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Is There a Relationship Between Entrepreneurship and Economic Growth?

The Case of Sweden, 1850-2000

Marcus Box, Xiang Lin and Karl Gratzer

Discussion PAPERS

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The Case of Sweden, 1850-2000[2]

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Abstract

Recent research in entrepreneurship suggests a causal link between entrepreneurial activity and economic growth: variations in entrepreneurship precede variations in economic growth. In particular, a positive effect of entrepreneurship on economic development in advanced, innovation-driven economies in the most recent decades is maintained. Self-employment has been of the most common indicators of entrepreneurship, both in policy and research. The unique feature with the present study is that it uses very long series of non-interrupted data on self-employment (1850-2000). We analyze not only the correlation between growth and variations in self-employment and economic growth in Sweden but also the causal relationship between self-employment and economic growth.

For the entire period (1850-2000), variations in self-employment had a significant, instantaneous positive correlation with GDP growth. However, no causal relationship could be discovered: variations in self-employment did not (Granger) cause GDP growth. Furthermore, we discovered a structural break in GDP growth as early as in the year of 1948, which gives two different periods: 1850-1948 and 1949-2000. Up until 1948, no (Granger) causality between self-employment and GDP in either direction could be established. For the other segment (1949-2000), GDP growth appears to have (Granger) caused self-employment growth, but not the other way around. For the period 1949-2000, but not for the previous period, variations in self-employment lagged with GDP growth. Consequently, GDP growth preceded self-employment growth, but self-employment growth did not precede GDP growth. Given that self-employment is a suitable indicator for entrepreneurship, the empirical results in this study are, in several respects, in disagreement with dominating assumptions in mainstream entrepreneurship research.

Keywords: entrepreneurship; self-employment; economic growth; Granger causality; Sweden

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Introduction

Is there a relationship between entrepreneurship and economic growth? This question has received considerable academic and political attention, and the almost unanimous answer appears to be 'yes'. The dominating paradigm in present-day entrepreneurship research views entrepreneurship as an endogenous component of economic growth, where a positive, causal relationship between entrepreneurial activity and growth is maintained (Audretsch and Thurik 2004, Braunerhjelm et al. 2010). This positive relationship, it is claimed, has been empirically verified across a wide spectrum: from the firm, the industry, the region, to the country (Acs 2006, Thurik and Wennekers 2004).

Within this paradigm, various models have evolved, essentially suggesting two closely related hypotheses. *First*, since the 1960s and 1970s, several developed economies have gone through a structural shift from 'managed' to 'entrepreneurial' economies. In these economies, entrepreneurship may have played a less important role historically. However, nowadays, entrepreneurship is one key factor for economic growth. *The second hypothesis* states that the level of economic development determines the very importance of entrepreneurship for economic growth: in low-income economies, entrepreneurship may have small effects on growth; in advanced, innovation-driven economies, entrepreneurship has a positive effect (Audretsch and Thurik 1997, 2001; Acs and Szerb 2009, Wennekers et al. 2010). In this study, we employ data that stretches over one hundred and fifty years, 1850-2000, and the specific aim is to test these assumptions, using the case of Sweden. In our study, we ask if there is a causal relationship between variations in entrepreneurship and economic growth, and, if so is the case, whether this causal relationship has changed over the course of time. From the mid-nineteenth century and on, Sweden has transformed from an agricultural to an industrialized economy, into an advanced, innovation-driven economy. Therefore, it could be expected *a priori* that Sweden would follow the patterns proposed by recent theory and models.

A substantial number of empirical studies maintain support for this mainstream paradigm, and nearly all of them utilize data on either self-employment or business ownership as indicators of entrepreneurship. In line with them, we employ data on self-employment in Sweden, 1850-2000 (Edvinsson 2005a). Even if self-employment is one of the most commonly used indicators for entrepreneurship, it may not be an ideal or even appropriate one. Yet, the considerable advantage with the data in our study is that it covers a very long period. Furthermore, even if much research claims that entrepreneurship has increased in most developed economies in recent decades (Carree et al. 2007), it is often difficult to determine changes in entrepreneurship over longer periods: most available data on entrepreneurship generally covers, at best, the period from the 1970s and onwards; several previous analyses are often cross-sectional or have consisted of rather short panels. Long series may reveal patterns and relationships that cannot be detected with short observation periods, and they are ideal for testing previous assumptions and theories. Furthermore, even though much empirical research corroborate the assumptions in these mainstream models, a number of individual countries deviate from them (Congregado et al. 2012, Koellinger and Thurik 2012). Finally, an additional advantage with the case of Sweden is that, over the past two hundred years – and as opposed to several other countries – Sweden has not been directly affected by catastrophes, severe civil conflict, wars, or foreign occupation, that otherwise may interrupt or infer statistical series.

Theoretical Background

Since the early eighteenth century, entrepreneurship and entrepreneurs have been perceived as essential driving forces for economic transformation and growth. Entrepreneurship is multidisciplinary, revealing significant contributions from several academic fields. One way of classifying the multitude of economic theories that have evolved is to divide them according to the *function* of entrepreneurship (Henrekson and Stenkula 2007). We can distinguish theories that focus on the entrepreneur as an innovator (Schumpeter 1911), as an arbitrator (Kirzner 1973), and as a risk-taker and decision-maker (Knight 1921). A fourth function is the entrepreneur as a coordinator (Say 1816). More recent theoretical contributions are often variants or analytical refinements of these functions, and several later theorists have chosen a more or less eclectic approach in the attempt to combine the various functions of entrepreneurship. In these theories, diametrically conflicting theories are frequently mixed (e.g., Baumol 1993; Casson 1982; Shane 2003). An eclectic definition represents a blend of the entrepreneurial functions, which Cantillon, Schumpeter, Knight and Kirzner regard as the quintessential features of entrepreneurship. In such definitions, the fact that diametrically opposing and often incompatible perspectives are mixed is seldom discussed. For instance, Schumpeter regarded the entrepreneur as an agent, or as a group of agents that introduced innovations. Schumpeter's entrepreneurs create disequilibria, while Kirzner's entrepreneurs are arbitrators that establish market equilibrium. For Knight, all small business owners are entrepreneurs. In disagreement with Knight, the Schumpeterian entrepreneur is not a risk taker or owner. In his late works, Schumpeter defines the entrepreneur as an economic function, while Kirzner personalizes the entrepreneurs into individuals endowed with the ability to identify opportunities that others cannot. Entrepreneurship in the Kirznerian sense does not require innovation. The definition of entrepreneurship is one of the most difficult and problematical aspects of the theory. The intellectual borrowing of concepts and theories from various schools of thought has been both beneficial and problematic. While it has contributed to improve and advance research, it has also created the potential for a cacophony of concepts, theories and empirical results (Landström and Lohrke 2010).

Parallel to the revival of entrepreneurship as an academic discipline, entrepreneurship is nowadays a significant agenda in economic policy at local, regional, national and international levels with a large number of suggestions for improving the conditions for entrepreneurship (Lundström and Sundin 2008). These aspirations have often been restrained by limited and imprecise information on how entrepreneurship is measured – as well as by imperfect knowledge of the factors affecting entrepreneurship (Ahmad and Hoffman 2008, Lunati et al. 2010). The development of measures of entrepreneurship is a balance between what is theoretically desirable and what is possible in practice. The most common and widespread measurements of entrepreneurship have been stocks and rates measures of the number of self-employed persons, of (new) small and medium enterprises (SMEs), or of individuals' attitudes towards entrepreneurship. There is substantial agreement that this 'mainstream view' only captures certain dimensions of the concept; the continual attention given to the problem in the OECD and the EU, as well as in international projects such as the Global Entrepreneurship Monitor (GEM), bear witness to this constant process.

Research on variations in entrepreneurship – and in self-employment – has received attention from several scholars in the social sciences.[3] Most empirical research in recent decades has used self-employment or business ownership data (or variations thereof) as national or aggregate indicators of entrepreneurship. A substantial body of research has employed data from large projects that have produced harmonized series over entrepreneurship, most notably Compendia (COMParative ENtrepreneurship Data for International Analysis), and the GEM database. These databases are nowadays the dominating sources for international analyses of entrepreneurship.[4] The considerable advantage of such definitions is that entrepreneurship is relatively 'simple' to measure; one disadvantage is that they may not capture transformation, innovation, and renewal among established firms, or do not necessarily represent indicators of a dynamic economy (Congregado et al. 2012). This forces us to consider the validity of definitions, as well as what consequences that choice of theory and definitions may have for conclusions in both policy and research.

The Link Between Entrepreneurship and Economic Growth

The mainstream in contemporary entrepreneurship research assumes a link from the individual level, through the firm, up to the macro level, in which entrepreneurship is viewed as an endogenous component of economic growth (Braunerhjelm et al. 2010). From a discourse perspective, this theory creates the conception that venturing activity is system-changing *per se*, thus carrying transformation capacity in the economy. In that respect, potentially growing and innovative firms are perceived as embedded within the total number of start-ups – therefore, while it is acknowledged that most new firms are not innovative and will not grow and create new jobs, a smaller share of them will. For that reason, if entrepreneurship increases – for instance as the stock of firms increase – so will the number of those firms that are 'entrepreneurial' and that qualitatively contribute to economic change (Wennekers and Thurik 1999; Carree and Thurik 2010). In this mainstream view, the (causal) link between entrepreneurial activity and macroeconomic development is considered as dependent on both time – that is, on 'history' – and on the level of economic development. First, an established hypothesis is that modern capitalist

[3] Economists and sociologists have regularly studied not only the relationship between self-employment and growth, but also the relation between self-employment and unemployment, changes in social security, or taxes (see for instance Blau 1987, Bruce and Mohsin 2006, Fölster 2002, Steinmetz and Wright 1989, Staber and Bögenhold 1993, Stenkula 2012).

[4] Compendia encloses harmonized OECD data on business ownership – both unincorporated (e.g., sole proprietorships) and incorporated businesses (OMIBs) – from the 1970s and onwards (Van Stel 2003). GEM is survey-based and has produced shorter cross-country time series (starting in 1999), essentially producing data on attitudes towards entrepreneurship, nascent entrepreneurship and on Total Entrepreneurial Activity (see Bosma and Levie 2010). It has been noted that the method of harmonizing data can be somewhat simplistic and that it may produce incorrect figures (Bjuggren et al. 2010).

economies shifted from 'managed' to 'entrepreneurial' economies in the 1970s and 1980s (see, in particular, Audretsch and Thurik 1997, 2000, 2001). Major global changes in both supply and demand conditions are identified as causes for this transition (Carree and Thurik 2010).[5] Different from the previous era of the 'managed' economy, entrepreneurship has today become increasingly important for economic growth and renewal. This 'historical' view principally maintains that entrepreneurship has played different roles over time: while entrepreneurship may have varied counter-cyclically to economic growth in the 'managed' post-war economy, it has become an important engine for economic growth during the past three to four decades in countries that have shifted to entrepreneurial economies.[6]

Second, 'stages of economic development'-models represent one closely related hypothesis. These models represent various relationships between entrepreneurship and the level of economic development across countries (e.g., Acs and Szerb 2009, Wennekers et al. 2010), assuming that entrepreneurship varies with the level of economic development. Specifically, within the framework of the GEM-project, an S-shaped model founded in Porter's typology of factor-, efficiency-, and innovation-driven economies has evolved (Acs and Szerb 2009, Bosma et al. 2008). Related lines of thought are found in a U-shaped stage model in which entrepreneurship is high in low-income countries, lower in middle-income countries (where economies of scale increase), and high in advanced economies (Wennekers et al. 2010). Even if the causal directions may be imprecise, this hypothesis proposes a minor or even negative impact of entrepreneurship on economic growth for low-income or newly industrialized economies while there may be positive effects in advanced economies. As countries move from one stage to another, the level of – as well as the nature of – entrepreneurship changes: the positive influence of entrepreneurship on economic development increases in advanced, innovation-driven (Western) economies, that is, in 'entrepreneurial' economies. Here, entrepreneurship is one important driving force for economic growth.

Several studies claim to confirm these hypotheses. Recent research, mostly covering the development from the 1970s and onwards, or even shorter periods, has generally used country panels from Compendia or GEM. Carree et al. (2002, 2007) investigated whether there is a long-term equilibrium relationship between the level of entrepreneurship and the stage of economic development – and whether deviations from an equilibrium rate of business ownership leads to, or 'causes', lower GDP levels. Their cross-country panel analyses showed a U- or L-shaped equilibrium rate: a rate below the equilibrium level impedes economic growth while levels above equilibrium do not seem to lead to lower levels of GDP.

A similar relationship was confirmed by Wennekers et al. (2005). These results therefore indicate that entrepreneurship is a driving force for economic growth in advanced, innovation-driven coun-

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5 For a critical view of the concept of the entrepreneurial economy, see Parker, R. (2001).

6 From a different angle, sociologists have suggested that the observed increase in self-employment from the 1970s in developed economies may be a structural response to declining opportunities for good jobs in the industrial sector rather than, as in earlier times, a cyclical response to unemployment (Steinmetz and Wright 1989; Bögenhold and Staber 1991).

tries. Additionally, Braunerhjelm et al. (2010), studying the causal relationship between self-employment and economic growth in several OECD countries 1981-2002, found that, in contrast to the 1980s, self-employment activities became more important for economic growth from the early 1990s. Parker et al. (2012) draw similar conclusions, finding no straightforward relationship between self-employment and economic change in the UK, 1978-2010. For the entire period, a pro-cyclical relationship was discovered, showing causal relationships running from self-employment to macroeconomic output, but not the other way around. Parker et al. (2012) found structural breaks: in 1978-1993, the causality was running *from* variations in economic output *to* self-employment variations. For the most recent period, 1993-2010, self-employment were both causing and being caused by output. Thus, these two studies corroborate the 'historical' hypothesis of an increasing impact from entrepreneurship on economic growth in the most recent decades.

In line with them, several other empirical studies have generally found that, in the past few decades, changes in entrepreneurial activity affect and anticipate macroeconomic growth, or that they are indicators of business cycle fluctuations (Carree and Thurik 2008, Hartog et al. 2010, Thessensohn and Thurik 2012, Van Stel et al. 2005). Koellinger and Thurik (2012) found that changes in entrepreneurial activity were leading the global business cycle. However, this was not apparent on a country-to-country basis: only a smaller share – seven out of 22 countries – confirmed the assumption that variation in entrepreneurship affects economic change.

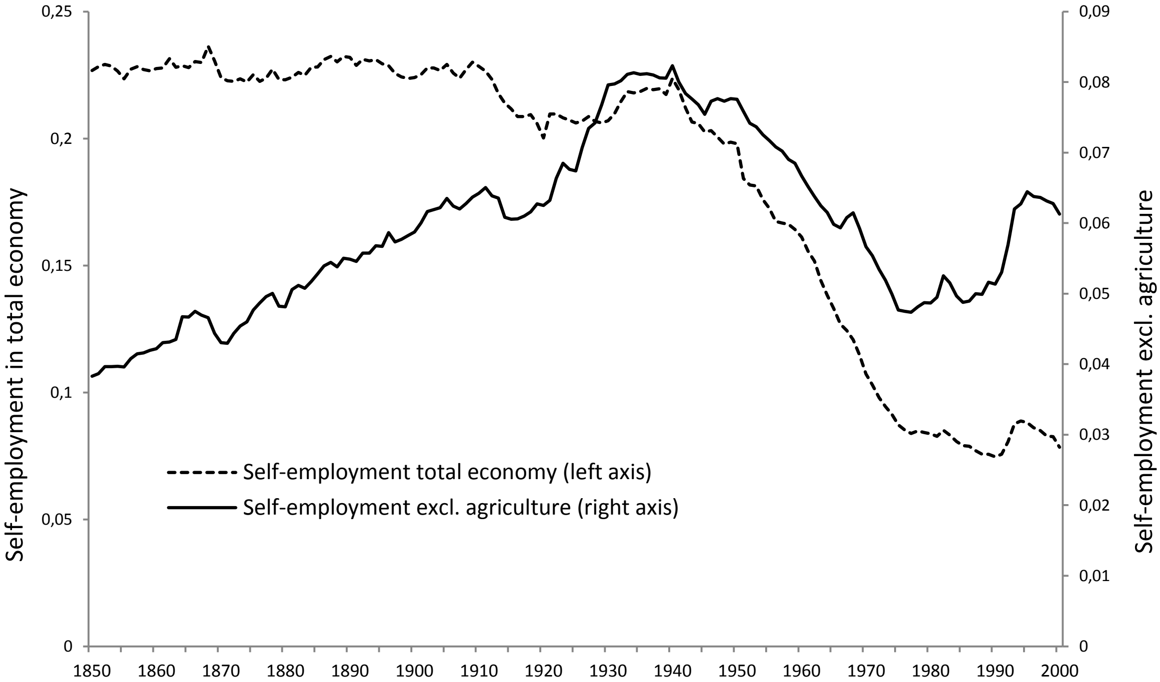
Furthermore, comparing changes in self-employment in the USA and in Spain 1987-2008, Congregado et al. (2012) discovered divergent patterns: for Spain, business cycle output variations significantly affected future rates of entrepreneurship. This could however not be detected for the US. These findings are in line with both cross-country studies and single-country studies that either maintain that periods of macroeconomic instability, slow growth, or high unemployment correspond to rising levels of self-employment (Blanchflower 2000, Lindh and Ohlsson 1998) or that macroeconomic growth affects variation in entrepreneurship (e.g., Shane 1996). In conclusion, past empirical results often find a positive impact, particularly during the most recent decades, from entrepreneurship. However, past results also indicate that several countries may deviate from established models. In particular, analyses over individual countries often reveal inconsistent results that do not correspond to recent cross-country panel studies.

Self-employment in Sweden from 1850 to 2000

In the very long term, it is possible to identify a continuous fall in self-employment in a large number of today's developed economies; this is mainly due to the constantly decreasing share of the agricultural sector from the onset of the industrialization (Wennekers et al. 2010). A sharp decline, followed by a subsequent revival of self-employment, can also be identified for several developed economies from the end of World War II; with some exceptions, self-employment rates generally fell sharply from here. However, the trend was reversed from the 1970/80s and onwards (Blau 1987; Bögenhold and Staber

1991). Data on non-incorporated self-employment in Sweden for the period 1850-2000 (Edvinsson 2005a) shows that the development in Sweden fits quite well with the international picture (Figure 1). The ratio of self-employment (calculated as the number of self-employed individuals in relation to the total workforce) in the entire economy fell abruptly from the 1940s. This was mainly due the sharp decline in self-employment activity in the agricultural sector (*Self-employment total economy*, Figure 1). Non-agricultural self-employment (*Self-employment excl. agriculture*, Figure 1) shows nearly identical patterns, particularly as concerns the most recent decades. From 1850 up to 1940, self-employment doubled in absolute terms. There was a larger fall in the years preceding and during World War I, but a fast increase in the interwar years. Self-employment in the non-agricultural sector grew throughout the entire interwar-period (while self-employment in agriculture fell throughout the entire 1920s). Non-agricultural self-employment peaked in the early 1940s, and fell during World War II. With some variation, it basically continued to diminish during the following three to four decades. This tendency was halted from the latter half of the 1970s, since when self-employment has, on average, grown. In particular, it rose extensively from the 1990s.

Figure 1. Self-employment ratio in Sweden, 1850-2000. Self-employment in the total economy (left axis) and non-agricultural self-employment (right axis).



Source: Edvinsson (2005a).

Although there are indications of a slight reversal from the mid-1990s, it can be established that at the end of the former century, the rate of self-employment was higher than it had been for nearly forty years. What can explain this development? Previous research has observed that variations in self-employment appear to be the inverse of the general macroeconomic development (e.g., Blanchflower 2000; Lindh and Ohlsson 1998); from a visual inspection of Figure 1, this observation seems partially reasonable For instance, the Swedish postwar-period exhibited a very long stage of high macroeconomic growth, a time during which self-employment fell sharply. The years from the early 1970s were characterized by slower economic growth and by crises. The relative take-off in self-employment in the early 1990s also corresponds to the onset of the economic depression. When the economy recovered in the second half of the last decade of the century, self-employment apparently fell again.[7] Furthermore, previous research has also claimed that major (global) changes in several supply and demand conditions have led to an increase in entrepreneurship in most economies during the most recent decades (Carree and Thurik 2010). The development of self-employment in Sweden may, of course, reflect these changes. However, the aim of this study is to test established hypotheses in recent entrepreneurship research that maintain a causal relationship between entrepreneurship and economic growth.

Methodology

In the present study, the time series data on self-employment (SE) and Gross Domestic Product (GDP) for the period 1850 to 2000 is derived from Edvinsson (2005a). In line with past research, non-agricultural self-employment is used throughout the entire analysis. We analyze the relationship between the growth rate of the Gross Domestic Product (GGDP) and the growth rate of self-employment (GSE). Not only will the instantaneous correlation between the two time series of GGDP and GSE be in focus in the analysis; we also aim at making correlations using 'historical', or lagged, data. This methodology will improve the possibility of testing previous assumptions and empirical results on the relationship between variations in entrepreneurship and economic growth. Our study employs a vector autoregressive (VAR) model to implement Granger causality tests. One important factor will be taken into consideration in the analysis, namely the possibility of structural breaks in the relationship between entrepreneurship and economic growth as suggested by previous studies (e.g., Carree and Thurik 2010; Parker et al. 2012). The relationship between the two growth rates series GGDP and GSE could vary according to changes in the economic structure over time. Ignoring structural breaks could lead to misleading conclusions of the relationship between GGDP and GSE, and the first task is therefore to identify possible structural breaks in the time series data.

Structural Breaks

We start with a simple regression model without any lags where the dependent variable is the growth rate of GDP (GGDP) and the independent variable is the growth rate of self-employment (GSE).

$$GGDP_t = \alpha + \beta * GSE_t + u_t \qquad (1)$$

[7] For a description of the Swedish economy, see Schön (2010).

The identified breaks according to (1) are considered later in the VAR model. The parameter stability tests will be carried out for a diagnostics check, testing whether such break(s) is (are) reasonable. In detecting structural breaks, a prior condition is that the time series under investigation should be stationary. This will be done using the Augmented Dickey-Fuller (ADF) unit-root test, based on generalized least squares proposed by Elliott et al. (1996) which offers greater power for non-zero and trended deterministic components for both series of growth rates. We expect both series to be stationary, which is the actual reason why the rates, and not the levels of, GDP and SE are in focus. After estimating (1) based on our full sample period (1851-2000), a standard CUSUM test, a diagnostics test for the stability of parameters, is implemented. Once there is a sign of significant shifts in parameters in (1), the multiple-breakpoints approach, developed by Bai and Perron (2003) to date structural breaks, is employed. The idea is to divide the sample period into several (m+1) corresponding segments. The parameters in the separate segments can then differ. For our investigation, (1) is transferred to

$$GGDP_t = \alpha_i + \beta_i * GSE_t + u_t \qquad (i=1,2,\ldots,m+1) \quad (2)$$

where the subscripts i constitute a segment index which is up to m+1 corresponding to m breaks. The *rss*, residual sum of squares, can be defined as the sum of individual *rss* (i), the *rss* in the ith segment, accordingly:

$$rss\ (i_1,\ldots, i_{m+1}) = \sum_{i=1}^{m+1} rss\ (i) \qquad (3)$$

The date (year) of breaks can then be identified by[8]

$$(i_1,\ldots, i_m) = \mathrm{argmin}_{(i1,\ldots,\, im)} rss\ (i_1,\ldots, i_{m+1}) \qquad (4)$$

Granger Causality Tests

As noted above, the present study does not only focus on the instantaneous correlation between GGDP and GSE, provided in (2), but also on correlations that use historical information – more specifically, how current GGDP and GSE are correlated with past values of GSE and GGDP, respectively. This is precisely the idea of Granger causality (Granger 1969), which tests whether additional historical information, the lags of a variable, would improve the predictive power of another variable. Correlation indicates a co-movement between two variables, but Granger causality relates to the concept of incremental predictive power of one time series in order to predict another time series. A stationary variable (Y)

[8] This dating approach is according to the assumption that the number of breaks, m, is known. Since there exists no prior knowledge of m, we shall first determine the value of m. To determine a reasonable m, we specify different models with different possible m; for instance, we set m = 0, 1, 2, …, M. M will be determined based on the associated model that minimizes BIC.

is said to 'Granger cause' another stationary variable, X, if 'historical' data of the former variable (Y) improves the prediction of X that is beyond the information included in the 'historical' data of X. Granger causality is different from the causality notion in any 'true' sense, but the procedure will provide additional information on the relationship between GGDP and GSE. Granger causality can be tested via a VAR model. Our VAR model is formulated on each segment according to the identified structural break(s):

$$GGDP_t=\alpha_{i1}+\sum_{j=1}^{k}\beta_{ij}GGDP_{t\text{-}j}+\sum_{j=1}^{k}\gamma_{ij}GSE_{t\text{-}j}+u_{GDPt} \qquad (5)$$

$$GSE_t=\alpha_{i2}+\sum_{j=1}^{k}\;{}_{ij}GGDP_{t\text{-}j}+\sum_{j=1}^{k}\;{}_{ij}GSE_{t\text{-}j}+u_{SEt}$$

This system contains total k lags of GGDP and GSE. k is determined according to a general lag selection principle of VAR (the lowest AIC or SIC). The null hypotheses of the non-Granger causality test for GGDP as the target variable are $\sum_{j=1}^{k}\gamma_j=0$, and, for GSE, as the target variable H_0: $\sum_{j=1}^{k}\;{}_j=0$. These hypotheses can be tested by the F-statistics that follows the F-distribution with the degrees of freedom of k and $T\text{-}k$. Note that the Granger causality tests are implemented in each segment according to the identified structural break(s). Since the identification is based on an instantaneous relationship, (1), diagnostics tests for the stability of the parameter, the CUSUM tests, for each equation in each segment according to (5) will be implemented.

Granger Causality in the Frequency Domain

The Granger causality in the time domain, discussed above, relates to the notion of incremental predictive power with 'historical' information of one time series to predict another time series. However, this procedure cannot handle causality at different frequencies, for instance causality at the typical business cycle frequency, the long-run causality at a low frequency, or the short-run causality at a high frequency, etc. Therefore, while Granger causality is a measure for the entire relationship between two time series, Granger causality in the frequency domain makes it possible to establish whether predictive power is concentrated at quickly or slowly fluctuating components. In essence, Granger causality is calculated for each individual frequency component separately, meaning that for each frequency, the power as well as the direction of the Granger causality can differ. Granger (1969), Geweke (1982) and Hosoya (1991) develop a method for Granger causality tests in the frequency domain. Breitung and Candelon (2006) largely simplify the testing procedure and we adopt their methodology in our study. We demonstrate the testing hypotheses based on the bivariate VAR model of GGDP and GSE (5). According to Breitung and Candelon (2006), the null of no causality of GGDP by GSE can be tested by the linear restrictions

$$\gamma_1\cos(\omega)+\gamma_2\cos(2\omega)+\cdots+\gamma_k\cos(k\omega)=0 \qquad (6)$$

$$\gamma_1\sin(\omega)+\gamma_2\sin(2\omega)+\cdots+\gamma_k\sin(k\omega)=0$$

where ω is frequency in (0,π). k is the number of lags, which can be determined according to AIC or BIC. It should be noted that in order to capture the feature associated with Granger causality in the frequency domain, k needs to be at least 3. Similarly, the null of no causality of GSE by GGDP can be tested by the linear restrictions

$$\theta_1 \cos(\omega) + \theta_2 \cos(2\omega) + \cdots + \theta_k \cos(k\omega) = 0 \qquad (7)$$
$$\theta_1 \sin(\omega) + \theta_2 \sin(2\omega) + \cdots + \theta_k \sin(k\omega) = 0.$$ [9]

Is There a Causal Link Between Entrepreneurship and Economic Growth?

Here, we analyze the causal relationship between self-employment growth (GSE) and GDP growth (GGDP) in Sweden from 1850 to 2000, calculated from the levels of corresponding variables in Edvinsson (2005a). The two growth rates series are plotted in Figure 2.

Unit-root Tests

The results of the unit-root test, the generalized-least-squared ADF, are reported in Table 1. The nulls of non-stationarity cannot be rejected for the levels of self-employment (SE) and GDP, respectively, but the nulls for the growth rates, GSE and GGDP, can be rejected. We conclude that both GDP and SE are *I*(1) processes.

Table 1. Unit-root test.

	N of lags	*tau*	*p-value*
GSE	2	-4.99654	7.599e-007
GGDP	3	-3.21379	0.00128
SE	9†	-2.11255	0.5382
GDP	10†	-0.23212	0.9924

The numbers of lags are optimally determined, given the maximum lags of 4 for the growth rates and 12 for the levels, respectively. †: the time trend is included.

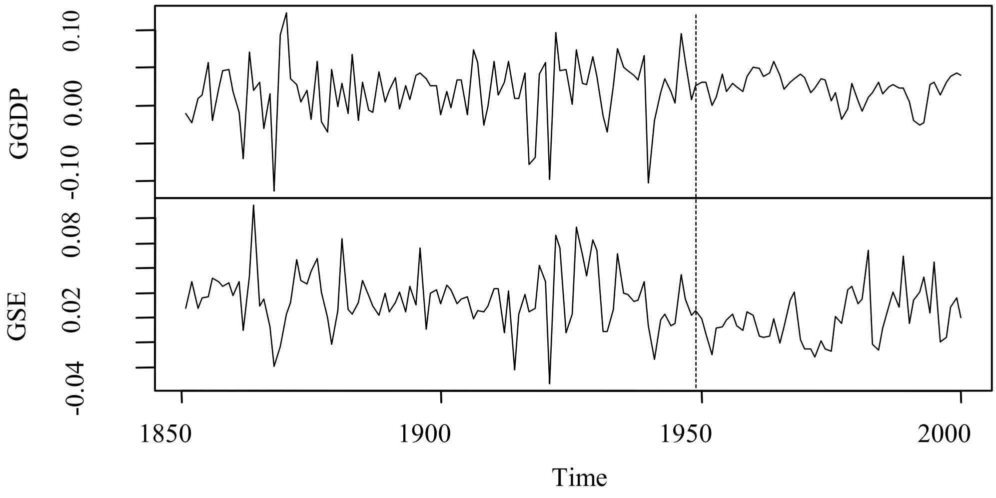
Structural Breaks and the Relationship Between GSE and GGDP

In order to identify structural breaks, we estimate (1) for the whole sample period, 1851-2000, by implementing OLS. The result is reported in the first column of Table 2. Both α and β are significant and the positive slope β=0.3886 indicates that a 0.39 percentage point increase in

[9] Breitung and Candelon (2006) further point out that the Wald testing statistics of (6) and (7) approximately follow the F-distribution, with degrees of freedom of 2 and T-2k. The non-Granger causality can be rejected if the estimated statistic is larger than the critical value. In order to establish an overview of the frequency ω in (0,π), the whole set of the Wald statistics with various ω in (0,π) as well as the critical value at 5% significant level are plotted. The non-Granger causality hypothesis can be rejected if the Wald statistics curve lies above the critical value.

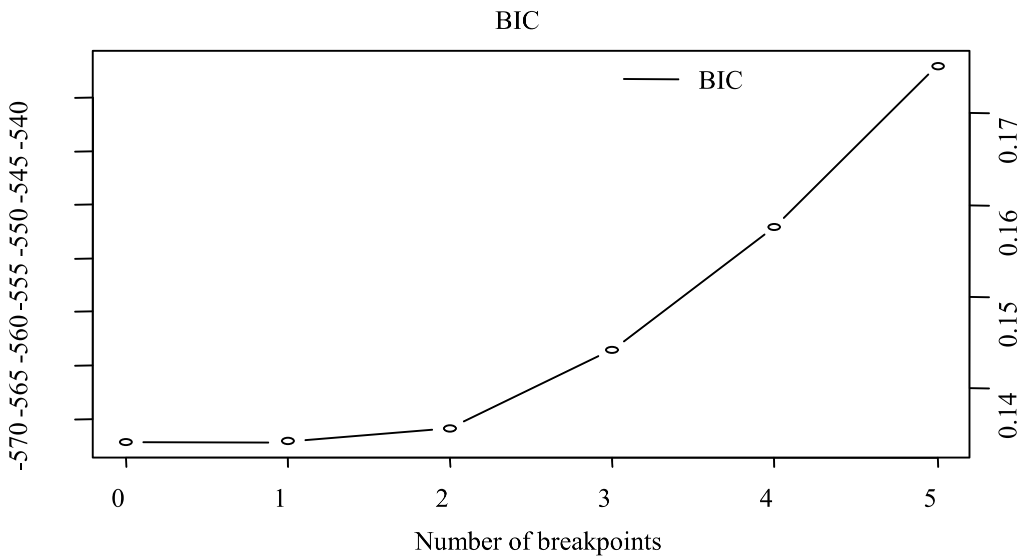
GDP is associated with a 1 percentage point positive growth rate in self-employment. However, and crucial, the parameters are not stable according to the CUSUM test. Then, we assume that the number of breaks could be 0, 1, 2, 3, 4, and 5. The associated BICs are presented in Figure 3. Both 'no break' and 'one break' minimize the BIC. Since the above analysis is based on 'no break' and fails to pass the CUSUM test, we accept one break point, m=1. The date (year) of the break is determined by the approach by minimizing the RSSs developed in Bai and Perron (2003). The year of 1948 is identified in the empirical data as the date (year) of the break, and a dashed vertical line indicating this year is added in Figure 2. As can be observed in the figure, the pattern of GGDP clearly changes from 1949, indicating a smoother, less volatile pattern as compared to the period 1851-1948.

Figure 2. Growth of self-employment (GSE) and GDP (GGDP).g



Note: the vertical dashed line indicates the time point of the break (1948).

Figure 3. BIC and number of breaks.



Note: the lowest point of the BIC curve corresponds to 1 break.

By taking this structural break into consideration, the model (1) is extended by including two dummy variables, D1 and D2, corresponding to two segments (1851-1948, 1949-2000), and by replacing GSE in (1) by D1*GSE and D2*GSE to capture differences in slopes.

$$GGDP_t = \alpha_1 * D1 + \alpha_2 * D2 + \beta_1 * (D1 * GSE_t) + \beta_2 * (D2 * GSE_t) + u_t \qquad (8)$$

The result is reported in the last two columns of Table 2. First of all, it can be observed that the model (8) now passes the CUSUM test, thus indicating stable parameters. In comparison with the single segment model (1), (8) fits the data much better which is indicated by an increased R-squared (0.07 and 0.16, respectively) and by the highly significant *F*-statistics. It can be further noted that the problem of heteroskedasticity has not been improved and, for that reason, robust standard errors are used. More importantly, several significant changes in the parameters can be identified in the extended model. The intercept in the period 1851-1948 is insignificant, while the slope is highly significant. This indicates a significant and instantaneous correlation between GSE and GGDP.

Table 2. Regression results: Growth of GDP as dependent variable. Different segments.

	1851-2000	*1851- 1948*		*1949-2000*
Intercept	0.0161***	0.0076		0.2249***
	(0.0036)†	(0.0051)†		(0.0036)†
Growth of SE	0.3886***	0.7099***		-0.2060
	(0.1510)†	(0.1782)†		(0.1321)†
R^2	0.07		0.16	
F	6.6193**		28.498***	
	(0.011)		(1.45e-14)	
$X^2_{SC}(4)$	0.3948		1.0793	
	(0.812)		(0.898)	
X^2_H	9.7428***		42.828***	
	(0. 0018)		(0.000)	
X^2_{FF}	2.1205		1.246	
	(0.1237)		(0.291)	
CUSUM	2.5680** (0.0112)		1.03757	
			(0.3012)	

The standard errors of coefficients are in parentheses. †: The robust standard error. *** indicates significance at 1%, ** at 5%, and * at 10%. $X^2_{SC}(4)$, X^2_H, and X^2_{FF} indicate the diagnostic tests of Breusch-Godfrey's serial correlation test up to a lag of 4, Breusch-Pagan's heteroskedasticity test and Ramsey's RESET function form test, respectively. P-values are given in parentheses. CUSUM denotes the CUSUM test for the stability of parameters.

However, such a significant correlation disappears in the period of 1949-2000: although the intercept turns out to be significant, the slope in that segment is no longer significant. The significance of the changes is tested and reported in Table 3, showing that changes in coefficients are all significant according to the *F*-statistics for the null hypothesis of $\lambda_i= \lambda$. This result serves as additional evidence of the identified structural break in GDP growth in 1948. This structural break coincides with a long, stable period of economic growth (Schön 2010), as well as with a new, active (Keynesian) economic policy in

Sweden (Jonung 2000; Lundberg 1983). In several instances, the post-war years can be described as a turning point from a fiscal and monetary policy perspective.[10]

Table 3. Stability of parameters across different segments: the case of GDP growth.

	1949-2000	
	Intercept	*Slope*
1851- 1948	5.781**	17.050***
	(0.02)	(6.1e-05)

p-values are given in parentheses. *** indicates significance at 1%, ** at 5%, and * at 10%.

Granger Causality Tests for GSE and GGDP

Since the two series of GGDP and GSE are stationary, a Granger causality test can be implemented in the VAR model (5) and the result is reported in Table 4. The first column presents the result for the whole sample (from 1850 to 2000), while the second and third columns report the results in the two segments (extended model). Particular attention is given to the CUSUM tests (Table 4 and Figure 4). For the equation in which the dependent variable is represented by GGDP, there are no problems for all specifications of segments.

However, for the equation in which GSE is the dependent variable, the model for the whole sample period cannot pass the CUSUM test. Once more, as previously identified, this would indicate the presence of a structural break in the data. On the other hand, the estimates with a structural break (1851-1948; 1949-2000) can pass the CUSUM tests – consequently, the result of Granger causality tests implemented individually in each segment is reliable. Note that the number of observations in each segment becomes rather small – 99 and 52, respectively – and therefore, the bootstrap standard errors are adopted in order to increase the precision. The results are reported in Table 4. Attention is paid to the last two columns representing two segments with the break at 1948, since they are reliable in the sense of no specification errors of unstable parameters. First of all, concerning the Granger causality tests, it turns out that the null of non-causality can only be rejected by GGDP to GSE in the second segment, 1949-2000. This means that GGDP Granger-causes GSE only after 1949 (i.e. 1949-2000) but not in the 1851-1948 period. Hence, GSE is correlated with historical GGDP in the period of 1949-2000, but not 1851-1948. On the other hand, our results also show that GSE does not (Granger)-cause GGDP in either segment. This indicates no correlation between GSE with historical GGDP in the entire sample period (1851-2000).

[10] The immediate post-war years have been described as an economic-political 'system crisis' (Lundberg 1983). Several economists were pessimistic about the post-war development. The Social Democratic government developed an extensive program for various socializations and regulations. These plans were extensively contested and, in the end, abandoned. According to Lundberg (1983), this system crisis in principle ended in 1948.

Table 4. VAR and no causality tests for growth rates.

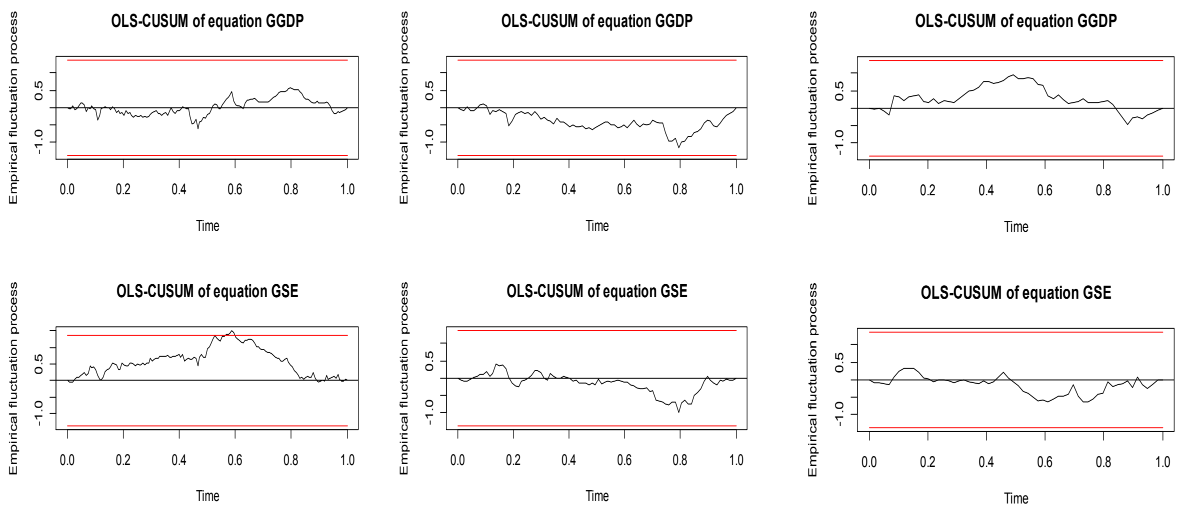
	1851-2000	*1851- 1948*	*1949-2000*
Granger causality	3.1203**	1.5002	1.2103
GSE → GGDP	(0.029)†	(0.207)†	(0.205)†
Granger causality	3.4169*	0.3598	4.356***
GGDP → GSE	(0.086)†	(0.705)†	(0.006)†
Instantaneous	14.1402***	11.5458***	1.7888
	(0.0002)	(0.0007)	(0.1811)
CUSUM equ. GGDP	Stable	Stable	Stable
CUSUM equ. GSE	Not stable	Stable	Stable
$X^2_{SC}(4)$	7.9216	4.0151	6.8857
	(0.4412)	(0.8558)	(0.549)
k ††	2		

†: Bootstrap standard error. ††: The optimal lag for the whole sample is determined by the AIC. $X^2_{SC}(4)$ indicates the diagnostic tests of Breusch-Godfrey's serial correlation test up to a lag of 4. *** indicates significance at 1%, ** at 5%, and * at 10%.

Second, focusing on instantaneous correlations, such an instantaneous correlation between GGDP and GSE can only be identified up until 1948 (i.e., 1851-1948). This instantaneous correlation disappeared after 1949. Intuitively, it can be imagined that both GGDP and GSE are affected by some common economic factors and common shocks. Instantaneous correlation implies that both GGDP and GSE would be affected simultaneously. The correlation therefore provides a picture of the relative magnitudes from common factors and shocks on GGDP and GSE. Consequently, these results are interpreted as, up until 1948, GGDP and GSE are simultaneously affected by common economic factors, such as economic policy, structural change, etc. Granger causality characterizes the significance of correlations between the historical values of one variable and another variable. In this case, GGDP (Granger)-causes GSE after 1949; thus GSE correlates with past GGDP. When using the notion of common factors and shocks in the interpretation of this significant correlation, this would first affect GGDP and take a while to have an impact on GSE. Putting these two correlations together, we can establish the following. In the sample period of 1851 to 1948, there is an instantaneous correlation, but no Granger causality in either direction. Hence. GDP growth and self-employment growth would simultaneously be affected by common factors. In the sample period of 1949-2000, we are able to identify that GGDP (Grange)-causes GSE, but not in the other direction. In this period, there is no instantaneous correlation. This means that GSE is only correlated with historical GGDP.

Figure 4a-c. Stability tests for the growth VAR model.

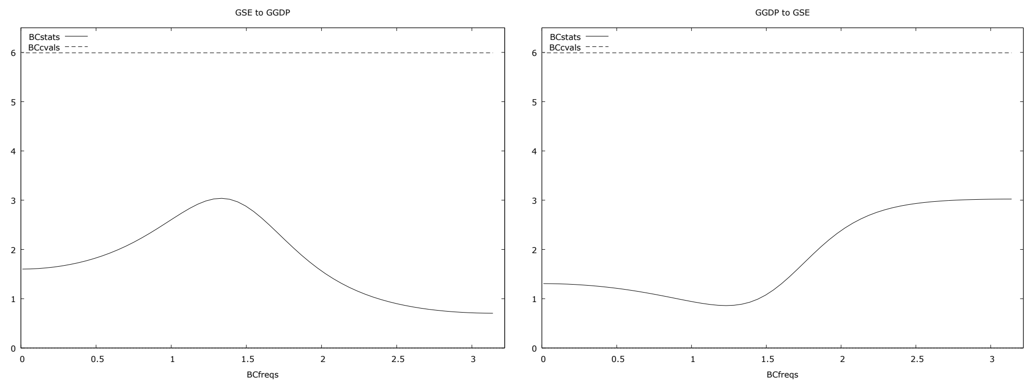
4a. 1851-2000 (whole segment)	4b. 1851-1948 (first segment)	4c. 1949-2000 (second segment)



Note: statistics of the CUSUM tests are plotted with symmetric bands. The statistics being outside of the bands leads to the rejection of the stability of the coefficients. The left-hand panel indicates the whole sample. The middle panel reflects the segment of 1851 to 1948. The right-hand panel shows the segment of 1949 to 2000.

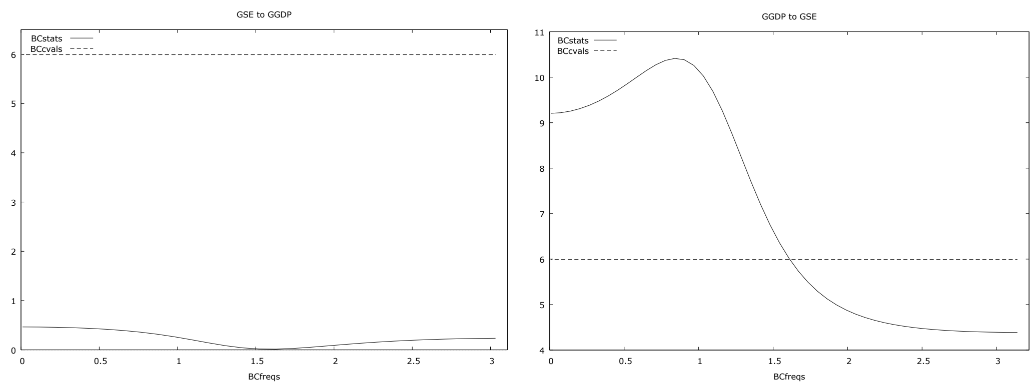
The above analysis has established a delay for self-employment growth. A Granger causality test in the frequency domain identifies the length of this delay. Even though we know that Granger causality can only be identified for GGDP to GSE in the second segment (as found above), we test two segments and all directions; the tests can serve as a confirmation of our previous results. The number of lags, k, used in the tests, are three for both segments. The results are presented in Figures 5 and 6, and the curves in the figures represent the Wald statistics of testing the null hypotheses specified in (6) and (7) with different frequencies ω in $(0,\pi)$. Figure 5 represents the segment of 1851-1948 (GSE to GGDP, and GGDP to GSE, respectively), and Figure 6 represents the segment of 1949-2000 (GSE to GGDP, and GGDP to GSE, respectively). The critical value of 5.99 is plotted as dashed lines; if a part of the curve (associated with the frequency ω) is located above the dashed line, the non-Granger causality can be rejected at the corresponding frequency ω.

Figure 5. The segment of 1851 to 1948: GSE to GGDP (left panel), GGDP to GSE (right panel).



The dashed lines represent 5% critical value. The curves represent statistics of Breitung and Candelon tests associated with different frequencies ω.

Figure 6. The segment of 1949 to 2000: GSE to GGDP (left panel), GGDP to GSE (right panel).



The dashed lines represent a 5% critical value. The curves represent statistics of Breitung and Candelon tests associated with different frequencies ω.

In the first segment, 1851 to 1948 (Figure 5), no parts of the curves are located above the dashed line. This indicates that non-Granger causality cannot be rejected at any frequency. This is consistent with the findings in the previous section: GGDP and GSE responded to common shocks simultaneously. In the second segment, 1949 to 2000 (Figure 6), however, the results differ. The left-hand panel indicates the non-Granger causality test GSE to GGDP, and it can be observed that no part of the curve is located above the dashed line. Therefore, the hypothesis that GSE does not Granger-cause GGDP cannot be rejected at any possible ω. On the other hand, in the right-hand panel of Figure 6, the Wald curve is situated above the dashed line when ω is less than 1.6, which approximately matches a four-year period. The null of non-Granger causality can therefore be rejected beyond four years, but not for shorter frequencies.

Discussion

In this study, we have been able to identify a positive correlation between self-employment growth and GDP growth in Sweden in the long term, 1850-2000. However, this correlation appears to have changed after World War II, more specifically in 1948. From this year, no significant correlation between self-employment growth and macroeconomic growth could be discovered. Furthermore, and interestingly, before 1948, no *causal* relationship between self-employment growth and GDP growth in either (Granger) direction could be established. In this earlier period (i.e., 1850-1948), GDP growth and self-employment growth appear to have responded simultaneously to common factors and shocks. However, from 1949 to 2000, GDP growth Granger-caused self-employment growth, but not the other way around. We found a delay for self-employment growth: between 1949 and 2000, GDP growth would first react to these common factors, and self-employment growth would respond with a delay. From 1949, variations in self-employment lagged with GDP growth (or with common shocks or factors) in the medium or long term – not the other way around.

Theory and research in the mainstream of entrepreneurship research propose that entrepreneurship has become a driving force for economic growth among advanced economies in the two to three past decades. Thus, entrepreneurship drives and precedes economic growth and this link is found to be empirically verified across a wide spectrum (Thurik and Wennekers 2004). The relationship is not purely straightforward – and it is not considered to be unaffected by time or history, nor by a country's level of development. From both 'historical' models (e.g., Audretsch and Thurik 1997, 2001) and 'stages of economic development'-models (Bosma et al. 2008, Wennekers et al. 2010) it would have been expected that changes in entrepreneurship in Sweden would display a positive, (Granger) causal relationship with economic growth during approximately the final two decades of the last century (or perhaps even earlier). This causal relationship would be either weaker, missing, or even opposite in earlier periods. It is very plausible to assume that entrepreneurship, enterprising activity, and innovation, affect economic growth and development. However, in the present study, no relationship in line with these theories was discovered, and we have not been able to establish that economic growth reacts to fluctuations in entrepreneurship in Sweden – a country ranked as an advanced, innovation-driven economy (e.g., Acs and Szerb 2009, 2012). Rather, in the recent several decades, changes in GDP were always ahead of changes in entrepreneurship. Accordingly, no shift or structural break in which changes in entrepreneurship would precede economic growth could thus be discovered for the most recent decades of the twentieth century. As a consequence, in this study, the case of Sweden does not correspond to recent established models and assumptions. It is interesting to note that the structural break discovered in the present study coincides with earlier empirical observations: the immediate post-war years have been viewed as a turning point and the onset of a long stabilization policy paradigm (Jonung 2000, Lundberg 1983).

Given our results, it could be asked whether Sweden is an exception to the rule. It may of course be so. However, research that has used country panels also gives evidence of substantial country heterogeneity. Indeed, there are rather few countries that actually do display the hypothesized relationships in recent models, in which changes in entrepreneurship has positive effects on (or any relationship between) economic growth. Several countries deviate from the average. At the global level, increases in entrepreneurship are an early indicator for a recovery from economic recessions. At the national level, entrepreneurship seems to react to economic fluctuations rather than causing them (Koellinger and Thurik 2012; see also Congregado et al. 2012). The results in the present study are in line with these observations. Therefore, Sweden does not seem to be an exception from the rule. Given our results, it could be asked if entrepreneurship has been properly measured. It is not obvious that self-employment is an inappropriate definition of entrepreneurship, and it is probably one of the most problematical and difficult aspects in the entrepreneurship literature. Self-employment is perhaps – at best – able to measure some characteristics of entrepreneurship, but it cannot capture all aspects of the phenomenon.

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