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ENTREPRENEURSHIP AND THE BUSINESS CYCLE

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Abstract: We found a new empirical regularity about the business cycle in a cross-country panel of 22 OECD countries for the period 1972-2007: Entrepreneurship is a leading indicator of the cycle in a Granger causality sense. This concept contradicts existing theoretical hypotheses that predict that entrepreneurship is pro-cyclical or not cyclical. We discuss possible causes and implications of this finding.

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ENTREPRENEURSHIP AND THE BUSINESS CYCLE

1 Introduction

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

We explore the empirical relationship between entrepreneurship 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 this kind. We contrast our empirical results with the two main theoretical predictions—independence (Bernanke and Gertler 1989, Carlstrom and Fuerst 1997) and pro-cyclicality (Rampini 2004). Our empirical evidence does not support either of these hypotheses. Instead, we find that entrepreneurship, on average across countries, is a leading indicator of the cycle and Granger-caused increases in GDP. This result cannot be replicated on a country by country basis which is not surprising because unanticipated country-specific policy shocks can influence pervasive aggregate variables like inflation and unemployment which will tend to outweigh the relatively local effects of entrepreneurship. Averaging across countries largely eliminates country-specific policy shocks that are unanticipated by entrepreneurs, hence reducing noise and disclosing the real effects that entrepreneurial activity exerts on the (world) economy. Taken together, our results suggest that entrepreneurs play a role in explaining business cycle dynamics, but in a way that is unexpected by existing theories. More specifically, our findings suggest that entrepreneurs play important parts in the recovery from economic recessions.

In the following section, related literature is discussed. Section three deals with the analysis of the co-movement of GDP, unemployment and business ownership using annual

[1] The only other empirical contributions on the topic that we are aware of are the ongoing 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 timeframe. Also, the focus of their analysis is different from ours—e.g., they focus on hysteresis effects and cross-country heterogeneity.

cross-country panel data from the OECD and Compendia 2007.1 for the period 1972-2007; a robustness check using data from the Global Entrepreneurship Monitor for the period 2001-2006; and an analysis of cross-country heterogeneity. In section four, we discuss possible reasons why the empirical evidence deviates from the theoretical predictions, and we suggest an alternative storyline that is consistent with our findings.

2 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, while outside lenders must jointly incur fixed costs to observe these returns. The greater the "collateralizable" net worth of the entrepreneurs' balance sheet, the lower the expected agency costs will be as implied by the optimal financial contract. Since 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. This is reflected by their simplifying assumption that the share of entrepreneurs in the economy is independent of business cycle fluctuations.

In a related spirit, 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 assumes that the share of entrepreneurs in a population is a constant that does not fluctuate with the cycle. Although this is not a theoretical result, it can be viewed as a natural null hypothesis. This is the first hypothesis we will put to an empirical test.

The only theoretical business cycle model we are aware of that examines the share of entrepreneurs endogenously 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. The idea is essentially this. Agents are 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 over employment. However, the share of entrepreneurs is restricted by a financial intermediary that determines the optimal rate of entrepreneurship, knowing 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. Since all agents are wealthier as a result of positive productivity shocks, and since risk aversion is assumed to decrease with wealth, it is optimal to have a higher share of entrepreneurs during economic booms.[2] Furthermore, it is also argued in the spirit of Bernanke and Gertler (1989) and Carlstrom and Fuerst (1997) that agency costs are countercyclical, since 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. This is the second hypothesis that we will empirically test here.

3 Analysis

The present section consists of three parts. The first deals with the analysis of the co-movement of GDP, unemployment and business ownership, using data from 22 OECD countries for the period 1972-2007. Both bilateral correlations and a simple three-variable vector autoregressive model will be presented. The second section is a robustness check of our results using an alternative measure of entrepreneurial activity from the Global Entrepreneurship Monitor (GEM) survey for the period 2001-2006. The GEM data also allow for the investigation of various types of entrepreneurship, differentiating between different motives and degrees of innovativeness among nascent entrepreneurs. The third section consists of an analysis of cross-country heterogeneity meant to examine if the aggregate results are driven by a few outlier countries that exhibit a particularly strong relationship between entrepreneurship and the cycle.

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

3.1 Entrepreneurship, unemployment and the cycle using OECD data

We construct a balanced cross-country panel of 22 OECD countries[3] with annual data for the period 1972-2007 using various sources. OECD data are used to determine annual real GDP, constant 2000 prices and 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[4], using data from *Compendia 2007.1* that corrects for measurement differences across countries and over time.[5] 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 without employees; conversely, the measure excludes unpaid family workers[6]. 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.[7] To address these conceptual shortcomings of business ownership rates as a measure of entrepreneurial activity, in section 3.3, we use data from the Global Entrepreneurship Monitor (GEM) as a second measure for robustness checks (Reynolds *et al.* 2005).

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 and 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

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[3] 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 left out because we are unable to correct for the influence of its unification on the time series.

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

[5] 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.

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

[7] 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.

actual data and to artificial data in numerous studies (see Jaimovich and Siu 2009 and Ravn and Uhlig 2002 for examples). 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. Since 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.

As a first step, we examine average effects by pooling observations across countries. Figure I shows average deviations of real GDP (corrected for inflation) and business ownership rates from their long-term trends. Five cycles are clearly visible. Casual observation of the two cyclical graphs suggests at least two phenomena. First, economic recoveries and boom periods in the last 35 years were typically preceded by rising levels of business ownership. In particular, the long economic upturn in the mid-1990s that culminated in the burst of the high tech bubble in 2000 and the recovery from the recession after 2001 were led by a rise in entrepreneurial activity. In addition, the long recovery from the oil crisis recession from 1975 to 1980 was preceded by an upswing in entrepreneurship, which started to increase in 1975 and reached its cyclical peak in 1978. Second, cyclical entrepreneurship typically reaches its maximum and starts declining just before a cyclical boom in GDP reaches its maximum. The only exception to this trend was the boom of 1990, which happened to coincide with the business cycle. Both observations suggest that entrepreneurship is typically a leading indicator of the business cycle.

>> Figure I about here <<

We further investigate the co-movement and phase shifts between trend deviations of real GDP and the business ownership rate in Table I using bivariate correlations (Burns and Mitchell 1946 and Kydland and Prescott 1990). The degree of co-movement contemporaneous with real GDP is indicated in the *t* column. The statistic in that column is the correlation coefficient of the cyclical deviations from a trend, measured as percentages, between the two time series. A number close to one would indicate that entrepreneurship is highly *pro-cyclical*; a number close to minus one would indicate high *counter-cyclicality*. What we find is a number that is not significantly different from zero. This descriptive evidence counters Rampini's (2004) hypothesis that entrepreneurship is pro-cyclical.

The remaining columns in the table display correlation coefficients between the time series[8] that have been shifted forward and backward by one to three years, indicating whether one series leads or lags behind the other. The business-ownership rate tends to lead the cycle by one to two years, meaning that the business-ownership cycle peaks before the GDP cycle. This is consistent with the evidence presented in Figure I. Although the correlation is not very strong, it is highly significant. In addition, the peak of the business cycle is typically followed by a decline in the business-ownership rate for the three consecutive years. This time pattern of co-movement between the two series counters the assumption that entrepreneurship is independent from the cycle (Bernanke and Gertler 1989, Carlstrom and Fuerst 1997).

A possible reason for the observed decline in entrepreneurial activity following an economic boom is the emergence of better labor market opportunities and, hence, higher opportunity costs of business ownership. Already, Lucas (1978) has shown how rising real wages increase the opportunity cost of self-employment, inducing marginal entrepreneurs to become employees.[9] To explore the relationship between labor market dynamics and business ownership, we included the unemployment cycle in Table I. As expected, unemployment is strongly countercyclical, decreasing at the peak of the cycle and in the following year. This pattern suggests that unemployment and business ownership rates could indeed be related.

>> Table I about here <<

We explore the cyclical co-movement of unemployment and business ownership rates in Table II. The correlation coefficients show that unemployment leads the business-ownership cycle by 1 to 2 years. Hence, increasing levels of unemployment are followed by a rise in business ownership. This effect has been labeled the "supply push" in the literature.[10] Furthermore, and perhaps more importantly, Table II also shows that unemployment figures tend to fall for 1 to 2 years after a surge in business ownership rates. Although this pattern is partly a result of the general upswing in economic activity that tends to follow an expansion

[8] Below we will not repeat that all time series used in this study are detrended.
[9] Also see Schaffner (1993), while Iyigun and Owen (1998), assuming a distribution of risk aversion, argue that with rising economic development and as relatively 'safe' professional earnings rise, fewer individuals are willing to run the risk associated with becoming an entrepreneur.
[10] Oxenfeldt (1943) was one of the first to argue 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 (Gilad and Levine 1986, Storey and Jones 1987, Foti and Vivarelli 1994, Audretsch and Vivarelli 1996, Thurik *et al.* 2008).

of entrepreneurial activity (see Table I), it is also possible that part of the effect stems from the additional economic activity and the jobs created by new entrepreneurial firms.[11]

>> Table II about here <<

The correlation patterns between GDP, unemployment and business ownership suggest co-movement that lends itself to a joint analysis in an autoregressive context. Toward this end, we use the cross-countries averages and estimate a simple three-variable vector auto-regression model with two lags, VAR(2), including deviations from trends in terms of business ownership, real GDP and unemployment (Lütkepohl 1993, Greene 2003).[12] 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

$$(1) \qquad \bar{y}_t = \bar{v} + \bar{\bar{A}}_1 \bar{y}_{t-1} + \bar{\bar{A}}_2 \bar{y}_{t-2} + \bar{u}_t \ ,$$

where

$\bar{y}_t = (y_{1t}, y_{2t}, y_{3t})'$ is a *3 x 1* random vector with
$y_1 =$ business ownership cycle,
$y_2 =$ real GDP cycle, and
$y_3 =$ unemployment cycle,
$\bar{\bar{A}}_1$ and $\bar{\bar{A}}_2$ are fixed *3 x 3* matrices of parameters,
$\bar{v}$ is a *3 x 1* vector of fixed parameters, and
$\bar{u}_t$ is assumed to be white noise; that is

$$E(\bar{u}_t) = 0$$
$$E(\bar{u}_t \bar{u}_t') = \Sigma$$
$$E(\bar{u}_t \bar{u}_s') = 0 \ \forall \ t \neq s$$

Model specification tests show that $\bar{u}_t$ is normally distributed[13] and that the variables are covariance stationary[14]. Wald tests for the lags of the endogenous variables are all significant, implying that none of the lagged coefficients are zero. Langrange-multiplier tests

[11] 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.
[12] Pooling cross-sectional units is possible in this context if one is interested in the average effects present in the sample (Holtz-Eakin *et al.* 1988). We study country-specific effects later by estimating a separate model for every country.
[13] Jarque-Bera, skewness and kurtosis tests are all insignificant.
[14] All of the eigenvalues lie inside the unit circle (see Lütkepohl 1993 for the specification of the test).

for autocorrelation (Johansen 1995) are insignificant for the first lag and significant for the second lag.

Table III reports the result of the corresponding Granger-causality tests (Granger 1969). Fluctuations in entrepreneurship help to predict GDP with 95% confidence. Hence, on average across countries, we conclude that entrepreneurship Granger causes the business cycle. Furthermore, fluctuations in entrepreneurship can be predicted by GDP and unemployment with 99% confidence. In other words, entrepreneurial activity is itself influenced by labor market opportunities and business cycle dynamics. Hence, entrepreneurship is far from independent of business cycle dynamics. Instead, entrepreneurs respond to changes in business conditions and labor market opportunities, providing a positive impulse for economies to recover from recessions.

>> 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 the business ownership rate is followed by a 0.08% rise in real GDP in year *t+1* and by a 0.18% rise in *t+2*. The plotted 90% confidence interval suggests that the effect is highly significant in the second year after the impulse. In subsequent years, the effect of the positive entrepreneurship shock levels out. Hence, we conclude that entrepreneurship is not pro-cyclical. Instead, it is a leading indicator of the business cycle and Granger-caused upswings.

To illustrate the strength of the effect, consider the following numerical example. The average business ownership rate in our sample across countries for the year 2007 is 13.4%. Assume that this rate does not change until 2008, when the economy slides into a recession of -3% below its long-term growth path. In this scenario, an unexpected increase in the business ownership rate in 2009 to 15.7% of the total labor force across countries (i.e., an increase of 17% above the percentage for 2008) would be sufficient to ensure recovery from the recession within two years.

>> Figure II about here <<

Similarly, the impulse response function in Figure III shows that an unexpected increase in the business ownership rate leads to a decrease in unemployment 2 to 3 years later. The effect is weakly significant.

These observations point to an important function of entrepreneurship, particularly in times of economic recessions: an impulse toward entrepreneurial activity is typically followed by economic recovery and a decrease in unemployment.

>> Figure III about here <<

3.2 Entrepreneurship and the cycle 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). 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 empirical 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:

"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 has, during the 12 months preceding the survey, done something tangible to start a new firm, who expects to own at least part of this new firm, and who has not paid

wages for more than three months.[15] GEM data on the prevalence of nascent entrepreneurs as a percentage of the adult population are available for all of the 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 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 and Minniti 2009). Due to the short time series of GEM data, we do not decompose these time series and restrict our analysis to bivariate correlations with GDP deviations from trends.[16]

Table IV summarizes the bivariate correlations of the lagged variables. Nascent entrepreneurship (row 1) exhibits a pattern similar to the business-ownership rate in Table I: nascent entrepreneurial activity is followed by a significant increase in GDP two years later. Two differences from Table I are noteworthy. First, the strongest positive correlation between

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

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

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 we 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. Second, the correlation coefficients are higher for the GEM measure (although the significance levels are lower due to the much smaller number of observations). Given that the GEM measure was constructed to measure entrepreneurship 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 stronger correlations between the GEM measure and GDP 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. In fact, innovative entrepreneurship has the strongest positive correlation with future GDP of all measures of entrepreneurial activity included in this study. 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 and Johansson 2009).

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.

>> Table IV about here <<

3.3 Country heterogeneity

Up until this point, we have reported results across countries. In addition to the analyses reported above, we repeated the analyses for every individual country. Table V presents the Granger-causality Wald tests of the business-ownership rate on real GDP.

>> Table V about here <<

Table V shows significant heterogeneity in the relationship between the business ownership rate and the business cycle across countries. This is not surprising because entrepreneurs are unlikely to fully anticipate country-specific policy shocks that can influence aggregate variables like inflation and unemployment which will tend to dominate the relatively local effects of start-up activity. Only 5 out of 22 countries exhibit significant Granger-causality of entrepreneurship on the cycle ($p<0.1$). One of these 5 countries, the USA, has an atypical pattern in terms of the impulse-response function: a small positive impulse toward entrepreneurship on GDP in year *t+1* is followed by a significant negative impulse in *t+2*. It is also noteworthy that the aggregate result (Granger causality Wald test of 0.03, see Table III) is "more significant" than the result in 21 out of 22 countries. The only exception is the USA, which happens to be an outlier in terms of the shape of the impulse-response function. Hence, we conclude that the aggregate result across countries is not driven by a few countries that exhibit a particularly strong relationship between entrepreneurship and the cycle.

Consistent with these results, Golpe (2009) and Congregado *et al.* (2009) also find evidence for cross-country heterogeneity by analyzing cyclical patterns of self-employment. Using quarterly data for Spain and the US from 1987-2004, Golpe (2009) finds that self-employment insignificantly leads the cycle in Spain, whereas self-employment exhibits a weakly negative correlation with future GDP in the US in the short run. In addition, he presents evidence for different patterns of co-movement in four out of 12 EU countries using annual data from 1983-2007. Also using quarterly data for Spain and the US from 1987-2004, Congregado *et al.* (2009) find evidence for hysteresis of self-employment in Spain, but not in the US. This implies that economic and/or policy shocks in Spain have a permanent effect on rates of self-employment, whereas no such persistency exists in the US.

Indeed, our result that entrepreneurship Granger-causes the cycle only seems to appear if we aggregate time series across countries, while results at the national level are typically weaker and inconsistent. How can one make sense of this cross-country heterogeneity?

We can think of two different explanations: desynchronized shocks across countries and specification bias.

Country-specific shocks can result from the fact that many country-specific variables influence national business cycles that are unanticipated by entrepreneurs, such as shocks in government spending, taxes, real estate market bubbles, (de)-regulation or monetary policy. Averaging across countries yields a much stronger and clearer picture than does a country-by-country analysis because country-specific policy shocks are averaged out, reducing noise and disclosing the "real shocks" entrepreneurial activity exert on the (world) economy.[17] One of the possible reasons for such country-specific policy shocks is constituted by political business cycles potentially triggered by non-rational voters in combination with ideological or opportunistic parties. Since voting cycles are asynchronous across countries, politically motivated shocks to the economy will typically be country-specific rather than systematic across countries. 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.

Alternatively, country-specific shocks may also result from poorly informed policy-makers who act on different information or policies. 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 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.[18] Such unanticipated or political policy shocks can have strong effects on cyclical dynamics that overshadow the "real" (but smaller) impulses coming from innovations and entrepreneurial activity.

The second reason for the observed inconsistency between the average and country-by-country results is econometric misspecification, which is an issue because either the aggregated or the disaggregated estimations could be inconsistent. Disaggregate estimations are inconsistent if country-by-country equations omit relevant foreign aggregate explanatory

[17] 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.
[18] We suspect that the strong policy shocks exerted by the Fed could be one reason why the US happens to be an outlier in terms of the impulse response function of business ownership in relation to GDP.

variables that are important for a single country (see McKinnon, 1982, who demonstrated this point for national money demand equations, which are influenced by international currency substitution). In our application, country-specific shocks can influence the GDP of other countries because of trade relations. The current crisis is an example of this mechanism: the housing and credit crisis in the US had a direct and unanticipated impact on the GDP of other countries. Hence, shocks to GDP of country *i* have the capacity to influence the GDP of country *j* in the disaggregate estimations of equation (1). This is particularly important for small, open economies and is unlikely to be anticipated by entrepreneurs. Thus, ignoring the correlation of GDP across countries leads to inconsistent results at the country level, whereas employing aggregate data avoids this specification bias.

Alternatively, 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. However, this result hinges on the assumption that error terms are independently distributed across countries, which is not the case if countries are economically integrated or involved in international trade. Hence, we conclude that the inconsistency between disaggregate and aggregate results in our application is likely to result from a specification bias among the disaggregate equations, which ignore the correlation of error terms across countries. The aggregate equation avoids this bias and yields more robust results, which are also consistent with the descriptive evidence in Figure I and Tables I and II.

Our analysis is limited by the fact that a more fine-grained analysis using quarterly data, longer timeframes and the inclusion of non-OECD countries is currently not possible due to a lack of available data. However, we do not see obvious reasons why one would expect to find different results from such an analysis if these data were available. Moreover, it is doubtful whether quarterly data would contribute to the fine-tuning of our models, since the time-span between the germination of the idea of setting up a business and the realization of its setup may vary considerably depending upon many factors, like the level of novelty of the product, the financial means of the founder, her/his determination, specific regulatory obstacles, etc. (Grilo and Thurik, 2008). Since these factors and their influence are expected to vary over time and by country, shorter time-spans will bring about new measurement issues. The same holds for terminating a business. The use of non-OECD countries would be worthwhile because, time and again, the level of economic development has been proven to influence the relationship between entrepreneurship or small firms' share and economic growth (van Stel *et*

al. 2005, Beck *et al.* 2005). This remains a subject for future research to take up when sufficiently long time series of comparable quality become available for non-OECD countries.

4 Discussion

In the present section, we will first discuss why earlier hypotheses about the interplay of entrepreneurship and the cycle should be rejected. Then we will give the outline of a model consistent with our empirical results. This concept is based upon the pro-cyclicality of opportunity costs to entrepreneurship and the mechanisms that may cause entrepreneurs to generate productivity shocks during recessions.

Our empirical results reject the hypotheses that (1) the share of entrepreneurs in the population is independent of the cycle (Bernanke and Gertler, 1989, Carlstrom and Fuerst, 1997) and (2) the share of entrepreneurs is pro-cyclical (Rampini, 2004). The first hypothesis is not an explicit theoretical result but is rather a convenient modeling assumption. Hence, it may not come as a surprise that the empirical data contradict it. Nevertheless, the question remains of why we fail to find the pattern that Rampini's (2004) model suggests.

One potential reason is that Rampini 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 the average income or their previous income.[19] 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 (Kahneman and Tversky 1979, Payne, Laughhunn and Crum 1981, Wehrung 1989, Tversky and Kahneman 1992, Tversky and Wakker 1995). 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.

[19] 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).

A second reason is Rampini's assumption 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. 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. 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 profile of investments in private enterprises and found them to be inferior to investments in publicly 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. What low payoffs of entrepreneurship exist have been traced to non-financial preferences such as a taste for independence and for being one's own boss (Blanchflower and Oswald 1998, Blanchflower 2000, Blanchflower *et al.* 2001, Benz and Frey 2008, Block and Koellinger 2009), a more varied work experience (Asterbro and Thompson, 2007), and judgmental errors on the part of entrepreneurs, such as overconfidence and excessive optimism (Cooper *et al.* 1988, Camerer and 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 countercyclical agency costs would imply procyclical 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. De Meza and Southey (1996) show theoretically that this perspective performs better in explaining the stylized facts about entrepreneurship.

A vision of the business cycle that would be consistent with our empirical results is the following: as in Roessler and Koellinger (2009), agents decide at any point in time whether they will become entrepreneurs or employees. Their expected payoff depends on the quality of the ideas that they have, which may fluctuate over time (i.e. productivity shocks). The opportunity cost to becoming self-employed is given by the best wage offer they receive from another entrepreneur, which also fluctuates over time. While unemployment surges during recessions (Kydland and Prescott 1990, Hall 2005, Elsby *et al.* 2009), the lack of employment alternatives is typically followed by an increase in self-employment. Related evidence for this pattern is presented by Evans and Leighton (1990), Caliendo and Uhlendorff (2008), Faria *et al.* (2008), Thurik *et al.* (2008) and Faria *et al.* (2010). In addition, the prices of production factors, such as qualified labor (Kydland and Prescott 1990) and capital (King and Watson 1996), tend to be lower during recessions. Hence, start-up costs and opportunity costs of entrepreneurship are lower during recessions. Both factors together can rationalize the increase in entrepreneurial activity during recessions that our results show. During booms, productive inputs will be more sought after and the price of capital and labor will increase. Hence, more highly paid jobs will be available to all agents, increasing the opportunity costs of entrepreneurship and hence decreasing self-employment. As consumption increases and productive inputs become more expensive, the economy 'overshoots' its long-term growth potential, inflation rises and the economy eventually slows down. Because of sticky contracts, producers cannot immediately adjust their employment levels and wages. Nevertheless, when they do, wages begin to decrease and unemployment rises. At this point, the opportunity costs of self-employment are lower, leading more agents to start their own businesses. If these new businesses incorporate positive productive shocks, the new wave of start-ups can stimulate the economy and generate additional output and demand, which starts the next cycle.

Entrepreneurial behavior can lead to a positive productivity shock during a recession via two mechanisms. First, additional entrepreneurs can increase aggregate productivity by imitating existing technologies and products, thereby diffusing knowledge, which leads to a more efficient use of productive resources in the economy (Schmitz 1989). More imitative entrepreneurship during recessions could be a simple consequence of higher unemployment and lower wages in cyclical troughs.

Second, it could be entrepreneurial innovations during recessions (i.e., better ideas on the part of agents) that lead to aggregate productivity shocks. Still, why should it be new firms that innovate in recessions and not established firms? One explanation is that innovative

ventures are more risky and uncertain than are imitative ventures. According to prospect theory (Kahneman and 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 "nothing to lose"—for example, as a result of a salary cut or unemployment in a recession. In fact, Koellinger (2008) shows empirical evidence for this pattern. In other words, "hanging is a powerful stimulus to the imagination" (paraphrase of Dr. Johnson found in Baumol 2002, p. 10), and 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. The same reasoning does not fully apply 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 and 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 and Rousseau 2009, Yorukoglu 1998).[20] Such compatibility costs can also result in the delayed adoption of new technologies in established firms (Jovanovic and 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.

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

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

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 (see Shah and Tripsas 2007 for an overview). 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's being a source of aggregate productivity shocks during recession, it could also be that more innovative entrepreneurship takes place during recessions.

Clearly, further research, both empirical and theoretical, is needed to improve our understanding of exactly how and why entrepreneurship leads the cycle. However, 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.[21] Yet, in contrast to the standard assumption that such shocks are exogenous, our results show that the share of entrepreneurs in the population systematically responds to changes in GDP and labor market conditions. Hence, a business cycle with an endogenous share of entrepreneurs in the population that *create* productivity shocks is similar to a 'perpetuum mobile'—it becomes self-perpetuating.

[21] This interpretation is related to a similar concept explaining the structural forces that lead to the creation of knowledge, its diffusion and commercialization, and the role played by entrepreneurship (Audretsch 2007a, Braunerhjelm 2008).

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Table I – Cyclical time patterns of real GDP

	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*
business-ownership rate cycle	-0.01 (N=704)	0.08** (N=748)	0.10*** (N=770)	0.03 (N=792)	-0.06* (N=770)	-0.11*** (N=748)	-0.08** (N=726)
unemployment cycle	0.08** (N=704)	0.18*** (N=748)	-0.03 (N=770)	-0.45*** (N=792)	-0.34*** (N=770)	0.05 (N=748)	0.20*** (N=726)

* denotes significance at >90% confidence
** denotes significance at >95% confidence
*** denotes significance at >99% confidence
Data for 22 OECD countries 1972-2007.

Table II – Cyclical time patterns of business ownership

	Bivariate correlation of business-ownership cycle (year *t*) with						
Lags in years	*t-3*	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*
unemployment cycle	-0.01 (N=704)	0.06* (N=748)	0.07** (N=770)	0.01 (N=792)	-0.08** (N=770)	-0.08** (N=748)	-0.05 (N=726)

* denotes significance at >90% confidence
** denotes significance at >95% confidence
** denotes significance at >95% confidence
Data for 22 OECD countries 1972-2007.

Table III – Granger-Causality Wald Tests

	Dependent Variable in Regression		
Regressor	GDP cycle	Business ownership cycle	Unemployment cycle
GDP cycle	0.01	0.00	0.00
Business ownership cycle	0.03	0.04	0.30
Unemployment cycle	0.17	0.01	0.32

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 IV - 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.

Table V – Heterogeneity across countries in Granger causality of business ownership on real GDP cycles

Country	Granger causality Wald test
Australia	0.12
Austria	0.09
Belgium	0.09
Canada	0.28
Denmark	0.30
Finland	0.43
France	0.38
Greece	0.34
Iceland	0.70
Ireland	0.05
Italy	0.58
Japan	0.12
Luxembourg	0.30
Netherlands	0.86
New Zealand	0.92
Norway	0.05
Portugal	0.83
Spain	0.43
Sweden	0.72
Switzerland	0.73
United Kingdom	0.76
USA	0.01
Notes: Results were computed from VAR(2) in equation (1) for the period 1972-2007.	

Figure I - Average deviations of real GDP and business ownership rates from trend in percent across 22 OECD countries

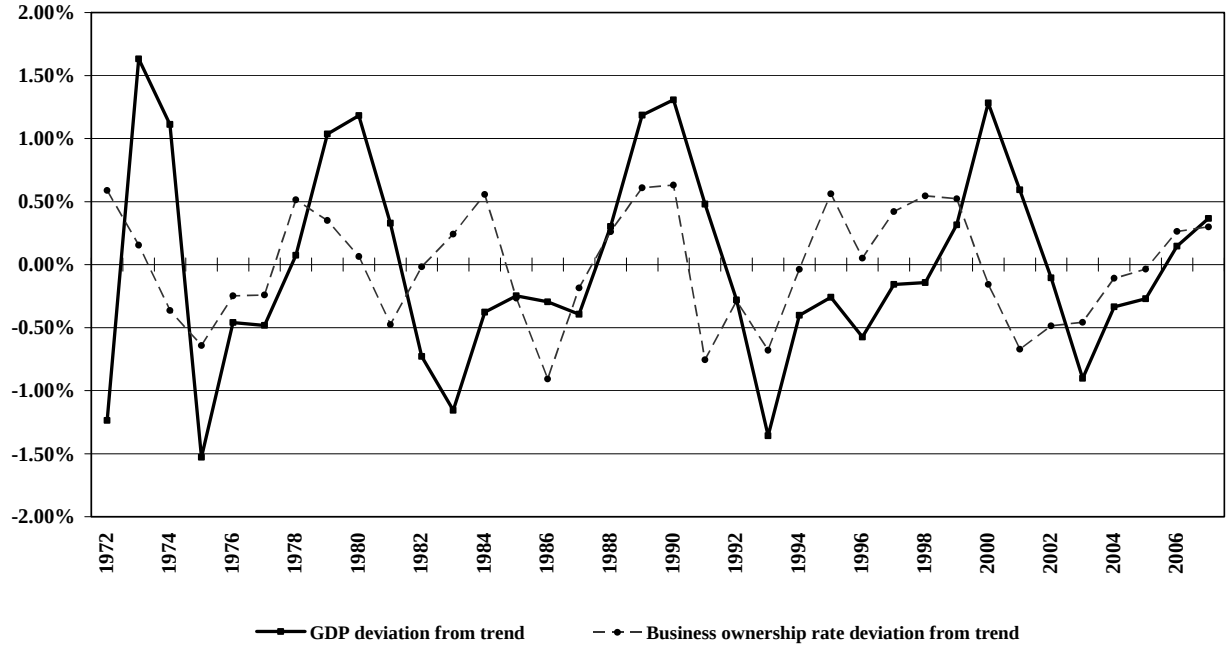
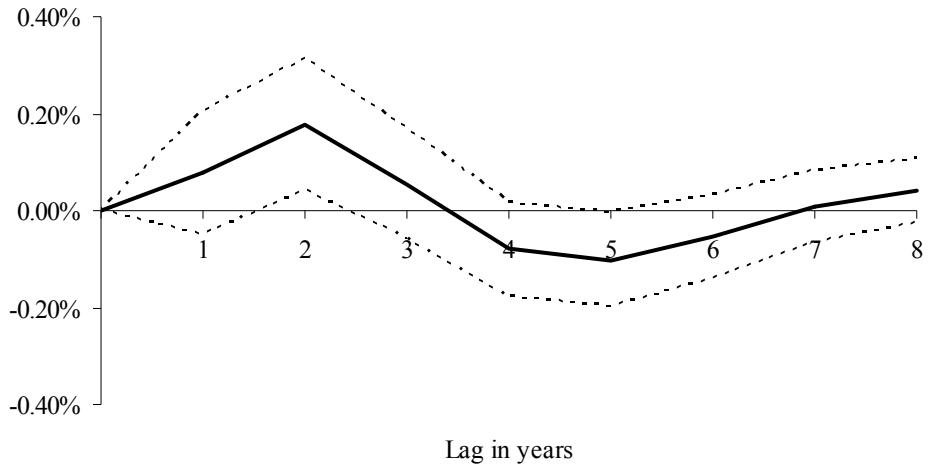
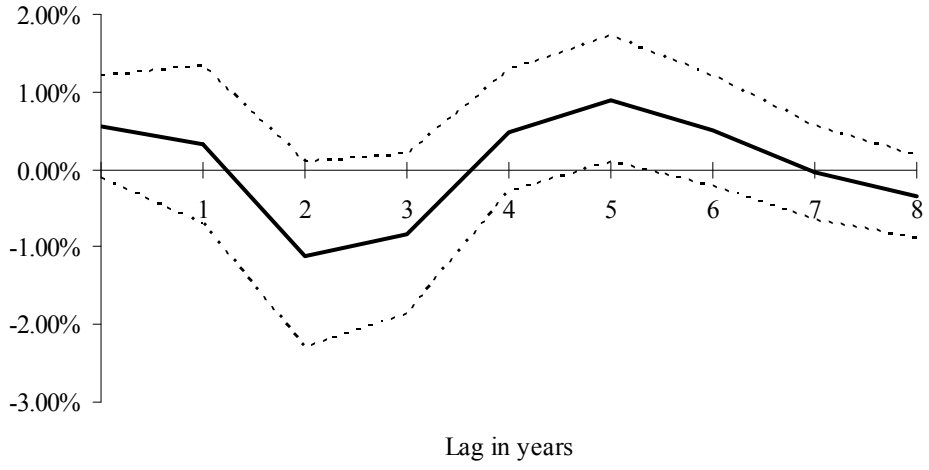


Figure II – Effect of a shock in business ownership to real GDP



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

Figure III – Effect of a shock in business ownership to unemployment



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