DEMOGRAPHY AND INNOVATIVE ENTREPRENEURSHIP

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Abstract

Demographic change will be one of the major challenges for economic policy in the developed world in the next decades. In this article, we analyze the relationship between age structure and the number of startups. We argue that an individual's decision to start a business is determined by his or her age and, therefore, that a change in a region's age distribution affects the expected number of startups in the region. Using German regional data, we estimate a count-data model and find that the expected number of startups is positively influenced by the fraction of individuals of working age—20–64 years old. A more detailed analysis of the working-age distribution suggests that startups in knowledge-based (high-tech) manufacturing industries are affected by changes in this distribution whereas firms in other industries are not. In particular, increases in the fraction of individuals in the 20–30 age range and individuals in the 40–50 age range have a positive effect on the number of high-tech startups.

JEL Code: J1, L26, O3, R11.

Keywords: demography, age distribution, entrepreneurship, innovation, region.

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1. Introduction

As a result of low birth rates and increased life expectancy, many Western countries have experienced the beginning of a major demographic change—the aging of their populations—during the past 20 years and this trend is likely to continue for the next decades. Although policymakers and scientific studies have paid a great deal of attention to the consequences of demographic change as it affects the stability of social security systems, the impact of an aging population on innovation and economic growth has attracted much less interest.

In this paper, it is argued that factors that affect one's propensity to become an entrepreneur, such as human capital, risk aversion, and time discounting, are likely to change over the lifecycle. Therefore, an individual's decision to start a business is linked to his or her current age. We postulate that this is especially true for innovative entrepreneurship. Consequently, demographic change may influence the level of entrepreneurial activities in a region, which may, in turn, have an impact on innovation and economic growth. Based on a sample of German regions, we empirically investigate the impact of demography on the number of regional startups, particularly innovative startups.

Our paper is motivated by three findings reported in previous studies. First, the results of empirical studies suggest that differences between countries' age distributions explain cross-country variation in economic growth (Bloom *et al.* 2007). Second, economic growth is determined not only by new knowledge creation—as suggested by models of the endogenous growth theory (Romer 1990)—but also by the ability and the willingness of innovative entrepreneurs to develop new products and processes based on new knowledge (Acs *et al.* 2006). New knowledge, spilling over from both public and private R&D, encourages knowledge-based entrepreneurship, often manifesting as innovative startups. Indeed, empirical studies confirm the positive relationship between innovative startups and regional economic performance (Audretsch *et al.* 2006; Audretsch *et al.* 2008). Third, there is empirical evidence that an individual's decision to engage in entrepreneurial activity is influenced by the individual's age. According to Parker (2004, 106), age is among the clearest influence factors on measures of entrepreneurship, and most empirical studies suggest a positive—usually an inverse u-shaped—relationship between an individual's age and the individual's decision to start a business.

The contribution of this paper is to shed light on the impact of age structure on the number of startups in a region. To the authors' knowledge, this relationship has not been analyzed in the literature to date. Existing empirical studies analyze the influence of individual age on the individual decision to become an entrepreneur but do not examine the relevance of regional age distribution on the number of startups in a region. Moreover, we distinguish between knowledge-intensive and non-knowledge-intensive startup activities in our investigation, a distinction unique to this paper.

The results of our econometric analysis suggest that a region's age distribution is an important determinant of the expected number of startups in the region. Moreover, startups in knowledge-based manufacturing industries seem to be more sensitive to changes in the age distribution than do other startups.

The paper is organized as follows. In Section 2 we shed some light on the linkage between an individual's human capital accumulation over the lifetime and his or her propensity to become an entrepreneur. We then extend the individual propensity to a regional context, suspecting that the region's overall age distribution might affect its number of startups. Next, we present data (Section 3) and explain the empirical method (Section 4.1). We present and discuss our findings in Sections 4.2 and 4.3, respectively, and conclude in Section 5 with a summary of our results and a view on ideas for future research.

2. Regional Age Distribution and Innovative Entrepreneurship

2.1 Does Age Influence an Individual's Decision to Start a Business?

Benjamin Franklin once said that you better "beware of the young doctor and the old barber." Consciously or not, with this bit of advice, Franklin neatly summed up two crucial points in the evolution of an individual's abilities and skills along his or her (work) lifecycle, cleverly making the distinction between physical work, which is better performed by the young, and more theoretical work, which is better practiced by the more mature. Even though this separation is a bit simplistic, it is a good starting point for a more detailed analysis.

Every person has certain innate biological characteristics, such as sex, race, or health, that initially determine the individual's expected lifetime and intelligence. With these characteristics as the foundation, socialization, education, on-the-job training, and medical care, along with cultural education in literature, music, and the arts, all contribute to the individual's stock of human capital (Becker 1964). This stock of human capital, along with the basics he or she was born with, influence an individual's marginal productivity, health, and soft skills (i.e., personal qualities like responsibility, integrity, or self-management, as well as interpersonal qualities like being a team player or a leader) over the lifetime. Against this background, we are interested in the impact of age on an individual's decision to become an entrepreneur, i.e., to start a business. According to the economic literature on entrepreneurship, a rational individual would choose to start his or her own business if the expected entrepreneurial income equals at least the wage earned in dependent employment (Kihlstrom and Laffont 1979). If this is true, it means that an individual's decision whether to become an entrepreneur or take the waged-income road is determined by several factors, among them being the person's basic physical characteristics and the stock of human capital, which will influence the type of work a person is suited for and whether he or she *could* become an entrepreneur or not. However, the final decision to start a business eventually depends on an individual's risk aversion and time discounting.

Along a person's lifecycle, the stock of human capital determines his or her productivity and appropriateness for certain employment, i.e., dependent or independent; however, a person's stock of human capital also *changes* with age, which means the person will be better suited for different types of employment at different intervals of the lifecycle. On the one hand, adolescents are fairly unbiased (at least on certain subjects), which can help release creative energy (Florida 2002). They are energetic and at their peak of physical power. Additionally, the ability to store and process information, solve problems, deal with complexity, and adjust to new situations is also highest at this time of life (Kaufman and Horn 1996; Ryan *et al.* 2000). Moreover, having recently finished school, adolescents' textbook knowledge is current. However, they lack life experience and have not yet had time to develop strong social and business networks. The so-called tacit knowledge accumulated over a lifetime peaks when a person is in his or her 50s and does not differ across groups until the 80s (Wang and Kaufman 1993; Kaufman and Horn 1996; Ryan *et al.* 2000). Hence, these factors take time to accumulate, evolving over a lifetime from participating in work life, social interaction, and learning-by-doing. On the other hand, there is evidence that an individual's ability to process fresh knowledge, reason logically, and be creative decreases with age (Ruth and Birren 1985). Creativity, in particular, can wane due to mindsets that have become solidified, perhaps even fossilized, from past experience. Thus, some abilities and skills increase over a person's lifecycle while others decrease.

Given a stock of human capital, Lévesque and Minniti (2006) introduce a theoretical model that focuses on an individual's risk aversion and time discounting over the lifetime where the propensity to become an entrepreneur is decreases with age. They argue that the opportunity cost of time increases with age as every individual lives only a certain length of time. If time is a limiting resource, an individual's time discount rate attached to future income will increase over time "and, as a result, activities requiring a time commitment before becoming income producing, such as a new firm, are penalized with respect to activities with immediate payoffs such as waged labor" (Lévesque and Minniti 2006, 188f). In a closely related empirical study, Van Praag and Booij (2003) found that risk aversion decreases with age whereas time discounting increases. "On the one hand older people are more settled and hence can take more risk. On the other hand people are more cautious and take less risks" (Van Praag and Booij 2003, 14). This inverse relationship suggests that there is an optimal period in an individual's life when both risk aversion and time discounting are of only moderate influence. Along with a proper stock of human capital, this period could be the "golden age" of entrepreneurship.

Taken together, these theoretical considerations suggest that factors supportive of entrepreneurship and factors that are a barrier to it are likely to change over the human lifecycle and therefore the propensity to become an entrepreneur may be determined by an individual's age. The results of most empirical studies based on individual data suggest an inverse u-shaped effect of age on the probability of becoming self-employed (e.g. Evans and Leighton 1989b; Blanchflower and Meyer 1994; Blanchflower 2000). However, there are a few studies (Blau 1987; Evans and Jovanovic 1989; Evans and Leighton 1989a) that do not find any significant effect of age on self-employment. Other empirical studies have analyzed the relationship between age and *willingness* to become self-employed. For instance, Mueller (2006) finds for a sample of German individuals that the relationship between age and willingness to start a business is a positive curvilinear one and reaches its maximum at the age of 41 years.

2.2 Is Age Especially Important for Startups in Knowledge-Based Industries?

We expect that age will be an especially important factor in the decision to engage in a *high-tech startup*. These startups are typically characterized by high knowledge and physical capital intensity, by a high degree of uncertainty (as to the success and economic value of the innovation), and a longer time horizon as compared to other businesses. Thus, being an entrepreneur in this particular field requires a special profile: extraordinary creativity or the vast experience necessary to come up with a promising idea; having access to (venture) capital; and, finally, having a rather long time horizon. All this adds up to further support the idea of a golden age of entrepreneurship, a time of life when an individual's human capital stock, degree of risk aversion, and extent of time discounting support such an occupational choice.

On the one hand, experience and the stock of tacit knowledge, both useful in starting a high-tech firm, increase with age. On the other hand, mindsets and routines that become established with age and leave little room for recognizing entrepreneurial opportunity or being creative may negatively affect an individual's decision to start a high-tech business. Further, a high-tech startup usually takes more time to become profitable than do other types of startups. This implies that an individual's age-dependent time discount rate should have an impact on innovative entrepreneurship as it increases with age due to a shrinking time horizon; that is, increasing age leads to a preference for shorter-term profits. In contrast, risk aversion usually decreases with age as the individual becomes more settled and secure in life. Risk aversion is generally highest at that point in life when the individual is just beginning to settle down and start his or her own family, usually around 30–40 years of age (Van Praag and Booij 2003).

2.3 Does Regional Age Distribution Influence the Number of Startups in a Region?

The above discussion leads us to regard an individual's age as a proxy for his or her human capital stock, risk aversion, and time discount rate—all important drivers of the decision concerning whether to become an entrepreneur. Projecting these individual-level theoretical considerations to the regional level leads to a simple conclusion: if an individual's decision to start a business is determined by age or human capital at a certain age, regional startup dynamics depend on the regional age distribution or regional stock of human capital. This conclusion is in accord with Audretsch and Keilbach's (2004) concept of a region's entrepreneurship capital as "a regional milieu of agents that is conducive to the creation of new firms." In their contribution, Audretsch and Keilbach assume that "entrepreneurship capital manifests itself by the creation of new firms"; however, they do not control for this relationship explicitly.

In this contribution, we start at the individual level with the assumption that age is a valid proxy for an individual's human capital stock, risk aversion, and time discount rate, which all factor into an individual's decision to become an entrepreneur. Based on this, we assume at the regional level that the number of entrepreneurs (i.e., a region's entrepreneurship capital) is determined by the regional age distribution, which, as mentioned, is a proxy for the prevailing stock of human capital in the region. We deliberately choose to conduct our analysis at the meso level as our initial intention was to study the impact of age distribution on start-up rates.

To approximate the regional distribution of entrepreneurship capital, we view an individual's decision about whether to become an entrepreneur as comparable to a Bernoulli experiment with a binary outcome: to be an entrepreneur or not to be an entrepreneur. Performed repeatedly at the regional level and under the assumption that the individual decision to become an entrepreneur is still a rare event, these Bernoulli experiments eventually result in a Poisson distribution, which is the basis of the empirical model we use in the next section.

3. Data

In analyzing the impact of demographic change on regional new business formation, we restrict our analysis to 31 NUTS-2 West German regions. West Germany is an ideal microcosm for analyzing the relationship between demographic change and new business formation for at least two reasons. First, West German regions share common institutions and mentalities, i.e., an entrepreneurial spirit,[1] and thus our analysis should not be affected by unobserved regional characteristics. Second, demographic change is more pronounced and advanced in Germany than in any other industrialized country. According to Sinn (2007), this advanced German demographic change is the result of the early introduction of a public pension system. Germany was the first industrialized country to institute a public pay-as-you-go pension system, which occurred in 1889. This system had a drastic impact on the importance of family as it became unnecessary to have children for the purpose of having someone to care for the parents in old age.

Our data on new business formation are generated from the German Social Insurance Statistics (see Fritsch and Brixy 2004, for a description of this data source). The Social Insurance Statistics requires every employer to report certain information, e.g., qualifications, about every employee subject to obligatory social insurance. The information collected can be transformed into an *establishment file* that provides longitudinal information about the establishments and their employees. The unit of measurement is the “establishment,” not the company, which is a suitable unit of measurement for regional studies. The empirical data thus derived include two categories of entities: firm headquarters and subsidiaries. As each establishment with at least one employee subject to social security has a permanent individual code number, startups and closures can be identified: the appearance of a new code number can be interpreted as a startup, the disappearance of a code number can be interpreted as a closure. New businesses with more than 20 employees in the first year of their existence are excluded. As a result, a considerable number of new subsidiaries of large firms contained in the database are not counted as startups. However, the share of new establishments in the data with more than 20 employees in the first year is rather small (about 2.5%). The number of new businesses is available for the period from 1987 to 2000. Among the new businesses, one can further distinguish between knowledge-intensive manufacturing startups and knowledge-intensive business services startups. Knowledge-intensive industries are defined as industries that have a share of highly qualified employees and a share of engineers and natural scientists that is larger than the 75% quantile of all industries. Knowledge-intensive manufacturing industries include chemicals, mineral oil processing, gears, drive units and other machine parts, computers, aerospace, and electronics. For our purposes, all knowledge-intensive business services are lumped into one catch-all category; these services include legal and tax advice, auditing, consulting, and architecture and engineering offices, among others.

Information on the age distribution of the regional population is taken from Eurostat. Eurostat provides the age distribution of the regional population in five-year intervals. The data are available at the NUTS2 regional level for the period from 1980–2000.

[1] Brixy *et al.* (2007) show, on the basis of the German section of the Global Entrepreneurship Monitor (GEM), that nascent entrepreneurs are evenly distributed across German regions, but that there are regional differences in the number of entrepreneurs who actually started their own business.

Table 1: Descriptive Statistics

Variable	1987–2000				1987–1993				1994–2000			
	Mean	Std.Dev.	Min	Max	Mean	Std.Dev.	Min	Max	Mean	Std.Dev.	Min	Max
Startups (counts)	5,059	3,053	1,079	12,376	4,707	2,830	1,048	11,859	5,411	3,290	1,111	12,894
Startups in knowledge-intensive business services (counts)	801	609	114	2,154	691	520	102	1,900	911	702	127	2,535
High-tech startups in knowledge-intensive manufacturing industries (counts)	66	42	11	173	66	43	11	172	67	42	10	173
Share of population 20–29 (%)	15.04	0.78	13.15	16.69	16.74	0.96	14.19	18.47	13.34	0.67	12.12	14.92
Share of population 30–39 (%)	15.54	0.60	14.49	16.54	14.30	0.65	13.25	15.46	16.78	0.62	15.46	18.03
Share of population 40–49 (%)	13.52	0.70	12.13	15.19	13.40	1.10	11.04	16.12	13.64	0.43	12.90	14.77
Share of population 50–64 (%)	19.35	0.74	17.99	20.99	19.03	0.78	17.50	20.82	19.68	1.00	17.92	21.16
Mean age	40.44	0.34	39.69	41.06	40.44	0.36	39.65	41.06	40.44	0.34	39.73	41.11
Labor market participation (%)	51.31	6.97	37.85	67.32	51.71	8.25	36.35	75.37	50.91	5.88	39.36	65.83
Share of highly skilled employees (%)	5.65	2.05	2.77	9.82	4.89	1.78	2.35	8.57	6.41	2.35	3.21	12.00
Share of engineers and natural scientists (%)	2.25	0.85	0.93	3.99	2.09	0.82	0.85	3.80	2.41	0.89	1.01	4.18

Mean, standard deviation, minimum, and maximum across 31 NUTS-2 West German regions.

Table 2: Analysis of Variance

Variable	Between groups			Within groups			Total		
	SS	df.	MS	SS	df.	MS	SS	df.	MS
Startups (counts)	3.91e+09	30	1.30e+08	3.64e+08	403	9.02e+05	4.28e+09	433	9.88e+06
Startups in knowledge-intensive business services (counts)	1.55e+08	30	5.19e+06	2.88e+07	403	7.14e+04	1.84e+08	433	4.26e+05
High-tech startups in knowledge-intensive manufacturing industries (counts)	7.58e+05	30	2.53e+04	6.84e+04	403	169.86	8.26e+05	433	1,908.90
Share of population 20–29 (%)	253.59	30	8.45	1,767.48	403	4.39	2,021.07	433	4.67
Share of population 30–39 (%)	150.65	30	5.02	929.50	403	2.31	1,080.15	433	2.49
Share of population 40–49 (%)	205.98	30	6.87	257.60	403	0.64	463.58	433	1.07
Share of population 50–64 (%)	227.21	30	7.57	340.18	403	0.84	567.39	433	1.31
Mean age	48.98	30	1.63	12.26	403	0.03	61.25	433	0.14
Labor market participation (%)	2.04e+04	30	679.97	8,726.44	403	21.65	2.91e+04	433	67.26
Share of highly skilled employees (%)	1,780.06	30	59.33	393.07	403	0.98	2,173.13	433	5.02
Share of engineers and natural scientists (%)	306.71	30	10.22	18.47	403	0.05	325.18	433	0.75

Taking a look at the mean age of the population (see Tables 1 and 2), it turns out that there is not much variation over the observation period. Apparently, mean age is not a good indicator for demographic change in our relatively short observation period. However, taking a closer look at the age distribution by focusing on the population shares of different age cohorts better reveals the extent of variation in the age distribution, even in our relatively short observation period. Within our given time period, we can observe the baby boomers' early working years and we can also see the baby burst among the younger age cohorts.

Our data on startups show that non-knowledge-intensive startups are the dominant type. This imbalance suggests the need for a more detailed separation of all startups, with a distinction between non-knowledge-intensive startups and knowledge-intensive startups in business services and manufacturing. Furthermore, note that the reunification of Germany caused an economic boom, with a higher labor market participation at the beginning of the 1990s, followed by the start of a recession. Finally, the slightly rising mean of the share of highly qualified employees might be indicative of the ongoing change into a knowledge-based society.

4. Econometric Specification and Estimation Results

4.1 Econometric Specification

As our dependent variable—the number of new firms in a region—is a count, the classical linear regression model is inadequate (Blundell *et al.* 1995). Hausman *et al.* (1984) argue that for count data, Poisson or negative binomial models are appropriate. Our first preference is given to a Poisson model with fixed regional effects and robust standard errors to control for overdispersion. This correction of the standard errors is described by Wooldridge (1999).[2]

[2] A STATA routine is provided by Simcoe (2007).

In the basic configuration of our model, we use the absolute size of population aged between 20 and 64 (logarithm) as an independent variable. Initially, this covers the regional pool of all potential startup founders of working age. However, this setup bears the risk of a simultaneity bias in our estimates as prospering regions with a large number of new businesses will attract people from outside the region, whereas stagnating or downsizing regions lose people. This migration pattern may even be age-specific as there are age-specific migration costs. To avoid this bias, the regional age distribution is taken from five years prior to the year of analysis and is extrapolated to the year of analysis under the assumptions of absence of migration and constant age-specific mortality rates. Significant coefficients of the five-year-lagged regional age distribution will further provide empirical evidence that entrepreneurs typically remain in the region where they have previously worked and are already integrated into the region's social network. In fact, we assume that knowledge embodied in persons more or less stays in the region and evolves intra-regionally. For this reason, we also refrain from using methods of spatial econometrics that would account for inter-regional effects (cf. Brunow and Hirte 2006).

We also add either the share of employees with a university degree or the share of employees with a degree in engineering or natural science to the model. As it has been found in other studies (cf. Acs and Armington 2004) that highly qualified employees are more likely to found their own businesses, these variables act as kind of "startup premium" for highly qualified employees. Finally, we add a set of control variables, including a full set of year dummies, to capture the time-series variation that is common to all regions, and the regional labor market participation, to control for region-specific business cycles. The share of employees with a university degree or a degree in engineering/natural science and the control variables enter the model with a one-year lag.

In a next step, we start zooming in on the regional pool of potential startup founders who are between the ages of 20 and 64. To account for the importance of this age group relative to the regional population as a whole, we add the share of population aged between 20 to 64 years relative to the whole population size. This share also reflects the burden the working population bears as it accounts for the number of individuals of working age in proportion to the older and younger generations, both of which depend on the working age population to financially support pensions for the older generation and investment in human capital for the younger generation. Zooming in even closer to the age distribution of the pool of potential startup founders, we separate the share of population aged between 20 to 64 years into those who are aged between 20 to 29 years, between 30 to 39 years, between 40 to 49 years, and between 50 to 64 years. We expect this procedure to bring to light possible age patterns in the likelihood of starting one's own businesses. As discussed above, several age patterns are conceivable in this context as the decision to become an entrepreneur depends on different factors that vary with age.

4.2 Estimation Results

We analyze the impact of regional age distribution on startups separately for high-tech startups and other startups since theoretical considerations discussed in Section 2 suggest that age distribution might be especially important for high-tech startups.

In our basic configuration, for all types of startups the pool of potential founders aged between 20 to 64 years has a significantly positive impact (cf. Table 3a–3c, Regressions I and II). As the absolute size of population between 20 and 64 entered as logarithm, the coefficient directly translates into elasticities in Poisson regressions. However, it turns out that neither the share of employees with a university degree nor the share of employees with a degree in engineering or natural science has a coefficient significantly different from zero. This result is in line with the results of Fritsch and Falck (2007), who also find that the share of highly qualified employees in a region has no significant impact on regional new firm formation. Obviously, a formal degree does not guarantee a "startup premium." We also find that the year dummies are jointly significant and that the control variable for regional labor market participation is significantly different from zero in all specifications. The significance of the control variables continues to hold in all further specifications.

In addition to the absolute *size* of population aged between 20 to 64 years, in a second step, we specify the regional age distribution by adding the *share* of population aged between 20 to 64 years (i.e., the number of working age people in proportion to the entire population). For all types of startups, the inclusion of the share of population aged between 20 to 64 leads to an insignificant coefficient for the absolute size of population between 20 and 64, while the share of population aged between 20 and 64 itself becomes only weakly significantly positive in some specifications (cf. Table 3a–3c, Regression III). This result suggests a high degree of multicollinearity between the absolute size of population between 20 and 64 and the share of population aged between 20 to 64. We therefore drop the absolute size of population aged 20 to 64 in the further specification and concentrate on shares. After dropping the absolute size of population aged 20 to 64, the share of population aged between 20 to 64 becomes significantly positive (cf. Table 3a–3c, Regressions IV). However, the share of employees with a university degree remains insignificant in all specifications. In the last and, for our purpose, most important step, we break down the share of population aged 20 to 64 into four groups: those between 20 to 29 years, between 30 to 39 years, between 40 to 49 years, and between 50 to 64 years (cf. Table 3a–3c, Regressions V). We are aware of high degrees of mulitcollinearity between these four age groups; nevertheless, we put them together in a "horse race" to determine if there is a dominant age group in the regional pool of potential startup founders. High degrees of multicollinearity may result in higher standard errors of the estimated coefficients and, therefore, in an underestimation of the importance of single age groups in the founding events. Nevertheless, we find that certain age groups do win our

Table 3a: Results

	Non-knowledge-intensive startups				
	I	II	III	IV	V
Population 20–64 (log)	0.333*** (0.035)	0.308*** (0.046)	0.025 (0.211)	---	---
Share of population 20–64	---	---	0.037 (0.030)	0.039*** (0.015)	---
Share of population 20–29	---	---	---	---	0.060 (0.040)
Share of population 30–39	---	---	---	---	0.021 (0.017)
Share of population 40–49	---	---	---	---	0.058** (0.029)
Share of population 50–64	---	---	---	---	0.041** (0.019)
Share of highly skilled employees	0.000 (0.006)	---	-0.001 (0.011)	-0.001 (0.015)	0.002 (0.014)
Share of engineers and natural scientists	---	0.035 (0.059)	---	---	---
Labor market participation	0.004*** (0.0003)	0.004*** (0.0004)	0.003*** (0.0004)	0.003*** (0.0005)	0.003*** (0.0002)
Year dummies	Yes***	Yes***	Yes***	Yes***	Yes***
Test of equality of “population share” coefficients (Chi²)	---	---	---	---	2.09
Test of “population share” coefficients simultaneously equal to zero (Chi²)	---	---	---	---	14.17***
N	403	403	403	403	403
Wald test	32,024.35***	47,728.12***	26,864.34***	10,179.18***	11,266.03***

Method: fixed effects Poisson regression with robust standard errors, as described by Wooldridge (1999).
All control variables are lagged for one year, age distribution in $t-5$ is extrapolated under the assumption of no migration.
Time: 1987–2000, Region: West German NUTS2 (31 regions).
Robust standard errors in parentheses.
*** significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

Table 3b: Results

	Startups in knowledge-intensive business services				
	I	II	III	IV	V
Population 20–64 (log)	0.531*** (0.057)	0.551*** (0.053)	0.058 (0.188)	---	---
Share of population 20–64	---	---	0.061* (0.032)	0.065*** (0.019)	---
Share of population 20–29	---	---	---	---	0.074 (0.048)
Share of population 30–39	---	---	---	---	0.069*** (0.019)
Share of population 40–49	---	---	---	---	0.065* (0.045)
Share of population 50–64	---	---	---	---	0.057** (0.023)
Share of highly skilled employees	0.004 (0.009)	---	-0.002 (0.015)	-0.001 (0.018)	0.000 (0.017)
Share of engineers and natural scientists	---	0.001 (0.065)	---	---	---
Labor market participation	0.007*** (0.0004)	0.007*** (0.0004)	0.006*** (0.0003)	0.006*** (0.0006)	0.006*** (0.0003)
Year dummies	Yes***	Yes***	Yes***	Yes***	Yes***
Test of equality of “population share” coefficients (Chi²)	---	---	---	---	1.56
Test of “population share” coefficients simultaneously equal to zero (Chi²)	---	---	---	---	43.35***
N	403	403	403	403	403
Wald test	39,435.29***	32,463.71***	37,240.86***	9,474.84***	11,562.20***

Method: fixed effects Poisson regression with robust standard errors, as described by Wooldridge (1999).
All control variables are lagged for one year, age distribution in $t-5$ is extrapolated under the assumption of no migration.
Time: 1987–2000, Region: West German NUTS2 (31 regions).
Robust standard errors in parentheses.
*** significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

Table 3c: Results

	High-tech startups in knowledge-intensive manufacturing industries				
	I	II	III	IV	V
Population 20–64 (log)	0.139* (0.073)	0.175*** (0.049)	-0.217 (0.192)	---	---
Share of population 20–64	---	---	0.043 (0.037)	0.028* (0.015)	---
Share of population 20–29	---	---	---	---	0.103** (0.050)
Share of population 30–39	---	---	---	---	-0.042* (0.022)
Share of population 40–49	---	---	---	---	0.092*** (0.029)
Share of population 50–64	---	---	---	---	0.035 (0.028)
Share of highly skilled employees	0.002 (0.022)	---	-0.000 (0.024)	-0.004 (0.025)	0.004 (0.024)
Share of engineers and natural scientists	---	-0.031 (0.100)	---	---	---
Labor market participation	0.008*** (0.001)	0.008*** (0.001)	0.007*** (0.0009)	0.008*** (0.0009)	0.007*** (0.0007)
Year dummies	Yes***	Yes***	Yes***	Yes***	Yes***
Test of equality of “population share” coefficients (Chi²)	---	---	---	---	10.63***
Test of “population share” coefficients simultaneously equal to zero (Chi²)	---	---	---	---	11.90***
N	403	403	403	403	403
Wald test	2,390.32***	2,324.28***	2,517.58***	1,204.66***	1,671.16***

Method: fixed effects Poisson regression with robust standard errors, as described by Wooldridge (1999).
All control variables are lagged for one year, age distribution in $t - 5$ is extrapolated under the assumption of no migration.
Time: 1987–2000, Region: West German NUTS2 (31 regions).
Robust standard errors in parentheses.
*** significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

“horse race.” When looking at the impact of age distribution on the different kinds of startups, we find that for the non-knowledge-intensive startups only the coefficients for the age groups between 40 and 49 years and between 50 to 64 years are significantly different from zero. The coefficient for the age group between 40 and 49 years is higher than the coefficient for the age group between 50 to 64 years. For startups in knowledge-intensive business services, the coefficient for the age group between 30 to 39 years also becomes different from zero; it is, in fact, highest for this age group and decreases with age. However, a test for the equality of the coefficients of all age shares reveals that there is no statistically significant age pattern in regional start-up activity involving non-knowledge-intensive startups or knowledge-intensive business service startups. These results, however, should be viewed with some caution due to the problem of high multicollinearity between these age groups, that is, the relatively high standard errors caused by multicollinearity may have caused this result. Nonetheless, a test for all the “share of population” coefficients being simultaneously equal to zero is rejected. This is in line with the positive impact of the share of population aged 20 to 64 in Regression IV.

When looking at the “high-tech” startups, this result changes, revealing a statistically significant age pattern—a pronounced u-shaped pattern with a significantly negative coefficient for the age group between 30 to 39 years and the largest and most significantly positive coefficients for the age groups between 20 to 29 years and 40 to 49 years. This is a particularly interesting result, as this age pattern shows up despite possibly high standard errors of the “share of population” coefficients caused by high multicollinearity between the population shares. Again, the share of employees with a university degree remains insignificant in all specifications.

4.3 Discussion

Our finding that the expected number of non-knowledge-based startups is not affected by age distribution might be explained by lower market entry barriers in the sense of sunk costs that allow for a trial-and-error strategy. It is simply less risky to give an idea for this type of business a try, regardless of the level of human capital attained. This also appears to be true for startups in knowledge-intensive business services. Apparently, it is less costly (and less risky) to try to commercialize knowledge in the service sector as doing so does not necessitate investments in machinery, as would be the case for a manufacturing-type startup.

Our results provide indirect empirical evidence for our presumption that founders of businesses in knowledge-based (high-tech) manufacturing industries emanate from specific age groups. In the literature, entrepreneurs in the age group between 50 to 64 years or older are also known as *third-age entrepreneurs* (Blackburn *et al.* 2000).[3] We call the entrepreneurs in the first age group (between 20–29 years of age) *adolescent entrepreneurs* and the ones in the middle groups (30–39 and 40–49) *second-career entrepreneurs* (Baucus and Human 1994), which simply means that individuals between 30–39 and 40–49 are most likely to have worked in some employment previously.

One explanation for our findings is that it is either *adolescent* or *late-second-career entrepreneurs* who will most successfully (and willingly) embark upon a high-tech startup. Our lifecycle-driven approach indicates that one source of entrepreneurs is young individuals who have just finished their education and are eager to put their knowledge to a real-world test. They are energetic and probably quite able to cope with a heavy workload as they are in good physical condition and not yet constrained by the demands of a family. Further, their lack of experience can actually be an advantage as they have not yet developed a “fossilized” mindset about what is possible and are thus open to new ideas and able to creatively exploit an opportunity. However, lack of experience can also, of course, be a disadvantage—a dearth of know-how regarding a market or industry can lead to costly mistakes or unprofitable use of time and energy: sometimes, it is very useful to know exactly what is impossible (Storey 1994). Moreover, accumulated know-who can be a very effective ice-breaker. Being socially embedded can facilitate raising venture capital and generally provides useful information, thus overcoming market entry barriers that can arise, for instance, from insufficient financing or seemingly insurmountable bureaucratic barriers. Know-who can be accumulated, but only with time, so in this case, their very youth disadvantages adolescent entrepreneurs. However, as it is likely that *adolescent entrepreneurs* are still at university or at least closely connected with one, this environment could compensate for the lack of personal contacts, at least in part.

Regarding *second-career entrepreneurs,* our findings are twofold. The younger group, or *early-second-careers entrepreneurs*, those between 30–39 years of age, are just settling down in life, starting their own families, purchasing real estate—in other words, they have a lot to lose by taking a risk such as starting their own business. The older group, or *late-second-career entrepreneurs*, those between 40–49 years of age, are more likely to have already traveled that path, are more settled and secure in their lives (Singh and DeNoble 2003). They have already raised their children, own a house, and have at least some financial backing and can afford to spend some time and money on doing what *they want*, instead of concentrating on what the *family needs*. In fact, they have been settled long enough that perhaps they now crave a little adventure, and they are financially secure enough to be able to engage in one without serious risk to their own well-being. They are also still young enough that they have the luxury of time on their side, that is, they can ride out the time it will take for their venture to start producing income without suffering either hardship or declining health. In regard to

[3] Other terms, such as “seniorpreneurs” (Arkebauer 1995) or “grey entrepreneurs” (Singh and DeNoble 2003) are also used. However, we chose the term “third-age entrepreneurs” because authors who use this term specify a

their human capital, their stock of codified knowledge has not depreciated very much yet and is complemented by a solid stock of know-how and know-who. They can thus evaluate the market in an informed manner, recognize an opportunity for what it is, and exploit same effectively due to prior experience in the real world of work (Steiner and Solem 1988). In short, they are the age group in the best condition and stage of life to realize a profit from their human capital investment. They are in a prime position to become entrepreneurs.

What are the implications of these findings with respect to the changing demographics of the developed world? We believe that one of the most important is that an aging population necessitates a stronger focus on the second peak of entrepreneurship, that involving the *late-second-career entrepreneurs*, and on developing strategies that will expand the age range of this group so that it encompasses *third-age entrepreneurs*. Demographic trends are unequivocal in showing that the 40–50-year-old cohort (the baby boomers) is ballooning in size whereas the following cohorts are comparatively small. It thus seems quite clear that if we want a continuing base of entrepreneurship, which is so essential to a thriving economy, we will have to find a way to keep its spirit alive and flourishing in ever-older people.

Increasing life expectancy and corresponding effects on time discounting, as well as the growing necessity for people to work more years of their lives, are developments that will aid in this effort. However, the enduring, although incorrect, belief that the pay-as-you-go pension systems are still viable, along with welfare states that promote early retirement, are forces in the opposite direction, and in fact can be actively detrimental to the spirit of entrepreneurship as people with a "guaranteed" retirement (or who think they have one) will not have much interest in learning new skills or keeping their old skills up to date. Overcoming this problem will involve attacking two fronts at the same time: a change in individual mindsets and a change in public institutions, both aimed at increasing the

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timespan for this particular age of entrepreneurship, namely, 50–75 years of age.

importance of and interest in individual self-reliance and lifelong learning. One possible strategy is to extend (compulsorily at first) the length of labor participation individuals must engage in before being eligible for state benefits, as has been done most recently in Germany. In the best of all possible worlds, such a policy might eventually lead to intergenerational cooperation, where young and old entrepreneurs join forces and complement each other, marrying the vigor and openness of youth with the experience and judgment of maturity. In such a happy world, we could with confidence visit both barbers and doctors, receiving the benefits of cutting-edge technology applied by experienced hands.

5. Summary and Outlook

The implications of demographic change for Western societies have received a lot of attention in recent years. The economic debate is mainly focused on the stability and adjustment of social security systems. In this paper we take a different perspective and focus on the relationship between age distribution and innovative entrepreneurship, which may be important for long-run growth of developed economies.

Based on a sample of German regions, we find that an increase in the fraction of individuals of working age—the 20–64 range—positively affects the expected number of startups. Consequently, a decrease in this fraction due to the aging of a region's population has a negative impact on the number of startups in a region. Moreover, we find that changes in the working age distribution of a region have an impact on the number of startups in knowledge-based (high-tech) manufacturing industries, but that the number of startups in other sectors is not so affected. In particular, we find a double peak in the propensity to become an innovative entrepreneur. An increase in the fractions of individuals in the 20–30 age range and individuals in the 40–50 age range has a positive effect on the number of high-tech startups.

Although our findings provide empirical evidence for the relevance of demography for startup activity, the demographic change due to the drop in birthrate since the early 1970s is only partly reflected in our data. Individuals of this generation did not enter the labor market and thus become potential entrepreneurs, until the early 1990s. However, we can at least track the first results of the baby burst among the younger age cohorts and since startups in knowledge-based manufacturing industries seem to be more sensitive to demographic change than other startups and demographic change is more pronounced and advanced in Germany than it is in any other industrialized country (Sinn 2007), our results may provide some insight into the future of innovative startups in other Western countries.

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References

Acs, Z. J. and C. Armington (2004). The impact of geographic differences in human capital on service firm formation rates. *Journal of Urban Economics*, 56, 244–278.

Acs, Z. J., D. B. Audretsch, P. Braunerhjelm and B. Carlsson (2006). *Growth and Entrepreneurship: An Empirial Assessment*. CEPR Discussion Paper No. 5409.

Arkebauer, J. B. (1995) *Golden Entrepreneuring; The Mature Person's Guide to a Successful Business*, Mcgraw-Hill: New York.

Arkebauer, J. B. (1995). *Golden Entrepreneuring. The Mature Person's Guide to a Successful Business*. New York: McGraw-Hill.

Audretsch, D. B. and M. Keilbach (2004). Does Entrepreneurship Capital Matter? *Entrepreneurship: Theory & Practice*, 28, 419-430.

Audretsch, D. B., M. C. Keilbach and E. E. Lehmann (2006). *Entrepreneurship and economic growth*. Oxford: Oxford University Press.

Audretsch, D. B., W. Bönte and M. Keilbach (2008). Entrepreneurship Capital and its Impact on Knowledge Diffusion and Economic Performance. *Journal of Business Venturing*, forthcoming.

Baucus, D. & S. E. Human (1994). Second Career Entrepreneurs: A Multiple Case of Entrepreneurial Processes and Antecedent Variables. *Entrepreneurship: Theory & Practice*, 19, 41-71.

Becker, G. S. (1964). *Human capital*. New York: Columbia University Press.

Blackburn, R., Hart, M. & O'Reilly, M. 2000, 'Entrepreneurship in the Third Age: New Dawn or Misplaced Expectations?' in *23rd ISBA National Small Firms Policy and Research Conference*, Aberdeen University, 1-17.

Blanchflower, D. G. (2000). Self-Employment in OECD Countries. *Labour Economics*, 7, 471-505.

Blanchflower, D. G. and B. Meyer (1994). A longitudinal analysis of young entrepreneurs in Australia and the United States. *Small Business Economics*, 6, 1-20.

Blau, D. M. (1987). A Time-Series Analysis of Self-Employment in the United States. *Journal of Political Economy*, 95, 445-467.

Bloom, D. E., D. Canning, G. Fink and J.E. Finlay (2007). Does Age Structure Forecast Economic Growth? NBER Working Paper No. 13221.

Blundell, R., R. Griffith and J. Van Reenan (1995). Dynamic Count Data Models of Technological Innovation. *The Economic Journal*, 105, 333-344.

Brixy, U., R. Sternberg and H. Stüber (2007). *Nascent Entrepreneurs in German regions: A comparison oft he regional distribution of newly founded firm and nascent entrepreneurs*. Presentation at the German Speaking section of the Regional Science Association International (GfR), Wien.

Brunow, S. and G. Hirte (2006). Age structure and regional economic growth. *Jahrbuch für Regionalwissenschaft*, 26, 3-23.

Evans, D. and B. Jovanovic (1989). An Estimated Model of Entrepreneurial Choice Under Liquidity Constraints. *Journal of Political Economy*, 97, 808–827.

Evans, D. S. and L. S. Leighton (1989a). he Determinants of Changes in U.S. Self-Employment, 1968-1987. *Small Business Economics*, 1, 111-119.

Evans, D. S. and L. S. Leighton (1989b). Some empirical aspects of entrepreneurship. *American Economic Review*, 79, 519-535.

Florida, R. (2002). *The Rise of the Creative Class*. New York: Basic Books.

Fritsch, M. and O. Falck (2007). New Business Formation by Industry over Space and Time: A Multi-Dimensional Analysis. *Regional Studies*, 41, 157-172.

Fritsch, M. and U. Brixy (2004). The Establishment File of the German Social Insurance Statistics. *Schmollers Jahrbuch: Zeitschrift fur Wirtschafts- und Sozialwissenschaften/Journal of Applied Social Science Studies*, 124, 183-190.

Hausman, J. A., B. H. Hall and Z. Griliches (1984). Econometric Models for Count Data with an Application to the Patents-R&D Relationship. *Econometrica*, 52, 909-938.

Kaufman, A. S. and J. L. Horn (1996). Age changes on tests of fluid and crystallized ability for women and men on the Kaufman Adolescent and Adult Intelligence Test (KAIT) at ages 17-94 years. *Archives of Clinical Neuropsychology*, 4, 97–121.

Kihlstrom, R. E. and J.-J. Laffont (1979). A General Equilibrium Entrepreneurial Theory of Firm Formation Based on Risk Aversion. *Journal of Political Economy*, 87, 719-748.

Lévesque, M. and M. Minniti (2006). The effect of aging on entrepreneurial behavior. *Journal of Business Venturing*, 21, 177-194.

Mueller, P. (2006). Entrepreneurship in the region: Breeding ground for nascent entrepreneurs? *Small Business Economics*, 27, 41-58.

Parker, S. C. (2004). *The economics of self-employment and entrepreneurship*. Cambridge: Cambridge University Press.

Romer, P. (1990). Endogenous Technological Change. *Journal of Political Economy*, 98, 71–102.

Ruth, K.-E. and J. E. Birren (1985). Creativity in Adulthood and Old Age: Relations to Intelligence, Sex and Mode of Testing. *International Journal of Behavioral Development*, 8, 99-109.

Ryan, J. J., J. M. Sattler and S. J. Lopez (2000). Age Effects on Wechsler Adult Intelligence Scale-III Subsets. *Archives of Clinical Neuropsychology*, 15, 311-317.

Simcoe, T. (2007). XTPQML: Stata module to estimate Fixed-effects Poisson (Quasi-ML) regression with robust standard errors,

Singh, G. and A. DeNoble (2003). Early Retirees As the Next Generation of Entrepreneurs. *Entrepreneurship: Theory & Practice*, 27, 207-226.

Sinn, H.-W. (2007). Can *Germany be Saved? The Malaise of the World's First Welfare State*. Boston, MA: MIT Press.

Steiner, M. P. and O. Solem (1988). Factors for Success in Small Manufacturing Firms. Journal of Small Business Management, 26, 51-55.

Storey, D. (1994). *Understanding the Small Business Sector*. London: Routledge.

Van Praag, B. M. S. and A. S. Booij (2003). *Risk aversion and the Subjective Time Discount Rate: A Joint approach*. CESifo Working Paper No. 923.

Wang, J.-J. and A. S. Kaufman (1993). Changes in fluid and crystallized intelligence across the 20- to 90-year age range on the K-BIT. *Journal of Psychoeducational Assessment*, 11, 29-37.

Wooldridge, J. M. (1999). Distribution-free estimation of some nonlinear panel data models. *Journal of Econometrics*, 90, 77-97.

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