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ADVERTISING INVESTMENT AS A TOOL FOR BOOSTING CONSUMPTION: TESTING GALBRAITH'S HYPOTHESIS FOR SPAIN

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ABSTRACT: The recession that most of the world economies have been facing in the last years has caused a great interest in the study of its macroeconomic effects. In this context, a debate has resurged regarding the advertising investment, as for its potential capacity to impel the consumer spending and to impact positively on the economic recovery. This idea, sustained in the so-called Galbraith's hypothesis, constitutes the core of this paper, where the main objective is to test that hypothesis by means of an empirical analysis. In this study, we focus on the Spanish case and the data correspond to the period 1976 -2010. A cointegration analysis is carried out, using two different approaches (Engle-Granger test and Gregory-Hansen test, respectively), to determine if there is any relationship between the advertising investment and six macromagnitudes (GDP, National Income, Consumption, Savings and Fixed Capital Formation), as well as the registered unemployment rate. Based on the results obtained, we conclude that Galbraith's hypothesis is not fulfilled for the Spanish case.

KEYWORDS: Advertising investment; Galbraith's hypothesis; macroeconomic effects; unemployment.

JEL CLASSIFICATION: E20; E21.

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INVESTIMENTO EM PUBLICIDADE COMO UMA FERRAMENTA PARA IMPULSIONAR O CONSUMO. TESTE DA HIPÓTESE DE GALBRAITH NA ESPANHA

RESUMO: A recessão que a maioria das economias mundiais suportaram nos últimos anos causou um grande interesse no estudo dos seus efeitos macroeconômicos. Neste contexto, ressurgiu o debate sobre os efeitos do investimento em publicidade, tanto pela sua capacidade potencial para estimular o gasto do consumidor, quanto pelo impacto positivo na recuperação económica. Esta ideia, sustentada na conhecida hipótese de Galbraith, constitui a base deste artigo, cujo objetivo fundamental é testar a citada hipótese por meio de uma análise empírica. Neste estudo, centramo-nos no caso da Espanha usando os dados correspondentes ao período compreendido entre os anos 1976 e 2010. Realizou-se uma análise de cointegração usando duas aproximações (Teste de Engle-Granger e teste de Gregory-Hansen respetivamente), para determinar se existe alguma relação entre investimento de publicidade e seis macro variáveis (PIB, Rendimento Nacional, Procura Interna, Consumo, Poupança e Formação de Capital Fixo), assim como a taxa de desemprego registado. Com os resultados obtidos concluímos que a hipótese de Galbraith não se cumpre no caso da Espanha.

PALAVRAS-CHAVE: Investimento em publicidade; hipótese de Galbraith; efeitos macroeconômicos; desemprego.

1. INTRODUCTION

J. K. Galbraith, in his work *The New Industrial State* (1967), considers the advertising investment[1] as an outstanding instrument to raise the global consumption and consequently to impact positively on job creation and national income, without forgetting the impact on savings and the Gross Domestic Product (GDP). He conceives the publicity, and more concretely the advertising investment, as a powerful motor, with macroeconomic effects, to boost the economic growth. In short, he claims that in case of an increase of the advertising investment this would cause a rise in the global consumption and, therefore, it would lead to job creation and an increase in the national income and, consequently, in the standard of living. He reformulated this idea some years later, even with more emphasis, in *The Affluent Society* (1969) and so he attracted the interest of researchers to testing the so-called "Galbraith's hypothesis" (Wilder, 1974).

This task has not been exempt of some controversy (Clark, 1988; Drake, 1989; Becker and Murphy, 1993; León, 1996; Belch and Belch, 2004; Etayo and Preciado, 2009) and, after having fallen into oblivion in the last decade, it has resurged nowadays in consequence of the economic crisis that is *affecting* both the European Union and the USA, which, in the field of scientific research, induces to show a preferential interest in studying the macroeconomic effects and even the use of the advertising investment as a key tool in economic recession periods (Dhalla, 1980 and O'Malley *et al.*, 2011).

The research carried out up to now shows certain heterodoxy as for the type of data used, variables included, implementation of methodologies, analytic systematization and interpretation of the different results. This may be the reason why there is not a certain consensus when it comes to validate or to refute the hypothesis formulated by Galbraith (García *et al.*, 2000).

Consequently, there is not a clear answer to the two key questions that, due to their explanatory nature, sustain the confirmation of the aforementioned hypothesis: does advertising investment induce to consumption? Or does consumption generate advertising investment? Although it may well be a third question: is there any feedback between them? And, anyway, is there any direct relationship between the advertising investment and the boost of the demand and, hence, the direct increment in consumption?

This is the reason why the research and analysis of the macroeconomic effects that may be caused by the advertising investment remain at the present time, because of their consequences, an outstanding objective for the design of public policies of incen-

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[1] There is a big debate in the literature on the theme of advertising being considered either as spending or investment. Galbraith considers advertising as an investment, so in the context of this paper we use always "advertising investment" hereinafter.

tives for consumption or savings, as well as for the social and cultural incidences that may happen if the hypothesis in question is validated. In this case, if the advertising investment acts as a lever of the consumption, it would be convenient to establish concrete policies (e. g., fiscal measures) directed towards boosting that investment. And, evidently, without ignoring the interest that it also offers for the study of commercial communication from the marketing perspective.

The research reflected by this paper is sustained basically in the methodological formulation which was successfully employed by Chowdhury (1994). It seeks to contribute to the verification of the assumptions formulated by Galbraith by means of an empiric development and taking into account harmonized and consolidated data of the advertising investment made in Spain in the period 1976-2010, which constitute a time series that allows to obtain results endowed with the indispensable robustness. The following macroeconomic variables were used: GDP, net national income, net disposable national income, final consumption, final consumption of households, net savings, fixed capital formation, registered unemployment and total advertising investment.

This paper is structured in the following way. First, shortly, we review the antecedents and most outstanding aspects of the literature that has discussed the fulfillment of Galbraith's hypothesis. Next, we deal with the empirical analysis of this question, describing both the scope of our study and the variables used, and then we carry out a cointegration analysis. Finally, we show the main conclusions and the bibliography.

2. GENESIS AND STATE OF THE ART

The antecedent to Galbraith's hypothesis relies, in opinion of Nevett (1996), on the research carried out by Borden (1942), who finds in the period 1919-1940 that the oscillations in the monthly advertising investment experienced a certain delay in relation to those registered in a production index that the author had created on his own and all these using data of the USA. That led him to think that the advertising investment showed the capacity to accentuate, to a great or a lesser extent, the economic fluctuations and, consequently, we could deduce the existence of a certain interaction.

Borden's formulation, in the idea that the advertising investment produces an effect of increment of the global consumption, would be followed by the works of Hansen (1960), Blank (1962), Yang (1964), Connor (1966) and Norris (1966). All of them are coincident when concluding the existence of a direct effect between the advertising investment and the stimulus of consumption in general terms.

Subsequent to "Galbraith's hypothesis", as Mújika (2004) points out, different studies also concluded that there is some degree of influence between the advertising investment and the increment of global consumption, but without these appreciations could constitute a universal validation. Within those studies we should mention, for their significance: Peel (1975), Wright *et al.* (1977 *apud* Norris, 1980), Ashley *et al.* (1980), Jung and Seldon (1995) and García *et al.* (2000).

However, other studies refute Galbraith's formulation (Metzen, 1967; Backman, 1968; Ekelund and Gramm, 1969; Verdon *et al.*, 1969; Mueller, 1971; Schemalensee, 1972; Taylor and Weiserbs, 1972; Ehremberg, 1974; Schmalensee, 1978; Ashley *et al.*, 1980; Norris, 1980; Jacobson and Nicosia, 1981; Sturgess, 1982; Waterson, 1982; Quarles and Jeffres, 1983; Duffy, 1991; and Chowdhury 1994). All those works agree in that the advertising investment only generates some effect on the consumption – and therefore it has repercussions on the savings and other macroeconomic variables – in some particular cases and so weakly that establishing a direct relationship could be even a rashness. Hence, Galbraith's hypothesis could be reduced to a mere speculative argument which is lacking the necessary theoretical foundation validated by the empirical testing.

Most of the aforementioned research is sustained in methodological developments of causation and cointegration. Of the first ones, one may point out Ashley *et al.* (1980) and Sturgess and Wilson (1984); and within the second ones, Baghestani (1991), Elliot (2001) and Guo (2003).

This evident controversy shows the enormous complexity of the problem, but this has not involved a decline in the interest of researchers in finding new conclusions by virtue of methodological applications which study the interaction of different macroeconomic variables in scenarios that have not been analyzed yet, as it happens in this paper with the delimitation of the scope of the study to the case of Spain.

3. EMPIRICAL ANALYSIS

3.1. SCOPE OF THE STUDY AND VARIABLES USED

In order to test the fulfillment of Galbraith's hypothesis in the case of Spain, for our analysis we have chosen the period 1976-2010, which begins after General Franco's Dictatorship, since before that Spanish economy did not move according to market approaches but rather it was a planned and intervened economy that prevented the typical mechanisms of the free market economy from being developed; hence, evidently, the analysis of the hypothesis in that context would make no sense. We consider that the

period of study is large enough (35 years) to analyze the potential presence of long term relationships between the variables considered, which are the following:

- x_1: Gross Domestic Product.
- x_2: Net National Income.
- x_3: Net Disposable National Income.
- x_4: Final Consumption.
- x_5: Final Consumption of Households.
- x_6: Net Savings.
- x_7: Fixed Capital Formation.
- x_8: Registered unemployment (%).
- x_9: Total advertising investment.

In order to eliminate the demographic effect (in the period considered, there was a considerable population increment, growing from 35.89 million people in 1976 to 47.02 millions in 2010), all the former variables, except for the registered unemployment (x_8), were quantified in terms of current euros *per capita*, considering the population of every year.

As for the sources of our data, for the macromagnitudes (variables x_1 to x_7, both included) we used the database *OECD Statistical Compendium*; the data of the unemployment (x_8) were obtained from the web of the Bank of Spain (www.bde.es); the total advertising investment (x_9) stems from the databases of Dupplo and Infoadex, which implied carrying out the pertinent homogenization and harmonization of the data; and, finally, for population data, the web of the National Institute of Statistics was consulted (www.ine.es).

Figures 1(a) y 1(b) show the diagrammatic representation of the time series corresponding to the nine variables included in our study.

Figure 1(a) – Variables measured in monetary terms

Legend:
- – – GDP
- ········· Net national income
- —— Net disposable national income
- ⚫ Final consumption
- —○— Final consumption households
- —— Net savings
- —○— Fixed capital formation
- —●— Total advertising expenditure
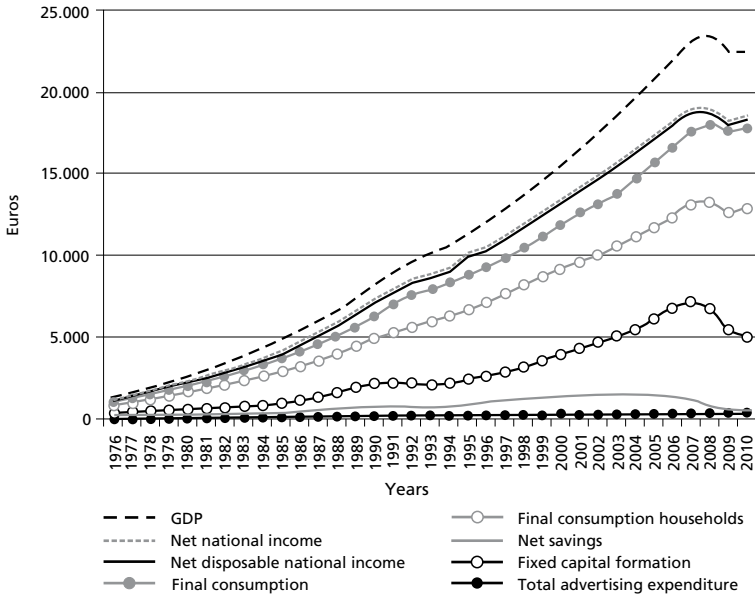
Figure 1(b) – Variables measured in percentage

—— Registered unemployment (%)
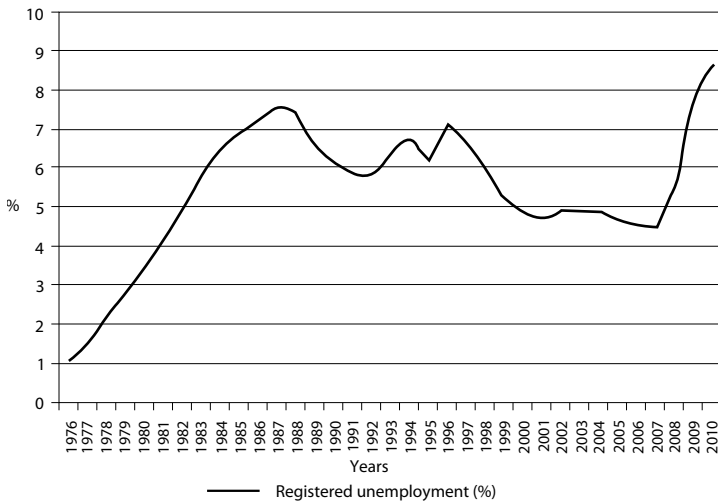
Source: Authors' elaboration.

Table 1 shows the main descriptive statistics of all the variables analyzed.

Table 1 – Descriptive statistics of the variables

Variables	Averages	Std. Dev.	Variation Coef.	Minimum	Maximum
x_1	11,061.4531	7,291.1063	65.9145	1,289.1071	23,573.9893
x_2	9,315.4270	5,996.1147	64.3676	1,122.0150	19,099.0027
x_3	9,280.4357	5,925.6011	63.8505	1,127.5854	18,881.4178
x_4	8,516.3462	5,564.9038	65.3438	987.5164	18,073.4048
x_5	6,456.6729	4,067.0801	62.9903	826.7671	13,262.4325
x_6	765.5872	484.2705	63.2548	138.0672	1,639.6492
x_7	2,792.3808	2,099.2402	75.1774	325.7987	7,151.2772
x_8	5.4266	1.7371	32.0113	1.0486	8.6360
x_9	168.2430	114.4074	68.0013	8.0379	353.3172

Source: Authors' elaboration.

It can be observed that there are big differences as for the variability of the different series. This is relatively small (32.01%) in the case of the registered unemployment (x_8), about twice as much (62.99% – 65.92%) for a block of six macromagnitudes which reveal a very similar behaviour – Gross Domestic Product (x_1), the two measures of National Income (x_2 and x_3) and Consumption (x_4 and x_5) and the Net Savings (x_6) –, slightly bigger (68.00%) as for the advertising expenditure (x_9) and, lastly, very pronounced (75.18%) in the case of the Fixed Capital Formation ($x7$).

Once we have described the main features of the different series, it is time to analyze the possibility of a noticeable structural relationship between the advertising expenditure and the other variables considered. To determine this econometrically, we should apply cointegration analysis techniques. Within these techniques, one of the best known is the so-called augmented Engle-Granger test (AEG test), which we carry out in the following section.

3.2. COINTEGRATION ANALYSIS

Cointegration tests aim to prove the existence of a long-term relationship between non-stationary variables with the same integration order (Engle and Granger, 1987; Enders, 2010).

If there is cointegration – i.e., if such variables are not stationary but they have the same order of integration, and the error term of their regression is stationary–, we would prove the existence of a long-term relationship between the previously described macromagnitudes and the advertising investment. Thus, cointegration tests can be considered as a prior test to avoid spurious regressions (Granger, 1986)[2].

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[2]   In case of presence of non-stationary variables, the R^2 and t statistics cannot be used as usual, since these statistics do not follow their standard distributions (Gujarati and Porter, 2010).

Unit root tests will be carried out on the proposed series as a first step and subsequently the corresponding cointegration analysis will be performed.

However, before performing all those tests, it would be convenient to make a comment on the size of our time series. Both unit root tests and cointegration tests perform better with big samples. Our series consists of 35 years, so it seems reasonable to extend the series to a quarterly frequency in order to increase the size over 35. But, regrettably, this solution faces some important difficulties in practice:

a) Although quarterly data for the macromagnitudes are available, it is impossible to get data on advertising investment at this level: the databases of Dupplo and Infoadex provide only annual data. In our paper we have included all the data available at this time, so it is impossible to increase the number of observations –advertising investment is the series which restricts the time period for all the remaining series.

b) If we had used quarterly data, we would have found seasonality problems: for instance, advertising investment usually increases systematically at the end of every year (due to Christmas season).

c) The power of unit root tests depends much more on the span of the data than on the number of observations, that is, for macroeconomic data, a long span of annual data would be preferred to a shorter span with monthly or quarterly data, even though the latter case may have more observations (Kennedy, 2008).

To sum up, we have no alternative but to keep the size in 35 data.

Unit roots tests

In order to establish the order of integration of the variables, we used three classic tests: Augmented Dickey-Fuller, Phillips-Perron and Kwiatkowski-Phillips-Schmidt-Shin tests (hereinafter, ADF, PP and KPSS, respectively).

One of the main drawbacks of the unit root tests is the possibility of not rejecting the non-stationary hypothesis due to the existence of structural breaks or outliers, which if were considered in the analysis could led to the rejection of that hypothesis.

In this sense, Perron (1989) shows that the ADF is sensitive to the presence of structural breaks, so, in case they exist, that test could lead to wrong conclusions.

Different authors (for instance, Perron and Vogelsang, 1992) distinguish two types of breaks according to their effects:

a) Additive outlier model (hereinafter, AO). Each break occurs in an instantaneous and precise instant.

b) Innovative outlier model (hereinafter, IO). Each break occurs gradually, prolonging its effect throughout the time.

Some researchers have criticized the IO because of the persistence of their effects (Kaiser and Maravall, 2001). For this reason, the AO is preferred to the IO.

Furthermore, Glynn *et al.* (2007) distinguish between two types of models: (i) models with exogenous breakpoints established by the researcher, and (ii) models with endogenous breakpoints, determined by quantitative methods.

In this paper, we opted to use a model with endogenous breakpoints, because we thought that its definition has less subjectivity.

The existence of structural breaks in time series makes necessary to use different tests depending on the number of breaks, so the following test will be applied for one break and two breaks respectively: Perron and Vogelsang test (1992) (hereinafter, PV) and Clemente, Montañés and Reyes (1998) test (hereinafter, CMR).

Cointegration

Only those variables that have a unit root can be used in the Engle-Granger and Gregory-Hansen cointegration tests.

The Engle-Granger test (EG, hereinafter) will be used for a first cointegration analysis without the presence of structural breaks. This analysis will be complemented with the Durbin-Watson test[3]. Potential structural breaks in the variables analyzed and their potential influence on the cointegration relationship of the series will be studied later on.

The EG test (Engle and Granger, 1987) is a two-stage technique based on the residuals obtained from a single-equation linear regression model. In the first stage, the integration order of the variables to be included in the model is determined; if the series turn out to be integrated of different order, it is possible to conclude that the variables are not cointegrated. In the second stage, for those variables that – according to the results of the first stage – have the same integration order, the functional long term relationship is specified and estimated, and then it is contrasted if the residuals are or not stationary; if so, a cointegration relationship would exist between the variables; if not, there would not be cointegration, and we would be in the presence of a spurious regression.

The presence of structural breaks in the series could hide existing cointegration relationships among them, so Gregory and Hansen (1996) developed a cointegration model for being used with series with structural breaks. This test (GH, hereinafter) implies two steps: first, we have to determine the integration order of the variables (the

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[3]   Despite the existence of literature showing the use of the Johansen test with series of different sizes, it is only recommended for sample sizes greater than 100. Thus, as our sample size is 35, such test will be omitted in this paper.

GH test requires that all the variables have a single unit root); second, we have to run a regression with up to four possibilities [changes in (i) level, (ii) change in level and trend, (iii) regime and (iv) regime and trend] and check if the test statistics overcome their corresponding critical values of the GH. If so, the null hypothesis of inexistence of a cointegration relationship could be rejected.

Results

In our study, in the first stage, to determine the order of integration of the series, the ADF, PP, KPSS, PV and CMR tests were used[4], considering as a primary rule the preference for the ADF test when it indicated stationarity and for the structural break tests (particularly the AO) in other case; and as a secondary rule, comparing the results of the PP and KPSS tests to substantiate the valuations.

We concluded that, for a significance level of 5%, all the variables would be I (1), i. e., integrated of order one.

That is to say, as the variable *investment in publicity* (x_9) is I (1), it would only be necessary to analyze the possibility of a cointegration relationship with the rest of variables which are I (1). As this condition is fulfilled by absolutely all the variables, in the second stage of the method of Engle-Granger, to determine the execution or not of Galbraith's hypothesis, we estimated, by OLS, the long term models $x_{it} = \beta_{0i} + \beta_{1i} \cdot x_{9t} + \varepsilon_{it}$ ($i = 1, \ldots, 8$ and 7; $t = 1976, 1977, \ldots, 2010$), where β_{0i} and β_{1i} are parameters and ε_{it} is the error term. The results of the estimates are summarized in Table 2.

Table 2 – Main results of the estimates of the long term models

Model	Explained variable (x_i)	Constant coefficient (β_{0i})	Coefficient x_9 (β_{1i})	R^2	Durbin-Watson Statistic
1	x_1	702.3682	61.5722***	0.9335	0.1865
2	x_2	731.8746*	51.0188***	0.9476	0.2169
3	x_3	783.4430*	50.5043***	0.9508	0.2288
4	x_4	626.9127	46.8931***	0.9294	0.1873
5	x_5	649.9995**	34.5136***	0.9426	0.1907
6	x_6	159.0470*	3.6051***	0.7254	0.2247
7	x_7	-143.0493	17.4476***	0.9042	0.1082
8	x_8	4.7001***	0.0043*	0.0809	0.1854

Notes: (*) Significant at 10%; (**) significant at 5%; (***) significant at 1%.
Source: Authors' elaboration.

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[4] In the ADF, PV and CMR the number of lags was selected by means of Akaike's Criterion (AIC); in the PP and KPSS the bandwith was chosen by means of the Newey-West using Bartlett kernel option. In all the tests we included a constant term. The results for all the unit root tests are shown in Annex I.

As one could have already imagined taking into account the information shown in Table 2, it can be observed that in all the cases except for the unemployment (x_8)[5], the advertising expenditure is statistically very significant, and the goodness of fit is very high. Nevertheless, the value of Durbin-Watson (DW) statistic is very low, which means positive autocorrelation in the errors and possibility of non-cointegration, being verified that $R^2 >$ DW, fact that accentuates the suspicion that we are in the presence of spurious regressions. To elucidate this question, an ADF test was applied to the residuals; its results are shown in Table 3; in this table, all the statistics are not significant (not even at 10%)[6], that is to say, the residuals are non-stationary and, consequently, there is not cointegration.

Table 3 - Results of the ADF test applied to the residuals

Variables	One unit root H_0: I (1)
x_1	-1.5799
x_2	-1.6118
x_3	-1.7114
x_4	-1.5432
x_5	-1.3981
x_6	-1.4121
x_7	-2.0370

Source: Authors' elaboration.

Alternatively the test ADF applied to the residuals, there is the possibility of applying the test of Durbin-Watson to the cointegration regression (DWRC test)[7]. In this test, the null hypothesis is H_0: DW = 0, *the variables are not cointegrated*, and the alternative hypothesis is H_1: DW > 0 *the variables are cointegrated*. In accordance with Gujarati (2003), in this test the critical value for a significance level of 5% is 0.386. If DW statistic does not overcome this value, H_0 is not rejected and vice versa.

In our models, all the DW statistics (last column of Table 3) are below 0.386. So we can claim that, at 5% level, we cannot reject that the series are not cointegrated.

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[5]   As the unemployment was not significant at 5%, we shall omit this variable in our analysis hereinafter.

[6]   The critical values used here for the Engle-Granger cointegration test were: -4.123 (1%), -3.461 (5%) and -3.130 (10%) [source: Enders (2010, p. 490), two variables, T = 50].

[7]   Gujarati (2003, p. 798) points out that: "There is a great debate about the superiority of the DWRC in relation to DF (...) The debate is related with the power of both statistics, that is to say, the probability of not incurring in a type II error. Engle and Granger, for example, prefer the DFA test to DWRC".

To sum up, both the ADF test and the DWRC test applied the residuals lead to conclude that there is not a cointegrating relationship between the advertising investment and the rest of variables selected in our analysis.

In the case of the model with structural breaks, the Gregory-Hansen test results at 5% (see Annex 2) show again that there is no long-term relationship between the investment in publicity and the selected Spanish economy macroeconomic variables.

This way, we can conclude that in accordance with all the results obtained (both by the Engle-Granger and the Gregory-Hansen method), in the case of the Spanish economy, the empirical evidence reveals the non-fulfillment of Galbraith's hypothesis.

4. CONCLUSIONS

J. K. Galbraith, in his works *The New Industrial State* (1967) and *The Affluent Society* (1969), formulated the hypothesis that, at macroeconomic level, the advertising investment could constitute a powerful stimulus for economic growth and job generation.

This hypothesis has raised an abundant literature that has tried to test its fulfillment in practice. About this, a review of the different studies shows that there is not unanimity as for the results observed, although it can be said that the studies that have refuted such a hypothesis are dominant.

After some time in which this hypothesis has been in a second place, the deep recession we have been suffering since the end of 2007 has risen again the interest for the study of the macroeconomic effects linked to Galbraith's postulate. There is a resurgence of the debate regarding the advertising investment, as for its potential capacity to impel consumption and to impact positively on the recovery.

In this context, this paper seeks to contribute with empirical evidences that help clarify the potential expansive role of the advertising investment, testing the fulfillment of Galbraith's hypothesis for the case of Spain, which had never been investigated so far. It was carried out an analysis that tested the possible relationship between the advertising investment and six macromagnitudes, as well as the registered unemployment rate, during the period 1976-2010. The results show the non-fulfillment of Galbraith's hypothesis.

We hope that our paper can prompt other Latin American researchers to analyze the role of advertising in the macroeconomic performance of their countries. This way, we would have more empirical evidence which could help us to know more precisely the completion of Galbraith's hypothesis.

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ANNEXES

Annex 1 – Results of unit root tests

Variables	ADF test	PP text	KPSS test	Tests with breaks	
				AO	IO
x1	Non stationary	Non stationary	Non stationary	Non stationary Breaks: 1991 and 2002	No breaks
x2	Non stationary	Non stationary	Non stationary	Non stationary Breaks: 1991 and 2001	No breaks
x3	Non stationary	Non stationary	Non stationary	Non stationary Breaks: 1991 and 2001	No breaks
x4	Non stationary	Non stationary	Non stationary	Non stationary Breaks: 1991 and 2001	No breaks
x5	Non stationary	Non stationary	Non stationary	Non stationary Breaks: 1991 and 2001	Non stationary Breaks: 1985 and 1997
x6	Non stationary	Non stationary	Non stationary	Non stationary Breaks: 1987 and 1996	Non stationary Breaks: 1993 and 2007
x7	Non stationary	Non stationary	Non stationary	Non stationary Breaks: 1991 and 2001	No breaks
x8	Non stationary	Non stationary	Stationary	Non stationary Breaks: 1985	No breaks
x9	Non stationary	Non stationary	Non stationary	Non stationary Breaks: 1990 and 2001	Non stationary Breaks: 1986 and 1996
dx1	Non stationary	Non stationary	Stationary	No breaks	No breaks
dx2	Stationary	Stationary	Stationary	No breaks	Stationary Breaks: 1984
dx3	Stationary	Stationary	Stationary	No breaks	Non stationary Breaks: 1984 and 1995
dx4	Stationary	Stationary	Stationary	Stationary Breaks: 1987	Non stationary Breaks: 1984 and 1998
dx5	Non stationary	Stationary	Stationary	No breaks	Stationary Breaks: 1995
dx6	Stationary	Stationary	Stationary	Stationary Breaks: 2005	Non stationary Breaks: 2002 and 2006
dx7	Non stationary	Non stationary	Stationary	No breaks	Stationary Breaks: 1995 and 2007
dx8	Non stationary	Non stationary	Stationary	No breaks	***
dx9	Stationary	Stationary	Stationary	Stationary Breaks: 2005	***
d2x1	Stationary	Stationary	***	***	***
d2x2	***	***	***	***	***
d2x3	***	***	***	***	Stationary Breaks: 2007
d2x4	***	***	***	***	Stationary Breaks: 2007
d2x5	Stationary	***	***	***	***
d2x6	***	***	***	***	No breaks
d2x7	Stationary	Stationary	***	***	No breaks
d2x8	Stationary	Stationary	***	No breaks	No breaks
d2x9	***	***	***	***	***

Note: H0 – existence of unit root in all cases except KPSS (where H1 is the unit root hypothesis). Significance level = 5%.
Source: Authors' elaboration.

Annex 2 – Results for Gregory-Hansen cointegration test

Model	Lag Length (AIC)	Test Statistic			Breakpoint			Critical values (1, 5 and 10%)		
		ADF	Z_t	Za	ADF	Z_t	Za	ADF	Z_t	Za
Change in level										
X1	2	-4.05	-3.46	-17.18	2004	2004	2004	-5.13	-5.13	-50.07
X2	2	-4.08	-3.47	-17.12	2004	2004	2004	-4.61	-4.61	-40.48
X3	2	-4.13	-3.21	-16.05	2004	2003	2003	-4.34	-4.34	-36.19
X4	2	-4.44	-3.42	-17.72	2004	2004	2004			
X5	2	-4.07	-3.38	-17.03	2004	2004	2004			
X6	2	-4.52	-3.80	-21.88	2003	2005	2005			
X7	1	-3.75	-3.77	-20.58	2002	2002	2002			
Change in level and trend										
X1	0	-3.15	-3.68	-15.58	2002	2002	2002	-5.45	-5.45	-57.28
X2	0	-2.96	-3.62	-13.39	2002	2002	2002	-4.99	-4.99	-47.96
X3	0	-2.92	-3.59	-13.09	2002	1982	1982	-4.72	-4.72	-43.22
X4	0	-3.04	-3.50	-14.46	2002	2002	2002			
X5	0	-3.15	-3.20	-15.27	2002	2002	2002			
X6	2	-4.12	-3.85	-21.35	2003	2005	2005			
X7	1	-3.36	-3.81	-20.70	2000	2002	2002			
Change in regime										
X1	0	-3.22	-3.70	-19.38	2003	2003	2003	-5.47	-5.47	-57.17
X2	1	-3.19	-3.63	-18.97	1988	2003	2003	-4.95	-4.95	-47.04
X3	1	-3.32	-3.62	-18.74	1988	2003	2003	-4.68	-4.68	-41.85
X4	0	-3.24	-3.68	-19.12	2004	2003	2003			
X5	0	-3.06	-3.51	-18.32	2003	2003	2003			
X6	0	-4.26	-4.33	-24.90	2005	2005	2005			
X7	1	-4.05	-4.01	-22.60	1998	2001	2001			
Change in regime and trend										
X1	1	-4.11	-2.81	-11.94	1994	1997	1997	-6.02	-6.02	-69.37
X2	2	-4.06	-3.29	-14.92	1995	1993	1993	-5.50	-5.50	-58.58
X3	2	-4.02	-3.39	-15.74	1993	1993	1993	-5.24	-5.24	-53.31
X4	1	-3.75	-3.24	-13.14	1993	1992	1992			
X5	1	-3.22	-3.31	-14.13	1994	1994	1994			
X6	2	-5.19	-4.09	-21.79	1997	2000	2000			
X7	1	-4.65	-4.37	-28.14	1997	1999	1999			

Source: Authors' elaboration.