Università degli studi di Firenze

Economics -XXVII cycle
Curriculum: Development Economics

Essays on Sustainability, Development and Resource Curse in a Spatial Perspective

Advisor:
Prof. Donato Romano
Supervisor:
Prof. Benedetto Rocchi
SSD: SECS-P/01

Author:
Paola Biasi

Academic Years 2012-2014

Alla mia famiglia

Contents

1 Introduction **7**

1.1 The resource curse . . . 7
1.2 The case study . . . 8
1.3 Research question . . . 11
1.4 The structure of the thesis . . . 11

References **13**

2 Sustainable development, resource use and regions: a rewiew **14**

2.1 Introduction . . . 14
2.2 Regional Sustainable Development . . . 16
2.3 Regional Sustainability Assessment . . . 19
2.4 The application of Sustainability Measurement Tools and Methods at the regional level: a critical review . . . 24
2.4.1 Environmental Sustainability Index . . . 24
2.4.2 Ecological Footprint . . . 24
2.4.3 Index of Sustainable Economic Welfare (ISEW) and Genuine Progress Indicator (GPI) . . . 25
2.4.4 Genuine Saving . . . 26
2.4.5 Environmental extensions in Input-Output and Social Accounting Matrix models . . . 27
2.4.6 General remarks . . . 27
2.5 Conclusions . . . 28

References **29**

3 The Genuine Savings indicator: estimates at the subnational level in Italy. **35**

3.1 Introduction . . . 35
3.2 The Genuine Savings indicator: conceptual framework and related literature. . . . 37

3.3 Theoretical model . . . 38
3.4 Methodology and Data . . . 40
3.4.1 Gross savings , physical capital and education expenditures . . . 41
3.4.2 Natural capital: Depletion and Pollution Damages . . . 42
3.5 Results and discussion . . . 43
3.6 GS adjusted for interactions between regions . . . 47
3.7 Conclusions . . . 50

Appendices **57**
3.A GS estimates: method and data sources . . . 57

References **59**

4 The resource curse at the subnational level: the case of Italy **63**
4.1 Introduction . . . 63
4.2 The impact of natural resource exploitation on a regional economy . . . 66
4.3 Data and methods . . . 70
4.4 Results . . . 72
4.5 Discussion . . . 79
4.6 Conclusions . . . 85

Appendices **86**
4.A Appendix . . . 87

References **91**

5 Sustainable Development and royalties allocation: a structural analysis and policy simulations for a lagged region in the south of Italy **95**
5.1 Introduction . . . 95
5.2 Methodology . . . 99
5.2.1 Introduction . . . 99
5.2.2 Bi-regional Social Accounting Matrix . . . 99
5.2.3 Enviromental analysis . . . 101
5.2.4 Social sustainability: extension of the Genuine Saving . 102
5.3 Data and empirical implementation . . . 103
5.3.1 SAM and multiplier decomposition . . . 103
5.3.2 Environmental data . . . 111
5.3.3 Social sustainability data . . . 115
5.4 Policy scenario and Genuine Saving extension . . . 116

5.5 Conclusions 124

References **126**

List of Tables

2.3.1 Criteria matrix for regional sustainability assessment methods 23

3.7.1 Net National Savings as a percentage of regional GDP 51
3.7.2 Education Expenditure as a percentage of regional GDP . . . 52
3.7.3 Energy and Mineral Depletion as a percentage of regional GDP 53
3.7.4 CO2 Damage as percentage of regional GDP 54
3.7.5 GS as percentage of regional GDP 55
3.7.6 GS including PM Damage as percentage of regional GDP . . . 56

4.4.1 SUR models 73
4.4.2 SUR models including "Institutional Quality" 76
4.4.3 Fixed and Random effects models 77
4.4.4 Random effect models with capital stock in the industrial sector (excluding the mining sector 78
4.5.1 SUR model excluding Basilicata region 83
4.5.2 Correlation Matrix for Resource Abundance and Indicators of Regional Competitiveness 84
4.A.1 Data and sources. 87
4.A.2 Summary statistics 90

5.3.1 Regional SAM framework 104
5.3.2 Bi-regional SAM framework 105
5.3.3 Total and regional multipliers for output, GDP and income. . 107
5.3.4 Output multipliers. 108
5.3.5 GDP multipliers. 109
5.3.6 Income multipliers 110
5.3.7 OPE for output, GDP and income multipliers 111
5.3.8 Emission coefficients, Basilicata 113
5.3.9 Emission coefficients, Rest of Italy 114
5.3.10 Cost of environmental degradation 115
5.4.1 Policy scenarios in the allocation of royalties 118

5.4.2 Short-run economic impacts of royalties allocation (M euro) . 119
5.4.3 Variation from the baseline and average multipliers of alternative policy scenarios 120
5.4.4 Environmental impacts of alternative scenarios in the allocation of royalty 120
5.4.5 Environmental impacts of royalties allocation (M euro of evnironmental damage and percentage distribution among pollutants) 122
5.4.6 Social impact of alternative scenarios in the allocation of royalties. Percentage variations from the baseline of the relative poverty gap 123
5.4.7 Contributions to sustainability of alternative scenarios in the allocation of royalties (M euro of marginal contribution to GS) 124

List of Figures

3.5.1 GS estimates for Italy, excluding PM damage (1995-2006) . . . 44
3.5.2 Mineral and Energy Depletion in current euros for main regions of production 45
3.5.3 PM damage as percentage of regional GDP 46
3.5.4 GS excluding PM damage 47
3.6.1 Ecological balance of payments among Italian regions (2008) . 49

4.2.1 DD at the sub-national level 68
4.5.1 Resource Abundance (ranks) 80
4.5.2 Resource abundance (value) 80

Introduction

1.1 The resource curse

"If natural resources really do help development, why do not we see a positive correlation today between natural wealth and other kinds of economic wealth?"(Sachs and Warner, 2001).

The negative relationship between the abundance in natural resources endowments and the economic performance in terms of growth and welfare - the so-called "resource curse" - has been the object of numerous studies. Such counterintuitive interaction appears indeed to be widespread, and particularly strong among developing countries. This relationship is surprisingly robust in cross country analyses: a seminal work by Sala I Martin (1997) finds resource abundance as having one of the most robust negative impact on growth, compared to other determinants identified in the related literature.

The role of natural resources in the process of development, particularly for oil and other non-renewable energy resources, changed dramatically throughout time. In the early stage of industrialization, the proximity to rich deposits of natural resources was a factor having a strong positive effect on the development path of a territory. Nowadays, this element is less crucial, to the point that, in recent decades, the empirical evidence suggests that, more often than not, large endowments of natural resources are rather associated with slow growth and underdevelopment.

Despite the vast majority of literature focusses on the economic determinants of such phenomenon, the role of natural resources in the economic system can be investigated in the light of a different approach: natural resources can be considered as assets of the economic system, a common natural heritage of a territory, a non-economic (strictly speaking) wealth, of which communities dispose; thus, their management also concerns the *sustainability* of development.

Since the seminal work of the Bruntland commission, that defines sustainable development as “the development that meets the needs of the present without compromising the ability of future generations to meet their own needs”, a lot of effort has been made to understand how sustainability can be operationalized, assessed and measured. Using a ”weak” definition of sustainability, some scholars focus on the identification of an economy’s productive base in order to understand sustainability. Under this perspective, the accounting value of an economy’s capital assets constitutes the wealth of the economy, in a broad definition of wealth that includes the social value of physical, human, and natural capital. Hence, a sustainable economy is defined as an economy able not to erode this productive base in inter-temporal terms.

Both in the case of resource curse and sustainability, a large part of the literature focuses on the interaction between natural assets and economic growth and sustainability at the aggregate level. Only recently, there is a growing interest for analysis conducted over a lower territorial level. In this regard, two aspects must be highlighted.

On the one hand, a large part of the impact of natural resources in economic development are relevant at the local level. Choosing the proper scale of analysis is crucial to understand the main problems caused in resource exploitation and resource-led models of development. On the other hand, as in the case of the *measurement* of sustainability, the territorial level is not neutral: measurement at the aggregate level can hide important “territorial sacrifices”, such as an unequal distribution of sustainability at the subnational level. In other words, the sustainability of the aggregate economic system may be sustained by an unsustainable management of natural resources in some subnational entity.

1.2 The case study

The aim of this thesis is to study the impact of natural resources on the regional economic system in Italy, both in terms of growth potential and of sustainability, with a special focus on Basilicata region. It is a resource rich region, but, from an economic point of view, it is part of an underdeveloped area of a developed country. It suffers from the same structural and institutional problems of Mezzogiorno, in terms of low economic dynamism, infrastructural gaps with the rest of Italy, low institutional quality, etc. It offers thus a very interesting case to study the interaction between resource use, economic development and sustainability, the impact of this interaction on the local economy and the trade-offs that may arise.

The exploitation of natural gas and oil in Basilicata dates back to the beginning of the '30s. However, during the '90s, the hydrocarbon production activities increased sensibly, thanks to the discovering of large oil fields by the Ente Nazionale Idrocarburi (ENI) during the '80s. This led to the creation of several infrastructures directly related to production, namely the Centro Oli in Viggiano, and the oil pipepline linking this structure to the ENI refinery in Taranto, in the neighbour region Puglia. During the '90s the production of crude oil and natural gas in the region increased gradually. At the end of the period the region contributed with approximately the 12% of total oil production in Italy (only 2% considering both oil and natural gas production). At the beginning of 21^{st} Century, however, the situation changed dramatically: between 2001 and 2002 the oil production in the region rose from 1,81 to 2453 thousands of tons, a huge "resource boom" that continued in the following years (3129 and 6328 thousands of tons in 2003 and 2004 respectively). Since then, Basilicata has been the most important producer of energetic resources among Italian regions. Starting from 2005 it produces alone the 70% of the whole italian production, with a peak in 2006, at the 80%. To have a better idea of the importance of the territory, it should be sufficient to mention that Basilicata's endowments constitutes the largest on-shore oil fields in continental Europe. This production clearly has a key role for the whole Italian economy. Indeed, it helps in reducing the country's dependence from imported energetic resources, satisfying approximately 6% of the national demand of oil.

Furthermore, the presence of these resources could potentially generates additional opportunities for development, beyond the direct economic impact, thanks to the institutional agreements among the Italian Government, local administration and the upstream operators. According to the ongoing framework, onshore production is subject to a 10% royalty tax; offshore production of gas ans oil respectively to 7% and 4%[1]. In 2011 the overall volume of royalties received by the State, regional and municipal authorities in Italy amounted at 276 million of Euro: regional authorities of Basilicata were the beneficiary of 36% of these value; 6% of the whole amount was distributed to the 8 municipalities involved by extractive activities. Finally, additional resources for the development of the area come from direct agreements between

[1]More specifically, the royalty paid by upstream operator to regional authorities increased from 7% to 10% in 2009. For each exploitation concession, the tax payment is exempted for the first 20 million standard cubic meters of gas and 20,000 tons of oil products annually for onshore production and the first 50 million standard cubic meters of gas and 50,000 Tons of oil in offshore production; for the legislation about this topic see the webpage of Italian Ministry for Economic Development (http://dgerm.sviluppoeconomico.gov.it/dgerm/); for a comparison with other countries see NomismaEnergia (2012)

local institutions and oil operators, such as the formal agreement between Basilicata and ENI in 1998 or with Total in 2006 (Total EP, 2013; ENI SpA, 2013).

Despite these figures, the impact of extraction activities is questioned in public debate. On the one hand, civil society and environmental associations claim that the exploitation of energetic natural resources in the region is not compatible with the exploitation of other types of natural and cultural resources, crowding out an alternative path of development based on tourism, high quality agricultural productions and the valorisation cultural heritage, generally perceived as more close to the territorial identity of the area. On the other hand, there is a widespread concern about the threats that extractive activities pose for the local population, not only for the risk of - even severe - accidents connected to these activities, but also for the general impact they may have on the quality of the environment and on local population health (Legambiente, 2013).

It is unquestionable that, at least theoretically, such activities (and the benefits connected) could represent an important opportunity for the development of the area; however, despite the considerable amount of economic resources aforementioned, the Basilicata region is still one of the more problematic regions in Italy and in Europe. In an analysis at the regional level implemented by the Bank of Italy for 4 European countries (Italy, United Kingdom, France and Spain), European regions were divided into 4 clusters, according to the characteristics of their economic structure. Based on this cluster analysis, Basilicata is part of the group of regions with the lower dynamism in terms of economic performance. The region also shows a bad performance with respect to its cluster of reference, in terms of GDP per capita, unemployment level and the role of high-tech services over the whole regional economy (Bank of Italy, 2012). A recent study of the Ministry of Economy and Finance signals that more than 32% of the regional population belongs to households at risk of poverty, and approximately 25% suffers from heavy deprivation (Ministero Economia e Finanza, 2014). Finally, according to the Bank of Italy, the exploitation of natural resources helped in sustaining employment in industry and services in the region between 2001 and 2011, with a direct and positive net impact in terms of number of employed. However, when the sector of oil production is excluded, the number of employees in the industrial sector seems to shrink more intensively in the municipalities involved by these activities with respect to other municipalities of the area (Bank of Italy, 2014). All these evidences suggest that something went wrong in the management of natural resources for the development of the area. With a heavy reliance on the energetic production (and the financial windfalls it produces) there is the risk of crowding out other economic activities, and consequently of increasing the dependency of the whole economy from the resource sector. At the same time, the problems that this path of development could generate should be considered, as a matter of sustainability in the long period from an economic, social and environmental perspective.

The need to properly account for all this problems is urgent and relevant in terms of policy making. Based on the ongoing agreements for the valorization of energetic resources in Italy, in the next years oil production will increase dramatically. With the words of the Wall Street Journal we can say that "Now, the Italian government—hungry for revenue and desperate to create jobs and jump start the recession-weary economy—is trying to clear the path for the country's own ENI SpA and other major oil companies to step up drilling. By taking steps to give regional and local governments a greater share of the spoils, it hopes to temper the opposition that has stymied more drilling until now" (Moloney, 2014). The oil production in Basilicata will nearly double, and the quota of national demand of hydrocarbons satisfied by internal production will increase from 6% to 10% .

Then, the eventual trade offs between sustainability, growth and local development may deepen with this incoming "second resource boom" for the region.

1.3 Research question

Based on the characteristics of the case under discussion, we want to provide scientific evidences on the relationship between natural resources and economic development in a wide perspective. In particular, the main questions we want to answer are the following: how are the sustainability conditions of the territories involved affected by the exploitation of non-renewable natural resources? What is the impact in terms of productive base and competitiveness of such activities for local development? Under what conditions can a growth path led by the use of natural resources effectively boost development and, more than this, a sustainable development?

In our perspective, the resource curse is the manifestation in the short run of an unsustainability problem that display itself in the long run.

1.4 The structure of the thesis

This thesis is composed of different but logically connected papers. We start from the analysis of the concept of sustainable development in its application to the regional level. The main aim of this part is to understand how the sustainability of development path should be assessed at this territorial level, through a critical review of available methods and indicators. Each of them is evaluated in its ability to depict sustainability in a regional context[2]. In the second paper we propose an original estimate of the Genuine Savings rate for the 20 Italian regions. In the framework of weak sustainability, this indicator it is shown to be particularly powerful, because it provides a measure of the sustainability of the whole system, and the interaction between natural an economic dynamics of a territory. Such an approach is strongly grounded in the economic theory, and at the same time is relevant from a policy making perspective, providing a forward looking indicator, well integrated with the standard framework of national accounts[3]. The results detect an unsustainable management of natural resources in Basilicata, providing some empirical support to the concerns about the negative effects of oil drilling mentioned above. The ongoing path of consumptions, together with the current rate of depletion of natural resources, may negatively affect the future wealth of the regional economic system, driving it to a level lower than the present one.

In the third paper we investigate one of the possible mechanisms through which this unsustainable trend may deploy its negative effects. Analysing the impact of the extractive resources sector on the whole economic system, we try to verify if a "Dutch disease" phenomenon also is also occurring at the regional level. The Dutch disease is one of the possible explanations of the resource curse proposed by scholars, and interestingly, a recent strand of the literature is focusing on this problem through regional analyses. Grounding on the evidence from the empirical exercise, we discuss the possible causal links through which the presence of extractive resources can generate turbulences in the economic system of Italian regions, beyond the classical (national) forms of Dutch Disease mainly acting through exchange rate channels.

Finally,in the last part we propose a policy simulation through the use of a bi-regional SAM for Basilicata and the rest of Italy, with an economic-environmental model. Moreover, we simulate several royalties allocation scenarios, proposing an empirical extension of the Genuine Saving rate, in order to assess the social sustainability implication of the policy scenarios considered.

[2]Presented at 3^{rd} Annual BEEER Conference, 12-13 May 2014, held in Bergen (Norway).

[3]Paper presented as invited speaker at Irpet seminars, 1^{st} October 2014, Florence (Italy).

References

Bank of Italy (2012). Economie regionali: l'economia della Basilicata - rapporto annuale. Technical Report 19, Bank of Italy.

Bank of Italy (2014). Economie regionali: l'economia della Basilicata - rapporto annuale. Technical Report 17, Bank of Italy.

ENI SpA (2013). Eni in Basilicata. local report. Technical report, ENI SpA.

Legambiente (2013). Petrolio in Val d'Agri. Technical report, Legambiente.

Ministero Economia e Finanza (2014). Documento di Economia e Finanza - sezione III. Technical report, Ministero Economia e Finanza.

Moloney, L. (2014). Italy taps oil for fix to economic woes; hungry for jobs and growth, rome seeks to clear local opposition. *The Wall Street Journal, Europe Edition*. 12 January 2014.

NomismaEnergia (2012). Tassazione della produzione di gas e petrolio in Italia: un confronto. Technical report, Nomisma Energia.

Sachs, J. D. and Warner, A. M. (2001). The curse of natural resources. *European Economic Review*, 45(4):827–838.

Sala I Martin, X. X. (1997). I just ran two million regressions. *American Economic Review*, 87(2):178–183.

Total EP (2013). Total EP in Basilicata. rapporto attività. Technical report, Total EP.

Sustainable development, resource use and regions: a rewiew

2.1 Introduction

Since the publication of the Bruntland Report, the concept of "sustainable development" challenged the economic science. In fact, the notion of "a development that meets the need of present generation without compromising the needs of future generations"(World Commission on Environment and Development, 1987) shed light on the limits and contradictions of the process of economic growth. On the one hand, it made clear the shortcomings of conventional measurement of well-being; on the other hand, it asked for a paradigm shift in development thinking, widening the concept of development to include a proper consideration of the quality of life and the environmental issues. Moreover, the focus on sustainability made it clear that policy aim should include the duration, in the future, of current achievements in terms of economic growth (Pearce et al., 1990). It highlighted that development can be pursued only with a balance of the three dimensions (or pillars) involved: economic, environmental and social.

Since then, the interactions between economic development, quality of life and the need to preserve natural resources and the environment became a popular topic. However, the perspective provided by the Bruntland Report is far from being clear-cut. The vagueness of the concept fuelled an intense debate that involved several fields of economic thinking and other disciplines, aimed at specifying the notion of "sustainable development" (Mebratu, 1998), and went beyond the limitations of conventional conceptual framework (Seghezzo, 2009; Padilla, 2002). Moreover, the concept of well-being itself was questioned in its ability to support meaningful intergenerational comparisons (Dasgupta et al., 2001).

In general, the most challenging research agenda in the sustainable development literature is related to the need to operationalize the concept. Obviously, due to the high degree of complexity, one of the main weaknesses of the concept emerges when putting it into practice. This led to the emergence of two complementary veins in literature: the *measurement* of sustainability and the analysis of its implications at different territorial scales.

A proper set of policy-relevant measurement tools is needed to monitor progress towards sustainability; in fact, one of the main criticism to the concept, at early 90s, was exactly the lack of indicators (Pearce et al., 1990). After two decades, we face the opposite problem. A huge amount of contributions tries to provide adequate tools for assessment. According to Atkinson (2007), "the search for sustainability indicators has become something of a mini-industry in the literature on sustainable development. So too has criticism of these indicators " making problematic, especially for policy design, making sense of the array of measurements available today. On the other hand, the territorial dimension of sustainable development has been investigated, asking what makes regions, territories and economic sectors sustainable and how they can contribute to sustainability (Haughton et al., 2008). Several alternative interpretations have been given to the concept of sustainability for *local* development practices (Jackson, 2007).

In what follows we focus on a specific strand of literature applying the concept of sustainable development to a well-defined subnational scale: the regional level. We will analyse how regional sustainable development is defined in the literature, what are the implications of applying the concept of sustainability in local/global settings and what challenges sustainability poses for regional studies and measurements. Moreover, a special attention will be devoted to a specific topic that received less attention in the literature: the management of natural non-renewable extractive resources at regional level and its interactions with the local well-being. The last topic overlaps with a different but contiguous literature, that related to the so-called *resource curse*. Despite the fact that this issue has been mostly analysed in a cross-country/aggregate fashion and with the aim of finding the true determinants of growth, in our opinion it represents an interesting and underexplored area of interaction among development, well being and environmental studies at local level.

The paper is structured as follows: in section 2 we will review the definitions of Regional Sustainable Development and the implications of a regional perspective in the study of sustainability. In section 3 a framework of relevant issues in Regional Sustainability Assessment will be proposed. In section 4 a selection of the available Assessment Tools will be evaluated in their application to the regional scale. Section 5 concludes.

2.2 Regional Sustainable Development

As we previously mentioned, the adaptation of the concept of Sustainable Development to the regional level mainly arises from a strand of literature devoted to make the concept operational for empirical applications. Indeed, at least in terms of policy making, the aggregate / global scale is less manageable than lower territorial levels. Moreover, due to the spatial nature of the process of development itself (Hudson, 2010; Pike et al., 2007), and despite the global dimension of some sustainability issues (such as climate change and global warming), the objective of Sustainable Development can be concretely and more easily pursued if the interactions between the three pillars of sustainability (economic, social development and environmental protection) are understood and managed at the local level.

According to Renn et al. (1998) there are several reasons making advantageous the "regionalization" of the concept. A region has a more adequate degree of homogeneity in population, natural environment and productive practices (both in agriculture and industry) than a national or a global scenario. This makes it a proper unit of analyses, both in designing the efforts towards achievements in sustainability, and for the presence of political and regulatory institutions entitled to monitor and enforce the adopted measures (Sedlacek and Gaube, 2010). Regions are a suitable level in implementing actions to foster sustainability, thanks to the opportunity of mutual learning and exchange of best practices, much more difficult at a higher scale. Moreover, lower territorial scales, such as cities or local communities seem less suitable to support the analysis of sustainability. In fact, as the dimension shrinks, the higher is the proportion of product and services traded outside the unit, the lower is the ability of political institutions to affect the overall economy; the unit of analysis has to be comprehensive enough to represent the main conflicts about sustainability choices (Renn et al., 1998).

Several contributions in literature try to clarify how sustainable development can be defined in a spatial perspective (Gibbs, 1991; Camagni et al., 1998; Nijkamp and Vreeker, 2000; Nijkamp et al., 1990). For example, Gibbs suggests that "environmental sustainable local economic growth can be defined as local economic change which contributes to global environmental sustainability, whilst also enhancing the local natural and constructed environment"[1]. However, this definition seems to be inadequate, both because it lacks of consideration of other relevant pillars of sustainable development (such as solidarity with the future generations) and because it relies on a narrow concept of sustainability focused only on environmental issues.

[1] Gibbs (1991) cited in Hardy and Lloyd (1994).

According to Graymore et al. (2010) a sustainable region is one where “human activity does not cause net negative impacts on the ecological, social or economic supporting systems ensuring the resilience, state and function of these interlinked systems can continue to support the population”. In detail, the authors claim that the ultimate “goal for regional sustainability should be: ‘the pressure caused by human activities cannot negatively impact on the resilience or carrying capacity of the region’s ecosystems’”. As it clearly emerges, the notion of sustainability in such a definition is strongly related to the concept of carrying capacity. However, it is very difficult to measure resilience and carrying capacity, both in a global and a local dimension. One the one hand, as authors themselves point out, it lacks an effective way to measure carrying capacity and resilience. Then, the need to conceptualize human activity in terms of pressures against a (known or assumed) sustainable thresholds, makes the criteria of sustainability somewhat discretional. Moreover, due to the fact that the concept of carrying capacity belongs to the realm of environmental science, the operative definition used as a base for assessment ends up with relying primarily on environmental grounds, leaving out, also in that case, the other pillars of sustainability.

In a well-being focused perspective,Nijkamp et al. (1992) define Regional Sustainable Development (RSD) as the development assuring the attainment of an acceptable level of welfare both in the present and in the future. Moreover, to be effectively sustainable, regional development has to be compatible with ecological dimension at the local level and able to support the sustainable development at the global level. As the authors claim, there are relevant implications in applying the notion of sustainability at the regional level. Regions are open systems, and their sustainable development path has to be considered in interaction with other regions. This can help to depict interregional, global-regional ad intertemporal trade-offs. Moreover, the regional sustainable development achievements have to be compatible with the goal of sustainability at the global level, so that, if all regions have a sustainable development path, the same condition should apply also for the global system as a whole.

Though the focus in Nijkamp’s definition is the sustainability of the encompassing territory (the relevant goal, in this perspective, is global sustainability), the concept of a well-being-centered RSD is particularly helpful. First, the focus on the process of development helps to consider the object of analysis in dynamic terms, depicting sustainability as a process in evolution and not only as a static phenomenon. Second, through this conceptual framework, the well-being of a population in a given reference space is understood in interaction with that of other territories.

Analyzing SD from a spatial perspective allows to properly consider also the "intragenerational equity" problem. According to the Bruntland Report definition, sustainability is not only a matter of solidarity with future generations. It is also an effort to move towards equality in the present, along different dimensions. Then, the quality of life, the well–being and the socioeconomic and ecological equality, evaluated in a spatial setting, can shed light on territorial transfers of sustainability, as to say when territories achievements in SD are attained through detriment of other territories (Zuindeau, 2007). Such approach can be applied at different territorial scales (towns, urban areas, regions, and countries) and it is not specifically conceived as an instrument to consider sustainability at the regional level. However, it seems to be particularly useful when the unit of analysis are the regions. In fact, this way of interpreting the phenomenon offers an interesting perspective to qualify sustainability efforts and possible territorial conflicts at the subnational level. Given that socio-environmental systems cannot be preserved everywhere, it can be possible that the achievement of sustainability goals at the higher territorial scale hide "sacrifices" at the lower level, as reductions in development, welfare or environmental protection in some regions, or areas in the reference territory used for specific economic activities or environmental purposes (Nijkamp et al., 1992). This poses the (ethical) question of "to what extent, and in particular below which spatial level, non-sustainability is justified in terms of the sustainable development of a larger territory" (Zuindeau, 2006). Taking the region (in other words, a meso-scale) as the unit of analyses can help policy makers in detecting an excessive uneven distribution of sustainability achievements, identifying inter-regional asymmetries and assuring that, when needed, territorial sacrifices are not concentrated in few areas but better scattered and jeopardized in a lower spatial level.

The problem of natural resources management, in particular extractive non-renewable resources, provides a useful example of how the concept of sustainable development can be analysed and applied with normative purposes to a definite spatial level. The sustainable use of a non-reneweable natural resource stock is an important, though not sufficient, condition of RSD (Nijkamp et al., 1990). In fact, the natural resource management affects the sustainability of the development path, influencing the characteristics of economic systems and the way present choices on environmental-related issues affect the welfare of present and future generations. In particular, a rich strand of economic literature investigates the so called "resource curse", that is a negative relationship between resource abundance and GDP growth, human capital accumulation, institutional quality and so on. According to recent evidences, this problem arises both at the national and sub-national level. Hence the resource curse literature, thought the initial contributions were more focused on growth determinants (Auty, 2001;

Frankel, 2010; Van der Ploeg, 2011; Sachs and Warner, 2001), shares with the sustainability literature the aim to investigate the interactions among social, environmental and economics systems, in what it is called the "paradox of plenty" (Hamilton and Atkinson, 2006). Several explanations of this phenomenon have been provided (Torvik, 2009), going from "dutch disease" problems, political economy explanations of mismanagement of resources (Robinson et al., 2006), and links among appropriability issues, social tensions and civil conflicts. Most of these contributions use a cross-countries perspective, adopting nations as units of analyses in testing theories. However, some recent contributions analyze the resource curse hypotesis on a lower spatial scale, namely, the regional/local level (Caselli and Michaels, 2009; James and Aadland, 2011) investigating how the interactions between social welfare, economic system and resource management disentagle in a concrete spatial setting.

It should be noted that RSD is a strongly context-specific concept. The variability in the endowment and use of natural resources, socio-economic situation and environmental charachteristics, makes difficult to typify RDS within a general framework (Nijkamp et al., 1990). For this reason, more than providing a general definition, the vast majority of contributions in literature focuses on specific aspect of regional sustainable development (Truffer and Coenen, 2012), or is scattered among a huge amount of connected topics, such as problems related to assessment framework (Wallis et al., 2007; Nijkamp and Vreeker, 2000), quantitative measurement and comparison among regions (Munda and Saisana, 2011; van Zeijl-Rozema et al., 2011), planning challenges (Wheeler, 2002, 2009) interactions of social, environmental and economic performance in concrete form (Gibbs et al., 2005), regulations, policy and institutional processes fostering sustainability progress at the regional level (Chatterton, 2002; Morgan, 2004; Gibbs, 1998). However, the definition of sustainability at regional scale is relevant not only from a theoretical point of view, but also for normative purposes; only a proper definition makes possible to understand what are the important aspects to be considered when sustainability at the regional level has to be assessed to support policy design.

2.3 Regional Sustainability Assessment

Despite the fact that the debate about the notion of sustainability is still open, since the early '90s there has been a big progress in the design and implementation of sustainability *indicators*, thanks to the initiatives promoted by intergovernamental institutions (i.e. United Nations), accademic community (as in the case of Environmental Sustainability Index) and Non-Governamental Organizations (for the case of Ecological Footprint) (Dahl, 2012). However, several problems are still present.

In a survey of eleven widely used indicators of sustainability, Böhringer and Jochem (2007) examine the explanatory power of indices, as well as their transparency and reliability in policy practice. On the one hand, there is a clear need, especially for policy makers, of a sinthetic indexes that can be easily understood and communicated. However aggregation, normalization and the choice of variables involve subjective judgement that often are not properly disclosed, while critical assumptions are not adequately mentioned or assessed. These elements, together with the problems of formal consistency, lead the authors to question the meaningfulness of some of these indexes, as well as their reliability and usefulness for policy advice.

In addition to statistical shortcomings, also problems with the conceptual framework should be considered.

Van de Kerk and Manuel (2008) for example claim that the Bruntland definition should be extended in order to consider adequately the social dimension. In that regard, sustainability indicators should assess "sustainable society", namely, a society that meets the needs of the present generation without compromising those of future ones, and "in which each human being has the opportunity to develop itself in freedom, within a well-balanced society and in harmony with its surroundings". Then, the distributive problems should be included in the analyses.

At the same time, according to Moldan et al. (2012) the main lack of the existing experience in sustainability indicators are related to the fact that environmental measures do not include specified targets. For this reasons, proper measurement tools concerning the environmental dimension should be related to some reference values based on byophisical properties of the systems. Only through a "distance to target" assessment it is possible to understand if current environmental situation is moving towards the target or not. Obviously, this perspective is mainly focused on environmental quality issues, making difficult its application to the other pillars of sustainable development. In fact, this last is a multidimensional concept, involving both the environmental *and* the economic or social scenario: whilst the first one refers to limits set by nature (such as carrying capacity), economic or social sustainability is a concept involving political (normative) reference values relying on political and public debate.

However, due to its complexity, a framework including all the three pillars of the concerned pehomenon can be hardly defined. One of the main limits of existing indicators is that "although there are various international efforts on measuring sustainability, only few of them have an integral approach taking into account environmental, economic and social aspects. In most cases the focus is on one of the three aspects. Although, it could be argued that they could serve supplementary to each other, sustainability is more than an aggregation of the important issues, it is also about their linkages and the dynamics developed in a system. This point will be missing if tried to use them supplementary and it is one of the most difficult parts to capture and reflect in measurement" (Singh et al. (2009), p.209).

Moving from a national to a regional perspective, the issue of measurement becomes still more challenging. Due to the aforementioned characteristics of regions and the implication of SD at this spatial level, additional considerations should be taken into account.

In that regard, the study of Loiseau et al. (2012) provides a rewiev of several assessment methods, taking into consideration four key features: 1) the level of maturity or formalization of each framework; 2) the ability to represent a system, with its internal flows and flows between the system and the techno/eco-sphere; 3) the quantity of flows inventoried (water, land, renewable and non renewable resources used etc); 4) the type of indicators provided (pressure vs. impact) and their usability (both in terms of relevance, feasibility and understanding). However, their focus is narrowed to the environmental dimension only; then the sthrengths and weaknesses highlighted do not cover the performance of each indicator in measuring sustainability in its broader sense.

Conversely, Graymore et al. (2008) explicitly provide a set of evaluation criteria. Using this framework they test 5 indicators of sustainability, through a case study (Table 2.3.1). Though the assessment framework is particularly wide and detailed, two main shortcomings can be identified. On the one side, it gives a central role to communication ability, feasibility, easyness in using and constructing methods. Obviously these are important aspect, but in general a trade off exists between policy relevance and communicative power. As Atkinson (2007) explain "it is often the case that an indicator is useful in one domain and less useful in another. For example, there is no doubting the success of ecological footprints as a rhetorical device. The analogy of a footprint – describing how biophysical limits might nominally bind on economic activity – graphically illustrates the notion of 'living beyond our means'. Whether decision-makers should base policy directly on this information is another matter. By contrast, resource and environmental accounting, [...], can be extremely useful in guiding policy but it is unlikely to interest, much less excite, a broader audience".

On the other hand, the criteria matrix in Table 2.3.1 is focused on indicators charachteristics more than on the object of analyses. The evaluation of assessment methods targeted at the regional level should be, in our opinion, more related to the peculiarity of regional features of sustainability. The aforementioned matrix do not focus on the specificity of sustainability at that spatial level. An indicator/method of assessment should be able to shed light on the problems involved at the regional scale. In a few words, the evaluation framework should not focus (only) on *how* to assess but on *what* to assess, given regional level of the analysis.

What informations are nedeed to meet sustainability at regional level, how to design green regional product accounts, and how to capture potential trade offs between regional economic growth and regional enviromental quality are the most relevant topics that should be researched (Capello and Nijkamp, 2010).

Then, a proper definition of regional sustainability. According to the aforementioned Nijkamp's definition of RSD, the assessment method applied should be able to:

- Focus on the population well-being and account for present and future generation's needs, with a balanced relevance for all the pillars of sustainability;
- Consider the territory as an open system and depict the interaction with the higher territorial level;
- Detect "territorial sacrifices" at national level; namely when all parts of national territory are considered, the assessment framework is able to shed light on eventual uneven distribution of sustainability achievement at the national level;
- Be policy relevant; the analysis at regional scale is manly driven by the need to operationalize sustainability and the assessment has to clearly identify what problems emerge in the interaction between human activities and environment.

Applying these concepts to the issue of non-renewable natural resource management implies that the assessment should be able to clarify how the current model of use of resources in the region analized interacts with economic system and affects population welfare, both in present and future generations and how relation with other regions can affect the dynamic of these features.

In the next section we will rewiew some popular tools and methods of assessment, highlighting their sthreghts and weaknesses in their application to the regional scale, according to the the aforementioned criteria.

Table 2.3.1: Criteria matrix for regional sustainability assessment methods

A. OVERALL EFFECTIVENESS OF SUSTAINABILITY ASSESSMENT AT REGIONAL SCALE
1. Assesses regional sustainability
• Equity intergenerational and intragenerational
• Level of human activity
• Level of pressure on supporting systems
• Status of supporting systems
2. Data availability and accessibility
• Uses existing data
• Data is locatable and accessible
• Data describes the region
• Data collection is cost effective (money and time)
• Ability to assess sustainability without all data
3. Assessment is easy to use
• No complicated calculations
• No specialist knowledge required (e.g. matrices)
• No specialist software required
• Easy to follow method
• Easy to use
• Small indicator set (i.e. manageable data set less than 40 indicators)
• Not time intensive (i.e. less than 3 months to complete)
B.METHOD
4. Assesses sustainability directly
• Produces an overall sustainability score/index through aggregation of indicator data
• Aggregation method is logical
• Objective assessment of sustainability
• Integrated assessment including relationships between indicators
5. Information not lost during aggregation of data
• Indicator performance is reported
• Sub-system/dimension performance is reported
• Overall system sustainability is reported
6. Transparency in method used to produce results
• Method was clear and well documented
• Easy to understand how final results were derived from indicator data
• Simplifications and assumptions kept to minimum to reduce impact on results
C.USEFULNESS OF RESULTS
7. Simplifies complexity of sustainability and facilitates communication to a range of audiences
• Easy to understand and interpret what results mean for regional sustainability
• Result can be described in a single page report card
• Able to visually represent the results
Sustainability reported at a range of levels (detailed, sub-system /dimension performance; overall system sustainability
8. Usefulness of the sustainability assessment results
• Time and data efficiency of assessment
• For regional managers
- Sustainability reported at a range of levels
- Relates to policy, strategic planning, decision making
- Points out where management actions are needed
- Targets or thresholds to measure against
- Can be used to assess trends overtime
• For community capacity building, social learning
- Result easy to understand
- Simple to use
- Data accessible
- Demonstrates links between sustainability and community activity

Source: Graymore et al. (2008)

2.4 The application of Sustainability Measurement Tools and Methods at the regional level: a critical review

In this section, we survey some of the most popular tools for sustainability measurement, assessing their limits and advantages in the application at the regional scale. Without claiming our review to be complete, we selected some of the most widely used indicators to provide a description of what are the main path followed by the assessment literature.

2.4.1 Environmental Sustainability Index

The framework elaborated by Esty et al. (2005) is based on five broad categories of issues: a) Environmental Systems; b) Reducing Environmental Stresses; c) Reducing Human Vulnerability to Environmental Stresses; d) Societal and Institutional Capacity to Respond to Environmental Challenges; e) Global Stewardship. Through the integration of 76 dataset into 21 indicators built on the "Pressure-State-Response" environmental policy model, the framework aims at measuring the ability of nations to protect the environment both in present and future time.

The tool is particularly helpful in comparing territories in their achievements to environmental sustainability. Despite the fact that this index is potentially easily applicable to a regional scale, to the best of my knowledge no such analyses is still available. The main weakness of this index is that it only partially depicts the interactions between human activity and environment. In fact, it is not able to capture sustainability in its broader sense of economic-social-environmental dynamics, nor describes the changes in well-being related to changes in environmental resource management schemes etc.

2.4.2 Ecological Footprint

One of the most popular tools to measure sustainability is the Ecological Footprint (EF) (Wackernagel and Rees, 1998). Its use is widespread because it is easy to understand and results can be synthesized in a single figure. Theoretically it is based on an extended concept of carrying capacity, measuring the quantity of productive land and water required to provide all the energy and material consumed, as well as to absorb wastes related to the activities of the economies (or individuals), given the prevailing technology. The interesting feature of this indicator is that it considers the pressure of a population, wherever on the Earth the area providing these resources is located. This feature makes EF able to detect the "territorial sacrifices" mentioned in section 2, comparing actual EF of specific territories or considering a target based on minimal necessary ecological conditions for sustainability (Wackernagel et al., 2002). Some applications at the regional level have been proposed in literature (see for example Bagliani et al. (2008); Hopton and White (2012)).

However, strong criticism have been raised against the use of this indicator, both in terms of statistical features and aggregation methods (Böhringer and Jochem, 2007) and in conceptual terms (Fiala, 2008). Aside from these shortcoming highlighted in the literature, in our perspective the main limit of this indicator is that it is unable to consider the non-environmental pillars of sustainability. In particular, only changes in environmental situation are considered, with no linkages with welfare changes or social/quality of life issues. In the same way, the equity problems are somewhat considered in intra-generational perspective, but it lacks an intergenerational dimension of the problem

2.4.3 Index of Sustainable Economic Welfare (ISEW) and Genuine Progress Indicator (GPI)

Cobb (1989) proposes the ISEW, an index based on the Measure of Economic Welfare (Nordhaus and Tobin, 1972). ISEW is conceived as an extension of Gross National Product, able to consider the externalities related to economic growth. Subsequent variations in methodology (Cobb et al., 1995) lead to the elaboration of the Genuine Progress Indicator, with the inclusion of natural resources consumption and environmental problems related to human activity and its environmental pressures. The main aims of this measure are: "1) to define and measure 'consumption' in a way that provides a better approximation of actual well-being than the simple measure of marketed goods and services appearing in the national accounts; and 2) to account for the sustainability of consumption by incorporating measures of changes in the value of capital stocks" (Hamilton, 1999). Then, the GPI is a measure of consumption adjusted for income distribution that includes non-market production and benefits, depurated from private costs and defensive expenditures, costs of environmental degradation and depreciation of natural capital, plus the growth in capital and net change in international position.

There has been several measurement of GPI at subnational level, including counties, provinces and cities (Clarke and Lawn, 2008; Bagstad and Shammin, 2012; Pulselli et al., 2006; Wen et al., 2007). Though the welfare-oriented approach seems promising for a proper sustainability assessment, this index is seriously flawed, if interactions at the interregional level have to be considered. In fact, in the application on country/county and city level in Vermount, Costanza claims that "Interregional flows of non-marketed goods and services (i.e. ecosystem services) are not captured in either GDP or GPI. For example, while Vermont may be benefiting from a better local environment, this may be at least partly at the expense of a depleted environment elsewhere in the country or the world. This effect is not addressed." (Costanza et al., 2004). Obviously, the lower the scale considered, the more this shortcoming is relevant.

2.4.4 Genuine Saving

One of the first indexes of sustainability based on environmentally adjusted capital stock available in the economic system was elaborated by Pearce and Atkinson (1993). Then, successive enhancements by Hamilton (2000) using the Hartwick rule (Hartwick, 1990) led to an indicator of sustainability measuring savings but, at the same time, accounting for natural resources depletion. In the latest versions of the indicator also the degradation of natural capital due to pollution and the investments in human capital are considered in finding the "genuine" value of savings (Hamilton, 2000). In the framework of the GS approach[2] , all the types of capital considered (produced, natural, human) are substitutes, according with a "weak sustainability" perspective[3]. According to the index, when GS is positive the economic system is on a sustainable path. Meanwhile, this indicator does not provide any information on the intra-generational distribution of sustainability achievements, nor seems to be able to typify the interactions between different territories when applied at the regional scale. However, it is particularly helpful in identifying sustainable development in its intertemporal dimension. To the best of my knowledge, only one contribution consider the GS in its application to the subnational level (Brown et al., 2005).

[2] Details on the theoretical ground will be discussed in the next chapter.

[3] There is a large debate in literature that opposes strong and weak sustainability perspectives. The main difference between them is in the nature of the relationships among the various typologies of capital; in the weak sustainability perspectives, natural and environmental capital are seen as substitutable inputs in producing wealth; in a strong sustainability perspective, they are complementary (Neumayer, 2003).

2.4.5 Environmental extensions in Input-Output and Social Accounting Matrix models

Among the assessment methods, Input-Output (IO) and Social Accounting Matrix (SAM) can provide an in-depth description of the interactions between environmental and economic systems. In general, IO tables focus on interdependences among productive sectors of the economy; SAM models, with proper disaggregation of institutional accounts, are also able to model the distributional impacts related to changes in the economic systems. In their environmental extensions, these tools are useful in investigating environmental pressures, resource use and pollution linked with economic activities, and quantify the impact of environmental or resource policy management (e. g. employment impact) (Berck and Hoffmann, 2002) or how different sectors are affected by environmental policies (Moffatt and Hanley, 2001). Moreover, Multiregional and Interregional SAM models can shed light on economic-environmental relationships between territories. In an open system, the changes in consumption patterns generate impacts beyond regional borders, implying import or export of sustainability that such tools are able to identify (Bertini and Paniccià, 2008). As the Ecological Footprint, these models are able to account for such a phenomenon, but in a more rigorous and a wider perspective overtaking the limits of an environmentally focused indicator, for example allowing solutions to assess potential trade-offs between environmental and social sustainability.

Several contributions in literature present environmental extensions of single/multiregional IO (Wiedmann, 2009) and SAM models at the subnational level (see Morilla et al. (2007)). The main limitation of these assessment methods is their static feature; hence, the sustainability of the development path of a territory in a long term, intergenerational perspective is not easy to capture without the complement of other assessment tools.

2.4.6 General remarks

The survey of sustainability assessment methods applied at the regional scale shows that there is not a best model as such, but different indicators and methods that can better serve for specific purposes. Without claiming to be complete, the breadth of different approaches and existing tools has been discussed to provide a general picture of where we are, and how long is the road for the development of an exhaustive assessment method.

Modelling sustainable development means operationalizing the concept, and providing adequate basic information to support policy making. From this point of view, and especially for an economist, several aspects are important. First, understanding how environmental policy can impact on macroeconomic variables, such as the level of output in an economy, and how this impact is distributed within the analysed system. Moreover, the interdependencies among sectors should be taken into account, to properly understand implications of policies for resource use and pollution. Finally, the long term consequences of present choices should be traced (Moffatt and Hanley, 2001). At the regional level these issues are still more complex, because of the need, as we previously highlighted, to consider also how policy interacts with economic, social and environmental systems outside the regional borders. According to this, the combination of two assessment tools seems promising in investigating regional sustainability: SAM models and GS. The first one, if properly shaped, provide the appropriate degree of disaggregation of relevant information, allowing for in-depth analysis of interactions between the three components of sustainability at different territorial scales. On the other hand, the Genuine Saving yields a snapshot of the development path of a system in time, and it helps to understand if actual trends are suitable to assure a minimum condition of intergenerational solidarity.

2.5 Conclusions

The methods for the assessment of sustainable development should provide a proper informative base to guide policy choices and decision making. However, the several dimensions of sustainable development are not easy to capture with a single indicator. When applied to the regional (subnational) level, the task becomes still more challenging. In fact, in that case, the interactions between different territories and different scales tell a big part of the story. Our contribution discusses several sustainability indicators and clarifies how valuable they are when applied at the local level, according to the definition of Regional Sustainable Development proposed by Nijkamp and colleagues (Nijkamp et al., 1990, 1992). In modelling spatio-temporal changes in ecological-economic-social interactions a single indicator is not enough to describe the ongoing situation, the interactions with other territories, and to provide valuable information to guide policy making. However, a combination of SAM models (as a powerful tool to understand interdependencies between the three pillars of sustainability) and Genuine Saving (that evaluate systems sustainability along a time path) seems a suitable solution to assess regional sustainability in its broader sense.

References

Atkinson, G.; Dietz, S. N. E. (2007). *Handbook of sustainable development*. Edward Elgar Publishing.

Auty, R. M. (2001). *Resource abundance and economic development*. Oxford University Press, Oxford.

Bagliani, M., Galli, A., Niccolucci, V., and Marchettini, N. (2008). Ecological footprint analysis applied to a sub-national area: the case of the province of Siena (Italy). *Journal of Environmental Management*, 86(2):354–364.

Bagstad, K. J. and Shammin, M. R. (2012). Can the genuine progress indicator better inform sustainable regional progress?— A case study for Northeast Ohio. *Ecological Indicators*, 18:330–341.

Berck, P. and Hoffmann, S. (2002). Assessing the employment impacts of environmental and natural resource policy. *Environmental and Resource Economics*, 22(1-2):133–156.

Bertini, S. and Paniccià, R. (2008). Polluting my neighbours: linking environmental accounts to a multiregional input-output model for Italy, methodology and first results. In *International Input–Output Meeting on Managing the Environment*, pages 9–11.

Böhringer, C. and Jochem, P. E. (2007). Measuring the immeasurable—a survey of sustainability indices. *Ecological Economics*, 63(1):1–8.

Brown, R. P., Asafu-Adjaye, J., Draca, M., and Straton, A. (2005). How useful is the genuine savings rate as a sustainability indicator for regions within countries? Australia and Queensland compared. *Australian Economic Review*, 38(4):370–388.

Camagni, R., Capello, R., and Nijkamp, P. (1998). Towards sustainable city policy: an economy-environment technology nexus. *Ecological economics*, 24(1):103–118.

Capello, R. and Nijkamp, P. (2010). *Handbook of regional growth and development theories*. Edward Elgar Publishing.

Caselli, F. and Michaels, G. (2009). Do oil windfalls improve living standards? evidence from Brazil. Technical Report 15550, National Bureau of Economic Research Working Paper.

Chatterton, P. (2002). Be realistic: Demand the impossible. moving towards' strong'sustainable development in an old industrial region? *Regional Studies*, 36(5):552–561.

Clarke, M. and Lawn, P. (2008). Is measuring genuine progress at the subnational level useful? *Ecological Indicators*, 8(5):573–581.

Cobb, C., Halstead, T., and Rowe, J. (1995). *The genuine progress indicator*. San Francisco, CA: Redefining Progress.

Cobb, C. W. (1989). *The index of sustainable economic welfare*. Beacon Press.

Costanza, R., Erickson, J., Fligger, K., Adams, A., Adams, C., Altschuler, B., Balter, S., Fisher, B., Hike, J., Kelly, J., et al. (2004). Estimates of the genuine progress indicator (GPI) for Vermont, Chittenden County and Burlington, from 1950 to 2000. *Ecological Economics*, 51(1):139–155.

Dahl, A. L. (2012). Achievements and gaps in indicators for sustainability. *Ecological Indicators*, 17:14–19.

Dasgupta, P. et al. (2001). Wealth as a criterion for sustainable development. *World Economics*, 2(3):19–44.

Esty, D. C., Levy, M., Srebotnjak, T., and De Sherbinin, A. (2005). *Environmental sustainability index: benchmarking national environmental stewardship*. New Haven: Yale Center for Environmental Law & Policy.

Fiala, N. (2008). Measuring sustainability: why the ecological footprint is bad economics and bad environmental science. *Ecological Economics*, 67(4):519–525.

Frankel, J. A. (2010). The natural resource curse: a survey. Technical Report 15836, National Bureau of Economic Research Working Paper.

Gibbs, D. (1991). Greening the local economy. *Local Economy: The Journal of the Local Economy Policy Unit*, 6(3):224–239.

Gibbs, D. (1998). Regional development agencies and sustainable development. *Regional Studies*, 32(4):365–368.

Gibbs, D., Deutz, P., and Proctor, A. (2005). Industrial ecology and eco-industrial development: A potential paradigm for local and regional development? *Regional Studies*, 39(2):171–183.

Graymore, M. L., Sipe, N. G., and Rickson, R. E. (2008). Regional sustainability: How useful are current tools of sustainability assessment at the regional scale? *Ecological Economics*, 67(3):362–372.

Graymore, M. L., Sipe, N. G., and Rickson, R. E. (2010). Sustaining human carrying capacity: a tool for regional sustainability assessment. *Ecological Economics*, 69(3):459–468.

Hamilton, C. (1999). The genuine progress indicator methodological developments and results from Australia. *Ecological Economics*, 30(1):13–28.

Hamilton, K. (2000). Genuine saving as a sustainability indicator. In *OECD Proceedings: Frameworks to Measure Sustainable Development*, pages 65–78.

Hamilton, K. and Atkinson, G. (2006). *Wealth, welfare and sustainability: advances in measuring sustainable development*. Edward Elgar Publishing.

Hardy, S. and Lloyd, G. (1994). An impossible dream? Sustainable regional economic and environmental development. *Journal of the Regional Studies Association*, 28(8):773–780.

Hartwick, J. M. (1990). Natural resources, national accounting and economic depreciation. *Journal of Public Economics*, 43(3):291–304.

Haughton, G., Morgan, K., et al. (2008). Sustainable regions. *Regional Studies*, 42(09):1219–1222.

Hopton, M. E. and White, D. (2012). A simplified ecological footprint at a regional scale. *Journal of Environmental Management*, 111:279–286.

Hudson, R. (2010). Regions and regional uneven development forever? Some reflective comments upon theory and practice. *Regional Studies*, 41(9):1149–1160.

Jackson, T. (2007). Mainstreaming sustainability in local economic development practice. *Local Economy*, 22(1):12–26.

James, A. and Aadland, D. (2011). The curse of natural resources: An empirical investigation of US counties. *Resource and Energy Economics*, 33(2):440–453.

Loiseau, E., Junqua, G., Roux, P., and Bellon-Maurel, V. (2012). Environmental assessment of a territory: An overview of existing tools and methods. *Journal of Environmental Management*, 112:213–225.

Mebratu, D. (1998). Sustainability and sustainable development: historical and conceptual review. *Environmental Impact Assessment Review*, 18(6):493–520.

Moffatt, I. and Hanley, N. (2001). Modelling sustainable development: systems dynamic and input–ouput approaches. *Environmental Modelling & Software*, 16(6):545–557.

Moldan, B., Janoušková, S., and Hák, T. (2012). How to understand and measure environmental sustainability: Indicators and targets. *Ecological Indicators*, 17:4–13.

Morgan, K. (2004). Sustainable regions: governance, innovation and scale. *European Planning Studies*, 12(6):871–889.

Morilla, C. R., Diaz-Salazar, G. L., and Cardenete, M. A. (2007). Economic and environmental efficiency using a social accounting matrix. *Ecological Economics*, 60(4):774–786.

Munda, G. and Saisana, M. (2011). Methodological considerations on regional sustainability assessment based on multicriteria and sensitivity analysis. *Regional Studies*, 45(2):261–276.

Neumayer, E. (2003). *Weak versus strong sustainability: exploring the limits of two opposing paradigms*. Edward Elgar Publishing.

Nijkamp, P., Lasschuit, P., and Soeteman, P. (1992). Sutainable development in a regional system. In *Sustainable development and the urban form*. Pion, London.

Nijkamp, P., van der Bergh, C., Soeteman, F. J., et al. (1990). Regional sustainable development and natural resource use. In *Proceedings of the World Bank Annual Conference on Development Economics 1990.*, pages 153–188. The World Bank.

Nijkamp, P. and Vreeker, R. (2000). Sustainability assessment of development scenarios: methodology and application to Thailand. *Ecological Economics*, 33(1):7–27.

Nordhaus, W. D. and Tobin, J. (1972). Is growth obsolete? In *Economic Research: Retrospect and Prospect Vol 5: Economic Growth*, pages 1–80. Nber.

Padilla, E. (2002). Intergenerational equity and sustainability. *Ecological Economics*, 41(1):69–83.

Pearce, D., Barbier, E., and Markandya, A. (1990). *Sustainable development: economics and environment in the Third World*. Aldershot : Edward Elgar.

Pearce, D. W. and Atkinson, G. D. (1993). Capital theory and the measurement of sustainable development: an indicator of "weak" sustainability. *Ecological Economics*, 8(2):103–108.

Pike, A., Rodríguez-Pose, A., and Tomaney, J. (2007). What kind of local and regional development and for whom? *Regional Studies*, 41(9):1253–1269.

Pulselli, F. M., Ciampalini, F., Tiezzi, E., and Zappia, C. (2006). The index of sustainable economic welfare (ISEW) for a local authority: A case study in Italy. *Ecological Economics*, 60(1):271–281.

Renn, O., Goble, R., and Kastenholz, H. (1998). How to apply the concept of sustainability to a region. *Technological Forecasting and Social Change*, 58(1):63–81.

Robinson, J. A., Torvik, R., and Verdier, T. (2006). Political foundations of the resource curse. *Journal of Development Economics*, 79(2):447–468.

Sachs, J. D. and Warner, A. M. (2001). The curse of natural resources. *European Economic Review*, 45(4):827–838.

Sedlacek, S. and Gaube, V. (2010). Regions on their way to sustainability: the role of institutions in fostering sustainable development at the regional level. *Environment, Development and Sustainability*, 12(1):117–134.

Seghezzo, L. (2009). The five dimensions of sustainability. *Environmental Politics*, 18(4):539–556.

Singh, R. K., Murty, H., Gupta, S., and Dikshit, A. (2009). An overview of sustainability assessment methodologies. *Ecological Indicators*, 9(2):189–212.

Torvik, R. (2009). Why do some resource-abundant countries succeed while others do not? *Oxford Review of Economic Policy*, 25(2):241–256.

Truffer, B. and Coenen, L. (2012). Environmental innovation and sustainability transitions in regional studies. *Regional Studies*, 46(1):1–21.

Van de Kerk, G. and Manuel, A. R. (2008). A comprehensive index for a sustainable society: The SSI—the Sustainable Society Index. *Ecological Economics*, 66(2):228–242.

Van der Ploeg, F. (2011). Natural resources: Curse or blessing? *Journal of Economic Literature*, pages 366–420.

van Zeijl-Rozema, A., Ferraguto, L., and Caratti, P. (2011). Comparing region-specific sustainability assessments through indicator systems: Feasible or not? *Ecological Economics*, 70(3):475–486.

Wackernagel, M. and Rees, W. (1998). *Our ecological footprint: reducing human impact on the earth*. New Society Publishers.

Wackernagel, M., Schulz, N. B., Deumling, D., Linares, A. C., Jenkins, M., Kapos, V., Monfreda, C., Loh, J., Myers, N., Norgaard, R., et al. (2002). Tracking the ecological overshoot of the human economy. In *Proceedings of the National Academy of Sciences*, volume 99, pages 9266–9271. National Academy of Sciences.

Wallis, A., Richards, A., O'Toole, K., and Mitchell, B. (2007). Measuring regional sustainability: lessons to be learned. *International Journal of Environment and Sustainable Development*, 6(2):193–207.

Wen, Z., Zhang, K., Du, B., Li, Y., and Li, W. (2007). Case study on the use of genuine progress indicator to measure urban economic welfare in China. *Ecological Economics*, 63(2):463–475.

Wheeler, S. (2009). Regions, megaregions, and sustainability. *Regional Studies*, 43(6):863–876.

Wheeler, S. M. (2002). The new regionalism: Key characteristics of an emerging movement. *Journal of the American Planning Association*, 68(3):267–278.

Wiedmann, T. (2009). A review of recent multi-region input–output models used for consumption-based emission and resource accounting. *Ecological Economics*, 69(2):211–222.

World Commission on Environment and Development (1987). *Our common future*. Oxford University Press, Oxford.

Zuindeau, B. (2006). Spatial approach to sustainable development: challenges of equity and efficacy. *Regional Studies*, 40(5):459–470.

Zuindeau, B. (2007). Territorial equity and sustainable development. *Environmental Values*, pages 253–268.

The Genuine Savings indicator: estimates at the subnational level in Italy.

3.1 Introduction

The analysis of the economic performance of countries and territories relies on monetary measures, such as GDP, to evaluate the growth process of such entities. However, this approach has been largely questioned in literature: in particular, from the seminal work of Bruntland commission (WCED, 1987) several efforts have been made to include also environmental and social issues in the economic analysis. Among other results, this wider perspective leads to the environmentally-adjusted macroeconomic indicators and national accounting with "green" dimensions, to properly take into consideration the sustainability implications of the growth process and development path.

According to Dasgupta et al. (2001) a proper indicator of sustainability is based on a comprehensive definition of wealth, that is "the accounting worth of an economy's capital asset [...] including not only the social wealth of manufactured capital, but also knowledge, human and natural capital". In that perspective, the management of the productive base of an economy is considered in its future implications. In other words, it is evaluated in its ability to generate wealth and sustain the present level of welfare also in the future. In such a framework, the definition of sustainability is related to non-declining utility: sustainable development is a development assuring a future utility at least equal to the current level.

In this work we propose the estimates of an "augmented" macroeconomic indicator at the subnational level (NUTS-2) in Italy, the Genuine Savings rate. This indicator relies on a solid economic theory, and it is calculated for more than 200 developing and developed countries by the World Bank for cross-countries comparison in terms of sustainability. It considers natural assets, in terms of resource depletion and pollution damages, together with economic wealth and the investments in human capital formation. All these measures are expressed in monetary values. According to the theoretical background previously mentioned, such a measure is able to provide an insight in the long run implications of the current development path.

More specifically, this indicator assumes a weak definition of sustainability, where natural and produced capital (including human capital) are perfectly substitutable. The main aim of GS is the measurement of the ability of economies in producing wealth, constructing an indicator with predictive power on the future implication of the ongoing level of welfare.

Obviously, the territorial level of application is not neutral: a country can be sustainable at the aggregate level, but such a measurement may hide different sustainability paths at the subnational level. Especially for what concerns the use of punctual natural resources (such as extractive energetic resources), the unsustainable management of natural assets in a portion of a territory can be an advantage for the rest of the economy at the aggregate level, creating a situation of "territorial sacrifice" as previously pointed out. Such a situation calls into question the performance of the territory at the aggregate level, in that sustainability is a matter of solidarity in both intergenerational and in intra-generational terms. Moreover, it is worth noting that, obviously, "If growth in a natural resource-intensive regional economy is unsustainable then this will have implications for the country as a whole" (Brown et al., 2005).

The estimates presented here disaggregate at the regional level the Genuine Saving rate calculated by the World Bank for Italy, from 1995 to 2008. Whenever possible, we follow the methodology implemented by the World Bank, improving that estimates using data collected at the regional level instead of international estimates. The main aim of this empirical exercise is to understand if the sustainability performance at the aggregate level hides unsustainability problem relevant at the subnational level.

The paper is structured as follows: section 2 presents the Genuine Saving indicator, its extensions and applications, and the relationship with the economic analysis of the resource curse provided by the literature. In section 3 we lay out the theoretical ground of the indicator. Section 4 reports the data used, showing the differences and similarities with respect to the estimates provided by the World Bank at the aggregate level for Italy. Section 5 presents and discuss the results. Section 6 discuss the role of interaction among regions on the GS performance.

3.2 The Genuine Savings indicator: conceptual framework and related literature.

The first formulation of Genuine Savings was proposed by Pearce and Atkinson (1993), based on a rearrangement of the so-called Hartwick rule (Hartwick, 1990) formulated for exhaustible resource-rich economies. The underlying model, based on a dynamic optimization problem, demonstrates that the resource rent from energetic resources extraction should be reinvested in produced capital. The Hartwick rule prescribes to maintain the stock of wealth disposable for the economic system: the main idea is to offset the depletion of non-renewable natural resource in order to follow a sustainable pattern of consumption, assuming a constant stream of income, through time. Following this framework Pearce and Atkinson (Pearce and Atkinson, 1992, 1993) propose an indicator of weak sustainability related to the capital theory: an economy is sustainable if its savings are higher than the combined depreciation on the two forms of capital (man-made and natural capital). This framework is related to the definition of Hicksian income, defined as the maximum amount that can be consumed without compromising the ability to afford the same level of consumption in the following periods (Hicks, 1946). According to Hamilton and Atkinson (2006), the main intuition of Pearce and Atkinson (1993) is that if total wealth is related to social welfare, looking at the changes in total wealth is possible to infer relevant information also on sustainability implications of the current consumption behaviour. In fact, whatever is the definition of sustainable development, it necessarily involves the creation and the maintaining of wealth. Then, as long as natural resource depletion is the liquidation of an asset, it should be properly included in national accounting framework as a negative contribution to income or net savings (Hamilton and Clemens, 1999; Hamilton, 2000). The genuine saving indicator is elaborated under this conceptual framework.

Several contributions try to extend both the theoretical model and the empirical specification of the GS indicator. Pezzey and Burke (2014) include the cost of the population growth, the technical progress and an higher precautionary cost for CO2 emissions with respect to the methodology applied by the World Bank. Similarly Pezzey et al. (2006) extend the GS, including technical progress and changing oil prices to provide estimates for Scotland over the period 1992-1999. Ferreira and Moro (2011) extend the empirical specification of the World Bank to include, among others, NOx (nitrogen oxides) and SOx (sulphur oxides) emissions and their external costs. Nourry (2008) compares the GS estimates by the World Bank with results based on French national statistics from 1990 to 2002. Mota et al. (2010) provide estimates for Portugal over the period 1990-2005. Hanley et al. (1999) use this indicator to evaluate the sustainability performance of Scotland, finding that, according to this measure, the current feature of the Scotland economy are largely unsustainable. Lindmark and Acar (2013) provide an analysis of long run development of Swedish economy through the estimates of GS from 1850 to 2000. Moreover, the use of GS indicator is widespread in literature and its use go beyond the need to evaluate the performance of specific countries or territory. Uwasu and Yabar (2011), for example, analyse averages, trend and stability of GS for 84 countries from 1981 to 2005 to investigate the impact of institutions, resources and wealth accumulation in a sustainability perspective. Additionally, You (2011) uses the World Bank estimates of the GS to evaluate the role of China's energy consumption on the sustainability of its economic growth. Other scholars test the accuracy of the GS in explain or predict welfare changes. Gnègnè (2009) finds a significant and positive (though weak) relationship between GS and Infant Mortality Rate and Human Development Index. Greasley et al. (2014) provide a test of the ability of GS to predict changes in future well-being over the long run (more than 100 years) in Britain.

Another strand of literature focuses on this indicator to explain its relationship with the resource curse: Neumayer (2004) shows a relationship between resource curse and Genuine Income (that is, GDP less depreciation of natural capital estimates by the World Bank for the Genuine Savings construction). In line with previous studies, the author suggests that the poor performance of resource-rich economies is related to overconsumption of such resources. Similarly Boos and Holm-Müller (2013) analyse the determinants of GS performance, claiming that a reduction of GS rate can be an early warning of a resource curse problem, even if RC phenomenon have not yet completely displayed itself.

In this paper we propose the estimates of GS as a macroeconomic indicator of sustainability able to give relevant policy information also at the regional level. In fact, the application of this indicator at the subnational level has yet to be explored. We apply this estimates to Italy, a developed country with a well-known problem of economic dualism, and an unequal distribution of non-renewable extractive resources, mainly concentrated in Basilicata, a region of the underdeveloped area of Mezzogiorno.

3.3 Theoretical model

The theoretical framework of this sustainability measure is elaborated by Hamilton and Clemens (1999). In their seminal work, the authors start from the definition of new green aggregates on the basis of optimization problem.

The theoretical model consider the maximization of a social welfare function including “standard” consumption, but also the value of natural asset of the economy. Through the theoretical model it is demonstrated that the Genuine Saving indicator is equal to the present value of the changes in utility, along the optimal growth path. As a consequence, “If genuine saving is negative at a point in time on the optimal path, then utility at some point in the future must be less than current utility – that is, the path is unsustainable” (Hamilton and Atkinson, 2006). In that way, the Genuine Saving indicator can be interpreted as a macroeconomic indicator of sustainability, able to consider the interaction between environmental and economic issues. It is able to provide useful informations in terms of policy guidance, in that it is a forward looking indicator; moreover, it gives information in an easily and clearly interpretable fashion.

Consider a closed economy with fixed labour supply and a single resource to produce a good that can be consumed C, invested in the production of capital K ($\dot{K}$ is the investment in physical capital) and human capital N (with investment m) or used to abate pollution e (at cost a).

The pollution stock X varies on the basis of pollution emission h, (with h=$h(F,a)$, namely, emissions are a function of the production function F and of abatement cost a), and d, the natural absorptive capacity of the environment.

Resource stock S grows at rate g and shrinks depending on the resource use rate, or resource depletion R. The utility function U has, in its arguments, both consumption C and environmental services B, with the latter negatively related to pollution stock. There is a rate of time preference, r. The wealth W, defined to be the present value of utility on the optimal path, is maximized subject to constraints as follow:

$$maxW = \int_t^{\infty} U(C,B)e^{-rs}ds \tag{3.1}$$

$$\dot{K} = F - C - m - a \tag{3.2}$$

$$\dot{X} = e - d \tag{3.3}$$

$$\dot{S} = -R + g \tag{3.4}$$

$$\dot{N} = q(m) \tag{3.5}$$

The dynamic problem can be solved deriving the current value Hamiltonian function H, maximized at each point in time

$$H = U + \sum \gamma_i N_i \tag{3.6}$$

with N representing the assets and γ_i the shadow price in utils for each of them. Defining the shadow prices in consumption units (dividing γ_i for marginal utility in consumption)

$$p_i = \frac{\gamma_i}{U_C} \tag{3.7}$$

we finally get that the Genuine Saving can be defined as equal to the net investment valued at shadow prices

$$G = \sum p_i \dot{N}_i \tag{3.8}$$

and

$$H = U + U_C G \tag{3.9}$$

Thus, "the Hamiltonian may be described as the utility prospect for the economy, since it combines both current utility and the contributions to future utility from current investment" (Hamilton and Atkinson, 2006). Moreover, it can be demonstrated that it exist a direct link between the Hamiltonian function and util denominated welfare, so that

$$U_C G = \dot{V} \tag{3.10}$$

Then, the Genuine Saving can be defined as equal to the change in social welfare V divided by the marginal utility of consumption. From the theoretical model it derives that, according to this measure, if an economy shows a negative Genuine Saving at a given point in time, then somewhere in the future utility will be lower than in the current period. In other words, the economy is on a unsustainable path.

3.4 Methodology and Data

Following the approach Atkinson et al. (2007), GS estimates can be defined as:

Genuine Saving:
Gross National Savings
- Capital depreciation (consumption of Fixed capital)

+ Education Expenditure
- Depletion of Energy Resources
- Depletion of Minerals
- Net Depletion of Forest
- CO2 Damages
- PM Damages

Basically, it is given by the variation of produced and human capital, less the value of natural capital consumed or destroyed through pollution. For our estimates we follow the World Bank methodology in order to calculate the Adjusted Net Savings (Bolt et al., 2002). When needed, appropriate modifications are implemented to reflect the regional equivalent of the data.

3.4.1 Gross savings , physical capital and education expenditures

According to the WB methodology, Gross national saving is calculated as the difference between GNI (Gross National Income) and public and private consumption plus net current transfers.

For our purposes, Regional Accounts data provided by Istat are used (ISTAT, 2012). These data are fully consistent with the European System of Accounts. Unluckily, Istat does not provide data on Gross savings and on Capital Consumption on a regional basis: then we estimate this aggregates through indirect methods.

We compute time series of gross savings and capital depreciation following the method elaborated by Bronzini et al. (2013) to calculate the Capital stock for industry for two Italian Macro-regions (Center-North and South). Basically, if we consider i= region, t = year, and s= sector, the method consists of three steps:

- Calculate $K_{i,1995,s}$, the regional gross capital stock by region and sector in a base year (1995), as the cumulative sum of investments by sector ad region from 1980 to 1995, Istat data;
- Calculate the ratio of $K_{(i,1995,s)}/\ K_{(ITA,1995,s)}$, namely the regional quota of national gross capital stock;
- Under the hypothesis that, for every year, the ratio between capital consumed and new investments is regionally invariant ($R_{(i,t,s)}/I_{(i,t,s)} \simeq R_{(ITA,t,s)}/I_{(ITA,t,s)}$), the value of Capital Consumed R for every Region i, year t and sector s can be calculated as

$$R_{(i,t,s)} = R(ITA,t,s) * (I(i,t,s)/I_{(ITA,t,s)}) \tag{3.11}$$

We apply the same methodology to estimate Capital Consumption and Net savings at the regional level, using Istat data on investment at the regional level, capital stock and capital depreciation at the national level (accordingly with Nace Rev. 2 classification of economic activities). Since we detect a strong correlation between Net savings and Net investment in national data, the estimate of Net Savings is based on this information: we estimate the net investment series for each region; then we disaggregate the national net savings at the regional level using the ratio (Total regional net investment)/ (Total national net investment). In that way, we are able to estimate regional time series considering the regional variation in economic structure of each specific region.

For what concerns education expenditures, the World Bank considers current public expenditure in education as a proxy of human capital formation. Regional Accounts provided by Istat collect Public expenditure for a large class of Functions according to Cofog classification (Classification Of Function Of Government), including Education Expenditure.

3.4.2 Natural capital: Depletion and Pollution Damages

Moving to Energy Depletion, this component of GS estimated by WB is calculated on the basis of Rents from Oil and Natural Gas extraction, where:

Rent = (Production Volume) x (International Market Price – Average Unit Production Cost)

In lack of specific data on unit production cost disaggregated at the regional basis, the Unit Rent Value in current dollars calculated by World bank is used for our estimate. Data on regional production volumes are provided by the General Directorate for Energetic Resources of the Italian Ministry of Economic Development. For offshore oil and gas production, the data provided are disaggregated on the basis of 5 offshore marine zones (Zone A, B, C , D , F). In that cases, for each concession, the production volumes are imputed to Regions on the basis of geographic location. Then, the total value calculated is converted to obtain the Energy Depletion in current Euros.

For what concerns Mineral Depletion, the whole data computed by the World Bank for Italy is imputed to Sardinia, the only region that, in the period under consideration, presents extractive licenses for mineral extraction of the metals included in the GS component (tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate). Also in that case, data are converted in current Euro.

Rent from Net Forest Depletion are excluded from the estimate of GS at the Regional Level. In fact, the value of this component for Italy estimated by WB is equal to zero for the whole period considered.

To calculate the component of CO2 damage, we use the data estimated by ENEA (2010). The methodology used is based on the regional energy balances data (BER), available in the Regional Energy Informative System (SIER), which are combined with the emission factors. The outcome is an estimate of Carbon dioxide amount for each region from 1990 until 2006, and includes a comprehensive set of sectors (energy, industry, transports, residential and services, agriculture and fishing) responsible for CO2 emission. Then, consistently with WB methodology, we attibute a damage of 20 US$ per tonne emitted (Frankhauser, 1994).

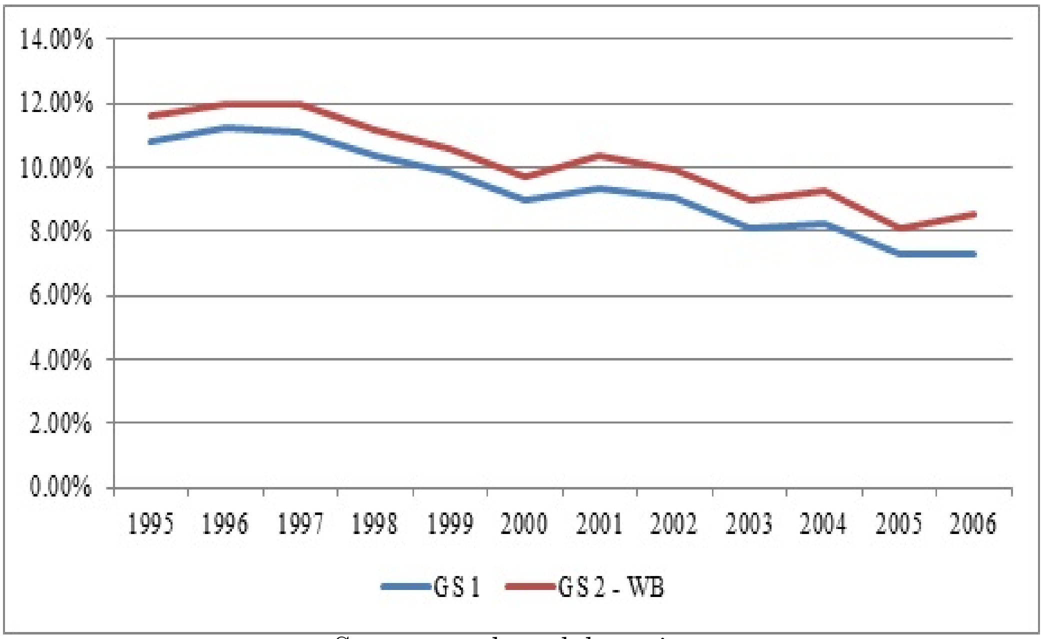
Finally, according to the methodology adopted in the calculation of the World Development Indicators, PM Damage is estimated as the Willingness to Pay (WTP) to avoid mortality and morbidity attributable to particulate emissions. However, neither the data on WTP used, nor the dimension of health damage or the actual and counterfactual concentration used to calculate it, nor the list of health endpoints considered is provided. Due to this missing information, the strategy adopted to end up with an estimate consistent with the WB methodology is the following: for each year, the PM damage in current US$ is imputed to regions on the basis of regional contribution to national PM emissions. This choice is justified by the fact that PM damages are mainly related to health damages. Therefore, they are highly localised in the specific area of emissions. The data on PM emission are provided by De Lauretis et al. (2009) that apportioned at the provincial and regional level (NUTS2 and NUTS3) pollutants and greenhouse gases emissions' estimates from the National Emission CORINAIR Inventory. Unfortunately, the data are provided only for 1990, 1995, 2000 and 2005. Then our estimates of GS including PM Damage is limited to the aforementioned years.

The variables considered and data source used for the quantification of each components are presented in Table 3.A.

3.5 Results and discussion

For each component of GS, we calculate the level in current euros and the percentage over regional GDP. Figure 3.5.1 shows a comparison between our estimates of GS for the whole country (GS 1) and the estimates provided by the World Bank (GS 2 – WB). In general, Italy do not fail this test of weak sustainability at the aggregate level. The differences among the two measure

Figure 3.5.1: GS estimates for Italy, excluding PM damage (1995-2006)



Source: author elaboration.

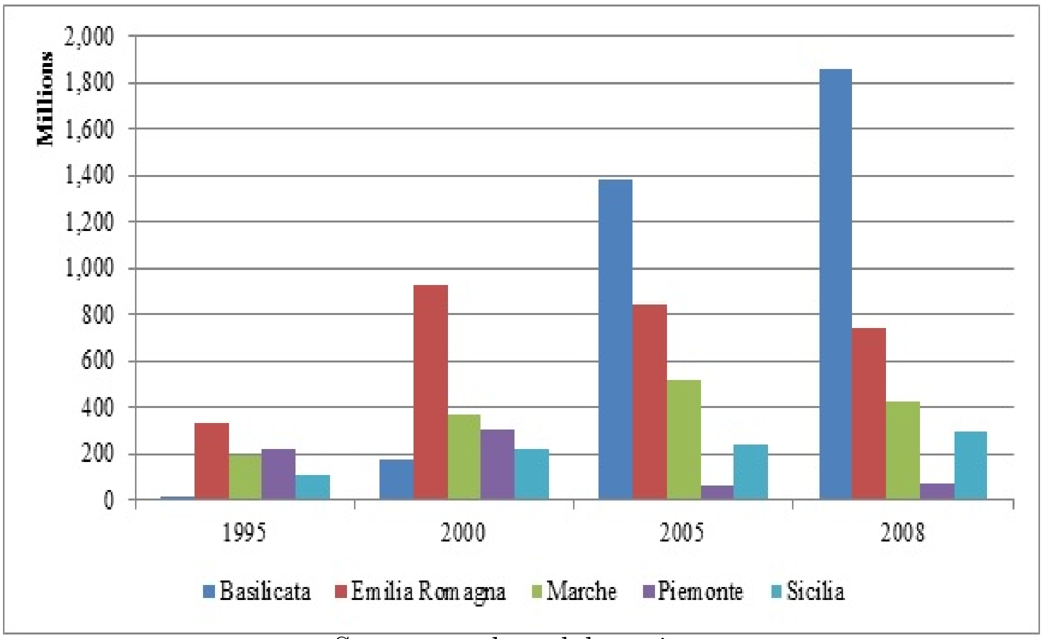
are clearly modest in terms of magnitude[1]. Moreover, there are not relevant differences in terms of trends. Despite some differences in methodology and data, our results at the national level seems to be consistent enough with WB results, so that an analysis of the indicator at the regional level can be carried out.

Table 3.7.1 shows the level of Net regional savings as a percentage of Regional GDP. Obviously the distribution of savings is affected by the different level of development and economic performance of the regions, with a higher incidence of Northern area. Aside from the regional variation, it is worth noting a general reduction in the level of savings for all regions over the period considered. The trend of this aggregate explains the general reduction in the GS level for the whole country. Similar considerations can be made for what concerns Education. However, in this case, the southern regions are those that more intensively invest in human capital formation (Table 3.7.2), according to Istat data.

Figure 3.5.2 and Table 3.7.3 show the estimates for Mineral and Energy Depletion. The degree of consumption of natural assets in this case is con-

[1]This difference may be related to the lack of net foreign current transfers in our estimates; on the contrary, this aggregate is included in the WB estimates. Unfortunately, data and information disaggregated at the regional level are not available.

Figure 3.5.2: Mineral and Energy Depletion in current euros for main regions of production



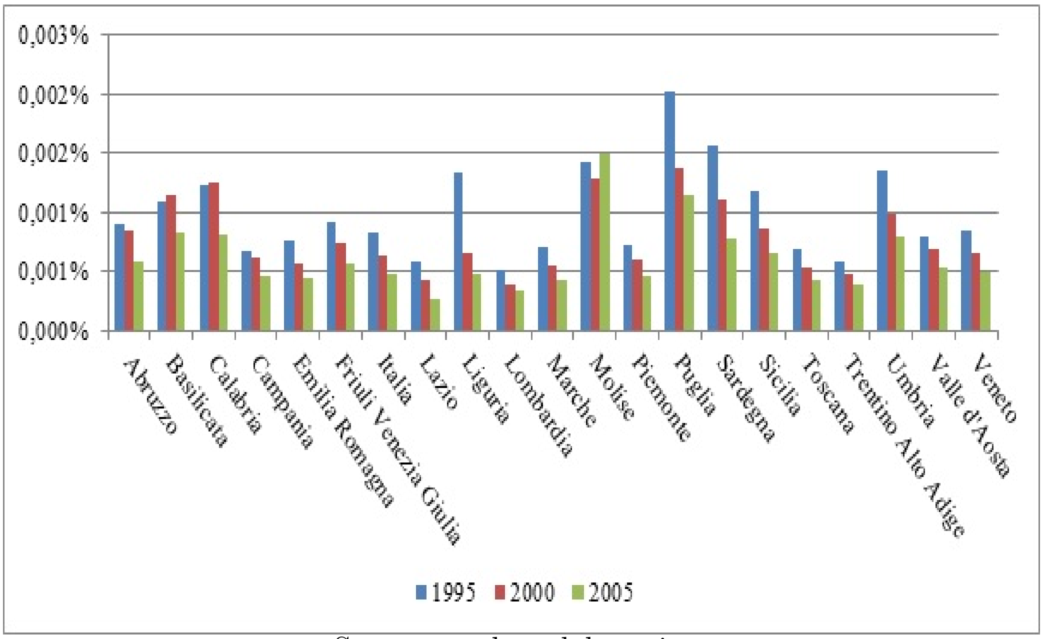
Source: author elaboration.

siderably variable, both along temporal and spatial dimension. In general, the value for END (Energy Depletion) is quite low. In fact, Italy is certainly not a resource rich economy (the average value of energy depletion is 0,18%, with a weak upward trend in the period considered). Nonetheless, the variation between regions is particularly wide in that respect: the contribution of regions to the production of energetic resource changes considerably over the period in analysis (Figure 2).

Interestingly, Basilicata is well above the national level: the average Mineral and Energy Depletion is more than 6% of Regional GDP. In 2008 it goes above the 17% of GDP, signalling that this region heavily relies on the exploitation of its natural assets for its economic development. The increase in this region drives the national average also, with a positive trend of about 1.6%. It is worth noting that the region experimented a sharp increase of energy depletion between 2003 and 2004, because of the considerable increase in production volumes. However, the data at the national level are not able to shed light on this dynamic that, instead, has important implication on local and national sustainability, as we will see later on.

Coherently with the WB procedure, we included in our estimates also the impact of pollution damage, limited to CO2 (Table 3.7.4) and PM damages

Figure 3.5.3: PM damage as percentage of regional GDP

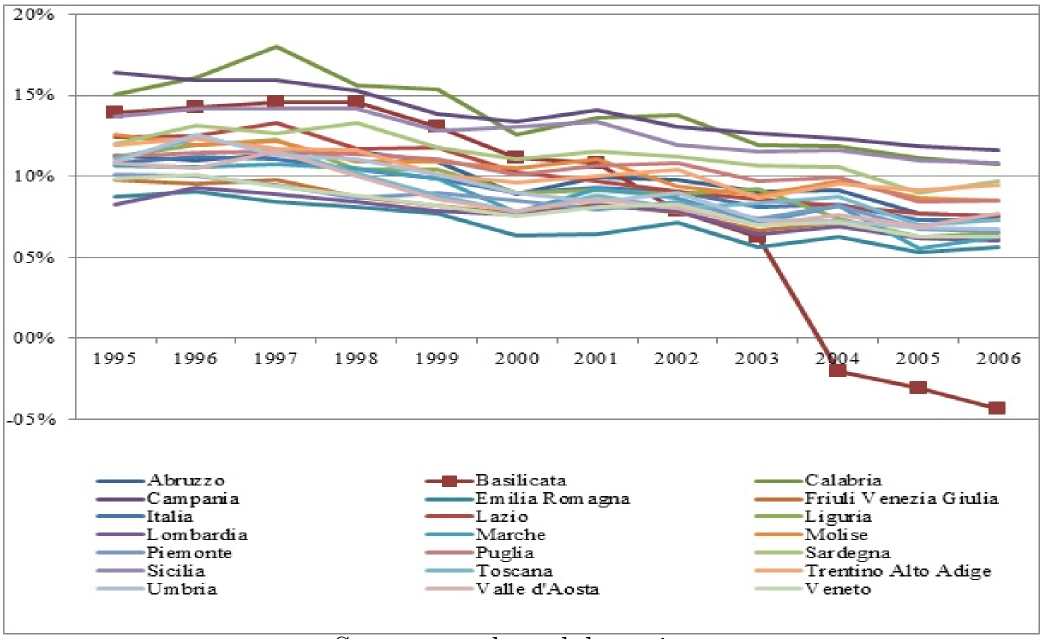


Source: author elaboration.

(only for 1995, 2000 and 2005; see Figure 3.5.3). In both cases the region with highest volume of damage is Lombardia (with an average of 1,296 millions of euro of CO2 damage and 966 millions for PM Damage in the period considered). However, Apulia has the highest percentage of pollution damage relative to its Regional GDP; it is the second region for volume of damage relative to pollution. This dynamic is strongly related to the presence of several highly polluting plants in that region (steel plant, coal power plants ecc.). However, the incidence of Pollution Damage considered is modest, with respect to the other components: for each pollutant, the average for Italy is well below 1% of GDP; as concernings regional data, also in the worst cases, the damage in monetary terms remain below the 2%.

Finally, we calculate the GS rate for all regions, including (Table 3.7.5) and excluding (Table 3.7.6) the PM damage. The time trend is quite stable for all the regions considered. There aren't dramatic differences among regions: in general, the values fluctuate from 12% to 6%, with a general reduction that characterize all the territories. This worsening is driven by the decreasing in the economic aggregates of the indicator (i.e. savings) more than by the decumulation of natural assets. Nonetheless, there is one considerable exception: the case of Basilicata. This region shows a fast, sensible and stable worsening of its GS level from 1999, with values increasingly be-

Figure 3.5.4: GS excluding PM damage



Source: author elaboration.

low zero from 2004 (Figure 3.5.4). Basically, this region is increasingly using the natural assets in its territory, without reinvesting adequately to cope with its natural capital exploitation. Then, it is strongly decumulating its wealth, and it is, according to our measure, along an unsustainable path of development.

Due to the (relatively) modest impact of PM Damage on the sustainability of Italian regions, similar consideration can be made taking into account GS data that include this component.

3.6 GS adjusted for interactions between regions

In general, as we highlighted in the previous section, GS rate is not able to depict interaction between territories and detect territorial sacrifices. In other words, we do not know if and how the worsening of sustainability level of Basilicata region has a direct effect on assuring the sustainability level in other Italians regions. Obviously, as long as oil production in Basilicata covers about 6% of national oil demand, it is more than an educated guess the idea that the sharp increase of production volumes fed the development process (also) in the rest of national territory. Despite this, GS in not able to provide information about this relationship. Moreover, it is worth noting that all the decisions about extraction of energetic resources and royalties allocation are taken at the central Government level. Then, from a conceptual point of view, it can be misleading to impute the resource depletion of national resources only to that region. To deal with this problem, we applied to our case of study an input-output framework elaborated by Hamilton and Atkinson (2006), able to calculate an "ecological balance of payments" accounting for international flows of resources between countries. The main aim of this model is to compute the direct and indirect resource use for each territory, encompassing the resource depletion needed to sustain final demand. We use this framework to calculate an "ecological balance of payment" among italian regions, considering flows of interregional trade. Defining X_{ij} as the net exports of region i to region j, and Y_j as GDP for region j, we can define a **Q** matrix where

$$q_{ij} = \begin{bmatrix} \dfrac{X_{ij}}{Y_j} & i \neq j \\ \dfrac{-\sum_k X_{kj}}{Y_j} & i = j \end{bmatrix}$$

Then we will have a squared matrix, with diagonal elements equal to the negative sum of import coefficient from other trading partners. Defining n the vector of regional resource depletion expressed as a percentage of GDP, C final consumption, I investment, we can calculate

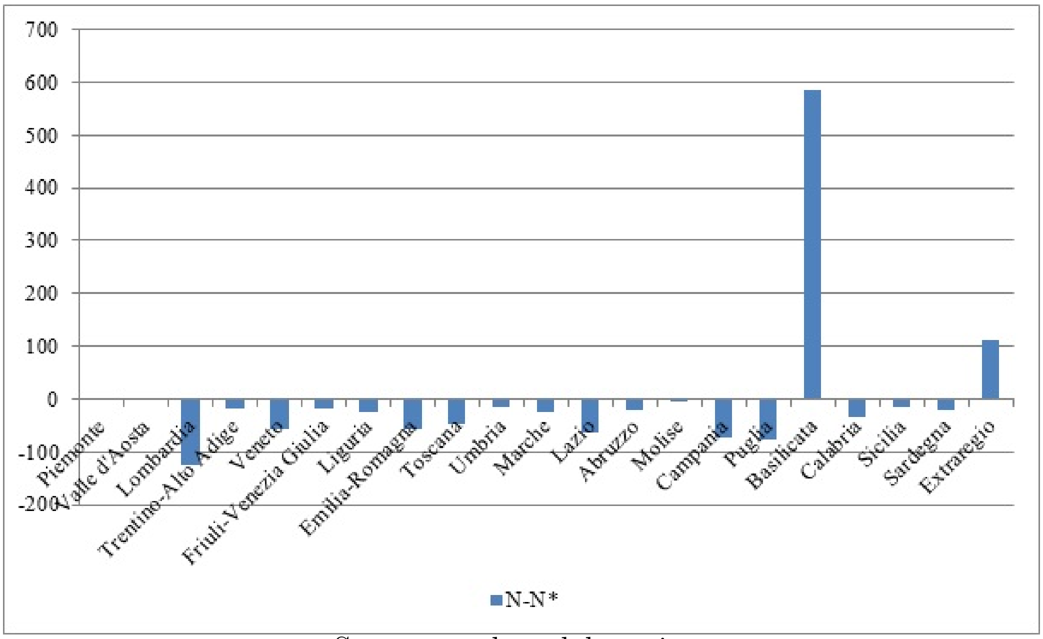
$$N = \hat{n}(I - Q)^{-1}(c + i) \tag{3.12}$$

as the value of domestic depletion required to support territorial product, and

$$N^* = n(I - Q)^{-1}\widehat{(c + i)} \tag{3.13}$$

that is the value of global resource consumption to support final demand of the region considered. Then the difference N-N^* can be defined as the balance of payment of each region with other italian territories. Specifically, it is the difference between the resources *produced* and resources *consumed* at the regional level, based on the level of final consumption, production and indirect resource consumption through interregional trade. Moreover, we can use N^* to correct the level of Energy Depletion for each region, imputing the actual level of resource depletion due to direct and indirect resource

Figure 3.6.1: Ecological balance of payments among Italian regions (2008)



Source: author elaboration.

consumption for each region, using Irpet data[2] on interregional trade flows[3].

As expected, Figure 3.6.1 shows a positive balance for Basilicata, that is a net exporter of resources for the rest of the economy. More interestingly, considering N* as the value of natural resource *actually consumed* in that territory, the Energy depletion component for this region falls from 17.02% in 2008 (Table 4) to 9.2%. Consequently, the value of GS calculated for that region rises from -9% to -1.2%[4].

According to this measure, Basilicata is still on an unsustainable (but less concerning) path of development.

[2]Data are provided by Irpet (Istituto regionale di programmazione economica della Toscana). The institute produces input-output tables for the italian regions and estimates also the interregional flows trade among italian regions.

[3]Obviously, we are aware that a large part of extractive resources consumed in Italy are imported; however, we are interested in shed light on the relationship between regions in terms of sustainable management of domestic national resources, to recalculate the GS component considering the actual consumption of such resources by each region. Then, we exclude the rest of the world from this accounting framework.

[4]In lack of specific data, we use the average of CO_2 Damage in Basilicata over the period considered to calculate the approximate value of GS with the N^*-level of consumption.

3.7 Conclusions

A sustainable economy can be defined, in a weak sustainability framework, as an economy that is able to produce wealth and sustain the actual level of wealth in the future. According to this perspective, we evaluated the sustainability performance of italian regions. The choice to focus on the regional level is justified by the need to shed light on the interaction between different territorial level and to understand if the measurement at the aggregate level can effectively mask "territorial sacrifices" at the subnational one. As we clarified, according to our measures, despite the fact that Italy as a whole do not fail the weak sustainability test of GS, at the subnational level there is a resource-rich territory, Basilicata, clearly over an unsustainable path of development. Interestingly, as we previously mentioned, the GS rate can be interpreted as an early warning of the so called "resource curse". In fact, according to the literature, the resource boom and the heavy exploitation of natural assets are very often associated with a slowing growth rate and stagnation. Therefore, an oil-led development model for this resource rich and underdeveloped region in the south of Italy could hide a trap more than an opportunity, and deserves further research.

Obviously, also the GS suffers from several shortcomings as a measure of sustainability (Pillarisetti, 2005). Specifically for our work, the quality of that estimates at the regional level strongly depends on the quality of the data available to create regional aggregates needed. Surely, widen the pollutants list, the environmental matrix of pollution damages and the spectrum of natural assets can be helpful to better consider the specificity of sustainability in the territories analysed. However, aside from the specific implication for the case under analysis and despite the aforementioned limits, this study clearly highlights the inconsistencies that can arise from the measurement of sustainability at different territorial level; that should be considered in formulating and evaluating environmental policies results.

Table 3.7.1: Net National Savings as a percentage of regional GDP

Region	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average
Abruzzo	7.09	6.84	7.08	6.95	6.53	5.20	5.97	5.60	4.86	5.24	3.51	3.62	3.86	1.79	5.71
Basilicata	6.88	7.28	7.89	7.70	6.52	5.95	5.72	5.42	4.86	4.58	3.64	3.97	3.44	1.40	5.87
Calabria	7.01	7.74	9.51	7.02	6.99	4.97	5.83	5.75	4.14	4.73	4.13	3.78	3.96	2.11	5.97
Campania	9.02	8.17	8.16	7.66	6.38	5.69	6.34	5.53	4.88	5.13	4.38	4.38	4.73	1.58	6.31
Emilia Romagna	7.06	7.43	6.94	6.48	6.09	5.42	5.35	5.58	4.06	4.73	3.81	3.91	4.08	1.65	5.57
Friuli V. G.	7.29	7.11	7.66	6.59	5.87	5.57	6.16	5.55	4.22	4.66	3.60	3.57	4.09	1.73	5.65
Italia	7.49	7.81	7.72	7.00	6.45	5.88	6.15	5.80	4.68	5.06	3.99	4.00	4.31	1.81	6.00
Lazio	8.86	8.84	9.86	8.26	8.48	7.15	6.65	6.03	5.36	5.02	4.49	4.34	4.75	1.80	6.94
Liguria	9.07	9.66	10.18	8.41	8.25	6.91	7.15	6.74	6.79	4.94	3.73	3.86	4.60	1.97	7.14
Lombardia	6.26	7.22	6.82	6.35	5.72	5.69	6.23	5.83	4.20	4.81	3.97	3.83	4.39	1.73	5.58
Marche	8.16	8.12	8.14	7.71	6.99	5.78	7.01	6.11	4.72	5.92	3.49	3.99	4.82	1.51	6.34
Molise	7.28	6.48	6.74	5.76	5.68	5.70	6.09	4.19	3.49	4.90	3.69	4.04	3.96	1.31	5.34
Piemonte	7.89	7.74	7.32	6.30	6.68	6.38	5.66	5.89	4.71	5.44	3.95	3.79	3.72	1.96	5.98
Puglia	6.26	6.29	6.44	6.40	6.09	5.30	5.68	5.69	4.19	4.89	3.17	3.45	3.67	2.55	5.32
Sardegna	6.38	7.12	7.04	7.54	6.17	5.59	5.93	5.53	4.86	5.45	3.78	4.45	4.87	1.58	5.82
Sicilia	7.09	7.32	7.30	7.18	5.81	6.38	6.55	5.15	4.55	5.21	4.15	4.22	4.32	1.58	5.91
Toscana	8.31	9.37	8.75	7.38	6.16	5.28	6.21	5.41	5.45	5.95	4.10	4.49	4.78	1.75	6.40
Trentino A. A.	8.15	8.56	8.10	8.17	6.49	6.49	6.86	7.11	5.38	6.00	5.22	5.18	4.88	1.99	6.81
Umbria	7.38	8.86	7.82	7.47	6.61	5.87	5.33	5.70	3.83	4.04	3.34	3.35	3.71	2.66	5.80
Valle d'Aosta	5.29	4.96	5.56	4.86	3.60	3.92	4.95	4.10	3.57	4.11	3.40	3.55	4.54	1.26	4.32
Veneto	7.90	8.00	7.39	6.84	6.31	5.65	6.19	6.23	4.73	4.93	3.94	3.89	4.04	1.92	6.00

Source: author elaboration.

Table 3.7.2: Education Expenditure as a percentage of regional GDP

Region	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average
Abruzzo	5.16	5.31	5.43	5.44	5.29	5.20	5.24	5.29	5.41	5.23	5.20	4.99	5.00	4.62	5.15
Basilicata	7.87	8.31	8.31	8.08	7.95	7.94	8.22	7.93	8.14	7.51	7.83	7.41	7.35	7.02	7.74
Calabria	9.23	9.67	9.70	9.65	9.28	9.08	9.16	9.06	9.02	8.19	8.29	8.08	7.98	7.81	8.68
Campania	7.82	8.18	8.15	8.01	7.96	8.14	8.21	7.92	8.13	7.54	7.78	7.55	7.46	7.08	7.75
Emilia Romagna	2.75	2.83	2.74	2.67	2.62	2.49	2.55	2.60	2.68	2.55	2.71	2.67	2.66	2.55	2.67
Friuli V. G.	3.29	3.26	3.13	3.15	3.13	3.08	3.07	3.11	3.28	3.12	3.18	3.19	3.23	3.17	3.18
Italia	4.14	4.26	4.24	4.20	4.19	4.11	4.15	4.13	4.20	3.97	4.09	4.01	4.00	3.85	4.11
Lazio	4.11	4.20	4.07	4.02	3.98	3.82	3.73	3.63	3.72	3.53	3.64	3.53	3.50	3.38	3.78
Liguria	3.50	3.43	3.32	3.29	3.33	3.24	3.24	3.29	3.32	3.25	3.26	3.27	3.22	3.12	3.28
Lombardia	2.54	2.58	2.60	2.59	2.72	2.53	2.58	2.59	2.64	2.52	2.62	2.58	2.60	2.47	2.61
Marche	3.76	3.87	3.88	3.82	3.76	3.81	3.85	3.77	3.94	3.73	3.81	3.80	3.77	3.64	3.81
Molise	6.20	6.30	6.26	6.04	6.15	6.03	6.14	6.13	6.29	5.81	5.85	5.60	5.48	5.34	5.89
Piemonte	2.96	3.10	3.08	3.12	3.09	3.09	3.14	3.21	3.25	3.21	3.26	3.25	3.27	3.21	3.18
Puglia	6.58	6.82	7.05	6.82	6.72	6.84	7.02	6.94	7.08	6.56	6.78	6.54	6.58	6.38	6.69
Sardegna	6.93	7.16	6.93	6.95	6.85	6.82	6.87	6.76	6.72	6.07	6.05	6.08	5.94	5.56	6.43
Sicilia	7.77	8.02	8.13	8.10	8.17	8.21	8.19	8.06	8.15	7.63	7.78	7.48	7.50	7.21	7.75
Toscana	3.59	3.71	3.71	3.67	3.51	3.41	3.50	3.45	3.55	3.36	3.49	3.36	3.37	3.24	3.50
Trentino A. A.	4.22	4.17	4.02	3.86	4.08	3.62	3.62	3.74	3.68	3.86	4.23	4.63	4.75	4.79	4.11
Umbria	4.29	4.52	4.33	4.39	4.27	4.08	4.01	4.13	4.28	3.97	4.21	4.03	4.16	3.97	4.18
Valle d'Aosta	6.12	6.02	6.51	5.72	5.56	4.58	4.27	4.59	3.92	4.01	4.19	4.72	4.76	5.25	5.00
Veneto	2.67	2.78	2.72	2.71	2.66	2.69	2.75	2.81	2.86	2.70	2.82	2.79	2.83	2.75	2.77

Source: author elaboration.

Table 3.7.3: Energy and Mineral Depletion as a percentage of regional GDP

Region	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average
Abruzzo	0.46	0.71	0.62	0.27	0.32	0.85	0.63	0.54	0.66	0.82	0.59	0.63	0.68	0.83	0.62
Basilicata	0.27	0.80	1.04	0.54	0.68	1.97	2.36	4.72	6.11	13.52	14.03	15.20	14.75	17.02	6.65
Calabria	0.49	0.62	0.58	0.38	0.28	0.80	0.69	0.45	0.63	0.60	0.83	0.65	0.46	0.57	0.57
Campania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emilia Romagna	0.41	0.55	0.59	0.43	0.35	0.87	0.74	0.39	0.53	0.43	0.66	0.45	0.41	0.53	0.52
Friuli V. G.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Italia	0.12	0.16	0.16	0.10	0.09	0.22	0.19	0.14	0.17	0.23	0.25	0.23	0.21	0.25	0.18
Lazio	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liguria	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lombardia	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Marche	0.79	0.98	0.76	0.50	0.41	1.20	1.14	0.70	1.10	1.08	1.36	1.16	0.93	1.03	0.94
Molise	0.25	0.28	0.15	0.15	0.17	0.41	0.39	0.19	0.31	0.41	0.27	0.39	0.33	0.43	0.29
Piemonte	0.27	0.37	0.40	0.18	0.19	0.31	0.19	0.12	0.06	0.01	0.05	0.04	0.03	0.06	0.16
Puglia	0.07	0.15	0.13	0.15	0.18	0.27	0.29	0.22	0.18	0.12	0.16	0.09	0.08	0.12	0.16
Sardegna	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sicilia	0.19	0.23	0.21	0.11	0.11	0.33	0.24	0.25	0.26	0.53	0.30	0.27	0.36	0.33	0.27
Toscana	0.00	0.0003	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trentino A. A.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Umbria	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Valle d'Aosta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Veneto	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: author elaboration.

Table 3.7.4: CO2 Damage as percentage of regional GDP

Region	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Average
Abruzzo	0.47	0.47	0.53	0.55	0.58	0.65	0.66	0.60	0.58	0.50	0.44	0.44	0.54
Basilicata	0.51	0.52	0.62	0.62	0.75	0.77	0.72	0.75	0.62	0.60	0.52	0.52	0.63
Calabria	0.68	0.67	0.64	0.65	0.61	0.69	0.72	0.62	0.58	0.46	0.45	0.46	0.60
Campania	0.40	0.39	0.42	0.40	0.44	0.49	0.47	0.43	0.36	0.32	0.31	0.29	0.39
Emilia Romagna	0.64	0.62	0.65	0.61	0.64	0.72	0.70	0.68	0.63	0.58	0.55	0.49	0.63
Friuli V. G.	0.79	0.82	0.98	1.00	0.80	0.95	1.00	0.91	0.81	0.66	0.64	0.61	0.83
Italia	0.69	0.66	0.72	0.72	0.73	0.80	0.79	0.71	0.61	0.54	0.52	0.50	0.66
Lazio	0.57	0.57	0.60	0.59	0.66	0.71	0.68	0.64	0.53	0.41	0.40	0.36	0.56
Liguria	1.38	1.16	1.25	1.26	1.13	1.18	1.22	1.11	0.88	0.81	0.74	0.66	1.07
Lombardia	0.53	0.52	0.53	0.54	0.59	0.61	0.60	0.52	0.45	0.41	0.41	0.41	0.51
Marche	0.43	0.46	0.51	0.54	0.52	0.57	0.53	0.53	0.43	0.39	0.43	0.36	0.47
Molise	0.62	0.56	0.64	0.76	0.79	0.85	0.76	0.77	0.63	0.61	0.58	0.75	0.69
Piemonte	0.47	0.47	0.52	0.57	0.60	0.66	0.65	0.57	0.49	0.43	0.44	0.41	0.52
Puglia	1.56	1.48	1.80	1.67	1.61	1.79	1.76	1.61	1.43	1.37	1.41	1.40	1.58
Sardegna	1.28	1.15	1.30	1.19	1.22	1.35	1.25	1.04	0.95	0.93	0.85	0.84	1.11
Sicilia	0.98	0.94	1.02	1.02	1.03	1.18	1.16	1.04	0.86	0.69	0.63	0.58	0.93
Toscana	0.80	0.73	0.80	0.90	0.81	0.90	0.88	0.80	0.65	0.58	0.56	0.53	0.74
Trentino A. A.	0.42	0.41	0.46	0.45	0.47	0.51	0.50	0.44	0.37	0.34	0.34	0.34	0.42
Umbria	0.75	0.77	0.82	0.83	0.79	0.96	0.95	0.86	0.83	0.75	0.72	0.68	0.81
Valle d'Aosta	0.58	0.49	0.56	0.55	0.56	0.64	0.63	0.64	0.52	0.52	0.72	0.61	0.59
Veneto	0.73	0.68	0.71	0.75	0.77	0.83	0.83	0.77	0.60	0.51	0.46	0.43	0.67

Source: author elaboration.

Table 3.7.5: GS as percentage of regional GDP

Region	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Average
Abruzzo	11.3	11.0	11.4	11.6	10.9	8.9	9.9	9.8	9.0	9.2	7.7	7.6	9.84
Basilicata	14.0	14.3	14.5	14.6	13.0	11.2	10.8	7.9	6.3	-2.0	-3.1	-4.3	8.09
Calabria	15.1	16.1	18.0	15.6	15.4	12.6	13.6	13.7	12.0	11.9	11.1	10.7	13.81
Campania	16.4	16.0	15.9	15.3	13.9	13.3	14.1	13.0	12.6	12.4	11.8	11.6	13.87
Emilia Romagna	8.8	9.1	8.4	8.1	7.7	6.3	6.5	7.1	5.6	6.3	5.3	5.6	7.07
Friuli V. G.	9.8	9.5	9.8	8.7	8.2	7.7	8.2	7.7	6.7	7.1	6.1	6.1	7.99
Italia	**10.83**	**11.25**	**11.09**	**10.39**	**9.82**	**8.97**	**9.33**	**9.07**	**8.10**	**8.27**	**7.31**	**7.29**	**9.31**
Lazio	12.4	12.5	13.3	11.7	11.8	10.3	9.7	9.0	8.5	8.1	7.7	7.5	10.22
Liguria	11.2	11.9	12.2	10.4	10.4	9.0	9.2	8.9	9.2	7.4	6.3	6.5	9.39
Lombardia	8.3	9.3	8.9	8.4	7.8	7.6	8.2	7.9	6.4	6.9	6.2	6.0	7.65
Marche	10.7	10.5	10.7	10.5	9.8	7.8	9.2	8.6	7.1	8.2	5.5	6.3	8.75
Molise	12.6	11.9	12.2	10.9	10.9	10.5	11.1	9.4	8.8	9.7	8.7	8.5	10.43
Piemonte	10.1	10.0	9.5	8.7	9.0	8.5	8.0	8.4	7.4	8.2	6.7	6.6	8.42
Puglia	11.2	11.5	11.6	11.4	11.0	10.1	10.7	10.8	9.7	10.0	8.4	8.5	10.39
Sardegna	12.0	13.1	12.7	13.3	11.8	11.1	11.5	11.3	10.6	10.6	9.0	9.7	11.39
Sicilia	13.7	14.2	14.2	14.1	12.8	13.1	13.3	11.9	11.6	11.6	11.0	10.8	12.70
Toscana	11.1	12.4	11.7	10.1	8.9	7.8	8.8	8.1	8.4	8.7	7.0	7.3	9.19
Trentino A. A.	11.9	12.3	11.7	11.6	10.1	9.6	10.0	10.4	8.7	9.5	9.1	9.5	10.37
Umbria	10.9	12.6	11.3	11.0	10.1	9.0	8.4	9.0	7.3	7.3	6.8	6.7	9.20
Valle d'Aosta	10.8	10.5	11.5	10.0	8.6	7.9	8.6	8.1	7.0	7.6	6.9	7.7	8.75
Veneto	9.8	10.1	9.4	8.8	8.2	7.5	8.1	8.3	7.0	7.1	6.3	6.3	8.07

Source: author elaboration.

Table 3.7.6: GS including PM Damage as percentage of regional GDP

Region	1995	2000	2005
Abruzzo	10.41	8.06	7.08
Basilicata	12.87	10.02	-3.91
Calabria	13.83	11.30	10.33
Campania	15.77	12.71	11.39
Emilia Romagna	8.00	5.76	4.85
Friuli V. G.	8.86	6.95	5.57
Italia	**10.00**	**8.34**	**6.82**
Lazio	11.81	9.84	7.47
Liguria	9.86	8.32	5.78
Lombardia	7.75	7.20	5.84
Marche	9.99	7.27	5.09
Molise	11.19	9.20	7.19
Piemonte	9.39	7.89	6.25
Puglia	9.19	8.70	7.24
Sardegna	10.47	9.95	8.20
Sicilia	12.52	12.21	10.35
Toscana	10.40	7.26	6.60
Trentino A. A.	11.35	9.13	8.72
Umbria	9.58	8.00	6.03
Valle d'Aosta	10.05	7.16	6.34
Veneto	8.99	6.85	5.79

Source: author elaboration.

Appendix

3.A GS estimates: method and data sources

Item	Definition	Formula	DATA
Gross national saving (GNS)	Difference between GNI and public and private consumption plus net current transfers.	Gross National Income less private and public consumption plus net current transfers	Istat, Regional Accounts (ISTAT, 2012)
Depreciation	Replacement value of capital used up in the process of production.	Estimated as a quota of National Consumption of fixed capital; for each region it is estimated as the sum of sectoral depreciation (calculated as the ratio between sectoral regional investment over total sectoral investment). The regional Gross capital stock is calculated as the sum of Gross Investment from 1980 to 1995, disaggregated on sectoral basis (Nace Rev 2). Then, for each sector, we calculated the ratio of capital consumption on the total of CC at the national basis and apply this ratio for every region, under the hypothesis that the quota of capital consumption on sectoral bases is regionally invariant. The stock is calculated as K(t)= K(t-1) - R(t) + I(t).	ISTAT (2010)
NNS Net national saving	**Difference between gross national saving and the consumption of fixed capital**		

Continued on next page

Continued from preceding page

Item	Definition	Formula	DATA
Education expenditure	Public current operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment.		Regional Accounts (ISTAT, 2010); Public expenditure in education (CoFoG classification) by region (Nuts 2) (ISTAT, 2010)
Energy depletion (END)	Ratio of present value (PV) of rents, discounted at 4%, to exhaustion time of the resource. Rent is calculated as the product of unit resource rents and the physical quantities of energy resources extracted. It covers coal, crude oil, and natural gas.	Rent = production volume x unit resource rent; unit rent is equal to unit price less unit cost of extraction	Unit rent data for Italy by WB (The World Bank, 2010). Data on Production volume by Ministry of Economic Development (Ministry of Economic Development, 2014); data of offshore extraction are imputed to the regions on the basis of geographic localization of platform.
Mineral depletion (MID)	Ratio of present value of rents, discounted at 4%, to exhaustion time of the resource. Rent is calculated as the product of unit resource rents and the physical quantities of mineral extracted. It covers tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate.	Rent = production volume x unit resource rent ; unit rent is equal to unit price less unit cost of extraction	Unit rent data for Italy calculated by WB (see END). The whole rent calculated for Italy in the period considered is imputed to Sardegna (the whole Italian production of minerals considered is related to extraction licenses released in that region)
CO2 damages (CO2D)	A conservative figure of $20 marginal global damages per ton of carbon emitted was taken from Fankhauser (1994).	CO2D = emissions (tons) x $20	Data on CO2 emission are calculated by ENEA (2010)

Continued on next page

Continued from preceding page

Item	**Definition**	**Formula**	**DATA**
PM damages (PMD)	Willingness to pay (WTP) to avoid mortality and morbidity attributable to particulate emissions.	PMD = disability adjusted life years (DALYs) lost due to PM emissions x WTP	Data on PM emission disaggregated on regional basis are calculated from De Lauretis et. al (2009); the value of Damage for each region is calculated as the contribution to national emission multiplied for the total damage calculated by WB for Italy
Adjusted net saving (ANS)	Net national saving plus education expenditure and minus energy depletion, mineral depletion, net forest depletion, carbon dioxide damage, and particulate emissions damage	ANS = NNS EE ED MD NFD CO2D PMD	

Concludes from previous page

Source: author elaboration based on Bolt et al. (2002).

References

Atkinson, G., Dietz, S., and Neumayer, E. (2007). *Handbook of sustainable development*. Edward Elgar Publishing.

Bolt, K., Matete, M., and Clemens, M. (2002). Manual for calculating adjusted net savings. Technical report, Environment Department, The World Bank.

Boos, A. and Holm-Müller, K. (2013). The relationship between the resource curse and genuine savings: Empirical evidence. *Journal of Sustainable Development*, 6(6):59–72.

Bronzini, R., Cannari, L., Staderini, A., Conti, L., D'Aurizio, L., Fabbrini, A., Filippone, A., Ilardi, G., Iuzzolino, G., Montanaro, P., Paccagnella, M., et al. (2013). L'industria meridionale e la crisi. Questioni di Economia e Finanza (Occasional papers) 194, Bank of Italy.

Brown, R. P., Asafu-Adjaye, J., Draca, M., and Straton, A. (2005). How useful is the genuine savings rate as a sustainability indicator for regions within countries? Australia and Queensland compared. *Australian Economic Review*, 38(4):370–388.

Dasgupta, P. et al. (2001). Wealth as a criterion for sustainable development. *World Economics*, 2(3):19–44.

De Lauretis, R., Caputo, A., Cóndor, R., Di Cristofaro, E., Gagna, A., Gonella, B., Lena, F., Liburdi, R., Romano, D., Taurino, E., et al. (2009). La disaggregazione a livello provinciale dell'inventario nazionale delle emissioni. Rapporto 92, Institute for Environmental Protection and Research—ISPRA.

ENEA (2010). Inventario annuale delle emissioni di gas serra su scala regionale. le emissioni di anidride carbonica dal sistema energetico. rapporto 2010. Technical report, Ente Nazionale per le Nuove tecnologie, l'Energia e lo sviluppo economico sostenibile.

Ferreira, S. and Moro, M. (2011). Constructing genuine savings indicators for Ireland, 1995–2005. *Journal of Environmental Management*, 92(3):542 – 553.

Frankhauser, S. (1994). The social cost of greenhouse gas emissions: an expected value approach. *Energy Journal*, 15(2):157–184.

Gnègnè, Y. (2009). Adjusted net saving and welfare change. *Ecological Economics*, 68(4):1127–1139.

Greasley, D., Hanley, N., Kunnas, J., McLaughlin, E., Oxley, L., and Warde, P. (2014). Testing genuine savings as a forward-looking indicator of future well-being over the (very) long-run. *Journal of Environmental Economics and Management*, 67(2):171–188.

Hamilton, K. (2000). Genuine saving as a sustainability indicator. *OECD Proceedings: Frameworks to Measure Sustainable Development*, pages 65–78.

Hamilton, K. and Atkinson, G. (2006). *Wealth, welfare and sustainability: advances in measuring sustainable development*. Edward Elgar Publishing.

Hamilton, K. and Clemens, M. (1999). Genuine savings rates in developing countries. *The World Bank Economic Review*, 13(2):333–356.

Hanley, N., Moffatt, I., Faichney, R., and Wilson, M. (1999). Measuring sustainability: a time series of alternative indicators for Scotland. *Ecological Economics*, 28(1):55–73.

Hartwick, J. M. (1990). Natural resources, national accounting and economic depreciation. *Journal of Public Economics*, 43(3):291–304.

Hicks, J. (1946). *Value and Capital. An Inquiry into Some Fundamental Principles of Economic Theory.* Oxford: Clarendon Press.

ISTAT (2010). Investimenti fissi lordi per branca proprietaria, stock di capitale e ammortamenti. `http://www.istat.it/it/archivio/4468`. Online, Accessed 19 April 2014.

ISTAT (2012). Conti economici territoriali - versione 23 novembre 2012. `http://www.istat.it/it/archivio/4468`. Online, Accessed 19 April 2014.

Lindmark, M. and Acar, S. (2013). Sustainability in the making? A historical estimate of swedish sustainable and unsustainable development 1850–2000. *Ecological Economics*, 86:176–187.

Ministry of Economic Development (2014). Hydrocarbons production. `http://unmig.sviluppoeconomico.gov.it/unmig/produzione/produzione.asp`. Online, Accessed 26 March 2014.

Mota, R. P., Domingos, T., and Martins, V. (2010). Analysis of genuine saving and potential green net national income: Portugal, 1990–2005. *Ecological Economics*, 69(10):1934–1942.

Neumayer, E. (2004). Does the "resource curse" hold for growth in genuine income as well? *World Development*, 32(10):1627–1640.

Nourry, M. (2008). Measuring sustainable development: Some empirical evidence for France from eight alternative indicators. *Ecological Economics*, 67(3):441–456.

Pearce, D. and Atkinson, G. (1992). Are national economies sustainable? measuring sustainable development. Technical Report GEC 92-11, Centre for Social and Economic Research in the Global Environment (CSERGE) Working Paper.

Pearce, D. W. and Atkinson, G. D. (1993). Capital theory and the measurement of sustainable development: an indicator of "weak" sustainability. *Ecological Economics*, 8(2):103–108.

Pezzey, J. C. and Burke, P. J. (2014). Towards a more inclusive and precautionary indicator of global sustainability. *Ecological Economics*, 106:141–154.

Pezzey, J. C., Hanley, N., Turner, K., and Tinch, D. (2006). Comparing augmented sustainability measures for Scotland: Is there a mismatch? *Ecological Economics*, 57(1):60–74.

Pillarisetti, J. R. (2005). The world bank's 'genuine savings' measure and sustainability. *Ecological Economics*, 55(4):599–609.

The World Bank (2010). Environment. `http://www.worldbank.org/en/topic/environment`. Online, Accessed 1 March 2014.

Uwasu, M. and Yabar, H. (2011). Assessment of sustainable development based on the capital approach. *Ecological Indicators*, 11(2):348–352.

WCED (1987). *Our common future*. Oxford University press.

You, J. (2011). China's energy consumption and sustainable development: Comparative evidence from GDP and genuine savings. *Renewable and Sustainable Energy Reviews*, 15(6):2984–2989.

The resource curse at the sub-national level: the case of Italy

4.1 Introduction

The role of natural resources on economic performance of countries has been largely investigated by the literature. From economic history to applied economics, the role of natural resources endowments has been analysed in its impact on the development process from different perspectives. Economic history shows that, for a long period, the availability of natural resource had clearly a strategic role in boosting economic growth and industrialization of countries; more recently however, the literature highlight that this relationship is more problematic than previously thought (Wright and Czelusta, 2007).

Natural resources should be considered as a natural component of national wealth, an asset supporting economic welfare, both in the present and in the future (Atkinson and Hamilton, 2003; Auty, 2001). Several models of sustainability based on capital theory include natural assets in national and territorial accounting, "greening" the GDP and other macroeconomic indicators, to properly take into consideration this form of wealth. In this view, the economic exploitation of natural capital should be considered as a form of consumption more than a production activity, and resource depletion should be counterbalanced by investments in other assets to make the ongoing level of welfare sustainable also in the future.

In general, the availability of natural resources, especially oil, gas and other mineral and energetic non-renewable ones, may constitute an opportunity for sustained economic growth and development. Nevertheless the results in the literature are ambiguous. In particular, the abundance of mining and extractive energetic resources raised a new interest among scholars in the last two decades, both for the economic and sustainability implications of their exploitation. Several contributions provide evidences of an association between resource abundance and the so called "paradox of plenty", or "resource curse" (RC). From the important work of Sachs and Warner (2001), the underperformance (in terms of growth) of resource-abundant countries with respect to resource-poor economies has been widely investigated. Scholars propose several alternative explanations for such a phenomenon. Indeed, some contributions focus on the displacement effects in the productive systems caused by changes in the terms of trade usually associated with an intensive exploitation of natural resources, the so-called "Dutch disease" (DD) and de-industrialization problems; others claim that political economy mechanisms (Robinson et al., 2006; Kolstad and Wiig, 2009; Auty, 2001; Mikesell, 1997) are able to transform a potential bless in a harming curse[1].

The existence itself of such a phenomenon is still debated, with empirical evidences both supporting (Van der Ploeg, 2011; Sachs and Warner, 2001; Van der Ploeg and Poelhekke, 2010) and denying it (Davis, 2013; Brunnschweiler and Bulte, 2008; Alexeev and Conrad, 2009). In general, one of the main problem with this literature is that cross-country analyses are prone to omitted variables problems, because the differences in economic, institutional and also historical characteristics of countries can be hardly controlled for in a proper way. Moreover, the analysis on an aggregate basis can hide within-country asymmetries in the effects of a resource boom, or in the local impact of resource exploitation.

For all these reasons, a recent strand of the literature focusing on a sub-national-within country perspective is arising. Ticci and Escobal (2012) study the impact of the extractive sector in Peru on the local development and wealth, finding that extractive activities foster a labour specialization, with a negative impact on agriculture and non-primary sectors. Instead, Caselli and Michaels (2009) use variation in oil output among Brazilian municipalities in order to investigate the effects of resource windfalls on government behaviour, municipal expenditures and social outcomes, finding a modest (or no detectable) impact on the level of public provisions. Hajkowicz et al. (2011) examine the relationship between socio-economic wellbeing and mining activities at the regional level in Australia, finding no evidence of negative relationship between them. On the contrary, they detect a positive impact on income, housing affordability, employment and other indicators. However, the authors claim that these results can be driven by an inadequate scale of analysis: indeed, inequalities led by resource abundance and the neg-

[1] Karl (2007) discuss the consequences of oil-led development in a wide perspective; see Van der Ploeg (2011) and Frankel (2010) for and exhaustive ad critical literature review on this topic, and Stevens and Dietsche (2008) for a special focus on the role of institutional quality.

ative impacts of such an activity are punctual and localised. For this reason, they argue that an eventual negative association between these variables is difficult to be detected at the regional level in Australia. Similar analyses, both at the state and county level, are available for the United States. Papyrakis and Gerlagh (2007) find a negative impact of resource abundance on R&D expenditure, schooling, openness and investments in 49 US states. Instead, James and Aadland (2011) investigates the existence of the RC at the county level, providing consistent results with the State-level analysis. Conversely, Domenech (2008) carries out a historical analysis (over the period 1860-2002) of the relation between resources, industrialization, wage growth and human capital accumulation in spanish provinces. He finds a positive impact of the former on all the variables considered, with the exception of the human capital formation (for which no negative impact is detected over the period considered). Finally, Papyrakis and Raveh (2014) provide evidence of a regional DD process in Canadian provinces.

In this paper we contribute to this literature studying the DD phenomenon at the sub-national level in Italy, adopting an approach similar to Papyrakis and Raveh (2014). Indeed, the presence of a resource rich region like Basilicata, in the lagging area of Mezzogiorno, offers an interesting and peculiar case study in that respect. Until now, only few works investigated the impact of resource abundance in Italy, with a specific focus on the RC problems (Florestano, 2013; Percoco, 2012; Iacono and Mideksa, 2014), with contrasting results. According to Florestano (2013), the hydrocarbon exploitation positively affects GDP; however, employment effect is almost null. Percoco (2012) detects a positive impact on the number of firms per inhabitant. Conversely, Iacono and Mideksa (2014) find no detectable effect of oil extraction on Basilicata's economic performance. Our analysis provides evidence of a negative association between resource abundance and the capital stock in the manufacturing sector, consistent with the presence of DD-type process.

In the next section we will discuss the relationship between natural resources exploitation and regional economic systems from a structural perspective, especially for what concerns the causal chains that may explain the emergence of a DD phenomenon. In other words, we focus on a RC interpretation that looks at the structural modification in the national/regional economy generated by resource booms[2]. In the following section we present the methodology adopted and the data used in our estimates on the Italian case. The last section discusses the results.

[2]We are aware of the importance of the other channel aforementioned; however, the test of such hypothesis go beyond the scope of this paper.

4.2 The impact of natural resource exploitation on a regional economy

At the national level a "Positive wealth shocks from the natural resource sector (along with consumer preferences that translate this into higher demand for non-traded goods) creates excess demand for non-traded products and drives up non-traded prices, including particularly non-traded input costs and wages. This in turn squeezes profit in traded activities such as manufacturing that use this non-traded products as an input yet sell their products on international markets at relatively fixed international prices." This mechanism is proposed as an explanation of the resource curse in several contributions (Sachs and Warner, 2001).

According to this view, the extra wealth generated by natural resources exploitation leads to an exchange rate appreciation. This in turn may cause a contraction of the manufacturing sector due to losses in comparative advantages, and a progressive reduction in the growth potential of the whole economy. In fact, as the growth of manufacturing sector is based on scale economies and knowledge intensification, its contraction harms the whole economic system beyond this direct impact, both in the short and in the long run. Two mechanisms are identified in the literature to explain this phenomenon: the Spending Effect (SE) and the Resource Movement Effect (RME). The SE is related to the appreciation of the national currency eroding competitive advantages of the manufacturing sector, via an increases in the prices of non traded goods. The RM effect is conversely related to the effect of attraction in the booming sector of productive inputs, as to say labour and capital, formerly allocated to manufacturing.

Do similar transmission channels operate also at a sub-national level?

One could say that the issue has been investigated by development economists since the very birth of the discipline. A proper use of this endowment for developing countries was considered a vital element to boost growth. According to the "big push" literature (Nurkse, 1966; Rosenstein-Rodan, 1957; Rostow, 1959), the exploitation of natural resources can be an important driving factor to boost growth in depressed areas, providing a sudden increase of demand. Consequently, market expansion helps in overcoming the initial fixed cost of industrialization (Sachs and Warner, 1999).

The presence of a relevant resource sector has a clear and strong relation with the development of the whole economy. However, it is at the local/regional level where the economic, social and environmental impacts become evident. Very soon in the development studies the role of natural resource exploitation has been seen as a potential source of adverse impacts at the local level. For the theoreticians of unbalanced growth (Hirschman, 1958), natural resource industries should be better conceptualized as "enclaves". The weak linkages with the rest of local economy makes it very difficult, for this sector, to be an element propelling growth at the local level. However, in both these perspectives, the presence of a resource boom generates some turbulences in the economic system.

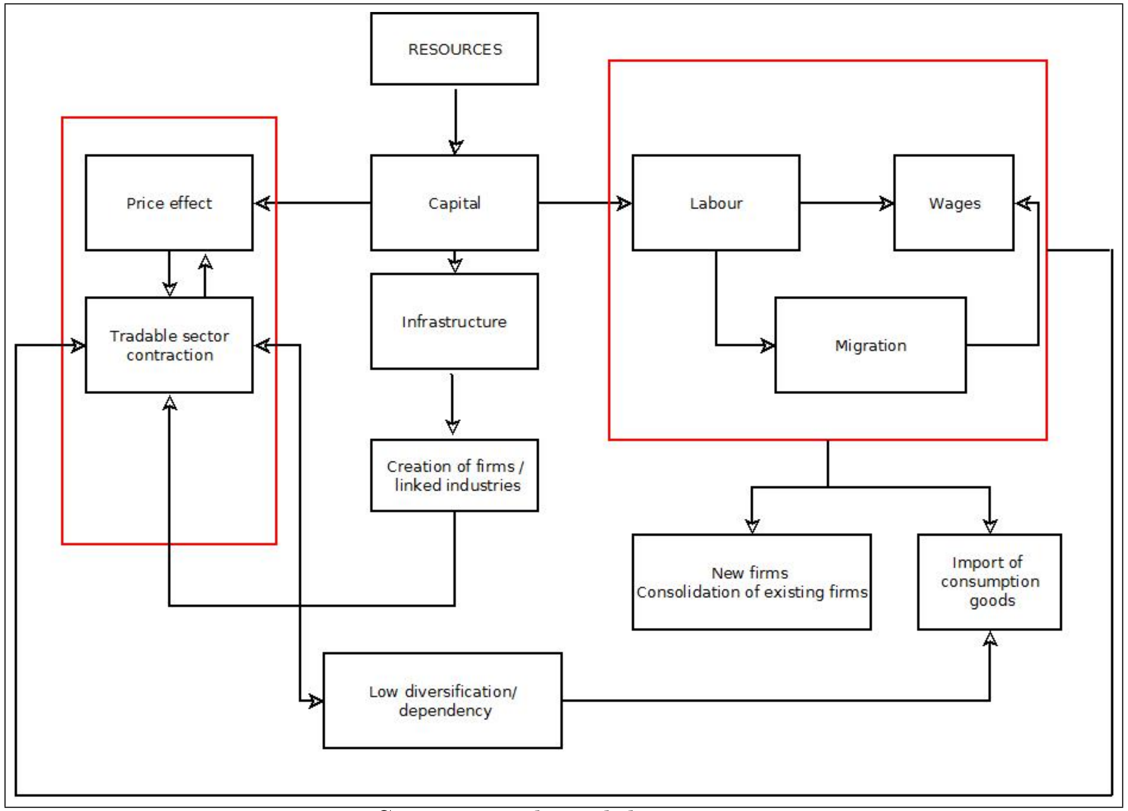
Then, how these turbulences displays themselves at the local level?

For our purposes, we focus on the mechanisms that can lead to DD at the regional level, an issue that the aforementioned studies investigates only in a marginal fashion. Then, we focus on direct and feedback effects that an unbalanced growth of the resource sector may have on prices, capital stock and labour in the rest of the regional manufacturing sector. The analysis is carried out under the framework of a demand shock in the regional economy. In fact, the resource sector can be analyzed as a unique large firm, that is able to generate large externalities on the territory in which it operates[3].

A set of hypothetical interactions between the natural resource industry and the rest of the regional economy, and the direct and indirect effect we consider are reported in Figure 4.2.1. Obviously, this relationship is characterized by positive and negative impacts for local economic growth, with the final outcome resulting from the balancing of this contrasting forces. Resource exploitation clearly increases, at the very beginning of its activities, the capital stock in regional economy. This industry is one of the most capital intensive among economic activities and requires important investments in physical capital, especially in the initial phases. In this period, the effects on local markets are particularly strong, while they generally decline in subsequent phases of economic activity There are also direct and indirect impacts in terms of employment, whose magnitude is strongly influenced by the availability of skilled labour in the area, and on how much the resource sector buys inputs on the local labour market. In fact, the higher this impact, the higher the indirect effects in terms of income (via higher wages) and population effect (through migration from other areas). The presence of a capital intensive sector often leads to an increase in infrastructures necessary to production. This can raise the set of available public goods and can create positive externalities for other firms in the area, directly or not related to the main production under analysis, with a potential positive effect on the rest of the productive system. At the same time, the multiplier effect on

[3] Aragón and Rud (2013) state that the role of extractive industries in local economy can be compared to that of a big firm that generates a large demand shock in the economic system; then, they analyze the impact of the Peruvian gold mine on the local economy under this framework. Similarly, Percoco (2012) includes this hypothesis in its analysis of the relationship between oil extraction and new firms creation in Basilicata.

Figure 4.2.1: DD at the sub-national level



Source: author elaboration.

incomes may lead to the creation of new firms, via agglomeration forces and localization incentives, and to the consolidation of the existing ones.

On the other hand, the whole turbulence in economic system can induce higher prices at the local level, the increase in imports of consumption goods and a reduction in the economic diversification of the local economy. Especially in depressed and lagging areas, the resource sector can crowd in entrepreneurial resources in a perverse way. It can be convenient to invest in subsidiary activities with a strong relationship with the main firms operating in the resource sector. However, due to the structure of economic activity in mining and quarrying sectors and the structure of backward and forward linkages, only low value added services are likely to flourish. This increases the dependency of the territory from the resource sector. In the long run, other industries potentially able to compete and enlarge the regional export base may be crowded out. Further, the augmented level of income in the local economy often rises the number of services activities; anyway, these are mainly related to final consumption more than productive activities. Eventually, these effects can lead to a negative impact on employment and productive sector on the whole.

This scheme is coherent with a large part of the literature that looks at the RC as the consequence of a turbulence in the economic system, focussing on the presence of some kind of displacement effects and crowding out logic (Sachs and Warner, 2001), and excluding the role of institutions in the resource windfalls management. In particular DD effects can be explained within such a framework.

Other scholars point out the presence of some kind of regional effects. Ticci and Escobal (2012), for example, discuss the impact of resource booms at the local level in terms of economic and social outcomes of households. Moreover, Fleming and Measham (2013) inspect these effects in terms of population movement (migration), consumption and employment effects, clarifying that transmission channels of DD operate also in sub-national setting.

Obviously, the strength of the impacts discussed in this general framework strongly depends, on the one hand, on the characteristics of local economy in which they operate: more or less developed area can be more or less "resilient" to shocks. On the other hand, the intensity of the resource boom and the relative importance of the extractive sector on the whole economic system play a role in the mechanism previously discussed: the higher its importance, the stronger the turbulences induced in local economies. The combination of a large resource industry with a lagging and weak local economy, as in the Basilicata case, is more likely to yield an adverse balance of positive and negative outcomes. A weak institutional frame may reinforce these effects through a non-efficient allocation of financial extra-resources generated by the exploitation of natural resources (Torvik, 2009).

4.3 Data and methods

To analyze the impact of natural resources on the Italian regional economies, we replicate the model used in Papyrakis and Raveh (2014) to analyse Regional DD in Canadian provinces and territories. Specifically, the empirical exercise is carried out to test for the presence of Resource Movement Effects (in terms of capital movement and labour movement) and Spending Effect (through prices changes and inflation) associated to resource abundance at the regional level in Italy from 2001 to 2008. We focus on the manufacturing sector to understand if any displacement effect arises in association with the development of extractive activities. The empirical specification of the model is a system of equations estimated by a SUR (Seemingly Unrelated Regressions) method. To test the robustness of our results we also separately estimate the single equations with panel fixed/random effects.

The variable used and the sources of data are described in the Appendix (Table 4.A.1), together with the summary statistics (provided in Table 4.A.2).

The main specification is the following:

$$\begin{aligned} Inflation_{i,t} = {} & \alpha_0 + \alpha_1 ResourceAbund_{i,t} + \alpha_2 ResourceAbund(ita)_{i,t} \\ & + \alpha_3 Prices_{i,t-1} + \alpha_4 K_{IND,i,t-1} + \alpha_5 L_{IND,i,t-1} \\ & + \alpha_6 VariationinK_{IND,i,t} + \alpha_7 VariationinL_{IND,i,t} \\ & + \delta_i + \epsilon_{i,t} \end{aligned} \tag{4.1}$$

$$\begin{aligned} VariationinK_{IND,i,t} = {} & \beta_0 + \beta_1 ResourceAbund_{i,t} + \beta_2 ResourceAbund(ita)_{i,t} \\ & + \beta_3 Prices_{i,t-1} + \beta_4 K_{IND,i,t-1} + \beta_5 L_{IND,i,t-1} \\ & + \beta 6 Inflation_{i,t} + \beta_7 VariationinL_{IND,i,t} + \\ & + \eta_i + \upsilon_{i,t} \end{aligned} \tag{4.2}$$

$$\begin{aligned} VariationinL_{IND,i,t} = {} & \gamma_0 + \gamma_1 ResourceAbund_{i,t} + \gamma_2 ResourceAbund(ita)_{i,t} \\ & + \gamma_3 Prices_{i,t-1} + \gamma_4 K_{IND,i,t-1} + \gamma_5 L_{IND,i,t-1} \\ & + \gamma 6 Inflation_{i,t} + \gamma_7 VariationinK_{IND,i,t} + \\ & + \xi_i + \mu_{i,t} \end{aligned} \tag{4.3}$$

The first equation focusses on the presence of higher inflation in regions that are relatively resource abundant. The second equation evaluates the impact of resource abundance on the variation in the share of the manufacturing sector in the capital stock (with respect to the previous period). Finally, the third equation searches for similar effects on the labour share.

Our variable of interest is *ResourceAbund*, which measures the resource abundance in each territory at time t. It is calculated as the total rent of oil and natural gas resources (unit rent, calculated as the difference between international price and a average extraction cost for all regions, multiplied by the quantity extracted) divided by regional GDP. Our focus on non-renewable extractive resources is related to the fact that, according to the literature, it is precisely this kind of resources that generates DD and in general RC phenomenon. The normalization with respect to GDP yields a measure of resource abundance able to signal the role of resources within the regional economy, more than physical extracted quantity in itself. In our opinion this produces a better information for what concerns the (possible) displacement effect we are looking for in this exercise. In a similar fashion we estimate the variable *ResourceAbund(ita)*, relating to the rest of Italy. Through this variable we account for displacement effects that can be driven by the presence of resources in other regions, according with the model proposed by Papyrakis and Raveh (2014).

Data on *Prices* and *Inflation* are retrieved from the Istat datawarehouse (ISTAT, 2012), respectively the sub-national Consumer Price Index for the whole population and the percentage variation of Sub-national Consumer Price index, on yearly average basis. Indeed, the variables related to capital and labour in the manufacturing sector are based on our elaborations on Istat data[4]. In particular, K_{IND} is the share of capital stock in the manufacturing sector over the total capital stock of the region, while $VatiationinK_{IND}$ is calculated as the annual percentage change of this variable. In the same way we elaborated the variables L_{IND} and $VatiationinL_{IND}$, still in the manufacturing sector.

Each dependent variable of Equations 1-3 enters as an independent variable in the other equations. We also control for capital stock and labour in manufacturing sector, prices and inflation level for each region i at year t. Each of these variables is included with a one year lag to account for non simultaneous effects. Similarly to Papyrakis and Raveh (2014) we estimate the three equations as a part of a Seemingly Unrelated Regression system (Zellner, 1962), to account for a contemporaneous cross-equation er-

[4]The method implemented to estimate the time series of the capital stock for each region is discussed in Chapter 3 of this thesis.

ror correlation (i.e. the error terms in the regression equations are correlated) because, according to our analysis, the effects we are investigating are linked between themeselves. Specifically, the SUR model is estimated both pooling observation and including territory fixed effect.

4.4 Results

As the Table 4.4.1 shows, resource rich regions do not differ in inflation levels with respect to other regions. However, it seems that a Resource Movement effect is present. Resource Abundance (*ResourceAbund*) generates a displacement effect both on manufacturing capital stock and labour (respectively -0.03 percentage points and -0.209 percentage points). However, the negative effect of *ResourceAbund* on the labour employed in the manufacturing sector turns out to be not significant when we account for regional differences including a territorial fixed effect (Regression 6). Moreover, Resource Abundance in the rest of Italy ($ResourceAbund_{ita}$) generates a displacement effect on the manufacturing capital stock, while no significant impact arises as concerning labour.

In Table 4.4.2, we include an additional regressor, namely "institutional quality". The share of investments (expenditure in Capital account) on Total expenditure (Capital account + Current Account) of local institutions is assumed as a proxy of "efficiency" of regional institutions:[5] a large share of investments may reveal a greater focus on the long term and development goals in designing regional policy[6].

This is to control for institutional quality heterogeneity. According to the literature, a weak institutional framework can have an adverse effect on the relationship resource abundance-economic performance. However, the inclusion of this regressor does not yield any relevant variation in the estimated coefficients for the variable of interest.

To check the robustness of estimates, we perform a standard panel data

[5] Data retrieved from the database Conti pubblici territoriali, available at http://www.dps.gov.it/it/cpt/.

[6] There is a large consensus in political economy literature that patronage relationships in public sector induce politicians to distribute jobs and favours in exchange of political support, leading to an increase in public expenditure in current account. Then we argue that, in lack of other relevant data, the measure we used is a good proxy of institutional quality. However, we are aware that patronage can affect also expenditure in capital account, financing large projects with negative social surpluses (the so-called "white elephants"; see Robinson and Ragnar (2005). Nevertheless, due to the dimension of the project financed at the local level, we argue that this problem can be really relevant in a national setting, more than at the regional level.

Table 4.4.1: SUR models

	SUR MODEL(POOLED)			SUR MODEL (REGION FIXED EFFECT)		
	(1)	(2)	(3)	(4)	(5)	(6)
	inflation	Variation in K_{IND}	Variation in L_{IND}	inflation	Variation in K_{IND}	Variation in L_{IND}
ResAbund	-2.611	-0.0373***	-0.209**	3.033	-0.0881***	-0.117
	(-1.28)	(-2.84)	(-2.21)	(-0.61)	(-5.14)	(-0.51)
ResAbundita	-156.8	-12.71***	0.71	155.1	-15.24***	-3.491
	(-0.64)	(-10.51)	(-0.06)	(-0.39)	(-20.64)	(-0.19)
L.Prices	0.0216	0.000528***	-0.000887	0.00944	0.000424***	-0.00280**
	(-1.47)	(-5.9)	(-1.25)	(-0.4)	(-4.94)	(-2.51)
L.K_{IND}	-2.431**	-0.0292***	-0.0386	14.78	-0.488***	-2.564**
	(-1.96)	(-3.60)	(-0.64)	(-0.53)	(-5.15)	(-2.05)
L.L_{IND}	-27.12*	0.0809	-0.448	-169.5	-2.27	-22.06
	(-1.81)	-0.8	(-0.62)	(-0.45)	(-1.64)	(-1.30)
Variation in K_{IND}	20.25		1.951***	34.29		1.242
	(-1.59)		(-3.32)	(-1.52)		(-1.2)
Variation in L_{IND}	-6.113***	0.0388***		-5.873***	0.00826	
	(-3.47)	(-3.32)		(-3.24)	(-1.2)	
L.inflation		-0.000106	-0.0140**		0.000465	-0.0153**
		(-0.13)	(-2.50)		(-0.86)	(-2.35)
_cons	0.741	-0.0383***	0.138*	-1.089	0.0653***	0.856***
	(-0.54)	(-3.79)	(-1.85)	(-0.16)	(-2.63)	(-2.82)
N	140	140	140	140	140	140
r2	0.158	0.555	0.133	0.231	0.873	0.26

t statistics in parentheses
* p <0.1, ** p <0.05, *** p <0.01

Source: author elaboration.

regression, including fixed territorial effects and random effects for each equation of the system[7]. Differently from previous results, we do not handle the three equation simultaneously, but estimate each of them separately. In this case all computations allow for the presence of heteroschedasticity and include the aforementioned variable of institutional quality. As Table 4.4.3 shows, the results are consistent with previous findings; there are no evidences of a Spending Effect in the data, while a negative and significant effect on manufacturing capital stock is robust to different specifications, even if small. The impact of resource abundance on the variation of the share in manufacturing labour is conversely less robust, both in significance and magnitude: however, according to the implemented tests, the results obtained through the random effect specification seems to be the more reliable for the third equation. A better inspection of this issue is left for further research.

As previously mentioned, there are no official estimates of Capital stock by industry at the regional level. We estimate the time series using Istat data and Bank of Italy methodology (Bronzini et al., 2013)[8]. The main problem associated to this method is our inability to isolate the tradable sector excluding mining and quarrying activities.

Therefore, a reverse causality problem may arise. In fact, the higher the resource abundance, the larger the mining sector in the industrial one, the higher the level of total industrial capital stock over the total stock of the territory. The same problem may arise for what regards labour. Despite this effect may be small, we correct our data to handle this problem. Through indirect methods, we estimate the gross capital stock for mining and quarrying activities in the following way:

- based on Istat national data and following the same methodology aforementioned, we calculate the cumulated sum of investments in extraction of energetic minerals (I_{energ}) and the cumulated sum of investments in the industrial sector (excluding construction) ($I_{industrial}$) until 1995;
- through the ratio $I_{energ}/I_{industrial}$ we obtain a measure of the role of mining activities over the whole industry sector from 1995 to 2001;
- the value is used to compute the consistency of capital stock for energetic mineral extraction activities at the national level;

[7]The Hausman test suggests the presence of Random effects in Equation 1 and 3, and Fixed effect in Equation 2. We then estimate the whole model with both methods and compare the results; we highlight that Equation 2 present similar results in our variable of interest despite the changes in estimator.

[8]For details on the methodology adopted in estimating capital stock at the sector-region level see Paper 2.

- finally, we disaggregate the capital stock at the national level, distributing the capital stock on the basis of the value of production from mining activities (for energetic resources) in physical units in every region.

Then, such value is subtracted from the aggregate capital stock of the industrial sector for each year and territory considered.

Table 4.4.4 shows the new results obtained estimating our model with panel random effect estimators. Also in this case, our findings are consistent with previous results, both in terms of significance and magnitude of coefficients.

Table 4.4.2: SUR models including "Institutional Quality"

	SUR MODEL (POOLED)			SUR MODEL (REGION FIXED EFFECT)		
	(1) inflation	(2) Variation in K_{IND}	(3) Variation in L_{IND}	(4) inflation	(5) Variation in K_{IND}	(6) Variation in L_{IND}
ResAbund	-2.482	-0.0383***	-0.211**	2.258	-0.0935***	0.117
	(-1.20)	(-2.89)	(-2.21)	(0.42)	(-5.06)	(0.49)
ResAbundita	-135.8	-12.86***	0.409	167.4	-15.08***	-4.655
	(-0.54)	(-10.35)	(0.03)	(0.42)	(-19.84)	(-0.26)
L.Prices	0.0199	0.000545***	-0.000860	0.00895	0.000422***	-0.00267**
	(1.29)	(5.70)	(-1.14)	(0.37)	(4.92)	(-2.44)
L.K_{IND}	-2.419*	-0.0291***	-0.0386	16.50	-0.472***	-2.837**
	(-1.95)	(-3.57)	(-0.64)	(0.59)	(-4.91)	(-2.31)
L.L_{IND}	-28.85*	0.100	-0.423	-167.6	-2.237	-21.02
	(-1.82)	(0.92)	(-0.55)	(-0.45)	(-1.62)	(-1.26)
Variation in K_{IND}	20.56		1.942***	33.81		1.459
	(1.61)		(3.30)	(1.49)		(1.44)
Variation in L_{IND}	-6.059***	0.0385***		-5.730***	0.0101	
	(-3.44)	(3.30)		(-3.10)	(1.44)	
Institutional Quality	-0.194	0.00199	0.00251	-0.844	-0.00633	0.234**
	(-0.33)	(0.51)	(0.09)	(-0.40)	(-0.80)	(2.50)
L.inflation		-0.0000344	-0.0139**		0.000516	-0.0163**
		(-0.04)	(-2.45)		(0.95)	(-2.54)
_cons	0.918	-0.0405***	0.135*	-1.284	0.0627**	0.871***
	(0.63)	(-3.69)	(1.66)	(-0.19)	(2.52)	(2.93)
N	140	140	140	140	140	140
r2	0.158	0.556	0.134	0.232	0.873	0.290

t statistics in parentheses
* p <0.1, ** p <0.05, *** p <0.01

Source: author elaboration.

Table 4.4.3: Fixed and Random effects models

	FE	FE	FE	RE	RE	RE
	(1)	(2)	(3)	(4)	(5)	(6)
	inflation	Variation in K_{IND}	Variation in L_{IND}	inflation	Variation in K_{IND}	Variation in L_{IND}
ResAbund	2.369	-0.0936***	0.0489	-2.397	-0.0857***	-0.258***
	(0.65)	(-8.20)	(0.30)	(-1.12)	(-10.16)	(-3.31)
ResAbundita	180.6	-15.21***	-15.82	-128.3	-15.18***	-12.80
	(0.35)	(-14.51)	(-0.62)	(-0.49)	(-14.73)	(-0.91)
L.Prices	0.00796	0.000411***	-0.00238	0.0197	0.000688***	-0.000331
	(0.35)	(4.72)	(-1.57)	(1.23)	(8.63)	(-0.43)
L.K_{IND}	16.02	-0.490***	-3.207**	-2.400*	-0.0438**	-0.0699
	(0.71)	(-5.75)	(-2.36)	(-1.87)	(-2.16)	(-1.26)
L.L_{IND}	-172.9	-2.361***	-22.85	-28.94*	-0.00772	-0.334
	(-1.34)	(-2.89)	(-0.68)	(-1.76)	(-0.04)	(-0.81)
Variation in K_{IND}	35.22		0.732	20.59		0.990*
	(1.30)		(0.64)	(1.56)		(1.76)
Variation in L_{IND}	-6.035**	0.00506		-5.763***	0.0139	
	(-2.77)	(0.60)		(-3.17)	(1.35)	
Institutional Quality	-0.773	-0.00518	0.231*	-0.200	-0.00179	0.00473
	(-0.55)	(-0.63)	(1.99)	(-0.33)	(-0.32)	(0.31)
L.inflation		0.000436	-0.0160*		-0.0000562	-0.0144*
		(0.71)	(-1.85)		(-0.12)	(-1.86)
_cons	-0.593	0.0525***	0.813**	0.936	-0.0492***	0.0979
	(-0.12)	(2.95)	(2.75)	(0.62)	(-4.69)	(1.33)
N	140	140	140	140	140	140
r2	0.113	0.798	0.219			

t statistics in parentheses

* p <0.1, ** p <0.05, *** p <0.01

Source: author elaboration.

Table 4.4.4: Random effect models with capital stock in the industrial sector (excluding the mining sector

	RE (1)	RE (2)	RE (3)
	inflation	Variation in K^*_{IND}	Variation in L_{IND}
ResAbund	-2.273	-0.0800***	-0.240**
	(-1.07)	(-3.10)	(-2.49)
ResAbundita	-213.0	-14.50***	-14.41
	(-1.00)	(-6.25)	(-1.47)
L.Prices	0.0204	0.000980***	-0.000633
	(1.37)	(5.66)	(-0.88)
L.K^*_{IND}	-3.102**	-0.0118	-0.153**
	(-2.11)	(-0.60)	(-2.20)
L.L_{IND}	5.108	-0.0191	1.043
	(0.28)	(-0.08)	(1.25)
Variation in K^*_{IND}	12.99*		0.705**
	(1.85)		(2.20)
Variation in L_{IND}	-6.098***	0.0489**	
	(-3.34)	(2.16)	
L.Inflation		0.00212	-0.0170***
		(1.36)	(-3.01)
_cons	0.932	-0.0923***	0.148*
	(0.65)	(-4.69)	(1.90)
N	140	140	140

t statistics in parentheses
* p <0.1, ** p <0.05, *** p <0.01

Source: author elaboration.

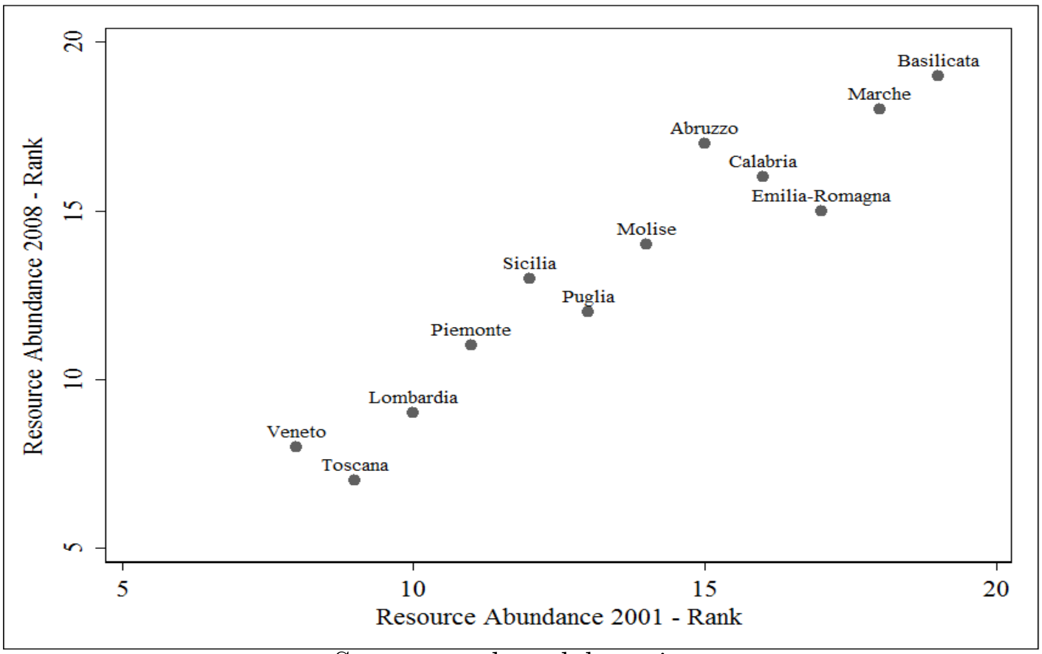
4.5 Discussion

According to our results, a DD phenomenon is working at the sub-national level in Italy. More specifically, there is no impact of resource abundance on inflation level in the italian regions. This finding is robust in several specification and model estimates. On the contrary, for what concerns the Resource Movement Effect our exercise signals that resource rich regions show a larger reduction in the capital stock of the manufacturing sector with respect to the non-rich ones. In fact, displacement effect arises in the case under analysis, consistently with previous evidences provided by the literature in that respect. The same effect emerges concernings labour in manufacturing sector, even if the impact is not conclusive. In fact, these findings become less robust through different estimates and model specifications.

It is worth noticing that in our framework the negative impact of natural resources may be mainly driven by the structure of the local economy in its interaction with the extractive sector, more than by the presence of the natural resources in themselves. In our interpretation, the provided evidence shows that a Dutch Disease phenomenon may arise because of an heavy reliance on the extractive sector and a perverse specialization model of the local economic development, quite independent from the impacts of prices. Obviously, due to the nature of data and the case under analysis, the large part of the effects we detected may be related to the impact of natural resources abundance in Basilicata. Indeed, this is the first Italian region for oil production and the third one in natural gas production in the period considered. Overall, it is the first producer of energetic, non-renewable resources (Figure 4.5.1).

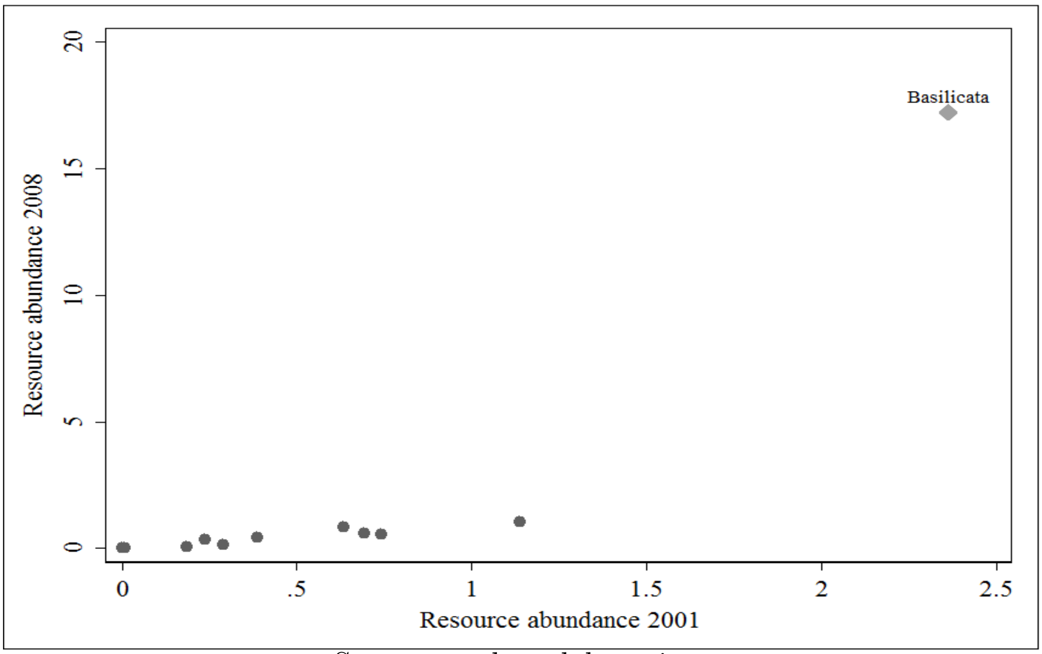
Moreover, the share of the resource rents for oil and gas production over the regional GDP is the largest among Italian regions during the period considered, and considerably higher with respect to other producer regions, showing a sharp increase between 2001 and 2008 (Figure 4.5.2).

Figure 4.5.1: Resource Abundance (ranks)



Source: author elaboration.

Figure 4.5.2: Resource abundance (value)



Source: author elaboration.

With such an heterogeneity in non-renewable natural resources endowments, the main region performs as an outlier with respect to other territories. However, it is worth noting that a similar structure of data is common in the large part of this literature, both at the national and sub-national level. In fact, especially for this kind of resources, endowments are highly punctual[9]. Moreover, the choice to focus on the within-Italy variation at the regional level is related also to the fact that, due to the data available and the characteristics of the case under analysis, it is very difficult to provide robust evidences on the impact of resource endowments on intersectoral structure of the economy based on a single region case study. For example, our results are not consistent with evidences provided by Iacono and Mideksa (2014). In their exercise, the authors analyze the impact of the resource boom in Basilicata in two steps: first of all, they compute its impact on GDP, Employment and Investments in the region, through a synthetic control method approach[10]. In the second step they consider the Gross Value Added distribution among 5 sectors. They find no evidence of a negative impact of resource extraction on Manufacturing Value Added in Italian Regions. Using a Diff in Diff estimator, with Basilicata as the treated region, they detect a positive impact of oil production on manufacturing GVA. As a consequence, they exclude the presence of Dutch Disease problems in that context. However, their results may be flawed by two problems. First, the industry disaggregation of the Gross Value Added of their data includes mining and quarrying activities in the manufacturing sector. A resource boom obviously generates an increase in the extractive sector value added, and consequently in the manufacturing sector as a whole. The same problem of endogeneity we tried to solve with our estimates of Capital stock (excluding the sector of extractive energetic resources) is therefore present in data. Second, the use of the synthetic control method does not account for spillovers between territories. Indeed, one of the regions of the donor pool used to generate the counterfactual territory in their analysis is directly affected by the resource extraction in Basilicata, as the crude oil produced in Basilicata oil fields is in large part phase transported through the oil pipeline linking the Val d'Agri oil center to Taranto refinery in Apulia. Then, an increase in oil extraction in Basilicata

[9]Part of the literature claims that exactly this characteristic is responsible for the resource curse: in part because of the reduced appropriability, that increases the probability of rent-seeking behaviors; in part because of the higher value of this resources over other economic activities inducing strong impacts on intersectoral structure of the economy (Torvik, 2009).

[10]The synthetic control method calculates the impact of an event or intervention: the treated unit is compared with a synthetic control units, that is based on a convex combination of non treated comparison units with similar characteristics to the treated one.

has a direct impact on the Gross Value Added of the manufacturing sector, employment and GDP in the control unit used to evaluate the impact of natural resources in the "treated" region.

Finally, to test for the robustness of our results we estimate the SUR model excluding Basilicata from our dataset. As Table 4.5.1 shows, the previous results are confirmed: the presence of energetic resources are associated with a displacement effect on the manufacturing sector[11].

As we highlighted previously, the impact of natural resources on regional economy spreads through a variety of channels . Indeed, the impact on capital and labour in manufacturing sector may be the first step of a process that may eventually reduce the competitiveness of the whole economy through the reduction of economic diversification of territories and the reduction of R&D expenditures of firms; but it can be also an impulse to the creation of new firms or the consolidation of the existing ones, and so on and so forth (Papyrakis and Gerlagh, 2007). Table 4.5.2 shows the correlation coefficient and statistical significance between resource abundance and several proxies of Regional competitiveness selected by Istat selection as "Local development indicators". The pooled data consider the 20 Italian regions from 1995 to 2013.

It is worth noticing that data signal a negative association between Resource Abundance and R&D expenditures of firms at the territorial level; the same relationship arises for what concerns employees in R&D firms. Coherently, there is a negative association between number of patents registered and resource abundance for each region in the period considered. All this data are consistent with the idea that a DD phenomenon, inducing a displacement effect on the manufacturing sector, can be detrimental for the competitiveness of regional economy as a whole, with a contraction of the activities characterized by knowledge intensity, economies of scale, business dynamism etc. Interestingly, data show also a negative association between the share of nonperforming loans over total loans and the resource abundance at the regional level. Obviously such associations only provide some suggestions on the nature of transmission channels that are likely to operate. The investigation of these hypotheses is left for further research.

[11]The coefficient for our variable of interest (ResAbundance) on "Variation of K_{IND}"is higher when we exclude the Basilicata region because of the changes in the range of the variable itself. Since it is measured in percentage terms, the coefficient expresses the impact of a unit change in ResAbundance, that is one percentage point: however, in relative terms, the variation measured is very different in scale. To obtain an information comparable to previous results we compute that, excluding from our dataset the Basilicata region, a variation in ResAbundance of 5% (similar to the previous case) leads to a 0.03 change in the dependent variable.

Table 4.5.1: SUR model excluding Basilicata region

	(1) inflation	(2) Variation in K_{IND}	(3) Variation in L_{IND}
ResAbund	124.7*	-0.494**	1.251
	(1.84)	(-1.98)	(0.41)
ResAbundita	198.2	-15.03***	9.581
	(0.48)	(-18.88)	(0.51)
L.Prices	0.00753	0.000460***	-0.00331***
	(0.30)	(5.22)	(-2.89)
L.K_{IND}	18.61	-0.434***	-2.694**
	(0.66)	(-4.49)	(-2.16)
L.L_{IND}	-197.5	-2.115	-18.44
	(-0.53)	(-1.54)	(-1.09)
Variation in K_{IND}	41.46*		2.207**
	(1.78)		(2.10)
Variation in L_{IND}	-5.782***	0.0148**	
	(-3.09)	(2.10)	
Institutional Quality	-0.658	-0.00519	0.213**
	(-0.30)	(-0.64)	(2.20)
L.inflation		0.000551	-0.0155**
		(1.01)	(-2.37)
_cons	-2.303	0.0538**	0.884***
	(-0.33)	(2.13)	(2.91)
N	133	133	133
R2	0.251	0.871	0.264

t statistics in parentheses
* p <0.1, ** p <0.05, *** p <0.01

Source: author elaboration.

Table 4.5.2: Correlation Matrix for Resource Abundance and Indicators of Regional Competitiveness

	Resource Abundance	Net firms registration in Business register	N. of new firms	Financial risk	R&D employees	R&D expenses	Patent
Resource Abundance	1						
Net firms registration in Business register	-0.0621	1					
N. of new firms	-0.0469	0.397***	1				
Financial risk	0.141*	0.231***	0.351***	1			
R&D employees	-0.124*	-0.215***	-0.122	-0.291***	1		
R&D expenses	-0.103*	-0.168**	-0.204**	-0.292***	0.749***	1	
Patent	-0.153*	-0.242***	-0.522***	-0.444***	0.633***	0.683***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: author elaboration.

4.6 Conclusions

The impact of natural resources on the economic system has been largely investigated by the economic literature, especially as regards the non renewable resources. The vast majority of contributions focus on the impact on aggregate terms, with cross countries studies, hardly capable to control for heterogeneity in economic structures of countries considered. However a recent strand of studies focus on the within-countries effect of natural resources, trying to clarifying the impact of non renewable natural resources on economic activities and welfare at the sub-national level.

Our paper discusses the impact of oil and natural gas production at the regional level in Italy. In particular, we focus on the impact on inflation level, capital stock and labour in manufacturing sector. We find no evidence of a "spending effect", while it emerges the presence of a "resource movement effect", that is a displacement effect on capital and labour in manufacturing sector.

These results show that a problems of "Dutch Disease" mechanism can spread also at the sub-national level, consistently with the results of the related literature on this topic.

Appendix

4.A Appendix

Table 4.A.1: Data and sources.

Variable	Formula	Source
Resource Abundance (ResAbund)	(Resource Rent_{it})/GDP_{it}; Resource rent= (Oil and gas production multiplied by unit rent of natural resource) Unit rent = international price net of extraction costs	Oil and natural gas production for regions retrieved from Ministry of Economic Development (Ministry of Economic Development, 2014). Unit rent: Wold Development Indicator – World Bank (The World Bank, 2010)
Resource Abundance (rest of Italy) (ResAbund_{ita})	(Resource Rent_{itait})/GDP_{itait} Resource rent=(Oil and gas mineral production multiplied by unit rent of natural resource) Unit rent = international price net of extraction costs	Oil and natural gas production for regions retrieved from Ministry of Economic Development (Ministry of Economic Development, 2014). Unit rent: Wold Development Indicator – World Bank (The World Bank, 2010)
Prices (Prices_{it})	Subnational Consumer Price Index for the whole population (base: December 1998:100) – yearly average	ISTAT (2012)

Continued on next page

Continued from preceding page

Variable	Formula	Source
Inflation (Infaltion$_{it}$)	Percentual variation (annual average) of sub-national Consumer Price Index for the whole population (base: December 1998:100) – yearly average	ISTAT (2012)
K$_{IND}$	Share of Regional capital stock in Industry (excluding construction) over total regional capital stock	Our elaboration based on Bronzini, Cannari, & Staderini (2013) and Istat Territorial Accounts data ISTAT (2010)
Variation in K$_{IND}$	Annual percentage change of regional capital stock share in industry sector (excluding Construction)	Our elaboration based on Bronzini, Cannari, & Staderini, (2013) and Istat Territorial Accounts data ISTAT (2010)
L $_{IND}$	Employed in Industry (excluding Construction) over total regional capital stock	Istat
Variation in L$_{IND}$	Annual percentage change of Employed in Industry (excluding Construction) over total regional capital stock	Our elaboration based on Istat data
Institutional Quality	Share of Regional expenditure (Capital account) on Total expenditure (Capital account + Current Account)	Conti Pubblici DPS database (Dipartimento per lo Sviluppo e la Coesione territoriale) (DPS - Dipartimento per lo Sviluppo e la coesione economica, 2013)

Continued on next page

Continued from preceding page

Variable	Formula	Source
Net firms registration in Business register	Companies registered in the register of companies, net of deaths on the total number of companies registered in the previous year (%)	Data Base for the Development Policy (ISTAT, 2013)
N. of new firms	Ratio of births per year , and companies active in the same year (%)	Data Base for the Development Policy Istat
Financial risk	Flow Adjusted bad debts and Performing loans (percentage)	Data Base for the Development Policy (ISTAT, 2013)
R&D employees	Employees to Research and Development (number per thousand inhabitants)	Data Base for the Development Policy (ISTAT, 2013)
R&D expenses	Expenditure for research and development of public and private enterprises to GDP (percent)	Data Base for the Development Policy (ISTAT, 2013)
Patent	Patents at the European Patent Office (EPO) (number per million inhabitants)	Data Base for the Development Policy (ISTAT, 2013)

Concludes from previous page

Table 4.A.2: Summary statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
K_{IND}	160	0.1470	0.0386	0.0770	0.2240
Variation in K_{IND}	160	-0.0081	0.0059	-0.0192	0.0099
L_{IND}	160	0.0021	0.003	0.0001	0.0140
Variation in L_{IND}	160	-0.0189	0.0274	-0.0814	0.0584
Resource Abundance	160	0.0074	0.0265	0.0000	0.1702
Resource Abundance (rest of Italy)	160	0.0020	0.0004	0.0011	0.0025
Prices	160	115.631	6.218	104.50	130.30
Inflation	160	2.4306	0.5676	1.40	4.20
Institutional Quality	160	0.1531	0.091	0.0248	0.5849
Net firms registration in Business register	380	1.2068	1.125	-2.7	6.3
N. of new firms	280	7.2379	1.168	4.80	10.80
Financial risk	340	2.4712	1.6074	0.40	12.30
R&D employees	335	2.6421	1.434	0.10	6.40
R&D expenses	335	0.3955	0.331	0.0	1.5
Patent	299	55.9197	49.54	0.90	205.50

References

Alexeev, M. and Conrad, R. (2009). The elusive curse of oil. *Review of Economics and Statistics*, 91(3):586–598.

Aragón, F. M. and Rud, J. P. (2013). Natural resources and local communities: evidence from a peruvian gold mine. *American Economic Journal: Economic Policy*, 5(2):1–25.

Atkinson, G. and Hamilton, K. (2003). Savings, growth and the resource curse hypothesis. *World Development*, 31(11):1793 – 1807. Part special issue: Links between poverty and environment degradation in Latin America.

Auty, R. M. (2001). *Resource abundance and economic development*. Oxford University Press, Oxford.

Bronzini, R., Cannari, L., Staderini, A., Conti, L., D'Aurizio, L., Fabbrini, A., Filippone, A., Ilardi, G., Iuzzolino, G., Montanaro, P., Paccagnella, M., et al. (2013). L'industria meridionale e la crisi. Questioni di Economia e Finanza (Occasional papers) 194, Bank of Italy.

Brunnschweiler, C. N. and Bulte, E. H. (2008). The resource curse revisited and revised: A tale of paradoxes and red herrings. *Journal of Environmental Economics and Management*, 55(3):248–264.

Caselli, F. and Michaels, G. (2009). Do oil windfalls improve living standards? evidence from Brazil. Technical Report 15550, National Bureau of Economic Research Working Paper.

Davis, G. A. (2013). Replicating Sachs and Warner's working papers on the resource curse. *Journal of Development Studies*, 49(12):1615–1630.

Domenech, J. (2008). Mineral resource abundance and regional growth in Spain, 1860–2000. *Journal of International Development*, 20(8):1122–1135.

DPS - Dipartimento per lo Sviluppo e la coesione economica (2013). Conti pubblici territoriali. `http://www.istat.it/it/archivio/16777`. Online, Accessed 26 March 2014.

Fleming, D. A. and Measham, T. G. (2013). Disentangling the natural resources curse: National and regional socioeconomic impacts of resource windfalls. In *2013 Annual Meeting, August 4-6, 2013, Washington, DC*, number 150526. Agricultural and Applied Economics Association.

Florestano, F. (2013). Hydrocarbon exploitation and macroeconomic performance: a structural var approach for Basilicata. *Economics and Policy of Energy and the Enviornment*, (1):147–174.

Frankel, J. A. (2010). The natural resource curse: a survey. Technical Report 15836, National Bureau of Economic Research Working Paper.

Hajkowicz, S. A., Heyenga, S., and Moffat, K. (2011). The relationship between mining and socio-economic well being in Australia's regions. *Resources Policy*, 36(1):30–38.

Hirschman, A. O. (1958). *The strategy of economic development*. Yale University Press, New Haven.

Iacono, R. and Mideksa, T. (2014). No blessing no curse? On the benefits of being a resource rich southern region of Italy.

ISTAT (2010). Investimenti fissi lordi per branca proprietaria, stock di capitale e ammortamenti. `http://www.istat.it/it/archivio/4468`. Online, Accessed 19 April 2014.

ISTAT (2012). Prezzi al consumo. `http://www.istat.it/it/archivio/14413`. Online, Accessed 11 April 2014.

ISTAT (2013). Banca dati di indicatori territoriali per le politiche di sviluppo. `http://www.istat.it/it/archivio/16777`. Online, Accessed 26 March 2014.

James, A. and Aadland, D. (2011). The curse of natural resources: An empirical investigation of US counties. *Resource and Energy Economics*, 33(2):440–453.

Karl, T. L. (2007). Oil-led development: social, political, and economic consequences. *Encyclopedia of energy*, 4:661–672.

Kolstad, I. and Wiig, A. (2009). It's the rents, stupid! the political economy of the resource curse. *Energy Policy*, 37(12):5317–5325.

Mikesell, R. F. (1997). Explaining the resource curse, with special reference to mineral-exporting countries. *Resources Policy*, 23(4):191–199.

Ministry of Economic Development (2014). Hydrocarbons production. `http://unmig.sviluppoeconomico.gov.it/unmig/produzione/produzione.asp`. Online, Accessed 26 March 2014.

Nurkse, R. (1966). *Problems of capital formation in underdeveloped countries.* New York: Cambridge University Press.

Papyrakis, E. and Gerlagh, R. (2007). Resource abundance and economic growth in the United States. *European Economic Review*, 51(4):1011–1039.

Papyrakis, E. and Raveh, O. (2014). An empirical analysis of a regional Dutch Disease: the case of Canada. *Environmental and Resource Economics*, 58(2):179–198.

Percoco, M. (2012). Mining activity and the setting up of new businesses in Basilicata. *Rivista economica del Mezzogiorno*, 26(4):881–898.

Robinson, J. A. and Ragnar, T. (2005). White elephants. *Journal of Public Economics*, 89(3):197– 210.

Robinson, J. A., Torvik, R., and Verdier, T. (2006). Political foundations of the resource curse. *Journal of Development Economics*, 79(2):447–468.

Rosenstein-Rodan, P. N. (1957). Notes on the theory of the" big push". Technical report, Cambridge, Mass.: Center for International Studies, Massachusetts Institute of Technology, 1957.

Rostow, W. W. (1959). The stages of economic growth. *The Economic History Review*, 12(1):1–16.

Sachs, J. D. and Warner, A. M. (1999). The big push, natural resource booms and growth. *Journal of Development Economics*, 59(1):43–76.

Sachs, J. D. and Warner, A. M. (2001). The curse of natural resources. *European Economic Review*, 45(4):827–838.

Stevens, P. and Dietsche, E. (2008). Resource curse: An analysis of causes, experiences and possible ways forward. *Energy Policy*, 36(1):56–65.

The World Bank (2010). Environment. `http://www.worldbank.org/en/topic/environment`. Online, Accessed 1 March 2014.

Ticci, E. and Escobal, J. (2012). Extractive industries and local development in the peruvian highlands. *Environment and Development Economics*, pages 1–26.

Torvik, R. (2009). Why do some resource-abundant countries succeed while others do not? *Oxford Review of Economic Policy*, 25(2):241–256.

Van der Ploeg, F. (2011). Natural resources: Curse or blessing? *Journal of Economic Literature*, 49(2):366–420.

Van der Ploeg, F. and Poelhekke, S. (2010). The pungent smell of "red herrings": Subsoil assets, rents, volatility and the resource curse. *Journal of Environmental Economics and Management*, 60(1):44–55.

Wright, G. and Czelusta, J. (2007). Resource-based growth, past and present. In Lederman, F. and Maloney, W., editors, *Natural Resources: Neither Curse Nor Destiny*, pages 183–211. The World Bank and Stanford University Press.

Zellner, A. (1962). An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias. *Journal of the American Statistical Association*, 57(298):348–368.

Sustainable Development and royalties allocation: a structural analysis and policy simulations for a lagged region in the south of Italy

5.1 Introduction

The main message of the sustainable development concept is the need to make the process of economic growth compatible with social and natural systems. Then, it call the attention on the need of policy intervention and planning to make such objectives affordable, both for the current and the future generations. Obviously, it implicates the use of proper analytical tools able to shed light on the main sustainability trade-offs, in order to understand where problems may arise, and finally provide policy guidance, for assuring that interactions between human activities, social system and environment becomes a "success story", in a sustainability perspective.

Especially for what concerns the use of non-renewable natural resources (such as oil and other energetic resources), the need to properly depict the interactions between economy, environment and society is strategic. As stressed in the previous section of this work, there is a large strand of literature on the "resource curse", suggesting that a mismanagement of valuable natural resources can lead to serious negative impacts on the economic and the social systems of the countries or regions where they are located. However, this is not an inescapable outcome: Norway's successful management of fiscal revenues from oil extraction and the positive impact of their allocation on the economic performance suggest that natural resources, when properly managed, can eventually be a bless, more than a curse (Larsen, 2006). The framework of weak sustainability provides a theoretical ground to interpret the different economic performances of resource rich economies. To maintain the economy on a "sustainable" development path, the exploitation of non-renewable natural resources should be associated with a counterbalancing accumulation of produced capital assets, as well as by increases in human capital. Then, especially for resource abundant developing countries or lagged regions in developed economies, a proper scheme of allocation of oil revenues can be strategic to boost development in a "sustainable" way.

This is an important policy issue for our case study, Basilicata. This lagged region of the Italian Mezzogiorno, despite the large volume of royalties gained thanks to oil exploitation in the last 15 years, didn't improve its economic performance with respect to other regions in Southern Italy after the development of extractive industry (Iacono and Mideksa, 2014). As we highlighted in previous sections of this work, Basilicata is on an unsustainable path of development, probably due to the over-exploitation of its natural resources. In fact, the Genuine Saving rate calculated for the region is negative (the only region in Italy), signaling an uneven distribution of sustainability burden among the Italian regions, and a problematic situation for Basilicata (Chapter 3). Moreover, the planned investments in oil extraction industry are likely to increase these problems in next years. The empirical exercise in Chapter 4 provides also evidence of a "Dutch disease" process working in the regional economy, detecting a possible displacement effect on capital and labour in the manufacturing sector associated with the expansion of the extractive activities. As shown by a recent empirical analysis on Basilicata based on a regional SAM model, relevant differences in the impacts on growth and equity may emerge from different allocations of additional fiscal revenues (Rocchi et al., 2015). The current allocation showed ineffective in fostering growth, while alternative regional policies would likely be better in promoting an acceptable compromise between growth and equity.

A revision of regional development policy seems necessary. The exploitation of energetic resources is a matter of national strategies. Consequently, the future developments of extractive activities are largely out of the control of the regional government of the Basilicata region. However, regional policy should try to affect the impacts of such an activity on the regional economy, at least mitigating the most adverse effects in terms of sustainability.

According to the current fiscal regulation in Italy, the largest part of fiscal revenues from the extraction of energetic resources (concession fees, royalties) accrues to the local institutions in the extraction areas (regional government and municipalities): in the case of Southern lagged regions the whole amount of oil rents. The additional flow of financial resources is relevant for a small, underdeveloped region like Basilicata. From 1997 to 2013 the earnings from oil extractions of the regional Government amounted to more than 990 M euro (Ministry of Economic Development, 2014). A proper allocation of these resources may represent a valuable support to policies, aiming at increasing the sustainability of development processes through the support of non-energy production activities growth and diversification, and the mitigation of environmental and social adverse effects.

Analyzing these problems at the sub-national level is a challenging task. First, the lack of data often reduces the possibility to carry out empirical analyses. Second, the smaller the economic system considered, the higher the degree of openness, the higher the probability of "leakages" of impacts outside the system. Part of the effects related to oil exploitation and the allocation of royalties can manifest themselves outside the regional borders. This is particularly true for regions of Southern Italy, as the Italian economy suffers of a well-known problem of dualism (Cherubini et al., 2012). Finally, a successful strategy in royalty allocation should be properly assessed in terms of sustainability at the regional level. The various trade-offs involved among economic development, environment protection and social sustainability promotion should be considered.

The aim of this paper is to analyze the potential impact of royalties allocation in Basilicata using an environmentally expanded multi-sector model. Such an empirical exercise provides an example of normative application of the sustainability concept, in order to support development policy design at the regional level. We analyze the main environmental-economic trade-offs related to different policy allocations of royalties derived from natural resources exploitation, assessing their impact on the Genuine Saving rate (GS), a forward looking indicator of sustainability (see Chapters 2 and 3). Moreover, we propose an empirical strategy to correct the Genuine Saving indicator to account also for social sustainability, a pillar of sustainability not considered in the standard implementation of this indicator: that is, we include a measurement of the cost of relative poverty alleviation in our simulations, considering this monetary value as a negative component of GS. Through this operation, we are able to provide an evaluation of different policy scenario also in terms of social sustainability.

We assume that local policy should be designed with the aim of improving the GS rate measured at the regional level in order to drive the regional system towards a sustainable path of development. Putting GS at the center of the research is particularly relevant in the case under analysis. With a given rate of savings resulting from economic activities, the exploitation of a non-renewable resource, such as oil and natural gas in the area, is a direct negative contribution to GS, affecting the Energy Depletion component. The allocation of oil rents can support a counterbalancing change of GS, for example supporting investments in capital assets. At the same time, the impact of royalty allocation on the regional economic activities may support growth and, through output increase, could generate further negative environmental impacts (pollution). Finally, the development process may affect in different ways the social distribution of economic impacts, leading to an enhancement or a deterioration of inequality and/or poverty indicators.

The analysis is based on a hybrid economic-environmental model, based on a bi-regional Social Accounting Matrix (SAM) for the Basilicata Region and the Rest of Italy and on the National Accounting Matrix and Environmental Account provided by Istat for the Italian regions. The compilation of hybrid economic-environmental accounts (the so called National Accounting Matrix with Environmental Accounts, NAMEA) is a standard output for several national statistical bureau, supporting a wide range of empirical applications (Costantini et al., 2012). Environmentally extended Input-Output or Social Accounting Matrix models have been largely proposed in literature. Thanks to their flexibility, these tools have been used for various purposes and at different territorial levels. Empirical applications range from the analyses of interactions between different territories in implementing CO2 reduction strategies (McGregor et al., 2008), to the definition of a consistent framework to assess social-environmental outcomes of development strategies (Alarcón et al., 2000), to the analysis of environmental performances of territories and of the role of regional policies in enhancing sustainability of development (Sansoni et al., 2010).

The main aim of this study is thus to provide a combination of two tools, the SAM and the GS, to support assessment and policy evaluation in terms of sustainability at the regional level. Applying this framework to our case study, we evaluate the sustainability implication of different allocation scenarios of royalties related to the exploitation of non-renewable energetic resources in this context.

The paper is structured as follows: section 2 describes the methodology used, section 3 presents the whole set of data and the empirical implementation. In section 4 the model is used to assess alternative policy scenarios in the allocation of royalties associated with different degrees of "sustainability", according with the concept elaborated by Hamilton and Clemens.

5.2 Methodology

5.2.1 Introduction

As previously mentioned, this study aimes at investigating the sustainability implications of different royalties allocation strategies in Basilicata. This will shed light on the sustainability trade-offs that arise in that context. The analysis is then performed along three main lines:

- several approaches in allocation of oil royalties are defined, each of which pursues different goals, ranging from pro-growth to pro-poor policy alternatives;
- the policy scenarios are evaluated in terms of economic impacts. Specifically, we assess their effects for GDP growth, output and incomes in the areas considered. The interactions between Basilicata and the national economy as a whole are also examined;
- finally, we assess the policy scenarios in terms of sustainability impact, i.e. we consider their effects on the GS, including a social sustainability component to the framework of the aforementioned indicator.

5.2.2 Bi-regional Social Accounting Matrix

A SAM is a square matrix representing, in comprehensive framework, the economic flows among agents within a given economic system (Round, 2003). Each column shows the expenditure of the specific (productive or institutional) sector considered, while rows represent revenues. Row and column totals are equal by definition, so that the meaningful economic condition that outflows and inflows of each component of the economic system (cost and revenues for production activities, expenditure and incomes for institutional sectors, savings and investments in capital formation account) are balanced is respected.

The SAM framework is based on an extension of input-output models including the whole set of transactions involving economic agents beyond production, such as income distribution, consumption, capital formation, economic transfers among institutional sector and so on. The disaggregation of accounts in the matrix allows the representation of economic interrelationships that otherwise would not be explicitly available in traditional accounting.

The SAM analysis starts from the distinction between endogenous accounts and exogenous accounts, that is, the accounts that are not endogenously determined by the model: in this study the model is closed with respect to income distribution, final consumption and inter-regional trade, leaving exogenous the current accounts for Public Administration, the capital accounts for both Basilicata and Rest of Italy, and the accounts related to the Rest of the World (ROW).

The matrix of multipliers M is calculated solving the usual linear model. Defined the matrix of endogenous accounting coefficients A, the vector of exogenous inflows towards endogenous accounts f and the vector of endogenous accounts totals x, we have

$$x = Ax + f = (I – A)^{-1} f = Mf \tag{5.1}$$

Then we can define

$$M = (I - A)^{-1} \tag{5.2}$$

In which every coefficient allows to estimate the total effects of exogenous changes on endogenous accounts. In a SAM framework the multipliers account for direct and indirect impacts through inter-industry linkages as well as induced impacts generated by income distribution and final consumptions. Finally, the regional disaggregation of accounts allows also to include in multipliers the impact of interregional interdependencies.

The matrix of multipliers can be used to simulate the impact on endogenous account (df) of a shock in exogenous accounts (dx) in a given scenario, so that

$$df = Mdx \tag{5.3}$$

In this study, we simulate the impact of the "actual" royalties allocation on endogenous accounts, to generate a baseline scenario (i.e. in absence of royalties expenditures). Then, every policy allocation of royalties is evaluated with respect to the baseline.

The regional disaggregation of the accounts of the original matrix can support a structural analysis of linkages between the economies of the regions. In a two-regions model, the matrix of endogenous accounts coefficients has the following structure:

$$A = \begin{bmatrix} A_{rr} & A_{rs} \\ A_{sr} & A_{ss} \end{bmatrix}$$

where A_{rr} and A_{ss} represent the column (expenditure) coefficients for the region r and s, while A_{rs} and A_{sr} indicate the interregional flows coefficient matrices. The matrix of SAM multipliers can be decomposed into three components: intraregional impacts, interregional spillovers and interregional feedbacks (Miller and Blair, 2009). Let

$$\tilde{A} = \begin{bmatrix} A_{rr} & 0 \\ 0 & A_{ss} \end{bmatrix}$$

and

$$A^* = (I - \tilde{A})^{-1}(A - \tilde{A}) \tag{5.4}$$

we have:

$$M_a = (I - \tilde{A})^{-1} \tag{5.5}$$

$$M_b = I + A^* \tag{5.6}$$

$$M_c = [I - (A^*)^2]^{-1} \tag{5.7}$$

The three matrices capture, respectively, the multiplier effect spreading impacts within each regional economy, the spreading of impacts beyond the borders of the region of origin of the initial shock, and finally, the multiplier effect returning back from the other region to the region of origin of the initial shock. The three components $M_a M_b$ and M_c can be used to decompose the matrix M of SAM multipliers according with the following relation (Stone, 1985).

$$M = I + (M_a – I) + (M_b – I)M_a + (M_c – I)M_b M_a \tag{5.8}$$

The four elements on the right side of the equation account for direct (identity matrix), regional, spillover and feedback impacts for any given exogenous shock on endogenous accounts. The decomposition allow us to calculate the impact of a change in exogenous accounts originated in a given region, in both the two regions represented in the model.

In uni-regional models interregional linkages are ignored, leading to a potential underestimation of the impact. Then, we calculate a measure of Overall Percentage Error (Miller and Blair, 2009) to quantify the (potential) errors caused by ignoring interregional linkages:

$$OPE = [(x_T^r - x_S^r)/I x_T^r] x100 \tag{5.9}$$

with x_T^r indicating the impact (sum of coefficients) in region r in the two-region model and x_S^r the impact in region r in a single region model. The higher the values of OPE, the higher the distortion of uni-regional model.

5.2.3 Enviromental analysis

In order to produce an environmental-economic analysis, we combine the SAM with the accounts on pollutants emissions. For each economic sector, we investigate the relationship between economic activities and pollutants emission, both in physical units and in terms of monetary damages produced.

Similarly to employment effects estimates in input-output frameworks, we are able to calculate the environmental consequences for pollutant emission in policy simulations. Define I as the vector of environmental impact of economic activity, measured in physical units (ton of pollutans emission) or damages produced (in monetary term); s indicates the diagonal matrix of intensity coefficient, with elements s_m representing the physical or monetary damage generated by sector m per unit of output produced. So

$$dI = \hat{s}Mdx \tag{5.10}$$

I is the impact of the exogenous shock in environmental terms. This is then included as a negative component of the GS as a measure of the environmental degradation connected to the direct, indirect and induced effects of economic activities stimuli of exogenous shocks.

5.2.4 Social sustainability: extension of the Genuine Saving

One of the limits of the GS indicator we deeply analyzed in the Chapter 3 is related to the absence of any consideration about social sustainability, one of the three pillars of the Bruntland definition of sustainability. Then, the combination with the SAM frameworks seems able to overcome these limitations. On the one hand, a SAM based model can support a deep understanding of the structural characteristics of economic-environmental system. On the other hand, the extension of input-output analysis to represent the process of income distribution allows the SAM approach to support also a "social" analysis of impacts, in terms of "intra-generational" equity. In order to do that, estimates of the poverty gap as a measure of such social sustainability dimension are introduced.

Defined a poverty threshold, the poverty gap is the gap between the disposable income of a household or an individual and the threshold itself. The total amount of transfers that would be necessary to eliminate poverty in a specific context can be interpreted as a measure of the distance from a social sustainability benchmark. Such a monetary measure can be easily integrated in empirical specification of the GS indicator, without any substantial modification of the theoretical model and its theoretical framework: in fact, this can be considered as the amount of resources that should be "invested" in poverty alleviation. Then, it does not concurs in generating savings and investments in physical capital, reducing the amount of natural resources that can be used up in the process of production or consumption without affecting sustainability. In that way, we can infer that the cost of poverty alleviation is a negative component of the GS rate.

5.3 Data and empirical implementation

5.3.1 SAM and multiplier decomposition

In this study the model used is based on a bi-regional SAM, where the italian economy is disaggregated between the Basilicata region and the rest of the country. The bi-regional SAM has been developed within a joint research project carried out by the University of Basilicata and the Department of Economics and Management of the University of Florence[1] based on a SAM produced by the Regional Institute for Economic Planning in Tuscany (IRPET, Florence). The SAM is referred to 2010. The whole set of accounts is duplicated for the two regions. The disaggregation of accounts includes:

- 54 commodities;
- 37 productive sectors;
- 5 productive factors categories, among which the value added produced is distributed;
- 23 functions for private and collective consumption
- current accounts for 6 typologies of institutional sectors, distinguished in Consumers and Producer households, Financial and non Financial firms, Central and Local Public Administration and the Third sector. Households account is further disaggregated into 10 income quantiles;
- capital formation accounts for 5 typologies of institutions;
- 4 accounts to represent transactions with the rest of the world. The complete SAM is a 301x301 square matrix. A scheme of the blocks included in the SAM used in the study is available in Tables 5.3.1 e 5.3.2.

[1]"A model for the analysis of development process in the Basilicata region (2013-2015)"

Table 5.3.1: Regional SAM framework

	Commodities	Industries	Factors	Households	Government	Capital	Rest of the world
Commodities		Intermediate consumptions		Private final consumptions	Collective final consumptions	Investments	Exports
Industries	Domestic supply						
Factors		Value added					Factor incomes from ROW
Households			Primary income distribution	Secondary income distribution		Current ff from ROW	
Government		Indirect taxes					
Capital				Savings		Capital account ff from ROW	
Rest of the world	imports		Factor incomes to ROW	Current financial flows to ROW		Capital account ff to ROW	

Table 5.3.2: Bi-regional SAM framework

<table>
<tr><th></th><th>Basilicata</th><th>Rest of Italy</th><th>Rest of the World</th></tr>
<tr><td>Basilicata</td><td>Regional Flows</td><td>Commodities and current transfers from Basilicata to Rest of Italy</td><td rowspan="2">Exports and financial flows to RoW</td></tr>
<tr><td>Rest of Italy</td><td>Commodities and current transfers from Rest of Italy to Basilicata</td><td>Regional Flows</td></tr>
<tr><td>Rest of the World</td><td colspan="2">Imports and financial flows from RoW</td><td></td></tr>
</table>

Due to the high level of disaggregation the SAM provides a lot of useful information in order to understand the structural characteristics of the economy. For example, according to our data, there are not relevant differences in value added distribution among productive factors between Basilicata and the Rest of Italy,with the only exception that the labour incomes are slightly higher (in relative terms) with respect to the same category in rest of Italy. Interestingly, the 3% of value added is distributed beyond the regional borders. Moreover, the 38% of disposable income of households in Basilicata comes from labour. Capital incomes account for approximately 18%. More than 15% is related to incoming transfers from the Public Administration (central and local) and the social security institutions (23.52%). The residual part of disposable incomes comes from firms (3%), intra households transfers (0.8%) and from other regions (1.71%). The 36% of the final demand is related to intermediate consumption, 28% is related to exports, private consumptions account for 23.98%, total investments (public and private) account for 6.74% while 4.38% is related to Public administration consumptions. In Table 5.3.3 we present the multipliers for output, GDP and gross households income for a unitary exogenous increase of the final demand towards the (aggregate) macro-sectors of the industries represented in the SAM. We distiguish in total and regional effects: that is, we consider the national (Basilicata + Rest of Italy) and regional (Basilicata only) impact of an exogenous shock. For what concerns regional output, the highest impact is associated with food and beverage productions and construction activities, while the highest impact in terms of GDP and incomes is related to public administration. Moreover, it is interesting to note that multipliers for regional GDP are well below 1, signaling that for each productive sector considered, the impact of a unitary change in exogenous demand is weak, because of the "dispersion" of the impulse elsewhere. A similar situation is found also for what concerns the impact on incomes. We use the Stone additive decomposition presented above to disentangle SAM multiplier in intraregional effect, interregional spillover and interregional feedbacks effects. This allow us to better understand the complex nature of these impact: through the intraregional component, we measure the effect in domestic output, GDP and incomes of a change in exogenous accounts in Basilicata region. The interregional spillover gives a measure of the impact on other regions (that is , the rest of Italy) of a shocks originated in Basilicata region. Finally, the feedback effect signals the impulse returning from the rest of Italy to the Basilicata. As Table 5.3.4, 5.3.5 and 5.3.6 show, the spillover effects are generally strong, signaling a high level of leakages in the economic system of the region, especially as regards output (and particularly in manufacturing sector). On the contrary, the feedback effects are in general very weak in that context. Table 5.3.7,

Table 5.3.3: Total and regional multipliers for output, GDP and income.

	Total output	Regional output	Total GDP	Regional GDP	Total income	Regional income
Agriculture	2.631	1.791	1.445	1.063	1.026	0.682
Mining	1.813	1.307	1.162	0.915	0.636	0.338
Manufacturing	3.068	1.917	1.057	0.570	0.782	0.347
Utility	2.909	1.948	1.082	0.664	0.761	0.375
Construction	2.970	2.028	1.293	0.863	0.966	0.571
Trade, Transportation	2.810	1.914	1.283	0.864	0.912	0.522
Hotels and Restaurants	2.530	1.593	1.297	0.872	0.915	0.516
Services	2.416	1.672	1.325	0.969	0.881	0.531
PA	2.600	1.804	1.465	1.057	1.165	0.788
Other personal and social services	2.687	1.819	1.417	0.996	1.087	0.705

Source: author elaboration.

indeed, reports the results for the OPE. This measure synthetically reports the strength of interregional leakages: as it can be shown, the extraregional income over the total one is particularly relevant.

Table 5.3.4: Output multipliers.

	Output		
	Intra regional effect	Inter regional spillover	Inter regional feedback
Agriculture, hunting	0.787	0.840	0.005
Fishing	0.185	0.714	0.004
Mining and quarrying	0.304	0.506	0.003
Manufacture of food products, beverages and tobacco	1.006	1.209	0.006
Manufacture of textiles and leather	0.838	1.230	0.005
Manufacture of wood	0.821	1.167	0.005
Manufacture of paper, printing and reproduction of recorded media	0.724	1.310	0.005
Manufacture of coke and refined petroleum products	0.959	0.471	0.003
Manufacture of chemicals and chemical products	0.465	1.190	0.005
Manufacture of basic pharmaceutical products and pharmaceutical preparations	0.669	0.971	0.004
Manufacture of rubber and plastic products	0.741	1.208	0.004
Manufacture of other non-metallic mineral products	0.933	0.999	0.005
Manufacture of basic metals and metal products	0.745	1.233	0.004
Manufacture of computer, electronic and optical products	0.662	0.860	0.004
Manufacture of electrical equipment	0.712	1.141	0.004
Manufacture of machinery and equipment n.e.c	0.771	1.241	0.005
Manufacture of motor vehicles, trailers and semi-trailers	0.984	1.304	0.005
Manufacture of other transport equipment	0.834	1.125	0.005
Electricity, gas, steam and air conditioning supply	0.920	0.838	0.004
Water Supply; Sewerage, Waste Management And Remediation Activities	0.984	1.162	0.005
Construction	1.024	0.942	0.005
Wholesale and retail trade and repair of motor vehicles and motorcycles	0.850	0.868	0.004
Transportation and storage	0.984	0.931	0.005
Accomodation and food service activities	0.760	0.937	0.005
Information and communication	0.724	0.992	0.004
Telecommunication	0.734	0.885	0.004
IT services	0.812	0.841	0.004
Financial and insurance activities	0.840	0.802	0.004
Real estate	0.428	0.536	0.003
Legal and accounting activities, managment, architectural and enginering activities	0.726	0.758	0.004
Scientific research and development	0.800	0.930	0.004
Other professional, scientific and technical activitie	0.881	1.022	0.005
Public administration and defence; compulsory social security	0.744	0.793	0.004
Education	0.816	0.770	0.005
Health and social work	0.846	0.816	0.004
Arts, entertainment and recreation	0.815	0.971	0.004
Other services	0.814	0.828	0.004

Source: author elaboration.

Table 5.3.5: GDP multipliers.

	GDP		
	Intra regional effect	Inter regional spillover	Interregional feedback
Agriculture, hunting	1.061	0.382	0.002
Fishing	0.748	0.319	0.002
Mining and quarrying	0.914	0.247	0.002
Manufacture of food products, beverages and tobacco	0.687	0.535	0.003
Manufacture of textiles and leather	0.545	0.511	0.002
Manufacture of wood	0.631	0.501	0.002
Manufacture of paper, printing and reproduction of recorded media	0.602	0.546	0.002
Manufacture of coke and refined petroleum products	0.616	0.218	0.002
Manufacture of chemicals and chemical products	0.333	0.496	0.002
Manufacture of basic pharmaceutical products and pharmaceutical preparations	0.555	0.422	0.002
Manufacture of rubber and plastic products	0.550	0.495	0.002
Manufacture of other non-metallic mineral products	0.716	0.442	0.003
Manufacture of basic metals and metal products	0.568	0.512	0.002
Manufacture of computer, electronic and optical products	0.584	0.403	0.002
Manufacture of electrical equipment	0.564	0.479	0.002
Manufacture of machinery and equipment n.e.c	0.598	0.521	0.002
Manufacture of motor vehicles, trailers and semi-trailers	0.487	0.538	0.002
Manufacture of other transport equipment	0.692	0.494	0.002
Electricity, gas, steam and air conditioning supply	0.653	0.362	0.002
Water Supply; Sewerage, Waste Management And Remediation Activities	0.676	0.509	0.002
Construction	0.861	0.429	0.002
Wholesale and retail trade and repair of motor vehicles and motorcycles	0.880	0.405	0.002
Transportation and storage	0.838	0.436	0.002
Accomodation and food service activities	0.870	0.424	0.002
Information and communication	0.825	0.456	0.002
Telecommunication	0.823	0.410	0.002
IT services	0.907	0.409	0.002
Financial and insurance activities	0.996	0.414	0.002
Real estate	1.063	0.256	0.002
Legal and accounting activities, managment, architectural and enginering activities	0.956	0.356	0.002
Scientific research and development	0.878	0.436	0.002
Other professional, scientific and technical activitie	0.834	0.477	0.002
Public administration and defence; compulsory social security	1.042	0.405	0.002
Education	1.243	0.423	0.002
Health and social work	0.942	0.400	0.002
Arts, entertainment and recreation	0.860	0.462	0.002
Other services	1.046	0.406	0.002

Source: author elaboration.

Table 5.3.6: Income multipliers

	Income		
	Intra regional effect	Inter regional spillover	Inter regional feedback
Agriculture, hunting	0.681	0.343	0.003
Fishing	-0.049	0.447	0.004
Mining and quarrying	0.335	0.297	0.003
Manufacture of food products, beverages and tobacco	0.427	0.472	0.003
Manufacture of textiles and leather	0.343	0.452	0.003
Manufacture of wood	0.380	0.450	0.003
Manufacture of paper, printing and reproduction of recorded media	0.362	0.483	0.003
Manufacture of coke and refined petroleum products	0.252	0.238	0.002
Manufacture of chemicals and chemical products	-0.144	0.557	0.003
Manufacture of basic pharmaceutical products and pharmaceutical preparations	0.376	0.376	0.002
Manufacture of rubber and plastic products	0.358	0.439	0.003
Manufacture of other non-metallic mineral products	0.425	0.410	0.003
Manufacture of basic metals and metal products	0.367	0.452	0.003
Manufacture of computer, electronic and optical products	0.415	0.367	0.002
Manufacture of electrical equipment	0.359	0.428	0.003
Manufacture of machinery and equipment n.e.c	0.392	0.461	0.003
Manufacture of motor vehicles, trailers and semi-trailers	0.316	0.469	0.002
Manufacture of other transport equipment	0.453	0.443	0.003
Electricity, gas, steam and air conditioning supply	0.322	0.345	0.003
Water Supply; Sewerage, Waste Management And Remediation Activities	0.455	0.452	0.003
Construction	0.568	0.395	0.003
Wholesale and retail trade and repair of motor vehicles and motorcycles	0.530	0.375	0.003
Transportation and storage	0.504	0.410	0.003
Accomodation and food service activities	0.512	0.399	0.003
Information and communication	0.422	0.440	0.003
Telecommunication	0.401	0.403	0.003
IT services	0.538	0.393	0.003
Financial and insurance activities	0.670	0.390	0.003
Real estate	0.465	0.286	0.003
Legal and accounting activities, managment, architectural and enginering activities	0.557	0.338	0.003
Scientific research and development	0.565	0.391	0.003
Other professional, scientific and technical activitie	0.536	0.437	0.003
Public administration and defence; compulsory social security	0.732	0.383	0.004
Education	1.035	0.381	0.004
Health and social work	0.670	0.368	0.003
Arts, entertainment and recreation	0.537	0.422	0.003
Other services	0.767	0.365	0.003

Source: author elaboration.

Table 5.3.7: OPE for output, GDP and income multipliers

	Extraregional output over total output	Extraregional GDP over total GDP	Extraregional income over total income
Agriculture	32%	26%	33%
Mining	28%	21%	47%
Manufacturing	38%	46%	56%
Utility	33%	39%	51%
Constructions	32%	33%	41%
Trade, Transportation	32%	33%	43%
Hotels and Restaurants	37%	33%	44%
Services	31%	27%	40%
Public Administration	31%	28%	32%
Other personal and social services	32%	30%	35%

Source: author elaboration.

5.3.2 Environmental data

Concerning the Environmental Accounts, the data used are provided by Istat through the RAMEA accounts (ISTAT, 2012), that is the National Accounting Matrix with Environmental Accounts (NAMEA) tailored at the regional level. This hybrid accounting framework includes economic accounts in monetary terms and physical flow accounts. The combination of economic aggregates and environmental pressures in a coherent framework is particularly helpful in assessing the economic-environment interactions at a specific spatial level.

As explained in Sansoni et al. (2010) the main features of the RAMEA are:

- 27 industries according to NACE rev. 1.1 classification and two household consumption categories according to COICOP[2] classification (Transports, Heating plus Other consumptions);
- 3 economic variables (Value Added, Final Household Consumption and Employment);

[2]The COICOP (Classification of Individual COnsumption by Purpose) classification is elaborated by the United Nation to classify consumption expenditures for three institutional sectors (households, non-profit institutions and general government). The detailed structure of classification and correspondence table with other consumption classification systems is available at http://ec.europa.eu/eurostat/ramon/index

- 10 air emissions associated with production and consumption activities (carbon dioxide, CO_2; nitrous oxide, N_2O; methane, CH_4; mono-nitrogen oxides, NOX; sulphur oxides, SOX; ammonia, NH_3; non-methane volatile organic compounds, NMVOC; carbon monoxide, CO; and particulate matters, PM and lead. Pb) plus three aggregated impact categories (CO_2 equivalent, for greenhouse gases; acidification potential, and Ozone).

These data allow us to carry out an environmental efficiency comparison between the Basilicata region and the rest of Italy. In tables 5.3.8 and 5.3.9 we calculate the emission intensities for the three aggregated impact categories, as quantity of emissions (equivalent metric tons) for one million of sector Value added and households consumption categories in both the area under analysis. As the Tables shows, Basilicata region underperforms, in terms of environmental efficiency, in the majority of the economic sectors for what concerns Ozone emissions. Greenhouse gas emissions are higher, for unit of output produced, for non-metal product industries and for mining and quarrying activities. On the contrary, less concerning is the environmental impact in terms of acidification potential.

These data are suitable for an impact analysis in physical terms. To support the analysis of the impacts on GS, an indicator expressed in monetary units, we evaluate the impact of single pollutants emissions, using the European Environmental Agency data on externalities and damages (European Environmental Agency, 2011). In table 5.3.10 the unitary cost of pollution is presented for a selection of pollutants: NH_3, SO_2 e NOx NMOVC and PM_{10} and CO_2. For the latter pollutant, the value is the same used in producing the estimates of GS rate at the regional level (Chapter 3). The environmental damage that can be associated to each scenario is calculated multiplying the impacts on the output of economic activities by the relevant coefficient expressing the environmental damage intensity (both in physical and in monetary terms).

Table 5.3.8: Emission coefficients, Basilicata

BASILICATA	Greenhouse gases (Kton CO2 eq)	Acidification potential (ton of H+eq))	Ozone (ton of O)
Households Transport	0.56	0.06	9.40
Households Housing, water, eletricity gas and other fuels	0.25	0.01	0.92
Households Other	0.00	0.00	0.43
Households Total	0.12	0.01	1.63
Agriculture, hunting and forestry	2.00	0.83	8.48
Fishing	0.00	0.00	0.00
Mining and quarrying	3.41	0.09	11.29
Manufacture of food products, beverages and tobacco	1.43	0.05	4.56
Manufacture of textiles and textile products	0.27	0.01	0.46
Manufacture of leather and leather products	0.63	0.01	9.58
Manufacture of wood, rubber and plastic products	0.64	0.03	4.85
Manufacture of pulp, paper and paper products; publishing and printing	0.28	0.01	2.71
Manufacture of coke, refined petroleum products, chemicals and pharmaceutical products	3.37	0.07	4.66
Manufacture of other non-metallic mineral products	11.20	0.44	14.76
Manufacture of basic metals and fabricated metal products	0.50	0.03	4.38
Manufacture of machinery and equipment n.e.c.	1.09	0.07	5.15
Electricity, gas and water supply	0.24	0.01	1.69
Construction	0.17	0.02	1.45
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	0.20	0.02	1.69
Hotels and restaurants	0.08	0.01	0.57
Transport, storage and communication	0.50	0.06	4.09
Financial intermediation	0.03	0.00	0.19
Real estate, renting and business activities	0.04	0.01	0.34
Public administration and defence; compulsory social security	0.03	0.00	0.38
Education	0.01	0.00	0.07
Health and social work	0.06	0.00	0.18
Other community, social and personal service activities	0.95	0.04	2.98
Private households with employed persons	0.00	0.00	0.00
Total economic activities	0.55	0.07	2.18

Source: author elaboration.

Table 5.3.9: Emission coefficients, Rest of Italy

Rest of Italy	Greenhouse gases (Kton CO2 eq)	Acidification potential (ton of H+eq))	Ozone (ton of O)
Households Transport	0.47	0.04	7.40
Households Housing, water, eletricity gas and other fuels	0.34	0.01	0.84
Households Other	0.00	0.00	0.31
Households Total	0.13	0.01	1.42
Agriculture, hunting and forestry	1.72	0.93	7.76
Fishing	0.51	0.15	9.75
Mining and quarrying	0.40	0.02	1.62
Manufacture of food products, beverages and tobacco	0.42	0.02	2.35
Manufacture of textiles and textile products	0.45	0.02	0.88
Manufacture of leather and leather products	0.14	0.01	5.69
Manufacture of wood, rubber and plastic products	0.18	0.01	2.99
Manufacture of pulp, paper and paper products; publishing and printing	0.48	0.01	1.84
Manufacture of coke, refined petroleum products, chemicals and pharmaceutical products	2.11	0.22	6.69
Manufacture of other non-metallic mineral products	3.56	0.28	9.96
Manufacture of basic metals and fabricated metal products	0.56	0.04	3.29
Manufacture of machinery and equipment n.e.c.	0.13	0.01	0.84
Electricity, gas and water supply	5.64	0.23	6.03
Construction	0.05	0.01	1.10
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	0.13	0.01	0.96
Hotels and restaurants	0.06	0.01	0.32
Transport, storage and communication	0.42	0.08	3.79
Financial intermediation	0.02	0.00	0.09
Real estate, renting and business activities	0.03	0.00	0.16
Public administration and defence; compulsory social security		0.01	0.39
	0.02	0.00	0.05
Health and social work	0.04	0.00	0.11
Other community, social and personal service activities	0.64	0.03	1.58
Private households with employed persons	0.00	0.00	0.00
Total economic activities	0.35	0.04	1.38

Source: author elaboration.

Table 5.3.10: Cost of environmental degradation

	Environmental degradation (Eur per tonne of emission)
NH3	13,129.00
NOx	8,394.00
PM10	23,120.00
SO2	7,994.00
NMVOC	625.00
CO2	25.64

Source: EEA (2011) and Frankhauser for Co2 damages.

5.3.3 Social sustainability data

We exploited the EU SILC (EU Statistics on Income and Living Conditions) data to include considerations in terms of social sustainability. EU- Silc is a survey on income, poverty and social conditions in the European countries at household and individual level. It includes cross-sectional and longitudinal multidimensional microdata: launched in 2003, it provides several indicators that constitutes the Joint Assessment Framework (JAF) of the EU2020 strategy.

These data are used in calculating the total poverty gap for households in the two considered areas, in order to estimate the dimension of total transfers that would be necessary to alleviate poverty. We rely on a relative poverty measure, according to the poverty line established by Istat in monitoring Italian advancements towards the strategy Europe 2020[3]. A household is considered poor when its per capita disposable equivalent income falls below the 60% of the median calculated at the national level. We calculate the poverty gap in SAM simulations according to the following procedure. Firstly, the households in Basilicata and in the rest of Italy are divided into 10 quantiles of income (using the household disposable equivalent income as provided in EU Silc data). Secondly, we estimate individual household poverty gap. Finally we aggregate individual gaps into the total for both areas, weighting the observations to get the estimates for the total population.

The variation of the initial poverty gap that can be associated with each policy scenario is calculated according with the impact on households' income yielding from the simulations with the SAM based model. First, we compute the percentage changes of income for each quantile in both areas generated by each policy scenario with respect to the baseline (explained in detail in

[3]Europe 2020 is the EU's growth strategy for sustainable development for inclusive and sustainable growth (European Commission, 2010).

section 4). Then, under the assumption that every household experiments the average variation of the income quantiles it belongs, we estimate the new household's incomes and the resulting new poverty line. Based on this, we finally compute the new individual and total poverty gap for each scenario considered, to be compared with the baseline one.

5.4 Policy scenario and Genuine Saving extension

The whole set of data and methods previously discussed is used to assess the impact on regional "sustainability" of alternative policy scenarios in the allocation of royalties. The assessment is carried out using the SAM model together with the additional information on environmental impacts of production activities and on relative poverty. The goal of the analysis is the quantification of the impact of each alternative on GS of the Basilicata region in 2010. According with the adopted analytical framework, the allocation of oil royalties may affect the GS rate in three ways:

- through a direct impact on savings when the royalties are allocated to finance investments increasing the capital stock used in production activities;
- through an indirect impact on environmental sustainability, because of the "growth effect" generated by the additional final demand and the subsequent emission of pollutants and associated environmental damage;
- through an indirect impact on social sustainability: a policy scenario increasing the poverty gap can be considered as "socially" unsustainable, reducing the GS rate; on the contrary a reduction of poverty, diminishing the resources that should be allocated to poverty alleviation, can be considered as an increase of the GS rate.

The assessment of these three components is carried out with reference to a set of alternative policy scenarios in the allocation of oil royalty. The actual use of additional oil-related financial resources accruing to the regional Government in 2010 is shortly described below.

In 2010, the reference year of the SAM used in the analysis, the total amount of rents earned by local institutions in Basilicata from the exploitation of energetic resources was equal to 77.17 M euro. The largest part of the total accrued to the regional government that allocated a total of 56.25

M euro into different uses (Rocchi et al., 2015). About 50% of the total (26.10 M euro) was used to fund an expenditure operating plan (Programma Operativo Val d'Agri, POV) aimed at promoting the economic development and the improvement of the quality of life in the area neighboring the oil fields. The POV is structured into different "pillars", including different actions ranging from the enhancement of local resources, to the realization of new infrastructures, to the improvement of the quality life of populations (for example supporting education and cultural activities), to the support of the local production activities. About 75% (19.41M euro) of the expenditures under the POV programme in 2010 can be classified as "investment" into capital assets (infrastructures, productive capital) or directed to increase human capital (expenditures in education). Therefore, they can be considered as a direct increase of the GS rate for the reference year.

In order to build a vector of exogenous shocks corresponding to the actual allocation of oil royalties in 2010, the POV expenditures are classified according to the commodity/activities classification of the SAM, using information collected by the research project "A model for the analysis of development process in the Basilicata region (2013-2015)".

The remaining part (25.15 M euro) of the royalties used in 2010 are allocated to finance the regional government budget without a specific destination of expenditures. In absence of any information on the actual use of these sums, the total amount is represented as an additional increase of the final demand, with a composition reflecting the SAM expenditure coefficients of the regional government current account of the SAM. This implies a substantial reduction of the *direct* impacts on the regional economy in the simulations, as the current outflows of regional government account includes financial flows towards central public administration, social security institutions and the rest of the world. Overall, the direct impact of these expenditures on the regional economic systems is quantified in 13.83 M euro of which 0.75 M euro allocated to investment expenditures and the rest to final consumptions.

The actual allocation of royalties is compared with four hypothetical scenarios referring to:

(a) the allocation of the whole amount of the royalties to increase in the current consumptions of regional public administration (Supporting public expenditure);

(b) the allocation of whole amount to increase the current consumptions and in the transfers to households of the regional public administration (Supporting public expenditure and social transfers);

Table 5.4.1: Policy scenarios in the allocation of royalties

	Total amount of royalties allocated (M euro)	Direct impacts (M euro)	Direct impacts share (%)	Investments in capital assets (M euro)	Investments share (%)
Actual 2010 allocation	54.2	39.9	73.46	20.2	50.61
Alternative allocations					
a) public consumption	54.2	54.2	100.00	0.0	0.00
b) public consumptions and transfers to households	54.2	54.2	100.00	0.0	0.00
c) funding production activities	54.2	27.7	51.14	27.7	100.00
d) funding investments in capital assets of production activities	54.2	54.2	100.00	54.2	100.00

Source: author elaboration.

(c) the allocation of the whole amount to finance private corporate and quasi-corporate non-financial firms (supporting the productive system in the short-run);

(d) the allocation of the whole amount to support investments in capital assets of private corporate and quasi-corporate non-financial production firms (enhancing the competitiveness of the productive systems).

The four scenarios refers to alternative policy goals ranging from the support of economic growth in the short-run (a and b), to social stability purposes (b), to the support of the regional productive system in the short-run (c), to its development in the long-run (d). The vectors of exogenous shocks representing the four policy scenarios are composed applying the relevant SAM expenditure coefficients to classify the total amount of royalties allocated in 2010[4]. In table 5.4.1 the essential data on the four scenarios are summarized.

Given the total amount of royalties (54.2 Meuro) the four scenarios imply a variable size of the direct impacts on the regional system. The direct contribution to GS in terms of investments in capital assets is variable as well.

The total economic impact of each scenario of allocation was calculated using the matrix of SAM multipliers. In Table 5.4.2 the impact of each scenario on output, GDP and gross income of households is provided for the two regions represented in the model (Basilicata and Rest of Italy).

[4]More specifically: the vectors corresponding to scenarios a) and b) reflect the composition of consumptions and transfers to different deciles of households resulting from the current account for regional public administration of the SAM; the vectors corresponding to scenarios c) and d) reflect the composition of expenditures in the capital account for non-financial corporate and quasi-corporate firms.

Table 5.4.2: Short-run economic impacts of royalties allocation (M euro)

	Baseline values	Actual	Scenarios of royalty allocation (a)	(b)	(c)	(d)
Basilicata						
Output	22,841	64.9	88.1	61.9	36.7	71.9
GDP	10,746	30.0	51.8	34.2	15.3	29.8
Households'income	12,724	28.4	36.8	61.3	9.7	18.9
Rest of Italy						
Output	3,042,155	35.6	50.9	44.1	33.1	64.7
GDP	1,355,111	16.4	26.1	21.1	14.1	27.6
Households'income	1,698,092	15.0	24.0	19.2	12.4	24.3

Source: author elaboration.

The total impacts are contrasted with the baseline values of the three economic aggregates, which is the value that output, GDP and households' incomes would have assumed in absence of any expenditures funded by royalties. The figures in Table 5.4.2 clearly reflect the openness of the regional economy: the leakages of economic impacts towards the rest of Italy are relevant and in some cases larger than the total impacts recorded within the regional borders (impacts on households' income in scenarios c and d). As expected, the size of total impacts relative to the baseline values of aggregates are completely different in the two regions and almost negligible in the rest of Italy. In Table 5.4.3 the percentage variations from the baseline values generated by different scenarios are provided for the Basilicata region.

The impacts on regional GDP range from 0.14 to 0.48%, a valuable contribution to regional growth in a general context of macroeconomic downturn. The highest average multipliers (euro of impacts for each euro of royalty allocated) are shown by the scenarios corresponding to policies directed to support final consumptions in the short-run (a and b). The figures referring to the actual allocation of royalties clearly reflect the mixed composition of the current policies of regional government, balancing between investment programs and allocations of oil rents for social goals.

The environmental impacts generated by output growth is calculated using the NAMEA data presented in section 3. Table 5.4.4 provides figures on the impacts expressed in physical terms corresponding to the five scenarios (the actual allocation in 2010 and the four hypothetical ones).

Table 5.4.3: Variation from the baseline and average multipliers of alternative policy scenarios

	Scenarios of royalty allocation				
	Actual	(a)	(b)	(c)	(d)
Variation from baseline (%)					
Output	0.28	0.39	0.27	0.16	0.31
GDP	0.28	0.48	0.32	0.14	0.28
Households'income	0.22	0.29	0.48	0.08	0.15
Average multiplier (euro)					
Output	1.2	1.6	1.1	0.7	1.3
GDP	0.6	1.0	0.6	0.3	0.6
Households'income	0.5	0.7	1.1	0.2	0.3

Source: author elaboration.

Table 5.4.4: Environmental impacts of alternative scenarios in the allocation of royalty

		Scenarios of royalty allocation			
	Actual	(a)	(b)	(c)	(d)
Basilicata					
NH3	3.93	4.75	7.63	2.90	5.66
Sox	6.24	1.80	1.64	4.09	8.00
NOx	27.10	28.75	29.21	15.85	31.00
PM10	5.12	3.87	4.29	2.84	5.56
COVNM	25.27	21.91	26.73	16.54	32.33
CO2	11.60	8.74	9.84	7.02	13.73
Rest of Italy					
NH3	5.85	8.17	9.49	4.39	8.58
Sox	26.40	34.58	30.54	21.59	42.21
NOx	39.55	50.91	45.25	32.46	63.47
PM10	5.42	6.00	5.50	4.85	9.48
COVNM	30.85	39.72	36.92	30.29	59.22
CO2	23.81	32.25	27.89	19.74	38.60

Source: author elaboration.

The variation of figures depends on the different overall growth effects generated by the alternative scenarios, as well as from the different composition of the exogenous shocks in terms of additional final demand directed towards production activities. Interestingly, the combination of interregional spillover and feedback effects with the different levels of environmental efficiency in the two regions, results in a larger impact in the Rest of Italy: all the figures in the second block of rows of the table are larger than the corresponding ones for the Basilicata region.

The total environmental damage corresponding to these emissions is provided for the five scenarios in the last row of Table 5.4.5. The columns show the percentage composition of these damages in terms of pollutants and regional origin.

According to our estimation, carbon dioxide emissions generate the largest part of damages, representing more than 40% of total economic damage in all scenarios. Production activities and final consumptions in the Basilicata region account for a variable share of the total damage, ranging from small shares in the SOx damages (less than 1% in scenarios a and b) to a share larger than 5% in the damages associated with NOx emissions (all scenarios). The total estimated damage ranges from 1.6 M euro of the scenario c (Supporting the productive system in the short-run), to 3.1 M euro of scenario d (Enhancing the competitiveness of the productive systems). It is worth noticing that scenarios with different direct impacts of royalty generate comparable environmental damages (for example the “Actual 2010” and the scenario b “Supporting public expenditure and social transfers”).

The results on relative poverty variations that can be associated with each scenario are summarized in Table 5.4.6. They refer only to the Basilicata region: indeed, the estimated impacts on poverty gap in the Rest of Italy are generally negligible, due to the small size of economic impacts transmitted via the interregional linkages relative to the size of the economy in the Rest of Italy.

Overall, the impacts on poverty are small. The “Actual 2010” scenario shows the best performance in “social” terms, yielding an overall reduction of the poverty gap of 0.47%. As expected, the impact on poverty in relative terms increases moving from the first to the third decile. Interestingly, the worst “social” impact is shown by scenario b, the only one including an explicit redistributive goal (Supporting public expenditure and social transfers): in this hypothetical case the allocation of royalties would result in an increase of relative poverty in comparison with the baseline. This counterintuitive outcome results from the structure of linkages within the economy and is a typical result of the SAM framework of analysis. Indeed, the impacts indirectly generated through the inter-industry linkages, the structure of primary income distribution and the structure of consumptions are able to reverse the composition of direct (exogenous) impacts on incomes (Rose et al., 2001). The results in Table 5.4.6 clearly show how much the availability of a suitable tool of analysis could be relevant for improving the targeting

Table 5.4.5: Environmental impacts of royalties allocation (M euro of evnironmental damage and percentage distribution among pollutants)

	Scenarios of royalty allocation				
	Actual	(a)	(b)	(c)	(d)
Basilicata					
NH3	2.42	2.55	4.29	2.38	2.38
Sox	2.34	0.59	0.56	2.05	2.05
NOx	10.68	9.89	10.50	8.34	8.34
PM10	5.55	3.67	4.25	4.12	4.12
COVNM	0.74	0.56	0.72	0.65	0.65
CO2	13.96	9.18	10.81	11.29	11.29
Rest of Italy					
NH3	3.61	4.39	5.34	3.61	3.61
Sox	14.84	16.68	15.49	16.26	16.26
NOx	10.40	11.89	10.98	11.36	11.36
PM10	5.88	5.69	5.44	7.03	7.03
COVNM	0.91	1.02	0.99	1.19	1.19
CO2	28.67	33.89	30.63	31.73	31.73
Total environmental damage (M euro)	2.1	2.4	2.3	1.6	3.1

Source: author elaboration.

of policies: a point even more important at the regional level with regard to social goals.

The sustainability assessment of the alternative policy scenarios in the allocation of oil royalty can be carried out according to the data presented in Table 5.4.7.

The analysis assumes an (unknown) "baseline" value of GS, resulting from the level of activity of the regional economy in the reference year and including the "energy depletion" negative component generated by the exploitation of energetic resources[5] and net of the impact of royalties allocation. In the case of the Basilicata region, as shown in the second chapter of this study, the GS is likely to be negative, signaling an "unsustainable" development path. The figures in table 5.4.7 show the extent in which the use of royalties can affect the final value of GS, modifying its economic and environmental components. A further correction is included to account also for the "social"

[5] As well as the environmental damage generated by economic activities at the "baseline level". In the Basilicata Region the energy depletion component is obviously preponderant within the "enviromemental" correction of net savings.

Table 5.4.6: Social impact of alternative scenarios in the allocation of royalties. Percentage variations from the baseline of the relative poverty gap

	Income deciles			
	1st decile	2nd	3rd	Total
Actual 2010 allocation	-0.15	-0.85	-3.03	-0.47
Alternative allocations				
a) public consumption	-0.06	-0.04	0.35	-0.03
b) public consumptions and transfers to households	0.35	1.53	4.65	0.86
c) funding production activities	-0.12	-0.64	-2.13	-0.35
d) funding investments in capital assets of production activities	-0.10	-0.43	-1.28	-0.24

Source: author elaboration.

dimension of sustainability (the poverty effect).

The five scenarios are characterized by a variable "economic" contribution to GS, represented by the share of royalties allocated to finance investments in capital assets and to support human capital formation. While the two "short-run" oriented hypothetical policies (a and b) do not yield any positive variation of savings, the two "long-run" oriented ones (c and d) show an increasing contribution through additional investments.

As regard to the "environmental" correction that can be linked to the use of royalties, all scenarios show a negative marginal contribution to GS, with the worst scenario (d) yielding an environmental damage almost double than the best one (c). Finally, the use of royalties can affect positively or negatively the GS according to the poverty effect.

It is worth noticing that, according to these results, the economic component of sustainability (additional investments) represents the most important policy tool to pursue "sustainability". Indeed, for the scenarios where the support of additional investments is included, the environmental and social components of the GS calculation are not able to counterbalance the economic one: the magnitude of environmental and social impacts is of a smaller order. Conversely, the environmental and social marginal contributions to GS are comparable in magnitude and may be potentially object of a "compensation" strategy, taking into account the different relevance that environmental and social "damages" may have at the regional level. While social adverse effects (like an increase in relative poverty) are more perceived as depending on local decisions and will entirely affect the regional welfare in future, the future adverse consequences in environmental terms are less clearly depending on regional choices.

According with the proposed framework of analysis, the "best" policy is represented by the scenario d, aiming at "Enhancing the competitiveness of the productive system": that is, allocating the whole amount of additional financial resources from oil rents into investments in capital assets and formation of human capital. The actual use of royalties clearly represents a compromise between short-run and long-run, economic and social goals. It is worth noticing that a better results with a similar balance among the three components could be achieved adopting the strategy of "Supporting the productive system in the short-run" (scenario c).

Finally, it should be noted that the assessment summarized in Table 5.4.7 refers to a long-run, sustainability perspective. The data in Table 5.4.2 and Table 5.4.3 represents the short-run side of the problem. The comparison between the two perspectives may shed light on the inter-generational trade-offs implicit in every assessment of "sustainability" of policy choices.

Table 5.4.7: Contributions to sustainability of alternative scenarios in the allocation of royalties (M euro of marginal contribution to GS)

	Scenarios,of royalty allocation				
	Actual	(a)	(b)	(c)	(d)
Additional investments	20.2	0.0	0.0	27.7	54.2
Environmental damage	-2.1	-2.4	-2.3	-1.6	-3.1
Poverty effect	1.6	0.1	-2.9	1.2	0.8
Total	19.6	-2.3	-5.3	27.3	51.9

5.5 Conclusions

In this article we provide an economic-environmental structural analysis of a lagged resource abundance region in the south of Italy, Basilicata. Through a bi-regional SAM, we analyze the structural connections of the regional economic system with the rest of Italy , identifying the regional effects, and interregional spillover and feedback effects of an exougenous shock in that region. Moreover, we shed light on the "leakages" that characterize the regional economic system with respect to the national economy to which it pertains.

Finally, we propose an extension of the Genuine Saving rate, a forward looking indicator of sustainability, to include a social sustainability dimension based on poverty alleviation. We apply this framework in evaluating several scenarios of royalties allocation in that context, to derive policy implication in a wide and properly defined sustainability perspective at the regional level.

Through our framework, we highlight the context-specific regional sustainability trade-offs. Moreover, we examine the social, environmental and economic consequences of different policies which are, in turn, oriented towards short run vis-à vis long run problems. Specifically, concerning our case study, the results clearly show that revising the strategy of royalties' allocation would yield in relevant improvements, for all the three pillars of sustainability, with respect to the actual situation.

References

Alarcón, J., Van Heemst, J., and Jong, N. D. (2000). Extending the SAM with social and environmental indicators: an application to Bolivia. *Economic Systems Research*, 12(4):473–496.

Cherubini, L., Ghezzi, L., Paniccià, R., and Rosignoli, S. (2012). L'interscambio commerciale tra il Mezzogiorno e il Centro Nord: struttura e meccanismi di propagazione degli shock. *Rivista di Economia e Statistica del Territorio*, pages 42–86.

Costantini, V., Mazzanti, M., and Montini, A. (2012). *Hybrid economic-environmental accounts*. Routledge, London.

European Commission (2010). Communication from the Commission Europe 2020. A strategy for smart, sustainable and inclusive growth. Technical report, European Commission.

European Environmental Agency (2011). Revealing the costs of air pollution from industrial facilities in Europe. Technical Report 15/2011, EEA (European Environment Agency).

Iacono, R. and Mideksa, T. (2014). No blessing no curse? On the benefits of being a resource rich southern region of Italy.

ISTAT (2012). Conti regionali delle emissioni atmosferiche. `http://www.istat.it/it/archivio/53128`. Online, Accessed 19 November 2014.

Larsen, E. R. (2006). Escaping the resource curse and the Dutch disease? *American Journal of Economics and Sociology*, 65(3):605–640.

McGregor, P. G., Swales, J. K., and Turner, K. (2008). The CO2 'trade balance'between Scotland and the rest of the UK: Performing a multi-region environmental input–output analysis with limited data. *Ecological Economics*, 66(4):662–673.

Miller, R. E. and Blair, P. D. (2009). *Input-output analysis: foundations and extensions*. Cambridge University Press.

Ministry of Economic Development (2014). Hydrocarbons production. `http://unmig.sviluppoeconomico.gov.it/unmig/produzione/produzione.asp`. Online, Accessed 26 March 2014.

Rocchi, B., Landi, C., Stefani, G., Romano, S., and Cozzi, M. (2015). Escaping the resource curse in regional development: a case study on the allocation of oil royalties. *Internationl Journal of Sustainable Development*, 18(1/2):115 – 138.

Rose, A. Z., Hanson, K., and Li, P. C. (2001). Income distribution effects of government transfers: sensitivity to closure rules in input–output and computable general equilibrium approaches. In Lahr, M. L. and Dietzenbacher, E., editors, *Input– Output Analysis: Frontiers and Extensions*, page 479–501. Palgrave, New York.

Round, J. (2003). Constructing SAMs for development policy analysis: lessons learned and challenges ahead. *Economic Systems Research*, 15(2):161–183.

Sansoni, M., Bonazzi, E., Goralczyk, M., and Stauvermann, P. J. (2010). Ramea: how to support regional policies towards sustainable development. *Sustainable Development*, 18(4):201–210.

Stone, R. (1985). The disaggregation of the household sector in the national accounts. In Pyatt, G.and Round, J., editor, *Social Accounting Matrices. A Basis for Planning*, pages 145–185. Washington, The World Bank.

Aknowledgments/ Ringraziamenti

Ringrazio innanzitutto il professor Rocchi per la sua paziente guida nella stesura di questo lavoro, il collegio dei docenti del Corso di Dottorato in Development Economics, i ricercatori dell'Irpet, in particolare Stefano Rosignoli, e tutti coloro che mi hanno aiutato con suggerimenti, critiche ed osservazioni che hanno senza dubbio contribuito a migliorare il lavoro. A me spetta la responsabilità per ogni errore contenuto in questa tesi.

Ringrazio i miei colleghi e i "frequentatori" a vario titolo dell'aula dottorandi, perché in questi tre anni ho imparato tantissimo da ognuno di loro, sia professionalmente che personalmente. I migliori ricordi di questo periodo saranno senza dubbio legati loro. Un ringraziamento speciale va a Daniela, amica che ad ogni occasione dimostra che su di lei si può sempre fare affidamento.

Ringrazio Salvatore, per la tenerezza e la pazienza con cui mi è stato accanto.

Ringrazio tutti gli amici vicini e lontani che hanno sopportato e lenito le mie ansie. Soprattutto Giulia, che non mi ha mai fatto mancare il suo sostegno.

Infine, ringrazio la mia famiglia, mia madre e mio padre. Qualsiasi risultato raggiunto è fondato sulle possibilità che ho avuto grazie ai loro sacrifici. Per questo va a loro la mia gratitudine.