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Explaining variation in nascent entrepreneurship

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Contents

Abstract

This paper aims at explaining cross-country variation in nascent entrepreneurship. Regression analysis is applied using various explanatory variables derived from three different approaches. We make use of the Global Entrepreneurship Monitor database, including nascent entrepreneurship rates for 36 countries in 2002 as well as variables from standardized national statistics. The *first approach* relates the level of entrepreneurship of a country to its *level of economic development*. We find evidence for a U-shaped relationship. The *second approach* deals with *a regime switch* where the innovative advantage moves from large, established enterprises to small and new firms, because new technologies have reduced the importance of scale economies in many sectors. The *third approach* assumes that nascent entrepreneurship partly depends upon various non-economic conditions in the domains *technology*, *demography*, *culture* and *institutions*, influencing opportunities, resources, skills and preferences. Several indicators of these aggregate conditions are found to influence nascent entrepreneurship. A full, eclectic model combining the three approaches includes a U-shaped relationship with per capita income as well as with Porter's innovative capacity index in addition to effects of the total business ownership rate (+), social security expenditure (-), the aggregate tax rate (+) and population growth (+). In the model a '(former) centralized command economies' dummy also plays a role (-). Finally, the paper investigates whether determinants of nascent entrepreneurship differ for opportunity-based and necessity-based forms of entrepreneurial activity. A U-shaped relationship with per capita income as well as with the innovative capacity index is only found for opportunity-based entrepreneurial activity. For economically advanced nations striving to promote entrepreneurship, the results suggest that improving incentive structures for entrepreneurship and promoting the entrepreneurial exploitation of scientific findings offer a promising approach for public policy.

1 Introduction

Many economies are troubled by low economic growth rates. Policymakers are looking for means to stimulate economic activity. A number of recent studies point at a positive impact of entrepreneurship on economic growth (see Carree and Thurik, 2003, for a survey). Hence it is important to investigate the determinants of entrepreneurship. By and large, three different strands of literature can be identified regarding the determinants of entrepreneurship. The *first* strand relates the level of entrepreneurship of a country to its *level of economic development*. The *second* strand deals with *a regime switch* where the innovative advantage moves from large, established corporations to small and new firms. The *third strand* assumes that (nascent) entrepreneurship partly depends upon non-economic conditions in the domains *technology*, *demography*, *culture* and *institutions*, influencing opportunities, resources, skills and preferences. In the current paper we investigate these three strands of literature empirically using data for 36 countries from the Global Entrepreneurship Monitor database. We operationalize entrepreneurship as the rate of nascent entrepreneurship, defined in the GEM database as the number of people that are actively involved in starting a new business, as a percentage of adult population. We analyze separate models dealing with these three strands of literature, as well as a combined (full) model.

The organization of the paper is as follows. In the first section we discuss the three literatures. In the next two sections we deal with the data and the research methods employed. The remaining sections contain subsequently the main results of our regressions on aggregate nascent entrepreneurship, a special topic study of necessity-based versus opportunity-based nascent entrepreneurship, and our conclusions. Finally, several appendices offer background information.

2 Literature review

Economic development and (nascent) entrepreneurship

Several authors (Kuznets 1971, Schultz 1990, Yamada 1996, Iyigun and Owen 1998) have reported a negative empirical relationship between economic development and the rate of business ownership (self-employment) in the labor force. Their studies use a large cross-section of countries with a wide variety of levels of economic development. There are several reasons for the decline of self-employment with increasing per capita income. At the demand side of entrepreneurship, a declining share of agriculture and an increasing share of manufacturing diminish the opportunities for self-employment. At the supply side, Lucas (1978) assumes an unequal distribution of 'managerial' talent among the working population. He shows how rising real wages raise the opportunity cost of self-employment relative to the return, inducing marginal entrepreneurs to become employees. Iyigun and Owen (1998) assume a distribution of risk aversion. They argue that with rising economic development fewer individuals are willing to run the risk associated with becoming an entrepreneur as the 'safe' professional earnings rise.

More recently, statistical evidence points at a *reversal* of the negative relationship between real income and self-employment occurring at an advanced level of economic development. At the demand side, the employment share of manufacturing starts declining while that of the services sector keeps increasing with rising per capita income, providing more opportunities for business ownership.[1] Also, from a certain level of economic development onwards, increasing income and wealth enhance the type of consumer demand for variety (Jackson 1984) that creates new market niches attainable for small firms. At the supply side, as hypothesized in social psychology, there is a hierarchy of human motivations, ranging from physical needs at the bottom to self-realization at the top (Maslow 1970). Once the main material needs have been satisfied, a still higher level of prosperity will give prominence to immaterial needs such as a growing need for self-realization. Because it provides more autonomy (in the multi-dimensional sense of 'independent self determination')[2], entrepreneurship then may become more highly valued as an occupational choice than at lower income levels.

Carree et al. (2002) summarize these arguments and hypothesize a U-shaped relationship between per capita income and the rate of self-employment (business ownership) in the labor force. In a three-equation regression analysis, using data for 23 OECD countries in the period 1976-1996, they find empirical support for this hypothesis. To our knowledge, an analysis of the relationship between the level of per capita income and either the annual gross inflow to self-employment or the nascent entrepreneurship rate has never been carried out. The above arguments with respect to the self-employment rate also apply with respect to the (potential) inflow to self-employment. Following this approach, one may expect a U-shaped relationship between per capita income and nascent entrepreneurship.

[1] This effect may be temporary in the case of future upscaling of average firm size in new services.

[2] See Van Gelderen et al. (2003) for an exposition of the 'multiple sources of autonomy as a startup motive'.

The changing role of entrepreneurship

Several studies argue that in the last 25 years the innovative advantage has moved from large, established corporations to small and new enterprises, because new technologies have reduced the importance of scale economies in many sectors. Also, related developments like the ICT revolution and the increased role of knowledge in the production process, as well as globalization, have led to an increasing degree of uncertainty in the world economy from the 1970s onwards (Audretsch and Thurik, 2001). This, in turn, has also created more room for new business startups as agents of change, trying to exploit new ideas.

Two regimes may be distinguished (Carree et al., 2002). In the Schumpeter Mark I regime ('creative destruction') new entrepreneurs challenge incumbent firms by introducing new inventions. In the Schumpeter Mark II regime ('creative accumulation') R&D activities of established corporations determine the rate of innovation. Industries in the latter regime develop a concentrated market structure, while industries in the former regime offer more opportunities to small firms and small entrepreneurial ventures. The bigger role in technological development, in recent decades, for new business startups at the cost of large incumbent firms is sometimes indicated as a 'Schumpeterian regime switch' or a switch from a 'managed' towards an 'entrepreneurial' economy (Audretsch and Thurik, 2001). Elsewhere this switch is referred to as one from an economy dominated by 'exploitation' activities towards one dominated by 'exploration' activities. The emergence of the entrepreneurial economy is reflected by a higher employment share of the self-employed. We will capture this regime switch where innovation plays a pivotal role by using Porter's innovative capacity index assuming that a U-shaped relationship exists between nascent entrepreneurship and this index.

An eclectic framework of entrepreneurship

Clearly, both economic and non-economic conditions, such as *technology*, *demography*, *culture* and *institutions,* influence the rate of nascent entrepreneurship. Recently, these influences have been integrated into a model. This model or framework is necessarily eclectic (Verheul et al., 2002) and distinguishes between the following parts. At the macro level, aggregate conditions create a stock of opportunities, resources, skills and preferences with respect to entrepreneurship, that are available to a nation's population. For each individual, relevant opportunities and one's own resources, skills and preferences determine the risks and rewards associated with wage-employment or business ownership. Individual occupational choice, including reconsideration of present occupational attainment, is based upon an assessment and weighing of these material and immaterial risks and rewards. The aggregation of these decisions determines the rate of nascent entrepreneurship. We will discuss the findings in the literature with respect to some major conditions for entrepreneurship in each of the economic and non-economic domains.

Next to per capita income, *other economic factors* also may impact nascent entrepreneurship. First, unemployment basically acts as a push factor for self-employment (Evans and Leighton, 1990; Audretsch and Thurik, 2000), while social security benefits determining the opportunity costs of unemployed persons interact with this factor (Noorderhaven et al. 2003). Second, in the short run business cycle fluctuations strongly influence the market opportunities for new entrepreneurs, as was born out by recent evidence (Reynolds et al., 2002). Third, income disparity can stimulate entrepreneurship. At the supply side, it may be both a push and a pull factor to enter self-employment. At the demand side, income disparity is likely to cause a more differentiated demand for goods and services. Empirical research by Ilmakunnas et al. (1999) on a cross-section of approximately 20 OECD-countries suggests that income inequality positively influences the rate of self-employment, although reversed causality cannot be ruled out. The role of te*chnology* has been dealt with above in the regime switch approach. Additionally, specific technological variables such as the availability of computers or the use of Internet services may play a role.

Demographic factors include population growth, age distribution, level of educational attainment and female labor participation (Verheul et al. 2002 and Wennekers et al. 2002). Population growth is expected to have a positive effect on entrepreneurship, for two reasons. First, a growing population provides opportunities for new economic activity as new and bigger consumer's markets emerge because of the growing population (demand side of entrepreneurship). Second, population growth may be a push factor to engage in new economic activity in order to make a living, particularly when population growth is due to immigration (supply side of entrepreneurship). As regards age distribution, while start-ups occur in all relevant age groups, prevalence rates of nascent entrepreneurship are highest in the age group between 25 and 34. Education is somewhat of an anomaly. Research conducted on a Swedish sample at the individual level shows that nascent entrepreneurs have attained on average a higher educational level than those in a control sample (Delmar and Davidsson, 2000). However, in a comparative study across fourteen OECD countries, a higher level of education tends to correlate with a smaller proportion of self-employment (Uhlaner et al., 2002). Female labor force participation is negatively associated with nascent entrepreneurship because men are more likely to have the intention to start a firm than are women (Delmar and Davidsson, 2000).

Culture may be defined as 'patterns of values and beliefs distinguishing the members of one group or category of people from another'. Davidsson (1995) identifies two views regarding the relationship between cultural values and entrepreneurial behavior. The first view is based on the idea that if a society contains more people with entrepreneurial values, more people will be entrepreneurs. A special case, empirically confirmed by de Wit (1993), is the hypothesis that children of self-employed fathers (parents) are more likely to become self-employed themselves. The second view holds that a clash of values between social groups may drive potential entrepreneurs away from the average organization and into self-employment. In this latter perspective, a national culture with strong uncertainty avoidance and low individualism may be conducive to (nascent) entrepreneurship (Wennekers et al., 2001).

Relevant *institutions* include the educational system, fiscal legislation and specific government policies focusing on new firms. At the demand side, institutions and policies dealing with regulation of entry, competition and the scope of the private sector (Henrekson, 2000) influence the opportunities to start a business. At the supply side, institutions play a role in stimulating entrepreneurial capabilities and preferences. Relevant institutions for strengthening abilities and motivation are business support organizations, large corporations with an interest in intrapreneurship or 'spinning-off', educational institutions and the media (Stevenson, 1996). The (venture) capital market and financial support schemes influence the resources available for business start-ups. Finally, fiscal legislation (tax rates and tax breaks), the social security system (replacement rates and relative entitlements of the self-employed), labor market regulation and bankruptcy legislation influence the rewards and the risks of the various occupational opportunities. The impact of taxes on the level of entrepreneurial activity is complex and even paradoxical (Verheul et al., 2002). On the one hand high tax rates reduce the return on entrepreneurship, on the other hand self-employment may offer greater opportunities to evade or avoid tax liabilities. For a selection of 12 OECD countries spanning the period 1972-1996, Parker and Robson (2003) find a significantly positive effect of personal income tax rates on self-employment. The effect of social security on entrepreneurial activity may also be two-sided. First, there is a negative impact in so far as generous social security for employees increases the opportunity costs of entrepreneurship. Second, social security in general may have a positive effect on entrepreneurial activity by creating a safety net for the case of business failure.

3 Data

In this section we discuss our data. We make use of the Global Entrepreneurship Monitor (GEM) and other sources. In 2002 there were 37 countries participating in GEM. Variables in the GEM database include nascent entrepreneurship, as well as a wide selection of explanatory variables from standardized national statistics. In this paper we employ three models explaining nascent entrepreneurship across countries. First, we hypothesize nascent entrepreneurship to be a function of economic development (as measured by per capita income). Second, we investigate a functional form with Porter's innovative capacity index. Third, we link aggregate conditions in domains such as demography, culture and institutions to nascent entrepreneurship. Besides these *structural* determinants of nascent entrepreneurship, in this model we also consider *cyclical variables* such as annual economic growth and the level of unemployment. In this section we describe the variables used in this paper. For those readers who are familiar with the GEM database we provide an annex containing the GEM labels of the variables used in this study. For some variables there are missing data. We assembled as many additional data as possible. The remaining missing values are listed in Annex I.

Nascent entrepreneurship

Data on nascent entrepreneurship in 2002 are taken from the GEM 2002 Adult Population Survey. This database contains various entrepreneurial measures that are constructed on the basis of surveys of –on average- some 3,000 respondents per country (37 countries in total). The nascent entrepreneurship rate is defined as the number of people that are actively involved in starting a new venture, as a percentage of adult population (18-64 years old). An individual may be considered a nascent entrepreneur if the following three conditions are met: if he or she has taken action to create a new business in the past year, if he or she expects to share ownership of the new firm, and if the firm has not yet paid salaries or wages for more than three months (Reynolds et al., 2002, p. 38). The nascent entrepreneurship rate (per 100 adults) ranges from 11.6 in Thailand, 10.9 in India, and 7.1 in the United States, to values below two in Russia, Sweden, Japan and Taiwan (2002).

Per capita income

Gross national income per capita 2001 is expressed in purchasing power parities per US$, and these data are taken from the 2002 World Development Indicators database of the World Bank.[1] Taiwan is missing in this database and we estimate the 2001 per capita income level in Taiwan to be 16,761 US$, based on information from Internet.[2] We do not use GDP per capita from the GEM database because this variable is measured at exchange rates.[3] We do not want fluctuations in exchange rates to impact the ranking of countries with respect to their level of economic development.

[1] Internet: http://www.worldbank.org/data/databytopic/GNIPC.pdf.

[2] http://siakhenn.tripod.com/capita.html.

[3] GEM label GDPPC01.

GCR Innovative Capacity Index 2001

This variable is taken from chapter 2.2 of the Global Competitiveness Report 2001-2002 of the World Economic Forum (Porter and Stern, 2002). It describes national innovative capacity as 'a country's potential –as both a political and economic entity- to produce a stream of commercially relevant innovations. This capacity is not simply the realized level of innovation but also reflects the fundamental conditions, investments, and policy choices that create the environment for innovation in a particular location or nation.' (Porter and Stern, 2002, p. 105). The GCR Innovation Capacity Index combines four sub-indexes, which all capture a different aspect of 'innovative capacity'. Each sub-index measures *the relative contribution* to the number of US patents in the period 1999-2000 (an indicator for a country's actual level of innovation), based on regressions using data from the GCR Survey.

The four sub-indexes are:

– the proportion of scientists and engineers in the workforce, which is an indicator for a country's innovation infrastructure,
– the innovation policy sub-index, captured by, among other things, intellectual property protection and R&D tax credits for the private sector,
– the cluster innovation environment sub-index, captured by, among other things, the pressure to innovate from domestic buyers and the presence of suppliers of specialized research and training, and
– the linkages (between innovation infrastructure and a nation's industrial clusters) sub-index, captured by the quality of scientific research institutions and the availability of venture capital.

For more information on the construction of the GCR Innovation Capacity Index we refer to Porter and Stern (2002). We constructed a value for Hong Kong, as this value is missing in the GCR.[1]

Other technology indicators

1 Computers per capita 2001.

2 Internet per capita 2001.

These two variables are defined as the number of computers respectively Internet subscribers per 1000 people, and are taken from tables 4.2.09 and 4.2.10 of the World Competitiveness Yearbook 2002 of the Institute for Management Development.

Demography

3 Age structure of population 2002.

We have shares in total population of five age groups: 20-24 years, 25-34; 35-44; 45-54 and 55-64 years. These data are taken from the International Data Base (IDB) of the US Bureau of the Census.

4 Female labor share 2001.

This variable measures the female share in total labor force and is obtained from table 3.2.13 of the World Competitiveness Yearbook 2002. Values for Belgium and Switzerland are taken from OECD Labor Force Statistics 1981-2001.

5 Participation in education (1997).

We have gross enrolment ratios in primary education, secondary education and tertiary education. Gross enrolment ratios are defined as the total number of students enrolled

[1] Although the overall index value is not given, three of the four sub-index values for Hong Kong *are* given, and based on that we approximate the Innovative Capacity Index for Hong Kong to be 22.8. We also corrected the values for Norway, Ireland and Israel, for which incorrect values were imported in the GEM database. Instead we use the original GCR data.

divided by the total number of people in the appropriate age range. These data are taken from table 2.12 of the 2001 World Development Indicators database (World Bank).

6 Population growth 1996-2002.

This is the growth rate of population between 1996 and 2002, expressed in percentages. Population data are taken from the US Census Bureau IDB (International Data Base). Population growth for Taiwan (1994-2000) is taken from Internet.[1]

Culture

7 Incumbent business ownership 2002

This proxy for the stock of entrepreneurial values and role models is computed as the sum of 'new businesses' and 'established businesse s', both measured as a percentage of adult population (18-64 years old), taken from the GEM 2002 Adult Population Survey. A firm is defined as a 'new business' if the firm has paid salaries and wages for more than three months but for less than 42 months, and as an 'established business' if the firm has paid salaries and wages for more than 42 months (Reynolds et al., 2002, p. 38). The business ownership variable thus measures the stock of incumbent business owners. Countries with more *incumbent* business owners may also have more people *planning* to become entrepreneur, because entrepreneurial role models are more readily available and entrepreneurship is considered a more common employment option in these countries.[2]

8 '(Former) centralized command economies' dummy

Over many decades of the 20th century, culture and institutions in the (now formerly) communist countries have grown to be unfavorable or even hostile to self-employment. We control for this negative impact on entrepreneurship by introducing a dummy. The variable has value 1 for Russia, Hungary, Poland, China, Croatia and Slovenia, and value 0 for all other countries in our sample.

Institutions

9 Social security cost as % GDP (2000).

10 Tax revenue as % GDP (1999).

These two variables are taken from tables 2.2.09 and 2.2.01, respectively, of the World Competitiveness Yearbook 2001.

11 Number of permits required to start a new business.

12 Number of days required to start a new business.

These two variables are taken from tables 8.05 and 8.06, respectively, of the Global Competitiveness Report 2001-2002.

Other economic factors

13 Income disparity (1999).

This variable is defined as the share of total income by the *top* 20% of population divided by the income share of the *bottom* 20% of population (ranked on the basis of

[1] http://www.library.uu.nl/wesp/populstat/Asia/taiwanc.htm.

[2] Note that we do not use the concept of 'Total Entrepreneurial Activity (TEA)', which is used in many GEM-publications. The TEA measure combines the nascent entrepreneurs and the 'new businesses'. Our business ownership variable combines the new businesses and the established businesses, while we use nascent entrepreneurship as our object of research. We make this partitioning because we want to distinguish between entrepreneurs with an existing business and entrepreneurs who attempt to start a business, but who do not yet have their business fully operational.

income). These data are taken from tables 4.4.08 and 4.4.09 of the World Competitiveness Yearbook 2002.

14 Economic growth 2001.

15 Economic growth 2002.

These two variables are defined as the annual % GDP growth in constant prices (i.e., real growth) for the respective years, and are taken from the World Economic Outlook 2002 of the International Monetary Fund (IMF).

16 Unemployment rate 2001.

This variable is taken from table 1.4.06 of the World Competitiveness Yearbook 2002. The value for Switzerland is missing and we use the unemployment rate from OECD Labour Force Statistics 1981-2001.

The correlation matrix is presented in table 1. From Annex I we see that Croatia has missing values for many variables. Therefore the correlations are computed excluding Croatia (36 observations). Equally, the variables female labor share, participation in education and income disparity are not in table 1, because they have other missing values besides Croatia. Finally, the five age group population share variables are highly intercorrelated. We include only the share of age group 45-54 in table 1, as this variable is most strongly correlated with nascent entrepreneurship.

table 1 Correlation matrix, 36 observations (Croatia excluded)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1. Nascent rate	1.00															
2. Business ownership	.63 **	1.00														
3. GCR Innov. Cap. Index	-.55 **	-.29	1.00													
4. Social security cost	-.45 **	-.43 **	.05	1.00												
5. Communist country	-.19	-.16	-.41 *	.23	1.00											
6. Computers per capita	-.38 *	-.16	.89 **	-.09	-.43 **	1.00										
7. Internet per capita	-.34 *	-.08	.81 **	-.18	-.42 *	.96 **	1.00									
8. Tax revenue	-.43 **	-.35 *	.54 **	.38 *	-.03	.56 **	.45 **	1.00								
9. Permits req. to start bus.	.25	.14	-.41 *	.27	.06	-.41 *	-.36 *	-.12	1.00							
10. Days req. to start bus.	.24	-.05	-.45 **	.31	.03	-.50 **	-.50 **	-.08	.78 **	1.00						
11. Population growth 96-02	.39 *	.18	-.10	-.42 *	-.36 *	.00	.02	-.59 **	-.09	-.09	1.00					
12. Economic growth 2001	.09	.21	-.21	-.04	.45 **	-.22	-.22	.04	.28	.03	-.31	1.00				
13. Economic growth 2002	-.03	.04	.06	-.18	.24	.02	.06	-.13	.20	-.02	.03	.67 **	1.00			
14. Unempl. rate 2001	.03	-.20	-.31	.11	.08	-.48 **	-.50 **	-.03	.04	.27	-.11	-.12	-.32	1.00		
15. Population share 45-54 yr.	-.63 **	-.39 *	.52 **	.28	.35 *	.54 **	.52 **	.45 **	-.44 **	-.41 *	-.36 *	-.01	.07	-.32	1.00	
16. Per capita income	-.44 **	-.29	.87 **	.02	-.43 **	.93 **	.87 **	.57 **	-.38 *	-.39 *	-.08	-.24	-.11	-.41 *	.56 **	1.00

* $p < .05$
** $p < .01$

4 Methods

As mentioned earlier, we employ three approaches explaining nascent entrepreneurship across countries. First, we hypothesize nascent entrepreneurship to be a (possibly U-shaped) function of economic development (as measured by per capita income). Second, we investigate various functional relationships between nascent entrepreneurship and the innovative capacity index. Third, we take the eclectic stand and investigate linear relationships between nascent entrepreneurship and a portfolio of determinants. Finally, we combine the three approaches to establish whether one of these approaches approach is dominant or whether a combined approach may be our best model.

In the *first* approach, we look at different functional forms of the relationship between nascent entrepreneurship and per capita income. We consider three specifications: a linear relation, a U-shape, and an L-shape.

- Linear specification. The cross-country variation in nascent entrepreneurship is explained by a constant and per capita income (YCAP). Nascent entrepreneurship continues to decline when per capita income rises, at a steady pace. In this specification, out-of-sample predictions imply that the entrepreneurship rate moves towards nil.
- Quadratic specification (U-shape). Besides a constant, we have both a linear and a squared per capita income term ($YCAP^2$). Nascent entrepreneurship declines with per capita income until a certain turning point, after which entrepreneurship increases with per capita income.
- Inverse specification (L-shape). Nascent entrepreneurship is explained by a constant and an inverse per capita income term, YCAP/(YCAP+1). Entrepreneurship gradually declines towards an asymptotic minimum value.

We look at the statistical fit of these three specifications (adjusted R^2 values). We also investigate whether there is a statistically superior specification, by applying likelihood ratio tests.

In the *second* approach we again test functional forms of nascent entrepreneurship but this time using the innovative capacity index instead of the level of economic development. In the *third* approach, we try to explain variation in nascent entrepreneurship rates by using several structural and cyclical variables derived from the 'eclectic framework of entrepreneurship', including *linear* terms of per capita income and the innovative capacity index. We establish an 'optimal' multiple regression specification using a general-to-specific modelling procedure, successively eliminating the independent variable with the smallest t-statistic and re-estimating until each variable is significant at 10% level.[1] Finally, a *full model* combines the three approaches.

[1] This method follows Bleany and Nishiyama (2002).

5 Main results

Approach 1 - Economic development and entrepreneurship

We computed regressions for the linear, quadratic and inverse specifications, as described in the 'Methods' section, using data for 36 countries participating in GEM (Croatia excluded). Based on a comparison of adjusted R^2 values and nested likelihood ratio tests we conclude that the linear specification is formally rejected, compared to the quadratic and inverse specifications. Details are in Annex II. So, entrepreneurship does not continue to decline at a steady pace towards zero as per capita income rises. Additional likelihood ratio tests reveal that the statistical fit of the quadratic specification (U-curve) is somewhat better than that of the inverse specification. The difference is not significant though. Apparently, from a certain level of economic development onwards, entrepreneurship starts to rise again as per capita income increases still further. Estimation results for the quadratic specification are in the left column of table 2. As an illustration, we depict in Figure 1 the estimated U-curve as well as the positions of the 37 GEM countries (including Croatia) in the per capita income/nascent entrepreneurship space (country two letter codes are in Annex I). The minimum of the curve lies at 22,199 US $, at the level of 3.3 nascent entrepreneurs per 100 adults. As a test of robustness we also carried out a regression excluding the uppermost observation at the right-hand side (the US). Both per capita income terms remain significant at 5% level.

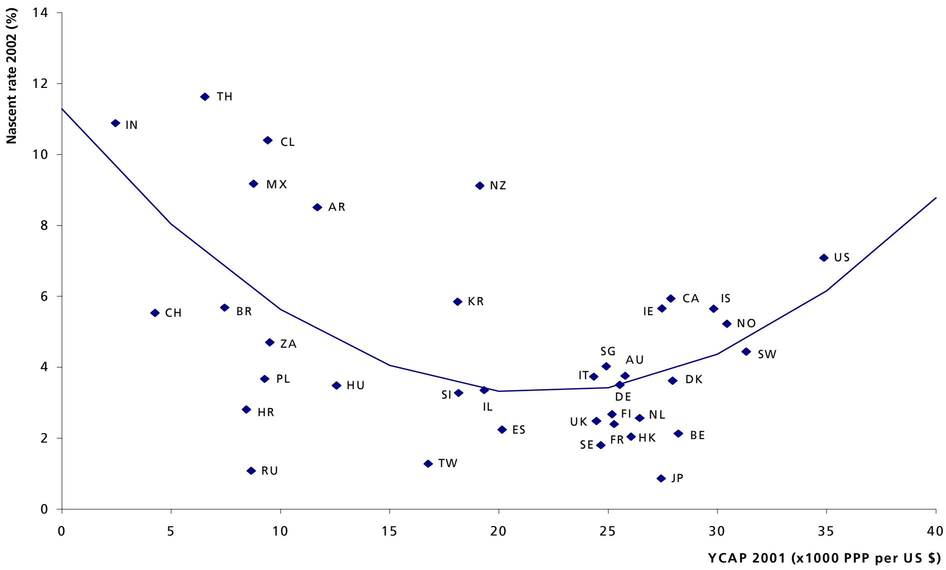
table 2 Regressions explaining nascent entrepreneurship in 2002, U-curves with economic development and innovative capacity

	Approach I: U-curve economic development	*Approach II: U-curve regime switch*
Constant	11.8	58.8
	(6.6)	(3.8)
Per capita income	-.76	
	(3.4)	
Per capita income, squared	.017	
	(2.8)	
GCR Innovative Capacity Index		-4.3
		(3.1)
GCR Inn. Cap. Index, squared		.085
		(2.8)
Adjusted R^2	.31	.40
Observations	36	36

Absolute t-values between parentheses.

Estimation samples exclude Croatian observations.

figure 1 Nascent entrepreneurship versus per capita income, the U-curve



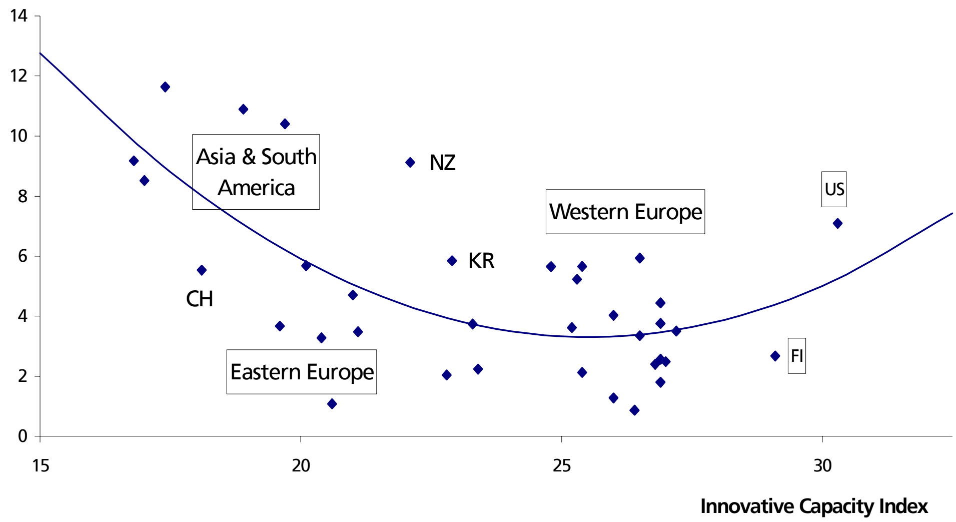
Approach 2 - Regime switch

To test the Schumpeterian regime switch we perform a similar exercise as in approach 1. Again we test linear, quadratic and inverse specifications, based on the innovative capacity index. We find again that the linear specification is rejected. This time however, the inverse specification is also formally rejected, in favor of the quadratic specification. This suggests that initially, an improving innovation system discourages new and small enterprises ('regime of creative accumulation') until a certain point onwards, after which a still further improvement of the innovation system favors entrepreneurship ('regime of creative destruction').[1] Estimation results are in the right column of table 2. The estimated curve is depicted in Figure 2. The minimum of the curve of 3.3 nascent entrepreneurs per 100 adults is reached at a level of the innovative capacity index of 25.5. For comparison, the index values for the 36 countries in our data set reach from 16.8 (Mexico) to 30.3 (the US), and 14 countries have a value higher than 25.5 (source: Porter and Stern, 2002, p. 104).

Compared to per capita income, the U-shaped relation with innovative capacity is somewhat less robust to removal of the US observation. The t-value of the squared term then drops to 1.7.

[1] The relation between innovation and entrepreneurship is a complex one. We assume an 'innovation pull' effect: if innovation is in the air because of the specific stage of the technology cycle there will be supply of entrepreneurial energy trying to exploit the opportunities. The reverse effect is also likely to exist when the supply of entrepreneurship, driven for instance by low opportunity costs, leads to the exploration of new markets because incumbent markets have high entry barriers. In reality, these two effects will probably interact leading to dynamic spurts in innovative and entrepreneurial behavior. Further research using times series data sets is needed to throw more light on the exact relationship between innovative and entrepreneurial behavior.

figure 2 Nascent entrepreneurship versus innovative capacity index, the U-curve



Technology cycles may explain the changing role of nascent entrepreneurship in that, when a cycle develops, there is extensive occurrence of entrepreneurial ventures. The experimental stage where the dominant designs of the new wave of products is not known yet calls for, or rather necessitates, entrepreneurial energy. This stage goes together with an upsurge of small and new firms that slowly destruct the role and power of the incumbent ones. This process of creative destruction is essential in the technology cycle where stages of creative accumulation (Schumpeter Mark II regime) are followed by those of creative destruction (Schumpeter Mark I regime). Elsewhere, this process has been termed the 'dynamic complementarity' of the role of small and large firms: small firms play an important role in exploring the new product/market combination, large firms play an important role exploiting its economic impact and finally, small firms play a role exploring the niches left over by the dominant designs of the product/market combinations.

The innovation U-curve cannot be seen fully apart from the economic development U-curve as the innovative capacity index is positively correlated with per capita income (see table 1). For instance, the proportion of scientists and engineers in the workforce (one of the innovation sub-indices) is generally higher in countries with higher levels of economic development. On the other hand, most countries have access to a wide range of new technologies and have ample opportunities to implement specific innovation policies, irrespective of their level of economic development.

Approach 3 - Eclectic framework: linear relationships

In the third approach we extensively investigate the role of a large number of (other) possible determinants of nascent entrepreneurship. From Annex I we see that data for Croatia are missing for half of the variables. Therefore, we exclude Croatia and continue with a data sample of 36 observations. We leave out female labor share, participation in education and income disparity from the initial set of variables as there are missing data for these variables in other countries besides Croatia. As described earlier, we apply a general-to-specific modelling procedure, resulting in a set of significant variables. It may be the case that some candidate explanatory variables are not in the final set of regressors due to multicollinearity with other regressors. We investigate this issue in Annex III and conclude that six out of the eight omitted variables are likely to have no impact on the nascent rate. For tax revenues and population growth, however, a positive effect on nascent entrepreneurship cannot be ruled out, because these variables seem to interact.

table 3 Regressions explaining nascent entrepreneurship in 2002, eclectic framework: linear relations and full model

	General-to-specific procedure: starting linear regression	*General-to-specific procedure: selected linear regression*	*Regression including tax revenues and population growth*	*Eclectic framework: full model*		
Constant	13.0	14.7	13.3	7.5	51.1	42.4
	(1.9)	(5.4)	(4.5)	(3.4)	(4.7)	(3.8)
Business ownership	.19	.17	.19	.18	.17	.16
	(2.2)	(2.6)	(2.9)	(2.7)	(3.0)	(3.0)
Social security cost as % GDP	-.046	-.044	-.043	-.029	-.047	-.036
	(1.2)	(1.8)	(1.6)	(1.0)	(2.1)	(1.7)
Communist country	-1.6	-2.6	-2.1	-1.8	-2.0	-2.1
	(.8)	(2.7)	(2.0)	(1.7)	(2.2)	(2.5)
Computers per capita	-.002					
	(.4)					
Tax revenue as % GDP	.068		.060	.083	.081	.093
	(1.2)		(1.5)	(1.9)	(2.4)	(2.7)
Number of Permits required to	.038					
start bus.	(.2)					
Population growth 1996-2002	.15		.13	.19	.15	.17
	(1.4)		(1.6)	(2.1)	(2.0)	(2.5)
Economic growth 2001	.039					
	(.2)					
Population share 45-54 years old	-.14					
	(.4)					
Unemployment rate	-.029					
	(.3)					
Per capita income	.043			-.71		-.36
	(.4)			(3.7)		(2.0)
Per capita income, squared				.014		.010
				(2.9)		(2.3)
GCR Innovative Capacity Index	-.43	-.45	-.51		-3.9	-2.9
	(1.9)	(4.7)	(4.6)		(4.1)	(2.9)
GCR Inn. Cap. Index, squared					.072	.051
					(3.6)	(2.4)
Adjusted R^2	.57	.63	.64	.62	.75	.78
Observations	36	36	36	36	36	36

Absolute t-values between parentheses.

Estimation samples exclude Croatian observations.

Last three columns use statistically superior specifications: quadratic for both per capita income and innovative capacity index (see annex II).

Estimation results for the eclectic framework approach, employing linear relationships only, are in table 3. Our initial set includes a constant and 12 possible determinants, including linear terms of per capita income and innovative capacity. The final set of regressors (given our tolerance level of 0.1) is presented in the second column. However, the variables tax revenues and population growth may have been omitted from the selected model due to multicollinearity (see Annex III) and therefore we also present results including these two variables in the model (third column).

Eclectic framework: a full model

In the last three columns of table 3 we present our full model, combining the selected variables from the general-to-specific procedure (including tax revenues and population growth) with the per capita income variables (linear and squared terms) and the innovative capacity index (linear and squared terms).

As regards the estimated U-curves for per capita income and innovative capacity, we conclude that these are highly robust, as all terms (linear and squared) are significant in regressions including various eclectic variables. Besides the effects of per capita income and innovative capacity, we find significant effects of five variables. *First*, incumbent business ownership has a positive influence on nascent entrepreneurship. The availability of entrepreneurial role models is thus found to be important. An additional explanation is that a larger number of incumbent business owners may also imply a higher turnover of enterprises. *Second,* we find a negative effect of social security on nascent entrepreneurship. In countries with an extensive social security system, the unemployed experience little need to set up shop for themselves. Besides, the opportunity costs of becoming self-employed are probably relatively high compared with wage-employment. Possibly, these effects dominate the potential positive effect stemming from a generous social minimum acting as a safety net in the case of business failure. *Third*, there is a negative effect for the (former) centralized command economies dummy. This reflects that the culture and institutions in the (former) communist countries are not yet very suitable for self-employment. *Fourth*, tax revenues as a percentage of GDP are found to have a positive effect on nascent entrepreneurship, supporting the tax evasion or tax avoidance hypothesis. *Fifth*, we find the hypothesized positive effect of population growth. This confirms earlier results by Hunt and Levie (2003), who use individual GEM-data within the context of a different model specification.[1]

[1] Using the method of Hierarchical Linear Modelling, Hunt and Levie (2003) link various entrepreneurship measures at the individual level (94,260 respondents) to a number of explanatory variables at the macro level, and find that 'population growth was the only consistent predictor of entrepreneurial activity, being significant and positive for all measures of entrepreneurial activity except corporate start-ups and informal investment'.

6 Differentiating between opportunity-based and necessity-based nascent entrepreneurship

In this section we investigate whether determinants of nascent entrepreneurship differ for opportunity-based and necessity-based forms of entrepreneurial activity. The Global Entrepreneurship Monitor distinguishes two basic (classes of) dominant reasons or motives why individuals participate in entrepreneurial activities: (a) primarily, they perceive a business opportunity (i.e., they elect to start a business as one of several possible career options), or (b) they see entrepreneurship as their last resort (i.e., they feel compelled to start their own business because all other options for work are either absent or unsatisfactory). Using this categorization, then, it is possible to label more than 97 percent of those who are entrepreneurially active as either 'opportunity' or 'necessity' entrepreneurs (Reynolds et al., 2002, p. 15). For our sample of 36 countries, the mean values are 3.4 (per 100 adults) for the opportunity nascent entrepreneurship rate and 1.0 for necessity nascent entrepreneurship. When we look at opportunity nascent entrepreneurship as a share of total nascent entrepreneurship (opportunity plus necessity) the mean is 79%. In Norway this share is as high as 99%. Relatively low shares (below 60%) are found in South Africa, Argentina, Brazil and Chile. In other words, in these countries relatively many nascent entrepreneurs engage in entrepreneurial activity out of necessity.

We analyze the determinants of opportunity and necessity nascent entrepreneurship separately for the three approaches employed in this paper. Details and estimated functions of the first two approaches are included in Annex II. As before, we establish the functional form with the best statistical fit making use of nested likelihood ratio tests. With respect to *per capita income*, for opportunity entrepreneurship we find the quadratic specification to have the best statistical fit. This finding is intuitively plausible in so far as many new opportunities for entrepreneurship arise with increasing per capita income. For necessity entrepreneurship we find a linearly decreasing function of per capita income. As regards *innovative capacity*, we find again a quadratic function for opportunity entrepreneurship and a decreasing function for necessity entrepreneurship (linear or inverse). Again, this seems intuitively plausible. Summing up, it seems reasonable to assume that the U-shaped patterns for total nascent entrepreneurship, as shown in Figures 1 and 2, are the net effect of two offsetting processes affecting opportunity and necessity entrepreneurship.

table 4a Regressions explaining OPPORTUNITY nascent entrepreneurship in 2002

	General-to-specific procedure: selected specification nascents total	*General-to-specific procedure: variable selection opportunity nascents*		*Combinations with per capita income and innovative capacity*		
Constant	6.9	8.1	.54	3.7	29.9	30.0
	(2.8)	(1.3)	(.9)	(2.5)	(2.7)	(2.6)
Business ownership	.16	.14	.23	.20	.19	.19
	(2.7)	(1.9)	(4.5)	(3.8)	(3.9)	(3.9)
Social security cost as % GDP	-.040	-.038				
	(1.8)	(1.2)				
Communist country	-1.3	-1.5				
	(1.4)	(0.8)				
Computers per capita		-.001				
		(.2)				
Tax revenue as % GDP		.060				
		(1.2)				
Number of Permits required to start bus.		-.052				
		(.3)				
Population growth 1996-2002		.12	.11	.11	.098	.096
		(1.2)	(2.0)	(2.0)	(1.9)	(2.0)
Economic growth 2001		.092				
		(.5)				
Population share 45-54 years old		.024				
		(.1)				
Unemployment rate		-.072				
		(1.0)				
Per capita income		.019		-.38		-.12
		(.2)		(2.5)		(.8)
Per capita income, squared				.01		.006
				(2.5)		(1.5)
Per capita income, inverse						
GCR Innovative Capacity Index	-.18	-.31			-2.5	-2.3
	(2.1)	(1.6)			(2.6)	(2.2)
GCR Inn. Cap. Index, squared					.051	.042
					(2.5)	(2.0)
GCR Inn. Cap. Index, inverse						
Adjusted R^2	.46	.40	.43	.50	.52	.58
Observations	36	36	36	36	36	36

Absolute t-values between parentheses.

Estimation samples exclude Croatian observations.

Last three columns use statistically superior specifications: quadratic for both per capita income and innovative capacity index (see annex II).

table 4b Regressions explaining NECESSITY nascent entrepreneurship in 2002

	General-to-specific procedure: selected specification nascents total	*General-to-specific procedure: variable selection necessity nascents*		*Combinations with per capita income and innovative capacity*		
Constant	6.0	2.4	1.6	1.6	47.7	47.6
	(5.5)	(.9)	(3.9)	(2.7)	(1.3)	(1.3)
Business ownership	.039	.068	.057	.056	.047	.046
	(1.5)	(2.2)	(2.7)	(2.4)	(2.1)	(1.8)
Social security cost as % GDP	-.002	-.002				
	(.2)	(.2)				
Communist country	-.98	-.28	-.71	-.73	-.81	-.82
	(2.5)	(.4)	(1.9)	(1.8)	(2.1)	(2.0)
Computers per capita		-.002	-.003	-.003	-.002	-.002
		(1.1)	(6.1)	(2.2)	(2.1)	(1.3)
Tax revenue as % GDP		.012				
		(.6)				
Number of Permits required to		.015				
start bus.		(.2)				
Population growth 1996-2002		.055	.044	.043	.036	.035
		(1.4)	(1.8)	(1.7)	(1.5)	(1.4)
Economic growth 2001		-.038				
		(.5)				
Population share 45-54 years old		-.055				
		(.4)				
Unemployment rate		.030				
		(1.0)				
Per capita income		.013		-.005		-.003
		(.3)		(.1)		(.1)
Per capita income, squared						
Per capita income, inverse						
GCR Innovative Capacity Index	-.22	-.063				
	(5.8)	(.8)				
GCR Inn. Cap. Index, squared						
GCR Inn. Cap. Index, inverse					-48.4	-48.2
					(1.3)	(1.2)
Adjusted R^2	.58	.59	.64	.63	.65	.64
Observations	36	36	36	36	36	36

Absolute t-values between parentheses.

Estimation samples exclude Croatian observations.

Last three columns use statistically superior specifications: linear for per capita income and inverse for innovative capacity index (see annex II).

Results for the *eclectic framework* are in tables 4a and 4b. We investigate the determinants in three ways. First, we compute regressions explaining opportunity or necessity entrepreneurship from the selected set of variables for total entrepreneurship from table 3. This involves the variables business ownership, social security cost, the communist country dummy and Porter's Innovative Capacity Index. Second, we apply the general-to-specific modelling procedure separately for opportunity and necessity entrepreneurship, possibly yielding different sets of explanatory variables. Third, given these selected specifications, we present combinations with functional forms of per capita income and innovative capacity. For this purpose we choose the functional forms with the best statistical fit, derived in Annex II.

From the first three columns of table 4a, we conclude that opportunity entrepreneurship is mainly driven by the role model effect of incumbent business ownership, by population growth and, to a lesser extent, is negatively influenced by social security expenditures. For necessity entrepreneurship (table 4b), roughly the same holds for incumbent business ownership and population growth. The positive effects of population growth for both opportunity and necessity entrepreneurship are consistent with the results of Hunt and Levie (2003). This supports the existence of demand and supply side effects of population growth. However, no effect of social security on necessity entrepreneurship is found, which possibly supports the view that generous social security may provide a safety net for nascent entrepreneurs. Additionally, the availability of computers has a strongly significant negative correlation with necessity entrepreneurship. Apparently, in a high tech environment, necessity entrepreneurship becomes less prominent, but this may be caused by a common underlying factor. Furthermore, for opportunity entrepreneurship, the negative effect of the '(former) centralized command economies' dummy is weaker compared to total nascent entrepreneurship in table 3, while its effect remains unabated for necessity entrepreneurship. In the cultural-institutional environment of former communist countries, entrepreneurship is apparently not a likely alternative for people without other work options.

From the last three columns of table 4a, we conclude that in the case of opportunity entrepreneurship, business ownership and population growth are quite robust to inclusion of a U-shaped relationship with per capita income and/or innovative capacity. For necessity entrepreneurship (table 4b), the inclusion of the decreasing function of per capita income and/or innovative capacity found in Annex II, diminishes the effect of all included variables except the communist country dummy.

7 Conclusions

In this paper three approaches for explaining nascent entrepreneurship across countries have been compared, using data for 36 countries participating in the Global Entrepreneurship Monitor 2002. The first approach hypothesizes a U-shaped relationship between nascent entrepreneurship and the level of economic development. Regression analysis, using per capita income as a measure of economic development, provides support for this hypothesis. The explanatory power of this model, as expressed by the adjusted R^2 is however quite modest. The second approach hypotheses a U-shaped relationship between nascent entrepreneurship and the innovative capacity index based upon the regime switch hypothesis. We also find support for this view. The third model is based upon the 'eclectic framework of entrepreneurship', relating nascent entrepreneurship to both economic and non-economic conditions. In a general-to-specific regression analysis, using 12 selected linear variables across these domains, five structural determinants are found to contribute to the explanation of nascent entrepreneurship, next to innovative capacity. These determinants are the incumbent business ownership rate (+), social security expenditure (-), tax revenues (+), population growth (+), and a (former) communist country dummy (-). The effects are robust, while their joint explanatory power is relatively high. A full model combining the three approaches has the highest explanatory power of all models (adjusted R^2=.78), while including significant and robust effects of all five determinants from the eclectic framework in addition to significant U-shaped relationships with both per capita income and the innovative capacity index.

Separate regressions for opportunity-based and necessity-based nascent entrepreneurship underline some of the conclusions reported above. In particular, they underscore that the U-shaped relationships with per capita income and with the innovative capacity index are related to the creation of new business opportunities at advanced levels of economic and technological development.

The results also suggest that the comparative rate of entrepreneurship is to some extent governed by underlying 'laws' related to the level of economic development. Cultural values, the availability of entrepreneurial role models, the incentive structure of the economic system and innovation policy provide additional structural influences on entrepreneurship. The combined impact of these structural variables suggests that the comparative rate of nascent entrepreneurship may be quite stable and path-dependent. In the short run, the influence of government policy can thus only be relatively modest. In the long run, through its impact on culture and institutions, government policy may well be of crucial importance. Additionally, the results suggest that developing nations on the one hand may do well to invest in their management qualities and not to overlook the importance of scale economies, given their stage of development.[1] On the other hand, for the economically most advanced nations, improving incentive structures for entrepreneurship and promoting the commercial exploitation of scientific findings through entrepreneurship education, transparent intellectual property rights and a well-

[1] For 23 OECD countries spanning the period 1976-1996 Carree et al. (2002) estimate the equilibrium rate of business ownership to be a U-shaped function of economic development. Moreover, deviations between the actual and the equilibrium level of business ownership (given the stage of economic development) are found to have a negative impact on economic growth.

developed market for venture capital offer the most promising approach for public policy. Additionally, governments in these countries striving to promote entrepreneurship are advised to be patient and persevering. The road to an entrepreneurial society is a long one (Bosma et al., 2002).

Our study has several *limitations* that should be borne in mind when interpreting the results. *Firstly*, the analysis pertains to the differences in nascent entrepreneurship across countries at one moment in time only. This is probably the main reason why no effect of cyclical variables was found. A preliminary analysis carried out by Reynolds et al. (2002), comparing so-called total entrepreneurship activity (TEA) rates for 29 countries in 2001 and 2002 however suggests the existence of a strong cyclical component of entrepreneurship (new business start-up rates) in the short run. On the other hand, the fact that the *relative rankings* of countries with respect to these TEA-rates are remarkably stable between these two years, is support for the view that structural economic and non-economic variables determine the underlying comparative rate of entrepreneurship in a society. *Secondly*, nascent entrepreneurship as used in our paper is an aggregate indicator of entrepreneurship. Disaggregation by sector may lead to different results. *Thirdly*, the innovative capacity index as used in this paper is a broad concept. The use of the underlying sub-indices as described in the 'Data' section may throw more light on which aspects of innovative capacity are most important from a policy perspective for stimulating entrepreneurial activity. *Fourthly*, by using the full set of GEM-countries in our regressions, the present paper implicitly assumed that the effects of the various independent variables are uniformly valid across a wide variety of countries. However, it is likely that there are interaction effects in the sense that the level of economic development influences the effects of various other determinants. For instance, computers and Internet use may be more important for setting up a business in highly developed countries than in less developed ones. More generally, the model does not explicitly take into account that there may be multiplier effects, originating in a two-way relationship between entrepreneurship and economic development.

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Annex I Participating countries in GEM and GEM-variable labels used in this paper

For the empirical part of the current paper we make use of the GEM database. The countries participating in GEM are listed below. Also, we provide the GEM labels of the variables used in this study (see section 'Data'), as well as countries for which data are missing (after adding data from other sources).

GEM participating countries (2002)

1. United States (US)
2. Russia (RU)
3. South Africa (ZA)
4. The Netherlands (NL)
5. Belgium (BE)
6. France (FR)
7. Spain (ES)
8. Hungary (HU)
9. Italy (IT)
10. Switzerland (SW)
11. United Kingdom (UK)
12. Denmark (DK)
13. Sweden (SE)
14. Norway (NO)
15. Poland (PL)
16. Germany (DE)
17. Mexico (MX)
18. Argentina (AR)
19. Brazil (BR)
20. Chile (CL)
21. Australia (AU)
22. New Zealand (NZ)
23. Singapore (SG)
24. Thailand (TH)
25. Japan (JP)
26. Korea (KR)
27. China (CH)
28. India (IN)
29. Canada (CA)
30. Ireland (IE)
31. Iceland (IS)
32. Finland (FI)
33. Croatia (HR)
34. Slovenia (SI)
35. Hong Kong (HK)
36. Taiwan (TW)
37. Israel (IL)

	GEM variable labels	(missing values)
1.	COMPPC01	(HR)
2.	NETUSE01	(HR)
3.	POP2024	
	POP2534	
	POP3544	
	POP4554	
	POP5564	
4.	FEMALF01	(CH, HR)
5.	ENPRIM97	(IS, TW)
	ENSEC97	(RU, IS, TW)
	ENTER97	(IS, HK, TW)
6.	100*(POP2002-POP1996)/POP1996	
7.	BABYBU02+ESTBBU02	
8.	Variable not taken from GEM	
9.	SSPCGDP	(HR)
10.	TAXBYGDP	(HR)
11.	SUBPERM	(HR)
12.	SUBDAYS	(HR)
13.	INCDIS99	(AR, HR)
14.	GR0001A	
15.	GR0102A	
16.	UNEMP01	

Nascent entrepreneurship: SUBOAN02

Per capita income in purchasing power parities: variable not taken from GEM.

Innovative capacity index: GCINCP01 (HR missing)

Annex II Investigating functional forms using nested likelihood ratio tests

In this annex we investigate different functional forms of nascent entrepreneurship, with respect to per capita income as well as to Porter's innovative capacity index. We make a distinction between opportunity and necessity entrepreneurship. For each measure we investigate three functional forms (linear, quadratic and inverse) and by means of a procedure using nested likelihood ratio tests, we investigate which form is statistically superior.

Regarding per capita income (YCAP), we consider the following independent variables:

- YCAP (linear term)
- $YCAP^2$ (squared term)
- YCAP/(YCAP+1) (inverse term)

Analogously for the innovative capacity index.

Functional forms are defined as follows (constant is always included).

- Linear specification includes: linear term
- Quadratic specification includes: linear term, squared term
- Inverse specification includes: inverse term

Besides these functional forms we need three auxiliary specifications, in order to get specifications nested.

- Auxiliary specification I includes: linear term, inverse term
- Auxiliary specification II includes: inverse term, squared term
- Auxiliary specification III includes: linear term, inverse term, squared term

The statistically superior specification is established by applying the following procedure.

Step 1

First, we test the linear versus the inverse specification and vice versa (tests 1 and 2):

Test 1: Linear specification versus Auxiliary specification I: does the inverse term add significantly to explained variance, given linear specification? (null hypothesis: no; 5% critical value is 3.84).

Test 2: Inverse specification versus Auxiliary specification I: does the linear term add significantly to explained variance, given inverse specification? (null hypothesis: no; 5% critical value is 3.84).

There are three possibilities:

1. If (null hypothesis of) Test 2 rejected, and Test 1 is not: the linear specification is statistically better than inverse. Continue with Test 3 to test linear versus quadratic (see step 2 below).
2. If Test 1 rejected, and Test 2 not: the inverse specification is statistically better than linear. Continue with Tests 5 and 6 to test inverse versus quadratic (see step 2).
3. If Tests 1 and 2 both rejected or both not rejected, then there is no statistically significant difference between the linear and the inverse specifications. Test both against quadratic specification (Tests 3 and 4; see step 2).

Step 2

Second, given the outcome of step 1, we test against quadratic specification.

ad. 1. If linear specification statistically better than inverse: test linear versus quadratic specification

> **Test 3:** Linear versus Quadratic specification: does the squared term add significantly to explained variance, given linear specification? (null hypothesis: no; 5% critical value is 3.84). If not, than the linear specification is statistically superior. Otherwise, the quadratic specification is.

ad. 2. If inverse specification statistically better than linear: test inverse versus quadratic. However, these specifications are not nested. Therefore, apply two auxiliary tests:

- **Test 5:** Inverse versus Auxiliary specification III: do linear and squared term add significantly to explained variance, given inverse specification? (null hypothesis: no; 5% critical value is 5.99).

- **Test 6:** Quadratic versus Auxiliary specification III: does inverse term add significantly to explained variance, given quadratic specification? (null hypothesis: no; 5% critical value is 3.84).

There are three possibilities:

- If Test 5 not rejected, and Test 6 is rejected: inverse specification is statistically superior.
- If Test 5 rejected, and Test 6 not rejected: quadratic specification is statistically superior.
- If both tests not rejected, or both rejected, then there is no statistically significant difference between the quadratic and the inverse specifications.

ad 3. If there is no statistical difference between the linear and the inverse specifications, test both against quadratic specification (Tests 3 and 4).

- **Test 3:** Linear versus Quadratic specification: does the squared term add significantly to explained variance, given linear specification? (null hypothesis: no; 5% critical value is 3.84)

- **Test 4:** Inverse versus Auxiliary specification II: does the squared term add significantly to explained variance, given inverse specification? (null hypothesis: no; 5% critical value is 3.84).

There are three possibilities:

- If Tests 3 and 4 both not rejected, then the squared term does not add significantly to explained variance, given inverse or linear specification. The quadratic specification is then not statistically superior.
- If Test 3 and 4 both rejected, then quadratic specification is statistically superior.
- If one test rejected and one not, then we can make no statistical distinction between all three specifications (linear, inverse and quadratic).

Results for per capita income (Approach I)

The results of the likelihood ratio test procedure for per capita income are in table II.1 (36 observations; Croatia excluded).

table II.1 Functional forms of per capita income

	Nascents total	*Nascents opportunity*	*Nascents necessity*
		Adjusted R^2 values	
Linear	.17	.03	.42
Quadratic	.31	.20	.44
Inverse	.26	.13	.37
	Nested likelihood ratio tests: linear versus inverse specification, and vice versa		
Test 1	**4.10**	**4.87**	1.12
Test 2	.00	1.03	**4.28**
	Nested likelihood ratio tests: linear or inverse versus quadratic specification		
Test 3			2.35
Test 4			
	Nested likelihood ratio tests: inverse versus quadratic specification, and vice versa		
Test 5*	3.73	4.37	
Test 6	.02	.00	
Statistically best fit	Quadratic, Inverse	Quadratic, Inverse	Linear

Statistically significant test statistics in bold (5% level)

Test 1: linear vs aux. I. Test 2: inverse vs aux. I. Test 3: linear vs quadr.

Test 4: inverse vs aux. II. Test 5: inverse vs aux. III. Test 6: quadratic vs aux. III.

** 5% critical value 5.99; tests 1-4 and 6: 5% critical value 3.84.*

We see that opportunity and necessity entrepreneurship differ in that opportunity entrepreneurship has a quadratic or inverse form, and necessity entrepreneurship a linear form. Although for opportunity entrepreneurship the statistical fits of the quadratic and the inverse specifications are not significantly different, the quadratic form seems to perform somewhat better, as the test statistic of test 5 is closer to the critical value than test statistic 6. Apparently, after a certain threshold level of per capita income, opportunity entrepreneurship starts to rise with per capita income, while necessity entrepreneurship continues to decline. This threshold level (minimum of U-shaped curve) lies at 20,106 US $ (nascents). For comparison, in our sample of 36 countries, 20 countries have a value higher than 20,106. These countries are thus all in the upward part of the curve, as regards opportunity entrepreneurship.

The estimation results of the statistically best specifications (see last row of table II.1) are in table II.2. For comparison, the per capita income values in our data set range from 2,450 US$ (purchasing power parities) in India to 34,870 US$ in the United States.

table II.2 Nascent rate as a function of per capita income (YCAP): statistically best forms

	Nascents total		*Nascents opportunity*		*Nascents necessity*
	Quadratic	*Inverse*	*Quadratic*	*Inverse*	*Linear*
Constant	11.8	31.3	8.0	18.0	2.6
	(6.6)	(4.3)	(5.6)	(3.0)	(7.7)
Linear term:	-.76		-.57		-.079
YCAP	(3.4)		(3.2)		(5.2)
Quadratic term:	.017		.014		
YAP^2	(2.8)		(2.9)		
Inverse term:		-28.4		-15.6	
YCAP/(YCAP+1)		(3.6)		(2.5)	
Adjusted R^2	.31	.26	.20	.13	.42
Observations	36	36	36	36	36
Minimum parabola: YCAP	22,199 US $		20,106 US $		
Minimum parabola: nascent rate	3.3%		2.3%		
Asymptotic minimum: nascent rate		2.8%		2.4%	
Zero: YCAP					32,690 US $

Absolute t-values between parentheses

Results for Porter's innovative capacity index (Approach II)

The results of the likelihood ratio test procedure for Porter's innovative capacity index are in table II.3 (36 observations; Croatia excluded).

table II.3 Functional forms of innovative capacity index

	Nascents total	*Nascents opportunity*	*Nascents necessity*
		Adjusted R^2 values	
Linear	.28	.10	.45
Quadratic	.40	.24	.49
Inverse	.33	.14	.48
	Nested likelihood ratio tests: linear versus inverse specification (and vice versa)		
Test 1	**7.56**	**7.02**	2.99
Test 2	**4.77**	**5.36**	0.85
	Nested likelihood ratio tests: linear or inverse versus quadratic specification		
Test 3	**7.93**	**7.13**	3.78
Test 4	**4.92**	**5.45**	1.01
	Nested likelihood ratio tests: inverse versus quadratic specification (and vice versa)		
Test 5 *			
Test 6			
Statistically best fit	Quadratic	Quadratic	Linear, Inverse

Statistically significant test statistics in bold (5% level)

Test 1: linear vs aux. I. Test 2: inverse vs aux. I. Test 3: linear vs quadr.

Test 4: inverse vs aux. II. Test 5: inverse vs aux. III. Test 6: quadratic vs aux. III.

** 5% critical value 5.99; tests 1-4 and 6: 5% critical value 3.84.*

Again, opportunity and necessity entrepreneurship have different functional forms. For opportunity entrepreneurship we find a quadratic form (positive relation with innovative capacity after threshold value of 24.5; in our data set 19 out of 36 countries have a value higher than 24.5), while for necessity entrepreneurship we find a continuously declining function (linear or inverse). Apparently, the 'Schumpeterian regime switch' applies to opportunity entrepreneurship only.

The estimation results of the statistically best specifications (see last row of table II.3) are in table II.4. For comparison, values for the innovative capacity index in our data set range from 16.8 in Mexico to 30.3 in the United States.

table II.4 Nascent rate as a function of innovative capacity index (innov): statistically best forms

	Nascents total	*Nascents opportunity*	*Nascents necessity*	
	Quadratic	*Quadratic*	*Linear*	*Inverse*
Constant	58.8	43.3	5.7	107.9
	(3.8)	(3.3)	(6.5)	(5.8)
Linear term:	-4.3	-3.3	-.20	
innov	(3.1)	(2.9)	(5.4)	
Quadratic term:	.085	.068		
innov^2	(2.8)	(2.7)		
Inverse term:				-111.5
innov/(innov+1)				(5.7)
Adjusted R2	.40	.24	.45	.48
Observations	36	36	36	36
Minimum parabola:				
innov. c. index	25.5	24.5		
Minimum parabola:				
nascent rate	3.3%	2.5%		
Asymptotic mini-				
mum: nascent rate				-3.6%
Zero: innov. c. index			28.7	

Absolute t-values between parentheses

Annex III Investigating multicollinearity

During the general-to-specific modelling procedure described in the paper, eight candidate explanatory variables from the starting set drop out of the model (see table 3). Most likely, these variables are not in the final model because they have no impact on nascent entrepreneurship. However, an alternative possibility is that these variables were dropped because of multicollinearity with other variables, causing t-values to be low. In such cases the omitted variable may actually have an impact on the dependent variable. In this annex we investigate this issue.

table III.1 Regressions explaining nascent entrepreneurship in 2002; multicollinearity issues

	Eclectic framework: selected regression (see table 3)	*Coefficient (t-statistic) of added variable*	*Adjusted R^2 of regression including this variable (baseline .632)*	*R^2 of regression on included independent variables (column 1)*	*p-value of F-statistic for regression on included independent variables*
Constant	14.7 (5.4)				
Business ownership	.17 (2.6)				
Social security cost as % GDP	-.044 (1.8)				
Communist country	-2.6 (2.7)				
Computers per capita		.002 (.6)	.624	.81	.000
Tax revenue as % GDP		.026 (.8)	.628	.43	.001
Number of Permits required to start bus.		.072 (.5)	.623	.31	.019
Population growth 1996-2002		.059 (.8)	.628	.31	.018
Economic growth 2001		.072 (.4)	.622	.30	.024
Population share 45-54 years old		-.15 (.6)	.624	.66	.000
Unemployment rate		-.025 (.4)	.622	.21	.104
Per capita income		.029 (.4)	.622	.77	.000
GCR Innovative Capacity Index	-.45 (4.7)				

Absolute t-values between parentheses. Estimation samples include 36 observations (Croatia is excluded).
The first column displays the selected regression from the eclectic framework (see table 3). The results in the second and third column refer to the addition of each variable individually *to the regression in the first column. The last two columns refer to a regression of each variable on the independent variables in the first column.*

Table III.1 is modelled after Bleany and Nishiyama (2002). The last two columns present R^2 values and F-statistics of regressions explaining each *omitted* variable from the *included* variables (column 1). From this table it appears that for seven out of the eight omitted variables the possibility of multicollinearity cannot be ruled out, as F-statistics are significant. Only for the unemployment rate, an effect on nascent entrepreneurship can be ruled out. However, this is a rather strict test in the sense that the correlation with *all* included variables is tested simultaneously (F-test of regression). Hence, the possibility of rejection of the null hypothesis is rather large. Perhaps a more realistic test is given in the second and third column. Here the effects of adding each variable individually to the equation are reported. We see that for all omitted variables, the t-value is below one, and the adjusted R^2 value decreases when adding the variable to the model. This suggests that multicollinearity has not played a role in determining the final set of regressors.

Investigating the matter further however, we cannot rule out an effect of the variables tax revenue as % gdp and population growth, as these variables seem to interact with each other. This possibility does not only appear from the strong and significant correlation between the two variables (-0.6) but also from the pattern in the steps of the general-to-specific modelling procedure. In the first step (the regression with the starting set of variables in the first column of table 3) these two variables have t-values above one, which is relatively high given the number of regressors. In the steps that are between the starting set and the final set of regressors (not in table 3) the maximum value of the t-statistic is 1.6 for both variables (significant at 15% level). This is in a regression including both variables. In a next step, when tax revenue is removed from the specification (because it had the lowest t-value in that step), the t-value of population growth drops to 0.8, after which this variable is also removed. This suggests that these two variables interact and hence, the possibility that these variables do have a certain impact on nascent entrepreneurship, despite the fact that they are not in the selected model, cannot be ruled out.

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