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The relationship among entrepreneurial activity, business cycles and economic openness

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Abstract We investigate the interplay among entrepreneurial activity, business cycles and unemployment in relation to economic openness. Additionally, we explore to what extent the observation frequency (quarterly versus annual data) influences the estimation results. Following the empirical literature, we estimate a pooled vector autoregression (VAR) model with fixed effects for the three macroeconomic variables. Using both quarterly and annual data for 19 OECD countries for the period 1998–2007, we observe that over the short term (after one quarter), a country's entrepreneurial activity is stimulated when its business cycle *lags behind* the world business cycle, whereas over the medium term (after 1 to 2 years), entrepreneurial activity is stimulated when its business cycle *leads* the world business cycle. This pattern suggests that a country's business cycle position relative to the world cycle creates different types of entrepreneurial opportunities depending on the time horizon considered. These results apply only to economies that are relatively open, which suggests that economic openness plays a role in generating entrepreneurial opportunities related to a country's cyclical performance.

Keywords Entrepreneurship · Self-employment · Unemployment · Business cycle · World trade · Open economies

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Introduction

The importance of entrepreneurship for modern economies has been studied widely (see Carree and Thurik 2010; Parker 2009, and Van Praag and Versloot 2007 for surveys). When considering the relationships between entrepreneurship and macroeconomic variables, three major macroeconomic concepts can be examined: the level of economic development, the growth of economic development and the business cycle.

Previous research examining the relationship between entrepreneurship and the *level* of economic development suggests that the level of economic development influences the rate of entrepreneurship in a non-linear fashion via intermediate mechanisms, such as sector structure, scale economies and occupational choice (Carree et al. 2002).

Second, there exists a body of literature addressing the relationship between entrepreneurship and the *growth* of economic development. New-firm start-up rates often positively influence a region's economic growth (Audretsch and Keilbach 2004), although this may not be true under all circumstances (Mueller et al. 2008). When static measures of entrepreneurship are analyzed, such as self-employment (business ownership) rates, an optimal rate of entrepreneurship is sometimes observed so that economies may have less or more entrepreneurs than is good for economic growth (Carree et al. 2002; Van Praag and Van Stel 2013; Van Stel et al. 2014). Moreover, previous investigations suggest not only that entrepreneurship causes economic growth but also that economic growth causes entrepreneurship: a two-way relation between entrepreneurship and macroeconomic performance exists (Thurik et al. 2008).[1] Parker (2011) provides a fascinating collection of publications addressing the interplay of entrepreneurship and recessions.

Third, a small body of literature addresses the interplay between entrepreneurship and business cycles (Parker 2012a, b). However, large-scale empirical research is lacking. A notable exception is a study conducted by Koellinger and Thurik (2012).[2] Using annual data for 22 OECD countries over the period 1972–2007, they estimate a vector autoregression (VAR) model that includes unemployment, self-employment and business cycle data and observe that entrepreneurship Granger-causes the cycle of the world economy.[3] The question of whether entrepreneurship is leading or lagging the cycle is also addressed by Parker et al. (2012) using UK data. Lamballais Tessensohn and Thurik (2012) use Global Entrepreneurship Monitor data to examine the interplay between different kinds of nascent entrepreneurship and business cycles for the period 2001–2011 for 21 countries. They find support for the hypothesis that some kinds of entrepreneurship are pre-cyclical. Using Spanish data, Congregado et al. (2012) observe that the magnitude of the so-called recession-push effect (i.e., the positive effect of unemployment on self-employment) is non-linear in the business cycle, i.e., the effect is disproportionately stronger when economic circumstances deteriorate. Faria et al. (2009) present a cyclical model of unemployment and entrepreneurship and determine that the estimated periodicity of the cycles for four OECD countries is between 5 and 10 years.

[1] Country studies based upon this two-way relation include Baptista and Thurik (2007) and Thurik (2003).
[2] A second groundbreaking study in this field is Golpe (2009).
[3] The world cycle in Koellinger and Thurik (2012) is defined as the average cyclical deviation from a long-term trend for the 22 OECD countries included in their study.

This paper focuses on this third, relatively unexplored strand of the literature. In particular, we aim to build on the groundbreaking work by Koellinger and Thurik (2012) who were the first to observe a statistical relationship between the entrepreneurship cycle and the business cycle of the world economy. Their work provides various avenues for future research.

The aim of this paper is to extend the analysis conducted by Koellinger and Thurik in two directions. First, we examine and compare the short- and medium-term interplay among entrepreneurship, business cycles and unemployment using quarterly and annual data for 19 OECD countries over the period 1998–2007. By using data of different observation frequencies, which cover (nearly) the same period, we investigate whether these relations depend on the time horizon. Using annual data, previous studies have found that the relation between entrepreneurship and macroeconomic performance differs over the short, medium and long term (Fritsch and Mueller 2004). However, to the best of our knowledge, this relationship has never been studied using quarterly cross-country data.[4] Second, the relationships among entrepreneurship, business cycles and unemployment may differ depending on the degree of economic openness. For instance, world trade is an important determinant of entrepreneurial opportunities, which in turn may influence national business cycles. These effects are likely stronger in more open economies (Rodrik 1998). Likewise, the impact of the world GDP cycle on an individual country's labor market is likely to be stronger in economies that are more open. To study these effects, we reparametrize the Koellinger and Thurik model to separate the effect of the world cycle from the individual country cycle, which will be expressed relative to the world cycle in this paper.

Hence, the contribution of our paper to the existing body of literature is twofold. First, we investigate the interplay among entrepreneurship, business cycles and unemployment for different time horizons using quarterly and annual data. Second, we investigate the role of economic openness in this interplay. Our analysis therefore allows us to address the following research questions. First, does the interplay among entrepreneurship, business cycles and unemployment differ over the short term versus the medium term? Second, does this interplay depend on the level of economic openness?

This paper is organized as follows. In "Data and variables", we discuss the quarterly and annual datasets used in this paper as well as the variables employed in the empirical analysis. "Model and estimation method" discusses the model and estimation method. "Estimation results" presents the estimation results and "Conclusions" concludes.

Data and variables

We use two datasets in this study. First, we use quarterly data from the *OECD Quarterly National Accounts*, especially the quarterly time series on self-employment, unemployment and GDP from the first quarter of 2000 until the last quarter of 2007.[5] Volume estimates of GDP are expressed in millions of U.S. $ using purchasing power

[4] Some studies analyze quarterly data for particular countries: Spain and the United States (Golpe 2009) and the United Kingdom (Parker et al. 2012).

[5] See the statistics section available at www.oecd.org.

parities for 2000. Quarterly self-employment is measured as the share of self-employed (including unpaid family workers) in the labor force and unemployment as the share of unemployed workers in the labor force.[6] These variables contain structural breaks due to changes in definitions over time. These changes are indicated in the *OECD Quarterly National Accounts* database. We correct for these structural breaks by applying the average growth rates of the periods immediately before and after the structural break, i.e., we interpolate the growth rate of the time series surrounding break years.[7]

Second, we use annual data for these same three variables from Panteia/EIM's Compendia dataset. Corrections for trend breaks as indicated above have also been applied to the Compendia data. Volume estimates for GDP are expressed in millions of U.S. $ using purchasing power parities for 2000. Self-employment (business ownership) in the Compendia includes owner-managers of unincorporated and incorporated enterprises but excludes unpaid family workers and business owners in the agriculture, hunting, forestry and fishing sectors (Van Stel 2005).[8] Unemployment rates are adapted from the *OECD Main Economic Indicators*. The annual data we use cover the period 1998–2007. The quarterly and annual datasets described above apply to different countries. We select countries for which data are available in both datasets.[9]

We decompose the data into trend and cyclical components as in Eq. (1) below. To de-trend the data, a Hodrick-Prescott (HP) filter is applied to each time series for self-employment, unemployment and GDP (Hodrick and Prescott 1997). De-trending through this filter requires the minimization of a function in which a smoothing parameter is specified. For quarterly data, a smoothing parameter, lambda, with a value of 1600 is advised, and we follow this convention. For annual data, we use a parameter value of 6.25, which is the value advised by Ravn and Uhlig (2002) and applied by Koellinger and Thurik (2012). We use the HP-filtered cyclical component $c_{i,t}$ and the trend $\tau_{i,t}$ from (1) to calculate the percent deviation of the cyclical component of Z_t from the trend, expressed as $\overline{Z}_t$ in (2). This percent deviation, which expresses the cyclical component relative to the trend, is used in all subsequent models.

$$Z_{i,t} = c_{i,t} + \tau_{i,t} \tag{1}$$

[6] The raw quarterly self-employment series was computed by subtracting the number of employees from total employment.

[7] For instance, if a trend break occurs in 2003, we use the average of the growth rates 2001–2002 and 2003–2004 to estimate the growth rate for 2002–2003. This growth rate is then applied backward to the level of 2003 (rather than forward) so that the most recent data in OECD Quarterly National Accounts always serve as the benchmark.

[8] Compendia contains harmonized annual data on the number of business owners for 30 OECD countries from 1972 onwards. It is one of the few cross-country data bases on entrepreneurship rates that exist to date, next to the Global Entrepreneurship Monitor and the World Bank Group Entrepreneurship Survey (Marcotte 2013). See http://www.entrepreneurship-sme.eu/ for the data and Van Stel (2005) for the harmonization methods applied to make business ownership rates comparable across countries.

[9] We include the following countries: Austria, Belgium, Denmark, Finland, France, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, the United Kingdom, Norway, the United States, Japan, Canada, Australia and New Zealand.

$$\bar{Z}_{i,t} = \frac{c_{i,t}}{\tau_{i,t}} \cdot 100 \tag{2}$$

Three additional variables are used in this study. The first is the *trading rate* (TR), an indicator of a country's economic openness. It is defined as the goods imported and exported as a share of GDP during the first quarter of 2006 as in (3), which measures the trading intensity relative to GDP (Rodrik 1998).[10] The share of imports and exports of GDP is the most widely used measure of openness (David 2007). Second, we use the world GDP cycle as defined in (4), which is an indicator of the extent to which the world economy moves above or below the trend, i.e., whether the world economy is experiencing an upturn or downturn. The world GDP cycle is measured as the weighted average deviation from the trend (i.e., the weighted average cyclical component) of all 19 countries in the dataset, weighted by their GDP share.[11] The third variable is the country deviation variable for GDP as expressed by Eq. (5), which measures the extent to which a country's GDP cyclical component deviates from the world GDP cyclical component.

$$TR_i = \frac{import_{i,2006Q1} + export_{i,2006Q1}}{GDP_{i,2006Q1}} \tag{3}$$

$$\overline{GDP}_{world,t} = \sum\nolimits_{i=1}^{n} \left(\frac{GDP_{i,t}}{\sum_{i=1}^{n} GDP_{i,t}} \cdot \overline{GDP}_{i,t} \right) \tag{4}$$

$$\overline{Country\ DEV}_{i,t} = \overline{GDP}_{i,t} - \overline{GDP}_{world,t} \tag{5}$$

The role of these three variables in the empirical analysis will be illustrated in "Model and estimation method".

Model and estimation method

Koellinger and Thurik (2012) introduced a model to examine the relationship among self-employment, unemployment and GDP at the national level. Their model incorporates lags for each variable, which makes it possible to detect causality among these endogens (Granger 1969). Following Koellinger and Thurik (2012), we study the relationships among (the cyclical components of) self-employment (E), unemployment (U) and GDP jointly in an autoregressive model. In a standard VAR model, each of the three variables is linearly related to its own lags and the lags of the other variables. However, simply adding the *country deviation* (see Eq. 5) as an exogenous variable could lead to

[10] Seasonally adjusted import and export data are drawn from the OECD Quarterly National Accounts.
[11] For both the quarterly and the annual data, we use Purchasing Power Parities (PPP's) of the year 2000 to express GDP in U.S. $.

multicollinearity because its correlation with GDP is high. Instead, we prefer a reparametrized VAR model that circumvents this problem[12]:

$$Y_{i,t} = \kappa_i + A_1 X_{i,t-1} + A_2 X_{i,t-2} + \ldots + A_p X_{i,t-p} + \varepsilon_{i,t} \tag{6}$$

where

$$Y_{i,t} = \left(\overline{GDP}_{i,t}\ \overline{E}_{i,t}\ \overline{U}_{i,t}\right)' \tag{7}$$

$$X_{i,t} = \left(\overline{GDP}_{world,t}\ \overline{E}_{i,t}\ \overline{U}_{i,t}\ \overline{Country\ DEV}_{i,t}\right)' \tag{8}$$

A_1 and A_2 are 3×4 matrices,

κ_i is a 3×1 vector and

$\varepsilon_{i,t}$ is a 3×1 vector that is assumed to represent white noise, which implies the following:

$$E\left[\varepsilon_{i,t}\right] = 0 \tag{9}$$

$$E\left[\varepsilon_{i,t}\varepsilon_{j,t}'\right] = \Omega \quad \forall\ i,\ j, t \tag{10}$$

$$E\left[\varepsilon_{i,t}\varepsilon_{j,S}'\right] = 0 \quad \forall t \neq s, \forall i, j \tag{11}$$

We emphasize that all variables in the $Y_{i,t}$ vector are percent deviations of the cyclical component from the trend. Because the set of explanatory variables is the same in each of the three sub-equations, estimating this system with Generalized Least Squares (GLS) is equivalent to performing OLS on each sub-equation. The *trading rate* is used to classify the countries into two groups: less open economies (TR<0.2) and more open economies (TR>0.2).[13] For the two groups of countries, each sub-equation requires two OLS estimation procedures, one per group. We estimate the parameters for both the quarterly and annual datasets and report conservative fixed effects panel estimates following Koellinger and Thurik (2012).[14]

Introducing the *trading rate* enables us to explore whether and how these different groups of countries (i.e., less and more open economies) behave differently. The *country deviation* variable enables us to investigate the impact of a country's cycle outperforming the world cycle. By estimating the parameters using both quarterly and annual data, we are able to examine short- and medium- term dynamics as well as the differences between them.

[12] See the Appendix for the proof demonstrating that this is in fact a reparametrization of a standard VAR model.

[13] Using this cut-off value, the number of countries in each group is approximately equal. The group of less open economies includes Canada, the United Kingdom, France, Portugal, Italy, Spain, New Zealand, Australia, Japan, Greece and the United States. The group of more open economies includes Belgium, the Netherlands, Ireland, Denmark, Austria, Norway, Sweden and Finland.

[14] OLS and fixed effects yield nearly identical results. This is unsurprising because detrending removes the country fixed effects (Koellinger and Thurik 2012).

Estimation results

This section provides the results of the model described in Eqs. (6–11). Tests indicate that the appropriate number of lags is two (i.e., $p=2$ in Eq. 6). We present each regression column-wise for the three dependent variables. Moreover, for each dependent variable there are two variants in which countries are grouped according to their trading rate. For the quarterly data, we have data for the period 2000Q1-2007Q4. However, due to the lags in the model, two observations are lost; therefore, for each country, 30 observations are available (2000Q3-2007Q4). The results are presented in Table 1.

Table 1 displays the parameter estimates using quarterly data. The effect of the world cycle on the cycle of individual countries is positive, which suggests that, on average, economies benefit from a growing world economy, at least over the short term (note that we consider lagged effects for one and two quarters). The effect is somewhat larger for more open economies (1.74−0.62 = 1.12 versus 1.42−0.51 = 0.91). With one exception, the results for self-employment and unemployment are not significant. The effects of the country deviation variables point to path-dependency: if a country outperforms the world cycle in a certain quarter, this will have a net positive effect on

Table 1 Fixed effects estimation results using quarterly data (2000Q3-2007Q4)

	$\overline{GDP}_{i,t}$		$\overline{E}_{i,t}$		$\overline{U}_{i,t}$	
	TR<0.2	*TR*>0.2	*TR*<0.2	*TR*>0.2	*TR*<0.2	*TR*>0.2
$\overline{GDP}_{world,t-1}$	1.42***	1.74***	−0.087	−0.22	−3.40***	−2.66***
	(14.69)	(9.77)	(0.23)	(0.36)	(5.70)	(2.79)
$\overline{GDP}_{world,t-2}$	−0.51***	−0.62***	−0.24	0.39	1.94***	−0.18
	(4.63)	(2.95)	(0.56)	(0.54)	(2.84)	(0.16)
$\overline{E}_{i,t-1}$	0.0049	−0.016	0.60***	0.52***	−0.21**	−0.091
	(0.34)	(0.81)	(10.77)	(7.71)	(2.32)	(0.88)
$\overline{E}_{i,t-2}$	0.0046	−0.0060	−0.077	0.0029	0.14	−0.11
	(0.32)	(0.30)	(1.40)	(0.04)	(1.58)	(1.09)
$\overline{U}_{i,t-1}$	−0.0022	−0.030**	−0.081**	0.039	0.90***	0.82***
	(0.24)	(2.38)	(2.26)	(0.89)	(15.82)	(12.28)
$\overline{U}_{i,t-2}$	−0.008	0.011	0.077**	−0.041	−0.091*	−0.04
	(0.95)	(0.92)	(2.24)	(0.98)	(1.66)	(0.60)
$\overline{Country\ DEV}_{i,t-1}$	0.88***	0.39***	0.13	−0.51**	−1.40***	−0.49
	(15.50)	(5.47)	(0.61)	(2.06)	(3.98)	(1.30)
$\overline{Country\ DEV}_{i,t-2}$	−0.25***	0.14**	0.032	0.044	0.94***	−0.50
	(4.48)	(1.97)	(0.15)	(0.18)	(2.71)	(1.32)
R^2_{adj}	0.81	0.76	0.34	0.27	0.85	0.85
N	330	240	330	240	330	240

Fixed effects parameter estimates and corresponding (absolute) t-values in parentheses. One, two or three asterisk(s) denote(s) significance at 90, 95 and 99% confidence levels, respectively. The variables $\overline{GDP}$, $\overline{E}$ and $\overline{U}$ represent the cyclical component relative to the trend of GDP, self-employment, and unemployment, respectively, while *TR* measures the share of import and export of goods in GDP. The variable $\overline{Country\ DEV}$ measures a country's GDP cyclical component in deviation from the world GDP cyclical component. HP-filtered quarterly data (lambda = 1600) originate from *OECD Quarterly National Accounts*. No unit roots found in the system

that country's cyclical component over the next two quarters (0.88−0.25 = 0.63 for less open economies and 0.39+0.14 = 0.53 for more open economies).

The results for the second equation explaining self-employment indicate that a rise (fall) in entrepreneurial activity is followed by a subsequent rise (fall) of this activity one quarter later in both groups of countries (0.60 versus 0.52). This result points to positive path-dependency in self-employment over the short run. For unemployment, although 'push' and 'pull' effects are different in both quarters and between both groups of countries, the net effect of unemployment on self-employment over two quarters approaches zero (−0.081+0.077 = −0.004 versus 0.039−0.041 = −0.002). The *country deviation* variable appears to have a negative effect on self-employment: if a country's GDP cycle is *leading* the world GDP cycle, entrepreneurial activity in that country decreases. Interestingly, this effect occurs only for countries with high trading rates (i.e., more open economies; the effect is −0.51). This finding may be explained as follows.[15] In an open economy that is booming, it is likely that more high-quality paid jobs in exporting sectors will become available and increase the demand for highly qualified employees. This increased demand pushes up wages, which, in turn, will cause marginal entrepreneurs to become wage-employed thereby reducing the number of entrepreneurs in the labor market (Lucas 1978). Interpreting this finding from a different angle, if a country's GDP cycle is *lagging* the world GDP cycle, the number of paid jobs will be lower and more labor market participants will turn to self-employment as their best employment option. Hence, short-term increases in entrepreneurial activity that result from lagging behind the world business cycle may be necessity-based.

The last equation explaining unemployment deviations from the trend indicates that the world GDP cycle has a negative effect on unemployment. A growing world economy contributes to lower unemployment rates. The net negative effect over two quarters is greater for more open economies (−2.66−0.18 = −2.84 versus −3.40+1.94 = −1.46). This is unsurprising because the labor markets of more open economies are likely to be more interconnected with global cyclical developments than are the labor markets of less open economies. We also observe a short-term negative association between self-employment and unemployment (−0.21 versus −0.091; the latter effect is not significant), suggesting that some start-ups immediately hire employees. The results also suggest a certain degree of positive short-term path-dependency for unemployment (0.90 versus 0.82). Finally, a positive country cycle relative to the world cycle seems to lower unemployment over the short term (−1.40 versus −0.49).

Table 2 provides the parameter estimates of the analyses using annual data. Because the lags are different from the lags in Table 1 (years rather than quarters), these results are not necessarily similar to those presented in Table 1. Two results are noteworthy. First, the contribution of a thriving world economy to reducing unemployment is not only large for the subsequent two *quarters* but also for the subsequent two *years* following a strong world cycle. Like the short-term quarterly results, the annual results indicate that this effect is much stronger for more open economies than for less open economies (−5.36 compared to −2.49). Second, when considering annual lags, in more open economies, the effect of a positive

[15] We cannot rule out the possibility that other explanations are also consistent with our results.

Table 2 Fixed effects estimation results using annual data (1998–2007)

	$\overline{GDP}_{i,t}$		$\overline{E}_{i,t}$		$\overline{U}_{i,t}$	
	TR<0.2	*TR*>0.2	*TR*<0.2	*TR*>0.2	*TR*<0.2	*TR*>0.2
$\overline{GDP}_{world,t-1}$	0.22	0.61***	−0.22	0.23	−2.49**	−5.36***
	(1.35)	(3.34)	(0.77)	(0.66)	(2.21)	(3.44)
$\overline{GDP}_{world,t-2}$	−0.49***	−0.35*	−0.33	0.35	1.87*	−1.15
	(3.08)	(1.83)	(1.18)	(0.94)	(1.68)	(0.70)
$\overline{E}_{i,t-1}$	−0.033	0.0098	0.40***	−0.21**	−0.22	−0.81*
	(0.68)	(0.19)	(4.54)	(2.08)	(0.63)	(1.80)
$\overline{E}_{i,t-2}$	−0.037	0.010	−0.43***	−0.36***	0.46	−0.49
	(0.80)	(0.16)	(5.25)	(2.91)	(1.43)	(0.91)
$\overline{U}_{i,t-1}$	−0.042**	−0.037**	0.018	0.011	0.46***	0.48***
	(2.45)	(2.39)	(0.58)	(0.36)	(3.85)	(3.65)
$\overline{U}_{i,t-2}$	−0.0060	0.028**	−0.026	0.094***	−0.37***	−0.50***
	(0.38)	(2.10)	(0.92)	(3.70)	(3.27)	(4.45)
$\overline{Country\ DEV}_{i,t-1}$	0.12	0.13	−0.069	0.70*	−1.02	−2.46
	(0.98)	(0.68)	(0.32)	(1.92)	(1.21)	(1.52)
$\overline{Country\ DEV}_{i,t-2}$	−0.46***	−0.10	−0.19	1.20***	0.72	−0.25
	(3.92)	(0.55)	(0.93)	(3.46)	(0.89)	(0.16)
R^2_{adj}	0.18	0.24	0.25	0.23	0.37	0.51
N	110	80	110	80	110	80

Fixed effects parameter estimates and corresponding (absolute) t-values in parentheses. One, two or three asterisk(s) denote(s) significance at 90, 95 and 99% confidence levels, respectively. The variables $\overline{GDP}$, $\overline{E}$ and $\overline{U}$ represent the cyclical component relative to the trend of GDP, self-employment, and unemployment, respectively, while *TR* measures the share of import and export of goods in GDP. The variable $\overline{Country\ DEV}$ measures a country's GDP cyclical component in deviation from the world GDP cyclical component. HP-filtered annual data (lambda = 6.25) originate from the Compendia dataset. No unit roots found in the system

country cycle (i.e., the *country deviation* variable) on entrepreneurship is positive (effect over 2 years is 0.70+1.20 = 1.90). High demand for products and services in a country likely creates opportunities for new entrepreneurs entering the market with new product/market combinations. This type of entrepreneurship may be more opportunity-based. These results suggest that contact with foreign business partners is important to creating new entrepreneurial activity from a growing economy. This is consistent with export spillover theory, which argues that international trade promotes knowledge spillovers from which new firms are particularly likely to benefit (Aitken et al. 1997; De Clercq et al. 2008). The results also suggest that it takes time (i.e., years not quarters) for this type of entrepreneurship to emerge.

Also indicated in Tables 1 and 2 is that, with some exceptions, the relationship between self-employment and unemployment is relatively weak (in both directions). This pattern can be explained by the short time lags incorporated in the models, i.e., two quarters and 2 years for Tables 1 and 2, respectively. The empirical research generally suggests longer lags for the influence of self-employment on unemployment and vice versa. For both directions of causality, Thurik et al. (2008) observe that the impact is strongest after 8 years (see their Table 3). It takes time before

higher unemployment rates induce a substantial number of individuals to become self-employed. Likewise, it takes time before new firms contribute to unemployment reductions at the macroeconomic level either by employing personnel themselves or by stimulating and challenging incumbent firms to increase their performance (Fritsch and Mueller 2004).

Koellinger and Thurik (2012) use several methods to study the interplay among entrepreneurial activity, business cycles and unemployment. When averaging observations across countries, they observe evidence that entrepreneurship Granger-causes the cycles of the world economy. When estimating their model for each country, they observe considerable heterogeneity of coefficients across countries, which they explain by influences of national policy and country-specific conditions. This study clearly suggests that economic openness is one condition that influences the interplay among entrepreneurial activity, business cycles and unemployment.

Conclusions

The second economic recession of the 21st Century started in 2008 and was deep and persistent. This stimulates novel ways of understanding the mechanics of business cycles. In this paper, we investigate the links among entrepreneurial activity, business cycles and unemployment following the analysis conducted by Koellinger and Thurik (2012). We extend their study – a pooled VAR model with fixed effects for these macroeconomic variables – by exploring the extent to which the observation frequency (quarterly versus annual data) influences the estimation results. We also investigate the extent to which results differ by economic openness. Using both quarterly and annual data for 19 OECD countries over the period 1998–2007, we observe that over the *short term* (after one quarter), a country's entrepreneurial activity is stimulated when its business cycle *lags behind* the world business cycle, whereas over the *medium term* (after 1 to 2 years), entrepreneurial activity is stimulated when its business cycle *leads* the world business cycle. This suggests that a country's business cycle position relative to the world cycle creates different types of entrepreneurial opportunities depending on the time horizon considered. In particular, entrepreneurial opportunities emerging over the short term (medium term) as a result of lagging (leading) the world business cycle may be more necessity-based (opportunity-based) in nature. Because we also observe that these results apply only to relatively open economies, economic openness may play a role in creating entrepreneurial opportunities related to a country's cyclical performance.

Our findings have policy implications for the composition of the labor force in more open economies. In particular, our results suggest that when open economies are growing, the share of self-employed workers in the labor force may decrease in the short term but increase in the medium term. Policy makers may consider compensating for the short-term self-employment drop in more open economies using specific short-term measures, such as temporary fiscal stimuli. As noted above, our paper also produces policy implications for different types of entrepreneurship that may result from recession and boom periods (i.e., necessity-based

versus opportunity-based)[16] and the different time lags with which these different types of entrepreneurship emerge following a recession or growth period. As is often the case in with policy measures, their (expected) outcomes depend largely upon environmental conditions, such as economic openness and phase of the business cycle. Uniform prescriptive measures remain sources of misunderstanding and failure. The results of the present paper require replication to underpin the fine-tuning of policy measures that can be applied throughout the business cycle and depending upon the degree of economic openness.

One limitation of our study is the small set of countries included in our estimation sample. Because we only examine OECD countries, the variation in economic openness is not large. In particular, on a worldwide scale, the countries in our study are all relatively open economies. Still, within this set of relatively open economies, it is interesting to examine differences between more and less open economies. An additional limitation of our study is that both quarterly and annual data were only available for 19 (OECD) countries. Additionally, our data period ends in 2007 so that the impact of the current crisis is not incorporated in the study. Future research should use more recent data for a broader range of countries. Furthermore, because results may differ by sector of economic activity, sectoral distinctions may provide additional insights, especially because some industries are more internationally oriented than others. Moreover, as in any macro-economic model, the possibility of temporal aggregation bias resulting from a difference between the interval of time between decisions of economic agents and the data-sampling interval (in our case quarters and years, respectively), cannot be ruled out (Christiano and Eichenbaum 1987).

Finally, this paper suggests that, depending on the time horizon considered, different types of entrepreneurial opportunities – necessity-based versus opportunity-based – might emerge from a country's relative business cycle position. This classification of types is closely related to Kirznerian versus Schumpeterian entrepreneurship, where the latter relates to innovation-producing entrepreneurial activity and the former emphasizes re-establishing market equilibrium by spotting and exploiting existing business opportunities and possibly adopting innovations developed abroad. The cyclical effect of Kirznerian versus Schumpeterian entrepreneurship is worthy of deeper investigation.

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Appendix

Proof that Eq. (6) is a reparametrization of a standard VAR model

Let the superscript of a matrix denote the operator that returns a submatrix containing the columns mentioned in the superscript, e.g., $X^{s:m}$ is a matrix containing columns s through m of matrix X. Furthermore, let the subscript *diag* denote the operator that

[16] See Lamballais Tessensohn and Thurik (2012).

creates a diagonal and hence symmetric matrix S of size $l \times l$ from a column vector x of length l such that $S_{i,i}=x_i \forall i=1 \ldots l$ and by definition $S_{i,j}=0 \forall i \neq j$. Then, Eq. (6) can be written as a standard $VAR(p)$ model with additional exogenous variables. The model from Eq. (6) can be rewritten as follows:

$$\begin{pmatrix} \overline{GDP}_{i,t} \\ \overline{E}_{i,t} \\ \overline{U}_{i,t} \end{pmatrix} = \kappa_i + A_1 X_{i,t-1} + A_2 X_{i,t-2} + \ldots + A_p X_{i,t-p} + \varepsilon_{i,t}$$

$$= \underbrace{A_1^{2:4} \begin{pmatrix} \overline{GDP}_{i,t-1} \\ \overline{E}_{i,t-1} \\ \overline{U}_{i,t-1} \end{pmatrix} + \ldots + A_p^{2:4} \begin{pmatrix} \overline{GDP}_{i,t-p} \\ \overline{E}_{i,t-p} \\ \overline{U}_{i,t-p} \end{pmatrix} + \varepsilon_{i,t}}_{\text{Standard } VAR(p) \text{ form}} + \underbrace{\left(A_1^1 - A_1^4\right)_{diag} \begin{pmatrix} \overline{GDP}_{world,t-1} \\ \overline{GDP}_{world,t-1} \\ \overline{GDP}_{world,t-1} \end{pmatrix} + \ldots + \left(A_p^1 - A_p^4\right)_{diag} \begin{pmatrix} \overline{GDP}_{world,t-p} \\ \overline{GDP}_{world,t-p} \\ \overline{GDP}_{world,t-p} \end{pmatrix} + \kappa_i}_{\text{Exogenous variables}}$$

The above equation indicates that equation (6) is in fact a reparametrization of a standard $VAR(p)$ model with additional exogenous variables.

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