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Genuine Saving and Weak Sustainability: A Critical Approach to the Spanish Case in the Long Run (1955-2010)*

Ahorro Genuino y sostenibilidad «débil»: una aproximación crítica desde el caso español en el largo plazo (1955-2010)

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Abstract

This paper takes a critical approach to Genuine Saving (GS) for the Spanish case. Based on the standard methodology used by the World Bank, it extends the series backwards, covering the period 1955-2010. The objective is to assess to what extent this indicator can offer complementary information for a better understanding of Spanish economic growth for that period and its environmental effects. The main conclusion is that GS provides some interesting information that can enrich the standard view of growth but presents many problems in properly measuring the depletion of natural resources and the environmental damage caused by growth. Taking these problems into account, the measurement of GS seems to be strongly biased by the evolution of GDP and therefore does not seem capable of reaching reliable conclusions about sustainability even in its weak sense.
Keywords*: Genuine Saving, sustainability, environmental indicators.*
JEL Classification: *Q51, Q57, N50.*

Resumen

Este trabajo realiza una aproximación crítica al Ahorro Genuino (GS) de la Economía española. Para ello toma como base la metodología estándar utilizada por el Banco Mundial y alarga la serie hacia atrás abarcando el periodo 1955-2010. El objetivo es valorar en qué medida ese indicador puede ofrecer información complementaria que permita entender mejor el crecimiento económico español de ese periodo y sus efectos ambientales. La principal conclusión es que el GS aporta información interesante que puede enriquecer la visión estándar del crecimiento, pero presenta muchos problemas a la hora de medir de manera adecuada el agotamiento de los recursos naturales y los daños ambientales del crecimiento. Eso hace que la medición estándar del GS esté muy mediatizada por la evolución del PIB y que, por tanto, no parezca un indicador adecuado para llegar a conclusiones fiables sobre la sostenibilidad ni siquiera en su sentido débil.
Palabras clave: *Ahorro Genuino, sostenibilidad, indicadores ambientales*

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1. Introduction

Since the publication, at the end of the 1980s, of the Bruntland Report, the concept of sustainable development, defined as the type of development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN WCED, 1987), is often set as an economic goal. However, this basic formulation is extremely ambiguous and gives rise to very different interpretations. From an economic point of view, these differences can be observed through the concepts of "Strong Sustainability" (SS) and "Weak Sustainability" (WS), two concepts that also emerged at the end of the 1980s and which represent very distinct views of the issue.

Both WS and SS consider the depletion of resources and the damage to the environment resulting from economic activities, but there are important differences in the way they deal with these problems. The concept of SS is linked to the theoretical approach of ecological economics and deals with the problem in interdisciplinary terms, taking into account concepts from physics or ecology, i.e. thermodynamics. In this view the economy is considered as an open system in a continuous relationship with nature through the entry and exit of energy and materials. Ecosystems are thus seen as the basic foundations for life. Although the concept of natural capital to value natural resources can be used, limits arise due to the substitution of natural resources for other forms of capital. The concept of the irreversibility of ecological damage beyond certain thresholds, the recognition of critical points to preserve life and the need to compensate the depletion of natural resources with other forms of natural capital are key factors in ensuring sustainability.

On the other hand, WS arises from the traditional approaches of neoclassical economics and considers that the main economic problem with nature is the absence of prices which would allow the proper integration of environmental issues into the market. In light of this, the main objective is to work out the monetary value of resources through the correct accounting of natural capital. After being valued, this kind of capital can be added to other forms of capital (man-made capital or human capital) as a component of the total wealth of an economy. In contrast with SS, this approach considers that sustainability can be reached if the total sum of capital does not diminish over time. Thus, if the amount of man-made or human capital compensates for the losses of natural capital during a period of time, weak sustainability is considered to exist, even if there has been a depletion of resources and/or environmental damage.

The concept of sustainability has been accompanied by the proposal of some indicators to measure the total wealth available to a society and assess whether it is maintained over time. The first of these indicators was the Index of Sustainable Economic Welfare (ISEW) that was developed in the late 1980s (Daly & Cobb, 1989). It is a very ambitious indicator that attempts to measure sustainability taking into account consumption, inequality, environmental damage, the positive effects of environmental quality and the social impacts of all this. Later it has been reformulated as the Genuine Progress Index (Lawn, 2005) and has recently been reconstructed for the Spanish case (O'Mahony et al., 2018, and O'Mahony in this issue of *Cuadernos Económicos de ICE*).[1]

Subsequently, other indicators have emerged, sponsored by international institutions such as United Nations (UN) or the World Bank (WB), that are linked directly to the concept of Weak Sustainability. The Comprehensive Wealth Index (CWI) or the Inclusive Wealth Index (IWI) are the two main ones. Both use the concept of Genuine Saving (GS) as a summarised measure of the capacity of an economy to generate net savings. According to this, if accumulated capital over a period of time compensates for the depreciation and destruction of natural resources in this period, net saving would exist, indicating (weak) sustainability.

Within this framework, the objective of this paper is to analyse the GS for Spain in the long run, using a methodology similar to that used by the WB, and extending the series from 1955 to 2010. The lack of some data in the historical series requires a slight modification of the standard methodology, but as we explain below the measurement follows comparable guidelines. Once the GS are measured and extended, the aim of the paper is to evaluate to what extent this indicator contributes to a better understanding of the evolution of the Spanish Economy in the second half of the twentieth Century. Ultimately, it attempts to assess if GS could be considered as a good way of measuring weak sustainability of Spanish economic growth. To do this, we applied the methodology of the defenders of the weak sustainability approach, however that does not mean that we take it for granted that this approach is inherently correct. Rather, it is about using this methodology to assess its soundness when measuring environmental aspects of growth. Thus, albeit indirectly, this paper enters the debate about the validity of WS measurements.

From here on this article will be divided into five sections. In the second and third the main indicators used in the WS, especially GS, will be summarized with an assessment of its strengths and weaknesses. Section 4 describes the sources and specific methodology used to calculate the GS for Spain and shows the main results. In section 5 the usefulness of that indicator to better understand the evolution of the Spanish economy is discussed. Finally, section 6 offers some concluding remarks.

2. Weak sustainability and the monetary indicators of wealth

Concerns about the adverse effects that accelerated economic growth was having on ecosystems began in the early 1970s with the Club of Rome report "The Limits to Growth" (Meadows, 1972). The report, written from a biophysics perspective,

[1] The ISEW is an indicator linked with the Ecological Economics approach and its proposal goes beyond the monetary valuation of natural capital, proposing a complex measurement of the environmental and social effects of growth. In this work, we will not analyse this indicator, although we will refer to it in the discussion section.

brought to light the dangers caused by the unchecked exploitation of resources, and considered the possibility of a collapse of civilization if measures were not taken. In contrast, some economists proposed a more optimistic view of the problem suggesting that technological change and the increase of alternative forms of capital could compensate for resource depletion (Solow, 1974; Stiglitz, 1974). In this vein, what is known as the "Hartwick Rule" determined, theoretically, what amount of man-made capital investment was needed to precisely compensate the reduction of non-renewable natural resources (Hartwick, 1977). This view assumes perfect "substitutability" between different forms of capital, and consequently deriving that the economy will remain sustainable if the total stock of available capital remains undiminished. The fundamental pillars of weak sustainability were established.

To advance in this approach it was necessary to improve the way of accounting natural resources. The first attempts to calculate a "green accounting" began at the end of 1980s. The first foundations (Repetto et al., 1989; Ahmed et al., 1989) were later systematized with the support of International Institutions such as the UN that from 1993 promoted a process of accounting standardization. After a long process of methodological refinement from 2003 on the System of Environmental Economics Accounting (SEEA) was created and is currently used in many countries (UN, 2016). The SEEA posits some general guidelines for the accounting of natural resources in monetary terms based on Net Present Value, which requires information about resources extracted and their prices, net profit, quantity of stock and expected rate of extraction, as well as the establishment of a discount rate (UN, 2016). Despite many conceptual and practical difficulties at the core of this type of accounting (Smith, 2007; Recuero, 2018), the monetary valuations of natural capital is taken as valid by its practitioners.

The information gathered by the SEEA provides interesting data for the discussion of both Strong and Weak Sustainability. However, the SEEA itself does not offer direct evidence of sustainability (Atkinson & Hamilton, 2007). Therefore, since the 1990s some indicators which include complementary information have been implemented. Several works sponsored by the WB and UN have posited theoretical proposals to measure real wealth such as the "Comprehensive Wealth Index" (CWI) or the "Inclusive Wealth Index" (IWI) and have tried also to approximate sustainability through the calculation of the Genuine Saving (GS) of the economies. All of these are capital-based indicators, as their objective is to measure wealth in monetary terms, accounting the various forms of capital into which wealth can be disaggregated.

The CWI calculation was proposed in the late 1990s (WB, 1997) and systematized in the following decade (Hamilton & Dixon, 2003; WB, 2006). The basic aim was to obtain a better measure of the total wealth of a society using consumption as a base, and then disaggregate it into different forms of capital (produced, natural and intangible capital) following a top-down methodology. In this approach produced capital is made up of the stocks of machinery, equipment and infrastructure that are calculated using the Perpetual Inventory Method (that is, basically, accounting the investment and applying a capital depreciation rate). Natural capital includes the stock of energy resources (oil, gas and coal), and of metals and minerals (bauxite, copper, gold, iron ore, lead, nickel, phosphate rock, silver, tin, and zinc) plus an estimation of the stock of renewable resources including forest resources, cropland, pastureland and protected areas. Finally, the intangible capital is accounted as a residual value, equal to the subtraction of the amounts of produced and natural capital from total wealth. This approach considers that intangible capital can include many factors which act upon wealth like human capital, social capital, the net value of foreign financial assets, and even all the institutions that contribute to the sustainability of wealth. Despite abundant difficulties in accounting for many of these items, works based on this approach have been developed providing figures for different countries and periods (WB, 2011; Lange et al., 2018).

The CWI were criticized by some authors who argued that the method implicitly assumed consumption always followed a sustainable path, thereby skewing estimates from the beginning (Arrow et al., 2012; Dasgupta & Duraiappah, 2012). In response, an alternative indicator named Inclusive Wealth Index (IWI) was proposed (Dasgupta, 2007). The IWI shares many assumptions with CWI, but also contains marked differences from it. In fact, IWI also attempts to measure wealth in monetary terms, but it follows a bottom up approach accounting directly for the different assets that constitute capital (mainly natural, produced and human capital) and in the words of its creators, this makes it possible to detect unsustainable trajectories.

The specific methodology for estimating IWI has undergone a number of changes in the various reports published on the subject (UN, 2012, 2014, 2017 and 2018). In the last one (UN, 2018) wealth was taken as the sum of produced, natural and human capital, accounted with their respective shadow prices. Social capital should be added to these but, given the difficulties in measuring it, it is not accounted for directly[2]. Produced capital includes the stock of reproducible capital based on investment (also following the Perpetual Inventory Method); natural capital is composed of the assigned value of non-renewable resources (energy and minerals), renewable resources (forest resources), farmland (cropland and pastures) and fishing grounds. Finally, human capital includes an estimation of the positive impact that improvements in education can make on average wages (UN, 2018). An adjusted version of the IWI is also proposed, which includes the damages caused by CO_2 emissions and the effects of taking Total Factor Productivity into consideration.[3]

Despite some differences in the specific assets included by CWI and IWI (Yamaguchi et al., 2019), it is obvious that both indices share the same objectives and, in fact, in recent years have moved considerably closer on their methodologies

[2] Together with knowledge and institutions, social capital is considered as an "elusive" factor. Given that they affect the rest of the capital forms, an optimistic view could consider that they can be captured through the shadow prices of natural, human and produced capital (UN, 2018)

[3] Including TFP in the measurement of wealth could capture technological progress as well as Social Capital (Arrow et al., 2012). The Adjusted IWI also includes some adjustments for changes in oil prices, affecting some oil exporting countries (UN, 2018).

(Lange et al., 2018; UN, 2018). Likewise, after quantifying wealth, both coincide in using the concept of Adjusted Net Savings, also known as Genuine Saving (GS), as a summarized way of approaching weak sustainability.

3. The Strengths and Weaknesses of Genuine Saving

The term GS was coined by Hamilton (1994) based on previous work by Pierce and Atkinson (1993), and basically measures net savings of one society as the difference between gross capital formation and total capital depreciation, assuming perfect substitutability between different forms of capital. Founded on these premises, subsequent works (WB, 1997; Hamilton & Clemens, 1999) proposed an adjusted version of net savings which included the losses derived from the depletion of natural resources and environmental damages. Taking into consideration these variables, the basic formulation of GS accounts for the Net Savings of an economy, minus Non-Renewable Natural Capital used, plus (minus) Renewable Natural Capital used, plus Human Capital, minus Social Cost of Carbon (SCC) and damages caused by Particulate Matter (PM). On this basis, a positive GS means higher levels of total capital during a specific period and is observed as a guarantee of future well-being (Arrow et al., 2012). In contrast, a negative GS is associated with problems in the maintenance of wealth, that is, with unsustainability. In spite of numerous debates about its virtues and flaws, GS has shown great resilience. In fact, measurements sponsored by the WB are still considered a good indicator and are used to rank countries (weak) sustainability and to guide economic policies (Asafu-Adjaye, 2004; Atkinson & Hamilton, 2007).

Nevertheless, criticism of GS is abundant. The first controversial topic is the way to measure the depletion of natural resources. The standard measures of the WB follow the methodology of the SEEA, but other forms of accounting for depletion have been proposed with very different results (Neumayer, 2000). On the other hand, the lack of data for certain key variables needed to calculate the Net Present Value of resources (i.e. the real stock of some resources or the appropriate discount rate), has led to the taking of certain shortcuts and accepting as valid the use of the “net price” of natural resources. That means that the standard valuation is based on the current rent per unit of resource (price minus marginal cost of extraction) multiplied by the amount of resource extracted (Dietz & Neumayer, 2007). This simplification of the measurements may be leading to the underestimation of the depletion of natural resources. Concerning environmental damages, measuring it only through CO_2 emissions and PM leaves out many important resources –i.e. water, land and biodiversity– that may suffer degradation because of economic growth. It is obvious that the inclusion of these resources would alter the results of GS (Atkinson & Hamilton, 2007; Biasi et al., 2015). Furthermore, the valuations of CO_2 produced by WB are very conservative. As we discuss below, If valuations based on less optimistic future scenarios are applied, the results of GS could vary considerably (Kunnas et al., 2014; Blum et al., 2016; O’Mahony, 2018).

On the other hand, human capital is measured using the annual governments' investment in education, and this measure has been criticized as biased (McGrath, 2020). For instance, it does not account for the depreciation of human capital or for the investments that can be made to reduce that depreciation (Boos, 2015). A further criticism of the standard measurements of GS is related to the failure to include other important elements which influence future consumption, such as the rate of population growth or technological change (Pezzey & Burke, 2014). Some works have suggested amendments to these, introducing estimates of the evolution of the population (Ferreira et al., 2008) or proposing an Augmented GS that incorporates technological change including the accounting of the Total Factor Productivity (Bloom et al., 2016).

In any case, the validity of data provided by GS to assess sustainability remains under discussion. The theory underlying GS considers that a positive saving gives rise to a sustainable situation (Arrow et al., 2012), whereas a negative saving in the present implies a reduction in future well-being and points clearly to unsustainability. According to WB data, this is the case for many developing countries where the depletion of natural resources is not compensated for by an investment in human or produced capital. In a reverse direction, in developed countries with high levels of investment the depletion of resources turns out to be innocuous in terms of Weak Sustainability. In other words, GS tends to produce a positive image of sustainability in countries with high rates of GDP growth (Pillarisetti, 2005) that very often are not in line with the results produced by other indicators such as, for instance, ecological footprint (Pillarisetti, 2010). This issue is related, in part, to the fact that GS is calculated at country level, without taking into account exchanges between rich and poor countries, which may affect each other's sustainability (Boos, 2015). From this point of view, it has been proposed that, a negative GS can be clearly indicative of sustainability problems but, on the contrary, a positive GS does not guarantee a sustainable path, due to the great number of variables that are not included in its calculation. From this perspective, GS provides only a one-sided sustainability test. It is an indicator of what is necessary for sustainable growth, but not an indicator of what is sufficient (Brown et al., 2003; Pezzey, 2004).

The controversies surrounding GS and its meaning are also carried over works measuring this variable in the long run, and therefore may serve to attest to what extent past GS accurately predicts that which subsequently occurs. McLaughlin et al. (2014) and Greasley et al. (2014), have produced the longest reconstruction in existence for a country, calculating the GS of the English economy from 1760 to 2000. Their series attempt to correct the main problems of the standard calculation of GS including measurements of technological change and different valuations of CO_2 emissions. These works consider that GS measurements for the past English economy fit quite well with consumption in England in later stages, and therefore suggest that current GS can be considered as a good predictor of future consumption, and therefore a good indicator of Weak Sustainability. Similar results are obtained when comparing the evolution of OECD countries with certain Latin American countries also in the very long run (Hanley et al., 2015; Blum et al., 2016). Nonetheless, the work of Lindmark et al. (2018) using standard measurements for the case of Sweden also in the long term, suggests that even though there is some correlation between positive GS and future well-being, this correlation is very weak and ultimately inconclusive. Between these two positions, other works (Lindmark & Acar, 2013; Acar & Gultekin, 2016; Labat et al., 2019) use the GS calculation not to reach any conclusion regarding sustainability but rather to analyze the evolution of an economy with the complementary data that this indicator provides.

4. A long-term analysis of GS in Spain

Based on the brief summary of the issue, this section uses the WB methodology to enlarge the GS calculated for Spain, with the aim of assessing the usefulness of the indicator for a better understanding of the Spanish economy during the period 1955-2010. From the point of view of mainstream economics using GDP as the main indicator, Spanish economic history in that period is usually presented as a success story. If historically (from 1850 to 1950) the Spanish economy had grown at an average rate of 1.3 % per annum (0.7 % per capita), in the period 1950-1974 the growth rose to a spectacular rate of 6.3 % per annum (5.5 % per capita), giving rise to the expression “the Spanish economic miracle”. After that, different crises in the seventies and early eighties caused growth to slow, but growth continued at an average rate of 3.3 % per annum (2.4 per capita) between 1975 and the eve of the crisis in 2007 (all figures are taken from Prados de la Escosura, 2017). The main cause of this was the intense capitalization of the economy taking place from the fifties on, in the framework of an incipient economic liberalization (after the autarky of the forties and early fifties) which allowed the country to engage in the international wave of economic growth of the Golden Age. Modernization of the economy through capitalization and mechanization allowed for a rapid rise in labor productivity in most sectors, and most particularly, for clear improvements in Total Factor Productivity (TFP) until the beginning of the twenty first century (Prados & Roses, 2009).

Within this framework, the gap between Spain and the more developed North Atlantic economies was progressively reduced by a process of convergence that took place, mainly, until 1975. From which point, after the crisis of the seventies and early eighties, Spain became a member of the European Union in 1986 and maintained a moderate process of convergence. Nevertheless, the Spanish economy has fluctuated between 80%-85 % of income per capita with respect to the richest European countries, remaining unable to fully catch up with them (Cereijo et al., 2007). In this approach, natural resources are not taken into account as special inputs, but only as a (non-disaggregated) part of total capital used for growth. In this sense, depletion of resources and environmental damage resulting from growth are not considered at all. Implicitly, this view assumes that sufficient technological change can overcome the environmental problems related to growth.

This narrative of success does not fit well with the story emerging from works concerned with the environmental effect of growth which tell a more pessimistic tale, suggesting that the ecological cost of Spanish growth was even greater than in other developed countries. In fact, materials used by the economy grew from four tonnes per capita in 1955 to more than 16 tonnes per capita in 2000 with a more intense growth of the use of abiotics (that is, non-renewable) materials (Carpintero, 2005; Carpintero & Naredo, 2004; Infante et al., 2015). And this increase in consumption, based on the use of large quantities of imported fossil fuels, led to an expansion of the ecological footprint and the ecological deficit of the Spanish economy being even greater than that of other economies with a bigger GDP per capita (Iriarte-Goñi & Tello, 2016). In fact, the growth of the ecological deficit (accounted in hectares per capita) stands at higher levels than other developed European countries, regardless of whether local or global average productivities are used to account it (Carpintero, 2005; Ewing et al., 2010, respectively). Although no specific measure for sustainability has been developed in those studies, all suggest a path of economic growth with problems maintaining itself in the same way in the future. In fact, Carpintero (2005) defines Spain as the "European dragon" suggesting a high level of resource depletion.[4] In a similar way, the estimation of an Index of Sustainable economic Welfare (ISEW) for Spain from 1970 to 2012, including an approach to energy depletion, to costs of climate change and water pollution and also to economic inequality effects, detects a widening gap between GDP Growth and real welfare (O'Mahony et al., 2018, and this issue of *Cuadernos Económicos de ICE*).

In this framework a basic question arises especially for economic historians concerned with environmental problems: could GS provide some element that helps to understand this disparity of interpretations or is it a measure biased towards the standard interpretation of growth?

4.1. Method and sources

The measurement of GS for Spain in the period 1955-2010 is estimated according to a similar method as that proposed by the World Bank (2006, 2011), making some assumptions for the lack of some historical data. Basically, this accounting includes estimates for produced, natural and human capital, and also environmental damages based on CO_2 emissions and PM. The basic formulation is GS equals Net Saving minus Non-Renewable Natural Capital used, plus (minus) Renewable Natural Capital used, plus Human Capital, minus Social Cost of Carbon and PM. For this purpose, data have been collected on the following variables:

Net saving = Gross National Saving minus consumption of fixed capital
[Gross National Saving = Gross National Income (GNI) (–) Public and private consumption (+) net transfer]

[4] These studies do not consider the role that the stock of produced capital, resulting from the growing use of energy and materials, can play in future development.

Data to calculate both Gross and Net national savings are taken from Prados de la Escosura (2017). Natural capital valuation for minerals has been calculated following the method of net price (WB, 2006; Qasim et al. 2018):

Production volume × unit resource rent

Unit resource rent = price minus cost of production (labor employed × average salaries)

Spain does not have any oil or natural gas deposits. Thus, the measurement of non-renewable natural capital only includes different types of coal, and metallic and not metallic minerals. All data for the period 1955-2010 have been taken from the Estadísticas Mineras de España (Spanish Mining Statistics) which offer annual information about quantities of extracted minerals, annual prices and cost of labor employed in extractions. Renewable Natural capital has been calculated taking into account annual increases in forest stocks calculated by Infante and Iriarte (2017), valued at annual market wood prices. Annual damage from wildfires affecting forests has been subtracted from annual forest values. Data on wildfires from 1955 to 2010 have been taken from the Estadísticas Forestales (Spanish Forests Statistics).

Human capital is estimated via Education expenditure and added to GS. Data for the period 1850-2000 are available in Espuelas (2013); data from 2001 to 2010 are taken from the World Bank Series.

The Social Cost of Carbon (SCC) is defined as the value of the marginal benefit of reducing one tonne of CO_2. To approximate the SCC is one of the most difficult tasks due to the enormous annual prices per CO_2 tonne proposed by the literature (Pezzey & Burke, 2014; Kunnas et al., 2016; O'Mahony, 2018). I follow here exactly the method of WB (2006 and 2011) for the period 1975-2010 using a price of $20 per tonne of CO_2, although this is a very problematic assumption that will be returned to in the discussion section. Emissions from 1955 to 1975 are taken from Rubio (2005). PM are also measured following the method of the WB (2006 and 2011) for the period 1990-2010. For previous years there is a lack of PM data. One estimate has been made based on emissions taken from Rubio (2005).

Data on population are used to calculate GS per capita. Data are taken from Nicolau (2005). Some works argue for the necessity of incorporating some measure of technological progress to GS which could capture the effect of accumulated technology on future growth and use the growth rates of TFP for this purpose (Pezzey et al., 2006; Mota & Domingos, 2013; Greasley et al., 2014). Nevertheless, no clear consensus exists regarding the possibility of adding TFP growth to GS. Some argue that TFP also captures improvements in human capital, thus to include it in GS accounts could result in double accounting (Blum et al., 2016). Taking into account those disagreements, this work not include TFP effects on GS.

4.2. Results of standard measurement of GS for Spain

Table 1 shows the main components of the Spanish GS between 1955 and 2010 expressed in international Dollars (Geary-Khamis) of 1990. Figures 1, 2 and 3 show some comparison between the estimates of this study for different areas.

TABLE 1

MAIN COMPONENTS OF THE SPANISH GENUINE SAVING (1955-2010), IN MILLION $ GK (1990)

	GNI	Net saving	Education expenditure	No Renewable Natural Capital	Renewable Natural Capital	SCC and PM	Genuine Saving
Million $ Geary Khamis (1990)							
1955	87.355	11.921	594	–1.103	268	–82	11.598
1956	94.531	14.585	662	–1.026	372	–93	14.500
1957	97.807	13.370	676	–1.219	241	–117	12.951
1958	104.701	16.096	765	–1.131	272	–140	15.863
1959	103.576	10.014	746	–1.109	515	–133	10.032
1960	104.107	12.349	865	–1.156	305	–127	12.235
1961	116.303	13.870	920	–1.085	223	–151	13.776
1962	127.497	14.384	1.034	–1.081	249	–188	14.398
1963	140.738	13.145	1.282	–980	397	–217	13.628
1964	148.568	13.377	1.489	–1.001	310	–244	13.931
1965	159.842	13.724	1.827	–1.178	185	–276	14.282
1966	171.884	15.691	2.158	–1.088	251	–325	16.687
1967	181.683	17.277	2.428	–1.520	249	–395	18.038
1968	192.406	18.374	2.669	–1.169	245	–509	19.611
1969	209.936	24.465	3.446	–1.084	248	–542	26.533
1970	216.748	22.895	4.102	–1.051	238	–609	25.575
1971	228.065	24.210	4.907	–1.070	247	–692	27.603
1972	251.837	30.927	4.529	–1.009	492	–829	34.111
1973	274.803	37.333	5.209	–1.069	245	–920	40.797
1974	296.823	40.545	5.433	–1.252	152	–1.062	43.816
1975	304.544	38.701	5.408	–1.434	–375	–1.040	41.259
1976	317.594	35.343	6.006	–1.487	–243	–1.232	38.388
1977	327.544	35.527	7.225	–1.283	312	–1.266	40.515
1978	336.164	38.053	8.406	–2.132	–329	–1.288	42.709
1979	342.449	37.201	8.685	–1.308	–200	–1.355	43.023

SOURCE: Own elaboration.

TABLE 1 ***(Cont.)***

MAIN COMPONENTS OF THE SPANISH GENUINE SAVING (1955-2010), IN MILLION $ GK (1990)

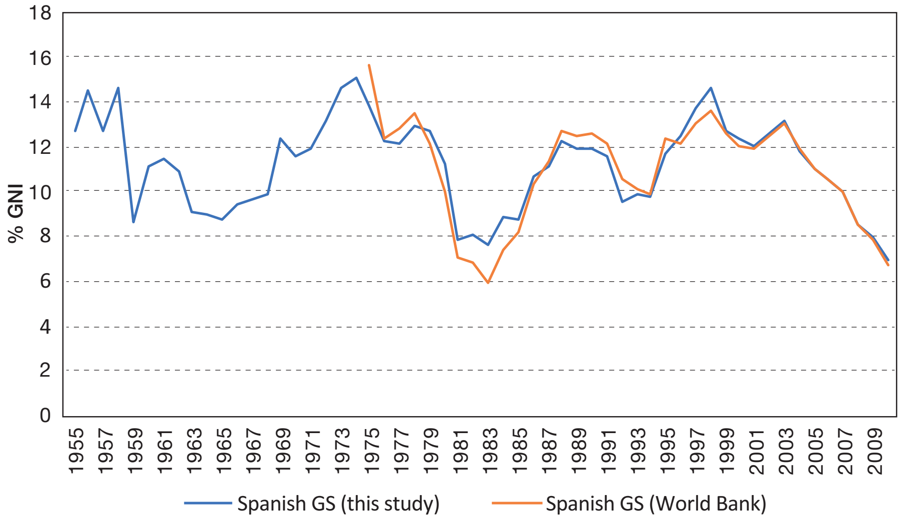
	GNI	Net saving	Education expenditure	No Renewable Natural Capital	Renewable Natural Capital	SCC and PM	Genuine Saving
Million $ Geary Khamis (1990)							
1980	352.870	34.264	8.998	–2.113	–160	–1.493	39.496
1981	350.747	22.583	8.709	–2.616	–373	–1.522	26.780
1982	356.462	24.014	9.071	–2.893	–130	–1.515	28.547
1983	362.487	23.510	9.385	–3.719	136	–1.533	27.780
1984	365.896	27.338	10.287	–3.583	–47	–1.517	32.477
1985	378.601	26.616	11.139	–3.501	–509	–1.638	32.107
1986	394.822	34.805	11.426	–2.529	–235	–1.766	41.701
1987	423.349	38.525	12.362	–2.160	–11	–1.808	46.907
1988	449.918	45.789	13.514	–2.195	142	–1.992	55.258
1989	480.129	46.662	14.917	–2.448	–404	–2.306	56.420
1990	503.164	48.380	16.337	–2.180	–107	–2.422	60.008
1991	519.373	46.608	17.965	–1.967	–230	–2.568	59.808
1992	526.957	36.616	18.461	–1.839	165	–2.753	50.650
1993	520.578	30.801	25.365	–1.828	185	–2.520	52.003
1994	530.178	29.953	24.993	–1.917	–1.267	–2.657	49.106
1995	555.662	44.576	25.534	–2.108	–14	–2.841	65.147
1996	571.805	50.096	26.391	–1.971	10	–2.937	71.589
1997	598.452	60.829	26.677	–2.043	75	–3.267	82.270
1998	629.066	70.598	27.423	–2.120	108	–3.698	92.311
1999	646.286	59.834	28.796	–1.984	166	–3.969	82.844
2000	681.951	60.801	30.186	–2.098	140	–4.275	84.754
2001	704.308	62.384	29.307	–2.198	271	–4.194	85.570
2002	724.665	67.737	30.321	–2.250	252	–4.592	91.467
2003	750.392	74.119	31.543	–2.271	81	–4.812	98.661
2004	773.631	67.105	32.406	–2.405	130	–5.200	92.036
2005	798.301	62.196	33.438	–2.576	–165	–5.588	87.306
2006	828.753	61.246	35.081	–2.788	54	–5.665	87.927
2007	854.182	57.256	37.084	–2.780	304	–5.966	85.899
2008	861.877	42.232	39.728	–2.491	305	–5.502	74.271
2009	838.617	32.974	41.548	–2.486	208	–4.729	67.515
2010	842.176	24.185	41.198	–2.052	156	–4.536	58.950

SOURCE: Own elaboration.

Figure 1 contrasts the estimates from this study with those offered by the World Bank for Spain in the period 1975-2010 (red line in graph 1). Figure 2 compares the case of Spain with the European Union (EU) (green line in Figure 2) and Figure 3 with three selected countries representing different levels of development (different colors in Figure 3).

FIGURE 1

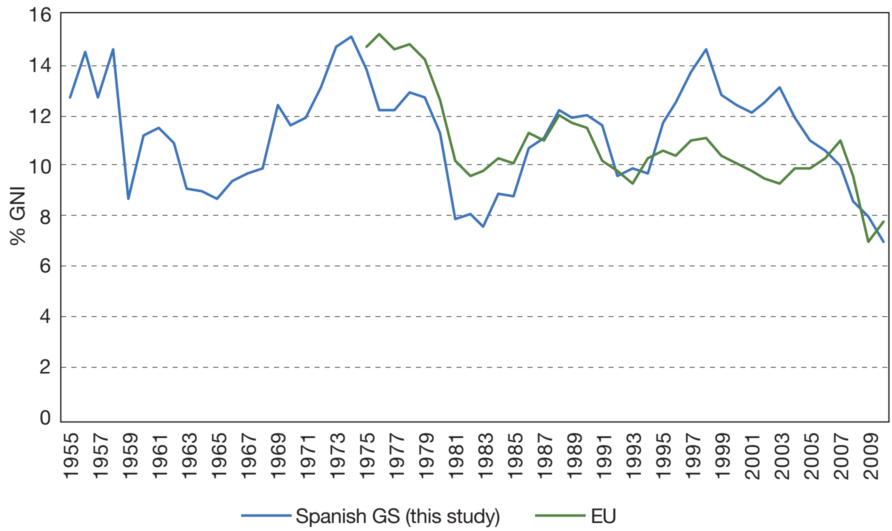
ESTIMATES OF GENUINE SAVING IN SPAIN AS PERCENTAGE OF GNI



SOURCE: World Bank (2011) and own elaboration.

FIGURE 2

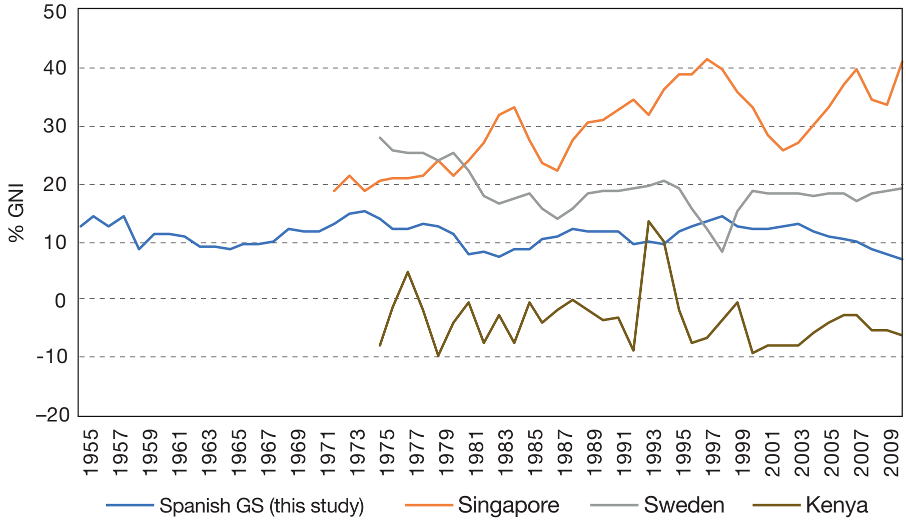
ESTIMATES OF GENUINE SAVING IN SPAIN AND THE EU AS PERCENTAGE OF GNI



SOURCE: World Bank (2011) and own elaboration.

FIGURE 3

ESTIMATES OF GENUINE SAVING IN SPAIN AND SELECTED COUNTRIES AS PERCENTAGE OF GNI



SOURCE: World Bank (2011) and own elaboration.

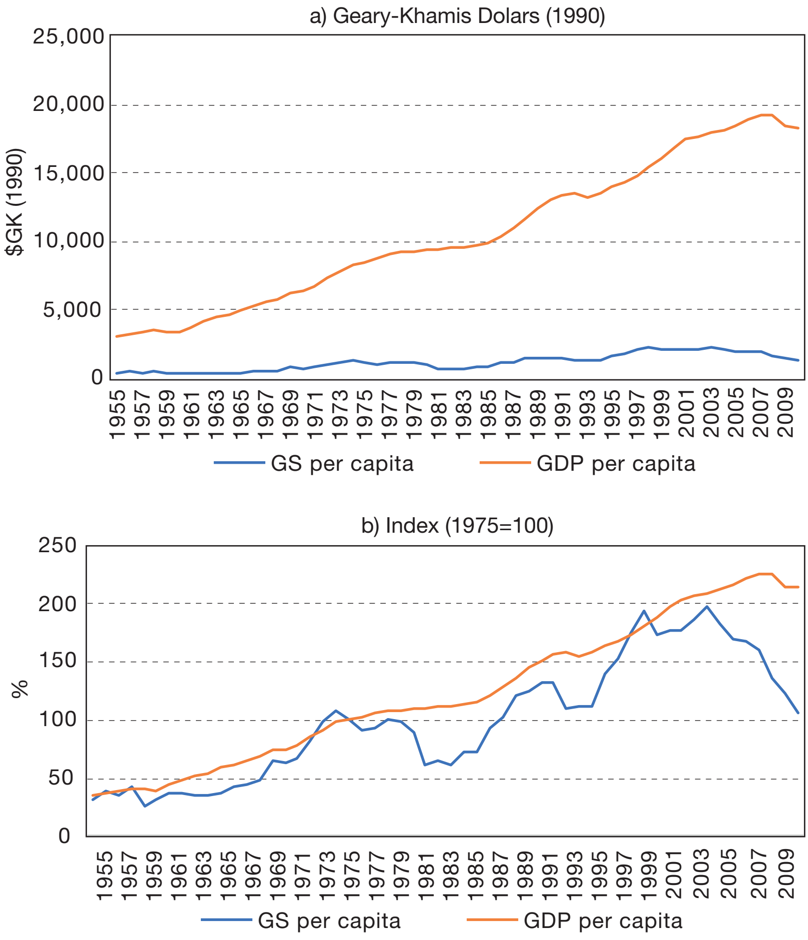
On the one hand, Figure 1 allows the methodology followed in our estimates to be validated. As can be seen, results for the period 1955-2010 match fairly well with results offered by WB for the period after 1975, even though the sources used are not the same in both cases. Saving cycles coincide in both estimates, although specific levels of saving are different in some years. These differences are due to different estimates of renewable natural capital represented by forest resources. In fact, in the WB accounts the contribution of forests to GS equals zero, assuming that annual growth of the forest mass is equal to forest extractions. As mentioned above, this study estimates accounts for forest stock excluding annual extraction and also annual loss due to wildfires. We consider that the proposal, based on direct investigations of the forestry sector, more closely reflects reality.

According to these data, Spanish GS has had a positive value for the entire period being considered, although the level and tendency have varied depending on different economic circumstances. In general terms these variations closely match the average of what has happened in the European Union (Figure 2), although in the case of Spain it can be observed that in the periods in which GS falls in Spain as well as in Europe, the fall in Spain is more marked and the same is true when it rises. These trends regarding Europe do not represent a great novelty. In fact, they reproduce, in the case of GS, a tendency that has often been indicated for the last decades of the 20th century with regard to the evolution of GDP (García Delgado & Myro Sánchez, 2019).

Apart from that, the GS of the Spanish economy for the period is in an intermediate position typical of a developed country with a medium economic level. Its GS level is between 10 % and 15 % of GNI, occasionally falling to below 8 % at the lowest. These figures far exceed those of many underdeveloped countries (see the case of Kenya in Figure 3), with high instability and usual negative savings level. On the other hand, the Spanish figures are relatively low in comparison to Northern European economies (see the case of Sweden) with greater sensitivity to environmental problems related to economic growth. At the same time, the level of savings remains well below the model of fast-growing Asian countries (see the case of Singapore in Figure 3) probably due to the differences in the level of investment in produced and human capital.

FIGURE 4

EVOLUTION OF SPANISH GDP CAPITA AND GS CAPITA



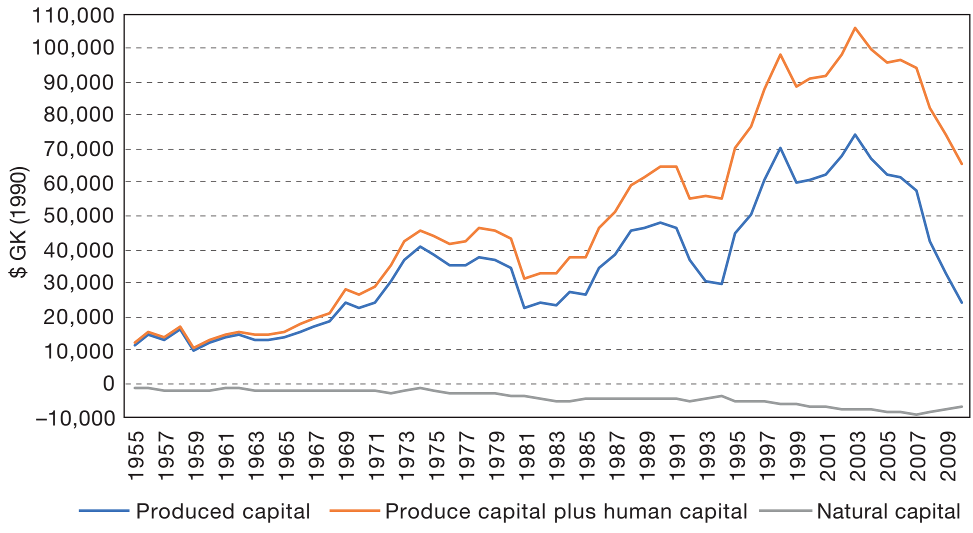
SOURCE: Prados de la Escosura (2017) and own elaboration.

If we focus on the tendency of GS, the main conclusion is that it tends to grow along with per capita GDP and vice versa. Accordingly, it shows a big improvement during the sixties in accordance with the rapid expansion of the Spanish economy during its Golden Age. In contrast it was negatively affected by the crisis of the seventies which in Spain was of greater intensity and duration than in Western Europe; GS grew once again during the economic expansion in the second half of the eighties, and after falling slightly during the crisis of the early nineties began a new period of expansion which lasted until the beginning of the 21st century. Then it stagnated and fell abruptly with the crisis of 2008. This trajectory indicates that the measure of GS is strongly biased by the evolution of GDP.

Figure 4 introduces some nuances to this idea. The first one shows the evolution of Spanish GDP per capita and Spanish GS per capita, both measured in 1990 Geary-Khamis Dollars; the second shows index numbers (1975 = 100). As can be seen, savings per capita were far more modest than GDP per capita, and this suggests that either consumption or depreciation of capital (produced and/or natural) played an important role in growth during the period; on the other hand, index numbers suggests that in the case of Spain the evolution of GS followed a very irregular path exaggerating the economic cycle, especially during the periods of crisis. In other words, it seems that the economic crises, in so far as they reduced savings per capita, could have had consequences not only at the time of the crisis –through GDP per capita losses– but also in subsequent phases, perhaps reinforcing the importance of crises that had yet to come.

FIGURE 5

GENUINE SAVING IN SPAIN AND ITS MAIN COMPONENTS (MILLION $ GEARY KHAMIS 1990)



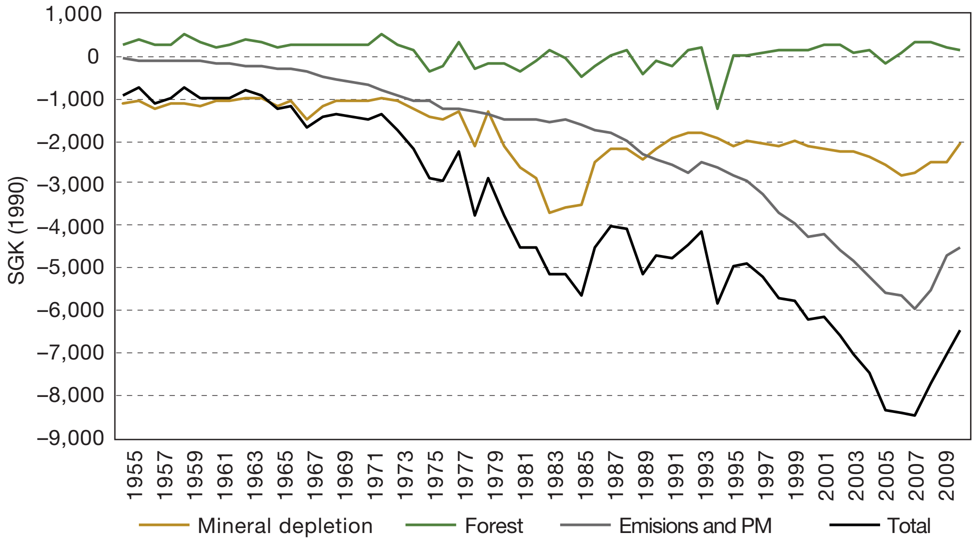
SOURCE: Own elaboration.

Figure 5 shows the evolution of GS differentiating between the savings caused by the accumulation of net produced capital (blue line) and the results after adding human capital (red line). It also accounts for losses caused by environmental depletion (grey line). Two aspects stand out in this disaggregation: on the one hand, it is clear that from around the mid-1980s the contribution of human capital to GS (i.e. the positive difference between the real GS curve and the net capital produced) turns out to be fundamental when explaining savings; on the other hand, this study shows that environmental depletion does not show a high cost in GS according to the methodology followed.

Figure 6 disaggregates the main environmental variables that affect GS. Firstly it measures the evolution of renewable natural capital, represented by forests; secondly, the evolution of non-renewable natural capital represented by the depletion of coal and non-energetic mineral deposits; and, finally, it also measures the environmental degradation of ecosystems represented by CO_2 emissions. According to these data Spanish economic growth between 1995 and 2010 did not display an observable deterioration of renewable natural capital, which remained practically constant throughout the period. On the contrary, non-renewable natural capital underwent a constant process of depletion throughout the entire period, with some peaks probably due to the rise in extractions, especially of energetic minerals (coal and anthracite and particularly lignite) in periods with high imported oil prices. Finally,

FIGURE 6

VALUE OF NATURAL CAPITAL AND SCC (CO_2) IN SPAIN (MILLION $ GEARY KHAMIS)



SOURCE: Own elaboration.

the environmental degradation due to CO_2 emissions stands out as the main factor in explaining losses of savings. The negative trend was growing during the whole period and only changed from 2008 due to the economic slowdown caused by the crisis.

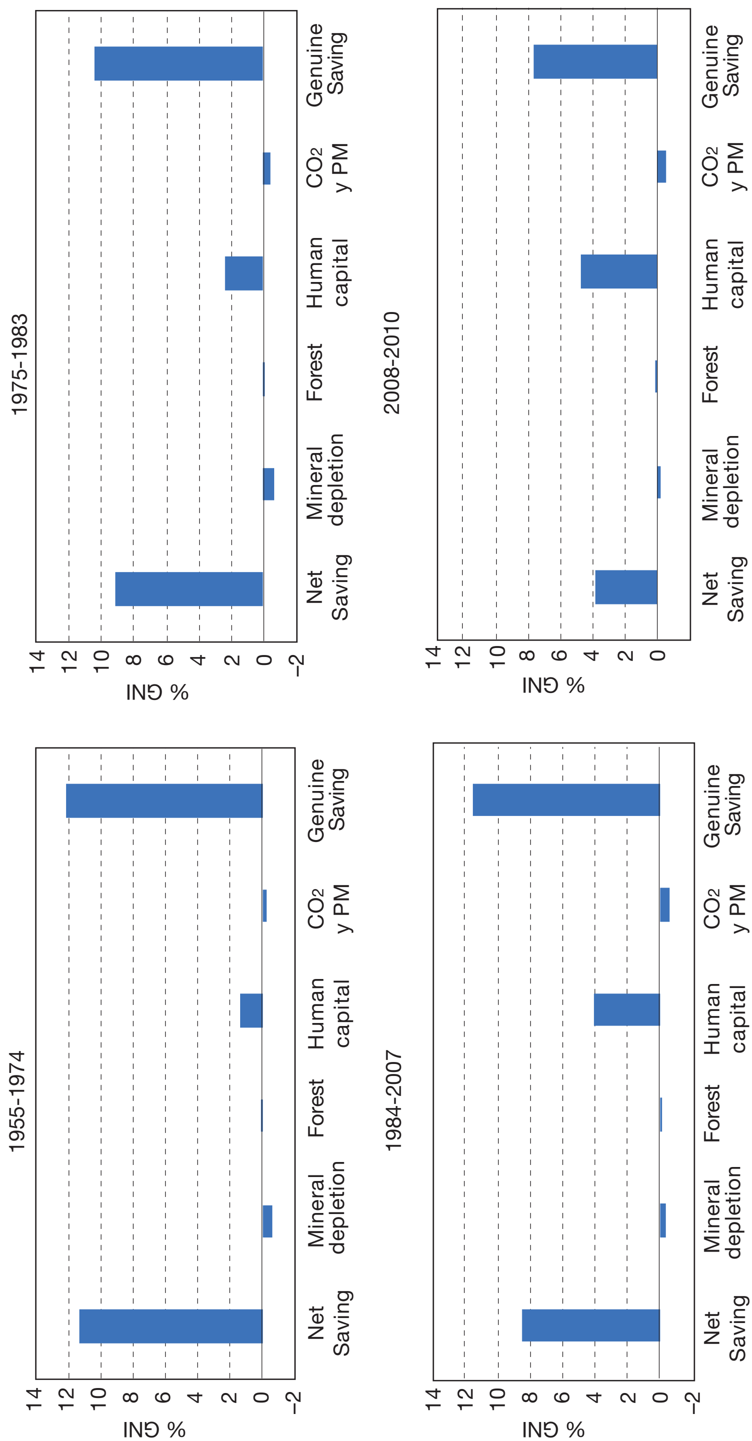
To complement this description, Figure 7 shows the GS disaggregated into its main components, expressed as percentages of GNI for four different periods, that is 1955-1974 (considerable growth in the last two decades of Franco's Dictatorship), 1974-1985 (extension of the oil crisis of the seventies and its consequences in Spain), 1986-2007 (effects of Spain joining the European Community) and 2008-2010 (effects of the financial crisis).

In the first period, the growth of GS can be explained mainly by the growth of Net Savings resulting from the high rates of investment in produced capital that began in the second half of the fifties and lasted up to 1974, in the context of an authoritarian developmental state. The country underwent rapid changes in urbanization and an intense rural exodus, and investments were concentrated on industrial, building and transport infrastructures including tourism facilities. All this generated a significant ecological depletion of non-renewable resources and a considerable amount of CO_2 emissions. To sum up, the high investment resulted in a GS of about 11 % of GNI as an average for the period despite the small contribution of human capital.

This model continued up to the middle of the 1980s, although the 1973 oil crisis and the problems derived from it caused net savings to drop to 9 % of GNI. The oil shortage led to an increase in the extraction of domestic coal. As a consequence, the depletion of non-renewable natural capital accelerated in absolute terms (Figure 3), although the effect as a percentage of GNI was barely perceptible (the annual average for the period 1975-1983 was only slightly higher than that of the previous period). In any case, an improvement in human capital which partly compensated for the drop in total savings can be observed in this period.

In the period 1984 y 2007 the Net Saving of the Spanish economy as an average was even lower (8.5 % of GNI). It is noteworthy that the great investment wave coming from Europe after Spain joined the UE in 1986, did not leave a large mark on net savings in this period. It could be that, as in the rest of the world, the growth of the financial sector led to a lower importance of produced capital in the rate of growth. Nevertheless, the drop in net saving was compensated for by a small decline in depletion (always in relative terms, that is, for unit of product) and particularly by a big expansion in human capital which grew from 1.7 to 3.7 of GNI. Despite these changes, GS stayed at a similar level to that in the previous period. Finally, in the period 2007-2010 marked by the international crisis, net investment dropped dramatically to 4 % of GNI and neither the increase of human capital nor the small decline in depletion and emissions (in relative terms once more) could compensate total GS losses.

FIGURE 7
SPANISH GS DISAGGREGATE BY COMPONENTS AND PERIODS



SOURCE: Own elaboration.

5. Discussion

The accounting of GS gives complementary information to the standard measure of GDP and suggests the idea of different forms of growth before and after the 1980s. In the first period growth was based on a strong increase of produced capital, which implied a rapid expansion of cities, infrastructures, heavy industry and transport. In the second, from the late 1980s on, the growing importance of human capital as a real driver of Genuine Saving began to emerge. And this in spite of the fact that Spain has never been characterized by its high expenditure on education in those decades, nor for recording particularly good results in the international education rankings (Guio & Choi de Mendizabal, 2014). Further to this, what is surprising about the results of the standard measurement is the small effect on savings from resource depletion and environmental damage which contrasts with data coming from works analyzing material and energy flows, ecological footprint or calculations of the ISEW of the Spanish economy. But these differences can be explained in several ways.

The first issue to consider is related to the origin of the energy consumed in Spain. It is known that the massive use of fossil fuels (mainly oil but also gas) was one of the key aspects of Spanish economic growth from the fifties on. But given the lack of oil and gas deposits in the country most of the energy was imported (Sudria, 1997; Camprubí, 2019). This situation poses a problem in Spanish GS estimates, as natural capital coming from imports is not fully accounted for. In fact, the use of this imported fossil energy is accounted indirectly (via CO_2 emissions) as an element of ecosystem degradation but is not accounted as depletion attributable to Spanish growth, and this undoubtedly lowers the negative valuation of the environmental effects. Bearing in mind the low energy efficiency of the Spanish economy, this problem could be particularly important (O'Mahony, 2018)

Another important factor that standard accounting of GS does not consider is urban sprawl. The extensive and rapid rural exodus starting in the fifties as well as the importance of buildings for tourism (apartments and hotels) mainly on the coast and adjacent areas, and the housing bubbles at the turn of the twenty-first century, have made the building industry one of prime importance (Naredo & Montiel, 2011). Standard estimates of GS take into account buildings mainly as capital accumulation, but possible effects of urban sprawl on territory fragmentation and biodiversity are not considered (Marul et al., 2014). Nevertheless, there have been some attempts to place a value on those effects, through the estimation of monetary values of ecosystem services that would be worth exploring in order to improve GS estimates (i.e. Dupras et al., 2016).

The third factor to consider is that of water stress and drought, which can be of particular importance in a Mediterranean country like Spain. From this perspective, accounting for water wastage and water degradation is important in assessing sustainability. Paradoxically, during the second half of the twenty century Spain became a net exporter of water, due to its specialization in crop exports with high water content (Duarte et al., 2014). Furthermore, tourist activities on the Mediterranean coast are associated with high water consumption, especially in periods of high water stress like summers (Ostos & Tello, 2014). Within this framework, it could be said that accounting for water consumption and degradation could substantially change the accounting of environmental damage in GS as has been demonstrated for other countries (Biassi et al. 2019).

However, the problems of GS do not only affect those resources that are not included, but also the calculation of those that are. In the case of non-renewable resources standard accounting only takes into consideration minerals entering the economic circuit as direct inputs, but not all the materials that are removed in order to obtain the required ores (slags, sands, ashes and so on). These materials do not have a price because they are not marketable, but its movement and untreated accumulation contribute to ecological damage. The physical assessment of these "hidden flows" of materials, have been shown to be of paramount importance in the case of Spain. In fact, in some years during the period 1955-2000 it could represent between 49 % and 54 % of the Total Material Requirements (TMR) of the national economy (Carpintero, 2005).

It is also important to bear in mind that market prices allocated for minerals do not take into consideration resource depletion (or at best do so in a very partial manner, due to a lack of real information), and consequently tend to underestimate future prices. In this sense some authors have proposed other kinds of valuation based on the so called "exergetic cost" of minerals (Naredo, 1998; Valero & Ranz, 1999; Valero & Valero, 2014). Exergy can be defined as a measure of the quality of systems and for the point being made here, it can be said that this quality diminishes as minerals concentrated in the earth's crust are extracted for economic purposes, increasing disorder in earth systems. From this perspective, the "exergetic cost" of each mineral could be defined as the amount of energy needed for a reversal of the process and a hypothetical restoration of the original system. Using current data for mineral extractions in Spain, Valero et al. (2014) calculated that the exergetic cost of mineral extraction in 2009 represented 18.9 % of Spanish GDP in that year. If we calculated the cost using the standard method of World Bank methodology, that percentage drops dramatically to 0.2 % of GDP for the same year. The problem is that if we account non-renewable resources following the exergetic cost method, losses derived from mineral depletion do not compensate gains coming from net savings and human capital and as a result Spanish GS would turn negative, suggesting that Spanish economic growth in 2009 was unsustainable[5].

The valuation problem emerges again with prices allocated for emissions. On the one hand, standard measurement of GS only takes into account CO_2 emissions, which are massive on a global scale and are also responsible for the greenhouse effect and global warming. Nevertheless, there are other Greenhouse Gases (GHGs) with similar effects whose full valuation could change GS figures. If we consider again the year 2009, Spanish GHG emissions, composed of methane and nitrogen

[5] This conclusion could change if gains coming from TFP were considered in the estimates of GS.

dioxide, would be 8% higher. But once again the main problem is the monetary valuation of emissions. Normally that valuation is accounted through the Social Carbon Cost (SCC) that can be defined as the positive monetary value of cleaning a tonne of CO_2 from the atmosphere (Kunnas et al., 2014). This value is calculated on the basis of projections of climatic models which propose different future scenarios with different concentrations of carbon. In this context the larger the future estimates of damage, the higher the present SCC. In other words, figures proposed by literature present huge price differences ranging from $20 per tonne (Nordhaus, 2007) to $131 or even $1400 per tonne in a hypothetical future scenario with no emissions control at all (Pezzey & Burke, 2014). A provisional test for the case of Spain reveals that an annual price of around $590-$600 per tonne applied to the past would have turned the Spanish GS negative for the whole period between 1955 and 2010.[6]

Finally, the valuation of renewable resources also has some important weaknesses. In the case of Spain throughout the period being studied the forest area has not only not reduced but has in fact grown due both to reforestation policies which began from the middle of the century, and to the incentives provided by the EU to individuals to replace unprofitable crops with tree plantations (Iriarte Goñi, 2017). But the accounting of this asset in GS is calculated only on the basis of actual prices of extracted wood, when, as is known, forests and also other ecosystems offer different environmental services related, for instance, to temperatures and rain regulation, biodiversity support, and soil conservation that are not accounted for in standard measurements of GS.

To sum up, the accounting of GS incorporates some variables that are often not taken into account in the explanation of growth and can offer some interesting insights to be considered when establishing alternative hypotheses regarding economic change. However, to read a positive GS as proof of the sustainability of an economy is hard to defend. Even without questioning the validity of the concept of Weak Sustainability it seems obvious that too many important elements are left out of the assessment. On the other hand, it is also clear that the valuation systems of the elements that are taken into account, are not very consistent because the range of variation, using alternative forms of measurement, is so big.

6. Concluding remarks

As stated in the introduction, the hypotheses of WS are used in this paper to measure the GS of Spain between 1955 and 2010 in order to assess the explanatory potential of this tool for a better understanding of Spanish economic growth and its possible sustainability.

[6] Again, this approach would probably change if effects of TFP in GS were accounted. A discussion of how to apply changing prices per tonne depending on carbon accumulation in the atmosphere in different historical periods see Lindmarck and Acar (2013) or O'Mahony (2018).

The results are somewhat ambiguous. On the one hand, it adds some further information and highlighting aspects that the GDP analysis alone does not offer. In the case of Spain, for example, it suggests the existence of two very different models of growth before and after the 1980s which give rise to hypotheses for future working. Furthermore, as is obvious, measuring Spanish GS following standard methodology allows for comparison with other countries for which this magnitude has also been calculated. But, despite these aspects, this work suggests that the GS is highly influenced by GDP, and this raises doubts about its viability as a truly alternative measure.

A key issue to consider is the weak sustainability interpretation of the indicator. Of course, to assume perfect substitutability between the different forms of capital is highly debatable. But even without dealing with this question, it is evident that making categorical statements about WS using standard GS is dangerous. On the one hand, the measurement of natural capital is highly partial, given that it leaves an enormous number of important assets out of the accounting. Not considering imported fossil fuels, nor accounting a scarcely available resource in Spain like water, or nor taking into account the environmental effects of such important activities as building, are just some of the problems that have been detected.

On the other hand, both the depletion of natural capital and the damage due to emissions, are subject to such a wide range of possible monetary valuations depending on the method chosen, that any conclusion is little more than guesswork. It is obvious that choosing very conservative assessment methods like those of the World Bank standard measurements has meant that Spanish GS in the long term has always been positive. However, this would not be the case if other assessment methods which give more weight to the loss of resources and the damage caused by emissions were used. In these circumstances, to talk of sustainability, even in its weak sense, seems in essence to be wishful thinking.

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