Chapter 7
Evaluation of Sustainable Economic Growth in Portuguese Agriculture and Other Sectors

Vítor João Pereira Domingues Martinho

1 Introduction

The tradeoff between economic growth and sustainability will be the big challenge in the future, considering the levels of economic growth needed and the increasing signs of sustainability problems, in different contexts (environmental, social, etc.) verified in many regions of the world.

In this way, all the good research studies in these subjects are well intended to shine some light on these problematic questions and to try and find some solutions for the conciliation between the earth's limits and human presence.

This study intends to be innovative in these fields, because it utilizes a Keynesian model based on the second law of Kaldor (1966, 1967) extended with new variables to capture the different levels of sustainability. There was no evidence found in theoretical literature for any study about the relationship between sustainability and economic growth using the relationship involving productivity growth as a function of the output growth (second law of Kaldor). In another way, performing this analysis for Portugal can be seen as another pertinent contribution, as there are very few studies concerning these aspects for Portuguese regions.

Indeed, Portugal has improved its performance, in a sustainable way, in many social, demographic, and educational indicators over recent years. This is proved by the data used, in this study, for the variables relating to population density, life expectancy, number of doctors in medicine, human resources in science and technology, and the infant mortality rate. The question here is to try to analyze if the evolution of these indicators is compatible with economic growth, from a sustainable perspective.

Nowadays, this is an important topic to discuss, what with the current debate in Portugal about sustainability and the pertinence, in terms of economic growth and

V.J.P.D. Martinho (✉)
Agricultural School, Polytechnic Institute of Viseu, 3500 Viseu, Portugal
e-mail: vdmartinho@esav.ipv.pt

V.J.P.D. Martinho (ed.), *The Agricultural Economics of the 21st Century*,
DOI 10.1007/978-3-319-09471-7_7

of the social public policies, considering the financial problems related with the Portuguese public budget.

In reality, there are many problems with the national public debt and the national economic growth, but without adjusted policies more problems may arise, namely those related to social, environmental, and demographic sustainability. The uneven development, in Portugal, between the north and south, between inland regions and on the shoreline, has been occurring over many years, but with unadjusted policies these asymmetries can increase.

2 Literature Background

Economic growth with sustainability in different areas of society, namely environmental, social, economic, demographic, and educational, is, indeed, the greatest challenge for world economies both nowadays and for the future. In this way, many authors such as Munasinghe (1995), Smulders (1995), Young (1999), Santagata (2002), Chukwu (2005), Garnaut (2005), Desrochers (2006), Greyson (2007), Fleisher et al. (2009), Kumagai (2009), Min et al. (2009), and Asheim and Mitra (2010), among others referred to below, have all discussed and demonstrated a strong concern for the issues related to this problem, which is a good sign, considering the pertinence of these questions for the future evolution of societies in several perspectives.

Certainly, the evolution of an economy is a complex process with several aspects and is a result of many interactions, such as those related to the aims of economic agents in obtaining great profits, conciliated with improvements in productivity of the factors and favorable public policies, the government's controls for climate change, taxes, wage pressures, competition, physical capital, consumers' preferences and capacity to consume, social conditions, and the availability of a workforce (Weber et al. 2005). The productivity of the factors is dependent upon the qualifications for human factors and on the level of scientific and technological development. Watanabe et al. (2005) also concluded about the importance of research, innovation, and technological development and diversification in some patterns of sustainable economic growth. The investment in scientific fields and in human resources may be determinant for economies to obtain competitive advantages, in the current world with high levels of globalization, in accordance with social and environmental sustainability, creating more jobs, improving efficiency, and preserving natural resources. From a similar perspective, Clarke and Islam (2005) analyzed the relationship between economic growth and welfare, considering social, economic, environmental, and political variables as well as some related to income, education, health, roads, the levels of urbanization, consumption, and others. They concluded that in some developing economies, without adjusted public policies, at some levels of economic growth, the countries achieve diminishing or negative welfare returns. In these cases the cost of economic growth can sometimes surpass the benefits. The relationship between welfare (measured by the domestic product), economic growth, and sustainable development was also a concern of

Dasgupta and Mitra (1999). About 2 years before, Islam et al. (2003) found similar conclusions, similar to those of Clarke and Islam (2005), considering variables linked to consumption, environmental quality, investment, technical progress, employment, workforce, social indicators, levels of waste, renewable resources, etc. The availability of scarce resources will be the big problem for future generations and may be the main determinant for the compatibility of sustainability with economic growth over the next few decades (Scholl and Semmler 2002).

Economic growth with financial and economic sustainability and stability is an issue in focus today for many countries facing their current domestic problems, including western and developed economies. For example, the discussion about the dimension of public debt is very much the order of the day in these economies, mostly because of the image of stability which is necessary to project to their creditors rather than the real implications of these debts in the economic evolution of these countries. Indeed Greiner (2013), with an endogenous growth model, found that the public debt does not influence the economic growth, in the long run, and does not change employment, but rather only affects economic stability. Sustainable economic growth in poor countries is another concern. Hunt (2011) defends an economic growth in these countries focused more upon the creation of institutions that promoted economic independence and competition rather than some form of investment. Economic sovereignty can be determinant, namely that related to the control of firms, specifically those with a high level of technology, export-oriented, and with great influence upon the domestic economy. This can be the main explanation for the recent differing behavior of the Swedish and Irish economies (Andreosso-O'Callaghan and Lenihan 2011). National policies should be able to promote some national industrial independence in order to mitigate the international impact upon the economy in times of crisis. The industrial sector and other sectors of tradable goods play a crucial role in the expansion of exports with direct implications for economic growth and for balanced job creation (N'Zué 2003).

In terms of economic growth and environmental sustainability, Chang and Carballo (2011) analyzed the relationship between energy use, carbon emissions, and economic growth in countries of Latin America and the Caribbean, with a co-integration model considering a vector error correction modeling, a vector autoregression, and Granger causality. The results show that it is difficult to implement strategies to promote more efficient energy consumption without affecting economic growth. The compromise between economic growth and the environment is often difficult to achieve in many countries. The discussions about the relationship between the environment and economic growth have occurred for decades (Cole 1999). In literature from the 1960s to the 1980s, few have clarified the questions related to the interactions between economic growth and the environment. Some authors defended that economic growth with sufficient technological progress will preserve the natural environment and others had the opinion that unlimited growth was not possible. In the 1990s the econometric estimations do not find, again, a unique explanation for these relationships, due to the varying effects of, for example, pollutants. Even the environmental Kuznets curve, that predicts some regularity between economic growth and the reduction of problems within the environment, merits many criticisms from Stern et al (1996). This author found that this regularity only occurs when based upon many unreal suppositions, namely that there is no influence upon environmental quality in production and no influence upon international trade. Zuo and Ai (2011) also studied the relationship between economic growth, sustainability, and energy consumption, with an endogenous growth model. They concluded that it is important to improve technologies of extraction and use of energy and to decrease dependence on nonrenewable energies. Indeed, countries such as China, for example, had to consider for their great levels of economic growth implementing policies of reducing the intensity of energy consumption and the consequent carbon emissions, namely due to the use of fossil fuels. Technical efficiency and technological progress were the source, after the Chinese economic reform in the 1970s, for improvements in productivity and of the consequent high and continuous levels of economic growth in China (Wu 2000). Certainly, if China benefited from a first stage form of some process of catching-up, it was after their successful economic growth, which in turn brought about innovation and returns from the investments made in new technologies. The efficiency and the necessity for adjusted policies in consumption and production of energy in developing countries was also analyzed by Keong (2005). The improvements in the evolution of economies and societies imply increased needs for energy by firms and by families and this can be solved by increasing energy production, but also with improvements in consumption behavior. Energy is crucial for economic evolution, but this progress must use clean energy, in an efficient way and competitively and by upgrading in productivity (Hefner 1995). It is also important to find strategies which distribute the income obtained in a perspective of sustainable and balanced development compatible with the environment (Li and Oberheitmann 2009). The relationship between economic growth and environmental sustainability was, also, examined by Chi et al. (2009), using an endogenous economic growth model. However, economic growth and environmental sustainability may not be reconcilable, considering the current demands for economic growth in order to reduce national public debts (Alier 2009). Fundamentally the questions related to environmental sustainability are about the efficiency of the exploitation, utilization, and resulting daily waste for natural resources from the daily activity of the various economic agents (families, enterprises, etc.). One of these crucial, yet limited, natural resources is drinkable water. Hallowes et al. (2008), for example, stressed the importance for efficient water use in South Africa, given its scarcity. It is predicted that in decades to come, water will be the major problem for sustainability in many countries including the more developed economies, facing high levels of pollution in soils, rivers, seas, and the atmosphere. The greenhouse effect derived from the high index of gaseous emissions has promoted climatic changes with great implications for the availability of water, namely in the world's southern regions. In order to solve the greenhouse problem, it is fundamental to think about better policies and regulations for the energy market (Ayres et al. 2007). There is a new concept of environmentally friendly economic growth which is referred to as "green growth." Green growth is based on the following principles (Janicke 2012): increasing resource productivity, refinanced investments for efficiency returns, innovation in conserving resources, improvements in the green markets, and prevention of damages from economic growth. However, this author claims that the best solution would be for rich countries to reduce the domestic product increase and improve their eco-innovation.

From a demographic point of view, Bai et al. (2012) analyzed the relationship between population indicators and sustainable economic growth in several cities and provinces of China. They found that cities with greater wealth and with a higher population tend to obtain more income and, in turn, attract more population. On the other hand, they also found that there are circular and cumulative processes between the population demographic and economic growth. In this way if the Chinese authorities intend to have a sustainable economic growth, they must clearly define their adjusted public policies.

3 Model, Data, and Results

The model considered was the equation of the second law of Kaldor, where the productivity growth rate is dependent upon the output growth rate, extended with more new variables related with demographic, social, and educational aspects, namely the following: the population density, life expectancy, number of doctors in medicine, human resources in science and technology, and the infant mortality rate. The outputs considered in the variables of the original Kaldor second law equation were used in real prices, after having removed inflation with consumer index prices. This model was built for the different Portuguese sectors considered in this current study, namely the following: agriculture, forestry, and fishing; industry (except construction); manufacturing; construction; wholesale and retail trade, transport, accommodation, and food service activities, information technology and communication; financial and insurance activities, real estate activities, and professional, scientific, and technical activities, administrative and support services; public administration and defense; compulsory social security, education, human health, and social work activities, arts, entertainment, and recreation; repair of household goods; and other services. The original equation of the Kaldor second law captures endogeneity of the factors, economic dynamics, spillover effects, and increasing returns to scale.

The data used were those related with the variables referred to before and were obtained, for the period 1995–2010, from Eurostat (2013) for the seven Portuguese NUTs II. Indeed, Portugal has an unbalanced development between the several seven regions, where two are islands, and it will be interesting to analyze these dynamics in their relationship to economic growth and the indicators related to other components of society, whether trying to identify compatibility and sustainability or not.

The results were obtained with the Stata (2011) software, with panel data methods (namely fixed and random effects), and tested with many statistical tests which are presented in Table 7.1 (where the new variables are considered in levels) and in Table 7.2 (where the new variables are considered for growth rate). The idea

Table 7.1 Estimation results of the Kaldor second law equation extended (new variables in levels), with panel data, for Portuguese economic sectors, over the period 1995–2010 and over the seven Portuguese NUTs II

	Const.[a]	Coef.[b]	Coef.[c]	Coef.[d]	Coef.[e]	Coef.[f]	Coef.[g]	F/Wald (mod.)[h]	F (Fe_OLS)[i]	Corr (u_i)[j]	F (Re_OLS)[k]	Hausman[l]	R^2 [m]
All economy													
Fe[n]	−0.375** (−1.730)	0.847* (16.290)	6.640e-06 (0.040)	0.004 (1.070)	0.001** (1.920)	−8.150e-06 (−0.130)	0.001 (0.800)	49.180*	6.390*	−0.747		45.570*	0.762
Agriculture, forestry, and fishing													
OLS[o]	−0.0442 (−0.070)	1.006* (8.940)	0.000 (0.400)	0.001 (0.150)	0.000 (0.100)	−0.000 (−0.810)	−0.006 (−1.130)				0.000	11.700**	0.438
Industry (except construction)													
OLS[o]	−0.318 (−1.390)	0.895* (18.710)	0.000 (1.260)	0.004 (1.460)	−0.000 (−0.150)	−0.000 (−0.980)	−0.002 (−0.720)				0.000	10.960**	0.778
Manufacturing													
OLS[o]	−0.403 (−1.490)	0.871* (20.500)	0.000 (0.870)	0.005 (1.480)	0.000 (0.340)	−0.000 (−1.290)	−.000 (−0.120)				0.000	12.020**	0.810
Construction													
OLS[o]	−0.112 (−0.250)	0.413* (6.330)	0.000 (0.750)	0.002 (0.350)	−0.000 (−0.940)	0.000 (0.850)	−0.005 (−1.210)				0.000	8.340	0.270
Wholesale and retail trade; transport, accommodation, and food service activities; information and communication													
Fe[n]	−0.448 (−1.300)	0.923* (13.340)	−0.000 (−0.090)	0.004 (0.660)	0.001** (1.880)	0.000 (0.390)	0.006* (2.590)	33.390*	2.300*	−0.777		13.11*	0.685
Financial and insurance activities; real estate activities; professional, scientific, and technical activities; administrative and support service													
OLS[o]	−0.297 (−0.790)	1.032* (21.240)	0.000 (0.380)	0.004 (0.700)	0.000 (0.420)	−0.000 (−1.610)	0.000 (0.060)				0.000	9.950**	0.818

Public administration and defense; compulsory social security, education, human health, and social work activities; arts, entertainment, and recreation; repair of household goods; and other services													
OLS[o]	−0.148 (−1.010)	0.775* (14.450)	5.490e-06 (0.300)	0.002 (0.970)	2.000e−06 (0.030)	−0.000 (−0.490)	−0.002 (−1.080)				0.000	6.890	0.700

Note: [a]Constant; [b]Kaldor second law coefficient; [c]Population density coefficient; [d]Life expectancy coefficient; [e]Medicine doctors coefficient; [f]Human resources in science and technology coefficient; [g]Infant mortality rate coefficient; [h]Test F for fixed effects model and test Wald for random effects; [i]Test F for fixed effects or OLS (Ho is OLS); [j]Correlation between errors and regressors in fixed effects; [k]Test F for random effects or OLS (Ho is OLS); [l]Hausman test (Ho is GLS); [m]R square; [n]Fixed effects (Fe); [o]Ordinary last square (OLS)

*Statically significant at 5 %; **Statically significant at 10 %

Table 7.2 Estimation results of the Kaldor second law equation extended (new variables in growth rates) with panel data, for Portuguese economic sectors, over the period 1995–2010 and over the seven Portuguese NUTs II

	Const.[a]	Coef.[b]	Coef.[c]	Coef.[d]	Coef.[e]	Coef.[f]	Coef.[g]	F/Wald (mod.)[h]	F (Fe_OLS)[i]	Corr (u_i)[j]	F (Re_OLS)[k]	Hausman[l]	R^2 [m]
All economy													
OLS[n]	−0.002 (−0.400)	0.656* (12.770)	−0.458* (−2.570)	0.176 (0.500)	0.083 (0.690)	−0.000 (−0.020)	−0.000 (−0.020)				0.000	5.610	0.664
Agriculture, forestry, and fishing													
OLS[n]	0.004 (0.280)	0.980* (8.900)	−1.767* (−2.830)	1.017 (0.770)	0.490 (1.120)	0.040 (0.730)	−0.031 (−1.480)				0.000	3.810	0.485
Industry (except construction)													
OLS[n]	0.009 (1.580)	0.835* (17.810)	−0.133 (−0.530)	−0.010 (−0.020)	0.181 (1.030)	0.036 (1.630)	−0.007 (−0.870)		2.040**			210.110*	0.765
Manufacturing													
OLS[n]	0.008 (1.170)	0.830* (19.510)	−0.132 (−0.440)	0.212 (0.350)	0.156 (0.750)	0.040 (1.510)	−0.002 (−0.190)		1.490			14.900*	0.793
Construction													
OLS[n]	−0.002 (−0.210)	0.361* (5.960)	−0.745 (−1.550)	0.611 (0.620)	0.068 (0.200)	0.011 (0.250)	−0.001 (−0.040)				0.000	1.680	0.250
Wholesale and retail trade, transport, accommodation, and food service activities, information and communication													
OLS[n]	−0.010 (−1.580)	0.762* (11.280)	−0.309 (−1.200)	−0.167 (−0.320)	0.012 (0.070)	−0.025 (−1.110)	0.010 (1.200)				0.000	1.470	0.603
Financial and insurance activities, real estate activities, professional, scientific, and technical activities, administrative and support service													
OLS[n]	−0.041* (−4.340)	1.040* (21.400)	0.349 (0.870)	0.943 (1.170)	0.561 (2.050)	0.008 (0.220)	0.005 (0.380)				0.000	1.320	0.825

Public administration and defense; compulsory social security; education; human health and social work activities; arts, entertainment, and recreation; repair of household goods; and other services													
OLS[n]	−0.008* (−2.100)	0.657* (14.080)	0.013 (0.090)	0.132 (0.420)	0.110 (1.040)	−0.024 (−1.800)	0.013* (2.570)		1.140			24.060*	0.704

Note: [a]Constant; [b]Kaldor second law coefficient; [c]Population density coefficient; [d]Life expectancy coefficient; [e]Medicine doctors coefficient; [f]Human resources in science and technology coefficient; [g]Infant mortality rate coefficient; [h]Test F for fixed effects model and test Wald for random effects; [i]Test F for fixed effects or OLS (Ho is OLS); [j]Correlation between errors and regressors in fixed effects; [k]Test F for random effects or OLS (Ho is OLS); [l]Hausman test (Ho is GLS); [m]R square; [n]Ordinary last square (OLS)

*Statistically significant at 5 %; **Statistically significant at 10 %

of considering these two models was to analyze the effects, in levels and in growth rate, of the social, demographic, and educational indicators in economic growth (represented by the productivity and its influence on the output).

By observing the two tables, it is possible to conclude that the indicators related to sustainability and represented by the new variables have had little influence upon the economic growth of the seven Portuguese NUTs II sectors, over the last two decades, even less when they are considered in levels.

But looking namely at Table 7.2, where the results are statistically more consistent, it can be observed that the Kaldor second law coefficient (expected to assume values between 0 and 1, considering that when this coefficient has a value next to 1 this signifies that the respective sector presents great increasing returns to scale and better economic growth) shows better values in agriculture, industry, manufacturing, and in sectors related with financial and insurance activities; real estate activities; professional, scientific, and technical activities; and administrative and support services. Construction presents the worse levels of economic growth dynamics and this is confirmed by the R^2.

Relative to the new variables (Table 7.2) the results show that the population density had a negative effect on the whole economic growth for the Portuguese economy (all aggregated economic sectors) and in agriculture, which in terms of sustainability may be an interesting conclusion that needs further investigation in future studies. This is because the New Economic Geography refers that the same effects represented in the original equation related to the second law of Kaldor appear where there is a larger population and concentration of enterprises (known as the centripetal forces). But, the New Economic Geography also considers the centrifugal forces which arrive from the agricultural sector and from effects of congestion on more populated areas. Maybe, this is the phenomena present here in these findings. In other words, for example, it is in industry and, principally, in manufacturing, which is considered by Kaldor to be the driving sector for economic growth, because in the capacity of producing tradable products and having scale dynamics, the evolution of economic growth is independent from the indicators used to represent sustainability at different levels. This is an alternative approach to analyzing the behavior of the demographic, social, and educational indicators in conciliation with economic growth over the last two decades within the seven Portuguese NUTs II and for the different economic sectors, namely agriculture, industry, construction, and several services.

Conclusions

Economic growth in economics literature is well explained by different ideologies, namely those related with the Classical theory, Keynesian theory, the Neo-classical theory, the theory of Endogenous Growth, and the recent New Economic Geography. Each one gives their perspective about the evolution for economic growth in different countries and regions, about the

(continued)

variables that must be considered and about regional convergence or divergence, and about constant returns to scale or increasing returns to scale. But few studies try to conciliate the models of these theories with the variables that represent sustainability at different levels (social, scientific, cultural, etc.).

In this study an attempt has been made to analyze the compatibility between economic growth, using the Kaldor second law equation, and some indicators for sustainability. The results show that, as expected by Kaldor, the sectors with more increasing returns to scale are industry and manufacturing, but also agriculture (maybe due to the modernization of the sector with more machinery and less labor force) and some services (namely financial and insurance services). On the other hand, the new variables have little influence upon economic growth for the various sectors of the Portuguese economy. Only population density presents a negative impact upon the economic performance of the whole economy and the agricultural sector.

These conclusions may be important indications for public institutions in defining public policies. This is because it is often claimed, for example, that some social policies can cause some damage towards economic growth. But the reality is that over the last two decades in Portugal there was no relation, considering these results, between the few social indicators considered here (interrelated with others) and economic growth.

In future studies it will be important to find further explanation for the conclusions presented here, namely, why economic growth in Portugal was, more or less, over the last 20 years independent from some indicators for sustainability. Indeed, some relation was expected between the several dimensions of society and the economic performance in Portugal.

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