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Business demography – apllication for Poland

Abstract

Business demography allows to measure the performance of enterprises in economy. The case of country in transition like Poland is a very interested case. The lack of data and low quality is still a problem, despite joining UE. Data available from the publications of the Central Statistical Office cover only firms registered in REGON (business register) which differ from number of active enterprises. The number of active enterprises represent about 60-70% of all registered firms. In my research I try to find the most important qualitative and quantitative factors determining births and deaths of enterprises in the context of economic changes during transition period. Due to lack of or limited additional surveys the analysis are focused mainly on available data and cover descriptive analysis based on demographic indicators and survival analysis. Analysis cover comparison with other EU countries basing on recent Eurostat data and publications. Closer look was done on example data from REGON register for selected region.

Keywords: business demography, enterprises' population dynamics, enterprises' birth rate, enterprises' death rate, enterprises' survival

Paper presented on XXVI - IUSSP International Population Conference, Marakech 2009.

Background

In 2000 in Lisbon, Council of Europe set up a strategic goal to change EU (to 2010 year) into economy: "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion" (Lenain, Butzow Mogensen, Royuela-Mora, 2005, p.10-11.). This goal can be achieved by creating policies helping in creation and development of entrepreneurship. The Council invited European Commission to publishing annual synthetic reports based on structural indicators. Indicators are constructed to give the politicians the information to measure the progress in achieving the goals set up by the Council. One of the areas covered by those indicators is business demography.
Council of Europe accepted finally the set of 14 indicators summing up different goals in economy, employment, education, social issues, regional issues and environment protection.
Lisbon Strategy is based on the open coordination method. According to this method Union keeps away from traditional centralized economic policy, basing more on co-evaluation of goal's achievements' by different countries. European Commission evaluates the structural indicators regularly and Council of Europe annually discuss the achievements and specifies the goals.
Eurostat Business Demography Project is set up to deliver statistical information, which let to observe new enterprises (according to economic activity) their survival, influence on employment and real deaths. Project concentrates on unified methodological assumptions and results of works on standardization of methods and definitions (Hult, 2003, p.1). In 2005 Lisbon Strategy was evaluated due to achieved results on the halfway. New priorities were established focused on „Growth and Jobs Strategy" forcing new enterprises as the key elements of the strategy (Schrőr , 2007, p.1).
Analysis of strategy realization progress revealed serious problems which should be solved as soon as possible. Those problems are: public finances weakness, unsatisfactory level of employment and work effectiveness causing low tempo of economic growth, very weak development of EU internal market, unbalanced character of growth.
Recently the interest in Business Demography in Poland increased significantly. First works appeared dedicated strictly to analysis of enterprises'' population dynamics development. Papers of such authors as P.Dominiak, I.Markowicz were published (Dominiak, 2005, Markowicz, 2008), where definitions of business demography as a research disciplines and connected detailed definitions appeared. Those are mainly works dedicated to SME sector. Works dedicated to bigger companies and corporate comes from authors: W.Rogowski and J.Socha (Rogowski, Socha 2005).
Analyses type business demography in Poland are not systemized yet. In her publication from 2008 I.Markowicz tries to list basic measures connected with enterprises' population description. In the paper author (Markowicz, 2008) lists a lot of different measures what makes the analysis not very clear for the readers. It is unclear what means the rate of enterprises emerging and exiting and what means the ratio of births and death.
Based on REGON register, one needs to remember about weaknesses of such measures due to unclear real activity moment. Enterprise's register doesn't mean real start of activity. In this paper the analyses are based on measures and definitions presented and published by Eurostat what makes possible all comparisons between countries. Basic definitions are given in annex to this paper. W.Rogowski and J.Socha (Rogowski, Socha, 2005, p.13-14) introduce the definition of crude ratio and net ratio. In following paper we propose to keep the difference between birth rate and death rate as a real dynamics measure according to Eurostat.

Analysis of business demography are usually presented in the following area:
1. number of births and birth rates
2. number of deaths and death rates
3. survival rates
4. influence on employment

The classification used in comparisons are:
1. the size of a company measured by number of people employed
2. sector of enterprise's activity
3. geographical situation (UE, new members and candidate countries)

According to such classifications and divisions we present selected results for Poland 1997-2007(2008) years in this paper.

Comparison of data for European countries is strongly limited due to following factors:
1. no unique definitions of births and deaths
2. no unique definitions of units (local unit, enterprise, self-employment)
3. economic changes (economic transformation)
4. limited data availability, incomparable registers.

Due to his situation values presented below need to be interpreted with cautions. Only the general levels can be used to comparisons between UE countries.

In many cases the moment of enterprise set up is strictly connected with it's formal registration, and enterprise closure is connected with deletion of the record in a business register (Schmiemann, 2006, p.11). The problem is that new registration is not always equal to real start-up of a company, at the same time real end of activity is often earlier the deletion from register. Data presented by different countries are additionally biased by different range of observations. Some countries include self-employment to enterprises' population other omit such data. In some countries reports concern enterprises, in other local units. Some countries include foreign companies, other don't. Definition of enterprise's birth was established on the EU level (European Commission, Regulation no. 2700/98). According to this definition birth does not include new enterprise due to split-up of earlier existing unit, or due to change in character of activity. Just like in case of deaths the take-overs and mergers are not considered.

Data and methods

Data used in his research comes from REGON register and covers years 1997-2007/2008. Basic figures were adjusted to active enterprises based on calculations presented by J.Chmiel 2005. Additionally for detailed survival analysis individual data from register for one region (Malopolskie voivodeship) were used. Birth cohort from 2003 was selected and followed till 5 years of existence (2008). If during this period enterprise was deleted from register it was marked as death (due to unknown reason of deletion from register all were marked as death). Significant part of enterprises that finished their activity did not reported this fact and were not deleted from register. Data used for event history analysis were not adjusted to Real activity and survival rates are much higher. Approximates assumes that active enterprises comparing to registered account ca. 60%.

In Malopolska viovodeship in 2003 16,238 new enterprises were registered and 6.902 of those were deleted from register during next 5 years, what gives 5-years survival rate 57%. Comparing to results from CSO panel survey on sample the 5-years survival rate was 30%.[1] After adjustment to active enterprises we get 0,57*0.6=0.3, comparable to country levels.

[1] CSO- Central Statistical Office, panel survey on representative sample of micro enterprises (0-9 employed workers).

Survival rates in micro studies in this paper should be adjusted but differences and some mechanisms, we wanted to show, still hold their value.

For macro studies birth and death rates, as well as survival and dynamics figures were presented. Birth rates and death rates are calculated as proportion of entries and exits of enterprises during the reference year to mean number of active enterprises in reference year (given in percent). The difference between those ration gives the real dynamics in enterprises' population in a given year (Business demography in Europe, Enterprise publications, EC 2002, p14).
Birth rates and death rates are calculated according to following formulae:

$$\text{Birth Rate}_t = \frac{\text{Number of births}_t}{\text{Mean number of active Enterprises}_t} 100\% \qquad (1)$$

$$\text{Death Rate}_t = \frac{\text{Number of deaths}_t}{\text{Mean number of active enterprises}_t} 100\% \qquad (2)$$

As a method for micro studies event history analysis techniques were chosen. Those methods allow to evaluate enterprise activity and survival depending on different characteristics. Time in those models is interval dependent variable. As independent characteristics we selected:
- employment (number of employed people)
- legal form (no specific legal form, co-partnerships, enterprises connected with government, others)
- gmina (wiejska i miejska)
- type of activity (education and culture, finance, hotels and restaurants, trade, information and communication, research activity, industry, transport, other)

Single episode model was applied as basic analysis method, situation with one origination state (registration) and one destination state (deleting from register). Enterprises still active after 5 years were censored. Process was described by survival function (Kaplan-Meier metod). Differences between survival curves were tested by log likelihood and Wilcoxon test. Analysis were completed by semiparametric proportional hazards Cox model[2], where all explanatory variables were included. Estimation was made by partial likelihood method. The influence of explanatory variables is measured by his model but shape of hazard function is not specified.

Birth process

For presentations of changes in the process of enterprises' births in Poland the birth rate was used. Birth rate is calculated as the proportion of newly registered firms in reference year to mean number of active enterprises in reference year in percent (see formula 1). Number of active enterprises were taken from estimations made by J.Chmiel (Chmiel, 1997, 1999, 2004). estimations covered the period of 1993-2002, for years 2003-2007 number of active enterprises was assumed to be at the level of ca. 54% of all registered enterprises. 54% is a mean value of proportion active to registered from years 2000-2002 (last available years from J.Chmiel estimations). Real values of calculated rates should be also corrected on the fact that not all newly register firms start their activity immediately after registration. Such corrections require additional research (not available at this moment). Assuming that the proportion of

[2] Controlled on proportionality assumption.

really active start ups is stable some conclusions about tempo and direction of changes can be stated based on the level of the ratio presented on the figure 1 (data from CSO, GUS 2008). In 1997-2007 years birth rate dropped from the level above 25% to the level 15%. In 2002-2005 years level of the rate was stable and stayed slightly above 15%. In a reference year in those period per 100 active enterprises 15 new firms were born.

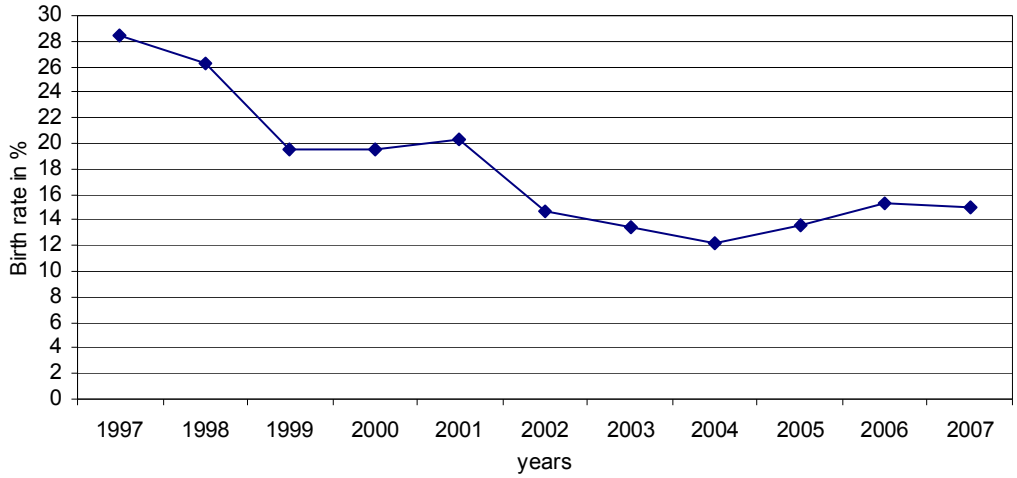

Figure 1. Enterprises' birth rates in Poland, 1997-2007 years
Source: Own calculations

Data presented on the figure 2 comes from Eurostat database. Rates presented concern: industry and services excluding public administration and units managing holdings (NACE Code C to K excluding 74.15), and all legal forms. Data presented for Poland were calculated basing on REGON register with correction on really active enterprises proposed by J.Chmiel (newest data come from 2002 year) (Chmiel, 2004). The same high level of birth rate as in Poland was observed in Great Britain and Portugal. Much higher birth rate was observed for Romania.

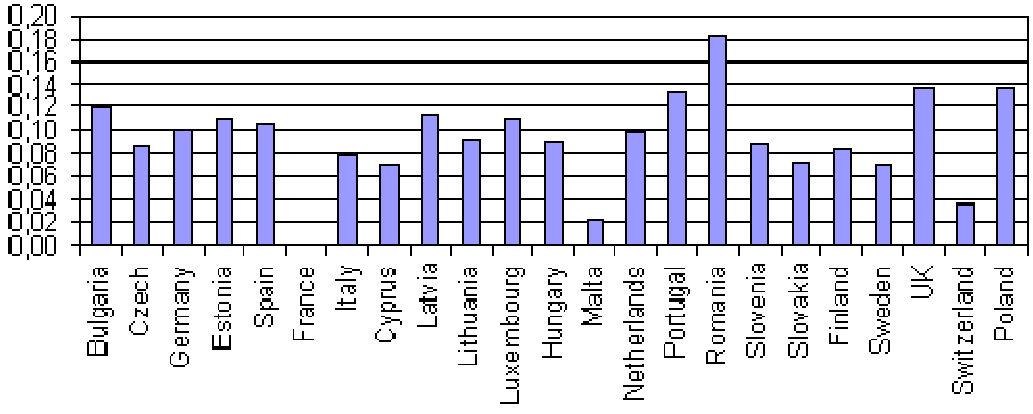

Figure. 2. Birth rates in selected European countries (data availability)
Source: Eurostat 2005.
*for Bulgaria, Czech Republic, Italy, Cyprus, Luxemburg, Hungary, Netherlands, Portugal, Slovakia, Finland, Switzerland data for 2004 year, for Lithuania data for 2002/2003 year.

Death process

Analyses of deaths process is much more difficult due to impossible adjustment to Eurostat definition. According to Eurostat's definition the death means exiting the market and no return within 2 years period. In case of Poland using REGON register it is difficult to necessity of individual data access. Further research and calculations would be required to reconstruct individual unit history.
Death rate would mean the proportion of number of enterprises deleted from register during the reference year to mean number of active enterprises during the reference year presented in percents (see formula 2).
Data presented on figure 3 concern quantities without correction due to no return within 2 years. Assuming that the proportion of returning enterprises is stable we can conclude on some basic changes in dynamics of death process basing on presented quantities.
Actually the death rate is ca. 12%. During the period 1997-2007 death rate dropped from 18 to 12%. But the trend of observed changes was not the same during the analyzed period. Downturn trend was observed in years 1997-2002, but in years 2002-2007 the upturn trend was observed. The lowest level of death rate ca. 7-10% was observed in 1999-2004.
Comparison between birth rate and death rate presented in the next chapter show the real increase of enterprises' population in Poland.

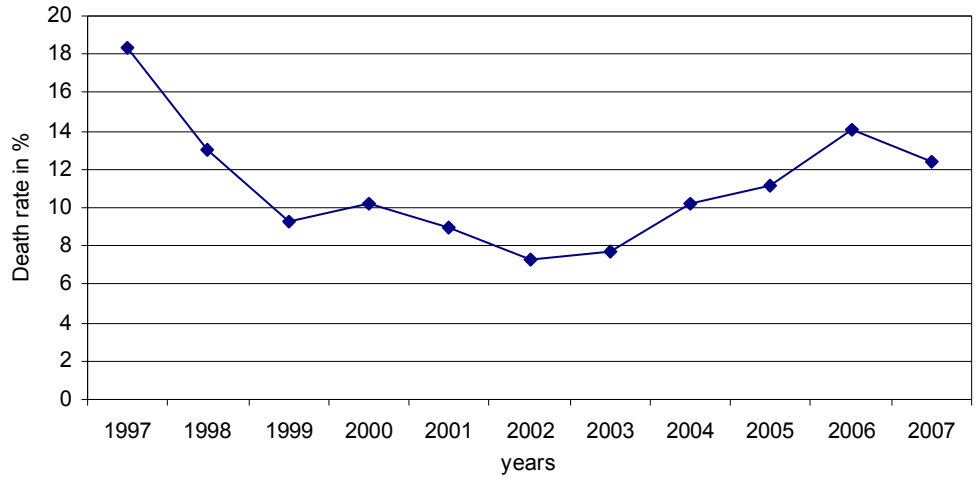

Figure 3. Enterprises' death rates in Poland, 1997-2007 years
Source: Own calculations

In 1999 for 9 countries (for which data were available) mean death rate was 7,9% (Hult, 2003, p.4). According to Eurostat report for 2005 (Schrőr, 2005, p.6) as high birth rate is observed in new UE members as high death rate for those countries is observed (above 10%). Death rate above 10% was observed in such countries as (1999-2001): Czech Republic, Estonia, Latvia, Lithuania, Hungary, Netherlands, Slovakia, UK and Romania. The highest rate was recorded in Slovakia in 2001 year amounting 14.7% (recently death rate in Slovakia dropped to the level of 5% see figure 4). The lowest death rates were observed in Spain, Portugal, Slovenia and Sweden (lowest level in Sweden for 1999-5,1%). Just like birth rates the death rates are highest for services and the lowest for industry. High levels of death rates for services confirm that despite barriers of entries are low the risk of failure is high. Recently (data for 2005 and 2004 years) the lowest death rates were observed in countries: Cyprus, Latvia, Slovenia, Slovakia and Switzerland. In Poland according to estimations for 2005 year,

death rate was ca. 11% and is similar to the level of this rate for Great Britain, Hungary and Estonia.

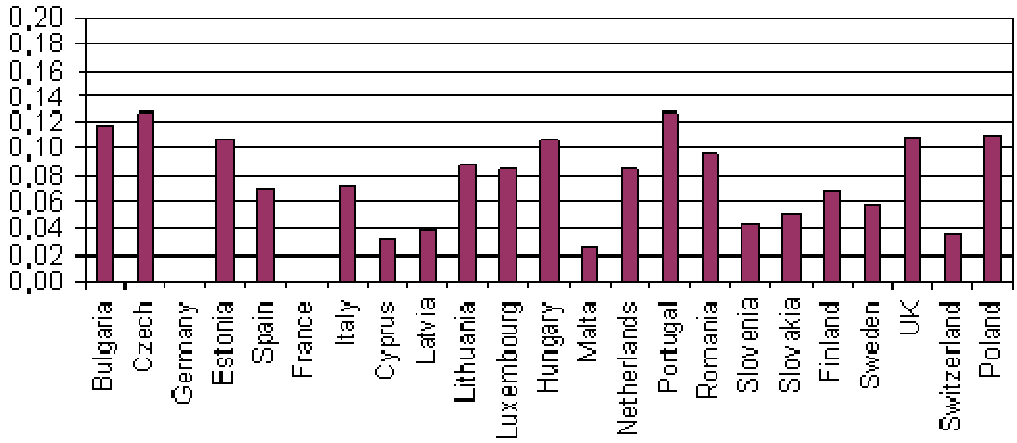

Figure 4. Death rates in selected European countries (data availability)
Source: Eurostat 2005.
*for Bulgaria, Czech Republic, Italy, Cyprus, Luxemburg, Hungary, Netherlands, Portugal, Slovakia, Finland, Switzerland data for 2004 year, for Lithuania data for 2002/2003 year.

Enterprises dynamics and survival

The difference between birth rates and death rates is a real enterprises' population dynamics picture. This difference in analyzed years 1997-2007 for population of enterprises is positive. In the period 1997-2001 the difference was at the level of 10-12%, in the period 2002-2003 on the level 6-7%, and in years 2003-2007 dropped to the level of ca. 2%. It can be concluded that in recent years (after 2001) dynamics of enterprises' population growth significantly decreased.

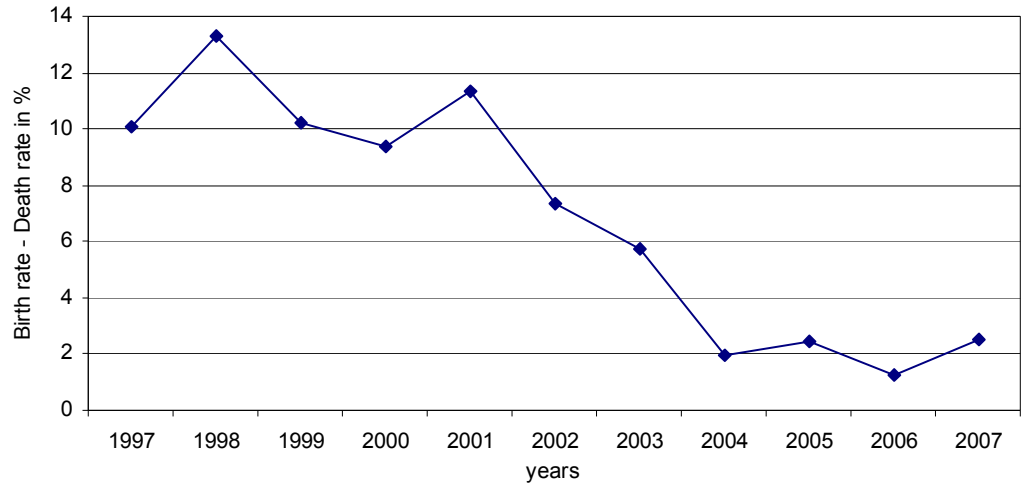

Figure 5. Difference between birth rate and death rate of Polish enterprises in 1997-2007
Source: Own calculations

In Poland in years 1995-1997 according to CSO and J.Chmiel estimations (J.Chmiel 1999) mean birth rate was 20,8% (mean number of births 236 609), and death rate was 7,2% (mean

number of deaths 80 367). Enterprises' population dynamics at that time was at the level of 13,6% annually. Birth rate in those estimations was calculated basing on births due to start of a new business and privatization of public companies. Deaths did not included changes in place and type of activity (Business demography in Europe, Enterprise publications, EC, 2002). According to data for 2002 year presented in J.Chmiel publications the death rate was at the level of 7%.
According to latest applications death rate was estimated on the level of 5-6% in I.Markowicz publication and on the level 7% according to Eurostat data, but those data concern only SME (Markowicz, 2008, p.178). In case of bigger companies (above 50 workers employed) this rate was estimated on the level of 13% (exit rate defined as: exiting the market after two years of staying on the market). The rate for all enterprises' population would be rather on the level of 11% (as presented in the previous chapter).
High level of birth rate can be connected with environment and policy positively influencing the development. Accompanying high level of death rate may suggest that some births were due to existing enterprises exclusion or that new enterprises have short survival time. Common index calculated as a difference between birth rate and death rate may be more informative and supply by the information about dynamics and flexibility of a market (Hult, 2003, p.4, Schrör, 2008). The level of this index may indicate which markets are more flexible to new challenges. The highest level of this index was observed in 2005 in Romania, Latvia and Poland (see figure 6).

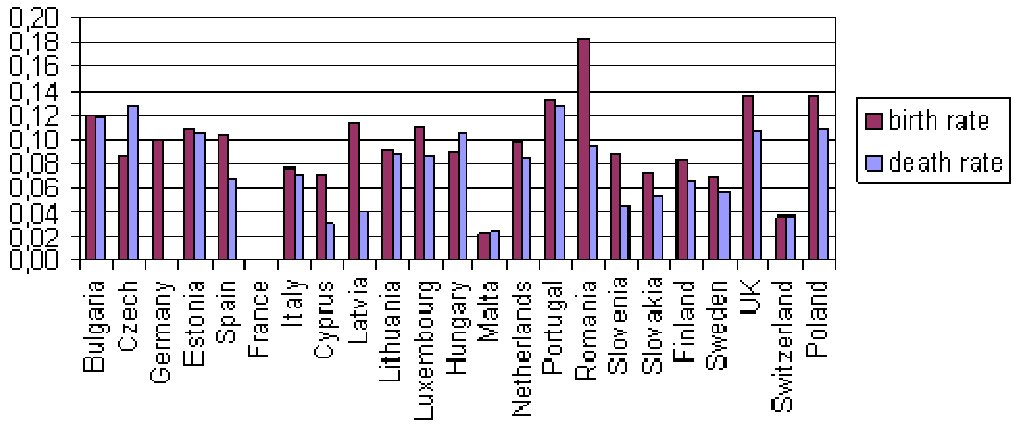

Figure 6. Death rates and birth rates for selected European countries (data availability)
Source: Eurostat 2005.
*for Bulgaria, Czech Republic, Italy, Cyprus, Luxemburg, Hungary, Netherlands, Portugal, Slovakia, Finland, Switzerland data for 2004 year, for Lithuania data for 2002/2003 year

Example of survival analysis based on selected region

Difference between birth rate and heath rate as a measure of enterprises dynamics for Malopolska voivodeship was much higher then mean for Poland.[3] Higher survival rate is closely related to higher enterprises' population dynamics in this region.
Among enterprises registered in 2003 after 5 years 57% were still active (figure 7). After 1 year the survival rate was 90% and 2-years survival rate was 80%. Mean life time for 6,902 enterprises deleted from register was 2.25 years (see table 6). Half of them was active for 25 month and shorter and half for 25 months and longer.

[3] Real figures should be much higher when adjusted to active enterprises proportion (ca.60%) and can not be compared to data presented in previous parts of his paper.

Table 1. Descriptive statistics for life time of enterprises deleted from register

N	Lower Quartile	Median	Upper Quartile	Mean	Std Dev
6902	13,00	25,00	40,00	27,33	17,54

Źródło: Opracowanie własne na podstawie danych z rejestru REGON.

Higher chances of survival hale enterprises registered in Urban areas comparing to enterprises registered in rural areas. In rural areas 5-year survival rate was 55% and for Urban areas was higher and amounted 58%. Differences are statistically significant confirmed by Wilcoxon test. After 2 years of activity 80% of enterprises registered in urban areas were still active and this percent for enterprises registered in rural areas was lower and amounted 75%.
Much higher chances for survival were among bigger enterprises employing 10 and more workers at start. 5-year survival rate for this group was 89% comparing with smaller enterprises (0-9 workers) with 5-year survival rate on the level of 57%. Such significant differences result also with small amount proportion of enterprises bigger with 10 and more workers at start. Mean life time, calculated for only enterprises deleted from register, for enterprises with 10 and more workers at start was much longer then for small enterprises and amounted above 3 years (1 year longer then for small enterprises). Almost 96% of enterprises with 10 and more workers were active after 2 years comparing to enterprises with 0-9 workers for which this percent was at the level 78%.
Significant differences were observed in survival rates according to legal form at start. For enterprises without specific form (the biggest group) including self-employment the 5-year survival rate was 53%. For co-partnerships the same measure was at the level of 72% and for companies connected with government activity was highest and amounted 90% (those groups were very small). Mean life time, calculated for enterprises deleted from register, for group without any specific legal form was 2.25 years, for other form was much higher and amounted above 3.3 years. After 2 years of activity 77% of enterprises without any specific legal form and 87% of co-partnerships were still on the market.

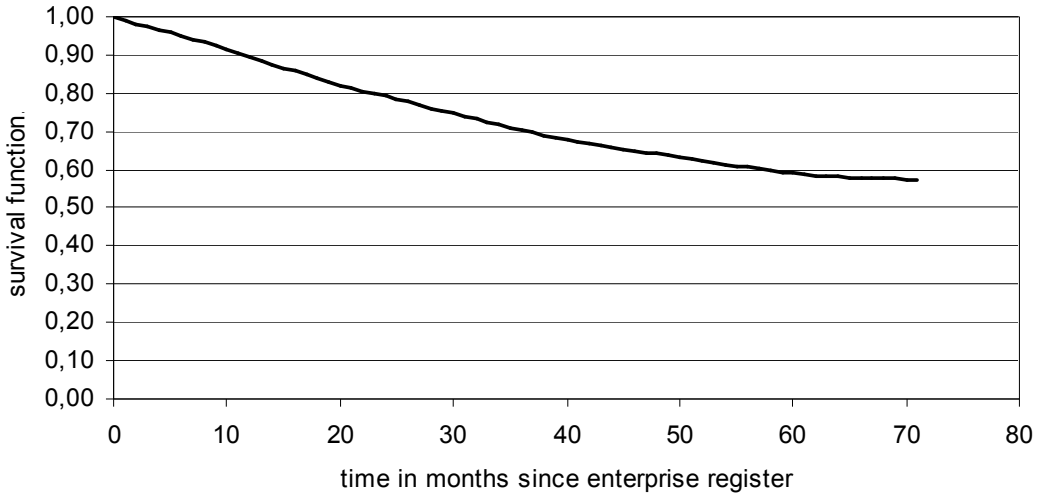

Figure 7. Survival curie for enterprises in Małopolskie voivodeship (total)
Source: Own calculations based on REGON.

In semiparametric proportional hazard Cox model time of enterprises life was dependent variable describing the process. Explanatory variables were selected as binary variables:
employment at start
1 – if employed 10 and more workers
0 – if employed 0-9 workers.
legal form at start
1 – any other legal form
0 – no specific form
place of registration
1 – rural areas
0 – urban areas.
type of activity 1
1 – sectors: education and culture, information and communication, others
0 – all other sectors.
type of activity 2
1 – sectors: finance, hotels and restaurants, transport
0 – all other sectors.

Table 2. Cox regression model estimates

Variable	DF	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio
employment at start	1	-1.09202	0.17599	38.5029	<.0001	0.336
legal form at start	1	-0.84788	0.04546	347.9110	<.0001	0.428
place of registration	1	0.06984	0.02534	7.5959	0.0059	1.072
type of activity 1	1	-0.25230	0.03933	41.1527	<.0001	0.777
type of activity 2	1	0.17656	0.02884	37.4825	<.0001	1.193

According to descriptive analysis enterprises with type of activity from group 1 had much lower risk then mean from population, and enterprises with type of activity from group 2 much lower risk of deleting from register (risk was measured by hazard rate).
Hazard ratio for binary variable measure the direction of influence of his variable on hazard function. Estimate on the level 0,336 for variable *employment at start* means that life time for group=1 (enterprises with 10 and more workers at start) is longer then for enterprises from group=0 (with 0-9 workers at start.
Estimates for variable *legal form at start* conclude that enterprises with any legal form at start had life time longer than enterprises without any legal form at start.
In case of place of registration enterprises registered in rural areas had life time sorter then registered in urban areas. This variable is time dependent.
For enterprises with activity (group 1): education, information and communication, others life time is much longer then enterprises with other types of activity. For enterprises with activity (group 2): finance, hotels and restaurants, trade, transport life time is much shorter then enterprises with other types of activity.

Results from semiparametric Cox model confirm results obtained for non-parametric analysis and allow to include all variables parallel.

Conclusions

Business demography is dynamically growing research area. The research is focused on enterprises' population dynamics measurement and empirical results. Analysis presented in this paper covers period 1997-2007 years. Data availability for earlier years is very limited.

Analysis was based on estimation of basic demographic indicators like birth rates and death rates. Basic conclusions are following:

1. Birth rate for enterprises in analysed period dropped to the level of ca. 14%, however in last two years we observe slight increase of this rate.
2. Death rate for all enterprises in analysed period increased to the level of ca. 12%. During the period 1997-2007 death rate was decreasing and next stabilized on the level ca. 7-10% The increasing trend is observed since 2002 till now.
3. Decreasing level of birth rate and increasing level of death rate result in slow dynamics of enterprises' population in Poland.
4. Dynamics of enterprises' population development measured by difference between birth rate and death rate decreased in recent years reaching the level of 2% (from ca 10% in the beginning of analysed period).
5. Levels of birth rate and death rate for Poland are close to figures presented for Great Britain and Portugal.
6. In EU dynamics of enterprises' population development (measured by difference between birth rates and death rates) is highest in Romania and Latvia and lowest in Czech Republic, Hungary, Malta, Switzerland and Bulgaria. However such comparisons must be interpreted very cautiously due to differences in methodology of figures calculations and availability of the data for different countries.

Additionally micro analysis were presented for selected region. Event history analysis techniques were applied covering non-parametric life tables and semi-parametric Cox regression model. Conclusions are following:

1. 5-year survival rate was 57%, 1-year survival amounted 90% and 2-year only 80%. Mean life time for enterprises deleted from register was 2.25year.

2. Higher chances for survival had enterprises register in urban areas comparing to rural areas. Much higher chances had also enterprises with 10 and more workers at start comparing to smaller units employing 0-9 workers.

4. Legal form At start had significant influence on survival rate of enterprises. Survival rate for enterprises without any legal form amounted 53% and for other group with specific form this rate was much higher and amounted 72% for co-partnerships and 90% for enterprises connected with government. Mean life time for enterprises from the second group was 1 year longer among enterprises deleted from register during 5 years.

5. Type of activity had also meaningful place in survival diagnosis. The longer life time was characteristic for enterprises with activity: education and culture, information and communication. Enterprises with activity: finance, hotels and restaurants, trade, and transport had much higher risk of leaving the market.

6. Results from semiparametric Cox model confirm results obtained for non-parametric analysis and allow to include all variables parallel. Despite low quality and limitations of REGON database the results are straightforward and give wider look on enterprises life time in Poland.

Analyses presented in this paper cover only empirical analysis of data but do not refer to theoretical background connected with enterprises behavior. Research hypothesis would be possible to formulate after theories review. Demographic theories were many times verified using analytical tools. Treating the population of enterprises as the population very common to human population it is possible to verify theories of enterprises behavior with demographic analysis tools. Next steps in business demography research would be verification of basic enterprise theories with demographic analysis tools.

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