An heterodox History of Spanish Economy into the Eurozone: Austrian School of Economics analysis of boom & bust

MIGUEL ANGEL ALONSO-NEIRA, ANTONIO SANCHEZ-BAYON, MARCOS CASTRO-OLIVA

Abstract

This is a heterodox Economic History on Political Economy, Macroeconomics and Applied Economics, based on the Austrian Economics theory of business cycles, applied to the case of the Spanish Economy during the boom-bust cycle (2002-2014). Attention is focused on the endemic problem of business cycles, such as successive and distorting periods of boom and bust that modern economies suffer, as with the Spanish economy. This work reviews the analysis of the Austrian School of Economics´ theory and its development, with attention to the empirical renewal line (into the school), which used econometric support, to help the communication with other economic schools. Consequently, there is a review of the main econometric literature on the Austrian cycle, followed with an illustration of the case of Spain in the Eurozone. In this way, it is possible to better understand the cycle of boom and bust by means of new currency emission and how to help econometric tools to illustrate economic principles.

Key words

economic cycle; monetary policy; capital-based Macroeconomics; Austrian School of Economics; heterodox approaches.

DOI: 10.23762/FSO_VOL11_NO2_1

Miguel Angel Alonso-Neira
e-mail: miguelangel.alonso@urjc.es
Prof. Applied Economics at University Rey Juan Carlos

Antonio Sanchez-Bayon[1]
e-mail: antonio.sbayon@urjc.es
Assoc. Prof. Applied Economics at University Rey Juan Carlos, Spain & PhD candidate in Economics & Business at University of Malaga

Marcos Castro-Oliva
e-mail: castroolivamarcos@gmail.com
Collaborator of GESCE-University Rey Juan Carlos

[1] Corresponding author

Introduction

The aim of this study is to apply the Austrian Business Cycle Theory (ABCT) to the Spanish Economy case, during the period 2002-2014: between the boom, following the introduction of the Euro (€), and the bust following the Great

Paper received: 31 December 2022 • Paper revised: 23 May 2023 • Paper accepted: 13 June 2023

Recession in 2008. The originality of this Austrian School of Economics review consists in the illustration of the theory with an empirical case (Alonso et al, 2013 & 2023). This means that, although the explanation of ABCT has traditionally been literary (Mises, 1912, 1949; Hayek, 1929, 1931), on this occasion real data and econometric methods will be used, as Machlup (1936, reviewed by Hutchinson, 1956, and Garrison, 2001) had already suggested, and other Austrian School authors have continued (i.e. Fekete, Alonso, Cachanosky, Padilla, Rallo, Ravier, Sánchez-Bayón & Castro-Oliva, 2022). It is hoped that this study will provide a better understanding of ABCT and updates thereto, in addition to building bridges with other economic approaches, the theories and models thereof (Sánchez-Bayón, 2020 & 2021; Sánchez-Bayón et al., 2022).

ABCT is part of the so-called monetary cycle theories, which reject the assumption of neutrality of money (either in the short run or in both the short and long run). However, unlike other approaches (Friedman, 1993; Lucas, 1972), it is characterised as an endogenous, disaggregated and capital-based theory of the disequilibrium cycle (Alonso, 2005; Alonso et al., 2011). ABCT states that an increase in the money supply, either by the Central Bank (through the so-called open market operations) or by commercial banks with fractional reserve banking (which expand credit via the bank multiplier), could reduce the interest rate (with an artificial expansion of credit and the origin of a financial boom). The interest rate of the economy (the so-called money or bank interest rate) is thus lowered below its natural level as a result of the "liquidity effect" (Garrison, 2001)[1]. This study, therefore, offers a review of ABCT development, with attention paid to empirical research based on econometric methods (after Garrison's model of capital-based macroeconomics). Also, it illustrates the ABCT using a specific historical episode: the economic cycle in Spain between 2002 and 2014 (i.e. boom, recession and recovery). The aim is to test whether ABCT serves to illustrate the Spanish economic cycle during the cited period.

1. Theoretical background review

1.1. ABCT foundations

The artificial reduction in interest rates is caused by the increase in the supply of loanable funds resulting from the expansion of bank credit, which moves entrepreneurs, who can now finance themselves more cheaply, to take on newly created loans and invest in long-term production processes (more time and capital-intensive and therefore more sensitive to interest rate variations), located in the stages furthest away from consumption, induced by the increase in the prices of capital goods given the decrease in interest rates

$$(a_n = {(1+i)^n - 1}\Big/{i(1+i)^n}).$$

On the other hand, the decrease in interest rates leads economic agents to save less and increase their present consumption. This increase in consumption may also be caused in part by the greater monetary availabilities resulting from credit expansion.

1 The term 'natural rate of interest' comes from Wicksell (1898), who took it from Böhm-Bawerk (1884, 1888), corresponding to the Austrian theory of the long-term rate of return on capital, which in turn is a reflection of the rate of time preference of economic variables; therefore, it is not affected by monetary factors (Garrison, 2006). It is important to note that ABCT is based on the existence and empirical importance of the "liquidity effect" (Keeler, 2021).

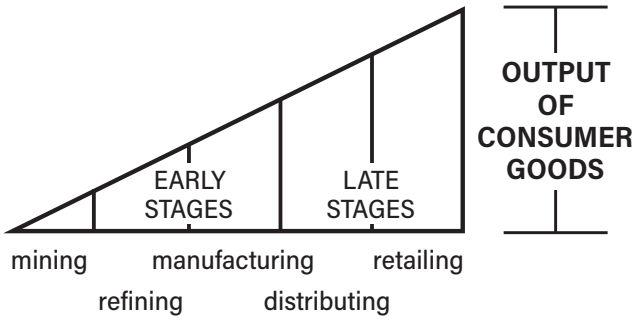
This situation causes serious perception issues for economic agents (Alonso, 2004), since the production structure tends to become more time and capital-intensive, while the demand for goods for immediate consumption increases. So, with more indirect production processes financed under artificially low interest rates, without any prior increase in real savings, there is a distortion of the production process, thanks to wrong signals. The situation seems to be a panacea, as the abundance of cheap money induces entrepreneurs to take out new loans and further lengthen the production structure, while households increase their consumption by borrowing as well. However, intervention in the loanable funds market creates an unsustainable situation in the long run, as there is an inter-temporal misalignment between savings and investment decisions. In other words, entrepreneurs invest in long-term production projects by paying for them with loans obtained at low interest rates, while consumer-savers do not lower their rate of time preference (therefore they do not postpone their present consumption in order to increase their future consumption capacity). On the contrary, in the context of low interest rates, consumers decide to save less and increase their present consumption by borrowing. The mismatch between savings and investment decisions leads to a scenario of unsustainable monetarily-induced growth.

The first economic symptoms that reveal the unsustainability of the situation created by the monetarily-induced inter-temporal mismatch between savings and investment decisions are:

- First, there is an increase in the price of labour and raw materials. Entrepreneurs who finance themselves with arbitrarily cheap credit require labour to implement their productive processes in the stages furthest away from consumption, which are more profitable in the short term because of the increase in the price of capital goods resulting from the artificial decrease in the monetary interest rate. Since we start from a situation of full employment of production resources[2], the only way for entrepreneurs to attract workers from the stages closer to consumption to those further away from it is to offer higher wages, which raises the costs of the new productive processes put in place (Machlup, 1931).
- Secondly, there is an increase in the price of consumer goods as a result of a decrease in supply, since labour has been taken away from the production processes closer to consumption and displaced to those located at more distant stages (Hayek, 1931). In addition, the latter have lengthened and new production processes (even further away from final consumption) which are more time- and capital-intensive due to the readjustment effect (Sánchez-Bayón et al., 2021), financed by the expansion of bank credit, have emerged. This results in an increasingly complex capital structure. The combination of all the above causes' consumer goods to reach the market more slowly, the supply to decrease and the price to increase due to the time discount effect (Garrison, 2001).

2 Theoretically, "production" means an objective view (what it is changed with the application of labour to satisfy necessities) and "productive" a subjective view (what it is expected to generate profits or more welfare).

Figure 0: Hayek's triangle (stages of production/production time)



Source: own elaboration based on Hayek (1931)

- Third, there is a relative increase in the accounting profits of companies closer to final consumption. Since the price of consumer goods increases in relative terms more than the price of labour and raw materials, and yet the price of intermediate products (capital goods) generated in the stages further away from consumption remain unchanged, the profits of firms which are closer to final consumption will tend to rise with respect to those of firms farther away. This fact goes to show entrepreneurs that they have erred in investing in production processes farther away from final consumption, since the highest profits are now to be found in companies producing goods for immediate consumption.
- Fourth, the so-called "Ricardo effect" (Hayek, 1929, reviewed as the readjustment effect, Sánchez-Bayón, 2021) is verified, but in the opposite direction. As the price of consumer goods rises above nominal wages, real wages fall. This sends a new market signal for businessmen to substitute capital equipment for labour factor at the margin (Huerta de Soto, 1998), which worsens the situation, because as the demand for capital goods decreases, the price falls, and the accounting profits of companies located in the stages furthest away from consumption continue to suffer.
- Fifth, there is an increase in interest rates. This rise is the result of three distinct causes. The first cause is because commercial banks will tend to add a premium for the inflation generated. The second is that there will be many production processes that, because of the above, will need to be refinanced, resulting in a scramble for additional loans and credit to save production processes. This will increase demand for loans and credits, making them more expensive. Finally, the third cause has to do with the actions of the Central Bank, since it is likely that in the final phases of the upward cycle, close to the financial crisis phase, in the expectation of an inflationary process, the monetary authorities will decide to raise the reference interest rates. Historical evidence shows that interest rates resulting from the market adjustment process derived from an expansion of bank credit can be even higher than the initial ones (Rothbard, 1963).
- Finally, as a result of the effects, accounting losses begin to appear in many companies located furthest away

from final consumption in the production process which, compared to the profits of the closest companies, reflect poor business investments induced by the artificial reduction of interest rates resulting from the processes of credit expansion without the prior backing of voluntary savings.

It is at this point that the expansionary phase of the cycle gives way to a recession and a financial crisis. With new higher interest rates, lower capital goods prices and higher wages, many companies in debt during the credit boom phase do not make profits and become unprofitable. This causes the assets of commercial banks to contract (as a result of delinquency), while their liabilities, made up of the deposits they created through the bank multiplier, remain the same, leading to a problem of insolvency in the banking system leading to the financial crisis phase of the business cycle.

The financial crisis phase, and the consequent tightening of bank credit, is quickly transmitted to the real economy in the form of an economic recession, when the inter-temporal misalignment between savings and investment decisions is discovered, leading to a spontaneous market adjustment process. This adjustment involves the paralysis of the refinancing activity of a multitude of projects undertaken during the credit expansion phase in the stages furthest away from consumption, and the transfer of labour from these stages (in which investment errors have accumulated) to others more in line with agents' preferences. The supply of credit contracts to a level consistent with the supply of savings (which in turn reflects the rate of time preference of the consumer-savers in a given economy). On the other hand, commercial banks, with a more precarious solvency-liquidity ratio, are much more restrained in granting new loans and credit lines. The tightening of the supply of bank credit leads to a rise in interest rates, which in turn leads to a decline in investment, which also falls below its initial level.

In the long run, this process leads to the destruction of a myriad of productive processes, resulting in a less capital-intensive production structure with fewer stages, which will provide smaller quantities of consumer goods in the future. As markets adjust, the economy shows negative growth rates, declining real wages and rising unemployment (Hülsmann, 2001).

Once the malinvestments undertaken in the early stages of the productive structure have been purged, the economy will only return to a sustainable growth path if it is based on technological advances or increases in savings by economic agents (Garrison, 2001). Moreover, ABCT does not end at this point, but also differentiates between "short recessions" in which the government does not interfere in the reallocation of misinvested capital, and "recessions that are prolonged in time" as a consequence of fiscal and monetary expansion policies driven by governments to perpetuate the employment levels resulting from the preceding man-made boom phase. These policies hinder a rapid and efficient liquidation of bad investment processes and the early reallocation of resources to other productive stages and sectors of the production structure.

Finding empirical illustrations of ABCT would allow us to distinguish them from alternative approaches that seek to explain the origin, the propagation mechanisms and the persistence of cyclical oscillations (Young, 2011).

1.2. Literature review

Although it is true that the academic literature in this line of research is limited, some papers can be found that use econometric methods to analyse ABCT in different historical periods. The aim of this section is to review a good part of them, with the aim

of discovering what type of data and econometric methods can be most useful. The most relevant contributions will be analysed in chronological order.

The first study is by Wainhouse (1984), who used Granger causality tests (1969) to analyse the impact of credit expansion on interest rates and the production structure of the United States of America using monthly data between 1959 and 1981. He concluded that the business cycle is the result of a process of credit expansion, as he established that fluctuations in the supply of credit lead to alterations in interest rates and, in turn, verifies the "time discount" effect by finding that changes in the rate at which credit is granted stimulate entrepreneurs to invest in the stages furthest away from consumption. In addition, it shows that the ratio of capital goods prices to consumer goods prices behaves according to the ABCT explanations, i.e. it increases in boom phases and decreases as the market adjusts.

Subsequently, Le Roux and Levin (1998), in line with Wainhouse's study, used monthly data for the South African economy between 1980 and 1996, reaching similar conclusions; that is, the South African Central Bank's monetary policy induced an expansion of bank credit unsupported by voluntary savings, which led to strong distortions in interest rates and in the structure of the productive process, giving rise to the "forced savings" effect.

Following this work, Keeler (2001) used standardised quarterly data for the United States of America (USA/U.S.), between 1950 and 1991, on money supply growth (measured by M1), with the slope of the yield curve (the spread between the ten-year and three-month federal bond rates) as a proxy. Between 1950 and 1991 of money supply growth (measured by M1), the slope of the yield curve (spread between the 10-year and three-month federal bond rates) as a proxy for the natural or Wicksellian rate of interest and the money interest rate in the short-term credit market, the allocation of resources within the production structure (for which the proxy is the ratio between the capacity utilisation of primary processing industries and the capacity utilisation of advanced processing industries), and output deviations (measured by the ratio between real GDP and natural real GDP). This author questioned whether Austrian explanations of the impact of monetary policy shocks can characterise eight cycles of the U.S. economy since the post-war period. Through the study of cross-correlations between variables with different lags, he concluded that fluctuations in the money supply have an immediate effect on the yield curve, and that changes in the latter positively affect both the inter-temporal allocation of production resources and cyclical deviations in output with some lag. These results are consistent with ABCT in that a decline in the interest rate induced by monetary expansion stimulates the shift of production resources from the productive stages which are closer to final consumption to the more distant stages. In the same way, it shows that the fact that the correlations between the allocation of resources within the productive structure of the economy and the cyclical deviations of production are positive until the fifth quarter and negative thereafter goes to show that the processes of allocation (in the boom phase) and reallocation (in the recessionary phase) of productive resources in the capital structure have an influence on the cyclical behaviour of economic activity.

Mulligan (2002) deviated from previous studies, evaluating the U.S. production structure between 1959 and 2000 by means of the Hayek triangle, using interest rate data with different maturities and employment data from nine productive sectors (manufacturing, construction, finance, insurance and real estate, the government sector, mining, services, transportation

and utilities, the retail trade industry, and the wholesale trade industry). This author used cointegration techniques and error correction vector models (ECVM) to conclude that, if labour is taken as the productive resource under analysis instead of capital (since the latter is much more complex to measure), the study presents very strong empirical evidence of co-integration between changes in sectorial employment and changes in interest rates. That is, employment in different productive sectors responds strongly and differentially to changes in interest rates over the business cycle. The author concludes that expansionary phases, when interest rates fall, they are marked by a redistribution of employment towards the productive stages furthest away from final consumption, while at the beginning of the recession, which is usually preceded by an increase in interest rates and followed by a reallocation of employment towards the productive stages, closer to final consumption (Hayek, 1931). According to ABCT, since interest rates signal which production processes are profitable and which are not, generating movements of productive factors between the different stages of the capital structure, with an impact in the economic system.

In the same sense, while conducting a study similar to that of Mulligan (2002), Young (2005) used quarterly data on job reallocation within the production structure and federal funds interest rates (as a proxy for monetary policy behaviour) for the U.S. between 1972 and 1993. He employed a dynamic panel data model and finds a statistically significant "Hayekian channel" for monetary policy. Specifically, he concluded that episodes of job reallocation occur in the production structure in response to monetary policy management as predicted by ABCT. However, although he found that the "Hayekian channel" is statistically significant, he also determined that monetary shocks only explain little more than 10% of the variability of job reallocation in the U.S. production structure, so that the contribution of monetary policy is quite modest.

In turn, Mulligan (2006) used monthly data on real consumable output, 10-year federal bond interest rates and three-month U.S. Treasury bills between January 1959 and March 2003 to determine the existence of cointegrating relationships between personal consumption expenditure and the "long-run-short-run" rate differential through an ECVM. The author concluded that an increase in the interest rate differential has a positive impact on all stages of the production structure, although this effect is greater in the stages which are furthest away from final consumption (producing capital goods) than in the stages closer to it (producing consumer goods). Furthermore, he concluded that this effect tends to dilute over time, although it ends earlier in the stages closer to consumption than in those farther away. Finally, he stated that this effect not only disappears over time, but also tends to reverse, the reversal being more intense in the stages farther away from consumption than in those closer to it. Therefore, these results are consistent with the postulates of ABCT.

Carilli and Dempster (2008) followed in the footsteps of Keeler (2001). Using quarterly data on personal consumption and savings, short-term interest rates, central bank (or Federal Reserve 'Fed') reserves, and U.S. GDP between the first quarter of 1959 and the second quarter of 2007, they established Granger (1969) causality contrasts between the growth rate of reserves and the interest differential (conceived as the spread between the natural rate of interest approximated by the savings-consumption ratio and the short-term credit market interest rate), and between the interest differential and the growth rate of real GDP. They concluded that the rate of growth of reserves causes the interest rate differential

in the Granger sense, and that the interest rate differential itself causes the rate of growth of real GDP in the Granger sense (Rothbard, 1993). These results are consistent with ABCT. In addition, they estimated a polynomial lagged Almon (1965) model with the real GDP growth rate as the dependent variable and different lags of the interest rate differential as explanatory variables. Based on this model, they presented the existence of "endogenous" turning points which show that an increase in the interest rate differential has a positive impact on the real GDP growth rate in the short run, and a negative impact in later periods. Again, this result would be consistent with ABCT, as the initial positive effect would tend to reverse as the market discovers bad investment processes undertaken in projects that require more time to mature than the market is willing to wait.

In a paper published in 2009, Bismans and Mougeot used a panel data model with fixed effects to estimate the relationship between the interest rate differential (using the long-term interest rate as a proxy for the natural rate of interest) and the cyclical deviations of real GDP, the ratio between consumption and investment expenditures and the ratio by quotient between the prices of consumption goods and the prices of production goods. They concluded that an increase in the interest differential generates an acceleration of real GDP. However, they also found that this acceleration tends to abate and reverse as the short-term interest rate converges to the long-term interest rate (i.e. as the interest rate differential narrows). These findings represent an empirical illustration of ABCT.

With a methodology that differs from previous studies, Young (2011) proposed an innovative analysis. Using TIOR data (i.e. the total industrial production requirement of a productive sector, as an approximation of the concept of indirect production) of 65 industries of the U.S. production structure and the effective federal funds rate between 2002 and 2009, he measured the degree of complexity of the capital structure of the U.S. economy throughout the period under consideration and how it was altered by the expansionary monetary policy of the Federal Reserve, concluding that the capital structure expanded because of the monetary expansions that began in 2002 and then contracted during the 2007-2008 recession. This research represents a good empirical illustration of ABCT, mainly in terms of the initially positive and subsequently negative effects that monetary inflation policies had on the U.S. production structure.

Following in the footsteps of Keeler (2001), Carilli and Dempster (2008), and Bismans and Mougeot (2009), Alonso et al. (2013) used quarterly data on the monetary base, long-term and short-term interest rates, the industrial production of different productive sectors and the aggregate industrial production in the U.S.A. between 1988 and 2010, to carry out a Granger (1969) causality test between the cyclical behaviour of the monetary aggregate MZM (money zero maturity) and the slope of the yield curve, between the yield curve and various ratios that represent the cyclical evolution of the U.S. production structure, and between the yield curve and the cyclical behaviour of aggregate industrial activity. They concluded that the cyclical fluctuations of the MZM cause the interest rate differential in the Granger sense, and that this, in turn, causes the cyclical variations of the ratios that reflect the production structure and the cyclical behaviour of the industrial aggregate activity. Furthermore, using polynomial distributed lag models that add the ratios that approximate the cyclical behaviour of the production structure and the variable that represents the cyclical behaviour of industrial activity as dependent variables, and a set of lags of the slope of the yield curve as explanatory variables, they found endogenous inflection points

whereby an increase in the interest rate differential has a positive impact on the ratios of the production structure and on industrial aggregate activity in the short term, and a negative impact in later periods. Both findings provide empirical evidence in favour of ABCT, since, as the authors themselves argued, they would confirm both the impulse and propagation mechanisms of the Austrian cycle.

In a 2013 paper, Fisher extended the work of Mulligan (2006) by integrating and evaluating the role of monetary policy in determining interest rates and consumption. Using quarterly data on monetary aggregate M1, real personal consumption expenditures, the effective federal funds rate, and real asset yields, for which the spread between the 10-year federal bond rate and three-month treasury bills between the first quarter of 1963 and the second quarter of 2012 functions as a proxy. There were co-integrating relationships and resorts to error correction models for different periods (the full sample, February 1982 to February 2012, and January 1980 to January 2009), in order to analyse the long-run relationships among monetary policy, interest rates and real consumption. So, it was concluded that Federal Reserve intervention in the loanable funds market lowers short-term interest rates through the management of the effective federal funds rate, which distorts the value of the slope of the yield curve. Furthermore, he argued that an increase in the money supply tends to destabilise short-term real personal consumption expenditures. These results suggest that the Fed's short-term actions disrupt long-term monetary, interest rate, consumption and investment expectations, findings which are consistent with ABCT.

Lester and Wolf (2013) dismissed the use of production, consumption and investment data from the U.S. National Income and Production Accounts (NIPA) as too aggregated and not particularly illuminating of the sequential process of the production structure. They argued that the available U.S. data on the stages of the production process accurately capture the Austrian notion of a production structure. They measured industrial production in three stages (early, intermediate and late) with the industrial production indexes of raw, primary and finished products, and the average prices of goods produced in the early, intermediate and late stages with the producer price indexes of raw, intermediate and finished goods (based on data obtained from the Bureau of Economic Analysis (BEA) and Bureau of Labor Statistics (BLS)). Subsequently, they estimated a structural vector autoregressive (VAR) model to determine the short-run changes in the productive structure as a result of monetary expansion processes (using the effective federal funds rate as an indicator of monetary policy). These authors argued that if ABCT is empirically relevant, a monetary expansion should increase the output and prices of goods in the early and late stages relative to the output and prices of goods corresponding to the intermediate stage. They found that while monetary expansions are followed by statistically significant changes in aggregate output, the magnitude of the changes in the productive structure and prices of the various stages is moderate, statistically insignificant, and sometimes bears the opposite sign to that predicted by ABCT. The work of Lester and Wolf (2013) represents a clear challenge to ABCT, having found no clear empirical evidence for it. However, it is possible that these authors used a monetary policy indicator that is not entirely consistent with ABCT.

In this regard, Luther and Cohen (2014) applied the same method as Lester and Wolf (2013). However, they criticised their use of the federal funds rate as an indicator of monetary policy, since, in their opinion, it fails to distinguish a low market interest rate from a market interest rate that is low

compared to the natural interest rate. These authors preferred to use the estimate of the natural rate of interest proposed by Selgin, Beckworth and Bahadir (2011) to record, using the same econometric methods as Lester and Wolf, that the market interest rate falls below its natural level as a result of a process of monetary expansion orchestrated by the Federal Reserve. However, their efforts to improve on Lester and Wolf's study do not substantially modify the results obtained since, similarly, they found little empirical evidence in favour of ABCT regarding the fact that a monetary expansion alters the production structure. Considering that other previous research did find empirical evidence that a monetary expansion produces distortions in the production structure, the results contrary to ABCT in the latter work may be due to the fact that the data set does not provide a good approximation of the production structure of an economy.

1.3. A brief graphical and mathematical illustration of ABCT

In this section, a brief mathematical and graphical demonstration of the theoretical development of ABCT will be carried out. For this purpose, this study is based on the works of Garrison (1978, 1989 and 2001) and Cachanosky and Padilla (2016), in which ABCT is illustrated in a more formal way. Firstly, the mathematical development of ABCT implemented by Cachanosky and Padilla (2016) provides an innovative view of the cycle theory, as it is the first and only mathematical version of Austrian theories on record to date. Secondly, the mathematical model of Cachanosky and Padilla (2016) is mainly based on the graphical model of Garrison (2001), which characterises the Austrian cycle by interconnecting three main graphs. The first of these is a loanable funds market, where we have the economy's interest rate on the vertical axis, and the economy's investment and savings on the horizontal axis, the levels of these two variables being determined by the interconnection of an increasing demand for funds and a decreasing supply of funds. The second is a production possibilities frontier, understood as a trade-off between sustainable combinations of monetary units spent on consumption (vertical axis) and monetary units spent on investment (horizontal axis). Finally, the third is the intertemporal structure of production, colloquially known as the Hayekian triangle, in which consumption is on the vertical axis and the period of production is on the horizontal axis. This graph reflects the concept of roundaboutness or indirect production introduced by Böhm-Bawerk (1888), which is defined as the process by which capital goods are first produced; goods for final consumption are subsequently produced through the combination thereof. These graphs interrelate with each other on the basis of their common axes; that is, the loanable funds market is related to the PPF on the basis of their common axis on which investment and savings are determined, the PPF is related to the Hayekian triangle on the basis of their common axis on which consumption is determined, and finally, the loanable funds market is related to the Hayekian triangle through the interest rate, since the slope of the Hayekian triangle represents the return on capital, which coincides with the interest rate determined in the loanable funds market.

The equations defining this model of stationary equilibrium with full employment of resources (capital and labour) are shown below. For mathematical simplicity, it is assumed that there is no long-run growth, being defined as a closed economy with no public sector (an issue that has raised the Salerno-Young-Engelhardt-Murphy controversy over Garrison's theory of long-run growth: Salerno, 2001; Young, 2009a, 2009b; Engelhardt, 2009; Murphy, 2017; Cachanosky, 2017):

$$I^D = A - \alpha i \text{ (Demand for loanable funds)} \quad (1)$$

$$I^S = B + \beta i \text{ (Supply for loanable funds)} \quad (2)$$

$$\bar{Y} = C + I \text{ (Production Possibilities Frontier)} \quad (3)$$

$$C = i\tau \text{ (Hayekian triangle slope)} \quad (4)$$

Therefore, the equations that define the main variables of the model in the balance with full use of resources are as follows:

$$i^* = {}^{(A-B)}\!/_{(\alpha+\beta)} \text{ (Rate of interest)} \quad (5)$$

$$I^* = {}^{(\beta A+\alpha B)}\!/_{(\alpha+\beta)} \text{ (Investment)} \quad (6)$$

$$C^* = {}^{[(\alpha+\beta)\bar{Y}-(\beta A+\alpha B)]}\!/_{(\alpha+\beta)} \text{ (Consumption)} \quad (7)$$

$$\tau^* = {}^{[(\alpha+\beta)\bar{Y}-(\beta A+\alpha B)]}\!/_{(A-B)} \text{ (Production period)} \quad (8)$$

We will now move directly to define how ABCT, understood as a process of credit expansion, followed by a boom and subsequent recession, it could be mathematized in the Macroeconomic capital-based model. This credit expansion injects as a ΔM that adds to the autonomous credit supply in the credit supply function, which causes it to shift; hence, the new credit supply is as follows: $S^1 = B + \Delta M + \beta i$. Consequently, attention should be paid to three different sets of points: first, the initial state of balance without credit expansion, which has already been defined above; second, how the main variables of the model are left after the increase in credit supply resulting from monetary expansion; and third, the value taken by the main variables of the model after the market reaction to an artificially low interest rate and the final situation.

The main variables of the model after credit expansion:

$$i_m^* = {}^{(A-B-M)}\!/_{(\alpha+\beta)} \quad (9)$$

$$I_m^* = {}^{[(\beta A+\alpha B)+\alpha M]}\!/_{(\alpha+\beta)} \quad (10)$$

$$C_m^* = {}^{[(\alpha+\beta)\bar{Y}-(\beta A+\alpha B)-\alpha M]}\!/_{(\alpha+\beta)} \quad (11)$$

$$\tau_m^* = {}^{[(\alpha+\beta)\bar{Y}-(\alpha B+\beta A)-\alpha M]}\!/_{(A-B-M)} \quad (12)$$

Difference from the initial situation:

$$i_m^* - i^* = [{}^{-1}/_{(\alpha+\beta)}]M < 0 \tag{13}$$

$$I_m^* - I^* = [{}^{\alpha}/_{(\alpha+\beta)}]M > 0 \tag{14}$$

$$C_m^* - C^* = [{}^{-\alpha}/_{(\alpha+\beta)}]M < 0 \tag{15}$$

$$\tau_m^* - \tau^* = {[(\alpha+\beta)(\bar{Y}-A)M]}/{[(A-B)(A-B-M)]} > 0 \tag{16}$$

The market reaction to an artificially low interest rate:

$$i_p^* = {[(A-B)\alpha+\beta M]}/{[\alpha(\alpha+\beta)]} \tag{17}$$

$$I_p^* = {[(\beta A+\alpha B)-\beta M]}/{(\alpha+\beta)} \tag{18}$$

$$C_p^* = {[(\alpha+\beta)\bar{Y}-(\beta A+\alpha B)+\beta M]}/{(\alpha+\beta)} \tag{19}$$

$$\tau_p^* = \frac{\alpha[(\alpha+\beta)\bar{Y}-(\beta A+\alpha B)+\beta M]}{(A-B)\alpha+\beta M} \tag{20}$$

Difference from the initial situation:

$$i_p^* - i^* = {\beta M}/{[\alpha(\alpha+\beta)]} > 0 \tag{21}$$

$$I_p^* - I^* = [-{}^{\beta}/_{(\alpha+\beta)}]M < 0 \tag{22}$$

$$C_p^* - C^* = [{}^{\beta}/_{(\alpha+\beta)}]M > 0 \tag{23}$$

$$\tau_p^* - \tau^* = \frac{(A-B)-(\alpha+\beta)\bar{Y}+(\beta A+\alpha B)}{(A-B)^2\alpha+(A-B)\beta M} < 0 \tag{24}$$

Credit expansion ΔM puts the economy above FPP and is distributed between the deviation of consumption and investment:

$$Y_m = \bar{Y} + M \tag{25}$$

$$(I_m^* - I^*) + \left(C_p^* - C^*\right) = M \tag{26}$$

Moreover, it becomes necessary to know the differences that occur between the variables affected by credit expansion and the value of the variables after the natural reaction of the market to an artificially low interest rate:

$$i_m^* - i_p^* = (-1/\alpha)M < 0 \tag{27}$$

$$I_m^* - I_p^* = M > 0 \tag{28}$$

$$C_m^* - C_p^* = -M < 0 \tag{29}$$

$$\tau_m^* - \tau_p^* = \frac{(\alpha+\beta)\left((\alpha+\beta)\bar{Y} - \alpha(A-B-M)\right) + (\beta A + \alpha B) - 2\alpha\beta M}{(A-B-M)(\alpha(A-B)+\beta M)} M > 0 \tag{30}$$

There are two interest rates at the same time in the market: a) i_m^* defines the slope of the hypotenuse of the Hayekian triangle for the stages furthest away from consumption; b) i_p^* fixes the slope for the stages closer to consumption. This verifies the breakage of the Hayekian triangle after credit expansion and the economic mismatch of increasing consumption and investment at the same time, with no savings to support it.

In addition, it is possible to calculate an approximation of how the variables would be after the process of capital restructuring in the economy through the intercept between the two hypotenuses mentioned above:

$$C_B^* = (\tau_m^* - \tau_B^*) i_m^* \tag{31}$$

$$C_B^* = \left(\tau_p^* - \tau_B^*\right) i_p^* \tag{32}$$

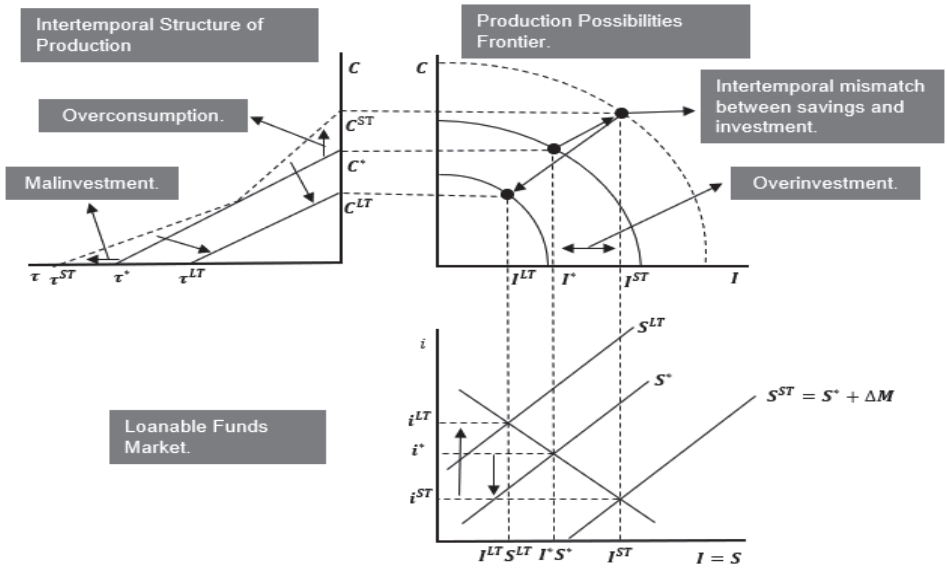
$$\tau_B^* = \left(\tau_p^* i_p^* - \tau_m^* i_{m)}^*\right) / (i_p^* - i_m^*) \tag{33}$$

$$C_B^* = \left[(\alpha+\beta)(\bar{Y} - A) - (\beta A + \alpha B)\right] / (\alpha+\beta) < C_m^* < C^* < C_p^* \tag{34}$$

Figure 1 represents Garrison's (1978, 1989, 2001) ABCT model, where the main peculiarity with respect to the usual macroeconomic models is that while the latter are based on labour, the Austrian model is based on capital (Ebeling, 2001). In this representation it is assumed, as in the previous mathematical illustration, that there is no sequential growth, i.e. the starting point is from a steady state situation. On the

other hand, it is assumed that the economy is closed, with no public sector (Ravier and Cachanosky, 2015) and is in a full employment equilibrium (Ravier, 2011). One may contrast this graphical demonstration with the mathematical demonstration above to ensure consistency and clarity of the developments.

Figure 1. Unsustainable economic growth (Austrian theory of the endogenous monetary cycle)



Source: own elaboration based on Garrison (2001)

2. Methodology and problems encountered

2.1. Overview

This paper proposes an empirical study based on the use of econometric methods of time series, the main objective of which is to characterise a specific historical episode: the economic cycle in Spain between 2002 and 2014 (i.e. boom, recession and recovery). The aim is to test whether ABCT serves to illustrate the Spanish economic cycle during the period. The econometric packages chosen to perform the calculations and estimations were STATA and R.

This study encounters a main problem which, in turn, generates another secondary problem. The initial obstacle derives from the non-econometric vision of the Austrian School, which was especially popularised by the "Rothbardian" approach or extreme apriorism (Rothbard, 1957), attributing to it an opposition to the application of quantitative methods in economics. However, this is not exactly the case, as from the very beginning, the Austrian School paid special attention to the methodological question, claiming the differentiation of methods in economics with respect to the natural sciences and engineering (Menger, 1883). Traditionally, Austrians are in favour of the aprioristic-deductive or logical-deductive research method, based on the genetic-causal study of human action; therefore, they reject the abuse of quantitative methods without theoretical or real support, or the Friedmanian error (Sánchez-Bayón, 2022), since it gives rise to circular reasoning which is incompatible

with the progress of economic theory and cannot be used to construct laws of tendency (Mises, 1949). This methodological rejection extends to the abuse of mathematical economics and econometrics, as they are understood as predictive tools of social engineering, and not as instruments by means of which to illustrate theory (Keeler, 2001, p. 331; Alonso et al., 2013, p. 45). In the social sciences, projections, forecasts or conjectures (not predictions) are the norm, especially in economics due to its dynamic and creative processes (Huerta de Soto, 2009).

Regarding ABCT, Carilli and Dempster (2008), Luther and Cohen (2014), and Alonso et al. (2013) point out the lack of empirical studies in favour of a monetary expansion orchestrated by any central bank which causes distortions in the productive structure of the economy. This is precisely the motivation of the present study: to illustrate ABCT while characterising a specific historical episode. Its objective is to determine whether, using econometric methods, ABCT contributes to an explanation of the observable historical economic data during the Spanish business cycle between 2002 and 2014. Therefore, this study should be viewed as providing a historical research method as an alternative to the techniques, which are also historical, that were traditionally used by the authors of the Austrian School in order to explain the scenarios of expansion and recession. Thus, Rothbard (1963) resorted to historical techniques to characterise the Great Depression of 1929 as a result of the distortions caused by the expansion of bank credit in the 1920s. He also showed that the New Deal frustrated the early liquidation of malinvestment, resulting in a prolonged secondary contraction (Mulligan, 2006).

Powell (2002) used the same techniques to find historical evidence that the Japanese crisis of 1990 reflected ABCT. He concluded that fiscal and monetary policies aimed at stimulating recovery prolonged the recession in Japan. Similarly, Callahan and Garrison (2003) asked whether the historical evidence allows one to explain the business cycle caused by the dotcom bubble through ABCT.

In addition to the methodological problems and the lack of previous literature, Young (2011) argued that this type of study may encounter a third problem derived from the difficulty of obtaining data that is consistent with Austrian theory, since a theory that is based on the disaggregated nature of the production structure and the concept of indirect production is not easily verifiable through the aggregate data available in the main institutional organisations which lack a measure of the temporal structure of production.

In conclusion, considering these problems, this study attempts to find, through the application of appropriate econometric techniques, distinctive empirical evidence in favour of ABCT in relation to other competing theories of the business cycle (along the lines already inaugurated by Morgenstern or Machlup, updated by Garrison or Cachanosky, and continued here). A good part of the aforementioned contributions have been taken into account for the purposes of this study; however, its originality stands out, not only for its vocation of dialogue between currents and its evolutionary synthesis in this respect, but also for being the first to approach the Spanish cycle of the period 2008-2014 econometrically according to the Austrian tradition.

2.2. Suggested hypotheses

This section mainly follows the contributions of Keeler (2001), Carilli and Dempster (2008), Bismans and Mougeot (2009) and Alonso et al. (2013) in establishing two categories of hypotheses in the study of the Spanish expansionary-recessionary cycle between 2002 and 2014. The first category of hypotheses would refer to the Austrian business cycle impulse mechanisms, which

would involve contrasting the three following hypotheses:

1. The monetary and credit expansion processes (ΔM) carried out by the European Central Bank caused a divergence between the natural rate of interest and the prevailing interest rate in the short-term credit market in Spain.
2. This divergence caused, with a certain delay of between six and 18 months (Friedman, 1968; Froyen, 1997), an artificial alteration of the production structure of the Spanish economy. This led to an increase in investment in the stages furthest away from final consumption (intermediate goods, capital goods and consumer durables, which would include construction), which are more time- and capital-intensive, to the detriment of the stages closer to final consumption (consumer goods), which are less time- and capital-intensive.
3. This divergence between the natural rate of interest (approximated by the 10-year bond rate) and the prevailing interest rate in the short-term credit market (approximated by the three-month treasury bill rate) also caused, with some delay, an artificial alteration in aggregate industrial activity.

The second category of hypotheses would refer to the propagation mechanisms of the Austrian expansionary-recessionary cycle that influence the volatility of the observed cyclical variations and their persistence over time. ABCT warns that the initial positive effect on the productive structure and aggregate economic activity caused by the divergence between the natural rate of interest and the interest rate of the credit market will tend to revert as the market's spontaneous adjustment process uncovers the bad investment processes induced by credit expansion (Huerta de Soto, 1998). This requires testing two additional hypotheses:

4. The divergence between the natural interest rate and the short-term credit market interest rate had a positive impact on the productive structure of the Spanish economy; however, as the market discovered the massive investment errors induced by the abundance of cheap credit, this positive effect tended to recede and reverse until the European Central Bank (ECB) again expanded the money supply. Therefore, after an initial correction process, a new positive impact on the productive structure should be observed and, therefore, the beginning of a new phase of an artificially induced boom. This implies, therefore, that the effect of the interest rate differential on Spain's production structure is first positive, then negative and then positive again.
5. The divergence between the natural interest rate and the short-term credit market interest rate caused a positive effect on aggregate industrial activity in Spain; however, as the market detected the massive investment errors induced by the abundance of cheap credit, this effect tended to reverse until the ECB started a new phase of monetary expansion, so that a new positive effect on aggregate industrial activity should be observed and, therefore, the beginning of a new phase of an induced boom. This would imply that the effect of the interest rate differential on Spain's aggregate industrial production is first positive, then negative and then positive again.

2.3. Data presentation and construction of variables

Following the premises, processes and results of the studies analysed in section 4, in order to test the hypotheses of the preceding section it will be necessary to define four variables: 1) a measure of the degree of laxity of the ECB's monetary policy, 2) a measure that reveals the impact of

monetary policy on the term structure of interest rates, 3) a measure that represents the productive structure of the Spanish economy, and 4) a measure of aggregate economic activity.

1. Regarding the first variable, the cyclical behaviour of the monetary aggregate M3 is taken as a measure of the degree of laxity of the ECB's monetary policy. For this purpose, we use the monthly data of the M3 between January 2002 and December 2014 (data extracted from the ECB's Statistical Data Warehouse) in deviations from its trend calculated by means of the Hodrick-Prescott filter (1997). This process allows us to determine the cyclical behaviour of the M3:

$$\Delta M3_t = ln\left({M3_t}/{trendM3_t}\right) \quad (35)$$

2. Research on the ABCT usually uses the differential between the natural interest rate, which is defined as a real economic variable that responds to the agents' time preference rate and not to the implementation of monetary policy, and the short-term credit market rate (or money rate), which does depend on the degree of laxity inherent in the monetary policy. However, there is no historical data available for the natural rate of interest, so it is necessary to estimate it. The authors of the Austrian School use two different approximations for the natural rate of interest. On the one hand, they use the savings-consumption ratio proposed by Rothbard (1993). In this sense, Carilli and Dempster (2008, p. 275) argue that:

> According to most mainstream analysts, the natural rate is determined primarily by the growth prospects of the economy, while Austrians prefer to think of the natural rate as reflecting the underlying time preferences of economic actors. Indeed, Rothbard (1993) suggests the savings–consumption ratio as the appropriate interest rate proxy based on the relationship between this ratio and the level of time preference (see Rothbard 1993, p. 342).

On the other hand, authors such as Keeler (2001), Mulligan (2006), Bismans and Mougeot (2009), Alonso et al. (2013), or Fisher (2013), prefer to use the long-term interest rate (10-year government bonds) as a proxy for the natural rate of interest. They resort to the slope of the yield curve as a proxy for the spread between the natural rate of interest and the prevailing money interest in the short-term credit market. In this sense, Keeler (2001) points out that:

> A monetary expansion will have a liquidity effect that will reduce short-term interest rates to a greater extent than long-term interest rates (Romer 1996, pp. 395-396). Long-term interest rates are affected since they are an average of short-term rates, but the effect is moderate. The contrast in the behaviors of short-term and long-term interest rates supports the notion that observed long-term rates are a good representation of natural interest rates, and in particular that the slope of the yield curve represents the Wicksellian idea of the differential between market and natural rates. The slope of the yield curve shows more regularity over business cycles in the magnitude of the slope and in the patterns of change than the levels of interest rates.

In the same way, Mulligan (2006, p. 78) uses the same approach, arguing that:

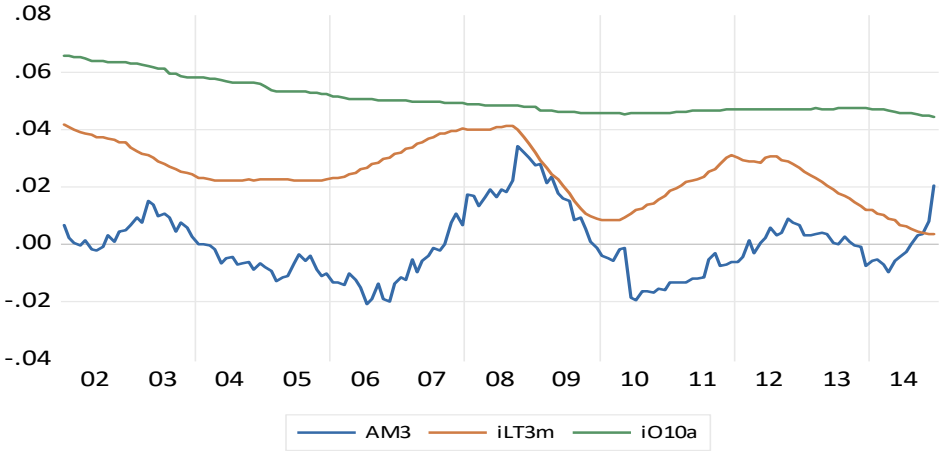
> The term spread is computed as the ten-year constant maturity rate minus the three-month secondary-market rate. Usually, the term spread falls as the central bank pursues expansionary monetary policy. When a large price premium dominates short-term interest rates, as often occurs in the late stages of monetary expansion, the term spread becomes negative. The term spread rises with tight monetary policy. The term spread is often used as a measure of the real interest rate (Keeler 2001, pp. 338–40).

This study uses the yield on 10-year bonds as an approximation of the natural interest rate (long-term interest rate that reflects the agents' time preference rate and does not respond to monetary phenomena), while using the yield on three-month Treasury bills as an approximation of the interest rate prevailing in the short-term credit market (based on data from the Spanish Treasury). Before constructing the spread, it is necessary to check that the yield on 10-year bonds does not respond to monetary phenomena, for which purpose the yield on 10-year bonds, the yield on three-month Treasury bills and the cyclical behaviour of the ECB's M3 monetary aggregate are plotted.

Figure 2 shows how the yield on three-month Treasury bills clearly responds to the cyclical behaviour of M3. However, the yield on 10-year bonds seems to be out of sync with the stance and intensity of monetary policy.

Another way to examine the link between short- and long-term interest rates and the tone of monetary policy is to calculate the correlations between the cyclical behaviour of M3 and the yield on three-month Treasury bills, the value of which is 0.62, and between the cyclical behaviour of M3 and the yield on 10-year bonds, the value of which is 0.05.

Figure 2. 10-year bond yields (iB10a), three-month Treasury bill yields (iTB3m) and the cyclical pattern of the ECB's M3 monetary aggregate (AM3)



Source: own elaboration

Once it has been proven that the yield on 10-year bonds can be considered a good approximation of the natural rate of interest, since it does not respond to the tone and orientation of the ECB's monetary policy, the spread between the yield on 10-year bonds and the yield on three-month Treasury bills is used as an approximation of the spread between the natural rate of interest and the monetary interest rate in the short-term credit market.

$$SPR_t = ln\left[{(1 + i_{10y})_t}/{(1 + i_{3m})_t}\right] \tag{36}$$

3. Obtaining a measure of a country's production structure is no easy task given the aggregate nature of most historical production series. However, in order to represent a relationship between the stages furthest away from final consumption and the stages closer to it, and to show how the former, which are more intensive in time and capital, expand in the early stages of the monetary expansion cycle at the expense of the latter, dedicated to the production of final consumption goods, and how this relationship ends up reversing over time, this paper resorts to the production indexes of capital goods, consumer durables and intermediate goods (which would represent the stages furthest away from final consumption), and the production index of consumer goods extracted from the National Institute of Statistics (INE) (which would represent the stages closer to final consumption) (Alonso et al., 2013).

It is assumed, in line with ABCT, that changes in the interest rate differential will influence three ratios constructed from these indices, namely capital goods/consumer goods, consumer durables (which in Spain includes construction)/consumer goods, and intermediate goods/consumer goods. Thus, if empirical evidence in favour of ABCT is found, it should be possible to verify that an increase in the interest rate differential would cause these ratios to rise, and that a decrease in the interest rate differential would tend to reduce these ratios.

Therefore, in order to reflect the cyclical behaviour of the production structure, as next step, there are constructed the some ratios based on deviations (using the filters of Hodrick and Prescott, 1997):

$$\Delta PE_{1t} = ln\left[\frac{\left({Capital\ goods}/{Consumer\ goods}\right)_t}{trend\left({Capital\ goods}/{Consumer\ goods}\right)_t}\right] \tag{37}$$

$$\Delta PE_{2t} = ln\left[\frac{\left({Consumer\ durables}/{Consumer\ goods}\right)_t}{trend\left({Consumer\ durables}/{Consumer\ goods}\right)_t}\right] \tag{38}$$

$$\Delta PE_{3t} = ln\left[\frac{\left({Intermediate\ goods}/{Consumer\ goods}\right)_t}{trend\left({Intermediate\ goods}/{Consumer\ goods}\right)_t}\right] \tag{39}$$

4. On the other hand, the industrial production index (IPI) is used to incorporate a measure of aggregate economic activity. In this case, fluctuations in aggregate economic activity are measured based on deviations of the IPI from its trend:

$$\Delta IPI_t = ln\left({IPI_t}/{trendIPI_t}\right) \quad (40)$$

For information purposes, Table 1 presents a description of the statistical analysis of the variables included in the study.

Table 1. Descriptive statistics of the variables included in the study

	$\Delta M3_t$	SPR_t	ΔPE_{1t}	ΔPE_{2t}	ΔPE_{3t}	ΔIPI_t
Mean	-0.000210	0.025041	-0.006719	-0.007845	-0.015952	-0.005514
Median	-0.001088	0.026404	0.027932	0.026049	-0.033919	0.020176
Maximum	0.034194	0.040149	0.135588	0.134412	0.666318	0.143688
Minimum	-0.020761	0.006699	-0.462416	-0.523590	-0.425986	-0.378886
Standard dev	0.011402	0.008760	0.118275	0.126432	0.161449	0.104998
Obliquity	0.660852	-0.444955	-2.316027	-2.407351	1.010099	-1.665102
Kurtosis	3.245550	2.267851	7.830418	8.527041	5.207727	5.837847

Source: own elaboration

3. Results and discussion

3.1. Impulse mechanisms of the business cycle

Following Wainhouse (1984), Carilli and Dempster (2008) and Alonso et al. (2013), this section uses Granger (1969) causality tests to test the hypotheses regarding the Austrian business cycle impulse mechanisms. Given the variables defined in the previous section, verifying the first three hypotheses stated in section 5 would imply the need to verify the following hypotheses:

1. $\Delta M3_t$ Granger-causes .
2. SPR_t Granger-causes ΔPE_{jt} (j=1,2,3).
3. SPR_t Granger-causes ΔIPI_t.

Before testing the hypotheses corresponding to the impulse mechanisms of the business cycle, the stationarity of the variables under study is determined by means of the augmented Dickey-Fuller test (used to verify whether a time series is stationary or not, where stationarity means that the variances and covariances of the means of the time series are constant over time). Based on the Akaike information criterion, a maximum of 13 lags are used. Table 2 shows that all variables are stationary at least at the 5% significance level, except the variable $\Delta M3_t$ which is stationary at the 10% significance level. However, the 10% significance level is accepted so that all the variables analysed are zero-order integrated ($I(0)$) and therefore stationary.

Table 2. Augmented Dickey-Fuller test

Null hypothesis	t-statistic and p-value	Result
A unit root is present in $\Delta M3_t$	-2.655328 (0.0844)*	Reject the null hypothesis
A unit root is present in SPR_t	-4.058279 (0.0402)**	Reject the null hypothesis
A unit root is present in ΔPE_{1t}	-3.179530 (0.0233)**	Reject the null hypothesis
A unit root is present in ΔPE_{2t}	-3.067758 (0.0313)**	Reject the null hypothesis
A unit root is present in ΔPE_{3t}	-3.638692 (0.0061)***	Reject the null hypothesis
A unit root is present in ΔIPI_t	-4.394998 (0.0005)***	Reject the null hypothesis

*** 1%, ** 5%, * 10%

Source: own elaboration

The next step is to perform the Granger causality tests. The goal consists in the determination of the optimal order of lags in each tests performed to solve the possible problems of autocorrelation, derived from establishing too few lags, and multicollinearity. Information criteria and other mechanisms are taken from Akaike (AIC), Hannan-Quinn (HQ), Schwarz (SC), the likelihood-ratio test (LR) and the final prediction error method (FPE), the search procedures for the optimal number of lags chosen following the Vector Autoregressive (VAR) methodology.

Table 3. Determination of the optimal order of lags

	LR	FPE	AIC	SC	HQ
$\Delta M3_t - SPR_t$	11.17444* (7)	$4.62e^{12}$* (3)	-20.42480* (3)	-20.20641* (2)	-20.33542* (2)
$SPR_t - \Delta PE_{1t}$	59.57691* (12)	$6.34e^{10}$* (12)	-15.51448*(12)	-14.34096*(12)	-15.03761*(12)
$SPR_t - \Delta PE_{2t}$	11.98364* (14)	$7.00e^{10}$* (15)	-15.42185*(15)	-14.19469*(12)	-14.89282*(14)
$SPR_t - \Delta PE_{3t}$	9.596704* (16)	$3.87e^{10}$* (16)	-16.01724*(16)	-14.80071*(12)	-15.49739*(12)
$SPR_t - \Delta IPI_t$	25.93219*(15)	$7.55e^{10}$* (15)	-15.35224*(18)	-14.06767*(12)	-14.79889*(15)

Source: own elaboration

Normally, in the econometric literature, the Granger causality tests are usually established for a number of specific lags; however, in the present study the decision was made to carry out the causality tests for all the sets of optimal lags obtained through the selection criteria selected in the previous paragraph in order to ensure the consistency of the results.

The first three rows of Table 4 present the results of the Granger causality test between $\Delta M3_t$ and SPR_t for the optimal lags chosen using the selection criteria shown in Table 3. It can be seen that $\Delta M3_t$ Granger-causes SPR_t at least at the 5% level of significance. However, SPR_t does not Granger-cause $\Delta M3_t$. These results provide empirical evidence that the cyclical behaviour of the monetary aggregate M3 Granger-causes changes in the interest rate differential with a lag period between two and seven months, implying that the ECB monetary policy stance caused changes in the slope of the Spanish yield curve for the period analysed.

It may be relevant to chart the impact of the cyclical behaviour of the monetary aggregate M3 on the interest rate differential,

especially when the observed correlation between the monetary policy tone and the interest rate differential over the period 2002-2014 is 0.67.

Figure 3. The impact of the cyclical behaviour of the monetary aggregate M3 on the interest rate differential.

Source: own elaboration

The fourth row of Table 4 shows the result of the Granger causality test between SPR_t and ΔPE_{1t} for the number of lags chosen using the selection criteria indicated. It can be seen that SPR_t Granger-causes ΔPE_{1t} at least at the 5% level of significance. However, ΔPE_{1t} does not Granger-cause SPR_t.

The fifth, sixth and seventh rows of Table 4 show the results of the Granger causality tests between SPR_t and ΔPE_{2t} for the optimal lags chosen using the defined selection criteria. They show that in two of the tests SPR_t Granger-causes ΔPE_{2t} at least at the 5% level of significance. On the other hand, ΔPE_{2t} does not Granger-cause SPR_t.

The eighth and ninth rows of Table 4 present the results of the Granger causality tests between SPR_t and ΔPE_{3t} for the optimal lags chosen using the defined selection criteria. It may be observed that in one of the two tests SPR_t Granger-causes ΔPE_{3t} at least at the 5% level of significance. Nonetheless, ΔPE_{3t} does not Granger-cause SPR_t.

These results provide empirical evidence that variations in the interest rate differential Granger-cause cyclical deviations in the production structure with a lag period between 12 and 16 months (Friedman and Schwartz, 1963; Friedman, 1968, 1993), which implies, for the specific case of Spain between 2002 and 2014, that variations in the slope of the Spanish yield curve caused alterations in the production structure of the Spanish economy.

The 10th, 11th and 12th rows of Table 4 show the results of the Granger causality tests between SPR_t and ΔIPI_t for the sets of optimal lags chosen using the above-mentioned selection criteria. They show how, at least at a 5% significance level, SPR_t Granger-causes ΔIPI_t; moreover, in two of the tests, ΔIPI_t also Granger-causes SPR_t. Therefore, there is a bidirectional causality

between the variables, which may be due to the marked countercyclical nature of the ECB's monetary policy between 2007 and 2014. The results obtained provide empirical evidence that changes in the interest rate differential Granger-cause cyclical swings in industrial aggregate activity with a lag period between 12 and 18 months. This implies, as far as this paper is concerned, that changes in the slope of Spain's yield curve (as an indicator of the tone and stance of monetary policy) caused changes in the country's aggregate economic activity and its production structure.

Table 4. Granger causality tests (the null hypothesis of non-causality is rejected at the 5% level of significance)

		H_0: $\Delta M3_t$ does not Granger-cause SPR_t	H_0: SPR_t does not Granger-cause $\Delta M3_t$
Observations	**Lags**	**F statistic and p-value**	**F statistic and p-value**
154	2	8.43415 (0.0003)***	1.74026 (0.1790)
153	3	5.67040 (0.0011)***	2.58956 (0.0552)*
149	7	2.92522 (0.0070)***	1.54715 (0.1568)
		H_0: SPR_t does not Granger-cause ΔPE_{1t}	H_0: ΔPE_{1t} does not Granger-cause SPR_t
Observations	**Lags**	**F statistic and p-value**	**F statistic and p-value**
144	12	3.09620 (0.0008)***	0.90799 (0.5413)
		H_0: SPR_t does not Granger-cause ΔPE_{2t}	H_0: ΔPE_{2t} does not Granger-cause SPR_t
Observations	**Lags**	**F statistic and p-value**	**F statistic and p-value**
144	12	6.28511 (0.0000)***	1.36861 (0.1906)
142	14	1.02489 (0.4343)	1.21383 (0.2753)
141	15	2.74101 (0.0220)**	1.29841 (0.2156)
		H_0: SPR_t does not Granger-cause ΔPE_{3t}	H_0: ΔPE_{3t} does not Granger-cause SPR_t
Observations	**Lags**	**F statistic and p-value**	**F statistic and p-value**
144	12	5.02607 (0.0000)***	1.09195 (0.3732)
140	16	1.62056 (0.0757)*	1.38734 (0.1620)
		H_0: SPR_t does not Granger-cause ΔIPI_t	H_0: ΔIPI_t does not Granger-cause SPR_t
Observations	**Lags**	**F statistic and p-value**	**F statistic and p-value**
144	12	3.63485 (0.0001)***	2.15950 (0.0180)**
141	15	2.44848 (0.0040)***	1.24612 (0.2495)
138	18	1.85638 (0.0284)**	2.25169 (0.0059)***

Source: own elaboration. *** 1%, ** 5%, * 10%

In summary, the Granger causality tests in Table 4 illustrate the first three hypotheses of Section 5 and, therefore, provide empirical evidence in favour of the Austrian cycle impulse mechanisms, since they show that the ECB's monetary policy course affected the slope of the Spanish yield curve, and that this in turn caused alterations in the productive structure of the economy, causing the initial monetary shock to be transmitted to the entire productive process represented by the industrial production index.

3.2. Propagation mechanisms of the business cycle

Having analysed the driving mechanisms of the Austrian business cycle, we now turn to test the fourth and fifth hypotheses put forward in section 5, which refer to the propagation mechanisms of the Austrian expansionary-recessionary cycle. The ABCT warns that an artificial increase in the interest rate differential caused by a process of monetary and credit expansion can have only positive effects on the production structure and aggregate economic activity in the short-term. As time goes on, the artificial distortions induced in the production structure and the resulting real resource constraints will cause the initial boom to turn into a recession as the spontaneous market adjustment process uncovers the malinvestments caused by the excess of inexpensive credit.

In the case of Spain between 2002 and 2014, looking at the evolution of the interest rate differential, it is clear that it increases from 2002, and then starts to decrease at the dawn of the recession (i.e. before 2007-2008). However, the differential increases again in the following years as a consequence of the orchestration of a new monetary expansion by the ECB. In this sense, if the Spanish economy responds to the story of the Austrian theory of the endogenous expansionary-recessionary cycle, it should be observed that the ratios of output ΔPE_{1t}, ΔPE_{2t} and ΔPE_{3t} and aggregate economic activity (as defined by the IPI) increase when the interest rate differential increases, and decrease when it decreases. However, after the initial expansionary-recessive movement, a new increase in output ratios and aggregate output should be observed as a consequence of a new countercyclical monetary expansion executed by the ECB, leading to a new distortion of the production structure and the beginning of a new phase of unsustainable boom (or expansionary-recessive business cycle).

One way of contrasting the above would be to locate endogenous turning points in the effect of the interest rate differential on the three ratios that represent Spain's production structure and on the industrial production index. Finding these endogenous turning points would reveal the existence of recurrent economic cycles that are self-perpetuating in line with the contributions of the Austrian approach (Alonso et al., 2013).

To account for this process, and following the contributions of Carilli and Dempster (2008) and Alonso et al. (2013), four polynomial distributed lag (PDL) models (Almon, 1965) are estimated, in which the dependent variables are the three ratios representing the Spanish production structure (ΔPE_{1t}, ΔPE_{2t} and ΔPE_{3t}) and the variable that accounts for aggregate economic activity (Industrial production index, IPI), while the explanatory variables incorporate n lags of the interest rate differential. The four models are represented as follows:

$$\Delta PE_{1t} = \alpha + \sum_{i=0}^{n} \beta_i SPR_{t-i} + \varepsilon_i \quad (41)$$

$$\Delta PE_{2t} = \alpha + \sum_{i=0}^{n} \beta_i SPR_{t-i} + \varepsilon_i \quad (42)$$

$$\Delta PE_{3t} = \alpha + \sum_{i=0}^{n} \beta_i SPR_{t-i} + \varepsilon_i \quad (43)$$

$$\Delta IPI_t = \alpha + \sum_{i=0}^{n} \beta_i SPR_{t-i} + \varepsilon_i \quad (44)$$

$$\text{Where } \beta_i = a_0 + \sum_{j=1}^{m} a_j i^j \quad (45)$$

If ABCT explains the Spanish case, the estimates of the regression coefficients (β_i) should initially increase up to a given number of lags, subsequently decreasing (also up to a specific number of lags), and finally show increasing values again. This evolution would outline a process of boom, recession, recovery and new boom, induced by the ECB's monetary policy stance and intensity.

Polynomial distributed lag (PDL) models require the determination of two unknowns: the length of the delays (n) and the degree of the polynomial (m) used to estimate the value of the betas. The logic of the historical data collected and of the ABCT suggests that it would be appropriate to apply a third-degree polynomial, in order to contemplate the process of an unsustainable boom, recession and recovery and a new induced boom. After several tests, the best values of Akaike and Schwartz criteria and adjusted R^2 are obtained from n = 45 y m = 3. Therefore, four third-degree polynomial distributed lag models with 45 lags are established.

Once the four models have been established, it is necessary to check the assumptions of homoscedasticity, as well as for the absence of multicollinearity and autocorrelation, in order to ensure the robustness and consistency of the results. The Breusch-Pagan-Godfrey heteroscedasticity tests ensure that the four models meet the homoscedasticity assumption. On the other hand, the variance inflation factors (VIF) ensure that all models comply with the assumption of non-multicollinearity. However, the Durbin-Watson statistics and the LM tests for serial correlation provide evidence that there is autocorrelation in the residuals. Therefore, it is necessary to introduce certain adjustments to avoid the problems derived from the existence of residual autocorrelation. In order to homogenise the results of the four models, an autoregressive variable AR(12) was introduced to solve the problems derived from the existence of autocorrelation. Once introduced, the result of the Durbin-Watson statistic allows us to accept the null hypothesis of absence of autocorrelation.

Columns 2 to 4 of Table 5 show the relationship between the three ratios that represent the cyclical behaviour of the Spanish production structure and the lagged changes in the interest rate differential. These columns reveal that the effect of an increase in the interest rate differential on these ratios is initially positive but becomes negative when

the interest rate differential decreases during the market's spontaneous adjustment process. Subsequently, it returns to positive values when the ECB initiates a new monetary expansion and generates a new increase in the interest rate differential. Thus, it can be observed that the betas show increasing values up to 12-16 lags (months) of the interest rate differential, which represents the boom phase of the Austrian cycle (in which the stages of the production structure furthest away from final consumption expand to the detriment of those closer to it). However, from that moment on, the estimates of the betas decrease until 31-34 lags (months), which characterises the deceleration and recession phase of the Austrian cycle (in which the stages of the production structure farther away from final consumption deteriorate more intensely than those closer to final consumption). Finally, the estimated values of the betas again show increasing values up to 45 lags (months), which implies that the economy enters a new phase of artificial boom induced by a new process of monetary expansion (which again raises the slope of the yield curve) orchestrated by the ECB.

It should be noted that the fit of the model is especially good for the cyclical behaviour of the ratio ΔPE_{2t} (consumer durables/consumer goods), with an adjusted R^2 greater than 0.90, which is consistent with the economic reality, since it should be remembered that the Spanish consumer durables index includes construction, for which the bubble and the subsequent bursting thereof in 2007-2008 marked the beginning of the economic and financial crisis. The fact that the goodness of fit is higher for this ratio implies that the effect of variations in the yield curve is especially significant on the construction sector, which is entirely predictable, since a large part of the newly created loans and credits were channelled at artificially low rates to this sector.

Similarly, column 5 reveals the relationship between the cyclical behaviour of aggregate industrial activity and lagged changes in the interest rate differential. The effect that the slope of the yield curve has on industrial aggregate activity is represented by the values of the betas. The regression coefficients show increasing values up to 13 lags (months) of the interest rate differential, reflecting the unsustainable growth phase of the Austrian cycle. However, thereafter the estimates decrease up to 33 lags (months), which is the deceleration and recession phase of the Austrian cycle. Finally, the betas return to increasing values up to 45 lags (months) of the rate differential, implying a new phase of unsustainable boom orchestrated by the new monetary inflation processes of the ECB.

Figure 4 represents the lagged effects of the interest rate differential on the three ratios that approximate the productive structure of the Spanish economy and on aggregate industrial activity. The figure allows us to visualise the existence of endogenous turning points in both the lagged impact of the slope of the yield curve on the production structure and on aggregate industrial activity. Thus, the evolution of the Spanish productive structure between 2012 and 2014 allows us to confirm the fourth and fifth hypotheses set out in section 5, since it has been possible to verify that the Spanish case responds to the concept of the expansionary-recessionary cycle set out by ABCT.

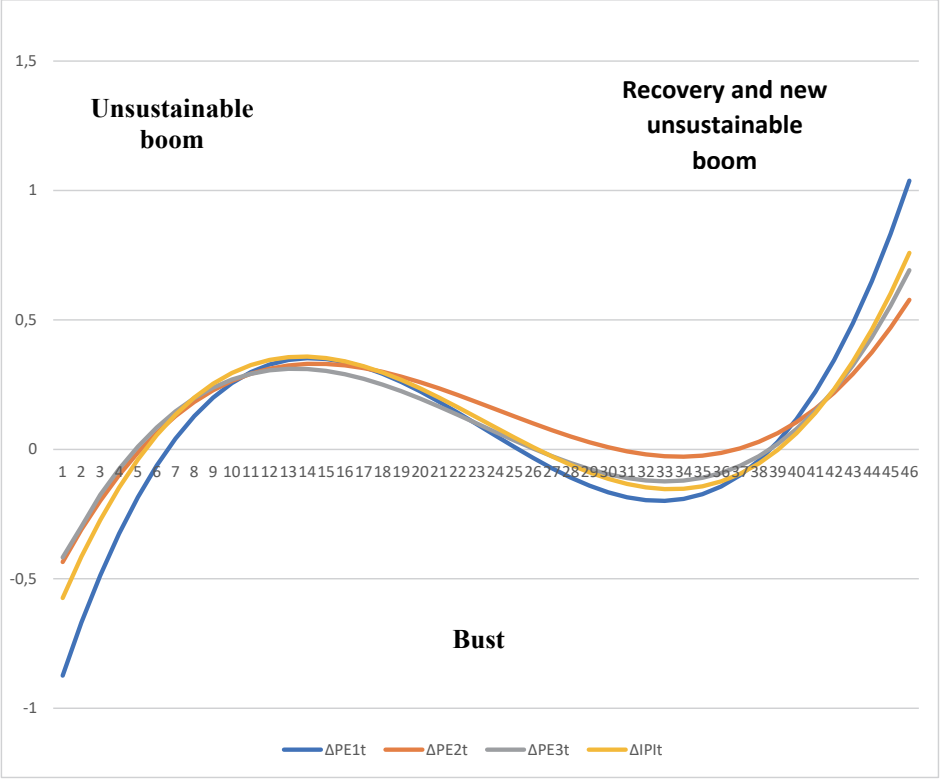
Table 5. Lagged effects of the interest rate differential on the three ratios that approximate the productive structure of the Spanish economy and on aggregate industrial activity

Coefficient β_i	ΔPE_{1t}	ΔPE_{2t}	ΔPE_{3t}	$\Delta IPEI_t$
SPR_t	-0.87381***	-0.43508**	-0.4171**	-0.57391**
SPR_{t-1}	-0.66934***	-0.31018*	-0.29911*	-0.41462*
SPR_{t-2}	-0.487***	-0.19847	-0.17564*	-0.27291*
SPR_{t-3}	-0.32578***	-0.09936	-0.076	-0.14798
SPR_{t-4}	-0.18464***	-0.01225	0.0105	-0.039
SPR_{t-5}	-0.06255	0.06347	0.08453	0.05484
SPR_{t-6}	0.04152	0.12837*	0.14678***	0.13435**
SPR_{t-7}	0.12861***	0.18306***	0.19794***	0.20035***
SPR_{t-8}	0.19974***	0.22814***	0.23869***	0.25366***
SPR_{t-9}	0.25595***	0.26419***	0.26973***	0.2951***
SPR_{t-10}	0.29826***	0.29182***	0.29172***	0.32547***
SPR_{t-11}	0.32771***	0.31162***	0.30536***	0.34559***
SPR_{t-12}	0.34533***	0.32419***	0.31134***	0.35629***
SPR_{t-13}	0.35215***	0.33011***	0.31034***	0.35838***
SPR_{t-14}	0.3492***	0.32999***	0.30304***	0.35266***
SPR_{t-15}	0.33752***	0.32443***	0.29013***	0.33996***
SPR_{t-16}	0.31812***	0.31401***	0.27229***	0.3211***
SPR_{t-17}	0.29205***	0.29934***	0.25021***	0.29689***
SPR_{t-18}	0.26034***	0.281***	0.22458***	0.26814***
SPR_{t-19}	0.22401***	0.2596***	0.19608***	0.23568***
SPR_{t-20}	0.1841***	0.23573***	0.16539***	0.20031***
SPR_{t-21}	0.14164***	0.20998***	0.13321***	0.16285***
SPR_{t-22}	0.09766***	0.18296***	0.10021***	0.12413**
SPR_{t-23}	0.05319	0.15525***	0.06708*	0.08495*
SPR_{t-24}	0.00926	0.12745**	0.0345	0.04613

Coefficient β_i	ΔPE_{1t}	ΔPE_{2t}	ΔPE_{3t}	$\Delta IPEI_t$
SPR_{t-25}	-0.03309	0.10016*	0.00317	0.00848
SPR_{t-26}	-0.07284	0.07397	-0.02624	-0.02717
SPR_{t-27}	-0.10896*	0.04949*	-0.05304	-0.06001*
SPR_{t-28}	-0.14041**	0.02729*	-0.07654*	-0.08923*
SPR_{t-29}	-0.16615**	0.00799*	-0.09605**	-0.11401**
SPR_{t-30}	-0.18518**	-0.00783**	-0.11091**	-0.13353***
SPR_{t-31}	-0.19644***	-0.01957**	-0.1204***	-0.14698***
SPR_{t-32}	-0.19891***	-0.02664**	-0.12387***	-0.15355***
SPR_{t-33}	-0.19155***	-0.02843**	-0.12061***	-0.15241**
SPR_{t-34}	-0.17335**	-0.02435**	-0.10994**	-0.14275**
SPR_{t-35}	-0.14325**	-0.01382**	-0.09118**	-0.12376**
SPR_{t-36}	-0.10025*	0.00378*	-0.06364*	-0.09461**
SPR_{t-37}	-0.04329	0.02903*	-0.02663	-0.0545*
SPR_{t-38}	0.02864	0.06253	0.02052	-0.00261*
SPR_{t-39}	0.11658**	0.10487	0.0785	0.06189
SPR_{t-40}	0.22156***	0.15665*	0.148*	0.13979*
SPR_{t-41}	0.34461***	0.21847*	0.22971**	0.23193*
SPR_{t-42}	0.48677***	0.29092*	0.3243***	0.33912**
SPR_{t-43}	0.64906***	0.3746**	0.43247***	0.46216**
SPR_{t-44}	0.83251***	0.4701**	0.5549***	0.60188**
SPR_{t-45}	1.03816***	0.57802**	0.69228***	0.7591**
AR(12)	0.936023***	0.899012***	0.713064***	0.824977***
Constant	-0.099335*	-0.160972***	-0.114378***	-0.118905***
Adjusted R^2	0.858081	0.910486	0.552995	0.672717
F statistic	111.8482	129.4053	23.68041	38.68347
p-value (F)	0.0000	0.0000	0.0000	0.0000
Log-likelihood	181.1145	213.2275	188.4084	156.6701

Source: own elaboration

Figure 4. Lagged effects of the interest rate differential on the three ratios that approximate the productive structure of the Spanish economy and on aggregate industrial activity (β_i values)



Source: own elaboration

Conclusions

This research has analysed the theory of investment errors induced by monetary and credit expansion processes without the prior support of real voluntary savings (only supported by political decisions). The ABCT establishes that a monetary expansion orchestrated by the central bank has only positive effects on the production structure and on aggregate economic activity in the short term (and not always). However, in the medium and long term, the constraints of real resource (associated with the unsustainable growth phase) and the intertemporal mismatch (between savings and investment decisions), it will cause the reverse of that kind of positive effect, when the spontaneous adjustment process of the market uncovers and purifies the massive investment errors in productive processes undertaken in the stages of the productive structure furthest away from final consumption. These stages produce capital goods and consumer durables that require more time to mature than consumer-savers are willing to wait. As a result, a good part of the production of these sectors will not be absorbed by the markets, resulting in a strong and undesirable accumulation of stock.

The aim was to review the ABCT and to transfer it to the field of Applied

Economics, using econometric techniques, in order to illustrate it through the characterisation of a specific historical episode: the Spanish cycle of the period 2002-2014. Resorting to the use of Granger causality tests and Almon´s polynomial distributed lag models, it has been possible to empirically prove that ABCT helps to explain the observable historical data from the Spanish cycle of 2002-2014. Granger causality tests have found that the cyclical behaviour of the ECB's monetary aggregate M3 Granger-causes the variations in the slope of the Spanish yield curve. According to Granger-causes for cyclical fluctuations of the production structure and aggregate industrial activity, it is confirming the impulse mechanisms of the Austrian cycle. With the polynomial distributed lags models applied, endogenous inflection points have been identified in the effect that the Spanish yield curve has on the cyclical behaviour of the productive structure and industrial aggregate activity, thus showing that the cycle of the Spanish economy between 2002 and 2014 could respond to the concept of the expansionary-recessionary cycle as proposed by the Austrian School. Likewise, the propagation mechanisms of the Austrian cycle would also have been verified, whereby a monetary shock from the ECB would have been transmitted, with a certain delay, to the entire real economy, causing distortions in the productive structure of the Spanish economy and cyclical oscillations in its aggregate industrial activity.

This study may have interpretative limitations, because according to the statistical literature, Granger causality tests imply incremental predictability rather than direct causality. However, although Granger causality tests do not infallibly assume a causal relationship between variables, they do provide some empirical evidence thereof. Similarly, care should be taken when interpreting the magnitudes obtained through polynomial distributed lag models. Nevertheless, both the significance and the signs of the estimates obtained provide strong evidence that the endogenous boom and bust characteristics of ABCT are present in the data.

Therefore, by means of applying econometric techniques (contributed by the Austrian School renewal) to the case of the Spanish business cycle between 2002 and 2014 (i.e. boom, recession and recovery), the present research does find empirical evidence in favour of ABCT in this particular historical episode. In this sense, and as a guideline for future lines of research, the results obtained may help to deepen further studies of this type (i.e. comparisons with other Eurozone countries) or encourage the application of econometric methods based on previous non-econometric studies (i.e. Rothbard, 1963; Powell, 2002; Callahan & Garrison, 2003). Furthermore, it may help to emphasise the unique features of the Austrian Business cycle theory in relation to competing business cycle theories (socialist theories, Keynesian and neo-Keynesian theories, modern monetary theory or new-classical theories of the real cycle, among others).

References

Almon, S. (1965), The distributed lag between capital appropriations and expenditures. *Econometrica: Journal of the Econometric Society, 33(1)*, 178–196.

Alonso, M.A. (2004), Una guía para el estudio de la Macroeconomía del Capital:¿ Existen razones para pensar que los ciclos recesivos responden a errores políticos y empresariales? *Procesos de mercado*, (1): 113-186.

Alonso, M.A. (2005), Las teorías monetarias del ciclo en el marco de la literatura sobre ciclos económicos. *Revista Libertas* 13(43), 1-28.

Alonso, M.A., Bagus, P., Rallo, J.R. (2011), La crisis subprime a la luz de la teoría austriaca del ciclo económico: Expansión crediticia, errores de decisión y riesgo moral. *Revista de Economía Mundial*, (28), 145-174.

Alonso, M.A., Bagus, P., Romero, A. (2013), Una ilustración empírica de la teoría austriaca del ciclo económico: el caso de Estados Unidos, 1988-2010. *Investigación económica* 72(285), 41-74.

Alonso, M.A., Sánchez-Bayón, A., Castro-Oliva, M. (2023), Teoría austriaca del ciclo económico aplicada al caso español: del inicio del euro a la gran recesión y su recuperación. *Revista de Métodos Cuantitativos para la Economía y la Empresa,* 35: 280-310. https://dx.doi.org/10.46661/revmetodoscuanteconempresa.6837

Bismans, F., Mougeot, C. (2009), Austrian business cycle theory: Empirical evidence. *The Review of Austrian Economics* 22(3), 241-257.

Böhm-Bawerk, E. (1884), *Geschichie und Kritik der Kapitalzins-Theorieen.* Innsbruck: Wagner'schen Universitäts-Buchhandlung.

Böhm-Bawerk, E. (1888), *Positive Theorie des Capitals*. Innsbruck: Wagner'schen Universitäts-Buchhandlung.

Cachanosky, N., Padilla, A. (2016), A Mathematical Version of Garrison's Model. *Quarterly Journal of Austrian Economics* 19(3), 225-247.

Cachanosky, N. (2017), Secular Growth in Garrison's Model: A Comment. *Quarterly Journal of Austrian Economics* 40(5), 354-359.

Callahan, G., Garrison, R. (2003), Does Austrian business cycle theory help explain the dot-com boom and bust? *The Quarterly Journal of Austrian Economics* 6(2), 67-98.

Carilli, A., Dempster, G. (2008), Is the Austrian business cycle theory still relevant?. *The Review of Austrian Economics* 21(4), 271-281.

Ebeling, R. (2001), Austrian Macroeconomics: Review of Time and Money. *Quarterly Journal of Austrian Macroeconomics 4(3)*, 47-66.

Engelhardt, L. (2009), Comment on 'A Capital-Based Theory of Economic Growth'. *Quarterly Journal of Austrian Economics 12(2)*, 60-62.

Fisher, E. A. (2013), Monetary policy and capital-based macroeconomics: an empirical examination for the United States (1963-2012), *Quarterly Journal of Austrian Economics 16(1)*, 45-74.

Friedman, M., Schwartz, A. (2008), *A monetary history of the United States, 1867-1960*. Princeton: Princeton University Press.

Friedman, M. (1968), The role of monetary policy. *The American Economic Review* 58(1), 1-17.

Friedman, M. (1993), The "plucking model" of business fluctuations revisited. *Economic Inquiry 31(2)*, 171-177.

Garrison, R. (1978), *Austrian macroeconomics: A diagrammatical exposition.* Menlo Park: Institute for Humane Studies.

Garrison, R. (1989), The Austrian theory of the business cycle in the light of modern macroeconomics. *The Review of Austrian Economics 3(1)*, 3-29.

Garrison, R. (2006), Natural and neutral rates of interest in theory and policy formulation. *Quarterly Journal of Austrian Economics 9(4)*, 57-68.

Garrison, R. (2001), *Time and Money.* London: Routledge.

Granger, C. (1969), Investigating Causal Relation by Econometric and Cross-sectional Method. *Econometrica 37*, 424-438.

Hayek, F. (1929), *Monetary Theory and the Trade Cycle. London: University of London.*

Hayek, F. (1931), *Prices and production.* London: Routledge.

Hayek, F. (1941), *The Pure Theory of Capital*. London: Macmillan.

Hodrick, R., Prescott, E. (1997), Postwar U.S. business cycles: an empirical investigation. *Journal of Money, credit, and Banking 29(1)*, 1-16.

Huerta de Soto, J. (1998), *Dinero, Crédito Bancario y Ciclos Económicos.* Madrid: Unión Editorial.

Huerta de Soto, J. (2009), *The Theory of the dynamic efficiency.* London: Routledge.

Hülsmann, J. G. (2001), Garrisonian macroeconomics. *Quarterly Journal of Austrian Economics 4(3)*, 33-41.

Hutchison, T. (1956), Professor Machlup on Verification in Economics. *Southern Economic Journal 17*: 476–83.

Keeler, J. (2001), Empirical evidence on the Austrian business cycle theory. *The Review of Austrian Economics 14(4)*, 331-351.

Le Roux, P., Levin, M. (1998), The capital structure and the business cycle: some tests of validity of the Austrian business cycle in South Africa. *Studies in Economics and Econometrics 22(3)*, 91-109.

Lester, R. B., Wolff, J. S. (2013), The empirical relevance of the Mises-Hayek theory of the trade cycle. *The Review of Austrian Economics 26*(4), 433-461.

Lucas, R. (1972), Expectations and the Neutrality of Money. *Journal of Economic Theory 4(2)*, 103-124.

Luther, W., Cohen, M. (2014), An empirical analysis of the Austrian business cycle theory. *Atlantic Economic Journal 42*(2), 153-169.

Machlup, F. (1931), *The Stock Market, Credit and Capital Formation*. London: Hodge.

Machlup, F. (1936), Why Bother with Methodology? *Economica* 3(9), 39-45.

Menger, C. (1883), *Untersuchungen über die Methode der Socialwissenschaften, und der Politischen Oekonomie insbesondere*. Leipzig: Verlag.

Mises, L. (1912), *Theorie des Geldes und der Umlaufsmittel.* Leipzig: Verlag.

Mises, L. (1949), *Human Action: A Treatise on Economics.* New Haven: Yale Univ. Press.

Mulligan, R. (2002), A Hayekian analysis of the term structure of production. *Quarterly Journal of Austrian Economics* 5(2), 17-33.

Mulligan, R. (2006), An empirical examination of Austrian business cycle theory. *Quarterly Journal of Austrian Economics* 9(2), 69-93.

Murphy, R. (2017), Is Garrison´s notion of "secular growth" compatible with the Solow growth literature? *Quarterly Journal of Austrian Economics* 20(4), 336-353.

Powell, B. (2002), Explaining Japan's recession. *Quarterly Journal of Austrian Economics* 5(2), 35-50.

Rothbard, M. (1957), In Defense of "Extreme Apriorism". *Southern Economic Journal* 18: 314-320.

Rothbard, M. (1963), *America´s Great Depression.* New York: Van Nostrand.

Salerno, J. (2001), Does the concept of secular growth have a place in capital-based macroeconomics? *Quarterly Journal of Austrian Economics* 4(3), 43-61.

Sánchez-Bayón, A. (2020), Renovación del pensamiento económico-empresarial tras la globalización. *Bajo Palabra* 24: 293-318. https://doi.org/10.15366/bp.2020.24.015

Sánchez-Bayón, A. (2021), The digital economy review under the technological singularity: technovation in labour relations and entrepreneur culture. *Sociología y Tecnociencia* 11(2): 53-80. https://doi.org/10.24197/st.Extra_2.2021.53-80

Sánchez-Bayón, A. (2022), ¿Crisis económica o economía en crisis? Relaciones ortodoxia-heterodoxia en la transición digital. *Rev. Semestre Económico* 11(1): 54–73 http://dx.doi.org/10.26867/se.2022.1.128

Sánchez-Bayón A, Castro-Oliva M. (2022), Historia de la reciente deflación del capital y los salarios en España: Revisión de los desarrollos de la teoría de ciclos económicos. *Iberian Journal of the History of Economic Thought*, *9*(2), 111-131. https://doi.org/10.5209/ijhe.82760

Sánchez-Bayón A, González-Arnedo E, Andreu-Escario A. (2022), Spanish Healthcare Sector Management in the COVID-19 Crisis Under the Perspective of Austrian Economics and New-Institutional Economics. *Frontiers in Public Health* 10:801525. DOI: 10.3389/fpubh.2022.801525

Sánchez-Bayón, A., Urbina, D. A., Castro-Oliva, M. (2021), Historia económica heterodoxa de la Escuela de Salamanca: padres de la Economía Política y Hacienda Pública y referentes de otras escuelas, Journal of the Sociology and Theory of Religion, 14 Extra-1 (2022): 65-102. DOI: https://doi.org/10.24197/jstr.Extra-1.2022.65-102.

Wainhouse, C. (1984), Empirical evidence for Hayek's theory of economic fluctuations. *Money in crisis: The federal reserve, the economy, and monetary reform*.

Wicksell, K. (1898), *Geldzins und Güterpreise.* Jena: Gustav Fischer.

Young, A. (2005), Reallocating labor to initiate changes in capital structures: Hayek revisited. *Economics letters* 89(3), 275-282.

Young, A. (2009a), A capital-based theory of secular growth. *Quarterly Journal of Austrian Economics* 12(1), 36-51.

Young, A. (2009b), A Capital-Based Theory of Secular Growth: Reply to Engelhardt. *Quarterly Journal of Austrian Economics 12(2)*, 63-67.

Young, A. (2011), The time structure of production in the U.S., 2002–2009. *The Review of Austrian Economics 25(2)*, 77-92.

Miguel Angel Alonso-Neira, PhD & BEcon. Scholar & Consultant. He is Full Prof. Applied Economics at University Rey Juan Carlos, Dir. Master in Austrian Economics-URJC & GESCE-URJC, also collaborator at IEB & UNIR. Morever, more than 200 scientific publications (co-dir. Procesos de Mercado). ORCID no. 0000-0002-6778-3594.

Antonio Sanchez-Bayon, PhD & JD in Law, PhD in Theology, PhD in Humanities, PhD & MEd. in Philosophy, PhD & MEc. in Economics, PhDc. in Economics & Business at University of Malaga. Scholar, Consultant & Lawyer. He is Assoc. Prof. Applied Economics at University Rey Juan Carlos, Researcher at GESCE-URJC & INES-UNIR, also Research- fellow at DePaul University. Moreover, he is the author of more than 200 scientific publi- cations (40 books indexed SPI & 45 articles indexed JCR/Scopus, h-i 26 GS). Member of boards of international scientific journals (i.e. *Retos, Semestre Economico, Economia & Negocios, Procesos de Mercado, JSTR, Energies*). Scientific interests: Comparate Political Economy & heterodox approaches; global & digital economy. ORCID no. https://orcid. org/0000-0003-4855-8356.

Marcos Castro-Oliva, Mc. & Bachelor in Economics. Collaborator of GESCE- University Rey Juan Carlos & banker. ORCID no. https://orcid.org/0000-0003-2891-0076.