Checking the robustness of hysteresis in the UK self-employment rates

by

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A MSc thesis submitted in conformity with the requirements
for the MSc in Economics, Finance and Computer Science

University of Huelva & International University of Andalusia

September 2016

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2016

Abstract

there is a growing body of empirical literature devoted to explore the existence of hysteresis or at least persistence in entrepreneurship, i.e. whether policy or economic shocks have persistent effects on the natural rate of entrepreneurship. The usual way to deal with this has been to look for unit roots by using alternative test or by using unobservable components models. In this research we perform a battery of tests and competing approaches in order to check the robustness of our results on the UK self-employment time series. The UK is a suitable case of study since the recent evolution of the UK self-employment rate has caught the eye of schoolars and forecasters.

JEL **classification**: C32, J23, M13.

Key words: Hysteresis, Unobserved components model; Time Series models; Business cycles; Self-employment; Entrepreneurship.

Resumen

Existe una creciente literatura empírica dedicada al análisis de la histéresis o al menos de persistencia en el autoempleo, esto es, si los shocks tienen efectos sobre la tasa natural de entrepreneurship. La forma más habitual de abordar esta cuestión ha sido la de contrastar la existencia de raíces unitarias a través de diferentes aproximaciones o a través de modelos de

componentes inobservables. En este trabajo realizamos un análisis de robustez de la existencia de histéresis en el autoempleo del Reino Unido. La singular evolución reciente de la tasa de autoempleo en el Reino Unido hace que sea un adecuado caso de estudio, al ser el centro de atención de analistas e investigadores.

Acknowledgments

I want to take this opportunity to thanks the help of some influential persons in this work. In particular to my supervisor and to Héctor Cárcel and Antonio Golpe, who have been very kind and patient with me.

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1 Introduction

In July 2016, 4,76 million of people were self-employed in the U.K. (15% of all people in employment), the highest number and self-employment ratio since records began. Some analysts hypothesize that the increase in self-employment has been mainly caused by a fall in people leaving self-employment rather than an increase in people entering, that is a certain degree of persistence, maybe due to the lack of opportunities to work as an employee at the onset of the economic downturn.

But what does this trend tell us about the state of the U.K. economy? Does the trend represent, the emergence of new entrepreneurs who are pushed into self-employment due to the lack of job opportunities and therefore a temporary shock on the occupational decisions? Or is it a permanent structural change in the labor market?

Self-employment in the UK rose rapidly in the 1980s, decreased during the mid-1990s, and rose again in the 2000s showing a particularly big jump after the crisis, and some forecasters suggests a significant rise in self-employment rate over the next years (Saridakis & Papaioannou, 2014).

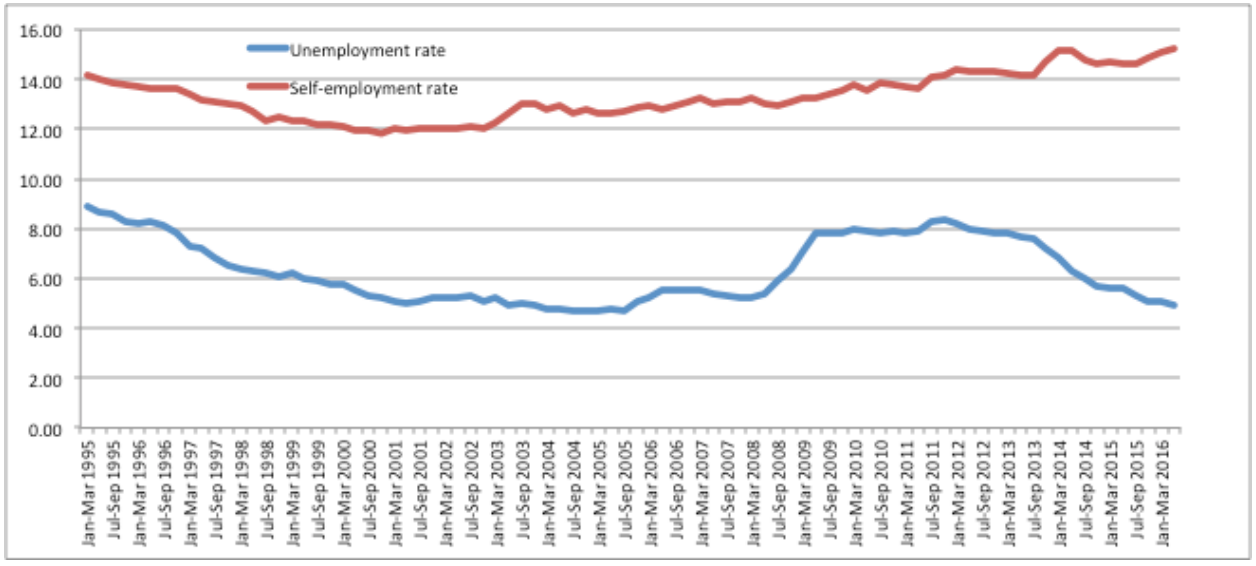

Figure 1. U.K. Self-employment and unemployment rates Evolution (quarterly data), 1995:1-2016:2. Source: Eurostat. Labour Force Survey.

Several factors might be behind the recent observed big jump in the UK self-employment. On the one hand, one could speculate that it is the result of the reaction to a situation in which the British economy was creating too few paid-employment and the opportunity cost of self-

employment is relatively low. In addition, the existence of different schemes of entrepreneurship promotion could reinforce the effects of this self-employment revival. But these are not the only causes of the recent development of the UK self-employment data another explanatory factor is related to the emergence of different forms of dependent self-employment. In particular, as a way to avoid the most onerous elements of the (paid-) employment protection legislation some wage earners are induced to switch to self-employment with a guaranteed demand by the employer, substituting the costs and rights associated to paid-employment by self-employed workers –sometimes subsidized– (Böheim & Muehlberger, 2006, 2009). A third potential explanation could be that this upswing showed in self-employment data can be the result of crowding out effects –i.e. non-subsidized firms or self-employed workers may be displaced by supported start ups (Caliendo and Kühn, 2011).

In sum, turning unemployment into self-employment is being one of the most common causes behind this revival in self-employment in many countries around the world, especially during the last crisis.

However, the above factors do not exhaust all the factors, which we can take into account for explaining the determinants of the substantial rise in U.K. self-employment. On the one hand, the UK labour market has become more flexible than the rest of European countries, thanks to the institutional framework conducted to favour labour market flexibility. One could argue that it should place the UK economy in a better position to respond to unemployment, but it can propitiate a growning percentage of individuals change their initial occupational choice, deciding to become entrepreneurs given that this flexibility tends to equal the relative valuation of paid-employment and self-employment, after the loss of rights and safe which characterized paid employment versus self-employement.

Finally, a last explanation could be applied for. As Acs (2006) argue average firm size was an increasing function of the wealth of the economy in intermediate stages of economic development, and a source of decreasing self-employment rates since marginal entrepreneurs find they can earn more money being employed by somebody else (Lucas, 1978). However, it seems that now the more developed the economy the higher the self-emoployment rate, since the development of the business services and the improvements in information tecnhnologies provide more opportunities for entrepreneurship. In other words, a U-shaped relationship may in

fact characterise the relationship between entrepreneurship and the stage of economic development.[1]

In sum, and whatever the cause of this upward trend –policy or economic shocks–, the key question is to know if the effects of these shocks are temporary or permanent, given that one could argue that only those individuals who decide to become etrepreneurs on the basis of a voluntary participation –opportunity entrepreneurship– will represent permanent transitions into self-employment, while as more and more self-employees becomes involved in necessity entrepreneurship the more we see temporary transitions, with people abandoning self-employment when economy and labour market show syntoms of recovery.

One could argue that looking for hysteresis in the UK self-employment is a hot policy issue and a good question of research at the time of writting, when policy makers and analysts are are wondering about the deep causes and perspectives of this evolution. In sum, the UK is a suitable case for study, and the use of alternative (and competing) strategies for checking the persistence is a good form to deal with the study of these questions.

Therefore, the goal of this paper is to explore whether aggregate rates of entrepreneurship. We do so using quarterly time-series data on self-employment rates for the UK. The UK self-employment development has attracted the analysts' attention since the UK self-employment experienced a sustainable increase during the 1980s[i], probably thanks to government intervention and liberalisation in a context of rapid economic growth (see Cowling, 2003 or Blanchflower and Shadforth, 2007), becoming the UK labour market in one of the more flexible ones in Europe. If it was the case, a low employment protection joint to a favorable tax system and the reduction of the credit constraints people faced could be the more likely reasons for explaining the self-employment boom in the UK.

Therefore, the UK is a suitable case of study, given that labour market conditions and the tax system seems to point to a highly sensitive self-employment responses to changing macroeconomic conditions.

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[1] This interpretation is consistent with the evidence provided by Blanchflower & Sandforth (2007), who analyse the evolution of the self-employment in the UK during four decades, and the time series analysis carried out by Cowling and Mitchell (1997), for the period 1972-1992.

Furthermore, there is another reason for suggesting the analysis of the UK self-employment as a singular case: in several previous studies the UK self-employment has been considered as an outlier (Cowling and Mitchell, 1997, Thurik, 2003, Faria et al, 2010, Carmona et al, 2010). In particular, the relationship between entrepreneurship and unemployment in the UK seems to have a specific nature, in such a way that entrepreneurship contributes less than elsewhere to alleviate the unemployment problem (Thurik, 2003) while the most important determinant of the proportion of workforce in self-employment is the income differential between self-employed and employed workers (Cowling and Mitchell, 1997) –i.e. in response to macroeconomic conditions and not in response to labour market conditions-

The remainder of this article has the following structure. The next section discusses briefly theoretical and empirical evidence on hysteresis in entrepreneurship. The third section describes the data, presents and discusses the results and performs different robustness checks for our findings. The final section concludes with a discussion of policy implications and some potential avenues for future research.

2 A selective review of previous literature

We all will agree in that the durability of shocks to entrepreneurship –policy or economic shocks– should be an important research question in the Economics of Entrepreneurship. In that sense, there is a growing body of empirical literature devoted to explore the existence of hysteresis or at least persistence in entrepreneurship. This literature includes both microeconometric (Millán et al, 2014) and macroeconometric evidence by using different approaches. Focusing on the latter, recent pieces of research provided by Congregado et al. (2012), Parker et al. (2012) or Gil-Alana & Payne (2015) have examined, by using time series analysis, if entrepreneurship exhibits hysteresis, as a way to check whether policy shocks, economic shocks or the shocks induced in the occupational choice decisions by a new employment legislation or a new tax treatment of employees and self-employees earnings, have only temporary effects on self-employment or if, by contrast have a permanent character, that is there are persistent.

In a time-series context, hysteresis can be defined and measured in various ways. The most popular approach in the empirical literature simply equates hysteresis with the existence of a unit root in a variable, by using integer or fractional integration. An alternative approach proposed by

Jaeger and Parkinson (1990, 1994) posits a more demanding criterion: hysteresis exists if cyclical changes affect the natural rate of a variable, even as the natural rate follows a unit root process. In which case, temporary shocks have permanent effects while the business cycle does not evolve independently of the natural rate; it then follows that a unit root is a necessary but not a sufficient condition for hysteresis.

To test for hysteresis in this way, we follow Jaeger and Parkinson (1990, 1994) and decompose entrepreneurship into two unobservable components: a non-stationary "natural rate" component, and a stationary "cyclical" component. These components can be estimated by maximum likelihood using the Kalman filter. This is the third approach carried out in this paper.

3 Data, Methodology and Results

This section describes the indicators and data sources used as proxy of entrepreneurship and the general strategy for checking the presence of hysteresis in the UK self-employment series.

3.1 Data and measurement issues

In common with most previous studies, entrepreneurship in this paper is defined in terms of self-employment, reflecting data availability at the time-series level (Storey, 1991, Parker, 2009).[2] Our empirical analysis uses seasonally adjusted[3] quarterly data on self-employment rates, for the UK. The self-employment rate, (S_t), is defined as the share of the workforce that is self-employed. The British self-employment data are seasonally adjusted quarterly observations drawn from the Labor Force Survey (LFS, Office for National Statistics). The sample starts in 1978(I) and conclude in 2016(II). It should be noted that independent owner-managers and directors of *incorporated* enterprises are classified as employers, i.e. in the survey workers are asked questions about their main job or business, including "Were you an employee or self employed?" If self-employed, the respondent was further asked whether they have any

[2] We all agree that entrepreneurship is difficult to measure and operationalize for empirical work. The most commonly used indicators of entrepreneurship be divided into three categories: (1) stock measures (self-employment or firm data), (2) flow measures (firm or self-employment entry/exit rates); and (3) indirect indicators of entrepreneurship such as competitiveness, patents, etc. In strict sense, self-employment data is related to the Knightian entrepreneur who assumes all the uncertainty connected with the firm (see Iversen et al. (2008) or O'kean & Menudo (2008) for a detailed discussion).

[3] Where seasonal adjustment is required, we use X12 ARIMA procedure applied to the whole available period.

employees. Finally, real GDP is denoted by Y_t. Data on British real GDP is taken from the Quarterly National Accounts database. These data are seasonally adjusted and are expressed in billions of chained 2005 UK pounds.

3.2 Unit roots

As a preliminary check, given that several studies equal hysteresis to unit roots, we perform standard unit root tests on the series. The results based on the Dickey and Fuller and Augmented Dickey Fuller tests and on the Phillips and Perron test are reported in Table 1, and they show that the series of the UK self-employment rate is integrated of order one –i.e. *I(0)* stationary in first differences-. However, this result should be taken with caution, given the low power of these procedures if the alternatives are of a fractional form. In order to avoid this possibility we are going to check the presence of hysteresis from an alternative approach, taking into account explicitly this possibility, by using the framework proposed by Gil-Alana & Hualde (2009).

Table 1. Unit roots tests.

Phillips Perron test statistic	Z(rho)	0.640
	Z(t)	0.696
Lag length		4
DF Test statistic		1.219
ADF Test statistic		-1.990
Lag length		7
Observations		227
Range		1959:3-2016:1
Crtical values		
Phillips Perron		
(1%)		Z(rho) -20.223
		Z(t) -3.468

(5%)	Z(rho) -13.954
	Z(t) -2.882
(10%)	Z(rho) -11.169
	-Z(t) 2.572
ADF	
(1%)	-3.468
(5%)	-2.882
(10%)	-2.572
DF GLS	
(1%)	-3.480
(5%)	-2.887
(10%)	-2.602

3.3 Fractional integration

As we mentioned above, the objective of this paper is to evaluate the robustness of hysteresis in the UK self-employment rates, by using alternative econometric models other than the traditional unit roots tests. The first alternative is the employment of fractional integration –see, Gil-Alana & Hualde (2009) for a survey– to infer the existence of hysteresis in UK self-employment rates. This approach has been recently applied into the field of the Economics of Entrepreneurship by Gil-Alana & Payne (2015).[4]

The key difference between the traditional approach of time-series and the fractional integration is that the number of differences required for rendering a series *I(0)* stationary is a fractional

[4] They applied fractional integration in order to explore the existence of hysteresis by using monthly time series data of US self-employment rates. Results suggest the existence of a nonstationary behaviour supporting previous evidence provided by Congregado et al. (2012), for the American entrepreneurship.

value rather an integer one. In particular, we will consider that the British self-employment rate can be *I(0)* stationary (i.e., *d=0*), nonstationary and nonmean-reverting (if *d≥1*), stationary with long memory (if *0 <d<0.5*) or nonstationary but mean reverting (if *0.5≤d<1*). In other words, the larger the value of *d*, the greater is the degree of dependence in the data to the past, and the longer the effects of shocks (more persistence).

Table 2. Estimates of the fractional parameter

	Coefficient	*Std. error*	*t-value*	*t-prob*
d parameter	0,7762	0,05297	4,29	0,0000
Constant	11,0493	7,849	1,41	0,1610

Log-likelihood: -1129,51
No. Observations: 227
No. parameters 3
AIC: 9,97
Method employed: Sowell 1992 con Oxmetrics 6. ARFIMA (*0,d,0*).

We estimate the fractional differencing parameter d. The estimate of the fractional differencing parameter is displayed in Table 2. We observe that the value of *d* is the interval (0, 1) implying long memory (*d > 0*) and mean reverting (*d < 1*) behaviour. We notice that the estimated value of d implies long-memory, i.e. nonstationarity but mean reverting. Then, shocks are mean reverting.

This buttresses our conclusion that a unit root exists in the self-employment rates. As noted above, a unit root is a maintained assumption needed to test for Jaeger and Parkinson's notion of hysteresis. We test this notion of hysteresis now.

3.4 An unobserved component model

Several macroeconomic studies equate hysteresis in a time series with a unit root process.[5] Independently of the use of integer or fractional unit roots the problem of these two approaches os that the existence of a unit root in the self-employment time-series is a necessary but not sufficient condition for hysteresis, namely. Alternatively, Congregado et al (2012) argue that hysteresis in self-employment arises if and only if changes to the cyclical component of a time series, induce permanent changes into its natural rate. In order to test this definition of persistence, Jaeger and Parkinson (1990,1994) proposed a framework from a decomposition of the time series into the sum of two unobservable components: the natural rate and the cyclical component. In order to illustrate the approach, and applied to our case under study, let us decompose the UK self-employment series, S_t into the sum of its two (unobservable) components: the non-stationary natural rate component, S_t^N, and the stationary cyclical component, S_t^C:

$$S_t = S_t^N + S_t^C \tag{1}$$

Now we are going to define the natural rate component as a random walk plus a term capturing a possible hysteresis effect:

$$S_t^N = S_{t-1}^N + \beta S_{t-1}^C + \varepsilon_t^N \tag{2}$$

where the β coefficient measures, in percentage points, how much the natural rate increases if the economy experiences a cyclical self-employment rate increase of 1 percent. Evidently, we can check like a unit root in the self-employment rate is a necessary but not sufficient condition for the existence of hysteresis since a unit root could be generated by an accumulation of shocks to the natural rate while at the same time $\beta = 0$ (Røed, 1997). In contrast, there is hysteresis if $\beta > 0$.

[5] See Blanchard and Summers (1986) or Layard et al. (1991) who used the term "pure" hysteresis for describing the presence of a unit root in time series.

The specification of the model is completed by writing the cyclical component of the self-employment rate as a stationary second-order autoregressive process:

$$S_t^C = \phi_1 S_{t-1}^C + \phi_2 S_{t-2}^C + \alpha \Delta Y_{t-1} + \varepsilon_t^C \tag{3}$$

augmented with a term, $\alpha \Delta Y_{t-1}$, which relates cyclical self-employment to lagged output growth, where Y_{t-1} is lagged real GDP. This enables the relationship between the business cycle and entrepreneurship to be analyzed. The random shocks ε_t^N and ε_t^C are assumed to be mean-zero draws from the normal distribution with variance-covariance matrix Ω; the state-space form of the model can be written as

$$S_t = \begin{pmatrix} 1 & 1 & 0 \end{pmatrix} \begin{pmatrix} S_t^N \\ S_t^C \\ S_{t-1}^C \end{pmatrix} \tag{4}$$

$$\begin{pmatrix} S_t^N \\ S_t^C \\ S_{t-1}^C \end{pmatrix} = \begin{pmatrix} 1 & \beta & 0 \\ 0 & \phi_1 & \phi_2 \\ 0 & 1 & 0 \end{pmatrix} \begin{pmatrix} S_{t-1}^N \\ S_{t-1}^C \\ S_{t-2}^C \end{pmatrix} + \begin{pmatrix} 0 \\ \alpha \\ 0 \end{pmatrix} \Delta Y_{t-1} + \begin{pmatrix} \varepsilon_t^N \\ \varepsilon_t^C \\ 0 \end{pmatrix} \tag{5}$$

$$\Omega = \begin{pmatrix} \sigma_N^2 & 0 & 0 \\ 0 & \sigma_C^2 & 0 \\ 0 & 0 & 0 \end{pmatrix} \tag{6}$$

To summarize, hysteresis is inferred if the coefficient β is significantly different from zero, whereas pro- or anti-cyclical variation is inferred depending on whether the coefficient α is positive or negative, respectively. The coefficients of the model (4) – (6) are estimated by maximum likelihood using a Kalman filter.

The estimation of the linear unobserved components model outlined above, enables hysteresis to be tested directly and the existence of business cycle effects to be examined.

The Table 3, presents the results of estimating (4) through (6) for aggregate self-employment rates. The parameter β is positive. This implies that self-employment exhibits hysteresis. In particular, if the cyclical component of self-employment increases by 1%, the natural rate of self-employment increases by 0.36%.

Table 3. Estimates of the linear unobserved component model

Natural rate equation	
β	0.3656* 0
Cyclical rate equation	
ϕ_1	1.4926* 0
ϕ_2	-0.5570** -0.003
α	0.3971* -0.001
σ	-2.9606* -0.001
Range	1956:1-2016:2

Notes: P-values are in parentheses.

The estimate of α reported in the fourth row suggest that only the aggregate self-employment series S_t also exhibits a significant impact of business cycle variations in output on cyclical self-employment.

4 Conclusions

This paper reported evidence of unit roots and estimated an unobserved components model for testing the existence of hysteresis in the self-employment rate in the United Kingdom. Defining hysteresis in terms of the interdependent evolution of a non-stationary natural rate and a stationary cyclical component, thereby distinguishing hysteresis from natural rate shocks, the results provide robust evidence of hysteresis in entrepreneurship. This implies that economic and/or policy shocks have permanent effects on rates of entrepreneurship. These results suggest that policy-makers need to take particular care when designing entrepreneurship policies. Our results argue for the use of much longer time horizons in formal evaluation exercises than the few years, which are commonly used to gauge entrepreneurship policy impacts.

Our results also shed new light about the issue of business cycle effects on entrepreneurship. As previous research we found some evidence of pro-cyclicality of self-employment rates.

Therefore, we cannot rule out the possibility that it might simply reflect data limitations or even biased by the implicit assumption of linearity. Further research is needed to determine whether it is different national and institutional conditions, or merely the nonlinearity, which lead different findings. Hence, future work might include at least the application of this methodology to a broader range of countries, and should also seek to extend the unit roots analysis and the model to a nonlinear framework in order to check the robustness also in this way.

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Appendix

Unit root tests

```
. dfuller Autoem

Dickey-Fuller test for unit root                   Number of obs   =       227

                                 ———— Interpolated Dickey-Fuller ————
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
———————————————————————————————————————————————————————————————————————————
 Z(t)             1.219           -3.468            -2.882           -2.572
———————————————————————————————————————————————————————————————————————————
MacKinnon approximate p-value for Z(t) = 0.9961

. dfgls Autoem

DF-GLS for Autoem                                        Number of obs =   213
Maxlag = 14 chosen by Schwert criterion

              DF-GLS tau      1% Critical       5% Critical      10% Critical
  [lags]     Test Statistic        Value             Value            Value
———————————————————————————————————————————————————————————————————————————
    14           -2.061           -3.480            -2.809           -2.530
    13           -1.985           -3.480            -2.820           -2.540
    12           -1.894           -3.480            -2.830           -2.550
    11           -1.846           -3.480            -2.841           -2.559
    10           -1.997           -3.480            -2.851           -2.569
     9           -2.045           -3.480            -2.860           -2.577
     8           -2.145           -3.480            -2.870           -2.586
     7           -1.990           -3.480            -2.879           -2.594
     6           -1.674           -3.480            -2.887           -2.602
     5           -1.397           -3.480            -2.895           -2.610
     4           -1.446           -3.480            -2.903           -2.617
     3           -1.630           -3.480            -2.911           -2.623
     2           -1.361           -3.480            -2.918           -2.630
     1           -1.134           -3.480            -2.925           -2.636

Opt Lag (Ng-Perron seq t) =  7 with RMSE  34.58952
Min SC   =   7.23213 at lag  1 with RMSE  36.26651
Min MAIC =  7.184502 at lag  4 with RMSE  35.26631

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Phillips-Perron test for unit root — Number of obs = 227; Newey-West lags = 4

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(rho)	0.640	-20.223	-13.954	-11.169
Z(t)	0.696	-3.468	-2.882	-2.572

MacKinnon approximate p-value for Z(t) = 0.9898

[i] In that sense, the UK has been one of the countries where the U-shaped relationship between entrepreneurship and economic development has presented more intensity (see, Acs, Audretsch and Evans, 1994; Caree et al. 2002, 2007; Freytag and Thurik 2007; Van Stel and Carree, 2004; and Wennekers et al. 2010).