TI 2009-032/3
Tinbergen Institute Discussion Paper

Entrepreneurship and the Business Cycle

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ENTREPRENEURSHIP AND THE BUSINESS CYCLE

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Forthcoming in the Review of Economics and Statistics

Version (2.0)

Date of completion of this updated manuscript: Mar 23, 2011

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ENTREPRENEURSHIP AND THE BUSINESS CYCLE

Abstract: We find new empirical regularities in the business cycle in a cross-country panel of 22 OECD countries for the period 1972-2007; entrepreneurship Granger-causes the cycles of the world economy. Furthermore, the entrepreneurial cycle is positively affected by the national unemployment cycle. We discuss possible causes and implications of these findings.

JEL Codes: L26, E32

Keywords: Entrepreneurship, business cycle

First version: April 2009

This version: March 2011 (forthcoming in the Review of Economics and Statistics)

Acknowledgements: We are grateful for comments from Boyan Jovanovic, Adriano Rampini, Dennis Fok, Wim Naude, Erik Canton, Marcus Dejardin, André van Stel, Dick van Dijk, Michael Fritsch, Maurice Bun, Sander Wennekers, Joao Faria, Christian Roessler, Avichai Snir, Schizas Emmanouil, Martin Carree, Niels Bosma, Philip-Hans Franses, two anonymous referees and participants at various conferences, workshops and seminars. This paper has been written in cooperation with the research program SCALES, carried out by EIM and financed by the Dutch Ministry of Economic Affairs.

I. Introduction

Despite the structural changes in modern economies that have led to the increasing importance of entrepreneurs (Audretsch & Thurik, 2001; Baumol, 2002; Audretsch, 2007), macroeconomic models of business cycles usually abstract from entrepreneurship, with only a few exceptions (Bernanke & Gertler, 1989; Carlstrom & Fuerst, 1997; Rampini, 2004). In addition, there is very little empirical evidence on this topic.[1] Therefore, in establishing the relationship between entrepreneurship and the business cycle, we find it worthwhile to 'let the data speak freely' (Hoover *et al.,* 2008; Juselius, 2009) instead of deducing and calibrating a model from more or less arbitrary assumptions regarding entrepreneurial behavior.

We explore the relationship between entrepreneurship[2] and the business cycle using panel data from 22 OECD countries for the period 1972-2007. To the best of our knowledge, this is the first study of its kind. We differentiate between the aggregate and the national level. The aggregate level refers to the weighted average of business cycle fluctuations across countries. We loosely refer to the aggregate-level business cycle as the global or world, economy[3]. The national level analyzes the data for each of the 22 countries separately and in a panel framework.

Differentiating between these two research levels of the relationship between the entrepreneurship and the business cycle, we obtain four results. First, global fluctuations in entrepreneurship are an early indicator of the world business cycle: they Granger-cause increases in GDP. Second, on this aggregate level, GDP and unemployment cycles do not predict the entrepreneurial cycle. This suggests that other factors besides the world business climate influence global trends in entrepreneurial activity. Third, at the national level, the

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[1] The only other empirical contributions on the topic that we are aware of are the work of Congregado *et al.* (2009) and Golpe (2009). In contrast to the present article, the work of these authors uses only self-employment data as a measure of entrepreneurial activity from a smaller number of countries covering a shorter time frame. Also, the focus of their analysis is different from ours, e.g., they focus on hysteresis effects and cross-country heterogeneity. Faria *et al.* (2009; 2010) focus on technical aspects of the dynamics and cyclicality of the relationship between unemployment and entrepreneurship.

[2] Entrepreneurship is defined in terms of owner-managers of firms.

[3] The 22 OECD countries account for more than 55% of the world GDP in all years included in our analysis (OECD 2010).

impact of entrepreneurship on the cycle seems to be weaker than at the aggregate level. Fourth, again at the national level, an upswing in the unemployment cycle leads to a subsequent upswing in the entrepreneurship cycle. Numerous tests using various methods and different data confirm the robustness of these main results. Taken together, our results suggest that entrepreneurship is intertwined with business cycle dynamics in ways that do not follow from existing theories.

In the following section, related literature is discussed. Section Three presents our empirical evidence, including a robustness check using another data set. Section Four discusses the empirical finding and concludes. The Appendix in Koellinger and Thurik (2009) and updated in March 2011 reports on various robustness checks using our main data set.

II. Related literature

Bernanke and Gertler (1989) study the influence of entrepreneurs' net worth on borrowing conditions and the resulting investment fluctuations in a neoclassical model of the business cycle. The key to their analysis is the principal-agent problem between entrepreneurs and lenders: only entrepreneurs can costlessly observe the returns on their individual projects, whereas outside lenders must jointly incur fixed costs to observe these returns. The greater the "collateralizable" net worth of the entrepreneur's balance sheet, the lower the expected agency costs will be, as implied by the optimal financial contract. Because entrepreneurs' net worth is likely to be pro-cyclical (i.e., entrepreneurs are more solvent during good times), there will be a decline in agency costs and an increase in real investments during booms. The opposite happens during recessions. Hence, an accelerator effect emerges due to the principal-agent problem between entrepreneurs and lenders. The focus of Bernanke and Gertler (1989) is on the real effects caused by random fluctuations in balance sheets (e.g., due to an unanticipated fall in real estate prices) and not on entrepreneurship per se. They assume that the potential share of entrepreneurs in the economy is independent of business cycle fluctuations, whereas the fraction of entrepreneurs who get funding and produce is pro-cyclical.

Carlstrom and Fuerst (1997) extend the work of Bernanke and Gertler (1989) by developing a computable general equilibrium model that can quantitatively capture the propagation of productivity shocks through agency costs. Similar to that of Bernanke and Gertler, the model by Carlstrom and Fuerst also does not focus on entrepreneurship per se and assumes that the potential share of entrepreneurs in a population is a constant that does not

fluctuate with the cycle. However, due to simplifying assumptions, they end up with the somewhat counter-intuitive result that bankruptcy rates and risk premia are highest during boom periods as a result of positive technology shocks and higher capital prices. Hence, the number of solvent entrepreneurs would then be counter-cyclical. Furthermore, the bankruptcy probability is the same across entrepreneurs, independent from their net worth. However, the authors point this out as one of the shortcomings of their model.

The only theoretical business cycle model we are aware of that explicitly focuses on the share of entrepreneurs in the labor force is that of Rampini (2004). In this real business cycle model, the risk associated with entrepreneurial activity implies that the amount of such activity should be pro-cyclical, which also results in the amplification and inter-temporal propagation of productivity shocks. Agents are assumed to be risk-averse and can choose between a risk-free production technology (i.e., wage employment) and a risky production technology (i.e., entrepreneurship). Productivity shocks shift the output of both technologies by a constant. As a result, all agents are wealthier during economic booms. The risk-free production technology is always available, which implies no structural unemployment. Furthermore, it is assumed that the expected value of risky entrepreneurship exceeds the opportunity costs of risk-free employment. Hence, all agents prefer entrepreneurship to employment. However, the share of entrepreneurs is restricted by a financial intermediary that determines the optimal rate of entrepreneurship, given the productivity shock of the period and the wealth and preferences of the agents. The intermediary designs an optimal incentive contract that allows entrepreneurs to insure a part of their risk via leverage. Because all agents are wealthier as a result of positive productivity shocks and because risk aversion is assumed to decrease with wealth, it is optimal to have a higher share of entrepreneurs during economic booms.[4] Furthermore, it is also argued in the spirit of Bernanke and Gertler (1989) that agency costs are counter-cyclical because more utility is lost due to the moral hazard problem when productivity is low. Hence, Rampini (2004) concludes that entrepreneurship is pro-cyclical, even if agents have access to financial intermediaries.

Aside from the abovementioned direct analyses of the relationship between entrepreneurship and the business cycle, there are several labor market-related effects identified in the entrepreneurship literature. A literature survey by Parker (2009, pp. 142-143)

[4] Alternatively, one might argue that risk preferences remain constant over time, but the higher level of wealth of agents during booms reduces liquidity constraints and hence increases entrepreneurial activity (Evans and Jovanovic, 1989).

discusses evidence from the US that new firm formation is pro-cyclical. He also points to the effect of falling wages in recessions, which may lower the opportunity costs for starting a business and encouraging marginal types of entrepreneurship. Yet, low-quality businesses may be removed in recessions, exerting a countervailing force on the total number of business owners. Congregado *et al*. (2009) discuss the recession-push and prosperity-pull concepts as well as numerous studies supporting these concepts. The recession-push argument would lead to a counter-cyclical and the prosperity-pull argument to a pro-cyclical effect.[5]

The vast majority of the business cycle literature, however, does not explicitly model entrepreneurial activity. This implies the hypothesis that entrepreneurship is either independent from the cycle or irrelevant for the real economy. The results are mixed and often indirect in the entrepreneurship literature (Thurik *et al*., 2008 and Congregado *et al*., 2009). This ambiguity does not lead to dominant hypotheses. Hence, we will focus on the data and link our results to the existing literature afterwards.

III. Analysis

In general, there are two ways of analyzing our data. Either observations can be averaged across countries to focus on global trends or coefficients can be averaged, putting more emphasis on national conditions. Of course, the two approaches address somewhat different questions: the first investigates if global trends in entrepreneurial activity exist and how they relate to the cycles of the world economy; the second approach investigates the average relationship between entrepreneurship and the cycle at the national level. These two perspectives are likely to yield diverging results if different factors influence the data at the aggregate and national levels. For example, low-skilled individuals who consider starting a business are more likely to be influenced by national labor market policies than by global technological trends, whereas the opposite can be expected for highly skilled opportunity entrepreneurs. Because the former constitute the majority of entrepreneurs (Kirchhoff, 1994), one can expect to find different relationships between unemployment and entrepreneurial activity at the national and global levels if labor market conditions are imperfectly correlated across countries.

[5] See also Thurik *et al*. (2008) and Parker (2009) discussing the interplay between unemployment and entrepreneurship.

Furthermore, economic variables at the country level are more likely to be influenced by national policies and the conditions in specific, closely related nations. The world economy is hardly influenced by the idiosyncratic policies of particular countries. Instead, global-scale business cycle fluctuations reflect more directly developments of global importance, such as major geopolitical changes, world market prices of commodities or technological breakthroughs. Of course, these global developments also impact on national business cycles, but the additional influence of national policies and conditions leads to country-specific patterns and dilutes the correlation of cycles across countries.

The present section consists of three parts. First, we present the global results of the co-movement of GDP, unemployment and business ownership, using data from 22 OECD countries for the period 1972-2007. The second part deals with the co-movement of these variables at the country level. The third part is a robustness check we carried out using a different data source, with the aim of replicating the results of our initial analysis using an alternative measure of entrepreneurship.

A. Aggregate analysis of entrepreneurship, unemployment and the cycle

We construct a balanced cross-country panel of 22 OECD countries[6] with annual data for the period 1972-2007 using various sources. OECD data are used to determine annual real GDP in constant 2000 prices in national currencies and standardized unemployment rates.

Entrepreneurial activity per country and per year is measured as the share of business owners in the total labor force[7], using data from *Compendia 2007.1* that corrects for measurement differences across countries and over time.[8] This is a broad measure of entrepreneurial activity that includes incorporated, self-employed individuals (owner-managers of incorporated businesses) and (unincorporated) self-employed persons with and

[6] The included countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Greece, Iceland, Ireland, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the USA. These are the 23 old OECD countries, with Germany excluded because we are unable to correct for the influence of its unification on the time series.

[7] The total labor force is the sum of the employed and the unemployed.

[8] Data are constructed by EIM (Zoetermeer, NL) on the basis of OECD material. See http://www.ondernemerschap.nl for the data and van Stel (2005) for an explanation of the method. Quarterly data regarding business ownership rates are not available for most countries.

without employees; conversely, the measure excludes unpaid family workers[9]. The business ownership rate also excludes so-called "side-owners," who generate less than 50% of their income by running their own businesses.

A disadvantage of using business ownership as a measure of entrepreneurial activity is that it does not fully capture early-stage ventures that do not yet generate a substantial contribution to the owner's income. In addition, business ownership rates reflect to some extent the existing industry structures in place rather than the introduction of new economic activity in the Schumpeterian (1934) and Kirznerian (1973) sense.[10] To address these conceptual shortcomings of business ownership rates as a measure of entrepreneurial activity, we also use data from the Global Entrepreneurship Monitor (GEM) (Reynolds *et al.,* 2005) as a second measure for robustness checks.

Following the convention of defining the business cycle as a series of deviations from long-term trends in GDP data, we decompose time series into trends and cycles using the Hodrick-Prescott filter (Hodrick & Prescott, 1997), referred to below as the HP filter. The HP filter is a standard method of removing trend movements that has been applied both to actual data and to artificial data in numerous studies.[11] The smoothing parameter λ of the filter, which penalizes acceleration in the trend relative to the business cycle component, needs to be specified. Most of the business cycle literature uses quarterly data and a λ value of 1600, as has been suggested by Hodrick and Prescott (1997). Unfortunately, business ownership rates are only available on an annual basis in most countries. Because the time period over which aggregation takes place affects the variance in the process at discrete time intervals, the λ value must be adjusted. Ravn and Uhlig (2002) show that the appropriate λ value for annual data is 6.25; this is the value we use for our analysis.

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[9] Unpaid family owners can be regarded as irrelevant in measuring the extent of entrepreneurship, as they do not own the businesses they work for and do not bear responsibility or risk in the way that 'real' entrepreneurs do.

[10] Despite these disadvantages, the business ownership rate is widely used: in Thurik *et al.* (2008), investigating the interrelationships between entrepreneurship and unemployment; in Erken *et al.* (2009), measuring the influence of entrepreneurship on total factor productivity; and in Carree *et al.* (2002), studying the influence of economic development. See also Parker (2009, Chapter 1).

[11] See Ravn and Uhlig (2002) and Jaimovich and Siu (2009), for example.

To test if our results are robust to different methods of de-trending the data, we repeat all analyses using a λ value of 100 and first differences of growth rates.[12] The main results we present below have been computed using the HP filer with a λ value of 6.25. They are not sensitive to the method of de-trending. The additional results are reported in the Appendix in Koellinger and Thurik (2009).

>> Table I about here <<

A first look at the data shows considerable variation of all three series and countries around a stable mean value of zero. Table 1 shows that the series are only weakly correlated across countries. While the GDP series of some countries are strongly correlated (e.g., the Netherlands and Belgium, USA and Canada), the series of other countries are independent (e.g., Spain and New Zealand) or even negatively correlated (e.g., Austria and Australia). The same holds for the unemployment series. The average of the correlation coefficients across countries is 0.34 for GDP and 0.39 for unemployment. The pattern in the data indicates a strong correlation of business cycles in countries that are geographically close or economically integrated, such as the European Union. The weakest systematic correlation across countries is shown by the entrepreneurship series, with an average correlation of only 0.06. This suggests that entrepreneurial activity at the country level exhibits considerable noise that disguises global trends.

To reveal these global trends, we aggregate observations across countries after detrending the original data. Observations of every country are weighted by the economic size of each country, using the average share of each country's GDP in the total GDP of all countries included in the analysis from 1972-2007. We use GDP in current prices and current USD to compute these weights. This yields time series for the 'world economy' that smooth out most of the national idiosyncrasies. We also experiment with unweighted data and

[12] According to additional tests we conducted, the method of de-trending influences the spectrum of the resulting series as well as the AR and MA order of variables. The HP filter with a λ = 100 or higher forces a common spectral shape on the series, which is not so much the case for an HP filter with λ = 6.25 and not at all for the first differences of growth rates. Our additional analyses also showed that GDP and unemployment have very similar spectra, while business ownership exhibits different peaks in the spectrum. ARMA specification tests using the Hannan-Rissanen (1982) procedure showed that GDP and unemployment have more complex AR and MA orders than business ownership.

different weighting methods and find that our main results reported below are not sensitive to weighting.[13]

>> Figure I about here <<

Figure I shows average deviations of world GDP (corrected for inflation) and entrepreneurship from their long-term trends from 1972-2007. At least four major cycles are clearly visible: (1) the deep double-dip of the oil crisis in the early 1970s, (2) the recovery and boom of 1979, (3) the boom of 1989, and (4) the high-tech boom of 2000, with the subsequent recession in 2001. Following the 2001 recession is a gradual recovery until 2007. Casual observation of the two graphs suggests at least two phenomena. First, economic recoveries and boom periods since the 1980s are typically preceded by rising levels of entrepreneurship. In particular, the 1989 boom, the high-tech boom of 2000 and the recovery from the recession after 2001 are led by a rise in entrepreneurial activity. Second, cyclical entrepreneurship typically reaches its maximum and starts declining just before a cyclical boom in GDP reaches its maximum. The only exceptions to this trend are the oil crisis and the boom of 1979. Both observations suggest that entrepreneurship is a leading indicator of the business cycle in the time frame we consider.

As expected, a descriptive analysis of GDP and unemployment shows that unemployment is strongly counter-cyclical. The contemporaneous correlation between the two series is -0.9 (significant at >99% confidence). A countercyclical relationship between GDP and entrepreneurship can be clearly rejected since the contemporaneous correlation between the two series is positive (0.3, significant at >90% confidence). A feedback between unemployment and entrepreneurship seems likely because labor market opportunities determine to a large extent the opportunity costs of entrepreneurship (Thurik *et al*., 2008). Indeed, the contemporaneous correlation between unemployment and entrepreneurship is -0.43 (significant at >98% confidence).

This interrelation between GDP, unemployment and entrepreneurship suggests a joint analysis of these three variables in an autoregressive context. Given the stationarity of

[13] Results are available from the authors on request.

detrended data[14], we estimate a vector auto-regression model with two lags, VAR(2), including deviations from trends in terms of business ownership, real GDP and unemployment (Lütkepohl, 2007; Greene, 2003). The optimal lag length of two is unanimously suggested by the Akaike (1974) information criterion, the Hannan-Quinn (1979) criterion and the Schwarz (1978) criterion for $1 < p_{max} < 7$.

Our reduced-form VAR(2) expresses each variable as a linear function of its own two past values and the two past values of the other two variables. The vector of errors is assumed to be serially uncorrelated with contemporaneous covariance across equations. Specifically, we estimate

(1) $$\overline{y_t} = \bar{v} + \overline{A_1}\,\overline{y_{t-1}} + \overline{A_2}\,\overline{y_{t-2}} + \overline{u_t},$$

where

$\overline{y_t} = (y_{1t}, y_{2t}, y_{3t})'$ is a *3 x 1* random vector with
$y_1 =$ real GDP cycle,
$y_2 =$ unemployment cycle, and
$y_3 =$ business ownership cycle,
$\overline{A_1}$ and $\overline{A_2}$ are fixed *3 x 3* matrices of parameters,
$\bar{v}$ is a *3 x 1* vector of fixed parameters, and
$\overline{u_t}$ is assumed to be white noise; that is

$$E(\overline{u_t}) = 0$$
$$E\left(\overline{u_t}\,\overline{u_t}'\right) = \Sigma$$
$$E\left(\overline{u_t}\,\overline{u_s}'\right) = 0 \;\forall\; t \neq s.$$

The model is estimated with least squares. Confidence intervals are based on common *t*-values, which have been shown to yield reasonably accurate estimates even for small samples (Lütkepohl, 2007; p. 94).

>> Table II about here <<

[14] There is no indication of unit roots in any of the series included in the model according to the augmented Dickey-Fuller (1979) test at 99% confidence levels, using Davidson and MacKinnon (1993) critical values.

Table II shows the parameter estimates. The coefficients suggest that entrepreneurship forecasts GDP upswings and unemployment downswings one year in advance. A two-year lag of entrepreneurship seems to predict the next business cycle turnaround.

The model test statistics show that non-normality of the residuals is of no concern. There is some indication of remaining autocorrelation in the error terms. However, plots[15] show that none of the autocorrelations reach significance at any lag length, but some partial autocorrelations at longer lags (L^3 and higher) are significant. Varying the lag length of the VAR model does not change this (instead, the residual autocorrelation seems to become stronger). In addition, the multivariate ARCH test does not raise any concerns about heteroscedasticity either. Alternative methods of detrending the data do not result in models with remaining autocorrelation, although they show similar relationships between entrepreneurship, GDP and unemployment (see Appendix in Koellinger and Thurik 2009). Hence, we conclude that the model in Table II captures the dynamics in the data reasonably well.

Table III reports the result of the corresponding Granger-causality tests (Granger, 1969). Fluctuations in entrepreneurship help to predict GDP with 98% confidence. Hence, we conclude that fluctuations in global trends of entrepreneurship Granger-cause the world business cycle. Furthermore, they predict future unemployment with 98% confidence. However, the reverse is not true. Neither GDP nor unemployment can forecast future entrepreneurship at the aggregate level.

>> Table III about here <<

Based on the estimates from (1), we compute orthogonalized impulse response functions (Sims, 1980) that allow us to investigate the thought experiment of how a random shock in entrepreneurship affects real GDP and unemployment in a later phase, holding everything else constant.

Figure II shows that an unexpected 1% rise in entrepreneurship is followed by a 0.19% rise in real GDP in year *t+1*. This is a considerably strong positive impulse on the world

[15] Available from the authors on request.

economy. The plotted 90% bootstrap confidence interval suggests that the effect is highly significant in the first year after the impulse. In subsequent years, the positive effect of the entrepreneurship shock levels out. Hence, we conclude that global entrepreneurship trends are a leading indicator of the world business cycle and Granger-cause upswings.

>> Figure II about here <<

Similarly, the impulse response function in Figure III shows that an unexpected increase in the global entrepreneurship leads to a decrease in unemployment one year later. The effect is also significant at >90% confidence. Again, the effect of the entrepreneurship shock levels off in later years, as the cycle progresses. Although this pattern is partly a result of the general upswing in economic activity that tends to follow an expansion of entrepreneurial activity, it is equally possible that part of the effect stems from the additional economic activity and the jobs created by new firms.[16]

In summary, these observations suggest that an impulse from global entrepreneurial activity is typically followed by a recovery of the world economy and a decrease in unemployment.

>> Figure III about here <<

B. Country level analysis of entrepreneurship, unemployment and the cycle

We replicate the VAR model of section II.A for every individual country. Consistent with Golpe (2009) and Congregado *et al.* (2009), we find considerable heterogeneity of coefficients across countries. Table IV shows that only 7 out of 22 countries exhibit significant Granger-causality of entrepreneurship on the cycle ($p < 0.10$). It is also noteworthy that the aggregate result (Granger causality Wald test of 0.02, see Table III) is in excess of the value in 21 out of 22 individual countries. We conclude that the aggregate result across

[16] For example, in a study covering the establishment of all private sector firms in Denmark, Malchow-Møller *et al.* (2009) estimate that 8% of total gross job creation in the economy is traceable to entrepreneurial firms.

countries is not driven by a few countries that exhibit a particularly strong relationship between entrepreneurship and the cycle.

>> Table IV about here <<

An obvious way to aggregate coefficients across countries is to use panel estimators. It is noteworthy that detrending the data removes country fixed effects. This is reflected in almost identical results for OLS, fixed effects and Blundell and Bond (1998) system GMM estimations. Unfortunately, there are still several caveats connected to applying these standard techniques in our application.[17] We choose to report fixed effects estimations below because they provide a conservative lower bound for the true coefficients.[18]

>> Table V about here <<

The coefficient of entrepreneurship in *t-1* still has the same sign as in the aggregate VAR model, but it is not significant anymore. Hence, while entrepreneurship Granger-causes the 'world' business cycle, this is not necessarily the case at the national level. Past values of GDP, unemployment and entrepreneurship at the country level (Table V) appear to be less informative about future economic development than at the level of the 'world' economy

[17] The caveats are: First, regressions have to be carried out for every dependent variable of the system separately, ignoring the covariance of error terms between the three equations. Second, panel estimators are developed for situations with "small T and large N." Because our panel has a very small N of 22 and a medium-sized T of 34, the asymptotic results of these estimators do not necessarily carry over to our application. Third, although at least system GMM allows for heteroscedasticity and autocorrelation within countries but not across them, the close economic relationships among many countries in our sample and the ignored interdependence between the three estimated equations make it plausible that some heteroscedasticity and autocorrelation remains in the models. Fourth, Pesaran and Smith (1995) point out that the average effect cannot be consistently estimated in dynamic panels when coefficients vary across countries because incorrectly ignoring coefficient heterogeneity causes serial correlation in the error term. The aggregation we perform above in section II.A circumvents these problems.

[18] If fixed effects would be present in the data, the dynamic panel bias would make simple OLS upward biased and fixed effects regression downward biased, providing upper and lower bounds for the true coefficients (Bond, 2002).

(Table II), possibly due to random policy shocks at the country level that add unexplained variance to the data.

Furthermore, in contrast to the aggregate results in Table II, in which business ownership rates could not be predicted by past values of GDP and unemployment, the picture is different at the level of individual countries. As Table IV shows, unemployment does have a positive effect on future business ownership rates. Intuitively, national labor market conditions influence the opportunity costs of people who consider starting a business (Lucas, 1978; Iyigun and Owen, 1998). While falling unemployment and better labor market opportunities depress new start-up activities, the opposite is true when unemployment rises. In this case, entrepreneurship is often an escape route for people who have lost their jobs to make a living. This effect has been labeled the "supply push" in the literature.[19] Hence, while entrepreneurship seems to fluctuate independently from the business cycle at the aggregate level, it does respond to cyclical labor market conditions at the national level.

C. Robustness check using GEM data

As a robustness check, we examine a second measure of entrepreneurial activity from a different data source, the Global Entrepreneurship Monitor (GEM) survey for the period 2001-2006. Essential in the GEM data collection is the recognition that setting up a business is a process involving various engagement levels (Grilo and Thurik, 2008; van der Zwan *et al.*, 2010). The GEM data also allow for the investigation of different motives and degrees of innovativeness among entrepreneurs.

GEM is currently the largest and most widely recognized cross-country research initiative used to study the prevalence, determinants and consequences of entrepreneurial activity. The core activity of GEM is the annual compilation of data on entrepreneurial activity based on a random sample of at least 2,000 adult-age individuals in each of the participating countries (Reynolds *et al.,* 2005). The GEM survey uses three questions to identify nascent entrepreneurs.

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[19] Oxenfeldt (1943) argued that unemployed individuals or individuals with low prospects for wage employment may become self-employed to earn a living. This effect of unemployment, lowering the opportunity costs of self-employment and driving individuals to start their own businesses, is often referred to as the "supply push" or the "push effect of unemployment". Evidence of this effect has been provided in many studies (Storey & Jones, 1987; Foti & Vivarelli, 1994; Audretsch & Vivarelli, 1996; Thurik *et al.,* 2008; Schaffner, 1993).

"Over the past twelve months, have you done anything to help start a new business, such as looking for equipment or a location, organizing a start-up team, working on a business plan, beginning to save money, or any other activity that would help launch a business?" (yes, no, don't know/refuse)

"Will you personally own all, part, or none of this business?" (all, part, none, don't know/refuse)

"Has the new business paid any salaries, wages, or payments in kind, including your own, for more than three months?" (yes, no, don't know/refuse)

An individual is coded as a nascent entrepreneur if he or she answers "yes" to question 1, "all" or "part" to question 2 and "no" to question 3. Thus, a nascent entrepreneur is defined as someone who, during the 12 months preceding the survey, has done something tangible to start a new firm, expects to own at least part of this new firm, and has not paid wages for more than three months.[20] GEM data on the prevalence of nascent entrepreneurs as a percentage of the adult population are available for all of the 22 OECD countries included in our previous exercise for the time period 2001-2006, with the exception of Luxembourg. However, not all countries participated in GEM every year, and this yields an unbalanced panel structure.

An advantage of using GEM data is that nascent entrepreneurs are categorized by their start-up motives (opportunity vs. necessity) and by the self-evaluated innovativeness of their ventures. Hence, we can examine whether different types of entrepreneurship show different patterns of relation to the business cycle. The differentiation between opportunity and necessity entrepreneurs is available for the entire time period 2001-2006. Each nascent entrepreneur is asked if s/he is involved in the start-up/firm to take advantage of a business opportunity or because s/he has no better choices for work (Reynolds *et al.,* 2005). Below, we consider the share of opportunity- and necessity-bound nascent entrepreneurs, leaving aside those who said they engaged for both reasons or did not know.

In addition, the GEM surveys for 2002-2004 included three follow-up questions related to the innovativeness of the business ideas of individuals who qualify as nascent entrepreneurs. These follow-up questions ask each nascent entrepreneur about the novelty of

[20] GEM uses the information on the duration that wages have been paid to differentiate between nascent, young, and established entrepreneurs.

the technology s/he attempts to use, the novelty of the product or service to his/her potential customers, and the expected degree of competition in the market s/he wishes to enter (Hessels *et al.,* 2008). Hence, these questions can be used to construct a profile of the innovativeness of business ideas pursued by nascent entrepreneurs. We define purely imitative entrepreneurs as nascent entrepreneurs who have neither a product nor a process innovation and expect many business competitors in the market they enter (Koellinger, 2008; Koellinger & Minniti, 2009).

>> Table VI about here <<

Because of the short time frame for which GEM data are available, it does not lend itself to detrending and an autoregressive analysis.[21] Instead, Table V summarizes the bivariate correlations of the lagged variables using panel data instead of aggregated data. Similar to the results in Table II, we find that an increase in nascent entrepreneurial activity is followed by a significant increase in GDP two years later. The strongest positive correlation between nascent entrepreneurship and future GDP is found at *t-2*, while the peak in business ownership is a little later, at *t-1*. This is what one should expect given that the GEM measure captures entrepreneurial activity at an earlier stage, before most ventures start to contribute significantly to the entrepreneur's income. Given that the GEM measure is constructed to measure entrepreneurship consistently across countries and is not just a side-product of official labor market statistics, one would also expect that it is a better dynamic measure of entrepreneurial activity in the Schumpeterian (1934) or Kirznerian (1973) sense than is the more static business ownership rate. Hence, finding strong correlations between the GEM measure and future GDP across countries adds credibility to our previous findings.

Interestingly, a comparison of the coefficients in rows 2 and 3 shows that innovative entrepreneurship has a much stronger positive influence on the economy than does imitative entrepreneurship. Again, this is what we should expect if innovative new businesses exhibit higher growth and better survival chances on average than do imitative start-ups (Henrekson & Johansson, 2010).

[21] The decomposition of GDP in trend and cycle is again computed for the period 1972-2007.

The comparison between the start-up motives (rows 4 and 5) indicates that opportunity entrepreneurship leads the cycle by two years, while necessity entrepreneurship leads the cycle by only one year. A somewhat speculative explanation for the lagging behind of necessity entrepreneurship has to do with the 'legitimation' or 'moral approval' of entrepreneurship within a culture (Etzioni, 1987). In this case, if there is a higher level of 'legitimation' of entrepreneurship, then it will manifest itself widely, resulting in more attention to entrepreneurship within the educational system, higher social status for entrepreneurs, and more tax incentives to encourage business start-ups. Obviously, this results in a higher supply of entrepreneurs. It may be that, here, we observe the cyclical variant of what Etzioni proposed as a cross-section structural cause: the opportunity entrepreneurs pave the way for necessity entrepreneurs.

IV. Discussion

Our results show that global trends in entrepreneurship are an early indicator of the recovery from economic recessions, while entrepreneurship at the national level reacts to unemployment fluctuations instead of causing them. Our discussion focuses on three aspects of these results. First, we discuss the disparity between the results at the aggregate and national levels. Where does it come from? Second, how do our empirical results relate to the theoretical conjectures about entrepreneurship and the cycle? And finally, what are the implications of our finding that entrepreneurship Granger-causes the business cycle, at least at the aggregate level?

A. Differences between the aggregate and national cycles

We see three economic factors that together help to explain the disparity between the aggregate and national levels.[22]

First, not all entrepreneurs are equal in their performance and motivation. This determines their potential impact on the economy. The majority of business start-ups engage in marginal, imitative economic activity (Kirchhoff, 1994; Wennekers & Thurik, 1999; Koellinger, 2008) or fail shortly after their inception (Dunne *et al*., 1988).[23] The potential

[22] We believe these economic factors are ultimately more important than the econometric caveats regarding the country level analyses (see footnote 16).

[23] See Davidsson et al. (2010) for a survey of the small firm growth literature.

impact of these marginal entrepreneurs on the macro economy is likely to be limited. The small share of successful, innovative and high-growth entrepreneurs, however, is likely to make a difference, as the success stories of the Richard Bransons and Steve Jobs' of this world demonstrate. These different types of entrepreneurs are likely to be motivated by different factors. High-potential entrepreneurs react more to the presence of good business opportunities than to a lack of employment alternatives (Bowen and de Clercq, 2008; Hessels *et al*., 2008). Good business opportunities are often related to newly invented technologies, geopolitical developments or changes in commodity prices that are of global importance (Shane, 2003, pp. 22-35). Hence, non-marginal entrepreneurship tends to exhibit global peaks whenever business opportunities of global magnitude arise, such as during the IT boom of the late 1990s. Marginal entrepreneurs, however, are more likely to respond to national labor market conditions because they play marginal roles in existing organizations as well. Hence, the increase in unemployment during recessions (Kydland & Prescott, 1990; Hall, 2005; Elsby *et al.,* 2009) triggers increases in marginal entrepreneurship (Evans and Leighton, 1990; Caliendo and Uhlendorff, 2008; Thurik *et al.,* 2008; Faria *et al.,* 2009 and Faria *et al.,* 2010). In addition, start-up costs for paying qualified labor (Kydland & Prescott, 1990) and borrowing capital (King & Watson, 1996) tend to be lower during recessions. Both factors together contribute to the increase in entrepreneurial activity, in response to recessions, which our results show at the national level.

Second, business cycles across countries are only weakly correlated (see Table I). This is because national business cycles are not only driven by global business conditions but also by unanticipated shocks in government spending, taxes, real estate market bubbles, (de)-regulation, monetary policy and other nationally relevant factors. One reason for country-specific policy shocks is constituted by political business cycles, which can be triggered by non-rational voters in combination with ideological or opportunistic parties. Because voting cycles are asynchronous across countries, politically motivated shocks to the economy will typically be country-specific rather than systematic across countries.[24] Another reason for country-specific shocks may result from poorly informed policy-makers. For example, Leamer (2009) argues that the excessive volatility of US interest rates set by the Fed between 2000 and 2005 contributed to the rise and burst of the US real estate bubble in 2008 and the

[24] Nordhaus *et al.* (1989) provide a comprehensive review of the rich theoretical literature on political business cycles and empirical evidence that speaks strongly against ultra-rational voters who would render political cycles ineffective.

subsequent recession. Leamer argues further that the Fed was targeting the wrong indicator (inflation) during that period and that a monetary policy focused on preventing the excessive building of homes or cars, with preemptive rate increases in the middle of expansions, would help to smooth out the cycle instead of amplifying it. The combined role of such unanticipated fiscal and monetary policy is likely to dominate the effects from mostly marginal entrepreneurial activity at the country level.[25]

National entrepreneurship rates will respond to many country-specific policy shocks, such as national changes in taxation or unemployment benefits. It is reasonable that most entrepreneurs will not be better than consumers at anticipating such policy shocks. Hence, only weakly correlated business cycles across countries in combination with national policy shocks contribute to the almost-zero correlation of entrepreneurial activity across countries, as shown in Table I.

Third, as a consequence of the above, aggregating cyclical fluctuations of GDP, unemployment and entrepreneurship across countries has a dual effect. First, it filters out national policy shocks on GDP and unemployment that are likely to dominate the impulse coming from productive entrepreneurial activity. Second, aggregated cyclical data focus on the subset of entrepreneurs who identify technologies and business opportunities that are globally important. Both effects together are more likely to disclose the "real shocks" that the highly productive part of entrepreneurial activity exerts on the economy in aggregated data rather than in national data.

B. Relation to theoretical literature

Our empirical results help to put the previous theoretical literature on the topic into perspective. Clearly, our data reject the null hypothesis that the share of entrepreneurs in the population is independent of the cycle. In addition, our results modify the hypothesis that the share of entrepreneurs is pro-cyclical (Rampini, 2004). Instead of being strictly pro-cyclical, entrepreneurial activity appears to lead the cycle at the global level. This is an important result rather than a nuance because it has repercussions for the conceptual reasons for the interplay of entrepreneurship and the cycle. While accepting Rampini's (2004) logic, we discuss

[25] A similar effect is known to arise from monetary demand across countries. For example, Arnold (1994) and Arnold and de Vries (2000) point out that the stability of euro-area monetary demand may be due to desynchronized shocks in monetary demand across countries, which are averaged out through the aggregation process.

several assumptions that might be responsible for the discrepancy between his theoretical results and our empirical outcomes.

First, Rampini (2004) assumes a decrease in absolute risk aversion of agents. This assumption drives the conclusion that entrepreneurial activity is pro-cyclical because it implies that higher average wealth among agents, as a result of positive productivity shocks, leads to a higher optimal share of entrepreneurs. However, prospective entrepreneurs might not be primarily concerned about *expected* payoffs in evaluating the attractiveness of different occupational choices. Rather, they might evaluate their current income relative to some reference point, such as average income or their previous income.[26] Agents who have a current income that falls below this reference point, for example, as a result of losing their jobs in a recession, may exhibit risk-seeking behavior.[27] The mechanism leading to pro-cyclical entrepreneurship in Rampini's model would cease to work if a significant share of the population were to exhibit increasing absolute risk aversion or if some agents were risk-seeking during recessions.

Second, Rampini (2004) assumes that entrepreneurs on average make profits that exceed their opportunity costs. This seems to be at odds with empirical evidence. New entrepreneurs have extremely high dropout rates.[28] Such high failure rates have repercussions for the financial attractiveness of entrepreneurship: using US data, Hamilton (2000) shows that staying in a wage job or moving back to it makes more economic sense than does starting a new business, except for the highest 25% of entrepreneurial incomes. Hence, contrary to expectations, entrepreneurship is a career choice that does not pay on average. In addition, entrepreneurial investments of individuals in their own companies exhibit comparatively low returns. Moskovitz and Vissing-Jørgensen (2002) have investigated the risk-return profiles of investments in private enterprises and found them to be inferior to investments in publicly

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[26] The minimum wage level can also be an evaluation point for countries with generous social safety systems. Nooteboom (1985) developed a theory in which retail profit margins are influenced by the minimum wage level. See also Nooteboom and Thurik (1985).

[27] See Kahneman and Tversky (1979), Payne et al.(1981), Wehrung (1989), Tversky and Kahneman (1992) and Tversky and Wakker (1995).

[28] For example, Evans and Leighton (1989) report for the United States that about a third of entrants leaves self-employment within three years. Similarly, Dunne, Roberts and Samuelson (1988)'s study of US Census of Manufacturers' data purports that on average, 61.5% of all firms exit in the first five years following the first census in which they are observed.

traded assets, such as stocks. In essence, empirical evidence suggests that entrepreneurship is not a wise career or investment choice from a purely monetary perspective.

Third, low payoffs to entrepreneurship have been traced to non-financial preferences, such as a taste for independence and for being one's own boss (Blanchflower & Oswald 1998; Blanchflower, 2000; Blanchflower *et al.,* 2001; Benz & Frey, 2008; Block & Koellinger, 2009), a more varied work experience (Astebro & Thompson, 2007), and judgmental errors on the part of entrepreneurs, such as overconfidence and excessive optimism (Cooper *et al.,* 1988; Camerer & Lovallo, 1999; Koellinger *et al.,* 2007). In the absence of strictly financial preferences and optimal decision-making, there is no obvious reason why positive productivity shocks and counter-cyclical agency costs would imply pro-cyclical entrepreneurship. In fact, one might even argue that the tendency of entrepreneurs to be overconfident leads to an information structure that is opposite the classic principal-agent-problem assumed by Bernanke and Gertler (1989), Carlstrom and Fuerst (1997) and Rampini (2004): instead of borrowers being better informed than lenders, it may be that banks are more realistic and more efficient processors of relevant information than are the entrepreneurs seeking financing.[29]

C. Implications

What are the implications of the finding that entrepreneurship Granger-causes the 'world' business cycle? Obviously, the answer to this question depends on whether this empirical pattern is structural.

Entrepreneurial behavior may be a structural cause of economic booms because it can lead to a positive productivity shock during a recession via two mechanisms. First, additional entrepreneurs contribute to aggregate productivity growth by diffusing new technologies and products even if they do not invent them themselves. This can lead to a more efficient use of productive resources in the economy (Schmitz, 1989).

Second, entrepreneurial innovations may lead to aggregate productivity shocks. However, why should it be new firms that innovate more vigorously in response to recessions and not established firms? One explanation is that innovative ventures are more risky and uncertain than are imitative ventures (Koellinger, 2008). According to prospect theory

[29] De Meza and Southey (1996) theoretically demonstrate that this perspective performs better in explaining the stylized facts about entrepreneurship.

(Kahneman & Tversky, 1979), an aversion to high risk and uncertainty is usually observed among individuals that are in a gain position relative to their individual reference points, whereas individuals in a loss position actually seek high risk and uncertainty. Applying this behavioral pattern to business start-up decisions would suggest that innovative business ideas that entail high risk and uncertainty are more likely to be pursued by individuals who have suddenly lower opportunity costs to self-employment than before, for example, as a result of a salary cut or unemployment in a recession (Koellinger, 2008). In other words, the alternative of unemployment can cause people to start businesses premised on rather unusual, innovative ideas. Of course, many of them will ultimately fail, but some will succeed and grow. If the tendency of entrepreneurs to accept higher risks during a recession coincides with the availability of new break-through technologies and new business opportunities, more of these new businesses will survive and grow (Audretsch, 1991; 1995), causing a global spike in business ownership rates that forecasts the next economic boom. The reasoning that people are more willing to accept risks during a recession does not carry over to established firms because agents in established firms typically absorb only a small share of the risk of the venture (Hart, 1995) and because large firms exhibit fewer profit fluctuations because they are more diversified (Mills & Schuman, 1985). In fact, there is empirical evidence that innovative activity measured by R&D spending in established firms is strongly pro-cyclical (Barlevy, 2007).

An alternative reason why new firms innovate during recessions instead of established firms is that established firms face the costs associated with making new production technologies compatible with installed production technologies, while new firms do not have to deal with incompatibilities; they start from scratch. Hence, the arrival of new, incompatible technologies will raise investment in new firms and decrease investment in established firms (Jovanovic & Rousseau, 2009; Yorukoglu, 1998).[30] Such compatibility costs result in the delayed adoption of new technologies in established firms (Jovanovic & Stolyarov, 2000). In addition, Klenow (1998) argues that the profits associated with the adoption of a new technology are highest just before a boom. If, for some reason, new firms are quicker to see the new opportunities, then their adoption decisions should lead the boom.

[30] In the model developed by Jovanovic and Rousseau (2009), the share of entrepreneurs is counter-cyclical if the source of variation is the cost of capital between old and new firms.

The pro-cyclical R&D spending of established firms (Barlevy, 2007) is not necessarily at odds with the hypothesis that there is more entrepreneurial innovation during recessions. The innovative activities of entrepreneurs often remain below the radar of official R&D measurements because they happen to a large extent before a business is incorporated and becomes part of the official statistics. An instructive example is user innovation, i.e., innovation that is first developed and applied by end-users rather than by suppliers (von Hippel, 1986; 1988). Users have commercialized their innovations and became "user entrepreneurs" in a wide range of industries.[31] Often, user entrepreneurship involves the introduction of radically new technology and, in some cases, the creation of entirely new industries (Baldwin *et al.,* 2006; Tripsas, 2008). Frustrated users are often 'accidental' entrepreneurs who stumble across an idea and then share it with others. The innovation happens *before* the formal evaluation of the idea as the basis of a commercial venture; it is not the result of commercial R&D activity and, hence, remains undetected by R&D and patent statistics. Shah and Tripsas (2007) argue that user entrepreneurship is more likely if users have relatively low opportunity costs, as would be the case during recessions. Such mechanisms suggest that in addition to more imitative entrepreneurship being a source of aggregate productivity shocks during recessions, it might also be that more innovative entrepreneurship takes place during recessions. If one were willing to accept a causal interpretation of our empirical findings, it would imply that entrepreneurs exert a portion of the "real shocks" and "innovations" that drive dynamics in real business cycle models.

Alternatively, entrepreneurial activity may not be the structural cause but simply an early indicator of a coming economic boom. For example, entrepreneurs may be quicker in detecting and reacting to new technologies and business opportunities than established firms, for the reasons outlined above. Nevertheless, the economic impulse resulting from their nascent business activities might be too small to cause an economic boom. Instead, larger, more established firms are probably slower to realize and adapt to positive productivity shocks but they might be ultimately responsible for the measurable increase in GDP and the decrease in unemployment. Which of these interpretations is correct is an interesting question for future research.

[31] See Shah and Tripsas (2007) for an overview.

V. Conclusion

Our empirical results of the interplay between the entrepreneurship and the business cycle correspond to the two faces of entrepreneurship. On the one side, entrepreneurs are agents of change and economic development, in a Schumpeterian sense, who anticipate and maybe even trigger economic booms (Baumol, 2002). On the other side, many business owners perform only marginal activities (Kirchhoff, 1994) and only escape to entrepreneurship if no regular jobs are available (Oxenfeldt, 1943). The prevalence of the former effect at the level of the world economy suggests an important and much overlooked function of entrepreneurship in the recovery from recessions.

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Table I – Average correlation of business cycle time series between countries

	GDP	*Unempl*	*Ent*
Average correlation	0.34	0.39	0.06
Note: Based on time series for 22 OECD countries 1972-2007, HP-filtered data ($\lambda = 6.25$)			

Table II – Vector autoregressive model on aggregated data

	Y_1 = *GDP*		Y_2= *Unempl*		Y_3 = *Ent*	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
GDP (t-1)	0.89***	(0.31)	-6.12***	(1.69)	0.10	(0.17)
GDP (t-2)	-0.56	(0.36)	4.62**	(1.98)	0.01	(0.20)
Unempl (t-1)	0.07	(0.06)	-0.19	(0.31)	0.01	(0.03)
Unempl (t-2)	-0.06*	(0.05)	0.30	(0.26)	0.01	(0.03)
Ent (t-1)	0.65**	(0.27)	-3.95**	(1.50)	0.71***	(0.15)
Ent (t-2)	-0.67**	(0.28)	2.96*	(1.56)	-0.54***	(0.16)
Model diagnostics						
Portmanteau (16) test of residual autocorrelation, modified (Ahn 1988)	0.04		LJB test for nonnormality of residuals (Doornik and Hansen 2008)		0.98	
LMF (5) statistic of residual autocorrelation (Edgerton and Shukur 1999)	0.12		MARCHLM (2) (Lütkepohl and Krätzig 2004)		0.57	
Notes: * denotes significance at >90% confidence ** denotes significance at >95% confidence *** denotes significance at >99% confidence HP-filtered data ($\lambda = 6.25$)						

Table III – Granger-Causality Wald Tests on world economy

	Dependent Variable in Regression		
Regressor	*GDP*	*Unempl*	*Ent*
GDP		0.00	0.85
Unemp	0.15		0.89
Ent	0.02	0.02	
Notes: Results were computed from a vector autoregression with two lags over the annual cross-country averages for the 1972-2007 period. Entries show the *p*-values for *Chi2*-tests that lags of the variable in the row labeled **Regressor** do not enter the reduced form equation for the column variable labeled **Dependent Variable**. HP-filtered data ($\lambda = 6.25$).			

Table IV - Granger causality of business ownership on real GDP cycles across countries

Country	Granger causality Wald test
Australia	0.09
Austria	0.07
Belgium	0.07
Canada	0.27
Denmark	0.28
Finland	0.90
France	0.37
Greece	0.38
Iceland	0.62
Ireland	0.07
Italy	0.58
Japan	0.10
Luxembourg	0.15
Netherlands	0.45
New Zealand	0.29
Norway	0.07
Portugal	0.48
Spain	0.07
Sweden	0.87
Switzerland	0.36
United Kingdom	0.71
USA	0.01
Notes: Results were computed from country specific VARs for the period 1972-2007 using HP-filtered data (λ = 6.25).	

Table V - Fixed effects regressions on cross-country panel

	Y_1 = *GDP*		Y_2= *Unempl*		Y_3 = *Ent*	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
GDP (t-1)	0.36**	(0.04)	-2.03**	(0.35)	0.03	(0.05)
GDP(t-2)	-0.26**	(0.04)	0.30	(0.30)	-0.01	(0.05)
Unempl (t-1)	-0.01	(0.00)	0.33**	(0.04)	0.01	(0.01)
Unempl (t-2)	0.01**	(0.00)	-0.25**	(0.03)	0.01*	(0.01)
Ent (t-1)	0.04	(0.03)	-0.17	(0.23)	0.07**	(0.04)
Ent (t-2)	0.03	(0.03)	0.06	(0.23)	-0.35**	(0.04)
Notes: All models include time dummies and a constant and including time dummies. OLS and one-step system GMM estimators (with 136 instruments, collapsed) deliver almost identical results. N=22, T=32, observations=726 * denotes significance at 90% confidence ** denotes significance at >95% confidence HP-filtered data (λ = 6.25)						

Table VI - Cyclical time patterns of real GDP with nascent entrepreneurial activity

	Bivariate correlation of real GDP cycle (year *t*) with						
Lags in years	*t-3*	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*
Nascent entrepreneurship	0.12 (N=72)	0.19* (N=92)	0.11 (N=109)	0.03 (N=109)	-0.05 (N=109)	-0.09 (N=109)	-0.13 (N=109)
Innovative nascent entr.	0.06 (N=55)	0.29** (N=55)	0.22 (N=55)	0.00 (N=55)	-0.13 (N=55)	-0.22 (N=55)	-0.07 (N=55)
Imitative nascent entr.	0.00 (N=55)	0.18 (N=55)	0.15 (N=55)	0.10 (N=55)	-0.04 (N=55	-0.19 (N=55)	0.01 (N=55)
Opportunity nascent entr.	0.12 (N=71)	0.20* (N=91)	0.08 (N=108)	0.03 (N=108)	-0.06 (N=108)	-0.09 (N=108)	-0.12 (N=108)
Necessity nascent entr.	-0.03 (N=71)	0.09 (N=91)	0.19** (N=108)	0.14 (N=108)	0.06 (N=108)	-0.01 (N=108)	-0.12 (N=108)

* denotes significance at >90% confidence
** denotes significance at >95% confidence
*** denotes significance at >99% confidence
Data for Australia, Belgium, Canada, Denmark, Finland, France, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK and USA.

Figure I - Average deviations of real GDP and business ownership rates from trend in percent across 22 OECD countries, HP-filtered data (λ = 6.25)

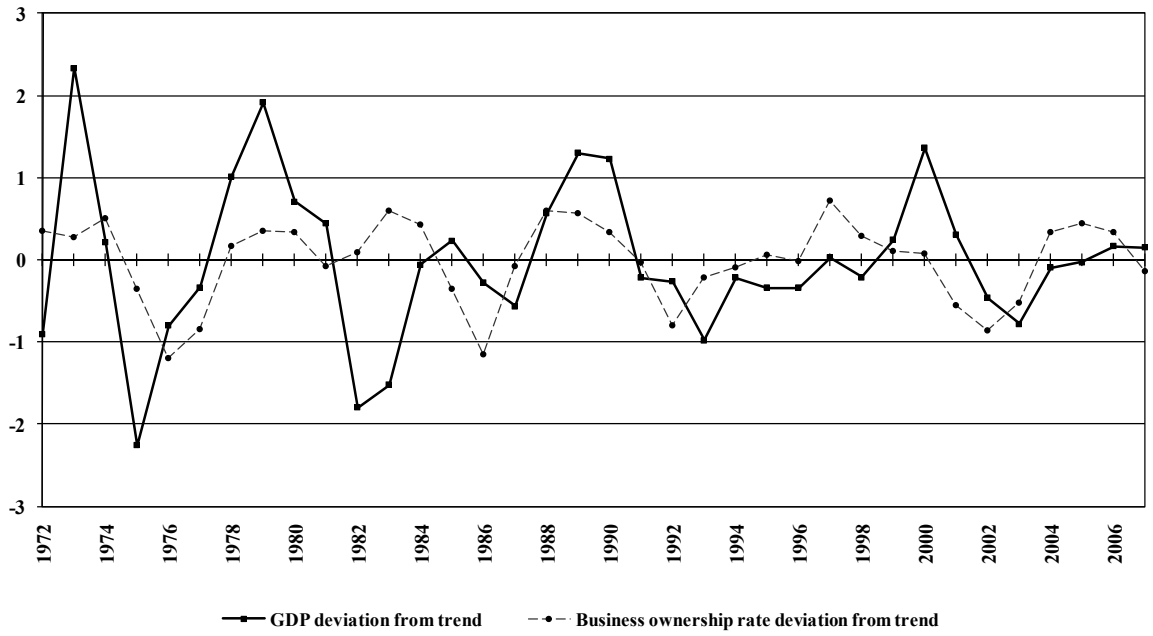
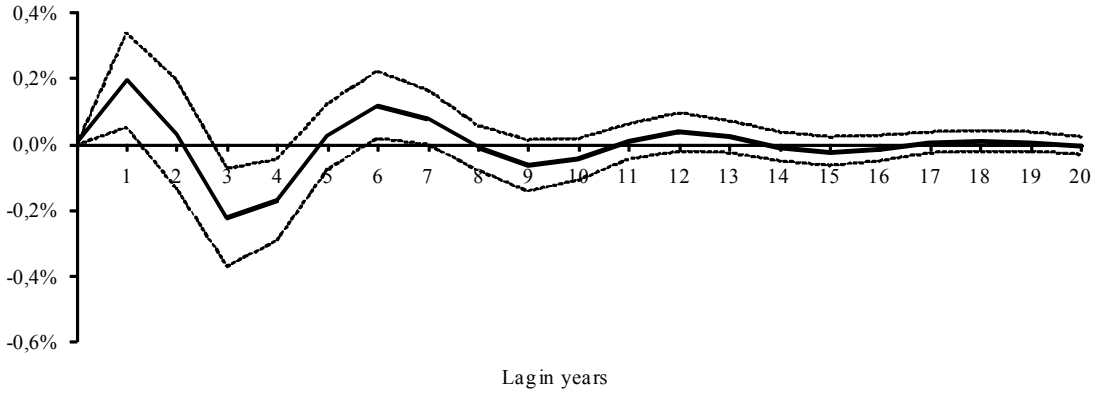
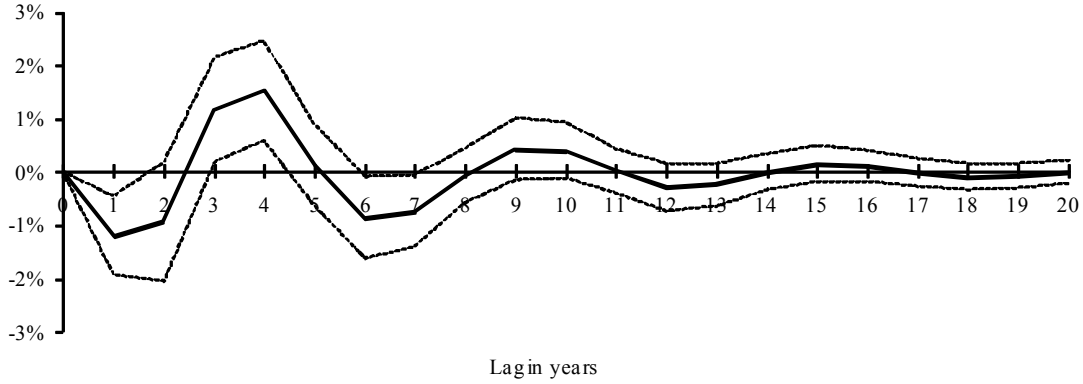


Figure II – Effect of a shock in business ownership (1%) to real GDP, HP-filtered data (λ = 6.25)



Note: Orthogonalized impulse response function in the business-ownership/unemployment/real-GDP VAR(2), with 90% bootstrapped confidence interval

Figure III – Effect of a shock in business ownership (1%) to unemployment, HP-filtered data ($\lambda = 6.25$)



Note: Orthogonalized impulse response function in the business-ownership/unemployment/real-GDP VAR(2), with 90% bootstrapped confidence interval

Appendix

Additional results

We present additional analyses based on differently detrended data below. Table numbers correspond to the table numbers in the text. The subscript (a) denotes that HP-filtered data with an alternative $\lambda = 100$ has been used. The subscript (b) refers to analyses using first differences of growth rates (D1). Aggregation of data across countries was carried out using the average share of the countries' GDP in aggregate GDP over the period 1972-2007, GDP in current prices and current USD to compute the weights. Alternatively, we also used 2007 weights to aggregate data (results not reported here). The method of weighting has hardly any influence on the resulting series and analyses. In addition, unweighted averages were used in an older version of this paper, again, with only marginally different results.[32] These robustness checks show that our main conclusions can be replicated in differently de-trended and differently weighted data.

[32] Available from the authors on request.

Specifications tests for the optimal lag length of the VAR models unanimously suggest a value of two for HP(100) and a value of one for D1 filtered data[33]. We specified the models accordingly.

Table A2a – Vector autoregressive model on world economy, HP-filtered data (λ = 100)

	Y_1 = *GDP*		Y_2 = *Ent*		Y_3 = *Unempl*	
	Coef.	Std. Dev.	Coef.	Std. Dev.	Coef.	Std. Dev.
GDP (t-1)	1.00***	(-0.32)	0.15	(-0.18)	-5.68***	(-1.71)
GDP (t-2)	-1.03***	(-0.34)	0.11	(-0.20)	7.32***	(-1.83)
Unempl (t-1)	0.01	(-0.05)	0.03	(-0.03)	0.23	(-0.29)
Unempl (t-2)	-0.10**	(-0.05)	0.02**	(-0.03)	0.53**	(-0.26)
Ent (t-1)	0.36	(-0.26)	1.15***	(-0.15)	-2.82**	(-1.38)
Ent (t-2)	-0.67***	(-0.25)	-0.53***	(-0.14)	3.19**	(-1.35)

Model diagnostics

Portmanteau (16) test of residual autocorrelation, modified (Ahn 1988)	0.41	LJB test for nonnormality of residuals (Doornik and Hansen 2008)	0.71
LMF (5) statistic of residual autocorrelation (Edgerton and Shukur 1999)	0.79	MARCHLM (2) (Lütkepohl and Krätzig 2004)	0.47

Notes:
* denotes significance at >90% confidence
** denotes significance at >95% confidence
*** denotes significance at >99% confidence

Table A2b – Vector autoregressive model on world economy, first differences of growth rates

	Y_1 = *GDP*		Y_2 = *Ent*		Y_3 = *Unempl*	
	Coef.	Std. Dev.	Coef.	Std. Dev.	Coef.	Std. Dev.
GDP (t-1)	0.39*	(0.20)	0.05	(0.13)	-7.97***	(-1.39)
Unempl (t-1)	0.09***	(0.03)	-0.01	(0.02)	-0.99***	(0.20)
Ent (t-1)	0.75**	(0.30)	-0.03	(0.19)	-3.87*	(-2.06)

Model diagnostics

Portmanteau (16) test of residual autocorrelation, modified (Ahn 1988)	0.28	LJB test for nonnormality of residuals (Doornik and Hansen 2008)	0.77
LMF (5) statistic of residual autocorrelation (Edgerton and Shukur 1999)	0.64	MARCHLM (2) (Lütkepohl and Krätzig 2004)	0.23

Notes:
* denotes significance at >90% confidence
** denotes significance at >95% confidence
*** denotes significance at >99% confidence

[33] We computed the Akaike (1974) information criterion, the Hannan-Quinn (1979) criterion and the Schwarz (1978) criterion for $1 < p_{max} < 7$.

Tables A2a and A2b show that entrepreneurship is an early indicator of the business cycle. The first year lag of entrepreneurship in the model with HP($\lambda = 100$)-filtered data is not significant, but the second year lag is. The model using first differences of growth rates strongly confirms that entrepreneurship is an early indicator of the cycle. Both models show no signs of a specification problem in the test statistics. In particular, there is no indication of remaining autocorrelation in the error terms. Both models also confirm that entrepreneurship at the aggregate level is not influenced by GDP or unemployment.

The Granger causality tests in Tables A3a and A3b strongly confirm these conclusions.

Table A3a – Granger-Causality Wald Tests on world economy, HP-filtered data ($\lambda = 100$)

	Dependent Variable in Regression		
Regressor	*GDP*	*Ent*	*Unempl*
GDP		0.50	0.00
Ent	0.01		0.03
Unempl	0.07	0.31	
Notes: Results were computed from a vector autoregression with two lags and a constant term over the annual cross-country averages for the 1972-2007 period. Entries show the p-values for Chi2-tests that lags of the variable in the row labeled **Regressor** do not enter the reduced form equation for the column variable labeled **Dependent Variable**.			

Table A3b – Granger-Causality Wald Tests on world economy, first differences of growth rates

	Dependent Variable in Regression		
Regressor	*GDP*	*Ent*	*Unempl*
GDP		0.72	0.00
Ent	0.01		0.05
Unempl	0.00	0.75	
Notes: Results were computed from a vector autoregression with two lags and a constant term over the annual cross-country averages for the 1972-2007 period. Entries show the p-values for Chi2-tests that lags of the variable in the row labeled **Regressor** do not enter the reduced form equation for the column variable labeled **Dependent Variable**.			

Tables A4a and A4b confirm that entrepreneurship is a less reliable or unreliable early indicator of the business cycle at the country level. In HP(λ = 100)-filtered data, entrepreneurship Granger-causes GDP only in the US and Denmark, whereas six countries show this relationship in the data that has been de-trended using first differences of growth rates. Both Tables reaffirm that the aggregate level results are not due to a few countries with particularly strong influence of entrepreneurship. This conclusion is supported if the US is excluded from the aggregate level analysis (results available from the authors on request).

Table A4a - Granger causality of business ownership on real GDP cycles across countries, HP-filtered data (λ = 100)

Country	Granger causality Wald test
Australia	0.51
Austria	0.23
Belgium	0.26
Canada	0.13
Denmark	0.09
Finland	0.91
France	0.94
Greece	0.68
Iceland	0.82
Ireland	0.12
Italy	0.37
Japan	0.43
Luxembourg	0.13
Netherlands	0.36
New Zealand	0.73
Norway	0.31
Portugal	0.26
Spain	0.33
Sweden	0.15
Switzerland	0.93
United Kingdom	0.68
USA	0.01
Notes: Results were computed from country specific VARs for the period 1972-2007.	

Table A4b - Granger causality of business ownership on real GDP cycles across countries, first differences of growth rates

Country	Granger causality Wald test
Australia	0.00
Austria	0.06
Belgium	0.98
Canada	0.64
Denmark	0.41
Finland	0.96
France	0.76
Greece	0.99
Iceland	0.06
Ireland	0.08
Italy	0.37
Japan	0.59
Luxembourg	0.49
Netherlands	0.34
New Zealand	0.18
Norway	0.48
Portugal	0.31
Spain	0.08
Sweden	0.96
Switzerland	0.92
United Kingdom	0.52
USA	0.04
Notes: Results were computed from country specific VARs for the period 1972-2007.	

The panel regressions in Tables A5a and A5b, which report average coefficients across countries under the conservative fixed-effects assumption, confirm the conclusion that entrepreneurship at the country level does not predict GDP or unemployment, but is instead positively driven by past increases in unemployment.

Table A5a - Fixed effects regressions on cross-country panel, HP-filtered data (λ = 100)

	Y = GDP		***Y = Unempl***		***Y = Ent***	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
GDP (t-1)	0.81**	(0.04)	-3.28**	(0.33)	0.02	(0.05)
GDP(t-2)	-0.33**	(0.04)	1.69**	(0.31)	-0.05	(0.05)
Unempl (t-1)	-0.00	(0.00)	0.45**	(0.03)	0.01**	(0.04)
Unempl (t-2)	-0.00	(0.00)	-0.05**	(0.02)	0.00	(0.00)
Ent (t-1)	0.00	(0.03)	-0.22	(0.23)	0.58**	(0.04)
Ent (t-2)	0.01	(0.03)	-0.25	(0.23)	-0.20**	(0.04)
Notes: All models include time dummies and a constant and including time dummies. OLS and system GMM estimators (with 136 instruments, collapsed) deliver almost identical results. N=22, T=32, observations=726 * denotes significance at 90% confidence ** denotes significance at >95% confidence						

Table A5b - Fixed effects regressions on cross-country panel, first differences of growth rates

	Y = GDP		***Y = Unempl***		***Y = Ent***	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
GDP (t-1)	-0.40**	(0.04)	-3.23**	(0.52)	0.04	(0.06)
GDP(t-2)	-0.26**	(0.04)	-1.33**	(0.51)	0.05	(0.05)
Unempl (t-1)	-0.00	(0.00)	-0.58**	(0.04)	0.00	(0.00)
Unempl (t-2)	-0.00	(0.00)	-0.36**	(0.03)	0.01**	(0.00)
Ent (t-1)	0.03	(0.03)	-0.45	(0.35)	-0.58**	(0.04)
Ent (t-2)	0.04	(0.03)	-0.11	(0.34)	-0.39**	(0.04)
Notes: All models include time dummies and a constant and including time dummies. OLS and system GMM estimators (with 136 instruments, collapsed) deliver almost identical results. N=22, T=32, observations=726 * denotes significance at 90% confidence ** denotes significance at >95% confidence						

A comparison of Figures 1, A1a and A1b shows that the detrending method influences the cyclical pattern that is extracted from the raw data. HP(λ = 100)-filtered data (Figure A1a) emphasizes the longer-term cyclical peaks and troughs, while the first differences of growth rates (Figure A1b) emphasizes short-term fluctuations compared to the reference of HP(λ = 6.25)-filtered data (Figure 1 in the text). The spectra of the extracted series also look markedly different for the three detrending methods. In particular, HP(λ = 100)-filtered data almost entirely filters out low frequencies and forces a common spectral shape on self-employment, GDP and unemployment, whereas first differences of growth rates emphasizes low frequencies and maintain a high degree of heterogeneity among the spectra of the three variables.

Although the detrending procedure has a large influence on the resulting time-series, the main results of our analyses are replicated.

Figure A1a - Average deviations of real GDP and business ownership rates from trend in percent across 22 OECD countries, HP-filtered data (λ = 100)

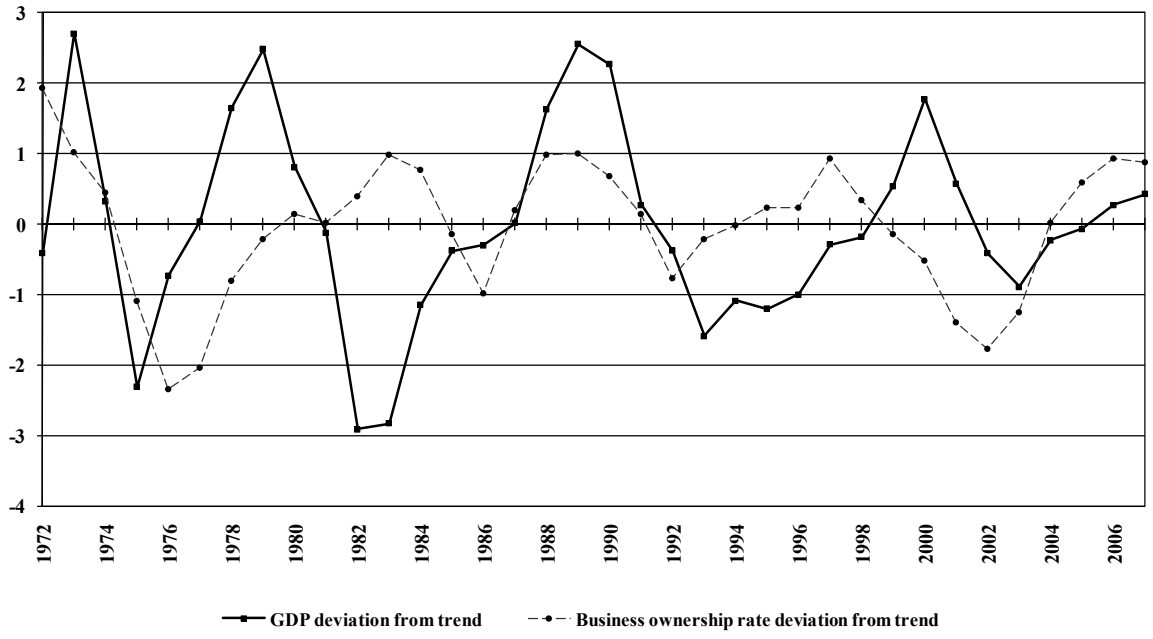


Figure A1b - Average deviations of real GDP and business ownership rates from trend in percent across 22 OECD countries, first differences of growth rates