Quaderni del Premio «Giorgio Rota»

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Rural Economies, Evolutionary Dynamics and New Paradigms

Centro di Ricerca e Documentazione Luigi Einaudi

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Indice

Il Premio «Giorgio Rota»

L'intento del Premio *«Giorgio Rota» Best Paper Award* è di riprendere l'attività di ricerca annualmente condotta dal Comitato / Fondazione Giorgio Rota prima della sua inclusione nel Centro Einaudi, sulla relazione tra il pensiero e l'agire economico e un aspetto (ogni anno diverso) del vivere in società, mantenendo vivo il ricordo e l'insegnamento dell'economista Giorgio Rota, uno dei primi animatori del Centro, prematuramente scomparso.

Dal 2012 il Cento Einaudi ha dunque raccolto questa eredità rinnovando la formula della ricerca: è stato perciò istituito questo premio annuale dedicato a giovani ricercatori, con una qualificazione accademica nei campi dell'economia, sociologia, geografia, scienza politica o altre scienze sociali. I paper possono essere presentati sia in italiano che in inglese, e non devono essere stati pubblicati prima della data della Conferenza Rota, l'evento pubblico nel quale i vincitori hanno modo di presentare il loro lavoro.

La prima edizione aveva per tema *Contemporary Economics and the Ethical Imperative* e la Conferenza Giorgio Rota 2013 si è tenuta presso il Centro Einaudi il 25 marzo 2013 con keynote speech di Alberto Petrucci, LUISS Guido Carli, Roma.

La seconda edizione, nel 2013, è stata su *Creative Entrepreneurship and New Media* con Conferenza Giorgio Rota presso il Centro Einaudi, 14 aprile 2014 e keynote speech di Mario Deaglio, Università di Torino.

La terza edizione ha analizzato il tema *The Economics of Illegal Activities and Corruption*, con Conferenza Giorgio Rota presso il Centro Einaudi, 15 giugno 2015. Keynote speech di Friedrich Schneider, Johannes Kepler University (Linz, Austria).

La quarta edizione verteva su *The Economics of Migration*. Il 20 giugno 2016 si è tenuta la Conferenza Giorgio Rota presso il Campus Luigi Einaudi, in collaborazione con FIERI. Keynote speech di Alessandra Venturini, Università di Torino. Dal 2016 inoltre il Premio è sostenuto dalla Fondazione CRT.

La quinta edizione, del 2017, trattava di *Economic Consequences of Inequality*, e i saggi vincitori sono stati presentati alla Conferenza Giorgio Rota del 4 maggio 2017, tenutasi presso il Campus Einaudi in collaborazione con il Dipartimento di Economia e Statistica "Cognetti de Martiis". L'Introduzione è di Andrea Brandolini, Banca d'Italia.

La sesta edizione del Premio, tenutasi nel 2018, è incentrata sul tema *The Economics of Health and Medical Care*. I paper vincitori sono stati presentati alla Conferenza Giorgio Rota tenutasi il 1° giugno 2018 presso il Campus Einaudi, in collaborazione con il Dipartimento di Economia e Statistica "Cognetti de Martiis". L'Introduzione è di Fabio Pammolli, Politecnico di Milano.

La settima edizione del Premio è incentrata sul tema *Rural Economies, Evolutionary Dynamics and New Paradigms*. I paper vincitori, riportati qui, sono stati presentati alla Conferenza Giorgio Rota il 6 maggio 2019 presso il Campus Einaudi, in collaborazione con il Dipartimento di Economia e Statistica "Cognetti de Martiis". Gli autori, Federico Fantechi, Georgios Manalis e Stefano Menegat, sono introdotti da un intervento di Donatella Saccone, docente di Economia politica all'Università di Scienze gastronomiche di Bra

Chi era Giorgio Rota

Giorgio Rota (1943-1984) è stato professore di Economia politica presso l'Università di Torino e consulente economico. Per il Centro Einaudi, è stato coordinatore agli studi e membro del comitato di direzione di «Biblioteca della libertà».
Le sue pubblicazioni scientifiche abbracciano diversi temi: l'economia dei beni di consumo durevoli, l'economia del risparmio, il mercato monetario e finanziario, l'inflazione e la variazione dei prezzi relativi, il debito pubblico. Ricordiamo tra esse: *Struttura ed evoluzione dei flussi finanziari in Italia: 1964-73* (Torino, Editoriale Valentino, 1975); *L'inflazione in Italia 1952/1974* (Torino, Editoriale Valentino, 1975); nei «Quaderni di Biblioteca della libertà», *Passato e futuro dell'inflazione in Italia* (1976) e *Inflazione per chi?* (1978); *Che cosa si produce come e per chi. Manuale italiano di microeconomia*, con Onorato Castellino, Elsa Fornero, Mario Monti, Sergio Ricossa (Torino, Giappichelli, 1978; seconda edizione 1983); *Investimenti produttivi e risparmio delle famiglie* (Milano, Il Sole 24 Ore, 1983); *Obiettivi keynesiani e spesa pubblica non keynesiana* (Torino, 1983).

Tra le sue ricerche va particolarmente citato il primo *Rapporto sul risparmio e sui risparmiatori in Italia* (1982), risultato di un'indagine sul campo condotta da BNL-Doxa-Centro Einaudi, le cui conclusioni riscossero notevole attenzione da parte degli organi di stampa. Da allora il *Rapporto sul risparmio,* ora *Indagine sul risparmio*, continua a essere pubblicato ogni anno.

Donatella Saccone

Introduzione

All research is (or should be) relevant: as well known, relevance is one of the parameters through which the quality of research is measured. However, some researches are even more relevant, because they are able to respond to the needs of current times, and I think that the researches that are part of this topic are an example of this. I also think that this is one of the reasons why the topic was selected, as the Director of Centro Einaudi, Giuseppe Russo, confirmed. The opening speech then wants to be a general reflection on the relevance of the topic and, in particular, an analysis of the evolution of how the relevance of the topic was perceived according to the dominant paradigm of economic development.

For those who studied Development Economics this is probably quite familiar. The rise of Development Economics occurred after the end of the Second World War. In the 1950s and 1960s the dominant paradigm of economic development mainly relies on the rationale to push countries towards industrialization, which in turn would lead to economic growth; after an initial increase in income inequalities, the benefits of economic growth would then spill over and trickle down to the whole population (Kuznets 1955). In this framework, how was conceived the role of rural economies and, in particular, of the agricultural sector?

We can individuate four main contributions that scholars saw for rural economies at that time, when the focus was merely on industrialization and economic growth (Johnston and Mellor 1961; Kuznets 1964). First, *product contribution*, that means that rural economies were considered as food providers for an expanding population. Second, *factor contribution*, since rural economies and rural areas were considered as a pool of workers who in the rural sector had zero (or very close to zero) productivity and who should be pushed to move to the industrial sector, where they would have a higher productivity at a constant wage. This was indeed the main rationale of the Lewis model (Lewis 1954). Third, *market contribution*, where rural economies were seen as potential markets for industrial output. Finally, exchange contribution, especially for developing countries, where the role for rural economies was to export primary goods in order to get the foreign currency necessary to import capital goods to be used in the industrialization process.

Of course, these four contributions were the reflection of the dominant paradigm at that time, related to the way in which economic development was conceived. Even if the early theories of industrialization were proposed in 1950s and 1960s, the related view of rural economies and of their role persisted at least until the 1980s. There were exceptions, of course, especially in the 1970s, then broken by the emergence of the Washington Consensus in the 1980s; in general, however, until the 1980s that was the role attributed to rural economies.

At a certain point, however, an important change in the paradigm of development occurred: from the 1990s the idea of development moved from a strictly economic conception to the idea

of human development first and of sustainable development then. We can individuate three main milestones in the institutionalization of these new paradigms. First, in 1990, the publication of the *Human Development Index*, that encompasses not only the economic dimension, but also dimensions related to human development, like health and education. Then, in 2000, the launch of the *Millennium Development Goals* (MDGs) by the UN, that are 8 goals related to a multidimensional view of development. Finally, in 2015, the definition of the *Sustainable Development Goals* (SDGs). They consist in 17 different goals to be achieved by 2030, that encompass a series of global challenges like poverty, inequality, health, education, environmental protection, peace and justice. By looking at them, it is quite clear that the role of rural economies that in previous decades economists individuated for the agricultural sector was extremely limited. In front of these new paradigms of sustainable development, what rural economies can do to promote sustainable development is indeed much more than the four contributions previously described.

Which are the main contributions that rural economies can provide to sustainable development? There are lots of contributions, but here I want to focus especially on two of them.

One is the so called *pro-poor growth*. The SDG 1 aims at ending poverty in all its forms everywhere and, even if it's an ambitious goal, rural areas have a lot to say about that. There have been a lot of studies estimating the elasticity of poverty to economic growth by sector, a concept that indicates how much poverty decreases when there is an increase in GDP per-capita (or in productivity) and how it differs across sectors. Using different types of estimation techniques, samples and data, all these studies demonstrated that the elasticity of poverty to economic growth is much higher when economic growth occurs in the agricultural sector rather than in the other two sectors of economic activity. A study published in 2018 in a special issue of the Journal «World Development» (Ivanic and Martin 2018) estimated the poverty change from a sectoral productivity increase equal to 1% of GDP at different levels of GDP per capita. The results of this study show that the elasticity of poverty to the increase in sectoral productivity is more than double when the increase in productivity occurs in the agricultural sector rather than in the other two sectors of activity. This gap narrows when the per capita GDP increases, so results are particularly meaningful for low income countries. The reason of this is clear when we look at the statistics about the concentration of the poor in rural areas: the 88% of the extremely poor live in rural areas; moreover, while the world population employed in the agricultural sector is on average 27%, in low-income countries this percentage increases to 70%.

There is also another reason why I do believe that rural economies can play an important role in sustainable development, that is because they are the *bulk of food production*. Of course, rural economies consist of both farm and off-farm activities, but the former represent the largest share. Food production can have a huge impact both on the environment and on society. Regarding the food-environment nexus, there is a bidirectional link: on the one hand food production impacts on the environment and, on the other hand, the protection of the environment is fundamental in order to guarantee the survival of rural economies as food providers. At the same time, food production can have a great impact on society, because food security and an equitable access to food can contribute to a healthy, inclusive and sustainable society. Again, we have a crucial role for rural economies in sustainable development.

However, we are facing a series of emerging trends that can undermine not only rural economies, but also sustainable development itself and their common destiny. This doesn't want to be a complete list but, just to give you an idea, I will report a series of trends that in my opinion are significant, as pointed out by a FAO report in 2017 (FAO 2017).

The first has to do with the current demographic trends. As well known, the world population is expected to reach 10 billions people by 2050. However, this rapid increase is not the only change that we have to expect, because this growing population on average will be richer than in the past, since there is also an upward trend in per-capita GDP. At the same time, this population will be more urbanized than in the past, so we have to expect an increase in food demand but also a qualitative change. In other words, we have to expect a higher food demand, but also a different composition of that demand. Before going to the implications of this trend, I also want to give you some data about the demographic trends in rural areas, because if worldwide the world population is increasing, in rural areas we are observing an opposite trend. Until 35 years ago the percentage of people living in rural areas was equal to 60%, while today this percentage is 46%. By 2050 it will further drop, with the percentage of people who will live in urban areas representing the ⅔ of the world population. This means that, in front of a general increase of the world population, the rural population will decrease of almost twenty hundred millions by 2050 (FAO 2017).

How these demographic trends will impact on food markets? On the other hand, we have to expect an increase in the demand for food. It has been estimated that, in a scenario of modest economic growth, the demand of agricultural products will increase by around 50% from now to 2050. At the same time, as discussed, we will probably face a decrease in the share and in the absolute number of people living in rural areas and employed in agriculture. Some optimistic economists would say that this is not a problem, because the solution can be provided by technological improvements that allow productivity gains. However, if we look at the other trends that are emerging, we can see that actually agricultural productivity is lowering, because the more natural resources are used, the less they are productive. We are indeed in front of the degradation of natural resources and the loss of biodiversity, further exacerbated by the diffusion of transboundary pests and diseases. The Asian green bugs that in these days you can see also in Turin and that are undermining our plantations are an example of this.

Another emerging trend has to do with climate change, which is affecting crops and rural livelihoods. Not only climate change is undermining rural areas and agriculture, but also agriculture is highly contributing to climate change. It is estimated by FAO that the contribution of the agricultural sector to greenhouse gas emissions is equal to 20-24% and half of these emissions comes from animal production. If you match this information with the emergence of an increasing and richer global population and with the subsequent shift towards a different type of food, like protein food, it is quite clear that the contribution of agriculture and rural economies to greenhouse gas emissions will further increase in the future.

In conclusion, we can say that rural economies and sustainable development are linked by a common destiny. The presented scenario makes clear that we must look at rural economies not only from the perspective of traditional Economics and the first contributions that

we discussed at the beginning: this is not because they were wrong, but because they were totally incomplete. In this new scenario, the contribution of rural economies to sustainable development is of course much richer than represented in those four contributions.

We can individuate some 'hot topic' in this common destiny between rural economies and sustainable development. Each of the three awarded papers focuses on one of them. One 'hot topic' is *resilience*, specifically the resilience of rural communities to changes, and it is addressed by the paper presented by Federico Fantechi, who studied the community disaster resilience in rural areas taking the case of Central Italy after the 1997 earthquake. Then we have, as a 'hot topic', *risk-coping and risk-sharing*, which is studied by Georgios Manalis, who presents a model of risk-sharing and land reforms applied to rural West Africa. Finally, another 'hot topic' is *innovation* and, specifically, social innovation in food systems: Stefano Menegat presents a paper that considers U.S. farmers' markets as an example of social innovation and tries to understand what is the future of these kinds of markets.

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FEDERICO FANTECHI

SPATIAL DYNAMICS OF COMMUNITY DISASTER RESILIENCE IN RURAL AREAS. EVIDENCES FROM CENTRAL ITALY AFTER THE 1997 EARTHQUAKE

Abstract. Socio-natural disasters are a global issue but, being the intersecting result of an uncontrollable nature and a complex society, they cannot have a unique global solution. Similar hazards could indeed result in different (or none at all) disasters depending on the affected territorial and social context.

Italy presents itself as an interesting and peculiar context and case study. Due to its particular geographical characteristics, three out of four major seismic event of the last decades, affected the country rural areas, in particular around the Central Apennines.

Rural communities, inhabiting this area, are burdened by decades-old processes of ageing and depopulation but, by controlling and taking care of the territory, they are important strategic resources for all Italian society. After the last major socio-natural disaster a question has arisen: are rural communities of Central Italy sentenced to be completely abandoned?

Through the framework of Community Resilience, the study envisions a time-sensitive quantitative analysis functional to observe resilience's dynamics over different degrees of rurality in Central Italy. We adopted a quasi-experimental strategy, making use of the communities' internal population variation as a proxy for community resilience, and a suitable control group to isolate – and individuate – the effect of the Community Resilience triggered by the disaster.

Our results highlight a stabilising effect, where the affected communities depopulate with slower rates in comparison with the control group. Moreover, we observed that different degrees of rurality in the affected area are not directly correlated with better or worse performance in population variation.

Keywords: Rural community resilience, natural disaster, quasi-experimental methods, disaster resilience

I. INTRODUCTION

Nowadays an increasing number of people around the world have been affected by disasters triggered by natural hazards (Guha-Sapir *et. al.* 2016). Natural phenomenon like tsunami, earthquakes, landslides, floods, volcanic eruptions, hurricanes or droughts occurs almost daily in different parts of the globe, but the occurrence of such events alone does not make a disaster. Natural events become disasters when they hit anthropised territories, affecting the communities living there; that is when a destructive force (nature) meets the built environment and its social and economic structure (society). Therefore, a more proper way to indicate such events would be 'socio-natural disasters' (Mela *et al.* 2017), rather than the more commonly used expression 'natural disasters'.

In the last two decades, especially since the publication of the Hyogo Framework for Action, the public attention on this topic has risen and much has already been done to reduce damage and improve the effectiveness of the recovery process caused by natural hazards with the complicity of society. Such actions and studies, intersecting – in a way – nature and society, falls under the wide umbrella of the concept of disaster resilience.

Socio-natural disasters are a global issue but, being the intersecting result of an uncontrollable nature and a complex society, they cannot have a unique global solution. Similar hazards could indeed result in different (or none at all) disasters depending on the affected territorial and social context. Studies on disaster resilience, as well as the policies to both prevent and recover from them, are then bound to the context of application.

Italy is a very interesting context and case study. The entire peninsula sits on the meeting point between the Eurasian Plate and the Adriatic Plate. As a result, the Apennine Mountains – crossing the country from North to South – contain many seismic faults, causing Italy to have an incredibly high amount of tectonic activity and seismic hazardous events (Valensise *et al.* 2017).

The '2016 Central Italy Earthquake' is the last large disastrous event occurred in Italy as the result of a specific natural event (a seismic swarm started in late summer 2016) intercepting a specific social context (rural communities of Central Italy). Despite the impact of this socio-natural disaster being still incalculable, it has at least raised the public level of attention on the topic of rural communities living in earthquake-prone areas, bringing out an important question: how can we avoid that these mostly rural

inhabited areas – already prone to depopulation and economic lagging – will be completely abandoned after the last disastrous event?
Since 2012, the Italian government has faced the general issue of depopulation of rural communities with the institution of the SNAI (National Strategy for Inner Areas) initiative enacted by the Italian Agency for Economic Development and Cohesion. According to the strategy, rural communities should find their own developing strategy (place-based policies) and the National Administration should guide them by providing know-how, organisation and the resources needed (Barca *et al.* 2012; Lucatelli 2014). All this because rural communities are incredibly important for a country like Italy, where more than 40% of its territory is mountainous. Rural communities, dispersed in the mountainous inner areas, are indeed strategic resources for all Italian society for instance by controlling and taking care of the territory.
A major disastrous event, like the 2016 Central Italy Earthquake, could be a point of no return for such communities in the depopulation process. In order to better understand the role played by such events on the depopulation process, this paper focuses on rural communities of Central Italy affected by earthquakes, exploring the relationship between different characteristics and degree of rurality, and the community ability to perform positively (to be resilient) after a disastrous event.
We aim at understanding if a socio-natural disaster can be an opportunity for the affected communities, by triggering the community ability for resilience and putting in motion changes affecting also the depopulation process. Focusing our study on different degrees of rurality, we want to observe the dynamics of population variation of rural communities affected by a socio-natural disaster to test if there is a causal relation or a threshold between rurality and positive trends and performances after the event.

The study envisions a longitudinal time-sensitive analysis – considering a period both before and after the earthquake – to observe the resilience dynamics in the specific context of Central Italy rural communities, making use of the communities' internal population variation as a proxy of resilience (Chamlee-Wright and Storr 2010; Aldrich 2013). The use of population variation as a proxy for resilience is not common, despite not being new, but it allows us to study the effects and dynamics of resilience accordingly with a context suffering from prolonged processes of depopulation. It will enable us to understand what happens when socio-natural disasters hit an area characterised by such cumulative processes.

The nuance of the study is given by both the quasi-experimental technique we employ and our context-bound framework. Indeed, we are thus able to indirectly isolate the effect of community resilience[1] using a control group and highlight what – in the conclusions – we call a double effect of space. First, we show how the earthquake resulted in a stabilising effect on population variation, where being a more or less rural community linearly correlate. However, such correlation does not persist when trying to explain better or worse performances in the years after the earthquake.

The paper is organised in four sections. Section one (*Introduction*) will introduce the research and present the theoretical framework while discussing the relevant literature. Section two (*Data and Methods*) presents the data utilised for the research and the methods and techniques used to analyse them. In the third section (*Presentation and discussion of results*) we present and discuss the main results making use of both maps and regression tables. Section four (*Conclusions*) presents our interpretation of such results for the Italian context and provides insights on possible policy implications and connected future researches.

2. THEORETICAL FRAMEWORK

Over the last two decades the concept of resilience, especially in the context of disaster studies, quickly became one of the main focus of academic studies and public policies to improve the response of society to adverse events. Interesting enough, the word 'resilience' is not a specific term of any field in social sciences. It was imported from physics during the 1970s where it describes the ability of a material to bend and then bounce back to its original equilibrium, rather than breaking after the stress is applied (Bodin and Wiman 2004; Zolli and Healy 2012; Wilson 2014; Martin e Sulley 2006). Over time, and across different fields, the concept of resilience has been framed – and defined – in many ways, according to the different subjects of study. The most prolific of these frames is probably the one of *regional resilience*, receiving most of its contributes from the fields of economic geography (Martin 2012; Carpenter 2015; Christopherson *et al.* 2010; Simmie and Martin 2010; Modica and Reggiani 2015) and disaster studies (Mayunga 2007; Cutter *et al.* 2008; Carpenter 2015). As argued in Faggian, Gemmiti, Jacquet and Santini (2018) most of these contributions focus on traditional economic indicators and fail in representing the

[1] We employ population variation as proxy for the effect of community resilience. Thanks to our experimental design we are able to isolate such effect from the general trend of population variation in Italy.

complexity of the social world. A very similar – and still very prolific – framework, proposed from sociological contributions, is the one of *community resilience*; this approach, largely used not only in sociological studies but also in studies on natural disasters (Gaillard 2007), focuses on capturing resilience along a series of sub-dimensions of the social structure (Faggian, Gemmiti, Jacquet and Santini 2018), highlighting the complexity of society and making it a key strength of the approach. Positioning ourselves inside the framework of community resilience, we adopt the definition given by Norris *et. al.* (2008) which has the advantage to be quite open and concise while highlighting, at the same time, all the important characteristics of the ability to be resilient.
Norris defines community resilience as a "Dynamic process composed by many adaptive capacities to response and change after adverse events" (Norris *et al.* 2008).

This definition has indeed many advantages. Other than being light, communicative and very adaptable to different fields, it has two important advantages from our perspective.
First, it defines resilience as a dynamic process – rather than an ability –, highlighting how it is not fixed in time but is sensible to the temporal dimension. Moreover, Norris' definition also has the benefit of stressing that community resilience is composed of many adaptive capacities, framing resilience as a complex concept without enclosing it into this or that field or dimension. Whit this definition Norris frames resilience as made of many adaptive capacities, all concurring to the same dynamic process. Expanding from the definition, we could say that the composition of resilience (the ability for resilience) is a complex concept but the resulting dynamic process (the effect of resilience) is not complex and can be singularly individuated.

Most sociological studies focus their attention on how this ability for resilience is composed (Gaillard 2007; Cutter *et. al.* 2008; Fisher and McKee 2017). This study does not involve directly the ability for resilience itself (how community resilience is composed), rather it focuses on studying and explaining the causal relationship between the effect of community resilience and the geographical and spatial distribution of rural communities. Indeed, while the composition of communities' resilience ability is complex, we are able – performing an ex-post longitudinal study – to indirectly isolate the effect of community resilience.

In particular, we will focus our attention on Italian rural communities, not by looking at the dichotomous differences between urban and rural communities, but instead by exploring the differences between different characteristics and degree of rurality.[2] Where the use of the dichotomy urban-rural highlights the common factors and dynamics of being either rural or urban, our framework focuses on the internal differences of rural areas as not being homogeneous defined (Cloke 1977).
Building on previous studies on community disaster resilience, it seems clear that the ability is composed differently for community living in rural areas compared to the ones living in urban environments (Cutter *et al.* 2016), producing different effects and performances between urban and rural communities. Despite the presence of a large number of works, a big problem – from our point of view – is that most major studies on disaster resilience are developed for urban contexts (Peacock *et al.* 1997; Vale and Campanella 2005; Chamlee-Wright and Storr 2009; Haas *et al.* 1977; McCreight 2010) and studies developed on and for rural communities represent only a residual category (Gaillard 2007; Solnit 2009; Wilson 2014; Sanders *et al.* 2015; Cutter *et al.* 2016).
The point here is that rural communities are very different from urban communities, under many levels. Either if you look at the social or economic structure of such communities, or at how relationships and social bonds are shaped, at their infrastructure or institution (Barca *et al.* 2012; Roberts *et al.* 2017; Faggian, Modica and Urso 2018); rural communities are inherently different. It is important then, even for policy implications, to study rural communities with a specific approach. An approach which holds as bedrock their specific characteristics and dynamics.

While exploring the relationship between different characteristics of rurality and the effect of community disaster resilience, our goal is to answer a question about *if* being more or less rural can have an impact on the community ability to perform positively (to be resilient) after a disastrous event. We focus our study on the communities affected by the 1997 Umbria and Marche earthquake, which allows us to perform an ex-post longitudinal study, considering a period of time both before and after the earthquake. This empirical strategy will allow us to focus on the effect of community resilience, triggered by the disastrous event and channeled over the reconstruction period.

2 We use the term 'degree of rurality' to frame our approach in opposition to the largely used dichotomy 'Urban vs Rural'. Indeed, rather than comparing urban and rural contexts, we focuse only on rural contexts and compare them among each other on different characteristics of rurality.

3. DATA AND METHODS

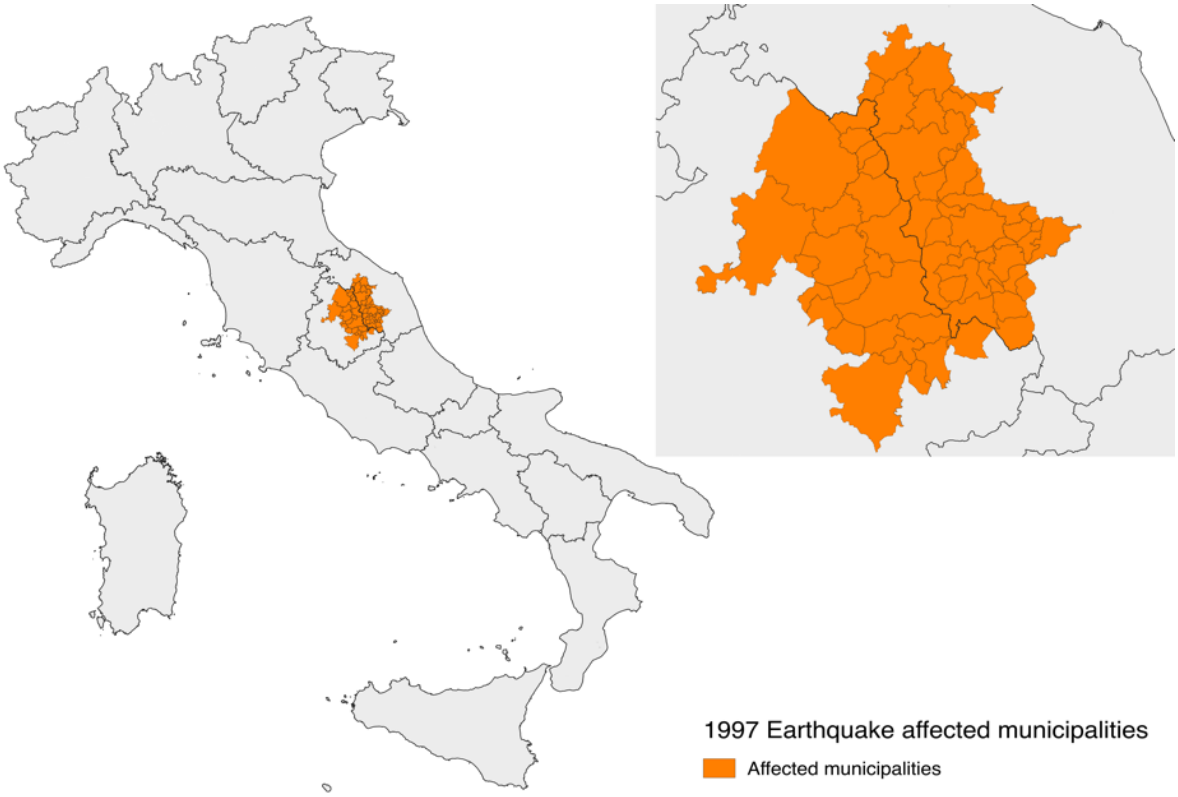
Our empirical strategy starts from the context of our interest, namely the resilience ability of rural communities living in Central Italy in response to a socio-natural disaster. Central Italy is not an administrative boundary *per se*. It rather indicates the rural and mostly mountainous area at the interception of the four regions of Marche, Lazio, Abruzzo and Umbria without any major city. This area holds all the peculiar traits of rural communities and it is located right over an active tectonic fault, where seismic events are quite common and sometimes extremely devastating (Valensise *et al.* 2017).

In the cluster of disaster resilience studies, such as in the near cluster of economic resilience, the holders of this ability are mostly identified as an aggregate entity varying on a scale going from the neighbourhood level, to the city, regional or even national level (e.g. Tatsuki and Hayashi 2000; Aldrich 2013; Kusumastuti *et. al.* 2014; Carnelli and Frigerio 2017; Wilson *et al.* 2018). Ideally, the concept of resilience – community resilience in our framework – could be applied at different levels of aggregation, depending on the subject of interest. Generally, such studies have the tendency to make use of the most disaggregate unit available, but this does not represent a rule as it should be the balancing result between the subject of interest, availability of data and unit of analysis, and aim of the research. This is why, an example among others, in theirs contribute on regional economic resilience Faggian, Gemmiti, Jacquet and Santini (2018) decided to employ the local labour system (LLS) level of analysis rather than the municipality one, despite the less disaggregated level of the LLS and the fact that data for this level of analysis are more time consuming and difficult to find.

Following this same logic, for our contribution in the study of community disaster resilience in the rural context of Central Italy, we decided to employ, as aggregate level of analysis, the administrative boundaries of municipalities. Indeed, administrative boundaries are particularly relevant in our context due to the fact that local administrations are quite involved in the reconstruction process after a socio-natural disaster. This is especially true in a context – like the Italian one – where the public sector is not only involved but leads and directs these processes. Moreover, this enable us to contextualise our study in the scientific and public discussion on depopulating rural communities, where – for both historical and administrative reasons – municipal boundaries are commonly used as unit of analysis (Lucatelli 2014).

The study is focused on rural communities of central Italy affected by the seismic events started in September-October 1997 and ended in March 1998. The affected area is administratively divided under the two Italian regions (NUTS 2) of Umbria and Marche and four provinces (NUTS 3), namely Ancona, Macerata, Perugia and Pesaro-Urbino. The area is here identified following the law[3] establishing it for a total of sixty-one municipalities. It is important to note that our final affected area will indeed be smaller, fifty-five municipalities. We excluded six municipalities from our analysis which, despite being listed inside the affected area, were only marginally affected by the earthquake and/or were big centres, over 25k inhabitants, with a radically different socio-economic structure that could have altered our results.

MAP 1 • 1997 EARTHQUAKE AFFECTED MUNICIPALITIES



3 Ord. 13.10.1997, n. 2694, G.U. n. 241, 15.10.1997. And Ord. 28.11.1997, n. 2719, G.U. n. 282, 03.12.1997.

As previously stated, this work represents an explorative study on the effects of disaster resilience ability for rural communities in Central Italy, by looking at population variation of the area before and after the earthquake of 1997. For this study, we are particularly interested at looking on the role of spatial and geographical characteristics of municipalities; particularly at looking if they have relevant effects on this ability and if these characteristics are able to identify successful paths in the short/medium-run recovery after an earthquake.
In order to carry on this analysis, we rely on a popular time-sensitive quasi-experimental technique known as 'Difference in Difference' (Bertrand *et al.* 2004; Lechner 2011). Indeed, this technique enables us – via the comparison of our affected municipalities with a control group over a period of time before and after the earthquake – to isolate the effect of a treatment. The treatment, in the context of this study, is the occurrence of an earthquake. Moreover, we are also interested in observing possible differences inside the treatment group, especially between the better and worse performing groups by repeating the analysis only for the one and the other and looking for patterns.

We are required to meet all the canonic assumption of an OLS model and to structure our database in panel form. In addition, DiD requires also a parallel trend assumption (Abadie 2005) between the treatment group and the control group for the period of time before the treatment. Considering our goals and the selected technique – alongside all the assumptions we need to meet – our empirical strategy could be represented in five steps:

1. Selection and construction of the variables.
2. Selection of a suitable control group.
3. Modelling the Difference in Difference analysis.
4. Identify better and worse performing groups of municipalities inside the treatment group.
5. Perform a comparative analysis on these groups.

The following paragraphs will account for steps 1, 2 and 4 in details. Steps 3 and 5 will be further described while discussing the results.

3.1 Selection and construction of the variables

For this study, we relied on freely available quantitative data provided by the Italian National Institute for Statistics, ISTAT. Our aggregate units of analysis are, indeed, the municipalities as the smallest administrative boundary identified in the 2001 Italian Census. Municipal borders are here used to identify communities. Indeed, the risk of not identifying entirely a community – or, on the other hand, collapsing more communities into one unit – is well counterbalanced by the fact that municipalities are important administrative units.

At municipal level we made use of many explanatory variables (*b* to *f*) to study the yearly variation of population (*a*):

a. *Population Variation*, calculated yearly. This is our dependent variable, used here as a proxy for the effect of resilience. We calculated the yearly share of variation, for a time period going from 1991 to 2011. Considering that the shock occurred between 1997 and 1998, we defined the years 1991-1996 as the before treatment period and 1999-2011 as the after-treatment ones. Yearly population variation is calculated as the percentage difference in population between one year and the following, using the reconstructed resident population for inter-census years (ISTAT).

b. *Population size*. We divided municipalities into 7 categories based on total residents. The intervals are intentionally disproportionate towards the low population levels since this is our focus. The seven categories are: municipalities under 500 inhabitants, between 501 and 1000, between 1001 and 2500, between 2501 and 5000, between 5001 and 10000, between 10001 and 25000, and municipalities with 25001 or more inhabitants. Municipalities are subdivided into these categories using data on resident population for the year 1996, hence in the before treatment period (data: ISTAT, reconstructed resident population for inter-census years).

c. *Mountainous degree*. Our indicator is based on a more precise distribution of municipalities for altitude zones. Again, the intervals were designed to better depict the specificities of our study area, hence median altitude on the sea level (data from ISTAT) was used to assign the municipalities. The categories are: 0-299 m a.s.l.; 300-599 m a.s.l.; 600-899 m a.s.l.; 900-1199 m a.s.l., 1200-1499 m a.s.l., 1500-1999 m a.s.l., 2000-2499 m a.s.l. and above 2500 m a.s.l. . We care to note that no municipality in our affected area falls in the last three categories.

d. Concentration of population. In order to account for the spatial distribution of population inside municipal territory, we designed this variable accounting for the share of population living in cities, villages and hamlets. The variable is constructed using census data, from the 1991 Italian census, and considers four categories: 'Non concentrated'; 'Concentrated single center' if more than 70% of the population lives in a single center; 'Concentrated two/three centres' if more than 70% of the population lives in two or three centres.
e. *Distance from the nearest pole*. The last spatial characteristic that we were able to consider, is the distance from the nearest pole. The attraction factor of poles as centres for services and labour market plays a central role as a pulling factor for migrations (Mabogunje 1970; Clark 1992). The distance here is calculated for every municipality as the linear distance from its centroid to the ones of the nearest pole. Poles, here, are identified as municipalities with more than 25,000 inhabitants (our elaboration on ISTAT data).
f. *Provincial fixed effects*. In order to control for other provincial specific factors, especially due to possible provincial policy or administrative decision, we included a dummy at NUTS3 level for which province they belong to.

It is important to note that municipalities administrative boundaries are identified as for the 2001 census, hence all administrative variation occurred before and after (specifically in the period of time 1991-2001 and 2001-2011) are traced back to the units identified for the 2001 census. All data have been then corrected – when needed – accordingly.

3.2 Selection of a suitable control group

The second step in our empirical strategy is to develop a suitable control group for our analysis. This is a core step for our research since the control group should give us the baseline on which calculate the treatment effect on affected municipalities. The adequate selection of control group is fundamental. Indeed, selecting a viable control group will enable us to indirectly isolate the effect of community resilience triggered by the earthquake.
We had two precise needs guiding the construction of the control group: being similar and comparable to our treatment group especially from a spatial and geographical point of view, and meeting the parallel trend assumption required by the model. In order to perform all of this, we employed a common matching technique (Rosenbaum

and Rubin 1985), making use of a popular matching algorithm via Stata known as psmatch2 (Leuven and Sianesi 2003 - Stata module).
Matching algorithms are incredibly useful, by easily doing for us a lot of the computational work required to match our case study over a population of more than eight thousand units.
The parallel trend between treatment and control group on population variation before the 1997 earthquake was here the main concern. We needed to match our treatment group with a control having the same population variation trend, as well as similar spatial and geographical characteristics. Since the algorithm does not allow for panel data we resolved by using the mean population variation for the years 1991-1996 as the output variable – namely the main matching variable. Considering that the mean variation is a relative value, we also restricted the matching only to municipalities under 25k inhabitants and we considered the absolute population at our first observation in time, 1991, as one of the covariants in the matching process.
Also, in order for our control group to best reflect the geographical and spatial characteristics of our treatment group, we considered two other characteristics. First, we restricted the matching again to exclude every coastal municipality and municipalities over 2000 m a.s.l. Second, we employed both categorical and continuous variables again as covariants to reflect the characteristics of our treatment group.
We employed a matching factor of 1 to 10, meaning that for every unit in the treatment group we located the 10 most suitable ones for the control group. Table 1 shows the fairly similar distribution between treatment and control group over the main geographical and spatial characteristics.

TABLE 1 • DESCRIPTIVE SPATIAL AND GEOGRAPHICAL STATISTICS FOR TREATMENT AND CONTROL GROUP

	Mountain degree					
	<=299	300-599	600-899	900-1199	1200-1499	
Treatment	5	27	13	7	3	
Control Group	62	150	143	69	29	
	Population size					
	< 500	501-1000	1001-2500	2501-5000	5001-10000	>100001
Treatment	9	9	18	8	8	3
Control Group	58	74	153	102	40	26
	Concentration of population					
	Not concentrated	Concentrated single center	Concentrated two or three centres	Concentrated multiple centres		
Treatment	35	4	7	9		
Control Group	239	76	52	86		

Considering the Italian context of rural communities, we also checked socio-economic indicators and the geographical distribution of the control group on the Italian territory to avoid eventual bias due to omitting important variables (Wooldridge 2013).

Table 2, shows means and standard deviations for common socio-economic indicators in our treatment and control group. Data are provided by Istat, for the 2001 census. No indicators suggest relevant socio-economic differences between the two groups.

As final step to validate our control group, we checked its geographical distribution on the Italian territory. Problems could generate over an excessive geographical clusterisation of the control in the Northern or Southern part of Italy since they have a fairly different history and cultural development. Map 2 shows the distribution over

the national territory. Our control group well represents the diversity of Italian rural areas, both in the North and South part of the peninsula. The map shows only a light clusterisation of the control over the Apennine ridge between Toscana, Emilia-Romagna and Liguria, which is ideal since the area is quite similar (both from a spatial, geographical and socio-economic perspective) to our treatment group.

TABLE 2 • DESCRIPTIVE SOCIO-ECONOMIC STATISTICS FOR TREATMENT AND CONTROL GROUP

	Treatment	Control Group
Dependency Index	0.66	0.63
	(0.13)	(0.15)
Education Inequality*	1.34	1.31
	(0.07)	(0.08)
Pct Foreigners	0.03	0.02
	(0.02)	(0.02)
Employment	0.95	0.92
	(0.02)	(0.07)
Female Employment	0.38	0.37
	(0.04)	(0.04)
Pendolarism	0.43	0.41
	(0.06)	(0.08)
Employed in Agricolture only	0.06	0.07
	(0.04)	(0.06)
Electoral Participation, 1999 European elections	0.82	0.76
	(0.1)	(0.06)
Pct religious Marriages	0.72	0.75
	(0.25)	(0.24)

* Ratio between Pct of people with no high school diploma and people with a university degree. Source: Istat, Census 2001.

3.3 Modelling the difference in difference analysis

In order to have a measure of the impact of the earthquake on population variation over depopulating Italian rural communities, we made use of a popular technique

known as difference in difference analysis (Lechner 2011). Our universe is composed by two groups of municipalities, a treatment group (municipalities affected by the earthquake) and control group (municipalities not affected by the earthquake), the latter is developed via matching techniques. Yearly population variation is observed for both groups in the period before and after the treatment, their comparison is thus used to estimate the effect of the treatment (DD effect).
The starting point is our dependent variable, population variation, which is modelled by the following equation

$$Y_i = \alpha + \beta T_i + \gamma t_i + \delta(T_i * t_i) + \varepsilon_i \qquad \text{(dependent variable)}$$

The coefficient $\alpha, \beta, \gamma, \delta$ are unknown parameters, while ε_1 is the random unobserved error containing the determinants omitted by the model. Coefficients are interpreted as follows:

Y_i = Dependant variable (Yearly variation in population)
α = Constant
β = Treatment group specific effect
γ = Common (between treatment and control) time trend
δ = True effect of the treatment

In order to measure the impact of the earthquake we estimated the differences in average population variation for the treatment group (T) before and after the treatment subtracting the same difference for the control group (C). The treatment period is indicated by 1 (after treatment) and 0 (before treatment). The resulting estimator is called, "difference in difference" estimator (DD)

$$\delta_{DD} = \overline{Y}_1^T - \overline{Y}_0^T - \left(\overline{Y}_1^C - \overline{Y}_0^C\right) \qquad \text{(DD estimator)}$$

This estimator, known also as "double difference" estimator, takes the difference between the pre-post comparison of the treatment group and subtracts the difference from the same comparison in the control group (which serves as baseline capturing the time trend). The resulting δ_{DD}, or simply "DD" is hence able to capture the variation generated by the treatment.

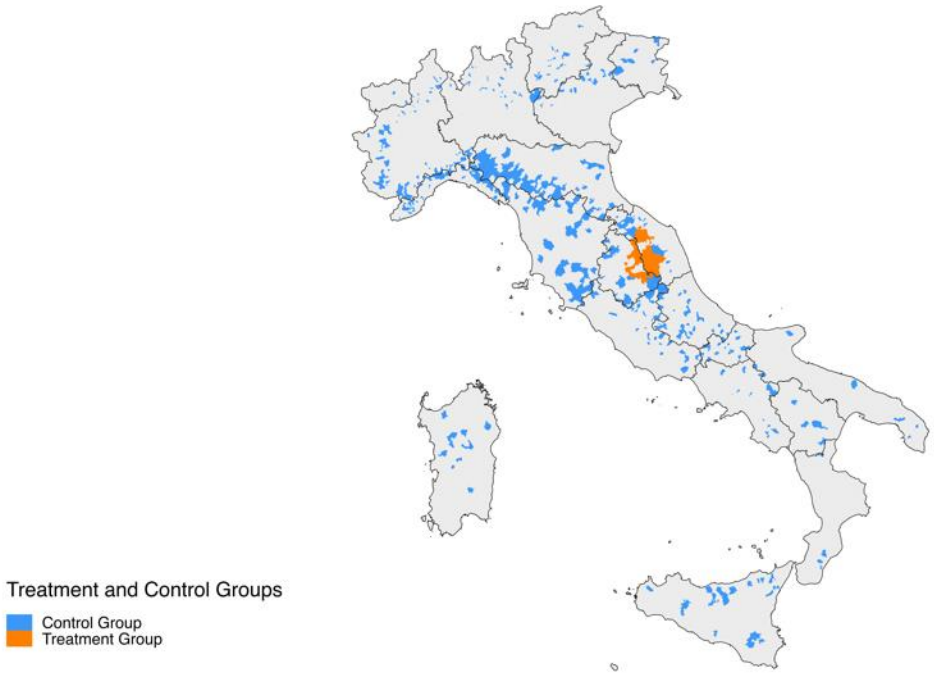
3.4 Identify better and worse performing groups of municipalities inside the treatment group

Finally, in order to highlight differences inside the treatment group and detect – if any – driving geographical and spatial effects, we first have to define better and worse performing groups of municipalities.

We followed the same logic than before by looking at performances in population variation, also considering that a general trend of depopulation is consolidated for mountainous and rural communities across all Italy. We defined as 'good performing municipalities' all the affected municipalities that in the 5 years period after the earthquake had a better population variation ratio than in the 5 years before.

In the same way, we defined as 'better performing municipalities' all the affected municipalities in the fourth quartile of the after-before population variation ratio. And, on the other hand, we identified a group called 'bad performing municipalities', when population variation in the after-period is worse than before, and the 'worse performing municipalities' group identifying the first quartile of the ratio.

MAP 2 • TREATMENT GROUP AND CONTROL GROUP



4. PRESENTATION AND DISCUSSION OF RESULTS

4.1 Effect of the earthquake on population variation

In the discussion of our empirical strategy, we have shown how we decided to operationalise the concept of community resilience. The operationalisation of a concept is, indeed, a heuristic process meant to translate it into indicators and measurable variables. Where most of the concepts are easily operationalised, the early stage of development of the concept of resilience in social sciences makes the process more complex. We shaped our empirical strategy to deal with this problem by going from a single theoretic definition of community resilience (as a "Dynamic process composed by many adaptive capacities to response and change after adverse events") to splitting the concept into two for its operationalisation: the ability for resilience and the effect of resilience.

Operatively the ability for resilience of communities is a complex adaptive ability composed by a set of capacities, where instead the effect of resilience is the combined effect that such ability has over time in response to a disturbance of the system. This paper focuses solely on the effect of resilience in dealing with a socio-natural disaster and – like for the selection of our unit of analysis – some key factor guided our operationalisation strategy. These key factors can be represented in a simple question: resilience to what?

Indeed, the effects of resilience (and consequently how to measure them) change drastically by changing what we are interested in. More economically grounded studies on community resilience may be interested in economic performances, and then employing economic indicators such as GDP, employment, indicators for innovation and so on (Hassink 2009; Christopherson *et. al.* 2010; Faggian, Modica and Urso 2018). Likewise, studies on recovery from socio-natural disasters may want to focus on physical or institutional infrastructures (Haas *et al.* 1977; Carpenther 2015; Carnelli and Frigerio 2017).

Our specific interest in community disaster resilience of Central Italy rural communities drove us to select population variation as a proxy for the effect of resilience. This is not completely new. Indeed, the variation of population over time – declined in various forms, from population growth to the rate at which different areas repopulate after a disaster – has been already used in literature on disaster resilience in many different contexts indicated as an observable effect of resilience of the community (Chamlee-Wright and Storr 2009; Aldrich 2013).

Our first step was to perform a difference in difference analysis between our affected municipalities and our control group to isolate the earthquake effect on population variation. To do so, we run a regression on panel data for our 55 municipalities composing the treatment group and for 453 municipalities selected as control group over a 20 years time span between 1991 and 2011. The earthquake's effect ("DD Effect" coefficient) is given by the interaction between the time trend and the treatment group.
Results are reported in table 3.
The first column of the table shows some interesting results. First, there is a significant ($t = 2.44$) positive effect on population variation after the earthquake. This does not mean that after the earthquake the affected municipalities started repopulating. Rather, it means that – after the earthquake – the affected municipalities performed better (in terms of population variation) than the control group, which is what was expected to happen without the earthquake itself. The simplest way of saying it is that the affected municipalities performed better than expected after the treatment.

Inside our framework, this represents the consequences of the ability for community resilience in the recovery period triggered by the earthquake of 1997. Effect which is, here, isolated from spatial and geographical characteristics thanks to our controls.
Indeed, from a spatial and geographical point of view, common and well-supported trends can be easily identified by looking at the coefficients. These suggested trends show a well-known, but not so endearing, situation for Italian rural communities. All the coefficients are highly significant ($p<0.001$) and indicate that smaller communities perform worse than bigger ones. Especially in the case of municipalities under 500 inhabitants, here our baseline category. The concentration of inhabitants in cities, villages and hamlets also plays an important role in population variation. Interesting enough not only where more than 70% of population is concentrated in those centres these perform better, but is also the case that we have generally better performances when inhabitants are concentrated over two or three poles rather than a single one.
Physical geography also plays a substantial role here, where communities situated in mountainous areas, especially over 900 m a.s.l., perform worse than the ones sitting on hill ground. Finally, the distance from the nearest pole[4] – expressed here in meters

[4] In the framework of our study poles are identified as cities over 25,000 inhabitants, since they generally are the places around which services and job market gravitate.

– identifies a strong correlation where the farther a community sits from a pole the worst it performs.

The second set of results comes from the comparison between the first column and column two to four, where we report the results of the same regression on different subsets of the treatment group. Namely, these subsets are: "Good Performing municipalities" (2), "Better Performing municipalities" (3), and "Worse Performing municipalities" (4).
There are two things we believe to be important to notice. First, by looking at the coefficients for the DD effect – column (2) and column (3), in this case, since column (4) is not significant – it is confirmed that we identified the subgroups effectively. In column (4) the DD effect coefficient for the "Worse performing municipalities" is not significative ($t = -1.56$). This suggests that even in the bottom one of our performance subsets the treatment still had a stabilising effect turning the expected negative coefficient into a not significative one.
Indeed, the other coefficients behave as expected by growing - almost doubling - between columns one and two, and then growing again in column three. On the other hand, however, all the coefficients for the controls change only marginally. This lack of substantial change between the controls' coefficients of column one and columns two to four is incredibly relevant. It highlights that there is no clear clusterisation of good or worse performing municipalities over one or another variables, therefore suggesting no discernible relations between better or worse performing municipalities and the spatial and geographical characteristics. This internal dimension to the affected area will be more extensively elaborated in the next paragraph.
Our results support the idea of a common trend where rural communities - i.e. smaller communities, living in mountainous areas further from poles of services - have more difficulties dealing with variation of population. On the other hand, they also indicate that the earthquake had on this area somewhat of a stabilising effect, resulting in the affected municipalities behaving better than the one in the control group.
Also, the comparison of coefficients for the same variable - exemption made for the mountains degree, where the ordinality is clear - does not suggest the existence of ordinalities of sort. In other words, rural communities do suffer more from depopulation, but our results suggest that the relationship with spatial and geographical characteristics is not purely linear.

TABLE 3 • DIFFERENCE IN DIFFERENCE COMPARISON TABLE

	(1)	(2)	(3)	(4)
	Affected Area	Good Performing	Best Performing	Worse Performing
Time Trend	-0.00227***	-0.00227***	-0.00227***	-0.00227***
	(0.000415)	(0.000415)	(0.000415)	(0.000415)
Treatment Group	-0.00523***	-0.00763***	-0.00824***	0.0155
	(0.00120)	(0.00113)	(0.00216)	(0.00799)
DD Effect	0.00318*	0.00627***	0.00888***	-0.0144
	(0.00130)	(0.00119)	(0.00235)	(0.00924)
< 500	0	0	0	0
	(.)	(.)	(.)	(.)
501 – 1000	0.00414***	0.00427***	0.00420***	0.00422**
	(0.00116)	(0.00123)	(0.00124)	(0.00128)
1001 – 2500	0.00382***	0.00420***	0.00448***	0.00511***
	(0.00110)	(0.00116)	(0.00117)	(0.00121)
2501 – 5000	0.00529***	0.00555***	0.00601***	0.00639***
	(0.00115)	(0.00121)	(0.00124)	(0.00127)
5001 – 10000	0.00586***	0.00659***	0.00711***	0.00789***
	(0.00118)	(0.00124)	(0.00126)	(0.00131)
10001 – 25000	0.00470***	0.00488***	0.00574***	0.00680***
	(0.00125)	(0.00131)	(0.00134)	(0.00138)
Not Mountainous/ Hills	0	0	0	0
	(.)	(.)	(.)	(.)
600 – 899	-0.00377***	-0.00367***	-0.00377***	-0.00375***
	(0.000519)	(0.000531)	(0.000549)	(0.000565)
900 -1199	-0.00621***	-0.00586***	-0.00599***	-0.00595***
	(0.000859)	(0.000906)	(0.000932)	(0.000940)
1200 – 1499	-0.00602***	-0.00626***	-0.00631***	-0.00680***
	(0.00145)	(0.00147)	(0.00148)	(0.00153)
Sprawled	0	0	0	0
	(.)	(.)	(.)	(.)
Monocentric	0.00159***	0.00129**	0.000866	0.000627
	(0.000460)	(0.000467)	(0.000499)	(0.000511)
Bi/Tri-centric	0.00392***	0.00376***	0.00322***	0.00340***
	(0.000584)	(0.000598)	(0.000648)	(0.000667)
Distance from nearest Pole	-0.000000338***	-0.000000343***	-0.000000338***	-0.000000339***
	(3.19e-08)	(3.21e-08)	(3.27e-08)	(3.31e-08)
_cons	0.0115***	0.0114***	0.0113***	0.0111***
	(0.00176)	(0.00179)	(0.00180)	(0.00182)
N	10040	9600	9200	9020
adj. R-sq	0,124	0,131	0,13	0,131
			Standard errors in parentheses	* p<0.05, ** p<0.01, *** p<0.001

4.2 Internal spatial and geographical differences

In the second step of our analysis, we used logistic regressions to study the relationship between the performance of municipalities and spatial and geographical characteristics for the affected area. Indeed, the first step of our analysis suggests that, despite a common trend of rural communities being more afflicted from depopulation in Italy, there is no consistent relation inside our affected group of municipalities between these characteristics and their performance. Map 3 shows the spatial distribution of affected municipalities by different performance groups and, in black provincial boundaries. It is noticeable that worse performing municipalities are somewhat concentrated in the southern area of Macerata's province. But, exception made for this, no other pattern is immediately manifest.

In order to examine this relation more in-depth, we focused our analysis on good and best-performing groups of municipalities to highlight eventual clusters over different categories. Logistics regression were run first over every Italian municipality under 25,000 inhabitants (for baseline), and then solely on the affected area. The dichotomous dependent variables used were the ones representing 'Good' and 'Best' Performing municipalities. Such groups of municipalities were selected ex-post via the difference in the after-before population variation ratio. Good and best performing municipalities both perform better in the after-period, the group of best performing holds the most positive ratios.

Table 4 summarises our results.

Column one (1) shows the results for all Italian municipalities under 25,000 inhabitants. They mostly confirm the pattern which sees smaller municipalities and more mountainous ones, situated farther from service poles, being less represented in the success group. The logistic regression was run on a wide set of municipalities (7425 Obs.). All variables are significative, at least at $p < 0.05$, exception made for the categorical variable representing the concentration of population in one or few centres (against more sprawled municipalities) which is not significant. This suggests that this kind of spatial distribution differences might be more relevant for our rural communities but it fades when using a wider dataset.

In other words, such rural – smaller municipalities and more mountainous ones, situated farther from service poles – communities had more problems and, generally, a worse yearly mean population variation over time. These facts, per se, do not uncover anything new, indeed this first column is our baseline to interpret the next two columns.

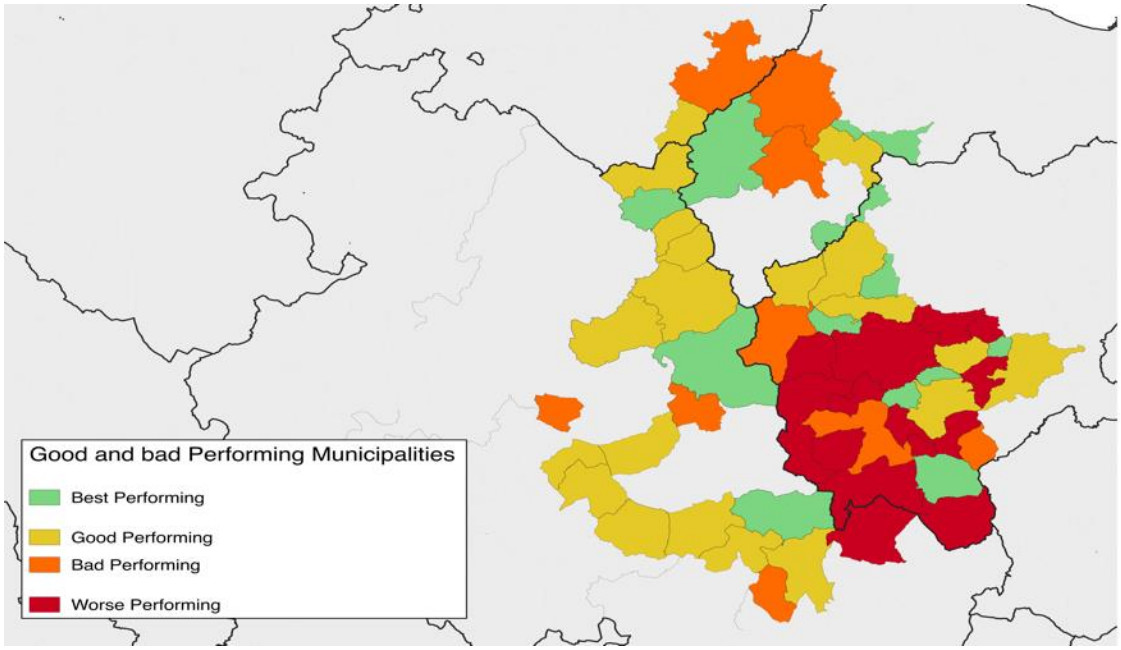
TABLE 4 • LOGIT COMPARISON

	Italy	Affected municipalities	
	success_general	success	super_success
Distance from nearest Pole	-0,00000906**	-0,000125	-0,000277*
	(0,00000290)	(0,0000956)	(0,000139)
Mountain Degree			
Not Mountainous/ Hills	0	0	0
	(.)	(.)	(.)
600-899	-0,209*	0,659	1,091
	(0,0858)	(1,031)	(1,173)
900-1199	-0,374**	-3,475	0
	(0,114)	(1,950)	(.)
1200-1499	-0,386*	3,431	5,043
	-0,151	(2,709)	(3,341)
1500-1999	-0,0572	.	.
	(0,164)	.	.
2000-2499	-0,0770	.	.
	(0,246)	.	.
>2500	-0,574	.	.
	(0,726)	.	.
Population Concentration			
Sprawled	0	0	0
	(.)	(.)	(.)
Monocentric	-0,0774	2,106	-0,812
	(0,0789)	(1,961)	(2,150)
Bi/Tri-centric	-0,0355	3,366	2,226
	(0,0749)	(1,908)	(1,531)
Population size			
<500	0	0	0
	(.)	(.)	(.)
501-1000	0,244*	3,391	3,381
	(0,101)	(2,061)	(2,364)
1001-2500	0,252*	0,641	-1,058
	(0,104)	(1,835)	(1,797)
2501-5000	0,249*	0	-1,129
	(0,112)	(.)	(2,314)
5001-10000	0,490***	1,557	0,0845
	(0,122)	(2,081)	(1,985)
10001-25000	0,388**	0,316	0
		(2,316)	(.)
_cons	-0,133	1,921	2,250
	(0,150)	(3,018)	(2,228)
Obs	7425	47	43
adj. R-sq	0,074	0,28	0,254
		Standard errors in parentheses	* p<0.05, ** p<0.01, *** p<0.001

Column two (2) and three (3) report the results for the logistic regressions on the possibility to be part of 'Good performing' (2) and 'Better performing' (3) groups, only for the municipalities affected by the 1997 earthquake in our case study. The results are pretty clear to report. All the selected predictors here lose any explanatory power they had in the baseline regression. Indeed, when fitting the model over our specific case study, it does appear that such geographical and spatial characteristics are not able to explain the distribution of municipalities over 'Good' and 'Better' performing groups.

Interpreted inside our theoretical framework, these results suggest that even though our predictors are able to partially explain the differences in the general trend of population variation over time, the same predictors fail at the job when dealing with only our earthquake affected municipalities, losing any explanatory power. Different characteristics and degrees of rurality do not create significant differences over the effect of community resilience triggered by the disastrous event.

MAP 3 • SPATIAL DISTRIBUTION FOR PERFORMANCE GROUPS



These results, coupled with the ones from the difference in difference, are the main findings of this study. They support the hypothesis that spatial and geographical characteristics, despite having a clear and well established general effect on population variation, do not have the similar penalising role on community resilience after an

earthquake. These finding suggest that, the effect of community resilience for an all-rural earthquake affect area is fairly consistent over different degrees of rurality.

5. CONCLUSIONS

5.1 The double effect of space

We started this study with a question about the role of spatial and geographical characteristics for the community disaster resilience of Italian rural communities. Although we analyse only one case study, the 1997 earthquake's affected area, we believe our quasi-experimental design for this paper is able to provide interesting insights on this causal relation, which can be generalised at least for the Italian context of rural community.

The first result that our study highlights is that the 1997 earthquake had a general stabilising effect on population variation in the affected area. Indeed, the DD effect in Table 3 indicates that such communities generally performed better than they had before. We called it a stabilising effect because the ratio of population variation in the after-period does not become positive, but instead it simply turns to be less negative compared to what it should have been without the earthquake. We believe this to be an interesting first result calling for a more in-depth analysis of the phenomenon via comparative studies.

Our intuition to explain it is that such effect is related to the completely public founded nature of the reconstruction process and policies. Public reconstruction was able to drive and support the resilience capacity embedded in the communities (Imperiale and Vanclay 2016), generating a stabilising effect on population variation for all the affected area.

The main focus of this study is space, for which we have isolated the effect of community resilience over different spatial characteristics and degrees of rurality. What emerges from the interpretation of our results is the presence of a 'double effect' of space.

On the one side, we are able to identify a well established spatial and geographical effect which shows that rural communities are less able to contrast a negative population variation trend over time. Inside our framework, we used population variation over time as a proxy for the effect of community resilience, hence our contribution here supports the idea that rural communities are penalised in this regard

from their geographical and spatial characteristics. Moreover, we were able to show the existence of a direct ordinality in those characteristics. By comparing rural communities among each other, rather than rural against urban communities, we were able to explore the characteristics of rurality on different levels. Our results indicate the presence of a correlation between municipalities ratio of population variation over time and them being situated in a more mountainous and high above sea level area far from big cities of centres of labour and services agglomeration. In the same way, also the internal spatial distribution of population - as well as the size of communities - shows a similar ordinality where smaller and more sprawled communities perform worse in the same regard.

The contribution of our study to the literature on resilience of rural communities comes from comparing, on the same characteristics, good and bad performing communities after a disaster. Indeed, our initial expectation when designing the research was to find a similar ordinal pattern showing a clusterisation of better performances in less rural areas, or at least indications of such correlation between rural characteristics and performance in population variation after the earthquake. Interesting enough our results show no detectable spatial and geographical patterns that enable us to identify better and worse performing municipalities when dealing with the aftermath of a socio-natural disaster. Indeed, all the coefficients and the relative standard deviations for our difference and difference, not only maintain the same ordinality but they also remain very constant across every regression. Considering that the effect of the earthquake varies accordingly to the different iterations - it almost doubles between the baseline and the regression for the "Good Performing" (2) - and also the considerable lack of explanatory power of the mentioned characteristics in identifying good and bad performing municipalities, our results suggest that spatial and geographical characteristics might only play a minor (minor than expected at least) role than expected.

Building on these first contributions, there are a series of research directions open for the future. Italy is not only largely composed of rural communities, but many of them are also disaster prone areas. The study of the relationship between such communities and their disaster resilience ability is then largely relevant both from an academic point of view and from a policy one.

Indeed, our contribution suggests that when dealing with a socio-natural disaster these communities are not less, neither more, resilient than urban ones; they are differently resilient.

Our study deals only with geographical and spatial characteristics of rural municipalities while isolating the effect of community resilience via our quasi-experimental empirical strategy.
In the end, what this study points out is that community disaster resilience works differently for these rural communities and that a combination of social, economic or institutional characteristics might play a more decisive role in community disaster resilience for rural communities. We were able to determine ex-post 'Good' and 'Bad' performing municipalities, showing that the spatial characteristics we considered were not able to explain their differences. More research is needed to understand which social, economic and institutional characteristics drive different performances. Nonetheless, our study is a starting point in this direction by identifying 'good' and 'bad' performing municipalities in relation to different spatial and geographical characteristics.
Rural communities are an important asset for Italian administrations and are often subjects of study and implementation of policies. Arguably, no other Italian territory is today more in need of public support and tailored policies than Central Italy. In this regard, our study and the future research that it will open up, can provide a useful framework and baseline to design effective policies tailored to the context which - following our results - could be successfully applied to different degrees of rurality.

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GEORGIOS MANALIS

LAND RIGHTS AND RISK SHARING IN RURAL WEST AFRICA[1]

Abstract. Despite arduous efforts of advancing land rights in Africa, most of the continent experiences low levels of ownership security.[2] Land reforms introduced by the state have failed to deliver the desired results of officially recognized property. I propose a novel contextualization of land rights that motivates a theoretical model to account for land reforms' effects when implemented in weak institutional environments with high risk. In environments such as rural Africa, communities have developed informal mechanisms of risk-sharing to provide households with a safety net. Therefore, when a land reform, aiming at granting individual property rights, takes place, it operates in a highly antagonistic way to the established informal insurance mechanisms. I use survey data from a land reform initiated in Burkina Faso in 2009 to evince the interaction between land holdings and transfers among community members. Subsequently, I build a model of risk-sharing with limited commitment to explain the competing forces developed between statutory land reforms and customary risk-sharing networks at a community level. The model shows that a land reform increases the share of surplus that a villager can extract from a risk-sharing contract among community members and decreases the profits of the community. Additionally, it shows a non-monotonic relation between land allocation and productivity pointing towards a trade-off between output efficiency and size of risk-sharing. It accurately accounts for the low participation rates from rural population to the Burkina Faso land reform and it provides a reasoning for potential land misallocation.

Keywords: land reforms, property rights, one sided limited commitment, optimal recursive contracts

[1] I would like to acknowledge Brais Álvarez Pereira for his immense help and Alessandro Ferrari for his insightful comments.

[2] See Figure 3.

I. INTRODUCTION

Agricultural village communities in rural areas across Africa have developed informal mechanisms of risk sharing in order to overcome the high-risk environment within which they operate. These informal mechanisms are mostly comprised of borrowing and lending or gift and loans in the form of consumption units, among members of the community.[3] These insurance transfers are developed at a local level, since they are mostly based upon spatially concentrated characteristics such as family kinship, ethnic descent or tribal belonging.

At the same time, development economics have emphasized the critical role of strong property rights in economic growth. The main benefits from individual ownership can be summarized into three broad categories.[4] The assurance effect, which would provide the necessary incentives to productively invest to land, since land is securely owned by the rights' holder. The transferability effect, which would allow more efficient land users to gain access to land through purchases.[5] The collateralization effect, which would allow the owner to pledge the plot as a collateral and hence gain access to credit.[6] However, the existing theory on benefits of property rights overlooks the already established mechanisms in the affected African communities. Pre-colonial institutions at an ethnic level strongly live up until today in rural Africa, creating conflict between statutory institutional interventions stemming from state initiatives and customary norms deeply rooted in African history.[7]

Even though, property rights are crucial for agricultural production, and rural African communities are mostly based on agriculture, the risk-sharing informal institutions do not require of firm individual property rights. Land ownership is reassured in the context of the community, but not formally. Villagers-farmers perceive their land as their own even without an official certificate of land ownership issued by a state authority. Since agricultural activity in rural Africa is usually confined in the limits of the village with production mostly aimed for household consumption, land ownership is sufficiently recognized at a communal level.

[3] Platteau, 1991.
[4] Bambio and Bouayad Agha 2018; Brasselle *et al.* 2002.
[5] Bambio and Bouayad Agha 2018.
[6] Feder and Nishio 1998.
[7] Michalopoulos and Papaioannou 2013.

The claim of the paper is that land reforms initiated by governmental authorities aiming at firmly establishing individual property rights, constitute an antagonistic mechanism to the risk reduction arrangements at a communal level. The theoretical premise lies on the fact that reforms attempting to render land as privately owned, interact with the main production factor (land) that forms the basis of the risk-sharing mechanism.

The case of Burkina Faso constitutes an illustrative example of a state that implemented a land reform aiming at establishing strong individual property rights. The reform was initiated by the enactment of a truly innovative and inclusive rural land law, allowing individuals to register their plots and obtain a certificate of official recognition. The legislation was followed by an extended effort to disseminate information about the formal procedure to be followed by individuals that wanted to register their plot. At the same time, the law did recognize the role of customary norms in land management. In order to include the affected communities and avoid the emergence of land disputes, it allowed for a period in which any objections to individual registration could be raised. In other words, it allowed for the approval of the community for individually enacted land registration. It has to be noted that this governmental plan to reform land management was closely assisted by the Millennium Challenge Corporation, which was actively engaged in all stages of implementation. Regarding the evaluation of the success of the Burkinabe plan, the results were not as expected. The number of approved land registrations and the number of agricultural households receiving certificates of ownership recognition were far below the set targets. Indeed, according to the United States Agency for International Development,[8] the land management almost a decade after the enactment of the law keeps on being under customary norms and community control.

To theoretically account for risk-sharing and land reform as competing mechanisms, I employ a model of optimal recursive contracts with limited commitment. A principal, head of the community and an agent, the individual farmer engage into reciprocal stage contingent transfers of consumption units. While the principal is fully committed, the agent can renege the contractual agreement at any point in time. Hence, in order for the risk-sharing mechanism to be sustainable, the principal must offer the agent a consumption path that is at least equal to her outside option. The outside option is the interaction channel between statutory land reform and community risk-sharing. Within this framework, I model the individual farmer as a small agricultural

[8] USAID, 2017.

household, which uses land as a production factor. In order to accurately trace the practices of African communities, I allow the fraction of land allocated to each household to be decided centrally by the principal. This is consistent with the practice of periodic redistribution of land in rural West African villages. This extension renders land as an additional insurance mechanism coexisting with consumption transfers inside the contract. In the presence of a land reform and limited commitment, the outside option of the household is to register the fraction of land that was lastly allocated within the contract and renege the contractual agreement. This distorts the incentives of the community to allocate land according to idiosyncratic productivity levels in order to render the contract sustainable. The antagonistic force stemming from the existence of a land reform entails efficiency costs on the functioning of the communal risk-sharing mechanism.

The paper unfolds as follows. In section 2, the related literature is presented. In section 3, the background of the 2009 land reform in Burkina Faso motivates the study. In section 4, empirical regularities from Burkinabe survey data before and after the reform evince the interaction between land holdings and risk-sharing. In section 5, the theoretical model of a second generation optimal contract with limited commitment is presented, in order to account for land re-allocation. Lastly, section 6 draws policy inferences and concludes the study.

2. LITERARY REVIEW

A large strand of literature advocates the importance of property rights in economic development. De Soto explicitly stresses the importance of property rights in alleviating poverty.[9] He considers secured property rights as the means to higher investment, easier access to credit and higher surplus value creation. Besley and Ghatak extensively study multiple channels through which property rights affect economic activity and how property rights are endogenously determined.[10] Based on this premise, in an attempt to quantify the effect of strong property rights on the access to credit markets (de Sotto effect). Besley *et al.* are challenging the 'magic bullet' nature of property rights reforms, when they are applied to environments with weak institutional frameworks.[11]

[9] De Soto 2001.
[10] Besley and Ghatak 2010.
[11] Besley *et al.* 2012.

Moving from the general study of property rights into the narrower field of land rights and agricultural production in rural Africa, Besley provides empirical evidence from Ghana.[12] According to this study, strong property rights incentivize investment through multiple theoretical channels. However, strong property rights might emerge endogenously as the result of increased investment. Along the same lines, Goldstein and Udry have emphasized the effect of the unclear property rights regime on agricultural investment taking advantage of fallowing as a common and beneficial practice in rural Africa.[13] However, the link between property rights and investment is yet to be solidly established. Brasselle *et al.* make an exhaustive review on the empirical studies conducted in rural Africa, attempting to link property rights and investment incentives.[14] They infer there is no systematic pattern across Sub-Saharan countries. This is due to the simultaneity that property rights and investment exhibit. Making long-term investments on a land plot constitutes a way of establishing ownership over it. On the other hand, having secured property rights allows the producer to make long-term investments. This two-way relationship is hard to disentangle in the data and reach a conclusive result.

The present paper links the concept of property rights with the distinctive characteristic of risk-sharing in rural communities. The particular environment of small communities engaging into transfers of consumption units to tackle adverse shocks has been a fruitful field to apply theories of optimal contracts. Townsend explores the magnitude of risk sharing in Indian villages.[15] He finds a substantial flexibility from the side of community to adapt to adverse shocks, concluding that the assumption of perfect insurance in village communities is not absurd. Ligon *et al.* build on the model of risk-sharing with limited commitment in order to explore the imperfect insurance observed in village economies.[16] The form of transfers among the members of the community is studied by Platteau and Abraham and Udry that find that loans can actively serve as a risk-insurance mechanism.[17] [18]

The theoretical premise of this paper is that land rights reforms and community risk-sharing are competing forces. In particular, I study an environment of risk-sharing, in the spirit of Thomas and Worrall and Kocherlakota, in which the main friction is

[12] Besley 1995.
[13] Goldstein and Udry 2008.
[14] Brasselle *et al.* 2002.
[15] Townsend 1994.
[16] Ligon *et al.* 2002.
[17] Platteau and Abraham 1987.
[18] Udry 1994.

limited commitment.[19] [20] However, models of this class assume an exogenous outside option, set at the level of autarky. In the theoretical framework presented in this paper, the level of the outside option is endogenous and depends on the functioning of the contract. More theoretical works that relate the contract allocation to the outside option are Ligon *et al.*, in which the self-insurance outside option is determined by storage opportunities within the contract and Cooley *et al.* who set the value of repudiation of financial contracts being dependent on the level of investment that took place within the contract.[21] [22] The closest paper to mine is Koeppl who studies the third party enforcement of contracts which is costly and its cost depends on resources allocated to it, within the contract.[23]

The paper in hand provides a novel contextualization of property rights and risk insurance mechanisms in small agricultural communities as competing mechanisms. It identifies the channel of transmission of land reform effects on risk-sharing contracts through the increase of the outside option. This results in land reforms jeopardizing the insurance networks by increasing the bargaining power of the individual within the community. Concerning the theoretical literature on optimal contracts with limited commitment, the contribution of the present paper lies on the interaction between the outside option and the functioning of the contract. This creates trade-off dynamics between the incentives of the principal to gain more and the incentives of the agent to deviate from the agreement.

3. Background on the land reform in Burkina Faso

A motivating example for the present study is the case of Burkina Faso, a landlocked country in the Western Africa's Sahelian zone. The economy of Burkina Faso is mostly based on agriculture (Fig. 4), with a recent increase of mining activities due to a gold mining boom in 2009-2010. The vast majority of working population is engaging to rural activities (90%). The predominant form of agricultural production is small-scale farming, managed by members belonging to the same lineage or family.[24]

[19] Thomas and Worrall 1988.
[20] Kocherlakota 1996.
[21] Ligon *et al.* 2000.
[22] Cooley *et al.* 2004.
[23] Koeppl 2007.
[24] USAID 2017.

Land use in Burkina Faso faces considerable problems mainly due to rapid increase of population fueling competition for available land, high internal migration and climate change. While those threatening factors are in place, land tenure security scores are at a record low relative to other African countries (Fig. 3). After independence in 1960, management of Burkinabé land was following entirely customary norms with the government only managing protected areas.[25] The concept of private property over land appears in 1984 with the introduction of *Réorganisation Agraire Foncière* (RAF). This legislation granted all land to the state in an attempt to disrupt the control of traditional chiefs over land and allowed rural population to gain access to land following government's rules.[26] Amendments of this law (1991, 1996) introduced a type of private ownership through granting user-rights over plots of land.

3.1 Loi 034/2009

Much legislative progress has been achieved since the 1980s regarding land tenure. In 2009 Burkina Faso adopted an inclusive and genuine piece of rural land tenure legislation (*Loi 034/2009*). This law's application locus is rural land and aims at equitable access to land, enhancing productivity, sustainable management and social peace (Article 1, *Loi 034/2009*). The legislative procedure was preceded by the establishment of the National Committee for Secure Land Tenure (CNSFMR) under the ministry of Agriculture aiming to coordinating rural land policy reform. The plan's most striking characteristic was inclusiveness, in terms of reconciliation between statutory land management based on national laws and customary land tenure referring to local norms. Rather than alienating all informal land practices, it integrated them in a formal national legislation.

In the attempt of introducing, implementing and monitoring the new legislation the Burkinabé government was assisted by the Millennium Challenge Corporation (MCC). This partnership led to a 5-year compact plan (2009-2014) of \$58 million under the title Rural Land Governance Project (RLG) (see section 4.1). Three activities took place under the Rural Land Governance plan. The first activity comprised of legal and procedural changes and dissemination of the details on the new legislation to rural communities. Activity 2 focused on developing the necessary institutional

[25] Ouedraogo 2002.
[26] Hughes 2014.

changes and capacity building, while activity 3 performed site-specific land tenure interventions.[27]

3.2 Rural Land Certificate of Possession (APFR)

The aforementioned inclusive character of the 2009 land reform was reflected in the ability provided to individual farmers of issuing the so called Rural Land Certificate of Possession (Attestation de Possession Foncière Rurale, APFR). Articles 36-50 of the 039/2009 law outlines the procedures to be followed for the issuance of the APFR. The predominant characteristic of the APFR is that the community in which the individual, requesting the certificate, belongs to is strongly engaged in the procedure and has the capacity to veto it.

The APFR can be issued to either individuals or collective associations. The issuing period is 75 days conditional on no objections being raised by the community. Essentially, the community has to approve the request of the certificate before it is granted. The cross checking that the referred parcel does not belong to another individual is made with the direct involvement of the customary and traditional authorities.[28]

The APFR differs from full land title on the capacity that grants to the holder regarding sale of the allocated parcel. Productive use of land which can lead to profiting out of it is allowed, however, sale of the parcel to a third party is forbidden. Transfer of the certificate to members of the same family is allowed with no additional cost (Article 47, *Loi 034/2009*). Moreover, APFRs may be used to obtain bank loans depending on the bank's requirements. [29]

3.3 Assessment of the results of the RLG

However inclusive and innovative the land tenure legislation was, its results concerning grant of private ownership were not as expected. The Millennium Challenge Corporation (MCC), the organization responsible also for the monitoring and the implementation of the new legislation in close collaboration with the Burkinabé government, issued reports on the progress of the program.

[27] IMPAQ 2015.
[28] Hughes 2014.
[29] *Ibidem*.

TABLE 1 • RESULTS FROM LAND REFORM IN BURKINA FASO [30]

Indicators	Actually achieved (July 2014)	Target	(%)
Number of APFRs approved by the local government	2167	6000	36.1%
Number of HHs receiving APFRs	403	3000	13.4%

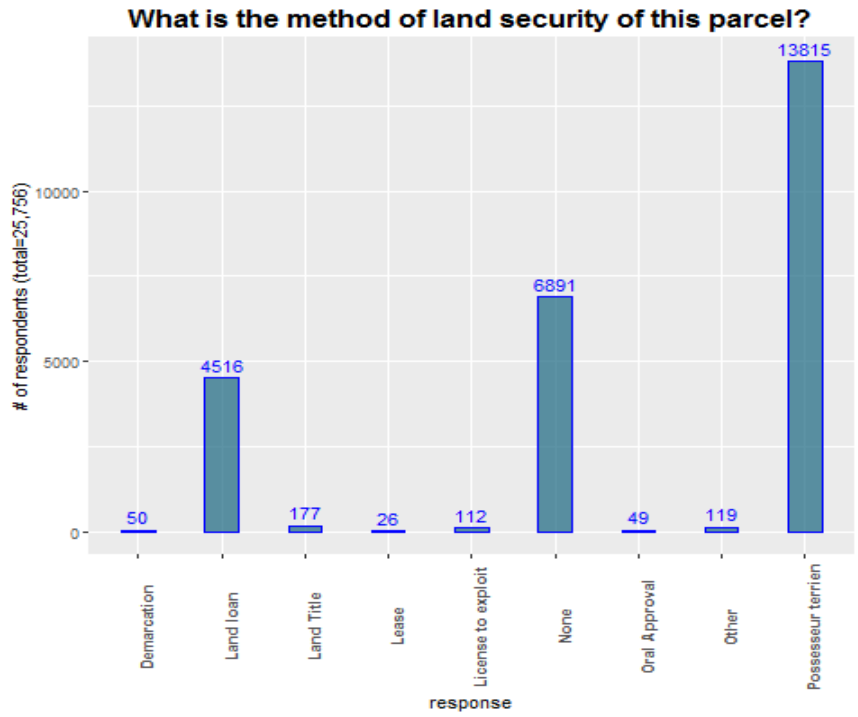
In Table 1 the results after the end of the 5-year plan are presented regarding the issuances of the APFRs. The difference between the actually achieved numbers and the targets set by the MCC is striking. A little more than one third of the set target of APFRs were approved by the local government, while the number of households actually receiving APFRs is a little more than one tenth of the target. Along these lines, the United States Agency for International Development (USAID) in its report on Burkina Faso in 2017, explicitly states: "Although the 2009 Rural Land Law and the 2012 RAF provide the mandate and mechanisms to formalize and secure a variety of tenure types in rural Burkina Faso, most rural land continues to be governed according to customary, informal rules, which differ between communities".[31]

In order to examine deeper the result of the land tenure reform in the region, I use survey data from the World Bank and in particular the Burkina Faso Enquête Multisectorielle Continue 2014 which belongs to the collection Living Standards Measurement Surveys (LSMS).[32] The study was conducted between 2014-2015 (5 years after the introduction of the reform) and it is nationally representative. Among many survey units there is the module referring to parcels which includes questions on the cultivating land each household holds. In Fig. 1, the responses to the method of land security are presented. It is striking that the option 'Land Title' which would correspond to an APFR is only answered by 177 respondents. From Fig. 1 it is apparent that the predominant land tenure regime is the 'Possesseur Terrien', which represents

[30] Even though by the end of the compact the target of 6000 APFRs approved by local authorities was not met, the MCC asserts that the project resulted to 13,447 filed applications for APFRs.
[31] USAID 2017.
[32] Institut National de la Statistique et de la Démographie. Enquête Multisectorielle Continue (EMC) 2014. Ref. BFA_2014_EMC_v01_M, https://microdata.worldbank.org/index.php/catalog/2538/get-microdata.

all native people that have inherited land from their family.[33] The second most answered option is 'None' indicating a complete absence of any official document certifying ownership.

FIGURE 1 • BURKINA FASO ENQUÊTE MULTISECTORIELLE CONTINUE 2014 - LSMS - WORLD BANK



The Burkina Faso land reform constitutes an illustrative case of the puzzle under examination. Economic theory has long advocated the benefits from establishing strong individual property rights. However, in the case of Burkina Faso, a puzzling phenomenon is observed. People are offered the opportunity to officially register their land plots, however they choose not to or they are prevented by local authorities. The reasoning behind this observation lies on the core of the present study. The premise which the theory builds upon is that land reforms introduced by the state act as a competing mechanism to the risk-sharing network developed in a community level.

[33] Ouedraogo 2002.

4. Data from Burkina Faso

4.1 Rural Land Governance Project

The empirical analysis is exploiting the Millennium Challenge Corporation (MCC) compact with the government of Burkina Faso. The ultimate aim of this project was alleviation of poverty by boosting economic growth. This 5-year plan, agreed in July 2008, consisted of four distinct projects aiming at different targets. The rural land governance (RLG) project, the agricultural development project, the roads project and the Burkinabé response improvement of girls' chances to succeed to schools' projects (BRIGHT II).

The present study focuses on the first project, the rural land governance. The motivation of the project was the pervasiveness of land conflicts due to scarcity of land resources and tension between statutory laws and customary norms regarding land tenure. Its primary target was to establish a legal framework through which rural population could gain easier access to local land governance and administration.

The RLG consisted of three main activities implemented in a sequential manner. The first activity focused on the legal and procedural change and communication. The second addresses the institutional development and capacity building and the third attempted site-specific land tenure interventions (see Table 3).

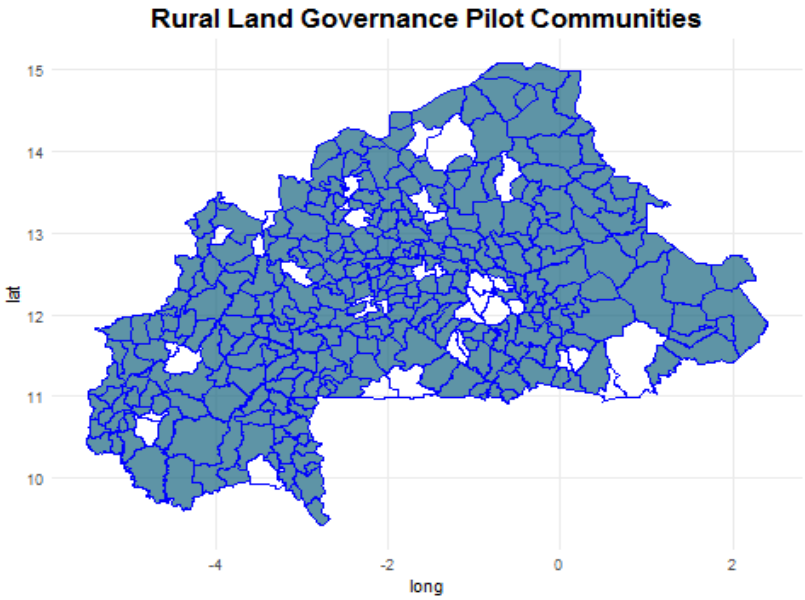
The time span of the compact was 5 years, from 2009 to 2014. The project was divided in two phases in which the prescribed activities took place sequentially. Phase I of the program lasted from 2009-2012. This phase focused on 17 pilot communes, where it implemented activity 1's plan and started implementing the actions described in activity 2 and 3. In Phase II the implementation of the plan was extended to 30 additional communes, counting in total 47 communes for which the MCC implemented the RLG project.

4.2 Monitoring the progress of RLG project

The MCC assigned the evaluation of the project to an independent organization IMPAQ. The evaluation consists of collection of survey data from the 17 pilot communes treated in Phase I. The survey is divided in baseline and interim, which refer to pre-reform and post-reform time periods respectively. However, the interim survey is conducted at the ending year of Phase I, so it does not capture the effects of Phase II activities. As a result, only the legal initiation of the reform, the dissemination of information regarding this legal option to rural population and some early option of APFR issuance is evaluated.

The methodology adopted by the evaluator is a difference-in-difference approach. For the difference-in-difference design a control and a treated group is needed. As mentioned, there were 17 pilot communes that were treated, and there were 17 additional control communes (Fig. 2) usually adjacent to ensure comparability.

FIGURE 2 • BURKINA FASO, IN WHITE ARE 34 CONTROL AND TREATED COMMUNES (SURVEYED)



The baseline and interim survey consist of four questionnaires focusing on different levels. Household, individual, parcel and production are the topics covered in the questionnaires. The size of the sample is 3,352 households from all 34 communes, accounting for more than 10,000 individuals and more than 6,000 land plots used for cultivation.

4.3 Empirical regularities in Burkina Faso

The purpose of this section is twofold. First, I am using the data to verify that the two pillars of the study namely risk-sharing and land re-allocation take place in the surveyed areas. Second, I use the survey data in hand in order to uncover the patterns that govern the interaction between risk-sharing and land allocation, in the presence of a reform that aims to establish strong individual ownership rights.

Before proceeding in describing the dataset I define the key variables of the analysis.

Risk-Sharing: consists of transfers of consumption units among members of an extended family or the same community.

In the survey data at an individual level, respondents are asked about the sources of income outside agricultural activities. The possible answers capture all types of extra income that do not come from production. More than 1500 (1396) respondents accounting for 14.6% (13.61%) answered that they have received a *transfer* in the past 12 months in the baseline (interim) survey. The range of the transfers ranges from 1000 to 300,000 (FCFA) with a mean of 5,413 (FCFA). The amount of the average transfer explicitly shows the high intensive margin of transfers, on top of non-agricultural income (see Table 2).

TABLE 2 • NON AGRICULTURAL INCOME (IN FCFA)

F02c2 (Income Non-Agricultural)		
	Baseline	Follow-Up
Paie/Salarie	45,803,350	47,202,545
Commerce	1.656e+08	2.25e+08
Transfers	55,629,835	56,763,714
Pensions	5,243,750	5,827,390
Elevage	2.605e+08	2.103e08
Forestiers	13,287,561	22,794,247
Artisant	16,027,523	13,900,070

The small extensive margin of individuals engaging into transfers in the sample size can be rationalised due to the individual character of this specific section of the survey. If instead of individuals, I check for villages that at least one of the residents has received a transfer, this would account for 365 villages out of the whole sample of 447. In other words, a 81.6% of the villages in the sample have at least one member that has received a transfer in the past 12 months. Additionally, the sample is consisted of individuals that belong to the same household, in which the head of the household is in control. This means that it is most likely that the transfer targets one person from each household and then it can be distributed to its members.

Land Size: The size of the plot, which the individual exploits for agricultural production.

In both surveys the size of the land plot used by holders of a single parcel, varies a lot. I can infer that the majority of the sample is consisted of small-farm owners less than 1 hectare. 60.4% have a parcel ranging from 0.1 to 1 hectare. Another 20.4% from 1 to 2 hectares, 12.3% from 2 to 3 hectares, a 5.8% holds a parcel of size between 3 and 4 hectares, a 3% of the sample between 4 and 5 hectares and another 5% cultivates a parcel over 5 hectares.

Since the survey is aiming at evaluating the effect of the Rural Land Project, the information captured by the survey questions are really detailed regarding the size and the number of plots, each individual exploits.

In Table 4 results are presented regarding different specifications of a linear probability model accounting for the effects of several individual characteristics on receiving a transfer both in the baseline and the interim survey. Being male reduces the probability of receiving a transfer under all specifications, showing that a large portion of the transfers being made are targeting the female part of the population. Being the head of the household increases the probability of receiving a transfer consistently under different versions of the specification. Also, age plays a critical role, the older you are the more likely to receive a transfer. Those results reveal the nature of transfers. They seem to be targeting the head of the household but at the same time work as an insurance mechanism. This is inferred by the observation that sensitive parts of the sample, such as female and old people are more likely to receive a transfer.

Additionally, table 4 reveals the effects of the reform to the probability of receiving a transfer. Under specification 4 (Model 4), a dummy variable showing whether the commune in which the individual resides was part of the implementation of the RLG project is added. Consistently, an individual in a treated area has less probability of receiving a transfer - also before and after the implementation of the project. However, the level after the end of Phase I is lower.

The interesting result relies on the comparison between specification 4 and specification 5. Under specification, all controls described above have been added, but also now the model includes the effect of the size of the land that an individual with a single parcel cultivates. In both pre-reform and post-reform specifications the increase of land size by one unit decreases the probability of receiving a transfer. However, post-reform, this effect turns statistically significant. This observation points

towards the direction, that size of land parcels acquire more importance when the option of registering it as individually owned becomes available.

Moreover, adding land size to the specification, turns other control variables, such as sex and being the head of the household, insignificant. This can be interpreted as the targeting of transfer is taking into account the land holdings of the individual more than whether the individual belongs to a sensitive group.

Finally, the land size also affects the effect of the treatment on the probability of receiving a transfer. In both, pre and post reform specifications, the effect of belonging to a community where RLG was implemented becomes statistically insignificant, when land size is added. The explanatory power of being treated is absorbed by the size of land. This is effectively explained by the functioning of the theoretical model presented in the paper. The community's reaction to a land reform that aims to establishing strong individual property rights is primarily based on land re-allocation which is largely determined by the head of the community.

5. ONE-SIDED LIMITED COMMITMENT WITH LAND RE-ALLOCATION

The theoretical part of the present study models the functioning of risk-sharing informal contracts among members of rural communities and their interaction with land reforms when land re-allocation is in place. To motivate the assumptions of the model I need to define certain customary aspects of the social structure in rural communities of Western Africa.

Customary land management in Burkina Faso is generally considered homogeneous. A predominant social figure at a community level is that of the land chief (*chef de terre*).[34] The land chief is a religious figure with legal power and has the complete control over land on behalf of the community.[35] [36] One of the main duties of the land chief is the periodic redistribution of land. This land re-allocation takes place among the members of the same community/village but also to foreigners in case they arrive. This practice aims at preventing the creation of monopolies in land-use or underuse of land plots. The periodic redistribution of land is decided upon the needs of the members of the community.

In the theoretical model presented in this section, the land chief is the principal of the risk-sharing contract (one side of the two-sided contract). The informal contract I am addressing does not only prescribe production units allocation among community

[34] The predominance of the land chief can be seen in Fig. 5.
[35] Ouedraogo 2002.
[36] The land chief is considered to be descended from lineage of the group of the first occupants of the earth.

members but also land re-allocation among the members. The ultimate target of the model is to trace the interaction between those two components and its welfare implications.

Two takeaways from the survey findings determine the structure of the model presented in this section. First, in agricultural communities, land is the major production factor. Second, land re-allocation together with exchange consumption units form the nature of risk-sharing in those communities.

The theoretical framework presented here attempts to shed light on the diverse views expressed regarding the land regime policy that should be followed in the African continent. Illustrative of the diversity of the land policy in Africa is the position that the World Bank has held. During the mid-1970s the World Bank was advocating a firm regime of strong individual property rights in Africa. It was persuaded by most of the literature's theoretical arguments relating land tenure security and agricultural productivity.[37] However, this stance evolved over time, resulting to the adoption of a more favourable view towards customary land tenure systems. The flexibility and efficient adaptation of indigenous land systems were appreciated.[38]

The environment builds on Ljunqvist and Sargent.[39] The contract prescribes the pooling of all households' resources in the hands of the principal who allocates consumption back to them. The principal after allocating consumption, invests the remainder outside the village at a risk free rate $\mathrm{R} = \frac{1}{\beta}$, where β is the common to all discount factor. The principal is the only one that can borrow and lend resources outside the community, the households rely only on the risk-sharing mechanism.

The community is consisting of a large number of villagers with the preferences over consumption.

$$E_{-1} \sum_{t=0}^{\infty} \beta^t u(c_t)$$

[37] Udry 2011.
[38] Migot-Adholla *et al.* 1991.
[39] Ljunqvist and Sargent 2000.

where $u(c)$ is increasing and strictly concave and β is the common discount factor $\beta \in (0,1)$. Each villager receives a stochastic idiosyncratic productivity each period $\{z_t\}_{t=0}^{\infty}$. Idiosyncratic productivity is iid with $\text{Prob}(z_t = z_s) = \Pi_s$, with $s \in \{1,2,\dots, S\}$ satisfying the property, $z_s < z_{s+1}$.
The villager is considered as a small agricultural household which produces output using a fraction of land as the primary production function. The technology is model as follows:

$$y_s = z_s f(\kappa_s \bar{l})$$

where z_s is the idiosyncratic productivity, $\bar{l}$ denotes land, which is in fixed supply normalized to 1 and κ_s is the variable of interest. It is the fraction of land that each period the principal decides for the villager to productively use it ($\kappa_s \in [0,1]$). κ_s effectively captures land re-allocation as a mechanism of risk sharing. Technology $f(.)$ is increasing in the fraction of land, κ_s ($f'(.) > 0$), strictly concave ($f''(.) < 0$) and I assume that with no land there is no produced output $f(0) = 0$.
Participation of the household to the community risk sharing mechanism entails transfers towards and from the community. The budget constraint of each individual household is:

$$c_s = y_s + \tau_s, \forall i \in N$$

If $\tau_s > 0$ then the household is receiving transfer from the community which adds up to the disposable income, while if $\tau_s < 0$, the household is rendering part of its output to be granted as transfers to other members of the community.
The land chief (principal) maximizes her stream of profits, which consists of the contemporaneous difference between the pooled output and the consumption allocation, and the discounted future profits stream. In a recursive form, the objective function is

$$P(v) = \max\_\{c_s, \kappa_s, w_s\} \sum_{s=1}^{S} \Pi_s [(y_s - c_s) + \beta P(w_s)]$$

or equivalently substituting the villager's budget constraint

$$P(v) = \max_{\{\tau_s, \kappa_s, w_s\}} \sum_{s=1}^{S} \Pi_s[(-\tau_s)+\beta P(w_s)]$$

where v is the expected discounted future utility previously promised to the villager and w_s is the promised value with which the agent will enter next period, given that $z_t = z_s$.

In the absence of commitment frictions the economy reaches its first best.

Proposition 1: *Given a promised utility v, the first best allocation satisfies the following properties. The consumption and promised utility sequences are constant and equal to the levels $c^{fb}(v)$ and $w^{fb}(v)$, while κ^{fb} is constant at its maximum level.*

Proof: see Appendix.

In the case of a commitment friction, while the head of the community is committed to the agreement, the villager is not. However, what fundamentally changes is the outside option of the villager. The primary channel of interaction between the land reform that aims to establishing strong individual property rights and the contractual agreement among community members emerges through the workings of the outside option. Assumption 1 defines the rationale behind the modelling of the outside option.

Assumption 1: *The land reform allows the agent-villager to register the fraction of land she was last allocated with, inside the contract.*

Assumption 1 determines the form of the outside option of the agent-villager.

$$u\big(z_s f(\kappa_s)\big) + \beta v^{\text{aut}}(\kappa_s)$$

First, notice that the fraction of land allocated to productive use is endogenous and it is determined within the contract. Second, due to the limited commitment friction, the agent-villager can leave the contract at any state. If she does so, due to the existence of a land reform, she can register the last allocated fraction of land (from within the contract) as individual property.

The continuation value of autarky takes the following form:

$$v^{\text{aut}}(\kappa_s) = \sum_{t=0}^{\infty} \beta^t \sum_{r=1}^{S} \Pi_r u\big(z_r f(\kappa_s)\big)$$

Note that the level of fraction of land is constant and equal to what was last decided within the contract.
The participation constraint of the contract takes the form:

$$u(c\_s) + \beta w\_s \geq u\big(z_s f(\kappa_s)\big) + \beta v^{\text{aut}}(\kappa_s)$$

The head of the community is choosing consumption allocated to the agent-villager, fraction of land and promised utility, in order to maximize her stream of profits.

$$P(v) = max_{c_s,\kappa_s,w_s} \sum_{s\in S} \Pi_s[(z_s f(\kappa_s) - c_s) + \beta P(w_s)]$$

where v is the promised utility that agent-villager enters the current period with and carries all past histories, in order to recursify the problem.
The maximization problem of the principal takes the following form:

$$P(v) = max_{c_s,\kappa_s,w_s} \sum_{s=1}^{S} \Pi_s[(z_s f(\kappa_s) - c_s) + \beta P(w_s)]$$

$$\sum_{s=1}^{S} \Pi_s\{u(c_s) + \beta w_s\} \geq v \ \ [PKC]$$

$$u(c_s) + \beta w_s \geq u\big(z_s f(\kappa_s)\big) + \beta v^{\text{aut}}(\kappa_s) \ \ [PC] \forall s$$

$$\kappa\_s \in [0,1]$$

$$w_s \in [v^{aut}, \bar{v}]$$

Proposition 2: *For a given promised utility v, when the participation constraint is non-binding, the consumption and promised utility allocations are constant and equal to $c_s = g_1(v)$ and $w_s = v$, while the fraction of land reaches the first best $(\kappa_s = \kappa_{max})$.*
When the participation constraint binds then consumption, promised utility and fraction of land satisfy equations 1,2 and 3 respectively.
$u'(c_s)[\theta + \phi_s] = 1$ (1)
$P'(w_s) = -(\theta + \phi_s)$ (2)
$u'\big(z_s f(\kappa_s)\big) = \frac{1}{\phi_s} - \frac{1}{z_s}\frac{\beta}{1-\beta} E_r u'\big(z_r f(\kappa_s)\big) z_r$ (3)
Proof: see Appendix.

The model as delineated above presents an interesting trade-off which encompasses the core interaction between land rights and risk sharing when seen as competing mechanisms. Notice that the level of fraction of land (κ_s) has two opposing effects on the model. First it raises the revenues of the community. This can be seen from the objective function of the principal-head of the community. A higher level of κ_s will increase the produced output for a given realisation of z_s and consequently the size of the pie to be allocated among consumption to households and profits for the principal. At the same time, κ_s is on the right-hand side of the participation constraint. A higher fraction of land allocated to the villager makes the outside option more attractive, increasing deviation incentives.

In order to characterize the nature of the land tenure system under the contract in the presence of a land reform as an outside option, I define the following possible land regimes:

Definition: *A land regime is* ***productive*** *if it adjusts fraction of land positively to idiosyncratic productivity* ($\frac{\partial \kappa_s}{\partial z_s} > 0$). *It is* ***rigid*** *if it does not adjust fraction of land to changes in idiosyncratic productivity* ($\frac{\partial \kappa_s}{\partial z_s} = 0$) *and it is* ***counter-productive*** *when it adjusts fraction of land opposite to idiosyncratic productivity* ($\frac{\partial \kappa_s}{\partial z_s} < 0$).

By manipulating the optimality condition with respect to fraction of land, I can obtain an optimal response of the κ_s to realisations of idiosyncratic productivity.

Proposition 3: *For a given* v *and for each* $s \in S$ *that leads to a binding participation constraint, there exists threshold* z_s^* *which determines the nature of the land regime under the contract.*

Land Regime		z_s
Productive	$\frac{\partial \kappa_s}{\partial z_s} > 0$	$z_t > z_s^* = \frac{1-\phi_s u'(z_s^* f(\kappa_s))}{\phi_s u''(z_s^* f(\kappa_s)) f(\kappa_s)}$
Rigid	$\frac{\partial \kappa_s}{\partial z_s} = 0$	$z_t = z_s^* = \frac{1-\phi_s u'(z_s^* f(\kappa_s))}{\phi_s u''(z_s^* f(\kappa_s)) f(\kappa_s)}$
Counter Productive	$\frac{\partial \kappa_s}{\partial z_s} < 0$	$z_t < z_s^* = \frac{1-\phi_s u'(z_s^* f(\kappa_s))}{\phi_s u''(z_s^* f(\kappa_s)) f(\kappa_s)}$

Using the following functional forms for utility and technology that satisfy the conditions on monotonicity and concavity,

$$u(c_s) = \frac{c_s^{(1-\alpha)}}{1-\alpha}$$
$$y_s = z_s f(\kappa_s) = z_s \kappa_s^{1-\gamma}$$

the above proposition takes the following form:

Land Regime		z_s
Productive	$\frac{\partial \kappa_s}{\partial z_s} > 0$	$z_t < z_s^* = [(1-\alpha)\phi_s]^{\frac{1}{\alpha}} \kappa_s^{-(1-\gamma)}$
Rigid	$\frac{\partial \kappa_s}{\partial z_s} = 0$	$z_t = z_s^* = [(1-\alpha)\phi_s]^{\frac{1}{\alpha}} \kappa_s^{-(1-\gamma)}$
Counter Productive	$\frac{\partial \kappa_s}{\partial z_s} < 0$	$z_t > z_s^* = [(1-\alpha)\phi_s]^{\frac{1}{\alpha}} \kappa_s^{-(1-\gamma)}$

Proof: see Appendix.

The result from proposition 3 illustrates the variability of the customary land tenure regime. In the presence of a land reform as an outside option, the principal responds strategically to the allocation of land to the agent such that to keep the contract sustainable at all times. This means that given an allocation of consumption, promised utility and a realisation of idiosyncratic productivity, the contract might optimally adjust fraction of land downwards, upwards or not at all. This is due to the strategic way of the principal to enforce contract participation. The land chief when proceeding to redistribution of land weighs those two opposing effects. How much allocated land, increases the size of the pie (her revenues) and how much the incentives of the villager to deviate. This essentially depends on how close to a realisation of productivity that would lead to a binding participation constraint the current idiosyncratic productivity is. This is when the threat of reneging the contract from the side of the villager becomes credible.

This strategic behaviour regarding allocation of land, entails efficiency costs. In the absence of the limited commitment friction, the incentives of the principal would be in line with a flexible land tenure regime. A flexible land tenure regime would increase principals revenues and would increase the size of the pie to be distributed among the members of the community. A land reform distorts those incentives, and induces a strategic allocation of land, which might lead to productive villagers being allocated smaller fraction of land, due to the threat of deviating from the contract.

6. Policy prescription and concluding remarks

The study of the interaction between land reforms and customary risk-sharing mechanisms as illustrated in section 5 provides valuable lessons regarding policy design of land reforms in weak institutional frameworks.

Attempts for reforming land rights should take into serious consideration the pre-existence of customary safety networks. This is critical in cases of ethnic minorities,

or vulnerable groups of people that have to rely solely to the community for tackling risk. Those customary norms prescribe transfers of production units and land re-allocation as ways to insure their members against risk. If these two mechanisms constitute the predominant means of risk-sharing in the affected communities, then a land reform can distort the functioning of the customary contract.

As shown in section 5 the land reform's effect on the outside option can bring efficiency costs. It creates a clear trade-off between the amount of risk-sharing and production efficiency. In order for the communities to maintain the existence of their informal contracts they can manipulate land allocation in a counter-productive way. In this case, a land reform can lead to misallocation of land, an inefficiency that would have been avoided, were the community was unaffected by land reforms.

Lastly, the present study provides a potential theoretical justification of the World Bank's stance on land rights in Africa. The international organization, since the early 1990s has adopted a more inclusive and integrating policy stance regarding the functioning of local communities regarding land management. Based on section 5 it is explicit that the land tenure regime under the informal contract can achieve a certain flexibility of adjustment to productivity leading to a more efficient allocation of land. To conclude, the implementation of a land reform aiming at granting private property should be preceded by a careful documentation and examination of the way local communities operate. The effect of a reform on the rural population might be beneficial if it strengthens the bargaining position of the villager, but also could bring detrimental effects regarding output efficiency.

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APPENDIX

PROPOSITION 1

Proof: Under the first best, commitment friction is absent, hence in the optimization problem, the principal-head of the community does not take into account the participation constraint of the agent-villager. Hence the problem becomes:

$$\mathrm{P(v)} \;=\; \max_{\mathrm{c_s},\,\kappa_s,\,\mathrm{w_s}} \sum_{s\in S} \Pi_s[(\mathrm{z_s f(\kappa_s)} - \mathrm{c_s}) + \beta \mathrm{P(w_s)}]$$

$$\sum_{s\in S} \Pi_s\{u(c_s) + \beta w_s\} \geq v \quad [PKC] \quad (\theta)$$

$$\kappa_s \in [0,1]$$

$$w_s \in [v^{aut}, \bar{v}]$$

Assigning the designated lagrange multipliers above, the lagrangian becomes:

$$\mathcal{L} = \sum_{s\in S} \Pi_s[(z_s f(\kappa_s) - c_s) + \beta P(w_s)] +$$

$$\theta\left[\sum_{s\in S}\Pi_s[u(c_s)+\beta w_s]-v\right]+$$

$$\Pi_s\nu_{1s}\kappa_s+\Pi_s\nu_{2s}(1-\kappa_s)=0$$

Deriving optimality conditions with respect to the choice variables:

$$\frac{\partial\mathcal{L}}{\partial c_s}=0\rightarrow-1+\theta u'(c_s)=0\rightarrow u'(c_s)=\frac{1}{\theta}\ \ [constant]$$

and

$$\frac{\partial\mathcal{L}}{\partial\kappa_s}=0\rightarrow z_s f'(\kappa_s)+(\nu_{1s}-\nu_{2s})=0\rightarrow f'(\kappa_s)=\frac{(\nu_{2s}-\nu_{1s})}{z_s}$$

since $f(0)=0$ then $\nu_{1s}=0$

$$f'(\kappa_s)=\frac{\nu_{2s}}{z_s}$$

since $f'()>0$ then $\nu_{2s}>0$ so $\kappa_s=1$

and

$$\frac{\partial\mathcal{L}}{\partial w_s}=0\rightarrow\beta P'(w_s)+\theta\beta=0\rightarrow P'(w_s)=-\theta\ \ [constant]$$

PROPOSITION 2

Proof: The maximization problem in the presence of the commitment friction takes the following form:

$$P(v)=max_{c_s,\kappa_s,w_s}\sum_{s=1}^{S}\Pi_s[(z_s f(\kappa_s)-c_s)+\beta P(w_s)]$$

$$\sum_{s=1}^{S} \Pi_s\{u(c_s) + \beta w_s\} \geq v \ \ [PKC]$$

$$u(c_s) + \beta w_s \geq u\big(z_s f(\kappa_s)\big) + \beta v^{\text{aut}}(\kappa_s) \ \ [PC] \forall s$$

$$\kappa\_s \in [0,1]$$

$$w_s \in [v^{aut}, \bar{v}]$$

Assigning the Lagrange mutlipliers as above, the Lagrangian reads:

$$\mathcal{L} = \sum_{s \in S} [(z_s f(\kappa_s) - c_s) + \beta P(w_s)] +$$

$$\theta \left[\sum_{s \in S} \Pi_s [u(c_s) + \beta w_s] - v \right] +$$

$$\Pi_s \phi_s [u(c_s) + \beta w_s - u(z_s f(\kappa_s) - \beta v^{\text{aut}})(\kappa_s)] +$$

$$\Pi_s \nu_{1s} \kappa_s + \Pi_s \nu_{2s} (1 - \kappa_s) = 0$$

Before deriving the optimality conditions, I derive the following:

$$\frac{\partial v^{\text{aut}}}{\partial \kappa_s} = \frac{1}{1-\beta} \sum_r \Pi_r u'\big(z_r f(\kappa_s)\big) z_r \, f'(\kappa_s)$$

$$\frac{\partial v^{\text{aut}}}{\partial \kappa_s} = \frac{1}{1-\beta} f'(\kappa_s) \sum_r \Pi_r u'\big(z_r f(\kappa_s)\big) z_r$$

$$\frac{\partial v^{\text{aut}}}{\partial \kappa_s} = \frac{1}{1-\beta} f'(\kappa_s) \underbrace{E_r u'\big(z_r f(\kappa_s)\big) z_r}_{\omega > 0}$$

$$\frac{\partial v^{\text{aut}}}{\partial \kappa_s} = \frac{1}{1-\beta} f'(\kappa_s) \omega$$

Deriving the focs:

$$\frac{\partial L}{\partial c_s}: \qquad \Pi_s(-1) + \theta\Pi_s u'(c_s) + \phi_s\Pi_s u'(c_s) = 0 \rightarrow u'(c_s)[\theta + \phi_s] = 1$$

$$\frac{\partial L}{\partial w_s}: \qquad \Pi_s\beta P'(w_s) + \theta\Pi_s\beta + \phi_s\Pi_s\beta = 0 \rightarrow P'(w_s) = -(\theta + \phi_s)$$

$$\frac{\partial L}{\partial \kappa_s}: \quad \Pi_s z_s f'(\kappa_s) - \Pi_s\phi_s\left[u'\big(z_s f(\kappa_s)\big)z_s f'(\kappa_s) + \beta\frac{\partial v^{\text{aut}}}{\partial \kappa_s}\right] + \Pi_s\nu_{1s} - \Pi_s\nu_{2s} = 0$$

$$\Pi_s z_s f'(\kappa_s) - \Pi_s\phi_s\left[u'\big(z_s f(\kappa_s)\big)z_s f'(\kappa_s) + \beta\frac{1}{1-\beta}f'(\kappa_s)\sum_r \Pi_r u'\big(z_r f(\kappa_s)\big)z_r\right] + \Pi_s\nu_{1s} - \Pi_s\nu_{2s} = 0$$

$$z_s f'(\kappa_s)\big[1 - \phi_s u'\big(z_s f(\kappa_s)\big)\big] - \phi_s\frac{\beta}{1-\beta}f'(\kappa_s)\omega + [\nu_{1s} - \nu_{2s}] = 0$$

Assume that constraints on κ_s are slack - corner solutions excluded $\nu_{1s}, \nu_{2s} = 0$

$$z_s\big[1 - \phi_s u'\big(z_s f(\kappa_s)\big)\big] = \phi_s\frac{\beta}{1-\beta}f'(\kappa_s)\omega$$

$$\big[1 - \phi_s u'\big(z_s f(\kappa_s)\big)\big] = \frac{\phi_s}{z_s}\frac{\beta}{1-\beta}\omega$$

$$\phi_s u'\big(z_s f(\kappa_s)\big) = 1 - \frac{\phi_s}{z_s}\frac{\beta}{1-\beta}\omega$$

$$u'\big(z_s f(\kappa_s)\big) = \frac{1}{\phi_s} - \frac{1}{z_s}\frac{\beta}{1-\beta}\omega$$

PROPOSITION 3:

Let the following functional forms:

$$u(c_s) = \frac{c_s^{(1-\alpha)}}{1-\alpha}$$

and

$$y = z_s f(\kappa_s) = z_s \kappa_s^{1-\gamma}$$

First, I derive the $\frac{\partial v_{aut}}{\partial \kappa_s}$ under those functional forms.

$$\frac{\partial v_{aut}}{\partial \kappa_s} = \sum_{t=0}^{\infty} \beta^t \sum_{r=1}^{S} \Pi_r u'\big(z_r f(\kappa_s)\big) z_r f'(\kappa_s)$$

$$\frac{\partial v_{aut}}{\partial \kappa_s} = \frac{1}{1-\beta} f'(\kappa_s) \sum_{r=1}^{S} \Pi_r u'\big(z_r f(\kappa_s)\big) z_r$$

$$\frac{\partial v_{aut}}{\partial \kappa_s} = \frac{1}{1-\beta} f'(\kappa_s) \underbrace{\sum_{r=1}^{S} \Pi_r u'\big(z_r f(\kappa_s)\big) z_r}_{\omega > 0}$$

Using the functional forms to get ω

$$\omega = \sum_r \Pi_r u'\big(z_r f(\kappa_s)\big) z_r = E_r u_c\big(z_r f(\kappa_s)\big) z_r$$

plugging the functional forms of u, f

$$\omega = \sum_r \Pi_r z_r^{-\alpha} f(\kappa_s)^{-\alpha} z_r$$

$$\omega = \sum_r \Pi_r z_r^{-\alpha} \left(\kappa_s^{1-\gamma}\right)^{-\alpha} z_r$$

$$\omega = \kappa_s^{-\alpha(1-\gamma)} \sum_r \Pi_r z_r^{-\alpha}$$

$$\omega = \kappa_s^{-\alpha(1-\gamma)} \xi$$

Now plug this expression to the foc wrt κ_s:

$$u_c\big(z_s f(\kappa_s)\big) = \frac{1}{\phi_s} - \frac{1}{z_s}\frac{\beta}{1-\beta}\omega$$

$$[z_s f(\kappa_s)]^{-\alpha} = \frac{1}{\phi_s} - \frac{1}{z_s}\frac{\beta}{1-\beta}\kappa_s^{-\alpha(1-\gamma)}\xi$$

$$z_s^{-\alpha}\left[\kappa_s^{1-\gamma}\right]^{-\alpha} = \frac{1}{\phi_s} - \frac{1}{z_s}\frac{\beta}{1-\beta}\kappa_s^{-\alpha(1-\gamma)}\xi$$

$$z_s^{-\alpha}\kappa_s^{-\alpha(1-\gamma)} = \frac{1}{\phi_s} - \frac{1}{z_s}\frac{\beta}{1-\beta}\kappa_s^{-\alpha(1-\gamma)}\xi$$

Now I want to derive a relationship between κ_s and z_s from the above relationship which is the optimal rule for setting the fraction of land
Step 1: Multiply by z_s:

$$z_s^{1-\alpha}\kappa_s^{-\alpha(1-\gamma)} = \frac{z_s}{\phi_s} - \frac{\beta}{1-\beta}\kappa_s^{-\alpha(1-\gamma)}\xi$$

Step 2: Multiply by ϕ_s:

$$\phi_s z_s^{1-\alpha}\kappa_s^{-\alpha(1-\gamma)} = z_s - \phi_s\frac{\beta}{1-\beta}\kappa_s^{-\alpha(1-\gamma)}\xi$$

Step 3: Transfer everything to the RHS and name it $\mathcal{H}(\kappa_s, z_s)$ on which you apply the IFT

$$\mathcal{H}(\kappa_s, z_s) = z_s - \phi_s z_s^{1-\alpha}\kappa_s^{-\alpha(1-\gamma)} - \phi_s\frac{\beta}{1-\beta}\kappa_s^{-\alpha(1-\gamma)}\xi = 0$$

From the IFT i know the following:

$$\frac{\partial \kappa_s}{\partial z_s} = -\frac{\frac{\partial \mathcal{H}(\kappa_s, z_s)}{\partial z_s}}{\frac{\partial \mathcal{H}(\kappa_s, z_s)}{\partial \kappa_s}}$$

where

$$\frac{\partial \mathcal{H}(\kappa_s, z_s)}{\partial z_s} = 1 - (1-\alpha)\phi_s \kappa_s^{-\alpha(1-\gamma)} z_s^{-\alpha}$$

and

$$\frac{\partial \mathcal{H}(\kappa_s, z_s)}{\partial \kappa_s} = -\left(-\alpha(1-\gamma)\phi_s z_s^{1-\alpha}\kappa_s^{-\alpha(1-\gamma)-1}\right) - \left(-\alpha(1-\gamma)\phi_s \frac{\beta}{1-\beta}\kappa_s^{-\alpha(1-\gamma)-1}\xi\right)$$

$$\frac{\partial \mathcal{H}(\kappa_s, z_s)}{\partial \kappa_s} = \alpha(1-\gamma)\phi_s z_s^{1-\alpha}\kappa_s^{-\alpha(1-\gamma)-1} + \alpha(1-\gamma)\phi_s \frac{\beta}{1-\beta}\kappa_s^{-\alpha(1-\gamma)-1}\xi \rightarrow$$

$$\rightarrow \frac{\partial \mathcal{H}(\kappa_s, z_s)}{\partial \kappa_s} = \alpha(1-\gamma)\phi_s \kappa_s^{-\alpha(1-\gamma)-1}\left(z_s^{1-\alpha} + \frac{\beta}{1-\beta}\xi\right)$$

Hence the IFT becomes as follows:

$$\frac{\partial \kappa_s}{\partial z_s} = -\frac{\frac{\partial \mathcal{H}(\kappa_s, z_s)}{\partial z_s}}{\frac{\partial \mathcal{H}(\kappa_s, z_s)}{\partial \kappa_s}} = -\frac{1-(1-\alpha)\phi_s \kappa_s^{-\alpha(1-\gamma)} z_s^{-\alpha}}{\alpha(1-\gamma)\phi_s \kappa_s^{-\alpha(1-\gamma)-1}\left(z_s^{1-\alpha} + \frac{\beta}{1-\beta}\xi\right)}$$

$$\frac{\partial \kappa_s}{\partial z_s} = \frac{(1-\alpha)\phi_s \kappa_s^{-\alpha(1-\gamma)} z_s^{-\alpha} - 1}{\alpha(1-\gamma)\phi_s \kappa_s^{-\alpha(1-\gamma)-1}\left(z_s^{1-\alpha} + \frac{\beta}{1-\beta}\xi\right)}$$

Note that the sign of the relationship between κ_s and z_s depends on the sign of the nominator:

Flexible Land Regime: $\frac{\partial \kappa_s}{\partial z_s} > 0$

$$(1-\alpha)\phi_s\kappa_s^{-\alpha(1-\gamma)}z_s^{-\alpha}-1>0$$

$$(1-\alpha)\phi_s\kappa_s^{-\alpha(1-\gamma)}z_s^{-\alpha}>1$$

$$(1-\alpha)\phi_s\kappa_s^{-\alpha(1-\gamma)}>\frac{1}{z_s^{-\alpha}}$$

$$z_s^{\alpha}<(1-\alpha)\phi_s\kappa_s^{-\alpha(1-\gamma)}$$

$$z_s<[(1-\alpha)\phi_s]^{\frac{1}{\alpha}}\kappa_s^{-(1-\gamma)}$$

Rigid Land Regime: $\frac{\partial\kappa_s}{\partial z_s}=0$

$$z_s=[(1-\alpha)\phi_s]^{\frac{1}{\alpha}}\kappa_s^{-(1-\gamma)}$$

Counter Productive Land Regime: $\frac{\partial\kappa_s}{\partial z_s}<0$

$$z_s>[(1-\alpha)\phi_s]^{\frac{1}{\alpha}}\kappa_s^{-(1-\gamma)}$$

To summarize the above result, the risk-sharing contract within the community might end up with a land allocation regime that falls within one or more of the following categories, depending on the relation between idiosyncratic productivity and fraction of land allocated to the villager at the time of the land reform implementation.

FIGURE 3 • TENURE INSECURITY IN AFRICAN COUNTRIES ("PRINDEX", 2018), TENURE INSECURITY: % OF PEOPLE WHO BELIEVE IT IS SOMEWHAT OR VERY LIKELY THAT THEY COULD LOSE THEIR RIGHT TO USE PROPERTY OR PART OF IT AGAINST THEIR WILL IN THE NEXT 5 YEARS.

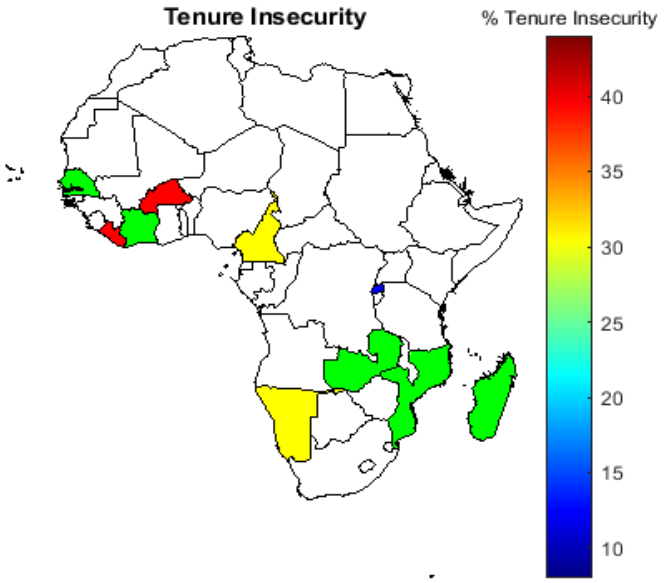


FIGURE 4 • SOURCE: WEST AFRICA: LAND USE AND LAND COVER DYNAMICS AND UNITED NATIONS

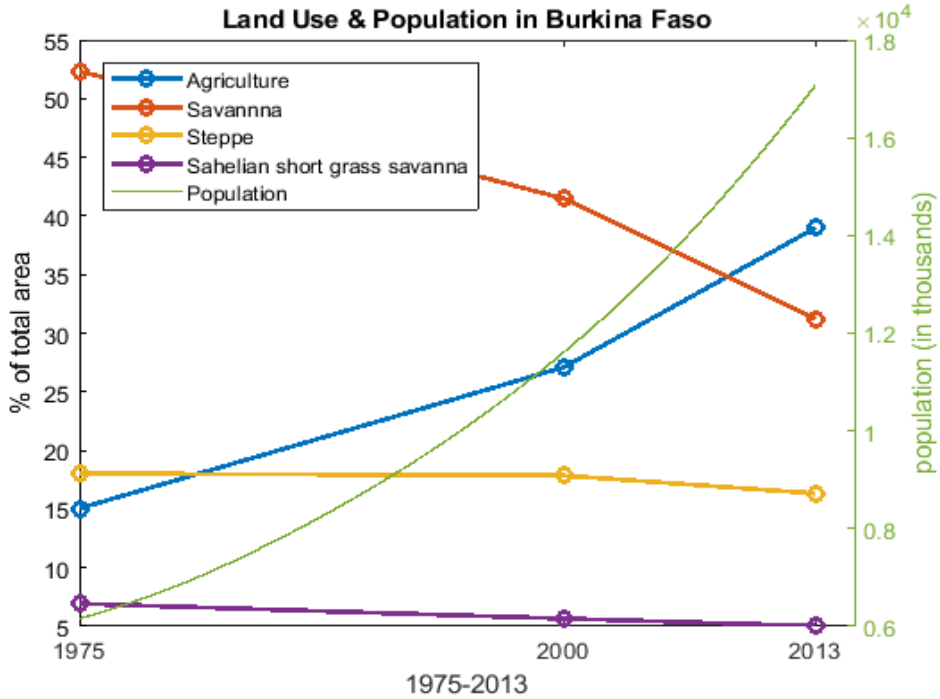


TABLE 3 • BURKINA FASO RURAL LAND GOVERNANCE PROJECT IMPACT EVALUATION (IMPAQ, 2015)

Rural Land Governance Project			
Activities	Title	Description	Phases
Activity No 1	Legal and Procedural Change and Communication	1. Support government's efforts to develop and implement improved rural land legislation and to develop, revise and implement other legal and procedural frameworks. 2. Significant public outreach program to inform people about the new legislations and its expected benefits	Phase I (2009-2012) (national level)
Activity No 2	Institutional Development and Capacity Building	1. Improve institutional capacity to deliver land services in rural areas. 2. Funding of series of land registration, mapping and decentralization services.	Phase I (2009-2012) (17 communes) Phase II (2012-2014) (additional 30 communes)
Activity No 3	Site-Specific Land Tenure Interventions	1. Site specific land rights formalization sub-activities 2. Provision of APFR certificates 3. Preparation of land titles and leases in selected project areas.	Phase I (2009-2012) (17 communes) Phase II (2012-2014) (additional 30 communes)

TABLE 4 • DEPENDENT VARIABLE: PROBABILITY OF RECEIVING A TRANSFER

Variables	(1) Model 1		(2) Model 2		(3) Model 3		(4) Model 4		(5) Model 5	
	Baseline	Interim	Baseline	Interim	Baseline	Interim	Baseline	Interim	Baseline	Interim
sex (1=Male, 0: Female)	-0.00413	-0.0172**	-0.0604***	-0.0769***	-0.0398***	-0.0489***	-0.0384***	-0.0483***	-0.0774***	-0.0348
	(0.007)	(0.00685)	(0.00958)	(0.00921)	(0.00971)	((0.00921))	(0.00972)	(0.00921)	(0.0273)	(0.0217)
chef de menage (1: True, 0:False)			0.0873***	0.0954***	0.0386***	0.0293***	0.0369***	0.0286***	0.0373	0.00692
			(0.0102)	(0.00990)	(0.0111)	(0.0109)	(0.0111)	(0.0109)	(0.0291)	(0.0232)
Age					0.00251***	0.00316***	0.00252***	0.00317***	0.00301***	0.00379***
					(0.000230)	(0.000231)	(0.000230)	(0.000231)	0.000538	(0.000439)
treated							-0.0230***	-0.0210***	-0.00820	-0.0153
							(0.00699)	(0.00677)	(0.0157)	(0.0125)
Land Size									-0.00458	-0.00862**
									(0.00474)	(0.00346)
Constant	0.148***	0.143***	0.145***	0.140***	0.0506***	0.0185*	0.0635***	0.0302***	0.0528**	0.0131
	(0.00463)	(0.00446)	(0.00463)	(0.00445)	(0.00977)	(0.00991)	(0.0105)	(0.0106)	(0.0241)	(0.0201)
Observations	10,361	10,258	10,361	10,258	10,361	10,258	10,361	10,234	2,018	3,138
R-squared	0.000	0.001	0.007	10,258	0.018	0.027	0.019	0.028	0.024	0.030

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

FIGURE 5 • MCC - BASELINE SURVEY - CONFLICT RESOLUTION

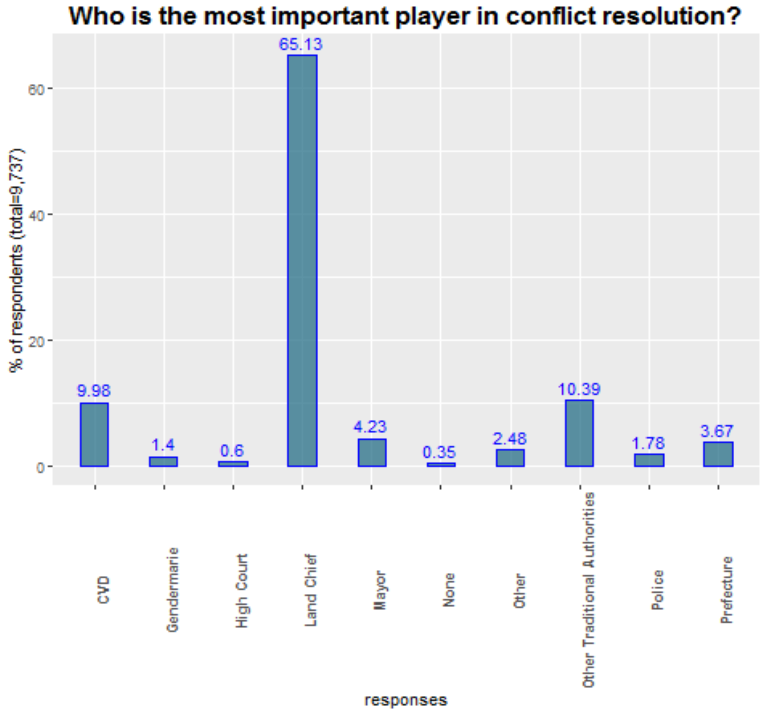
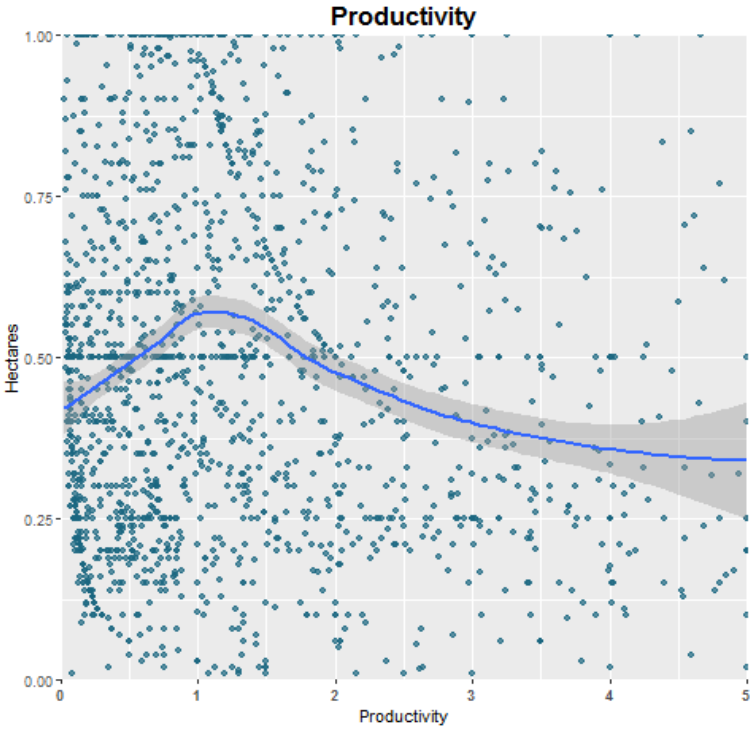


FIGURE 6 • LAND ALLOCATION AND PRODUCTIVITY



STEFANO MENEGAT

ALTERNATIVE FOOD NETWORKS: GROWING NICHES OR PARADIGM SHIFT? EXPLORING THE CASE OF U.S. FARMERS' MARKETS THROUGH A SYSTEM DYNAMICS APPROACH[1]

Abstract: This article assesses the potential of Alternative Food Networks (AFNs) to successfully scale-up in order to be considered as an alternative paradigm to conventional, mass-distribution, retailing systems. To investigate this issue we consider the process of diffusion of AFNs as the typical process of adoption of a social innovation among potential adopters, which include both consumers and producers. By implementing a system dynamics model based on data relative to the development of farmers' markets (FMs) in the U.S., we find that the adoption/diffusion scheme depicts the historical evolution of such experiences across the Country. Our model underlines the role played by three main leverage points in determining the dynamics under investigation: the rate of opening of new farms, the rate of farm closings and the rate of urbanization. The baseline scenario, simulated without including policy intervention, shows that U.S. FMs reached their maximum diffusion over the past few years and the trend may turn negative in the forthcoming decades. To complete the analysis, we simulate 23 alternative scenarios for the development of US farmers' markets through the application of two hypothesis of policy intervention to the three leverage points. Only 10 scenarios out of 23 increased the number of farmers' markets during the period 2016-2044, and only three resulted both effective in increasing the number of FMs' and efficient in satisfying consumers' demand. No simulation indicates that U.S. FMs have the potential to radically scale-up and become a real alternative to conventional retailing systems. However, the best outcome has been obtained through the joint implementation of a strong control over concentration processes and a steady increase in the rate of farm openings. In conclusion we provide some policy-implications and few research indications for the further development of the debate about the future of U.S. farmers' markets.

Keywords: agri-food systems; alternative food networks; system dynamics; farmers' markets

1 I would like to thank Dr. Davide Poggio, Dr. Michele Lancione, Andrea Saavedra and Francesco Menegat for their helpful advice and recommendations. All errors and omissions are my own.

I. INTRODUCTION

The last decade of the twentieth century sought the emergence of new discourses and practices relative to the rural-urban divide in westernized societies. Both agricultural and urban landscapes in their geographical, cultural and environmental acceptations, have been gradually reconsidered as complementary and interdependent sources of wellbeing for society at large (MEA 2005; Barton and Pretty 2010). The assumption about the functional divide between the city (producing wealth and consuming primary goods) and the countryside (producing primary goods and consuming wealth) has been increasingly recognized as a misreading of the complex interactions allowing the prosperity of societies (Scott *et al.* 2007). In reaction to such dichotomy, food systems have been identified as the nexus between rural and urban landscapes where the integrity of both people and ecosystems is at stake (Morgan 2015; Marsden and Sonnino 2012). By growing as a cultural, economic and political phenomenon, the original insights brought in by such perspective set the ground for the development of a new kind of relationship between the city and the countryside, directly involving both food consumers and producers (Parkins and Craig 2009). In reaction to the commodification of human nutrition entailed by the tendency of industrial societies to consider food as a convenience good, experiences of alternative food networks (AFNs) emerged as strategies to redefine food as a credence good where the relationship between producers and consumers allows the exchange of non-standardized products outside the conventional channels of mass distribution (DuPuis and Goodman 2005; Renting *et al.* 2003). Defined as a form of social innovation which is developed between producers and consumers, AFNs include: direct marketing, community supported agriculture programs, farmers' markets, community self-organized schemes, transition networks (Goodman *et al.* 2012). While several analyses provided evidence that AFNs can generate environmental, economic and social benefits (Pretty 2001; Brown and Miller 2008; Hughes *et al.* 2008; Coley *et al.* 2009; DeWeerdt 2009; Martinez 2010; Santini and Gomez y Paloma 2013), it is still debated in the literature whether such experiences will be able in the next future to scale-up or not (Sonnino and Marsden 2005). On this issue, the available literature follows two main theoretical frameworks: 1. A well developed literature adopting behavioural and economic approaches investigated the role played by both consumer's and producer's motivation towards participating in AFNs (Zepeda 2009; Zepeda and Li 2006; Bond *et al.* 2006); 2. A second approach, based on disciplines

like critical geography, sociology and anthropology, examined the role played by political issues, struggles and motivations underlying the functioning and the expansion of AFNs as social and cultural movements (Goodman *et al.* 2012; Parkins and Craig 2009; Renting *et al.* 2003). Both streams of research provided relevant information about the structure of AFNs, shedding light on the opportunities and the barriers that may affect their development in the future. By integrating the literature available with an original perspective based on the interpretation of AFNs as systems of social innovation, this paper analyses their evolution in industrialized countries in order to assess whether such experiences can be considered as emerging paradigms able to challenge conventional mass-distribution systems or simply as growing green niches involving small fractions of producers and consumers (Smith 2006; 2007). As a case study, the analysis explores the growing role of local food markets in the U.S. (Hardesty 2008), by focusing on the case of farmers' markets (FMs). By implementing a system dynamics model, the study aims to provide further insights about the historical development and the prospects for the future expansion of AFNs in western countries, shedding light on the major barriers that might affect their evolution and the possible policy-options that could be effective in overcoming them. The article is organized as follows: section two introduces the theoretical framework adopted; section three presents the methods and the detailed description of the model developed; section four includes the analysis of the scenarios elaborated and section five discusses the results of the simulations in terms of policy implications; in the conclusions, the limitations of the approach here adopted are underlined and future research directions are suggested.

2. AFNs, SOCIAL INNOVATION AND THE DIFFUSION OF FMs IN THE U.S.

Following the classification proposed by Goodman *et al.* (2012), FMs can be considered as a first generation, market-oriented, scheme of AFN. Rather than being breakthrough innovations revolutionizing the functioning of agri-food systems, it is more appropriate to refer to the evolution of U.S. FMs as a renaissance leaded by an incremental process of social innovation (Hinrichs *et al.* 2004). Such definition refers to the introduction of "[..] *novel solution to a social problem* [..] [by which] *the value created accrues primarily to society rather than to private individuals"* (Phills *et al.* 2008: 36). According to the literature on AFNs, the recent development of FMs can be seen as a result of an innovative process oriented towards a twofold goal: (i) to provide answers to social

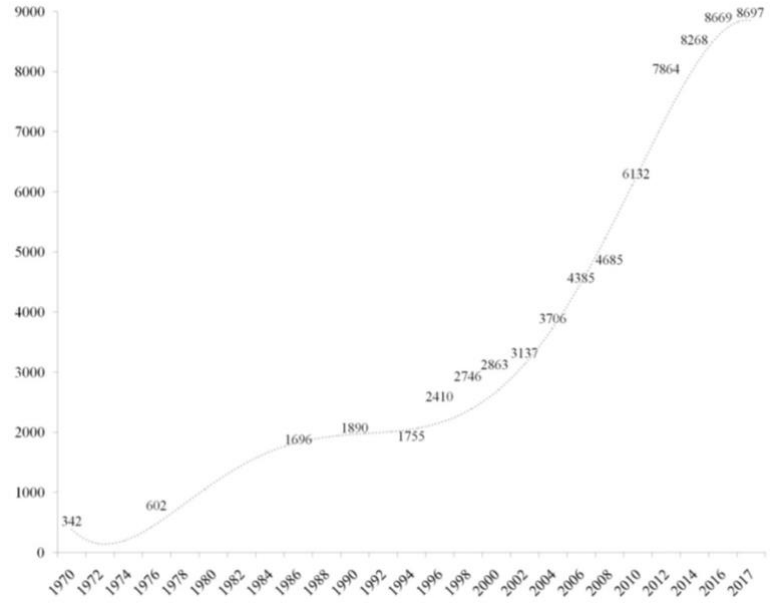
concerns, such as environmental, socio-economic or public health issues (Goodman *et al.* 2012; Seyfang 2006; Hinrichs *et al.* 2004); and (ii) to allow the organization of new forms of business strategies, rules and social relationships to emerge and shape a new system of production and consumption (Holloway and Kneafsey 2004). When social innovations arise, they generally take place at the scale of niches embedded in the dominant socio-technical system (Smith, 2007). According to the scheme proposed by the new institutional economics theory (North 1991), the widespread adoption of both technical and social innovations is subject to the implementation of an institutional framework regulating the new form of production and/or consumption. AFNs are good examples of innovation niches that depend on and interact with the institutional, socio-economic and technical frameworks (Smith, 2006). Within this context, innovators –both producers and consumers– perpetuate the classical scheme of diffusion of innovations, where imitators follow pioneers until demand or supply result saturated (Rogers, 1962). As Heffernan (1982) and Nowak (1984) stated, the adoption/diffusion of innovative practices in agri-food systems can be better addressed by analyzing the aggregate economic, structural and institutional characteristics of the context rather than the personal motivations of farmers, who are normally subject to numerous constraints from the surrounding environment (Padel 2001).

2.1 FMs as forms of social innovation

For what pertains the case study considered in this paper, Brown (2002) notes how the first farmers-pioneers were pushed to re-discover the economic and the social relevance of direct marketing and local community engagement in response to the generalized crisis that affected the U.S. farming sector from the end of the 1970s'. The socio-economic and institutional conditions established during thirty years (1945-1975) of national policies oriented to increase specialization and consolidation of large businesses (Sexton 2013) compromised the resiliency of small farms, which gradually sought FMs as alternative channels to market their products while realizing higher margins. After a period of increasing, albeit informal, interest around FMs, in 1976 the U.S. Government approved the first law oriented to institutionalize the re-emerging social and economic practice that small-farm owners were undertaking in order to sustain their income (Brown 2002). Following the Farmer-to-Consumer Direct Marketing Act (PL 94-463), new and institutionalized FMs grew exponentially across the Country, reaching a peak in 2017 at 8,697 markets (Fig. 1).

Although data for the years prior to 1994 is partially missing (Brown 2001), the graph illustrates that AFNs, and, in particular FMs, cannot interpreted simply as fads determined by the diffusion of temporary consumption habits. On the contrary, these experiences are consolidated structures of the US farming landscape, able to grow and expand when the institutional framework results adequate. The US administration dedicated much attention to the promotion of FMs over the past decades, with several federal and sub-federal programs to improve and to communicate the range of such experiences. However, what emerges from the graph 1 is the fact that the diffusion of U.S. FMs seems to be following the typical S-shaped trend due to the exhaustion of the potential gains associated with the diffusion of innovations in mature markets (Rogers 1962).

FIGURE 1 • NUMBER OF FMS IN THE U.S. 1970-2017



Source: own elaboration based on USDA (2016) and Brown (2001).

As a report from the U.S. Department of Agriculture (USDA 2015) underlines, the growth pace of FMs has dramatically slowed down during the last years, and the reason could depend on both the demand or the supply side.

In the first case, demand for locally grown food would have reached a plateau. In this scenario, competition among farmers would increase dramatically, the less efficient

FMs would close, and the rate of opening of new FMs would decrease until stopping at a certain level.
The second hypothesis assumes that supply is stabilizing due to barriers in the process of involving more farmers in the organization of FMs, or given the scarcity of small farms located in proximity of urban areas. As the authors of the report argue, if farmers are located too far from their potential customers, their participation in AFNs would shift towards other forms of retailing systems (such as food hubs or institutional purchasing) that could allow them to better manage the high transaction costs of direct marketing (USDA 2015).
While the first hypothesis is often assumed to be the major driver responsible for the observed trend, there is still no evidence that the potential market for FMs has been saturated. By contrast, the proportion of farms for which FMs represent a viable marketing channel could be very low, because farming operations have to be, at the same time, small or medium-sized and have located in proximity of urban agglomerations that represent their primary catchment areas (Mack and Tong 2015). As Padel (2001) argues, early adopters correspond to particular regional categories of customers (divided by sex, gender, income level, education) and farmers (small-farms owners, educated, progressives). After the innovation is introduced, the niche can attract other categories of subjects, often animated by different goals then the ones of the pioneers. In the medium-term, such dynamics design a double S-shaped curve for both the two typologies of adopters: consumers and producers.

2.2 Drivers of the of the diffusion of FMs in the U.S.

During the past twenty years, many survey-based studies in different contexts across the U.S. investigated the attractiveness of FMs among households, underlying the relationship between local food consumption and social, demographic and economic characteristics of individuals (Zepeda 2009; Bond *et al.* 2006; Zepeda and Li 2006). By analyzing geographical data, Schupp (2015) studied the diffusion of FMs among neighborhoods of several cities in the US obtaining results similar to those of individual-based surveys. However, for the sake of this paper, it is necessary to adopt a nation-wide point of view in order to obtain an estimate of the main drivers determining the aggregate demand for FMs. Unfortunately, there are no studies exploring this dimension. To temporarily fill this gap, it is useful to assess what variables are more correlated with the diffusion of FMs across the US. By considering several demographic and economic characteristics of the 3,142 US counties, an

Ordinary Least Square regression (OLS) confirms that several components contribute more than others to the diffusion of FMs (Tab. 1).

TABLE 1 • FACTORS EXPLAINING THE NUMBER OF FMS IN U.S. COUNTIES: O.L.S. RESULTS

	Coefficient	Std. Error	t-ratio	p-value	
Constant	3.000180	1.411850	2.12500	0.033670	**
Population Size	0.000012	0.000001	9.32230	<0.00001	***
Average Age	0.024039	0.014620	1.64470	0.100130	
Number of Farms	0.000640	0.000170	3.67240	0.000240	***
Household Size	-1.594460	0.344100	-4.63370	<0.00001	***
Pop. Density	0.000417	0.000073	5.70780	<0.00001	***
Urbanization Rate	1.448100	0.369870	3.91520	0.000090	***

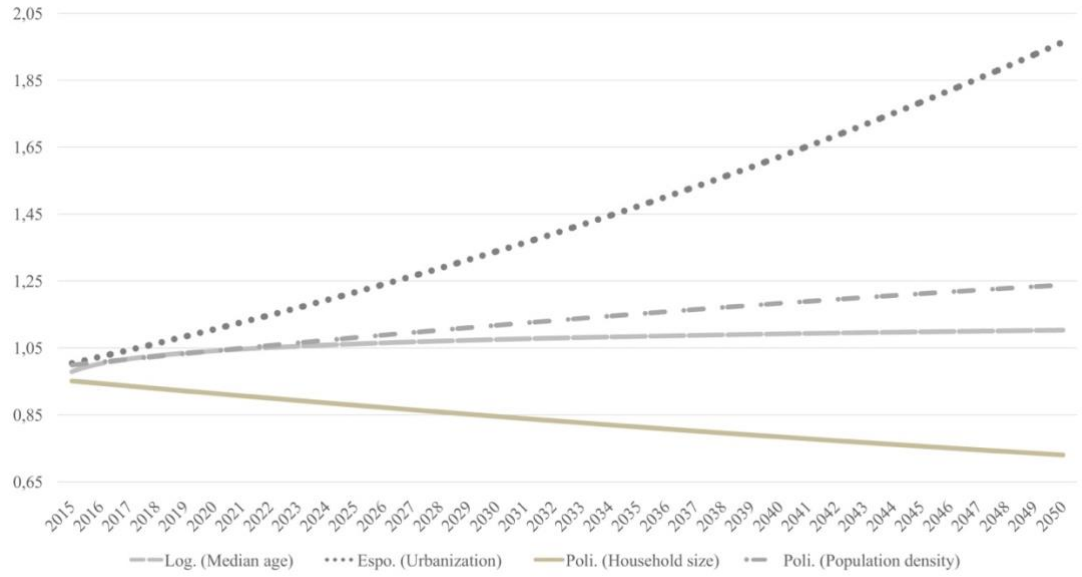
Mean dependent var.	2.358	S.D. dep. Var.	5.251
Sum squared resid.	27705.7	S.E. of regression	2.972
R-squared	0.68	Adjusted R-squared	0.679
F(6, 3136)	138.9	P-value(F)	1.80E-156
Log-likelihood	-7880	Akaike criterion	15774.1
Schwarz criterion	15816.4	Hannan-Quinn	15789.3

Source: own elaboration on USDA (2014) and United States Census Bureau (2010).

Except for the component "Average Age", whose p-value is too high, the other variables are strongly correlated with the diffusion of FMs. In particular, it is interesting to note that the average household size has a negative effect on the dependent variable (number of FMs), and the reason is, intuitively, that a greater number of small households consumes more than a lower quantity of larger ones. Urbanization, median age and population density are other factors influencing the distribution of FMs in a positive way, along with the population of the county. Assuming that population size will not change significantly during the next decades at the national level, the analysis can focus on the other components of the regression. By looking at the expected future trends of the variables correlated with the diffusion of FMs (Fig. 2), we can conclude that the aggregate demand will keep growing in the future, since the indicators are expected to increase in the forthcoming years. In this perspective, we also considered the variable "Average Age", which is relevant to our analysis for two reasons: first, Schupp (2015) found that this variable is useful in explaining the geographical diffusion of FMs by using data more precise than the ones used to perform the above regression and, second, this variable is expected to have a

greater impact in the future, when baby boomers' aging will affect US households' consumption patterns (Knickman and Snell 2002).

FIGURE 2 • AGGREGATE DEMAND FOR U.S. FMS: PROJECTION OF MAIN DRIVERS. INDEX NUMBERS (2015 = 1).



Data Source: Our elaboration based on Nowak and Walton (2005); U.S. Census Bureau (2010).

Another factor influencing the diffusion of FMs is the quantity of farming operations. After 1974, the quantity of U.S. farms tended to stabilize around low negative rates after fifty years of steady decline (Sexton 2013) and, during the past decades, both the number of farms and arable land followed a linear negative trend, while the average farm size increased. This behavior reflects two sides of the same phenomenon: the impact of the process of urbanization and the effect of specialization and consolidation of the farming sector.

This first attempt to define the different variables affecting FMs diffusion is still rough and needs deeper analysis. Nevertheless, such preliminary assessment reveals some important insights for the aim of this paper: both socio-demographic variables (population density, age, households size) and the structure of the farming sector (number of farms) impact the distribution of FMs across the Country. Moreover, the urbanization process behaves as a cross variable, influencing both FMs diffusion (higher demand) and farm closings (declining supply). The second point merits particular attention, because urbanization (especially in the form of urban sprawl) has

the highest impact on peri-urban areas, where increasing land values and increasing competition for commercial land use compromise the viability of small-farm operations, which represent the stock of "adopters" that are most likely to join a FM (Holloway and Kneafsey 2004).

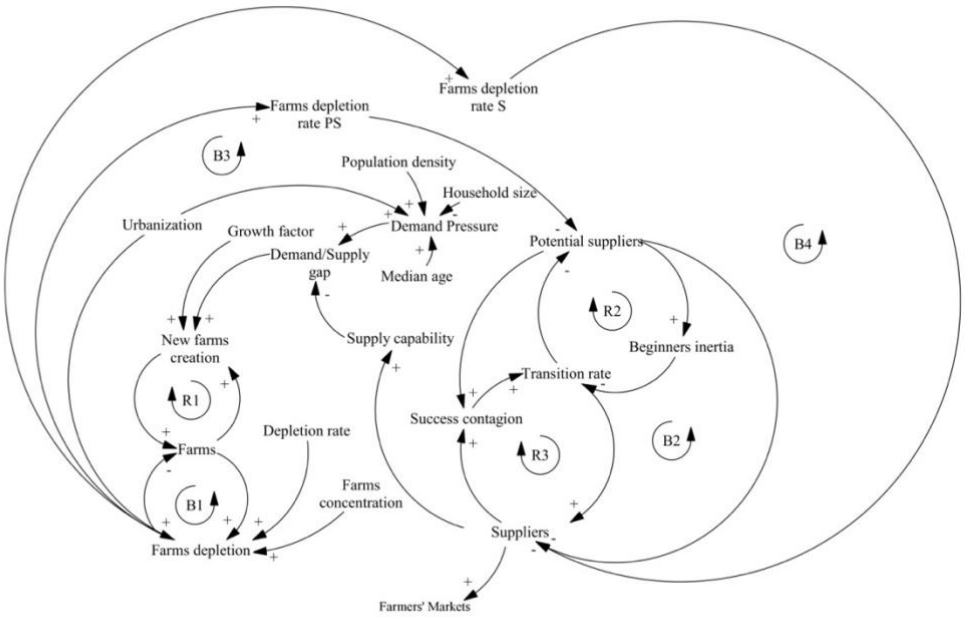
3. METHODS AND MODEL DESCRIPTION

System dynamics is a method developed in the mid of the 1950s (Forrester 1958). Originally conceived for the analysis of business cycles (Forrester 1976), its use was soon extended to environmental modeling and socio-economic simulations (Sterman 2000; Meadows *et al.* 1972; Ford 1999). The main goal of a system dynamics model is not to predict the future, but to "*link the past to the present by showing how present conditions arose, and extend the present into persuasive alternative features under a variety of scenarios determined by policy alternatives*" (Forrester 1993: 19). Thanks to their flexibility, system dynamics models are a valuable framework for effective, quantitative storytelling, where categories and semantics are chosen according to the researcher's goal (Guhathakurta 2002). While several researches have investigated production choices among farmers from a systemic point of view (Shi and Gill 2005; Rozman *et al.* 2009; Li *et al.* 2012), such approach has not yet been implemented for retailing strategies like direct marketing, FMs or more generally AFNs.

3.1 The Model: Causal Loop Diagram

According to the concepts introduced in the previous paragraphs, the model implemented considers two main dynamics affecting the diffusion of FMs in the US: the diffusion of social innovations through the adoption/diffusion model (Bass 1992; Sterman 2000) and several structural trends affecting both the demographic and the farming systems. The first stage for the implementation of a system dynamics model is to define the causal relationships involving the variables considered in order to explain a certain phenomenon. This results in a causal loop diagram (CLD) explaining the mechanisms driving the development of FMs according to the diffusion of social innovations among both consumers and producers (Fig. 3).

FIGURE 3 • CAUSAL LOOP DIAGRAM



Labels in Fig. 3 represent the causal variables associated with the diffusion of FMs as forms of social innovation. Each label is connected to the others through lines specifying the direction of the causality (arrows) and the effect on the subsequent variable (a reinforcing effect is denoted by the sign "+" , while a negative correlation is denoted by "-"). The capital letters indicate the networks of causal mechanisms behaving as reinforcing ("R") and balancing ("B") feedback loops. System dynamics is a useful tool to represent the complex interactions underlying the functioning of feedback loops, where a change in a variable is transmitted through a circuit of causal events which eventually reinforce or balance the initial effect on the first variable. For example, looking at "R3" it is easy to recognize the reinforcing mechanism involving the variables "suppliers", "success contagion" and "transition rate": more suppliers involved in FMs increase the perception of FMs as successful strategies for other farmers, which in turn increase the rate of adoption of such strategy, which, again, increases the number of suppliers and so on. As in every modeling approach, it has been necessary to introduce few relevant assumption about the functioning of the causal system above represented. The three assumptions presented in Tab. 2 allow to better focus on the mechanism of diffusion of FMs.

TABLE 2 • MAIN ASSUMPTIONS INCLUDED IN THE MODEL

a) Demand for locally grown food is higher than current supply and its evolution follows the evolution of population dynamics, urbanization rate and household's size.

b) There are no delays affecting farmers' decision to join or to quit a FM

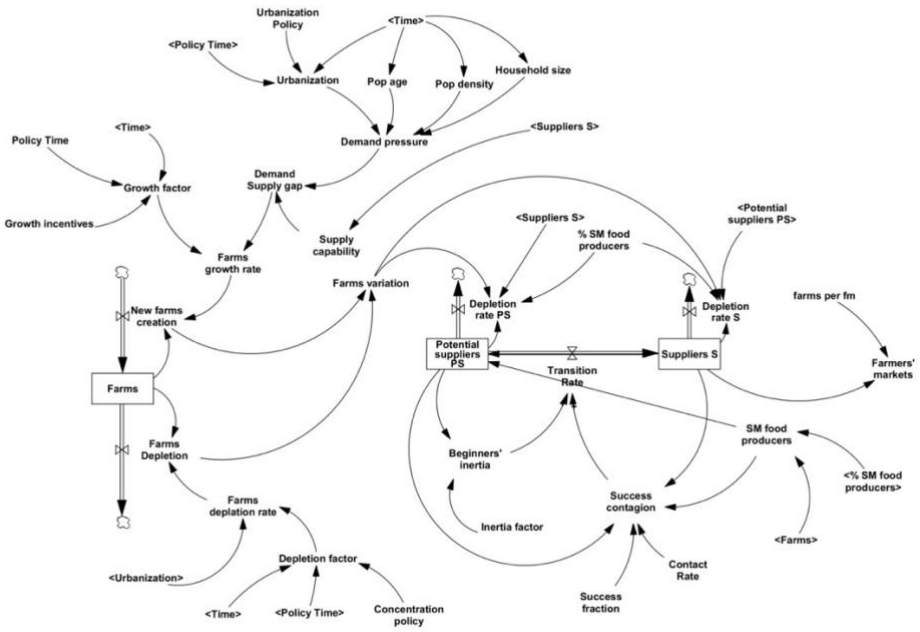
c) Only small and medium family-owned operations producing fresh food and/or diary products can sell their products at FMs

Once the network of causal mechanisms at play in the determination of the phenomenon considered has been defined, it is possible to proceed towards its mathematical formalization.

3.2 The model: stock-flow diagram

The model is based on a set of equations regulating the size of three stocks at a particular point in time (1994): Farms, Potential Suppliers and Suppliers. Five equations define the flows associated with the three stocks (Tab. 3). Figure 4 shows the stock-flow diagram of the model through the interface of the Vensim® simulation software.

FIGURE 4 • STOCK-FLOW DIAGRAM



The first stock parameter is the aggregate quantity of farming operations in the US, whose initial value was equal to 2,1 million units in 1994 (USDA 2014). The second stock equation links the number of potential adopters, defined by the total amount of small and medium farms producing food suitable for direct marketing (fresh food, diary, etc.), with the total amount of suppliers, which are the farmers who decided to form or to join a local FM. According to the USDA (1994), 86,432 farms were selling their products directly to consumers in 1994, but only 20,946 farmers were reported as FMs vendors (Payne 2002). By contrast, a more recent estimate conducted by Ragland and Tropp (2009) found that in the early stages of FMs expansion in the U.S., the average number of vendors per market was 31. We used the latter figure to estimate the number of FM vendors for the year 1994, according to the number of operative FMs provided by USDA FMs count. Following Ragland and Tropp's argument, during the recent period of growth in the number of FMs, the quantity of vendors per market decreased to 22. We included also this value in the model.

TABLE 3 • THE MODEL: STOCK AND FLOW EQUATIONS

Stock equations				
Name	Description	Equation	Initial Value	Source

Farms	Total amount of U.S. farms	INTEG (+ New farms creation-Farms Depletion)	2.10E+06	USDA (2014)
Potential suppliers PS	Number of farms satisfying the criteria for being FMs suppliers	= INTEG (-Transition Rate+Depletion rate PS)	(SM food producers - Suppliers S)	/
Suppliers S	Number of farms selling their products at FMs	INTEG (Transition Rate+Depletion rate S)	51,750	Our elaboration based on Ragland and Tropp (2009) and USDA (1994)

Flow equations		
Name	Description	Equation
New farms creation	Number of farms created each year	Farms growth rate*Farms
Farms depletion	Number of farms closed each year	Farms*Farms depletion rate
Variation rate PS	Yearly variation in the number of Potential Suppliers	"% SM food producers"*Farms variation* (Potential suppliers PS / (Suppliers S+Potential suppliers PS))
Variation rate S	Yearly variation in the number of Suppliers	"% SM food producers"*Farms variation* (Suppliers S / (Potential suppliers PS+Suppliers S))
Transition Rate	Number of potential suppliers that each year become suppliers	Beginners' inertia + Success contagion

Several endogenous variables define the set of relationships within the stocks and the flows (Tab. 4). The time step chosen for the simulation is equal to one year and the period under investigation corresponds to 50 years, starting from 1994.

TABLE 4 • THE MODEL: ENDOGENOUS VARIABLES

Name	Description	Equation
Farms growth rate	The rate of growth of new farms	Growth factor*Demand/Supply gap
Demand pressure	The structural trend of the demand	Household size + Popage + Popdensity+Urbanization
Supply capability	The trend of the supply	Suppliers S/Initial Value "Suppliers"
Demand/Supply gap	The gap between the trend of the demand and the trend of the supply	Demand pressure/Supply capability
Farms depletion rate	The rate of farm closings	Depletion factor*Urbanization
Farms variation	The difference between farms openings and closings	New farms creation-Farms Depletion
Beginners' inertia	Conformism and skepticism that counter-act the imitation of pioneers	Inertia factor*Potential suppliers PS
Success contagion	Imitation factor, more pioneers attract more potential suppliers, overcoming the negative effect of initial skepticism	Contact Rate c*Success fraction*Potential suppliers PS*SuppliersS / SM food producers

SM food producers	Number of small and medium farms producing food for direct consumption	Farms*"% SM food producers"
Farmers' markets	Total amount of operative FMs	Suppliers S/farms per fm

3.3 Model calibration

To establish whether the model is able to represent the complex phenomena under investigation or not, it is necessary to calibrate some control variables and compare the outcomes of a first simulation to the observed data available (1994-2016). According to Hoppe (2014), the number of small farms producing vegetables, fruit, dairy and poultry (thus excluding both big businesses and commodity-specialized farms that use mediators in the supply chain, as in the case of cash crops, beef, hogs or other livestock producers), is equal to 205,812 units. This value, referred to the year 2012, corresponds to nearly 10% of all US farms. It is important to underline that the "Beginners' inertia" and the "Success contagion" factors are two components of the adoption/diffusion model as introduced by Bass (1969) and further developed by Sterman (2000) in a system dynamics perspective. The variables "Contact rate", "Success factor" and "Inertia factor" have been chosen arbitrarily. These values represent: (1) the number of farmers met every year by each FM supplier ("Contact rate"); (2) the number of farmers that every year decide to form or join a FM ("Success factor"). In this case a very low imitation factor has been chosen, indicating that in order to persuade a new farmer to join a FM, it takes at least three years (or three suppliers to persuade one potential supplier in only one year); (3) the number of farmers that every year decide to leave a FM is given by the variable "Inertia factor". In this case, the value is very high, since many farmers may attempt several times to join or form an FM, but often these experiences result unsuccessful (Stephenson *et al.* 2008). Finally, the net rate of farm openings, given by the difference between farm openings and closings, can be considered as a constant, which value has been observed at -0.8% per year during the past decades (USDA 2014).

TABLE 5 • THE MODEL: EXOGENOUS VARIABLES AND FUNCTIONS

Name	Description	Value/Equation	Source
Constants			
% SM food producers	Percentage of small and medium farms producing food for direct consumption	0.10	Own elaboration based on Hoppe (2014)
Contact Rate c	Number of farmers contacted by one supplier during one year	81	Assumption

Success fraction	Imitation factor among potential suppliers	0.0043	Assumption
Inertia factor	Skepticism among potential suppliers	-0.077	Assumption
Farms per FM	Average number of farms per FM	22	Ragland and Tropp (2009)
Depletion factor	Historical factor of farm closings, depending on concentration processes	IF THEN ELSE(Time>=Policy Time, Concentration policy*0.015 , 0.015)	USDA (2014)
Growth factor	Historical factor of farm opening	IF THEN ELSE(Time>=Policy Time, Growth incentives*0.007 , 0.007)	USDA (2014)
Exogenous functions			
Household size	Average size of U.S. households, projected trend	IF THEN ELSE (Time>0, (-0.286*LN(Time) + 3.6863) / 3.6863 , 3.6863/3.6863)	Own elaboration on US Census Bureau (2010)
Pop age	Average age of U.S. citizens, projected trend	IF THEN ELSE (Time>0, (1.4578*LN (Time) + 36.784)/36.784 , 36.784/36.784)	Own elaboration on US Census Bureau (2010)
Pop density	Average population density in U.S., projected trend	(9e-005*EXP (0.0056*Time))/ 9e-005	Own elaboration on US Census Bureau (2010)
Urbanization	Average urbanization rate in U.S., projected trend	IF THEN ELSE (Time>=Policy Time, Urbanization Policy* (0.0251*EXP(0.0177*Time))/ 0.0251, (0.0251*EXP(0.0177*Time))/ 0.0251)	Own elaboration on Nowak and Walton (2005)

3.4 Model validation and baseline scenario

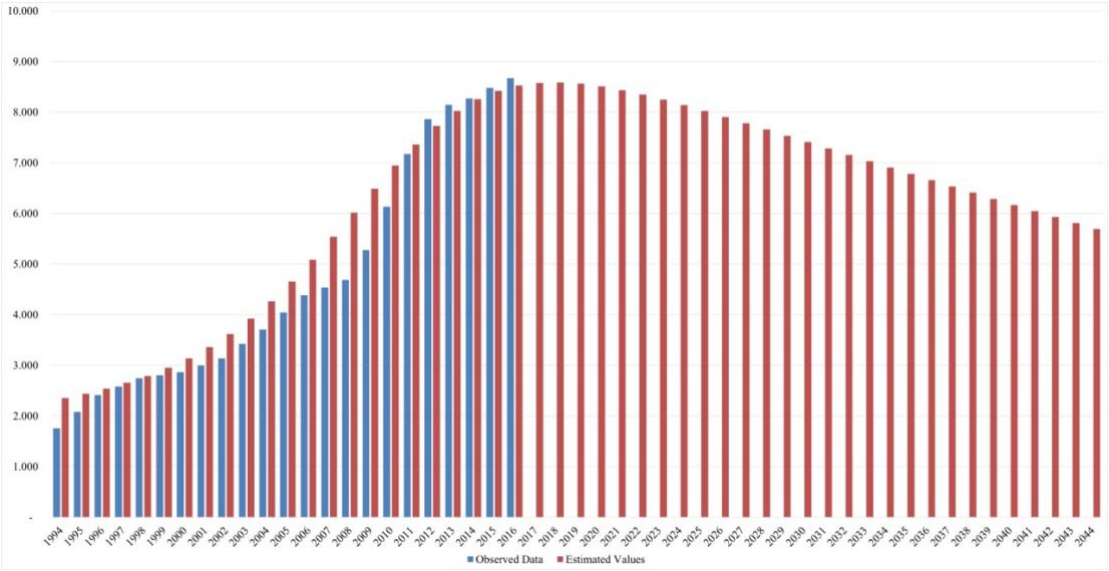
In order to check the validity of the model, the national count of US FMs provided by the USDA has been used as a benchmark for the period 1994-2016. Fig. 5 shows the observed (blue) and the estimated (red) values for the number of FMs. The model results reliable, with a coefficient of determination (R^2) equal to 93.7%, and a mean absolute error equal to 387 (10.7% in relative terms). A sensitivity analysis has been performed for three exogenous variables which values were arbitrarily assigned. The results show that in some cases the number of FMs is sensitive to a variation in our assumptions. Nevertheless, the analysis showed only a numerical sensitivity, while no evidence was found for either a behavioral sensitivity nor a policy sensitivity.

TABLE 6 • THE MODEL. SENSITIVITY OF (±10%) CHANGE IN THE ASSUMPTION ABOUT THE VALUE OF THREE VARIABLES ON THE NUMBER OF FMS

	Negative 10%			**Positive 10%**		
	FMs average	*% change*	*Sensitive*	*FMs average*	*% change*	*Sensitive*
Success fraction	4990	-21.38%	Yes	6576	3.61%	no
Contact rate	4990	-21.38%	Yes	6576	3.61%	no
Inertia factor	5758	-9.28%	No	6509	2.55%	no

Fig. 5 shows the outcome of the system (number of FMs) after the simulation of a baseline scenario. According to the initial conditions provided, the total amount of FMs in the US increases until a certain peak, then it declines. This behavior is due to the fact that the increasing urbanization (as projected in Fig. 3) in the long term leads to the depletion of a greater quantity of land, reinforcing farm concentration and thereby increasing the rate of farm closings. Such an explanation allows to consider the rate of urbanization as a major leverage point of the system implemented. Furthermore, it supports the initial hypothesis that the current trend in FMs diffusion might be determined by the decreasing availability of suppliers.

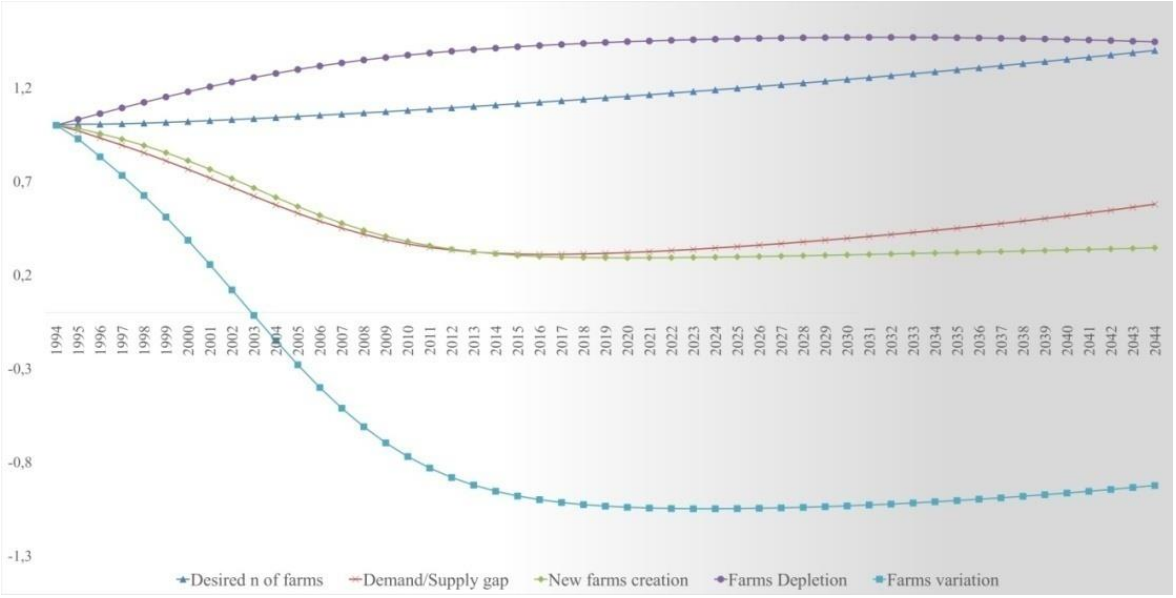
FIGURE 5 • BASELINE SCENARIO:
TOTAL NUMBER OF FMS IN THE U.S. SIMULATED (RED) VS. OBSERVED (BLUE) DATA



While demand saturation may occur in many towns, villages and neighborhoods, the national aggregate demand might be still compatible with another expansion of FMs. This view is confirmed by observing the simulation's results in terms of efficiency of the supply in satisfying the demand (Fig. 6). While the demand pressure increases

steadily, the number of operative farms drops, determining the ineffectiveness of the systems in providing urban food needs ("Demand/Supply gap").

FIGURE 6 • BASELINE SCENARIO, MAIN INDICATORS' TREND (1994-2044).
VALUES IN SHADED AREA ARE PROJECTIONS

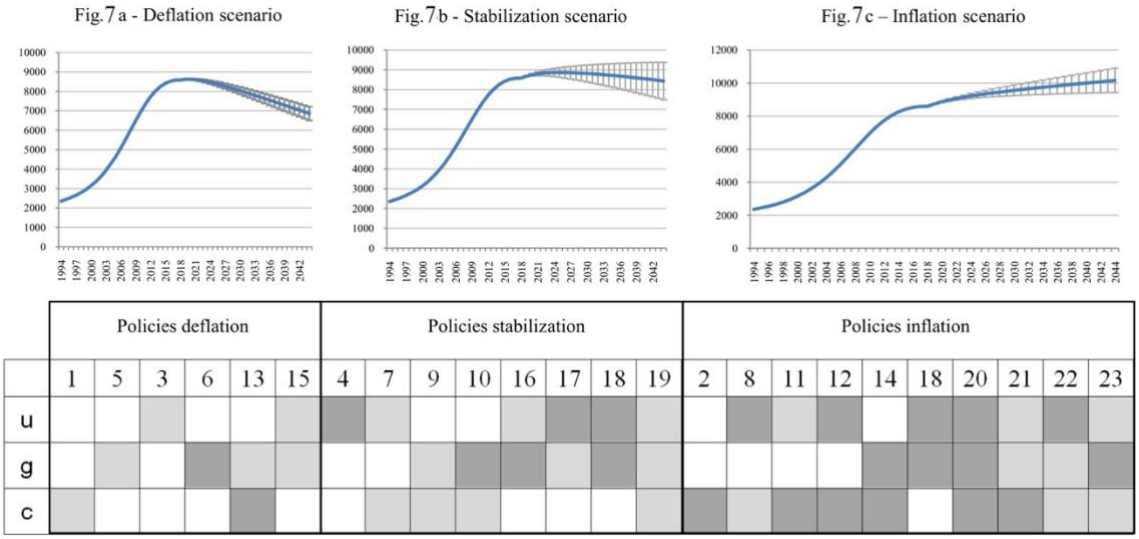


4. SCENARIO ANALYSIS

Three leverage points have been selected as potential targets of policy intervention in order to conduct the scenario analysis: the growth rate of new farms; the closing rate of existing farms; the urbanization rate. The alternative scenarios have been projected starting from the year 2017 through the activation of three external variables denominated "policy time". Three hypothetical policy tools are therefore oriented to stimulate the growth of new farms (G), to reduce the concentration of existing farms (C) and to reduce the urbanization rate (U). The magnitude of the policy intervention is set equal to three different levels: no-policy, low-policy and high-policy, resulting in different changes in the values of U, G and C. Policies oriented to boost the opening of new businesses can have an effect ranging from +30% (low-policy) to +80% (high-policy), whereas policies oriented to decrease the concentration of farms or the urbanization factor can range from -30% (low-policy) to -80% (high-policy) on a year-by-year basis. The combination of the three variables at three different levels of implementation (zero, low and high policy) gives as a result 24 scenarios including the baseline one. All the scenarios improved the baseline projections. However, the majority of the simulations fail to further increase the diffusion of FMs over the 2016

level. Therefore, the first consideration emerging from the scenario analysis is that the chosen set of policies oriented to promote the development of AFNs in the US has low effectiveness. The second consideration relates to the factors determining this behavior: because of the structure of the adoption/diffusion model, the number of small and medium farms interested in selling their products at FMs can no longer grow exponentially after that the majority of the "potential adopters" becomes "suppliers". Another consideration follows: the range of policies considered in the analysis does not entail dramatic changes in the structure of US farming system, therefore the opportunity space for the development of new cycles of innovation is limited. By considering what emerged from the simulations, we propose a scenario analysis based on the 23 scenarios grouped into three sets of alternative outcomes:
The first set – defined as "deflation scenarios" (Fig. 7a) – includes the scenarios giving a negative outcome at the end of the simulation. Fig. 7a shows the average between the six trends projected and the standard deviation. Policies allowing this evolutionary pattern should be considered as ineffective.
The second set includes the "stabilization" scenarios (Fig. 7b) for which the outcome variable (number of FMs) is more or less equal to the number of FMs observed at the beginning of the simulation. Seven scenarios compose this set which could be defined as a set of solutions oriented to mitigate the negative impact of farms concentration and urbanization on the diffusion of Fms.
The third (Fig. 7c) set includes nine scenarios of inflation. Through the implementation of a particular set of policies, the number of US FMs in the future could keep increasing, although at a linear rate.

FIGURE 7 • SCENARIOS' CLASSIFICATION BASED ON THE AVERAGE OUTCOME. BOXES REPRESENT THE MAGNITUDE OF THE POLICY INTERVENTION (WHITE = ZERO; LIGHT GREY = LOW-POLICY; DARK GREY = HIGH-POLICY). GREY BARS ARE STANDARD DEVIATION



4.1 Scenario analysis: effectiveness

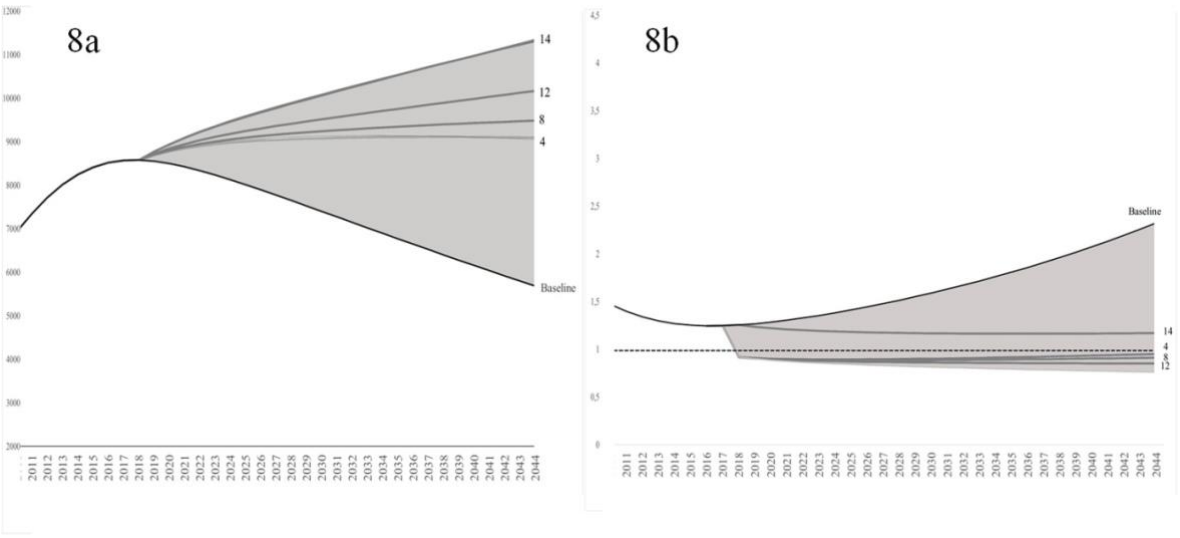
The analysis of the three groups of scenarios reveals some interesting insights: (1) scenarios focusing on the implementation of only one of the three policy tools at a low level resulted ineffective in expanding the diffusion of FMs. If taken one at a time, a small stimulus to the growth of new farms, a limited control of urban sprawl or the slight limitation of farms concentration resulted ineffective. (2) The implementation of more radical policies (±80%) is a condition necessary but not sufficient to undertake a scenario of inflation. For example, a strong stimulus to the growth rate of new farms could be totally ineffective if not coupled with policies constraining the rates of urbanization and farmland concentration. Strong policies oriented to increase the variable "G" require at least one additional policy intervention in order to be effective. A similar discourse applies to the variable "U" and "C". (3) The most sensitive policy-variable is "C". In fact, almost all the policies involving high changes in "C" (-80%) are effective in increasing the number of FMs in the long period. (4) While the most effective scenario entails a joint intervention on the three policy-variables, it is interesting to underline that a similar result could be achieved through a strong policy intervention on only two variables: farms concentration ("C") and new farms growth rate ("G").

4.2 Scenario analysis: efficiency

By examining the outcome of the simulations, it is possible to assess the efficiency of the system after the implementation of different sets of policies. The whole system is

considered efficient when both demand pressure and supply dynamics follow the same pattern. Thus, in conditions of increasing demand, an efficient system shows an increasing supply, while an inefficient system will be unbalanced, with a growing gap between the supply and the demand dynamics. In the model implemented, this behavior is represented by the variable "Demand/supply gap", which reflects an efficient equilibrium when its value is near to one, whereas the system results unbalanced. Fig. 8b presents the range of values of the variable "Demand/supply gap" obtained for the 23 simulated scenarios.

FIGURE 8 • SCENARIO ANALYSIS: RANGE OF EFFECTIVENESS (8A) AND EFFICIENCY (8B). BASELINE SCENARIO, S14, S12, S8 AND S4. EFFICIENCY THRESHOLD = 1.



The baseline scenario shows a dynamic efficiency that increases throughout the period 1994-2015. For later periods, the gap between the structural trend of the demand (increasing) and the supply (decreasing) makes it more and more difficult for US FMs to correctly meet the demand for locally grown food. Only seven scenarios bring the system towards a constant efficient condition or a linear improvement in efficiency over time. Scenarios where the gap between demand and supply is constant are only partially efficient, while scenarios where the gap is increasing, are considered inefficient. On the other hand, scenarios presenting a gap between demand and supply that tends towards the threshold value can be considered as efficient (s14, s4, s12, s8). One of the most efficient scenarios (s4) is not effective in increasing the number of FMs over time (Fig. 8a). By contrast, the outcome of scenarios s8, s12 and s14 revealed both efficient and effective. Scenario s14 is particularly effective in increasing

the number of FMs and in pursuing dynamic efficiency on the long period. This scenario shows that the best mix of policies for achieving a sustainable and efficient pattern of growth should be based on strong incentives to create new farms combined with a strong policy intervention oriented to reduce farms concentration.

5. POLICY IMPLICATIONS

Through the simulation of 23 different scenarios, we showed that US FMs could still increase in the future through the adoption of three different policies:

1. Policy instruments oriented to increase the farms growth rate: this category includes economic subsidies, private and public programs oriented to improve young people's interest towards agriculture, promotion of cooperatives and other mutualistic structures to sustain start-up initiatives, promotion of urban farming.
2. Policy instruments oriented to decrease the rate of closings of existing small and medium farms, such as: measures contrasting financial speculation on agricultural land, discouraging crop monocultures near urban areas, offering financial assistance to small businesses or policies encouraging multifunctional agriculture practices entailing diversification and positive externalities.
3. Policy instruments oriented to reduce the rate of urbanization: for instance, through the creation of "green belts" around urban areas, the limitation of financial speculation on built land, the limitation of urban-sprawl, the protection of the agricultural landscape through the creation of rural and peri-urban protected areas.

In the case of the best performing scenario both in terms of effectiveness and efficiency (s14), an example of integrate policy may include the introduction of a new scheme of economic incentives to remunerate the social, cultural and the ecosystem's services provided by small and medium farms located in peri-urban contexts (Depietri *et al.* 2016) to stimulate the openings of new farms, and the gradual shift from subsidies schemes from capital-intensive to labor-intensive operations, in order to contrast farmland concentration. However, as mentioned above, the most effective scenarios do not allow another S-shaped expansion of US FMs. In fact, to obtain a new wave of exponential growth, a major change in the structural dynamics of US farming system, such as, for example, the inversion of the process of farmland concentration would be necessary, although unrealistic. In sum, policies may help the development of FMs to consolidate as market niches, but the analysis proposed in

this article did not find evidence that AFNs may further scale-up in the forthcoming years, enabling a major paradigm shift. The short list of hypothetical policies here proposed is certainly not exhaustive, yet it provides some useful examples to open the debate on the future role of FMs, AFNs and, more generally, the potential goals of policy proposals oriented to strengthen the role of local food systems.

CONCLUSIONS

This article investigated the evolution of AFNs aiming to assess whether such experiences may be considered as the preliminary phase of a paradigmatic shift from the conventional, standardized form of mass retailing systems toward a new form of urban-rural relation or not. By adopting a definition of AFNs as forms of social innovations, the article analyzed the recent trend in the development of FMs in the US and the causal mechanisms sustaining it. A quantitative analysis has been performed through the implementation of a system dynamics model. Preliminary results confirm that the number of FMs in the US is currently stabilizing after a period of exponential growth. The simulation showed that the last expanding phase peaked in recent years, and another exponential growth of U.S. FMs will not be possible in the future given that the number of potential suppliers (small and medium farms producing food suitable for direct marketing) is limited. While the lack of additional potential adopters due to the characteristics of the US farming system hinders another phase of exponential growth, there is still potential to increase the number of FMs in a linear way if the net rate of opening of new small businesses is increased. The model developed in this study considered three leverage points (farms growth rate, farms concentration rate and urbanization rate) as targets of policy-intervention. 23 scenarios simulated by introducing alternative sets of policy intervention showed that the most effective and efficient way to sustain the future growth of FMs in the US includes high incentives to the opening of new farms (in order to increase the quantity of potential suppliers) and the parallel reduction in the rate of land concentration (to increase the resilience of small businesses). Although proposals for more radical reforms may re-boost the process of diffusion of AFNs in the US, from the analysis here proposed it seems correct to conclude that such experiences are close to reach their maximum development as forms of market niches without having the possibility to scale-up as new paradigms. This last point adds a relevant contribution to the recent debate on the definition of AFNs as actual "alternatives" to conventional retailing systems and urban-rural relations (Sonnino and Marsden 2005). The model developed

within this study suffers numerous limitations, especially for what pertains the strong assumptions introduced and the under-representation of the complex set of relationships driving the behavior of both consumers and farmers. However, further enquiries may refine this preliminary framework in order to better assess the nature and the prospects for the future development of AFNs in different contexts.

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