

Table 18: The impact of lagged start-up rates on (sector adjusted) regional employment change - Almon Method: Labor market approach – Robust Huber-White estimates

	Dependent variable: Sector adjusted Two-year regional employment change			
	Almon Method assuming a polynomial of			
	2 nd order	3 rd order	4 th order	5 th order
Start-up rate current year	10.507	9.197	12.189	0.433
Start-up rate year t-1	5.375	5.178	2.775	0.335
Start-up rate year t-2	1.332	1.738	-1.343	0.318
Start-up rate year t-3	-1.622	-1.009	-2.504	0.237
Start-up rate year t-4	-3.487	-2.950	-2.408	-0.024
Start-up rate year t-5	-4.262	-3.973	-2.120	-0.477
Start-up rate year t-6	-3.948	-3.966	-2.071	-0.962
Start-up rate year t-7	-2.545	-2.815	-2.054	-1.066
Start-up rate year t-8	-0.053	-0.407	-1.226	-0.057
Start-up rate year t-9	3.528	3.370	1.891	3.197
Start-up rate year t-10	8.199	8.629	9.410	10.294
Economic size	0.000	0.000	0.000	0.000
Spatial Autocorrelation	0.474	0.480	0.477	0.331
Constant	-7.840	-7.750	-7.057	-15.148
R ²	0.216	0.217	0.2256	0.226
F-value	27.600	28.400	39.140	12.300
N. Observations (No. Obs. Per NUT)	270(9)	270(9)	270(9)	270(9)

Figure 3: The structure of the impact of new business formation on regional employment growth based on a regression that accounts for growth rates over eleven years

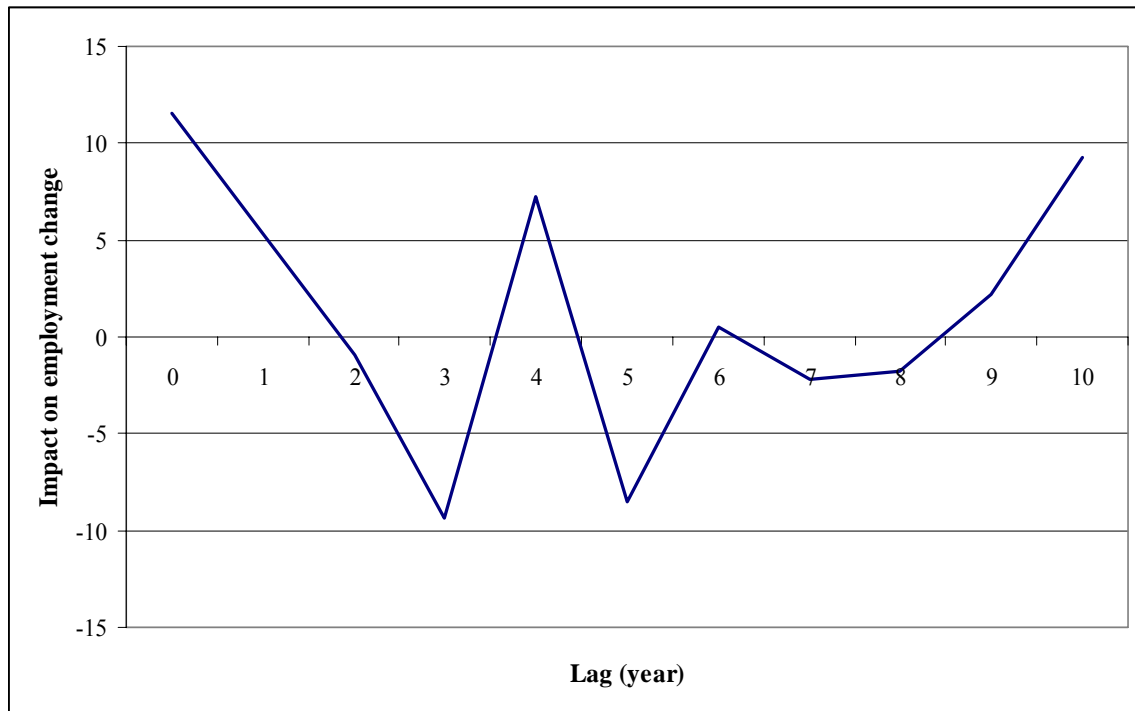
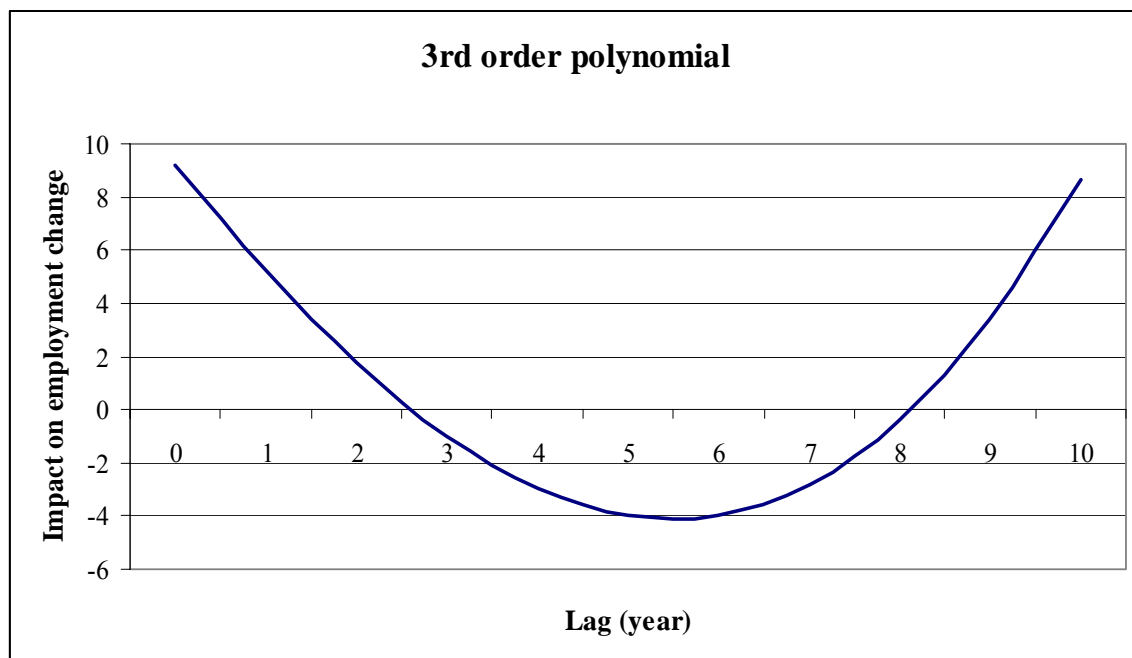
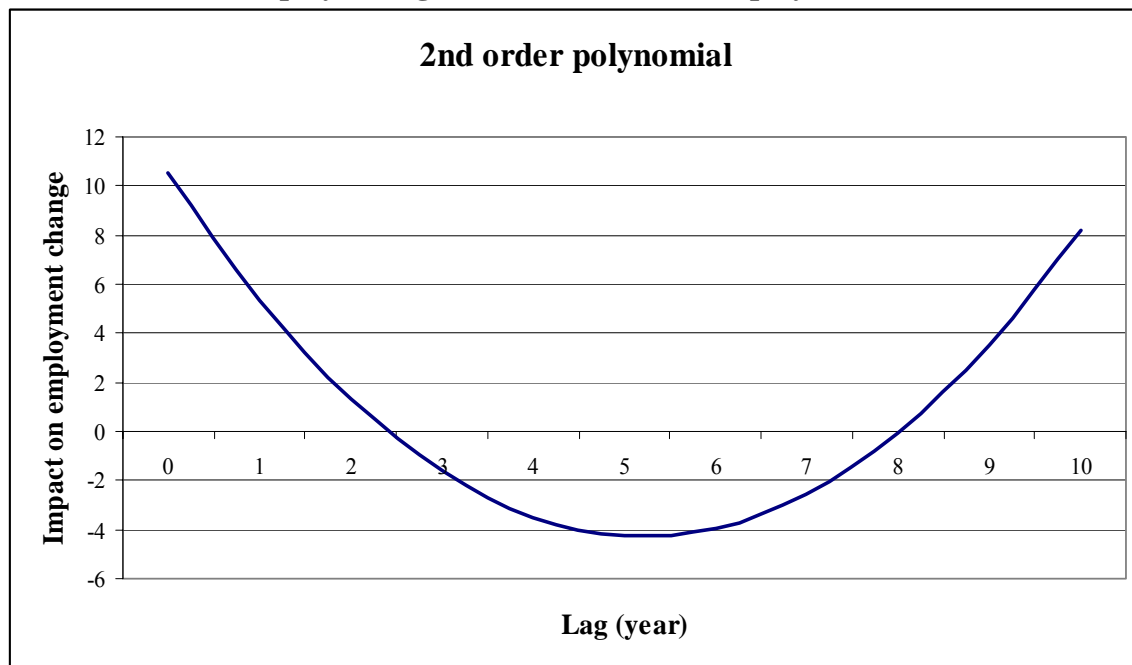


Figure 4: The lag structure of the impact of new business formation on regional employment growth based on Almon polynomials



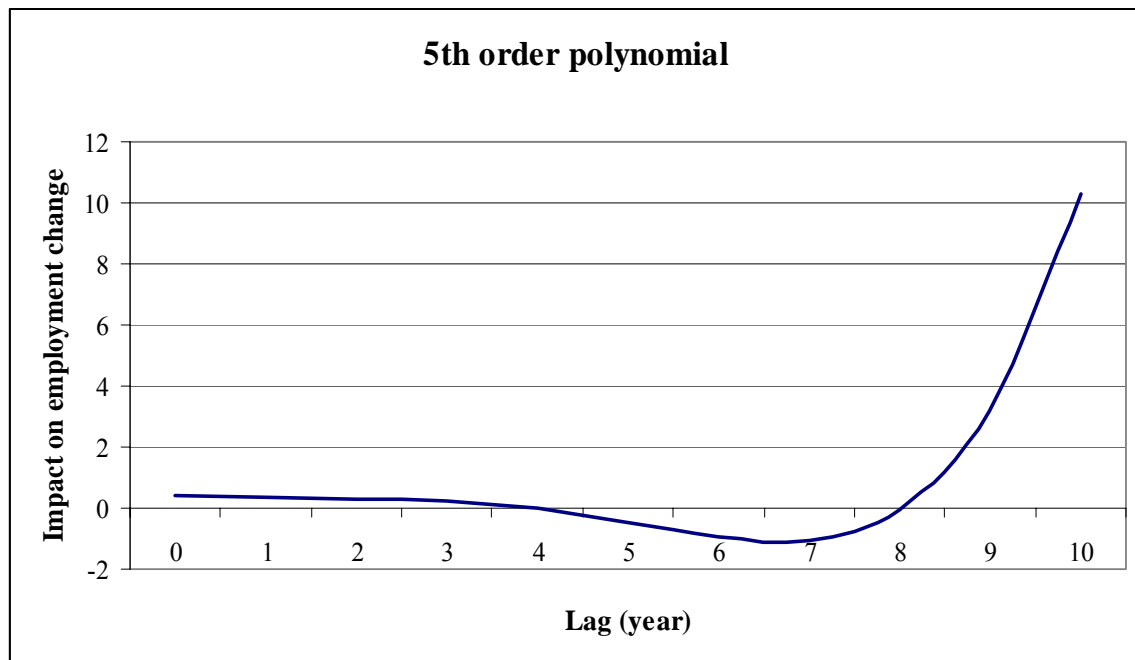
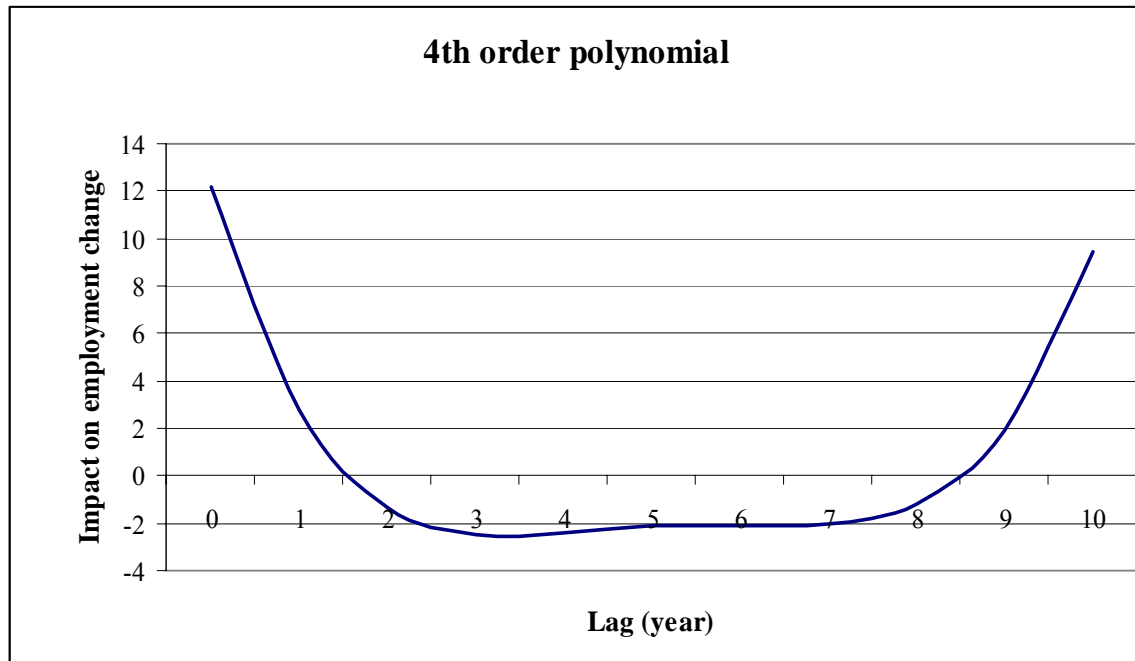


Figure 5: Direct and indirect effects of new business formation on regional employment growth over time

