The importance of geographical proximity: Evidence on the concentration of firms, culture and political ideologies

A dissertation presented by

Daniele Mantegazzi

Submitted to the

Faculty of Economics

Università della Svizzera italiana

for the degree of

Ph.D. in Economics

Thesis Committee:

Prof. Rico Maggi, supervisor, Università della Svizzera italiana

Prof. Raphaël Parchet, internal examiner, Università della Svizzera italiana

Prof. Frank van Oort, external examiner, Erasmus University Rotterdam

August 2018

To my family

Acknowledgements

This dissertation is the outcome of my Ph.D. research, which kept me busy for the last 5 years. During these years, I have grown both professionally and personally, and I would not have been able to accomplish this important project without the help and the support of many people. It is my great pleasure and honor to express my gratitude to them.

First and foremost, I would like to sincerely thank my supervisor, Professor Rico Maggi, for his guidance, his generous assistance, his motivational impulses and invaluable inputs. Already during my years as undergraduate student, I had the opportunity to collaborate with him and he has always been prompted for inestimable advices of every kind.

I also would like to thank my thesis committee, Professor Raphaël Parchet and Professor Frank van Oort, for evaluating my thesis and their insightful comments and suggestions, which are very important to me.

During my PhD, I had the opportunity to visit the Department of Economic Geography at the University of Groningen thanks to a Doc.CH grant founded by the Swiss National Science Foundation. I owe my deepest gratitude to Professor Philip McCann and Dr. Viktor Venhorst, who supervised me during the whole year of my stay and, with their stimulating and motivating guidance, contributed significantly to the value of my thesis. Their input has been great to my research and my personal and professional growth.

My visit in Groningen was important to me also because I met friendly and helpful colleagues with whom I had innumerable fruitful discussions, and, above all, I found very dear friends with whom I shared countless enjoyable moments. Hence, I want to deeply thank Anna, Anne, Dylan, Els, Fikri, Gwenda, Heike, Jannes, Joost, Karina, Laurence, Lili, Marten, Mirjam, Nikos, Paul, Richard, Sierdjan, Suzan and Viktor.

During my doctoral studies, I benefited enormously from the Swiss Program for Beginning Doctoral Students in Economics offered by the Study Center Gerzensee. I would like to express my gratitude to the Foundation of the Swiss National Bank and to the professors who taught there. Besides learning and developing the analytical and methodological skills needed in order to conduct high-level economic and academic research, the year in Gerzensee was important to me also because I met many dear friends. In particular, I would like to sincerely thank Afsoon, Anna, Ben, Christian, Kathi, Nana, Simon B., Simon H. and Yannic.

I would like to show my gratitude to Professor Levente Littvay, who taught "Multilevel Regression Modelling" at the European Consortium for Political Research Winter School in Bamberg (2015) and provided valuable insight and assistance in developing Chapter 1.

I also thank colleagues at the European Regional Science Association congresses in Lisbon (2015), Vienna (2016) and Groningen (2017), the Swiss Society of Economics and Statistics annual congress in Lugano (2016), the North American Regional Science Council in Minneapolis (2016), the Regional Science Association International world congress in Goa (2018), the Association of European Schools Of Planning Young Academics conference in Groningen (2018) and the Regional Studies Association annual conference in Lugano (2018), for their useful comments.

I want to thank my colleagues and friends at the Institute for Economic Research (IRE), for all the conversations and support in every step of my doctoral studies. We have a lovely working environment with professional and serious discussions as well as funny and amusing moments. In particular, I would like to express my deep gratitude to Ale, Andrea, Davide, Fede M., Fede R., Igor, Moreno, Paolo, Riccardo and Stefano for sharing stories and helping each other. A very special thanks to Leti, for all her incredible support, her open door at any time, her invaluable and hearty encouragement and for making every possible effort to provide this nice environment.

I would like to thank my friends, Andrès, Bas, Davide, Fra, Giuliano, Loris and Nico, as well as my love, Vanessa, and all the others who stood by me in these years, for all their unlimited support and much appreciated encouragement.

Finally, and most importantly, I would like to thank my beloved family, Lolla and Robi, as well as Chanty, Mayla, Mini and Tom, and, above all, my dear parents, Ariane and Carlo, whose sacrifices, love and encouragement have bought me to where I am and who taught me the most important life lessons. For all this, I dedicate this dissertation to them.

Daniele Mantegazzi, Lugano, August 2018

Contents

List of Figures

List of Tables

Introduction

This dissertation is composed of three independent research articles focusing on the importance of geographical concentrations along various dimensions in regional economics. More specifically, the thesis deals with topics regarding agglomeration spillovers, firm performance, culture and soft institutions as well as the geographical concentration of political ideologies. The aim of this work is to provide empirical evidence of the importance of spatial proximity in different contexts. In particular, the purpose of this thesis is threefold: 1) to analyze the effects of spatial concentrations of firms on their ability to access to credit; 2) to examine whether language barriers influence the geographical extension of different types of agglomeration spillovers; and 3) to empirically identify whether there is any spatial concentration of political ideologies and verify whether this concentration is correlated with income and income inequality.

In the last decades, there has been an increasing attention from various actors in the society to the topic of economic globalization, defined as the growing openness of local and national economies, which integrate into a single world economy (Iammarino and McCann, 2013; Pike et al., 2017). During the 1990s and early 2000s, the acceleration of this process, combined with the beginning of the Digital Age (Castells, 1996), contributed to the rise of views in which geographical distances are no longer important. Indeed, some have claimed that the world was becoming "flat", in the sense that the emergence of a global network, in which all economic actors operate, drastically reduces (and maybe eliminates) the need and the benefits of spatial proximity (O'Brien, 1992; Friedman, 2005).

In contrast with this view, as highlighted by Pike et al. (2017), in the last decades there has been an increase in the urbanization process, in which people and economic activities are more and more concentrated in cities. Hence, globalization, rather than making the world more "flat", is in reality making it more "spiky" (Florida, 2005; Rodríguez-Pose and Crescenzi, 2008) and "curved" (McCann, 2008). Indeed, as highlighted by McCann (2018), the evolution of globalization processes over the last centuries clearly shows that geographical distance has become today even more important than in the past. In particular, the first era of globalization, which started in the seventeenth century and lasted until the middle of the twentieth century, was characterized by trade relationships occurring over large distances with neighboring countries trading different types of goods. This is a characteristic feature of international trade during the European colonial period. However, modern globalization, which started in the middle of the twentieth century, is mainly characterized by trade relationships between neighboring countries with similar economic profiles and trading similar goods. Modern globalization is not based on competing on the cost of inputs, but is based on adding value into the production process, which depends on knowledge exchange, especially through face-

to-face interactions. As the importance of knowledge increases, so does the need for concentration, which highlights the importance of cities in this modern globalization process. This has led to the term "global regionalism" (Iammarino and McCann, 2013), describing groups of neighboring countries which are more and more integrated on various economic dimensions. Hence, as underlined by Iammarino and McCann (2013), geographical proximity has become even more important in processes of knowledge spillovers and agglomeration externalities. In particular, the role of global cities is nowadays particularly relevant because of their ability to concentrate economic activities, attract financial and human capital as well as facilitate innovation processes (Pike et al., 2017). The underlying reason is that there are productivity gains due to clustering, proximity and economies of scale. At the sub-national level, a consequence of these processes is an increase in inter-regional divergence (Brackman and van Marrenwijk, 2008). All these changes demonstrate and support the arguments which were already formalized from a theoretical perspective in the "new economic geography" literature, which relies on the concept of economies of scale at the national level, the regional level (cities), and the firm level (Krugman, 1991).

Nevertheless, although there is an increasing number of studies demonstrating the importance of geographical proximity in international trade and economic geography, various actors in the society argue that this is no longer true and that the world is in a "post-geography trading phase" (Financial Times, 2016), supporting claims such as the "end of geography", the "death of distance", or the "world is flat" (McCann, 2008). Political narratives built on these arguments, even if incorrect, might have significant consequences. Indeed, as highlighted by McCann (2018), the results of the Brexit referendum represent a key example, in which these claims have been used to justify the easiness with which the UK economy could replace the trade relationships with the European Union with new and deeper trade relationships with countries farther away. Similar arguments are also supported by various politicians and actors in the Swiss society aiming at cancelling the bilateral agreements between Switzerland and the European Union. The increasing evidence from economic geography clearly contradicts these narratives, but seems to suffer from problems of persuasion, making it difficult to build serious debates within a society, because often based on arguments unrelated to empirical reality (McCann, 2018).

The purpose of this thesis is to enrich the current discussion on the relevance of spatial proximity by proposing empirical analyses demonstrating that distance still represents an obstacle for various processes in regional economics. The contribution of this work is to demonstrate for the first time the importance of geographical proximity in unexplored dimensions of regional economics. More specifically, the first study aims at empirically verifying whether agglomeration spillovers affect a particular indicator of firm performance, namely firm solvency, which, in turn, determines

firms' ability to borrow. In the second research, the goal is to examine empirically whether the spatial scale of the different types of agglomeration spillovers shape and/or are shaped by cultural and soft institutional discontinuities, as reflected by linguistic differences between localities. Finally, the third analysis proposes a new definition of spatial cohesion, based on the geographical concentration of political ideologies, and aims at empirically identifying whether there is any spatial concentration of political ideologies and verify whether these concentrations are correlated with income and income inequality.

These three chapters, in particular the first two studies, link to the endogenous growth theory (Romer, 1986; Lucas, 1988; Krugman, 1991; Rebelo, 1991; Aghion and Howitt, 1992; based on the works of Arrow, 1962; Uzawa, 1965; Sidrauski, 1967), stating that positive externalities and knowledge spillover effects have an important influence on economic development. In particular, knowledge spillovers and externalities are among the key drivers supporting the agglomeration of firms. Within this context, cluster theories state that the geographical concentration of economic activities generates different cost-saving benefits and productivity advantages which are external to firms. Marshall (1920) first described clusters as a "concentration of specialized industries in particular localities".

Hence, according to economic theory, the economic performance of regions and firms is enhanced by the existence of agglomeration economies in the regions (McCann, 2001). In addition, economists have identified different kinds of agglomeration economies. The three main typologies of agglomeration externalities which have been investigated by researchers are localization economies, urbanization spillovers and competition externalities.

Localization (also known as specialization or MAR) economies (Marshall, 1920; Arrow, 1962; Romer, 1986) arise from the geographical concentration of businesses belonging to the same industry, allowing communication and cooperation processes. Within this framework, firms benefit from the concentration of other businesses belonging to the same industry because of three main reasons: larger pools of skilled labor in the surrounding area, more specialized suppliers and knowledge inflows from competitors.

Specialization economies are external to firms but internal to industry. On the contrary, urbanization (or Jacobs) externalities (Jacobs, 1969), as specified in Hoover (1937, 1948), are external to firms, while internal to urban concentration. The main idea behind this kind of agglomeration economies is that the diversity of spatially concentrated industries promotes the cross pollination of ideas across industries. Thus, while specialization economies arise from the geographical

concentration of firms belonging to the same industry, urbanization economies derive from the spatial concentration of businesses belonging to different industries.

Competition (or Porter) externalities (Porter, 1990) arise from the spatial concentration of firms competing in the same market. Hence, like specialization economies, competition externalities take the form of intra-industry transmission of knowledge spillovers, however, they derive from the regional competition within industries, as in the case of Jacobs externalities.

Taking into account this strand of the literature, the first chapter of this thesis empirically tests whether various typologies of agglomeration spillovers impact a particular indicator of firm performance, namely firm solvency. This indicator is not self-reported by firms (as it is often the case with other indicators used in the literature), rather it is computed from an external and standardized perspective and it is used by financial markets in order to reduce the asymmetries in information characterizing them (Bernanke et al., 1999). Therefore, this measure is important in determining firms' ability to borrow. The underlying research question of this study is the following: do agglomeration spillovers impact on firm solvency? The analysis focuses on whether employment specialization and diversity patterns influence firm solvency.

The empirical results of this study imply that agglomeration mechanisms shape firm's credit accessibility, along with the characteristics of the firm itself and geographical information. As highlighted by the economic literature, this has in turn implications on firm's investment possibility and therefore on their ability to strengthen their productivity. This study finds that firms located in Ticino benefit from the municipal concentration of firms within the same industry, while urbanization externalities, at both municipal and cantonal levels, seem to generate congestion diseconomies, having a predicted negative impact on firm solvency.

The second study of this thesis combines the stream of literature on agglomeration economies with a growing body of literature highlighting that culture, "soft" or informal institutions and economy are interrelated (Beugelsdijk and Maseland, 2011; De Jong, 2009), and, in particular, that culture and informal or soft institutions heavily shape and are shaped by economic geography (Pike et al., 2011; Storper, 2013). More specifically, the aim of this chapter is to examine whether there is any detailed empirical evidence that a particular dimension of culture, namely language, does indeed influence economic geography, in a context where neither ethnic diversity nor poor institutional quality are key features.

In order to do so, this analysis examines whether language borders influence the geographical extension of different types of agglomeration spillovers. In particular, this research examines

empirically how local employment patterns are related to linguistic differences between localities. The analysis focuses on Switzerland, which represents an appropriate case-study for examining these types of cultural differences, because in the specific case of Switzerland linguistic differences have indeed been argued to be the key marker of cultural differences (Hofstede, 2001). In this context, this study tracks how employment patterns in one locality are related to those in neighboring localities, and examines whether these relationships differ across linguistic borders in a manner which is distinct from simply different locality administrative borders. In particular, the analysis examines whether employment specialization or diversity patterns differ across different types of borders, after controlling for geographical, economic and topographical features.

The results of this study demonstrate that, in the context of Switzerland, linguistic differences shape the economic geography of agglomeration mechanisms. These findings imply that the spatial scale of the different types of agglomeration spillovers are indeed mediated and altered by linguistic discontinuities. More specifically, according to the results, specialization externalities are enhanced when firms are located close to municipalities with the same language, whereas competition and diversity externalities are reinforced when firms are located close to municipalities with different languages. Exactly why these particular empirical results emerge is a different question and is left for future research. It is possible that linguistic discontinuities may represent an obstacle to the geographical extension of specialization externalities. As seen above, localization economies tend to arise from the direct interaction among firms operating in the same sector and in the same area, and therefore on the basis of these results it seems reasonable to infer that linguistic differences may introduce an obstacle to direct knowledge-interactions among firms operating in broadly the same field. On the other hand, the results suggest that linguistic differences may encourage knowledge interactions between firms operating in different fields, in a manner reflecting the arguments of Jacobs (1969), although, at this stage these explanations can only be tentative and speculative and require much more deliberation.

The third chapter of this thesis analyses geographical concentrations and the relevance of spatial proximity from a different perspective. More specifically, the aim is to propose a new definition of spatial cohesion, representing a new way to capture social interactions, based on the geographical concentration of political ideologies. The research links to the literature on geographical sorting, stating that people with similar income levels cluster together due to similar constraint in the residential decision (Fujita, 1989, based on the pioneering work of von Thünen, 1826 and Alonso, 1964) and because of individual preferences to live close to people with similar socio-economic characteristics (Tiebout, 1956). At the same time, the political science literature is increasingly interested in the phenomenon of partisan sorting, which analyzes whether individuals with similar

political preferences are nowadays more geographically clustered (Bishop, 2008; Abramowitz, 2010; Abrams and Fiorina, 2012; Tam Cho et al., 2013). Additionally, according to the literature on voting behavior, people sorting themselves based on socio-economic characteristics are also expected to share similar political ideologies. The implication is that income-sorting processes and partisan-sorting forces are likely to be interrelated phenomena, leading to the clustering of people having similar levels of income and political ideologies.

The aim of this research is to empirically identify whether there is any spatial concentration of political ideologies in the context of Switzerland and determine the spatial extension of these concentrations. Moreover, this study analyzes whether this clustering of political preferences is correlated with income and income inequality. The analysis focuses on Switzerland, which represents a very interesting case because it practices a semi-direct democracy, which allows having a rich dataset on many referenda, which is independent from short-term, candidate-related and party-related factors. The benefit of using data related to referenda is that they are the direct observed outcome of underlying unobserved political ideologies.

Following Hermann and Leuthold (2003), this research analyzes the results of 312 federal referenda between 1981 and 2017 at the municipal level. This study identifies Hermann and Leuthold (2003)'s three dimensions representing the Swiss political ideology space and expressing the following political beliefs: left vs. right, liberal vs. conservative and ecological vs. technocratic. Additionally, on each of these three dimensions, this analysis empirically assesses the existence of spatial concentrations of Swiss municipalities sharing the same political ideology. This result is particularly interesting because it shows that the various sorting processes leading to the concentration of people sharing similar political preferences extend beyond municipal borders. Finally, based on these results, this research finds significant differences in the level of income and income inequality of Swiss municipalities, depending on their belonging to a political ideology cluster. This result contributes and further supports the findings and claims of other scholars, related to the concept of "the geography of discontent", referring to the spatial distribution of discontent in a country, reflecting inequalities between regions in terms of economic welfare (Los et al., 2017; Rodríguez-Pose, 2017; McCann, 2018) and according to which economic geography is particularly important in understanding how people vote.

In general, the results of the analyses contained in this thesis contribute to the current discussion on the importance of geographical proximity, by empirically demonstrating that distance still represents an obstacle for various processes in economics, against the view that the world has become "flat". These results further support the findings and claims of other scholars, arguing that,

along with the rise of globalization processes, distance has become even more important. More specifically, the findings of this thesis shed light on unexplored aspects of agglomeration processes and demonstrate the importance of geographical proximity in the cases of firm's credit accessibility, the interaction between culture and agglomeration externalities, and the interaction between political ideologies and economic welfare. These findings are particularly interesting because they emerge from the Swiss context, a small open economy in which globalization processes have always had great impacts and where distances are notably small.

The rest of the thesis is organized as follows: the next chapter is dedicated to the analysis on the effects of spatial concentrations of firms on their ability to access to credit. The second chapter examines whether linguistic differences influence the geographical extension of different types of agglomeration spillovers, while the third chapter empirically identifies whether there is any spatial concentration of political ideologies and verifies whether this concentration is correlated with welfare. Finally, a conclusion paragraph draws results and conclusions of the dissertation.

References

Abramowitz, A., 2010, "Transformation and polarization: The 2008 presidential election and the new American electorate", *Electoral Studies*, 29(4):594-603.

Abrams, S. and Fiorina, M., 2012, "'The big sort' that wasn't: A skeptical Reexamination", *Political Science and Politics*, 45(2):203-10.

Aghion, P. and Howitt, P., 1992, "A Model of Growth through Creative Destruction", *Econometrica*, 60(2):323-51.

Alonso, W., 1964, *Location and Land Use*. Harvard University Press, Cambridge, MA.

Arrow, K., 1962, "Economic Welfare and the Allocation of Resources for Invention." In *The Rate and Direction of Inventive Activity: Economic and Social Factors*, 609–626. National Bureau of Economic Research, Inc.

Bernanke, B., Gertler, M. and Gilchrist, S., 1999. "The financial accelerator in a quantitative business cycle framework". In Taylor, J. and Woodford, M., editors, *Handbook of Macroeconomics*, 1(1):1341-1393. Elsevier.

Beugelsdijk, S. and Maseland, R., 2010, *Culture in Economics: History, Methodological Reflections and Contemporary Applications*, Cambridge University Press.

Bishop, B., 2008, *The Big Sort: Why the Clustering of Like-Minded America Is Tearing Us Apart*, Houghton Mifflin, Boston.

Brakman, S. and van Marrewijk, C., 2008, "It's a big world after all: on the economic impact of location and distance", *Cambridge Journals of Regions, Economy and Society*, 1(3):411-437.

Castells, M., 1996, *The rise of the network society: the information age: economy, society and culture Vol.1*. Oxford: Blackwell.

De Jong, 2009, *Culture and Economics: On Values, Economics and International Business*, London: Routledge.

Financial Times, 2016, UK entering a "post- geography trading world" says Liam Fox, 29 September.

Florida, R., 2005, *The flight of the creative class: and how it is transforming work, leisure, community and everyday life.* New York: Harper Collins

Friedman, T., 2005, *The world is flat: a brief history of the twenty-first century.* New York: Farrar, Straus, and Giroux.

Fujita, M., 1989, *Urban Economic Theory: Land Use and City Size*. Cambridge University Press, Cambridge.

Hermann, M. and Leuthold, H., 2003, *Atlas der politischen Landschaften: ein weltanschauliches Porträt der Schweiz*, vdf Hochschulverlag AG, Zürich.

Hofstede, G., 2001, *Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations Across Nations*, 2nd Edition, Thousand Oaks CA: Sage Publications.

Hoover, E., 1937, *Location Theory and the Shoe and Leather Industries*, Harvard University Press, Cambridge Mass.

Hoover, E., 1948, *The Location of Economic Activity*, McGraw Hill, New York.

Iammarino, S. and McCann, P., 2013, *Multinationals and economic geography: location and technology, innovation*. Edward Elgar, Cheltenham.

Jacobs, J., 1969, *The economy of cities*, Vintage international. Random House.

Krugman, P., 1991, "Increasing returns and economic geography", *Journal of Political Economy*, 99:483-499.

Los, B., McCann, P., Springford, J., and Thissen, M., 2017, "The mismatch between local voting and the local economic consequences of Brexit", *Regional Studies*, 51:786-799.

Lucas, R., 1988, "On the mechanics of economic development", *Journal of Monetary Economics*, 22:3-42.

Marshall, A., 1920, *Principles of Economics: An Introductory Volume*, Macmillan and Co.

McCann, P., 2001, *Urban and Regional Economics*, Oxford University Press.

McCann, P., 2008, "Globalization and economic geography: the world is curved, not flat", *Cambridge Journal of Regions, Economy and Society*, 1(3):351-370.

McCann, P., 2018, “The trade, geography and regional implications of Brexit”, *Papers in Regional Science*, 97:3-8.

O’Brien, R., 1992, *Global financial integration: the end of geography*. New York: Council on Foreign Relations Press.

Pike, A., Rodríguez-Pose, A., and Tomaney, J., 2011, *Handbook of Local and Regional Development*. New York: Routledge.

Pike, A., Rodríguez-Pose, A., and Tomaney, J., 2017, *Local and Regional Development. 2nd Edition*, New York: Routledge.

Porter, M., 1990, *The Competitive Advantage of Nations*, MacMillan, Houndmills.

Rebelo, S., 1991, “Long-Run Policy Analysis and Long-Run Growth”, *Journal of Political Economy*, 99(3):500-521.

Rodríguez-Pose, A. and Crescenzi, A., 2008, “Mountains in a flat world: why proximity still matters for the location of economic activity”, *Cambridge Journal of Regions, Economy and Society*, 1(3):371-388.

Rodríguez-Pose, A., 2017, “The revenge of the places that don’t matter (and what to do about it)”, *Cambridge Journal of Regions, Economy and Society*, 11(1):189-209.

Romer, P., 1986, “Increasing Returns and Long-run Growth.”, *Journal of Political Economy*, 94(5):1002–37

Sidrauski, M., 1967, “Rational choices and patterns of growth in a monetary economy”, *American Economic Review*, 57:534-544.

Storper, M., 2013, *Keys to the City: How Economics, Institutions, Social Interaction, and Politics Shape Development*, Princeton: Princeton University Press.

Tam Cho, W., Gimpel, J. and Hui, I., 2013, “Voter Migration and the Geographic Sorting of the American Electorate”, *Annals of the Association of American Geographers*, 103(4):856-870.

Tiebout, C., 1956, “A pure theory of local expenditures”, *Journal of Political Economy*, 64:416-424.

Uzawa, H., 1965, “Optimum Technical Change in an Aggregative Model of Economic Growth”, *International Economic Review*, 6:18-31.

von Thünen, J., 1826, *Der isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie*. Friedrich Perthes, Hamburg.

Chapter 1: Agglomeration matters for firm solvency[1][2]

Daniele Mantegazzi

Abstract

Recent empirical findings show a negative relationship between credit constraints and firm performance, due to asymmetries in information in the financial sector. Moreover, economic theory predicts a positive impact of agglomeration mechanisms on firm performance, generally identified with self-reported information. This paper examines whether agglomeration externalities affect firm solvency, a standardized indicator of firm performance, which helps decreasing asymmetries in information in financial markets and therefore determines firm's ability to borrow. Moreover, this study overcomes problems of aggregation bias by applying spatial multilevel techniques. The results provide empirical evidence that agglomeration mechanisms shape in different ways firm's credit accessibility.

JEL classification: C21, O18, R1

Keywords: Agglomeration economies, firm performance, firm solvency, aggregation bias, spatial multilevel analysis.

[1] This chapter is based on Mantegazzi (2016), Agglomeration matters for firm solvency. Presented at the 56th ERSA Congress, Vienna. *Submitted to an international journal.*

[2] The author would like to show his gratitude to Prof. Rico Maggi, Prof. Philip McCann, Prof. Levente Littvay and Dr. Viktor Venhorst who provided valuable insight and expertise. The author would also like to thank Dr. Valentina Mini for her comments and assistance on an earlier version of this study.

1.1 Introduction

Economic theory highlights a positive relationship between firms' credit accessibility and firm performance. Firms' ability to obtain credits from banks and financial institutions affects their investment decisions and possibilities (Chen and Guariglia, 2013). Another important body of the economic literature underlines how the economic performance of firms, typically measured with firm productivity or employment growth, is enhanced by the existence of agglomeration economies in the region (McCann, 2001).

The aim of this paper is to link these research streams. In particular, the goal is to empirically study how different typologies of agglomeration economies affect a particular indicator of firm performance, namely firm solvency. This standardized measure determines firms' ability to borrow. The analysis focuses on whether employment specialization and diversity patterns influence firm solvency. The approach used is not meant to assess or support any mechanism underlying such relationship, it is rather the most direct method of empirically identifying the existence of such relationship.

In addition, this paper contributes to the literature by overcoming problems of aggregation bias in the analysis of agglomeration economies. Empirical studies show ambiguous results in assessing whether and how agglomeration produces positive, null or negative effects in terms of economic performance (Rosenthal and Strange, 2004; Beaudry and Schiffauerova, 2009; De Groot et al., 2015). Recent overviews (Van Oort et al., 2012; De Groot et al., 2015) point out that this ambiguity emerges because traditional analyses are applied either on aggregated data or firm-level data, without simultaneously accounting for the heterogeneity at both levels, creating problems of aggregation bias. This paper overcomes problems of aggregation bias by simultaneously analyzing firm- and regional-level data and applying spatial multilevel techniques.

The study applies this approach to a dataset combining firm- and municipal-level information from the Swiss canton Ticino. The findings highlight that less than 10% of the variance of firm performance is at the aggregated level. This underlines the importance of using firm-level data and implies that studies considering only aggregated data miss more than 90% of the information, likely generating the ambiguity that characterizes the literature. At the same time, researchers also need to account for the heterogeneity across municipalities. The results suggest that specialization externalities positively influence firm solvency, while urbanization externalities have a predicted negative impact on it. Finally, this analysis indicates that including an appropriate specification of spatial interaction allows better representing reality.

The paper is organized as follows: the next section presents a review of the related literature. The third section describes the model and the fourth section presents the database adopted for this research. Section five presents the results and the last section concludes.

1.2 Literature review

According to the economic literature, financial markets are particularly important in enhancing economic growth (Rajan and Zingales, 1998). Following Shumpeter's (1991) hypothesis, the financial sector reallocates capital to the highest value use, financing investments which strengthen productivity. Yet, theoretical models studying the financial sector assume asymmetries in information and other credit market frictions (Bernanke et al., 1999). Hence, financial market decisions rely on limited information and firms might encounter obstacles in obtaining external credits. Indeed, a recent empirical analysis shows a negative relationship between credit constraints and firm productivity (Ganau, 2016).

Another important branch of economic theory states that the geographical concentration of economic activities generates different cost-saving benefits and productivity advantages which are external to firms and positively impacts their performance (McCann, 2001). The two main typologies of such spillover effects which have been investigated by researchers are specialization (or MAR) economies (Marshall, 1920; Arrow, 1962; Romer, 1986) and urbanization (or Jacobs) externalities (Jacobs, 1969). The main conclusion is that different typologies of agglomeration economies are hypothesized to boost regional growth in different ways. Moreover, traditional analyses on agglomeration externalities focus on their effects on the economic performance of firms, which is generally measured as employment level, employment growth or productivity (for an overview see Beaudry and Schiffauerova, 2009).

The contribution of this research is to combine these two streams of the economic literature by empirically testing whether various typologies of agglomeration spillovers and mechanisms impact a particular indicator of firm performance, namely firm solvency. As better explained in section 1.4, this indicator is not self-reported by firms (as it is often the case with other indicators used in the literature), rather it is computed from an external and standardized perspective and it is used by financial markets in order to reduce the above-mentioned asymmetries in information. Therefore, this measure is important in determining firms ability to borrow. The underlying research question of this study is the following: do agglomeration spillovers impact on firm solvency? As seen above, firms with a higher performance are expected to have a higher accessibility to credits and agglomeration spillovers positively affect the economic performance of firms. Hence, the following hypothesis is specified:

Hypothesis 1: firms located close to other business activities are expected to have a higher solvency, allowing them to have a better access to credit.

This paper also contributes to the literature from a technical perspective. In contrast with the theory, the empirical literature on agglomeration mechanisms is still debating to what extent these effects shape or are shaped by economic geography. Consequently, the empirical results are rather ambiguous in assessing whether and how agglomeration produces positive, null or negative effects (Rosenthal and Strange, 2004; Beaudry and Schiffauerova, 2009; De Groot et al., 2015). Recent overviews (Van Oort et al., 2012; De Groot et al., 2015) indicate that this ambiguity may be due to a lack of research into the relationship between agglomeration externalities and individual firm performance. Traditional analyses are applied either on aggregated data or firm-level data, without simultaneously accounting for the heterogeneity at both levels, causing problems of aggregation bias. Because of problems of aggregation bias, several works offer an incomplete understanding of these effects on the performance of firms, and this may explain the contrast between economic theory and the findings of empirical research. To overcome problems of aggregation bias, researchers need to consider linkages connecting the micro level with the macro one (Jones, 1991). Following Van Oort et al. (2012) and De Groot et al. (2015) it is important to account for the possibility of hierarchies in the data, hence the empirical methodology used in this research simultaneously analyzes firm- and regional-level data and applies spatial multilevel techniques. This leads to the following hypothesis:

Hypothesis 2: Simultaneously analyzing firm- and regional-level data in the analysis of agglomeration mechanisms allows improving empirical reliability.

1.3 Methodology

As already explained, this paper overcomes problems of aggregation bias by simultaneously analyzing firm- and regional-level data. Van Oort et al. (2012) and De Groot et al. (2015) highlight how important it is that the empirical methodology is able to account for the possibility of hierarchies in the data and spatial interactions. Hence, in order to consider both the nested structure of the data and the spatial dependence of regions and firms, this research combines the multilevel literature with spatial econometric techniques.

Corrado and Fingleton (2011) review, from a theoretical point of view, different methodologies to control for spatial spillovers in a hierarchical model. Moreover, Savitz and Raudenbush (2009) and Pierewan and Tampubolon (2014) include the geographical interactions by adding a spatial lag to the error term of the model. The main drawback of this model is that the dependence among neighboring units is left unexplained. This research aims at explaining the spatial relationships by modelling a spatial lag for the explanatory variables at the municipal level. The

underlying idea is that firm performance not only depends on the characteristics of the firm itself and the characteristics of the municipality where the firm is located, but also on the characteristics of the surrounding municipalities. For this reason, this study extends the basic hierarchical model by adding a spatial lag for the characteristics of the municipality. Hence, the spatial multilevel model here proposed is expressed by the following equation.

$$y_{ij} = \gamma_{00} + \sum_{k=1}^{K} x_{kij}\gamma_{k0} + \sum_{h=1}^{H} z_{hj}\gamma_{0h} + \sum_{h=1}^{H} \delta_{0h} \sum_{l=1}^{J} w_{lj} z_{hl} + u_{0j} + \sum_{k=1}^{K} x_{kij} u_{kj} + \varepsilon_{ij} \qquad (1.1)$$

where y_{ij} is the dependent variable, x_{kij} is the k-th characteristic of firm i in region j, z_{hj} is the h-th characteristic of region j, K and H are the number of regressors at the firm and municipal level, respectively. In addition, w_{ij} is the $[i,j]$-th element of the spatial weights matrix W and is a (negative) function of the distance between observation i and observation j, with $w_{ij} = 0$ if $i = j$.[3] Finally, $\varepsilon_i \sim N(0, \sigma_\varepsilon^2)$ represents the traditional individual level error term, $u_{0j} \sim N\left(0, \sigma_{u_0}^2\right)$ is the variability arising from differences between municipalities, u_{kj} is the variance of the impact of the individual characteristics $x_{kij} \sim N\left(0, \sigma_{u_k}^2\right)$ on the dependent variable between municipalities and n is the number of observations.

1.4 Data and variables

This research considers firms nested into municipalities, the smallest geo-political unit of the Swiss canton Ticino. These territorial and political units are able to apply different fiscal policies through the level of the municipal tax rate. Additionally, they exhibit some decisional autonomy allowing them to invest in infrastructure projects. These considerations allow hypothesizing that within the same municipality firms face similar socio-economic, political and cultural environments. These reasons justify the choice of using municipalities as second level units.

The dataset has been created by merging Swiss official secondary data with firm-level data obtained from Bisnode Dun & Bradstreet Switzerland Ltd. Bisnode D&B is a partner in the worldwide network of Dun & Bradstreet, the largest global service provider for business-to-business commercial information and credit history. The dataset comprises 953 firms from the manufacturing and services industries located in 68 Ticino municipalities. The reference year of this study is 2011. As shown in Table 1.1, the considered sample reasonably represents the 31,689 firms operating in Ticino in 2011.

[3] According to Anselin (1988), there exist different definitions of the spatial weights matrix W. At the and of section 1.4 the specifications used in this study are introduced.

Table 1.1 - Comparison between sample and population of firms in Ticino

	Sample	**Population**
Number of firms	953	31,689
Average number of employees per firm	4.96	5.4
Firms in service sector	82 %	84 %
Firms located in the district of Bellinzona	8.6 %	11.9 %
Firms located in the district of Blenio	1.0 %	1.2 %
Firms located in the district of Leventina	1.3 %	2.1 %
Firms located in the district of Locarno	15.4 %	17.9 %
Firms located in the district of Lugano	51.3 %	47.3 %
Firms located in the district of Mendrisio	18.4 %	15.7 %
Firms located in the district of Riviera	2.8 %	2.5 %
Firms located in the district of Vallemaggia	1.2 %	1.5 %

The dependent variable of this study is firm solvency. It is identified with the SCORE indicator provided by Bisnode D&B Switzerland Ltd., ranging between 1 and 100, and indicating the credit rating profile of firms. This variable is computed by analyzing information concerning the payment history, debt collection and recovery information, information regarding operations and management as well as ties to other companies, both foreign and domestic. It is important to notice that this indicator is not self-reported by firms themselves, instead it is externally calculated in a standardized manner. Moreover, Bisnode D&B does not use any measure of agglomeration economies to compute the score indicator, ruling out potential problems of endogeneity. This indicator can also be interpreted as the inverse of the failure risk of the firms and it is used by the financial markets when deciding whether to grant credits to firms, since it allows to decrease the asymmetry of information.

The analysis considers three groups of explanatory variables: establishment-level characteristics, municipal-level information and agglomeration economies indices, varying across both sectors and municipalities. In order to interpret all the estimations on a similar scale, all the continuous independent variables, at both firm and municipal levels, need to be normalized. In particular, following Enders and Tofighi (2007), all the continuous municipal-level variables are standardized around their grand mean and all the continuous firm-level variables around their group mean. This procedure allows the coefficients related to firm-level variables to capture only differences within municipalities, and not between municipalities.

Following the literature on agglomeration economies (Henderson et al., 1995; Combes, 2000; Van Oort et al., 2012 and Mameli et al., 2014), this research focuses the analysis on two typologies of agglomeration economies, both defined at sectoral and municipal levels. MAR (specialization

economies) are computed as the ratio of the employment share of sector s in municipality m divided by the same ratio at the overall cantonal level[4]. JACOBS (urbanization economies) are measured with the ratio of the inverse of a Herfindhal index of sectoral concentration of all sectors in municipality m, except the considered sector s divided by the same ratio at the overall cantonal level[5]. Data on the total number of employees per sector and municipality are obtained from the Swiss structural business statistic (STATENT), offered by the Swiss Federal Statistical Office (FSO). NOGA 2008 sectoral nomenclature (2-digit code) are used, which aggregates sectors into 32 industrial sectors and 48 service sectors[6].

The availability of firm-level data allows controlling for linear and quadratic effects of the AGE of the firms, measured in years (as in Evans, 1987; Raspe and Van Oort, 2011). The underlying idea is that firms learn from their own experience. However, as firms evolve over their life cycle, the marginal effect of this learning process is expected to decline. Additionally, in order to capture the effects related to internal economies of scale and possible size congestion effects, this study also accounts for linear and quadratic effects of the SIZE of the firms, computed as the number of employees of the firms (following Jovanovic, 1982; Evans, 1987; Raspe and Van Oort, 2011). Finally, to distinguish firms in the industrial sector from those working in the service sector, this research includes a dummy variable which takes value 1 if the firm is operating in the SERVICE SECTOR, 0 otherwise (as in McGahan and Porter, 1997 and Van Oort et al., 2012). Data related to firm characteristics are obtained from the Bisnode D&B Switzerland Ltd. dataset. Table 1.2 reports the descriptive statistics related to firm-level variables as well as those relative to the two indicators of agglomeration economies.

Table 1.2 - Descriptive statistics of firm-level indicators and agglomeration economies

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Score	38.78	16.79	10	97
Age	23.76	13.29	4	121
Size (number of employees)	4.96	5.82	1	60
Service sector (dummy)	0.82	-	-	-
MAR	1.67	4.72	0	131
Jacobs	0.54	0.15	0.10	0.75

n = 953 firms

[4] A value of MAR above 1 implies that in municipality m there is a higher employment share in sector s than the one registered at the cantonal level. The higher the value of MAR, the higher the specialization in sector s in municipality m.
[5] The inverse of the Herfindhal index is maximum when all sectors except the considered sector s have the same employment share in municipality m. Hence, a higher value of JACOBS indicates a high degree of diversification for sector s in municipality m.
[6] The NOGA 2008 is modelled after the latest version of the Statistical classification of economic activities in the European Community (NACE, rev. 2).

Besides agglomeration economies indices and characteristics at the firm level, in order to prevent problems of omitted-variable bias which might create problems of identification, this study also includes some independent variables at the municipal level, which are listed in Table 1.3, and Table 1.4 shows the related descriptive statistics (following Henderson et al., 1995; Gordon and McCann, 2000; Rosenthal and Strange, 2004; Raspe and Van Oort, 2008, 2011; Schwellnus and Arnold, 2008; Blanchard et al., 2009; De Bok and Van Oort, 2011; Van Oort et al., 2012 and Giovannetti et al., 2013).

Table 1.3 - List of municipal-level variables

Variable	**Definition**	**Source**
Airport (dummy)	Presence of an airport	Federal Office for Spatial Development
Highway – rail (dummy)	Presence of a rail station and/or highway ramp	Federal Office for Spatial Development
Proximity	Inverse of travel time to nearest regional center[7]	Federal Office for Spatial Development
ImmoInv	Per capita private investment in immobile capital	B&Wbs (FSO)
IndArea	Industrial and commercial area rate	GEOSTAT (FSO)
University (dummy)	Presence of a university	Cantonal Department of Education, Culture and Sports
Custom (dummy)	Presence of a custom station[8]	FSO
Human capital	Per capita number of students in higher education levels	Cantonal Department of Education, Culture and Sports
Social capital	Voter turnout	State Chancellery of canton Ticino
Tax rate	Level of municipal tax rate	Cantonal Department of Institutions
Wage	Average municipal wage	Swiss Federal Tax Administration
Wage growth	Average municipal wage growth	Swiss Federal Tax Administration
Unemployment rate	Municipal unemployment rate	Swiss State Secretariat for Economic Affairs
Population	Size of municipal population	STATPOP (FSO)
Population density	Number of inhabitants per square kilometer	STATPOP (FSO)

[7] In canton Ticino there are 5 regional centers: Bellinzona, Chiasso, Locarno, Lugano and Mendrisio.

[8] The literature generally uses a dummy taking value 1 if the region shares a border with another nation. However, this would skew the results because some municipalities might share a border with another nation, but there might not be any infrastructure connecting the municipality with the neighboring nation. Hence, measuring the presence of a customs station better captures the possibility of accounting for potential spillover coming from another nation.

Table 1.4 - Descriptive statistics of municipal-level indicators

Variable	Mean	Std. Dev.	Min.	Max.
Airport (dummy)	0.02	-	-	-
Highway – rail (dummy)	0.47	-	-	-
Proximity	0.18	0.24	0.03	1
ImmoInv	1.38	2.66	0	13.60
IndArea	9.06	7.75	0	29.36
University (dummy)	0.07	-	-	-
Custom (dummy)	0.16	-	-	-
Human capital	1.88	0.48	0.79	2.92
Social capital	60.43	6.86	45.72	73.30
Tax rate	81.91	11.87	53	100
Wage	72’156	9’959	55’171	111’894
Wage growth	-0.67	5.24	-22.15	6.72
Unemployment rate	2.82	0.97	1.07	5.69
Population	4’139	7’004	479	55’151
Population density	892	1’267	8	8’063

n = 68 municipalities

A synthesis of municipal indicators

Analyzing the distribution of the municipal characteristics previously introduced shows that these variables are spatially associated. Therefore, this research performs an exploratory factor analysis in order to identify the underlying independent structure at the municipal level. Before carrying out the analysis, all the continuous variables have been standardized.

As a first step this study selects the number of factors to obtain. When five unobserved variables are identified, only four of these factors have eigenvalues greater than one, while the fifth is below. Following Kaiser (1960), only factors having eigenvalues greater than one are considered, hence four underlying independent and unobserved variables are identified. To further support this choice, the factor analysis with four factors records the lowest BIC value. In order to maximize the explained variance, the exploratory factor analysis is performed with VARIMAX-rotation.

Table 1.5 shows the results of the exploratory factor analysis, reporting for each observed variable the corresponding loadings indicating the correlation between these indicators and the unobserved four factors. Values in bold indicate the loading of the variables which are combined together in the resulting four factors.

Table 1.5 - Factor scores at the municipal level

Variable	**Factor 1** Regional centrality	**Factor 2** Welfare	**Factor 3** Industrialization	**Factor 4** Rurality
Airport	**0.33**	-0.03	0.02	-0.02
Highway – rail	**0.33**	-0.02	**0.42**	**-0.33**
Proximity	**0.89**	0.03	0.01	-0.10
ImmoInv	-0.02	0.05	**0.51**	-0.18
IndArea	0.04	-0.00	**0.90**	-0.02
University	**0.59**	0.04	0.12	0.03
Custom	**0.46**	-0.05	0.05	-0.08
Human capital	0.04	**0.44**	0.15	0.05
Social capital	-0.07	**0.32**	0.20	0.28
Tax rate	-0.13	**-0.61**	-0.21	**0.53**
Wage	0.01	**0.99**	-0.05	0.01
Wage growth	-0.11	**0.35**	-0.04	**0.42**
Unemployment rate	0.25	-0.12	0.14	**-0.39**
Population	**0.79**	0.02	0.06	0.12
Population density	0.21	0.15	0.02	**-0.61**

The first factor shows high scores on the degree of proximity to a regional center, the level of population, the presence of a university as well as the existence of a rail station and/or a highway ramp, an airport and a customs station. These characteristics and infrastructures are typical of the main regional centers of canton Ticino, hence, this factor is identified as being a measure of the "regional centrality" of each municipality.

Factor 2 combines different dimensions of the level of wellbeing. Particularly, it records high scores in locations with high average levels of human capital, social capital, wages and the growth rate of wages. Moreover, this factor is negatively related to high levels of tax rate, which usually indicate municipalities with low levels of financial health. Therefore, this factor can be identified as being a measure of the average level of "welfare" for each location.

The factor labelled "industrialization" shows high values on the ratio of industrial and commercial area divided by the total settlement and urban area, the amount of private investment in immobile capital goods (excluding houses) per capita and the presence of a rail station and/or a highway ramp. Hence, locations with high scores on this factor can be interpreted as being characterized by an environment allowing the industrial and commercial sectors to be particularly active.

Finally, the fourth factor is positively related to high levels of tax rate and the average growth rate of wages. Additionally, it negatively depends on high levels of population density, unemployment rate and the presence of a rail station and/or a highway ramp. Municipalities recording high scores on this factor can be interpreted as being locations with low levels of infrastructure and not densely populated. Therefore, this factor is identified as a measure of "rurality" for each municipality.

The scale of the spatial interactions

There exist different specifications of the spatial dependence matrix, W. Savitz and Raudenbush (2009) and Pierewan and Tampubolon (2014) use as the spatial dependence matrix, W, a contiguity matrix with entry $w_{ij} = 1$ if region i and region j share at least one border, 0 otherwise. This approach restricts spatial interactions. In order to account for the spatial dependence among municipalities in a more realistic way, this research considers a spatial weight matrix based on the inverse travel times between the centroids of the municipalities[9].

Moreover, the geographical area which this research analyses is characterized by a relatively high number of municipalities with rather small territorial extensions. This indicates that, on average, the distance between the different municipalities is comparably low. Therefore, the spatial interactions of canton Ticino are expected to be on a higher scale than the one considered with a contiguity spatial dependence matrix. For these reasons, considering the entire scale of the spatial interactions gives a more realistic representation.

Spatial econometricians (Anselin, 1988; Kelejian and Prucha, 1998; LeSage and Pace, 2009) usually standardize the W matrix, such that each row sums to unity. This allows interpreting any matrix product involving W as a weighted average of a certain variable observed in all locations.

1.5 Results

Besides finding the impact of agglomeration economies on firm solvency, this analysis has three empirical goals and is based on the comparison among eight models. First, this study aims to show the importance of the heterogeneity at both firm and regional levels. Second, various specifications of a spatial lag are introduced and this study identifies the one best representing reality. In particular, different models adding a spatial lag to the error term and/or the municipal independent

[9] Travel time data are provided by the Federal Office for Spatial Development and consider the trip by car in minutes. The municipalities are based on the 2000 definition of the Swiss Federal Office for Statistics. The distances that involve municipalities which were geographically different in 2012 from the official definition of 2000 - because of aggregations or newly created municipalities - are computed by weight averaging the distances based on the 2000 definition and their population.

variables are compared. Moreover, this research also distinguishes between contiguity- and distance-based spatial lags. The goal is not to get involved in a theoretical or methodological debate, rather the aim is simply to empirically examine which extension of the spatial spillovers better represent reality. The results indicate that spatial effects among municipalities occur in Ticino and take place within the entire cantonal territory (distance-based spatial lag added to the independent variables). The third goal is to highlight the fact that researchers need to account for spatial slope effects, in order to capture cross-municipality differences in the effects of some firm characteristics. This section starts by focusing on the comparison between the fit of the different models in order to identify the one best capturing reality. Once this model has been identified, the analysis proceeds by interpreting the estimates and the results, particularly focusing on the effects of agglomeration externalities.

Table 1.6 - Model fit comparison

	Model 0	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Firm characteristics		YES	YES	YES	YES	YES	YES	YES
Municipal characteristics		YES	YES	YES	YES	YES	YES	YES
Spatial error term			YES		YES			
Contiguity-based spatial lag				YES	YES		YES	
Distance-based spatial lag						YES	YES	YES
Random slopes								YES
Variance intercept	26.0	7.8	4.2	6.6	3.9	6.9	0.1	3.9
Variance residuals	264	232	232	231	232	226	228.3	206
Deviance	8060	7914	1713	1907	1906	7888	7878	7863
# parameters	3	14	15	20	21	20	26	29
AIC	8066	7942	7943	7947	7948	7928	7930	7921
BIC	8081	8010	8015	8044	8050	8026	8057	8062

n: 953 firms in 68 municipalities

In the first model (Model 0), as reported in Table 1.6, the dependent variable is regressed on a random intercept without including any regressors. Hence, the intercept can vary randomly across municipalities, allowing distinguishing the between-municipality variance of firm performance from its between-firm variance. In particular, it is possible to compute the interclass correlation coefficient (ICC), measuring the ratio of variance in the dependent variable which is accounted for by

municipalities (Luke, 2004). The ICC of Model 0 indicates that 8.96% of the total variance is cross-municipality variance. The result highlights that less than 10% of the variance among firms is at the aggregated level. This underlines the importance of using firm-level data and implies that studies considering only aggregated data miss more than 90% of the information, generating the ambiguity that indeed characterizes the literature.

The next step of this study is to explain this variance by including the explanatory variables at both firm and municipal levels, without yet considering any spatial interactions. As indicated in column 2 of Table 1.6, the variance at the municipal level decreases from 26.0 to 7.8. Additionally, by comparing[10] the baseline model (Model 0) with the one considering characteristics at both firm and regional levels, without any spatial interactions (Model 1), indicates that the baseline model provides a significantly worse fit (χ^2 = 146.4, df = 11, $p \leq 0.001$). This result highlights that it is also important to account for the heterogeneity at the municipal level in order to decrease the unexplained cross-municipality variance of firm performance.

Subsequently, the model without any spatial interactions (Model 1) is compared with the model including a spatial lag in the error term (Model 2) and with the one allowing spatial interactions to occur among contiguous municipalities (Model 3). In both cases it is not possible to asses that the model without spatial interactions is significantly worse (χ^2 = 1.3, df = 1, p = 0.26; χ^2 = 6.6, df = 6, p = 0.36, respectively). Additionally, Model 4 shows that after inserting the spatial lag to the independent variables at the municipal level, as already done in Model 3, adding a spatial lag to the error term does not allow significantly better capturing the interactions among neighboring units. In fact, the model fit provided by Model 1 is not significantly worse than that of Model 4 (χ^2 = 7.7, df = 7, p = 0.36). For this reason, the analysis continues by considering a spatial lag added only to the independent variables and considers a different specification of spatial interactions. Particularly, Models 2, 3 and 4 are based on a contiguity spatial dependence matrix. However, canton Ticino is expected to exhibit spatial relationships on a higher scale than the one considered in the previous models. For these reasons, Models 5, 6, 7 and 8 consider a spatial weights matrix based on the inverse travel times between the centroids of the municipalities.

In Model 5 spatial interactions occur within the entire cantonal territory. Comparing its ability to fit the data with that of Model 1, the findings suggest that considering this more precise specification of the relationships among municipalities is preferable (χ^2 = 25.4, df = 6, $p \leq 0.001$).

[10] It is possible to compare two multilevel models if one is nested within the other one. In particular, the difference in the deviances of the two models is chi-squared distributed with degrees of freedom equal to the difference of the number of estimated parameters (Luke, 2004).

Model 6 tests for spatial interactions occurring on more levels simultaneously. In particular, it considers relationships taking place within contiguous municipalities and, at the same time, it accounts for spatial effects occurring over the entire cantonal territory. The results of Model 6, in contrast with those of Model 5, show that controlling for spatial interactions on more levels does not significantly improve the ability to analyze and understand the performance of firms (χ^2 = 10.0, df = 6, p = 0.12). For this reason, the analysis proceeds by considering only spillovers occurring within the entire cantonal territory.

The different models so far considered allow the intercept to vary across municipalities, but they assume that the effects of firm-level characteristics are constant all over the cantonal territory. In this respect, as already suggested by Raspe and van Oort (2011), this research seeks to understand whether the effects of some firm-level variables may vary across municipalities. Hence, the analysis is extended by allowing the parameters associated with firm age, firm size and the level of specialization externalities to differ among the various geographical territories. The underlying idea is that characteristics at the municipal level might have an impact on the way that firm-level variables determine firm performance.

As reported in Table 1.6, among the considered models, Model 7 best captures reality. In fact, besides recording the lowest AIC, by contrasting the model considering spatial interactions in the entire cantonal area and with only a random intercept (Model 5) with the one also allowing for random slopes (Model 7), the findings suggest that Model 5 is significantly worse (χ^2 = 24.9, df = 9, p = 0.003). This clearly indicates that, in order to better capture reality, researchers should control for the variance of the effects of some firm-level characteristics across regions. Therefore, the final conclusions are based on the results of Model 7, shown in Table 1.7.

Specifically focusing on the agglomeration economies indicators, the final model underlines that, in general, firms situated in Ticino benefit from specialization economies at the municipal level. Hence, firms located in municipalities with high concentrations of businesses belonging to the same industry have a predicted higher level of solvency. Moreover, the effects of MAR record relatively high levels of variance among municipalities, indicating that specialization externalities do not homogeneously impact firm performance, but rather heterogeneously. Additionally, the diversification measure, on average, is negatively associated with firm solvency. This effect, even though it appears to be weak at the municipal level, is stronger and more significant when dynamics in the entire cantonal territory are considered. As suggested by Baldwin et al. (2010) and Harris and Moffat (2012), this indicates that high degrees of diversification might generate congestion diseconomies, which negatively affect firm performance. Considering that canton Ticino is

characterized by a relatively low level of industrial density (especially when compared to areas such as Zürich, Geneva, Basel or Milan), these findings are in line with those of De Groot et al. (2015), which argue that regions with a relatively low level of industrial density are expected to exhibit positive specialization effects and negative urbanization externalities.

Table 1.7 - Spatial multilevel model on firm solvency

Standardized independent variables	**Model 7**	
Intercept	41.46	***
Age	-0.55	
Age*Age	1.91	
Size	6.39	***
Size*Size	-2.01	
Service sector (dummy)	-4.19	***
MAR	3.12	***
Jacobs	-1.29	*
Regional centrality	0.34	
Welfare	-0.05	
Industrialization	1.19	
Rurality	-0.20	
Spatial MAR	0.27	
Spatial Jacobs	-3.54	***
Spatial regional centrality	1.32	
Spatial welfare	4.39	*
Spatial industrialization	-2.09	
Spatial rurality	1.30	
Variance intercept	3.9	
Variance age	9.1	
Variance size	31.1	
Variance MAR	13.9	
Variance residuals	206	

Significance levels: *** p < 0.01, ** p < 0.05, * p < 0.1
n: 953 firms in 68 municipalities

Focusing on firm-level characteristics, linear and quadratic effects of age are simultaneously estimated. On average, in canton Ticino it is not possible to assess that firm solvency is affected by their age. However, there is a cross-municipality variance associated with the effects of age, indicating that there is a certain degree of heterogeneity across municipalities. This analysis also tests for the size of a firm by simultaneously estimating linear and quadratic effects. The results indicate that, on average, firms located in canton Ticino exhibit strong and significant internal returns to scale, in terms of number of employees. Moreover, the strength of these internal economies of scale is

location specific, given that the results indicate that the effects of size are heterogeneous across municipalities. Additionally, Model 7 shows that firms operating in the service sector have significantly lower predicted score levels, ceteris paribus. However, this result might be driven by the high proportion of firms in the service sector operating in the wholesale and retail trade sectors, which in 2011 were suffering from the particular economic situation generated by the financial crisis of 2008.

In addition, Model 7 gives some insight into municipal-level variables. As expected, positive and significant effect of the spatial lag of the municipal factor "welfare" is found, indicating that firms are expected to benefit from being located in a municipality surrounded by municipalities with high levels of human and social capital, economic welfare and low levels of taxation.

1.6 Conclusions

The results of this paper highlight that firm solvency provides useful insights in the study of agglomeration mechanisms. Traditional analyses on agglomeration economies focus on their effects on self-reported indicators of firm performance, such as employment growth or productivity. On the contrary, the indicator of firm solvency used in this research is computed from an external and standardized perspective. Moreover, this variable is accessible to everyone and helps financial markets to reduce asymmetries in information faced when deciding whether to grant credits to firms.

Hence, the empirical results of this study imply that agglomeration mechanisms shape firm's credit accessibility, along with the characteristics of the firm itself and geographical information. As highlighted by the economic literature, this has in turn implications on firm's investment possibility and therefore on their ability to strengthen their productivity. This paper finds that firms located in Ticino benefit from the municipal concentration of firms within the same industry, while urbanization externalities, at both municipal and cantonal levels, seem to generate congestion diseconomies, having a predicted negative impact on firm solvency. Exactly why these results emerge, however, is beyond the scope of this study.

In addition, this paper finds that problems of aggregation bias in the analysis of agglomeration economies are important. It is crucial to account for the heterogeneity at both firm and municipal levels. In particular, in the context of Ticino, less than 10% of the variance of firm performance is at the aggregated level. This implies that when aggregate data are analyzed, more than 90% of the information is not considered. This research contributes to the study of agglomeration economies by overcoming this problem. In particular, both firm- and regional-level data are analyzed and spatial multilevel techniques are applied. The results indicate that to better understand the geography of agglomeration mechanisms, researchers do not only need to account for spatial mean effects, by

allowing the intercept of the model to vary across municipalities, but also need to control for spatial slope effects, in order to capture cross-municipality differences in the effects of some characteristics at the firm level. In particular, this research finds that firm age and firm size, as well as MAR externalities heterogeneously impact the performance of firms, depending on the context in which the firms are located.

Given the specific characteristics of canton Ticino (a relatively small territory with small firm agglomerations), future research will extend the analysis to other geographical contexts in order to understand whether the results are confirmed for larger concentrations of firms. Additionally, considering more years should permit verifying if the results hold over time or whether they change in different economic situations. These extensions will further disambiguate the results of past studies and will permit a clearer judgment concerning the relevance of cluster-based economic policies.

References

Anselin, L., 1988, *Spatial Econometric: Method and Models*. Dordrecht: Kluwer Academic Publishers.

Arrow, K., 1962, "Economic Welfare and the Allocation of Resources for Invention". In *The Rate and Direction of Inventive Activity: Economic and Social Factors*, 609–626. National Bureau of Economic Research, Inc.

Baldwin, J., Brown, W. and Rigby, D., 2010, "Agglomeration economies: Microdata panel estimates from Canadian manufacturing", *Journal of Regional Science,* 50(5):915–934.

Beaudry, C. and Schiffauerova, A., 2009, "Who's right, Marshall or Jacobs? The localization versus urbanization debate", *Research Policy*, 38(2):318–337.

Bernanke, B., Gertler, M. and Gilchrist, S., 1999. "The financial accelerator in a quantitative business cycle framework". In Taylor, J. and Woodford, M., editors, *Handbook of Macroeconomics*, 1(1):1341-1393. Elsevier.

Blanchard, O., Solow, R., and Wilson, B., 1995, "Productivity and Unemployment", Manuscript, MIT Press.

Chen, M. and Guariglia, A., 2013, "Internal financial constraints and firm productivity in China: do liquidity and export behavior make a difference?", *Journal of Comparative Economics*, 41:1123–1140.

Combes, P., 2000, "Economic Structure and Local Growth: France, 1984-1993", *Journal of Urban Economics*, 47(3):329–355.

Corrado, L. and Fingleton, B., 2011, "Multilevel Modelling with Spatial Effects", Working Papers 1105, University of Strathclyde Business School, Department of Economics.

De Bok, M. and Van Oort, F., 2011, "Agglomeration economies, accessibility and the spatial choice behavior of relocating firms", *Journal of Transport and Land Use,* 4(1):5–24.

De Groot, H. L., Poot, J., and Smit, M. J., 2015, "Which agglomeration externalities matter most and why?", *Journal of Economic Surveys*, 0(0):1–27.

Enders, C. and Tofighi, D., 2007, "Centering predictor variables in cross-sectional multilevel models: a new look at an old issue", *Psychological methods*, 12(2):121–138.

Evans, D., 1987, "The relationship between firm growth, size, and age: Estimates for100 manufacturing industries", *The Journal of Industrial Economics*, 35(4):567–581.

Ganau, R., 2016, "Productivity, Credit Constraints and the Role of Short Run Localization Economies: Micro-Evidence from Italy", *Regional Studies*, 50(11):1834-1848.

Giovannetti, G., Ricchiuti, G., and Velucchi, M., 2013, "Location, internationalization and performance of firms in Italy: a multilevel approach", *Applied Economics*, 45(18):2665–2673.

Gordon, I. and McCann, P., 2000, "Industrial Clusters: Complexes, Agglomeration and/or Social Networks?", *Urban Studies*, 37(3):513–532.

Harris, R. and Moffat, J., 2012, "Is Productivity Higher In British Cities?", *Journal of Regional Science*, 52(5):762–786.

Henderson, V., Kuncoro, A., and Turner, M., 1995, "Industrial Development in Cities", *Journal of Political Economy*, 103(5):1067–90.

Jacobs, J., 1969, "*The economy of cities*", Vintage international. Random House.

Jones, K., 1991, "Specifying and estimating multi-level models for geographical research", *Transactions of the Institute of British Geographers*, 16(2):148–159.

Jovanovic, B., 1982, "Selection and the Evolution of Industry", *Econometrica*, 50(3):649–70.

Kaiser, H., 1960, "The application of electronic computers to factor analysis", *Educational and Psychological Measurement*, 20(1):141–151.

Kelejian, H. and Prucha, I., 1998, "A Generalized Spatial Two-Stage Least Squares Procedure for Estimating a Spatial Autoregressive Model with Autoregressive Disturbances", *The Journal of Real Estate Finance and Economics*, 17(1):99–121.

LeSage, J. and Pace, K., 2009, *Introduction to Spatial Econometrics*. Statistics: A Series of Textbooks and Monographs. CRC Press.

Luke, D., 2004, *Multilevel Modeling*. SAGE Publications.

Mameli, F., Faggian, A., and McCann, P., 2014, "Estimation of Local Employment Growth: Do Sectoral Aggregation and Industry Definition Matter?", *Regional Studies*, 48(11):1813–1828.

Marshall, A., 1920, *Principles of Economics: An Introductory Volume*, Macmillan and Co.

McCann, P., 2001, *Urban and Regional Economics*, Oxford University Press.

McGahan, A. and Porter, M., 1997, "How much does industry matter, really?", *Strategic Management Journal*, 18(S1):15–30.

Pierewan, A. and Tampubolon, G., 2014, "Spatial dependence multilevel model of well-being across regions in Europe", *Applied Geography*, 47:168–176.

Rajan, R. and Zingales, L, 1998, "Financial Dependence and Growth", *The American Economic Review*, 88(3):559-86.

Raspe, O. and Van Oort, F., 2008, "Firm Growth and Localized Knowledge Externalities", *Journal of Regional Analysis and Policy*, 38(2).

Raspe, O. and Van Oort, F., 2011, "Firm heterogeneity, productivity and spatially bounded knowledge externalities." *Socio-Economic Planning Sciences*, 45(1):38–47.

Romer, P., 1986, "Increasing Returns and Long-run Growth", *Journal of Political Economy*, 94(5):1002–37.

Rosenthal, S. and Strange, W., 2004, "Evidence on the nature and sources of agglomeration economies". In Henderson, J. and Thisse, J., editors, *Handbook of Regional and Urban Economics*, volume 4 of *Handbook of Regional and Urban Economics*, 49:2119–2171. Elsevier.

Savitz, N. and Raudenbush, S., 2009, "Exploiting spatial dependence to improve measurement of neighborhood social processes", *Sociological Methodology*, 39(1):151–183.

Schumpeter, J., 1911, *A theory of economic development*. Cambridge, MA: Harvard University Press.

Schwellnus, C. and Arnold, J., 2008, "Do corporate taxes reduce productivity and investment at the firm level?: Cross-country evidence from the Amadeus dataset.", OECD Economics Department Working Papers 641, OECD Publishing.

Van Oort, F., Burger, M., Knoben, and J., Raspe, O., 2012, "Multilevel Approaches And The Firm-Agglomeration Ambiguity In Economic Growth Studies", *Journal of Economic Surveys*, 26(3):468–491.

Chapter 2: The impact of language borders on the spatial decay of agglomeration spillovers [11]

Daniele Mantegazzi, Philip McCann, Viktor Venhorst

Abstract

Recent research argues that 'soft' institutions, like language and culture, are interrelated with the working of the spatial economy. In a geographical setting there is evidence that culture affects interpersonal relationships but there is no equivalent evidence regarding the effects of culture on agglomeration spillovers. This paper examines whether language, a specific dimension of culture, affects the geographical extension of agglomeration spillovers by observing the geography of employment patterns in a linguistically discontinuous setting. The findings, for the first time, provide empirical evidence that independent of governance and institutional issues, language borders differently shape the distance decay of agglomeration spillovers.

JEL classification: O18; R11; R12; Z10

Keywords: Agglomeration externalities, Economic geography, Spatial decay, Language.

[11] This chapter is based on Mantegazzi, McCann and Venhorst (2017), The impact of language borders on the spatial decay of agglomeration spillovers. Presented at the 57th ERSA Congress, Groningen. *Revised and resubmitted to an international journal.* Minor editorial changes have been made for a better fit with the style of the thesis.

2.1 Introduction

A growing body of literature highlights that culture and the economy are interrelated (Beugelsdijk and Maseland, 2011; De Jong, 2009), via the influence of culture on shaping the 'soft' or informal institutional underpinnings of the economy. Following these ideas, for economic geographers there are broadly two lines of argumentation deployed in the literature. First, some economic geographers (Pike et al., 2011; Storper, 2013) consider that culture and informal or soft institutions heavily shape and are shaped by economic geography, at least as much as by hard institutions. These arguments tend to focus on the nature and the quality of the institutional settings and in particular on the role played by the institutional set-up in facilitating participation and engagement by different constituencies in the economy. Second, there are other economic geography arguments and evidence that cultural markers, defined primarily in terms of ethnic diversity (Bakkens et al., 2013; Tselios et al., 2015a, 2015b; Nijkamp et al., 2015), influence interpersonal relationships, and in a spatial setting these interpersonal relationships in turn influence local economic outcomes. Yet, in general the links between economic geography and culture still remain rather vague and contested. There are some scholars who argue that culture cannot be modeled as such, particularly as it pertains to the former argument; while other scholars are skeptical of the role played by culture in shaping economic geography, unless this can be demonstrated analytically in a formal model setting, something which has never previously been done.

The purpose of this paper is not to engage in these types of conceptual, theoretical or methodological debates. Rather, the aim is simply to examine whether there is any detailed empirical evidence that a particular dimension of culture, namely language (Tabellini 2008), does indeed influence economic geography, in a context where neither ethnic diversity nor differing nor poor institutional quality are key features. More specifically, this study examines whether language borders influence one particular aspect of economic geography, specifically the geographical extension of different types of agglomeration spillovers within the same country. To capture any such spillover effects, the analysis empirically examines how local employment patterns are related to linguistic differences between localities. The paper focuses on Switzerland, which represents an appropriate case-study for examining these types of differences, because, as underlined by Eugster et al. (2011), these clearly defined and sharp language borders are not associated with changes in the geographical or political setting. Neither the nature nor the quality of the institutional and governance set-up varies according to the local linguistic context, so any observed effects cannot be attributed to either national or regional governance issues.

In this context, the study tracks how employment patterns in one locality are related to those in neighboring localities, and examines whether these relationships differ across language borders in a manner which is distinct from simply different locality administrative borders. In particular, this analysis examines whether employment specialization or diversity patterns differ across different types of borders, after controlling for geographical, economic and topographical features. The tracking of employment patterns is not in any way meant to be a test or an advocating of any particular model of regional growth or spillovers, as this topic has been a source of much debate over the last three decades. Rather, the methodology employed is simply the most direct method of identifying whether the geography of agglomeration spillovers affects and is affected by linguistic differences, while making no claims as to the mechanisms underlying any such linkages or spillovers.

This empirical approach demonstrates that language borders do indeed affect the spatial decay of various proxies for agglomeration spillovers, in different ways. Moreover, given that this one particular feature of culture, namely linguistic differences, can be shown in this specific context to affect this one particular aspect of economic geography, namely agglomeration-employment spillovers, these empirical results support those scholars arguing that culture shapes, and is shaped by, economic geography.

The rest of the paper is structured as follows. Section 2 presents a review of the relevant literature. In Section 3 the econometric model is described. The database is presented in Section 4, followed by the empirical results in Section 5 and Section 6 concludes.

2.2 Literature review

As mentioned above, a growing body of literature highlights that culture and soft or informal institutions and economy are interrelated (Beugelsdijk and Maseland, 2011; De Jong, 2009; Pike et al., 2011; Storper, 2013; Nathan and Lee, 2013; du Gay and Pryke, 2002; Gertler, 2003; Cooke and Lazzeretti, 2008). In particular, cultural characteristics may impact on economic behavior and economic geography processes in different ways and which in turn may lead to regional differentiation. Moreover, the literature on border effects (Brakman et al., 2012) also points to such conclusions, whereby both the underlying behavior and the spatial extension of spillovers may be shaped by the presence of different types of borders.

At the same time, the existing literature on agglomeration spillovers is itself characterized by a largely unresolved debate regarding the effects of these various mechanisms in shaping, or being shaped by, economic geography. Indeed, recent meta-analyses (Melo et al., 2009; Beaudry and Schiffauerova, 2009; De Groot et al., 2015) highlight that the results are still rather unclear and

inconclusive in determining whether localization or urbanization economies generate different outcomes in different contexts, although it is clear that any observed spillover effects attenuate with distance (Fotheringham and Pitts, 1995; Rosenthal and Strange, 2003; Rice et al., 2006; Smit and De Groot, 2013; Saito and Wu, 2016). As such, there is no general consensus on the spatial extension of these spillovers, and no evidence whatsoever on the role played by culture in shaping these effects. In fact, traditional analyses generally do not include issues of culture, thereby disregarding whether various cultural environments heterogeneously affect the geographical extension of agglomeration spillovers. In particular, the fact that different spatial units (e.g. municipalities, regions) may or may not share common cultural characteristics is typically not considered, neglecting whether and how this may impact on the externalities arising from the concentration of firms.

Yet, in order to better understand how culture may impact on the different costs and benefits related to the regional concentration of firms, this research focuses on one particular dimension of culture, namely language (Tabellini 2008), and aims at verifying whether the existence of linguistic differences across Swiss municipalities has an impact on the geographical extension of the benefits that firms might gain from being located near to other business activities. The underlying research question of this study is the following: do linguistic discontinuities impact on the spatial decay of agglomeration spillovers?

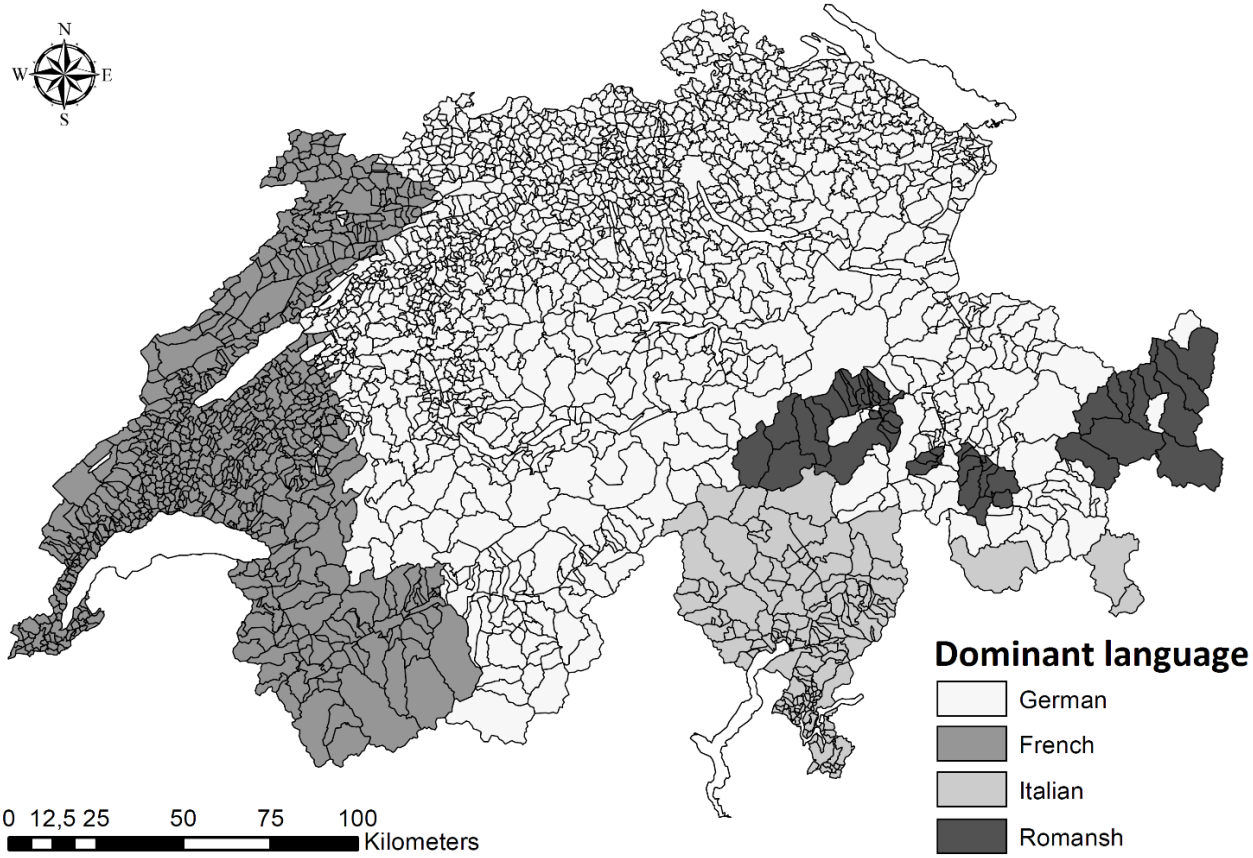
In general, the absence of previous studies on the relationship between language and agglomeration spillovers implies that there is no clear guideline or model allowing forming a priori hypotheses. However, there are some heuristics that can give some ideas on how language and agglomerations might be related. Previous studies on the economic effects of cultural diversity indicate that the direction of the impact could be either positive or negative. Cultural diversity can increase the economic performance because of skill complementarities (Lazear, 1999), learning processes (Berliant and Fujita, 2008), or augmented social capital (Putnam, 2007). On the other hand, cultural diversity may also create communication barriers or social conflicts that generate excessive transaction costs (Kochan et al., 2003). Given that both forces take place at the same time, it is difficult to form hypotheses. However, the nature of the various types of agglomeration mechanism may help in order to form some expectations. Specifically, specialization externalities tend to imply that learning forces are concentrated within "industrial communities", suggesting that linguistic differences might act as an obstacle to wider spread effects. Alternatively, Jacobs (1969) indicates that some learning mechanisms are facilitated in diverse environment, implying that the coexistence of different languages might boost agglomeration spillovers across various spatial scales. In general, diversified cities and regions tend to exhibit wide ranging linkages (McCann and Acs, 2011; Caragliu et al., 2016). Again, the net result is ambiguous and therefore it is difficult to suggest an a priori

hypothesis. All that can be said at this stage is that while there are grounds for believing that linguistic differences may shape the patterns of agglomeration spillovers, the links between linguistic patterns and the spatial and distance-decay of agglomeration effects cannot be specified ex ante.

In order to investigate these issues, Switzerland represents a very interesting case because it does not suffer from problems of poor institutions, it has strong and homogeneous general economic conditions (Nunziata and Rocco, 2016) and, as shown in Figure 2.1, it consists of four language regions: German, French, Italian and Romansh[12]. In general, language does not always coincide with culture, in that there might be situations in which the same culture is shared among groups of people with different languages, or circumstances in which different cultures coexist within the same linguistic area. Moreover, in Switzerland people generally speak more than one national language[13] and might therefore be able to communicate with people from another linguistic region. Nevertheless, even though language borders do not stop communication between the different language areas in Switzerland, the language barrier between Swiss linguistic areas is sharp[14] and there are clear cultural gaps, because native languages are the medium through which attitudes, norms, beliefs and values are transmitted from one generation to the next (Eugster et al., 2011). In fact, as highlighted by Hofstede (2001), in the Swiss context the various linguistic regions are clearly associated with different cultures, with wide cultural differences between the language areas, as reflected, for example, also in different voting patterns (Goldberg, 2017), different fiscal preferences (Eugster and Parchet, 2018), different demands for redistributive social insurance (Eugster et al., 2011) or different attitudes towards work (Diekmann et al., 1998). Moreover, as underlined by Eugster et al. (2011), this clearly defined and sharp language border is not associated with changes in the geographical or institutional settings. This context therefore allows analyzing the impact of linguistic discontinuities on the spatial extension of agglomeration spillovers by comparing these effects across the various Swiss language regions, based on the plausible assumption that at this border there are no additional factors other than language - representing a specific dimension of culture - that change in such a discontinuous way.

[12] These are the four official languages in Switzerland. German is spoken by 63.7% of the Swiss population, French by 20.4%, Italian by 6.5%, and Romansh by 0.5%.
[13] According to Werlen (2008), about 73% of the inhabitants of the French speaking areas of Switzerland speak also another national language. This value is equal to 85% for the inhabitants of the German speaking parts and 92% for those of the Italian speaking regions.
[14] At the language border between the French and the German speaking regions of Switzerland, the number of inhabitants whose mother tongue is French (German) drops from more than 90% to less than 5% within 5 kilometres.

Figure 2.1 - Dominant national language in all Swiss municipalities, 2000



Data Source: Federal Population Census (2000) of the Swiss Federal Statistic Office

2.3 Methodology

In this analysis, Swiss municipalities are grouped into different linguistic categories whereas the industrial sectors are not, and the aim is to examine whether the sectoral employment patterns and distributions observed across different distances and municipal boundaries differ according to linguistic borders they traverse. Yet, the task of this study is not simply a matter of adding a linguistic variable to existing analytical frameworks. Rather, the aim is to empirically examine whether linguistic differences shape the spatial distance-decay properties of agglomeration spillovers. Following Van Oort et al. (2012) and De Groot et al. (2015), it is important that the empirical methodology applied is able to account for the possibility of hierarchies in the data. Therefore, this paper analyzes a cross-classified multilevel model in which firms are nested into both municipalities and sectors. This implies that the model is able to account for possible correlation within the same sector and within the same municipality. Hence, the model here estimated has the form represented in equation (2.1).

$$y_{fmst} = \beta_0 + \sum_{k=1}^{K} \beta_{k(tv)} (x_{kfmst} - \bar{x}_{kfms}) + \sum_{k=1}^{K} \beta_{k(ti)} \bar{x}_{kfms} + \sum_{h=1}^{H} \gamma_h z_{hmt} + \sum_{i=1}^{I} \delta_i AI_{imst} + \sum_{r=1}^{R} \sum_{i=1}^{I} \theta_{ri(sl)} \sum_{\substack{n \neq m \\ \forall\, n \in r \\ \forall\, lang_n = lang_m}} w_n AI_{inst} + \sum_{r=1}^{R} \sum_{i=1}^{I} \theta_{ri(dl)} \sum_{\substack{n \neq m \\ \forall\, n \in r \\ \forall\, lang_n \neq lang_m}} w_n AI_{inst} + \xi D_{year} + \mu_m + \mu_s + \varepsilon_{fmst} \quad (2.1)$$

Where y_{fmst} is the performance of firm f, located in municipality m, operating in sector s in time t. Additionally, $(x_{kfmst} - \bar{x}_{kfms})$ is the time-varying component of the k-th firm-level variable, whereas $\bar{x}_{kfms}$ is its time-invariant component[15]. z_{hmt} is the h-th municipal characteristics, K and H are the number of firm-level regressors and municipal regressors, respectively. Moreover, AI_{imst} is the i-th agglomeration index, with I being the total number of agglomeration indices. $\theta_{ri(sl)}$ and $\theta_{ri(dl)}$ allow measuring the geographical extension of agglomeration spillovers in municipalities with the same language and in those with a different language, respectively. As explained in the next section, this study follows Rosenthal and Strange (2003) and builds R concentric rings at different distances from municipality m and for each type of agglomeration economies i computes its spatial lag, by weight averaging the indices of the municipalities n intersected by ring r, where w_n represents the weight of municipality n. In order to analyze whether the existence of language borders has an impact on the spatial decay of agglomeration spillovers, two different spatial lags for agglomeration economies are computed: one for municipalities n intersected by ring r that share the same language of municipality m and one for those that do not share the same language. Finally, D_{year} is a dummy variable capturing year fixed effects, $\mu_m \sim N(0, \sigma_m^2)$, $\mu_s \sim N(0, \sigma_s^2)$ and $\varepsilon_{fmst} \sim N(0, \sigma_f^2)$ are error terms at the municipal, sectoral and individual levels, respectively.

2.4 Data and variables

This study analyzes a large balanced panel dataset constructed from the official Swiss structural business statistic (STATENT), offered by the Swiss Federal Statistical Office (FSO) and covering the period 2011 – 2013. This database provides basic information on all establishments in Switzerland, with about 650,000 observations annually. This analysis only considers observations

[15] As explained in the next section, firm-level heterogeneity bias is controlled for by applying Mundlak's (1978) approach, which allows estimating the time-varying and time-invariant components of firm-level variables.

present in all the three years and located in municipalities with at least three establishments per year[16]. This database has been combined with Swiss official secondary data at the municipal level. After selecting the data as described above, the resulting database comprises 475,088 establishments from both the manufacturing and service sectors which are located in 2,362 Swiss municipalities.

Following the spirit of the seminal papers in the analysis of agglomeration economies (for an overview see Beaudry and Schiffauerova, 2009; and Combes and Gobillon, 2015), the establishment-level employment growth is used as dependent variable, which is computed as the difference in the log of number of employees between year t and year $t+1$. In the literature, this is the most widely-used indicator of agglomeration-spillovers (Beaudry and Schiffauerova, 2009), and is the only dependent variable which these data permits employing. The agglomeration-related literature suggests that in some cases such spillovers might be labor saving or the labor supply may be inelastic and therefore they may not necessarily translate into employment growth (Combes et al., 2004; Suedekum, 2009). However, using Mundlak's approach allows considering the net effect on employment growth, net of labor saving and capital/labor substitution occurring at the level of each firm.

As seen in the previous section, the explanatory variables can be divided into establishment-level variables, municipal-level variables and agglomeration indices, which vary across both sectors and municipalities. Additionally, in order to compare the different estimates, all the independent variables are normalized. Specifically, this study follows Enders and Tofighi (2007) and standardizes the municipal-level variables around their grand mean and the firm-level variables around their group mean. This approach allows the effects of the firm-level variables to capture only within municipalities differences, and not between municipalities.

Agglomeration economies indices

The main interest of this research is to analyze the spatial decay of agglomeration spillovers, with a particular interest in determining whether the existence of a language border between municipalities has an impact on it. The analysis considers three different typologies of agglomeration spillovers: specialization, competition and diversity. In order to measure specialization, a simple location quotient is considered, which is computed as the ratio of the employment share of sector s

[16] This selection procedure is required because from the dataset it is not possible to distinguish between establishments that became insolvent from those that are censored due to merger or voluntary liquidation. Buehler et al. (2012) find in their analyses that in Switzerland, between 1995 and 2000, about 6% of firms become insolvent and 9% exit due to merger or voluntary liquidation. Hence, it seems reasonable that this selection procedure does not generate problems of selection bias because it is not excluding only establishments that failed, and they only represent a minor part of Swiss establishments.

in municipality m divided by the same ratio at the national level[17]. In terms of competition, the relative number of firms per employee is considered, which is computed as the number of firms in sector s in municipality m divided by the number of employees working in the same sector and in the same municipality, scaled by the same ratio at the national level. Finally, diversity is measured as the ratio of the inverse of a modified Hirschman-Herfindahl index of sectoral concentration of all sectors in municipality m, except the considered sector s, divided by the same ratio at the overall national level[18]. In order to compute these indices, data on the total number of firms and employees per sector and municipality are used, which are obtained from the STATENT provided by the FSO.

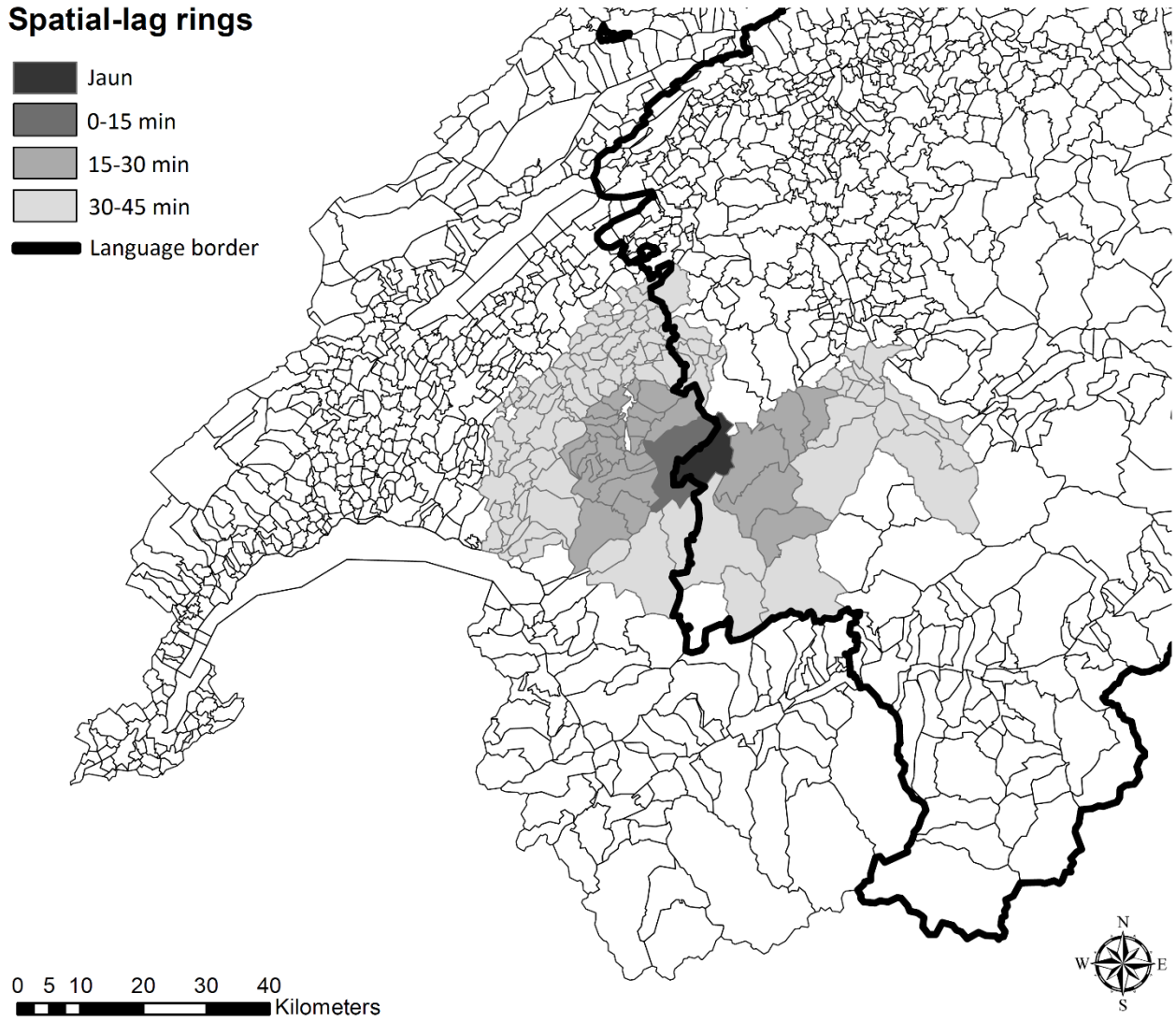
As described in Groot et al. (2014), the literature uses different indices to measure the various types of agglomeration economies. The vast majority of the studies studying agglomeration spillovers uses indices based on shares, as in the case of the indices presented above. Hence, in order to be most consistent with the literature, these indices are considered to be the preferred specification. Nevertheless, the results are tested using also alternative measures of these variables, in order to verify whether the findings are consistent across the various specifications. In particular, as a robustness check, in order to measure specialization, the share of sector s on total employment in municipality m is also used. Moreover, in terms of competition the absolute number of firms per employee in sector s in municipality m is also considered.

As mentioned above, in order to measure the geographical extension of agglomeration spillovers, this study adopts the approach used in Rosenthal and Strange (2003) and applied in various other studies (Fu, 2007; Baldwin et al., 2008; Rosenthal and Strange, 2008; Graham, 2009; Smit and De Groot, 2013 and Saito and Wu, 2016). Specifically, for each municipality m concentric rings at different distances from the centroid of that municipality are built and for each ring the spatial lag of the three types of agglomeration spillovers are computed by weight-averaging the indices of the municipalities intersected by the corresponding ring. Agglomeration spillovers are by definition higher when there is a larger working force. To account for the fact that different municipalities with a similar value of agglomeration indices might have different sizes in terms of workers, the weighting procedure considers the size of the surrounding municipalities in terms of number of employees and gives more importance to those municipalities with a larger working force. In addition, for each ring and for each typology of agglomeration spillovers two different spatial lags are built: one for those municipalities within the ring which have the same language of municipality m, and one for those

[17] A value of specialization above 1 means that in municipality m the employment share of sector s is higher than the national average. Appendix 2.A provides the formula used in the construction of this index.
[18] Higher values of diversification imply that the employment share of all the other sectors in municipality m are more similar. On the contrary, lower values of this index mean that the majority of the workforce in municipality m is employed in few sectors. Appendix 2.A provides the formula used in the construction of this index.

municipality which have a different language. From a theoretical perspective there is no a priori guidance on how many rings to consider and how large these rings should be. However, from an empirical point of view it is possible to have a meaningful insight by considering the spatial distribution of cities and municipalities. After analyzing this distribution in the Swiss context[19], a cutoff distance at 45 minute travel time is imposed and rings of 15 minute travel time are considered, because they provide reasonably detailed information about the spatial decay of the concentration of firms. The advantage of travel time is that it allows comparing regions characterized by very different topographical environments, which is crucial in a context like Switzerland where there are both flat areas and regions with very high mountains[20].

Figure 2.2 - Spatial-lag rings



[19] The spatial distribution of cities and municipalities in Switzerland is presented in Appendix 2.B.
[20] Considering travel time distances implies that from a graphical perspective the rings have a modified circular shape, depending on the morphological characteristics of the surrounding area.

Thus, as shown in Figure 2.2, in which the case of the municipality of Jaun[21] – marked in black – is graphically represented, following this approach, for each typology of agglomeration spillovers and for each linguistic group three different spatial lags are obtained – marked in grey in Figure 2.2, with decreasing intensity for rings that are farther away and with the language border represented by the solid black line[22].

Table 2.1 provides information concerning the distance of Swiss municipalities from the nearest language border. In particular, about 10% of the Swiss municipalities are less than a 15 minute travel time from a municipality which belongs to another language region. In addition, the table shows that 30% of Swiss municipalities are less than a 30 minute travel time from a language border and more than 50% are less than a 45 minute travel time from it. This clearly indicates that linguistic discontinuities involve a conspicuous part of Swiss municipalities.

Table 2.1 - Distance of Swiss municipalities from a language border

Distance from different language region (in minute)	Number of municipalities	Frequency
0 – 15	239	9.8%
15 – 30	477	19.9%
30 – 45	520	21.7%
> 45	1160	48.6%

Mameli et al. (2014) demonstrate that the empirical results on the analysis of agglomeration economies can be very different depending on the level of sectoral aggregation considered. Furthermore, the authors find that it is generally preferable to analyze more disaggregated data. Hence, this research focuses on the study of the spatial decay of agglomeration spillovers using a NOGA 2008 four-digits sectoral specification[23], which allows analyzing 545 different sectors.

Establishment-level variables

The accessibility to establishment-level information allows capturing the effects related to internal economies of scale and also potential size-related congestion effects, by controlling for log-linear and log-quadratic effects of the size of establishments, computed as the number of employees of each establishment (following Jovanovic, 1982; Evans, 1987; Carroll and Hannan, 2000;

[21] The only reason the graphical representation is focusing on the municipality of Jaun is that it is located near a language border, which allows showing how this study considers linguistic discontinuities in this analysis.
[22] Appendix 2.C shows the descriptive statistic of the dependent variable, the three typologies of agglomeration spillovers and their spatial lags. Appendix 2.D presents the correlation between the agglomeration indices and their spatial lags.
[23] The NOGA 2008 is modelled after the latest version of the Statistical classification of economic activities in the European Community (NACE, rev. 2).

Audretsch and Dohse, 2007; Raspe and Van Oort, 2008 and 2011). Additionally, the gender composition of the workforce at the establishment level is used as a control variable, which is computed as the number of female workers divided by the total number of employees. Using the STATENT database allows considering all the establishments located in Switzerland. However, it contains very few variables at the establishment level, so, in order to correct for establishment-level heterogeneity bias, Mundlak's (1978) approach is applied. As highlighted in Bell and Jones (2015), this procedure allows estimating the time-invariant component of establishment-level variables, which provides fixed effects estimates, and the time-varying component of the same variables.

Municipal-level variables

In order to avoid problems of omitted-variable bias which might cause problems of identification with regards to the measure of the effects of agglomeration spillovers and their spatial extension, a large variety of characteristics at the municipal level are controlled for, which can be classified into five broad categories[24].

The first groups all the demographic information at the municipal level in year t (following Combes, 2000; Audretsch and Dohse, 2007; Brülhart and Sbergami, 2009; Raspe and Van Oort, 2008, 2011 and Mameli et al., 2014). The second category collects all the socio-economic information at the municipal level in year t (following Henderson et al., 1995; Blanchard et al., 1995; Gordon and McCann, 2000; Audretsch and Dohse, 2007; Brülhart and Sbergami, 2009 and Raspe and Van Oort, 2008, 2011). The third category of municipal-level independent variables groups all the information related to the private and public level of investments in 11 types of infrastructure in every municipality in year t (as done in in Eberts and McMillen, 1999; Fingleton and McCann, 2007; De Bok and Van Oort, 2011; Raspe and Van Oort, 2011; Giovanetti et al., 2013 and Mameli et al., 2014). The fourth category includes municipal-level independent variables providing information about the infrastructure accessibility of each municipality in year t (following Eberts and McMillen, 1999; Rosenthal and Strange, 2004; Fingleton and McCann, 2007; De Bok and Van Oort, 2011; Giovanetti et al., 2013 and Mameli et al., 2014). Finally, the fifth category collects information concerning the cultural composition of each municipality.

2.5 Results

This section first describes the empirical results based on regressing the model using the preferred specification of agglomeration spillovers. Subsequently, a series of robustness checks are performed in order to confirm that these results are consistent across various dimensions. In

[24] The list of the control variables at the municipal level included in each category is presented in Appendix 2.E.

particular, the aim of the second part of the analysis is to verify whether the specification used impacts on the validity of the results. Moreover, potential problems related to reverse causality are also tested for.

Estimation results

Table 2.2 reports the estimates of the effects of agglomeration spillovers at various distances from their location, taking into consideration linguistic differences.

Table 2.2 - Cross-classified multilevel model on employment growth at the establishment level in Switzerland

Fixed effects:				
Specialization	0,0000	(0,0005)		
Spatial lags:	*Same language*		*Different language*	
Specialization 0-15 min	0,0013*	(0,0006)	-0,0008	(0,0005)
Specialization 15-30 min	-0,0006	(0,0006)	-0,0002	(0,0005)
Specialization 30-45 min	0,0003	(0,0005)	-0,0004	(0,0006)
Competition	-0,0006	(0,0006)		
Spatial lags:	*Same language*		*Different language*	
Competition 0-15 min	-0,0013*	(0,0005)	0,0009	(0,0005)
Competition 15-30 min	0,0005	(0,0006)	0,0003	(0,0006)
Competition 30-45 min	0,0003	(0,0006)	0,0003	(0,0006)
Diversity	-0,0082	(0,0070)		
Spatial lags:	*Same language*		*Different language*	
Diversity 0-15 min	-0,0100	(0,0089)	0,0201	(0,0233)
Diversity 15-30 min	-0,0092	(0,0085)	0,0418*	(0,0151)
Diversity 30-45 min	0,0026	(0,0086)	0,0275	(0,0214)
Random effects:				
Municipal-level variance	0,0000			
Sector-level variance (4 digit)	0,0003			
Establishment-level variance	0,0548			
Municipal-level variables	Yes			
Establishment-level variables	Yes			
Mundlack correction	Yes			
Year fixed effects	Yes			
Deviance	121'323			
Observations	950'176; 2'362 municipalities; 545 sectors			

* $p < 0.05$, ** $p < 0.01$; standard errors between parentheses

The results allow separately analyzing the geographical extension of the three typologies of agglomeration spillovers considered, differentiating between the spatial decay in regions with the

same language from those with a different language. Specifically, for each typology of agglomeration spillovers it is possible to graphically represent their effects on employment growth at the firm level at various distances (on the horizontal axis) in areas with the same language (marked in blue) and in areas with a different language (marked in red), with the 95 percent confidence interval in each case (represented with vertical lines around the point estimates). This graphical representation allows clearly visualizing whether the pattern of the spatial extension of the various types of agglomeration spillovers differ between regions with the same language from those with a different language.

Figure 2.3 shows the results related to specialization externalities. The direct estimate at the municipal level is not significantly different from zero. This means that, on average, the concentration of business activities operating in the same industrial sector and in the same municipality does not affect these firms in terms of employment growth. Considering the spatial lag of specialization in municipalities located less than a 15 minute travel time away, the effect is positive and statistically significant in municipalities with the same language, whereas the result is negative but not statistically significant in municipalities with a different language. Hence, employment growth at the firm level is significantly higher when there is a high concentration of firms operating in the same industrial sector in municipalities belonging to the same linguistic region and located less than a 15 minute travel time away. No such effect operates for linguistic barriers within the same spatial domain. However, at distances above a 15 minute travel time the results are never significantly different from zero.

Figure 2.3 - The geographical extension of specialization externalities

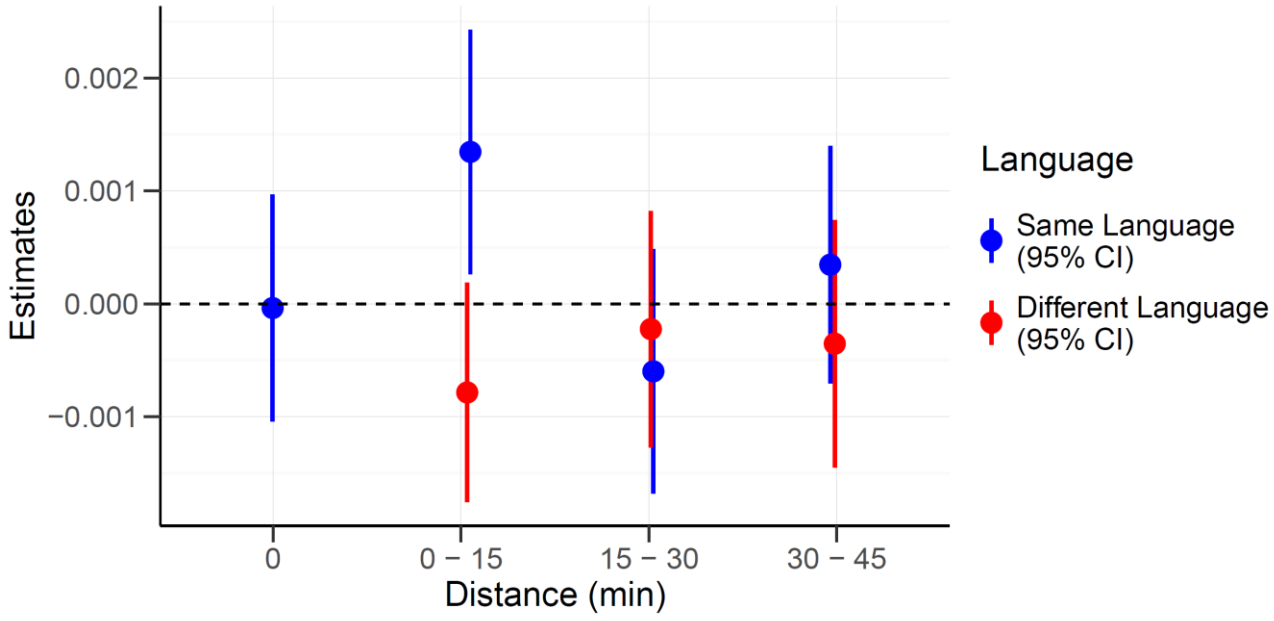


Figure 2.4 shows the results related to competition externalities. The direct estimate of competition spillovers at the municipal level is not significantly different from zero. Considering the spatial lag of competition in municipalities located less than a 15 minute travel time away, the effect is negative and statistically significant in municipalities with the same language, whereas the result is positive but not statistically significant in municipalities with a different language. This means that employment growth at the firm level is significantly lower when there are high levels of competition in municipalities belonging to the same language region and located less than 15 minute travel time away. Furthermore, competition externalities within a 15 minute travel time in municipalities with the same language are significantly different from the result in municipalities with a different language. This indicates that in these two types of regions the estimates for competition effects follow different patterns. At distances above a 15 minute travel time the results are never significantly different from zero.

Figure 2.4 – The geographical extension of competition externalities

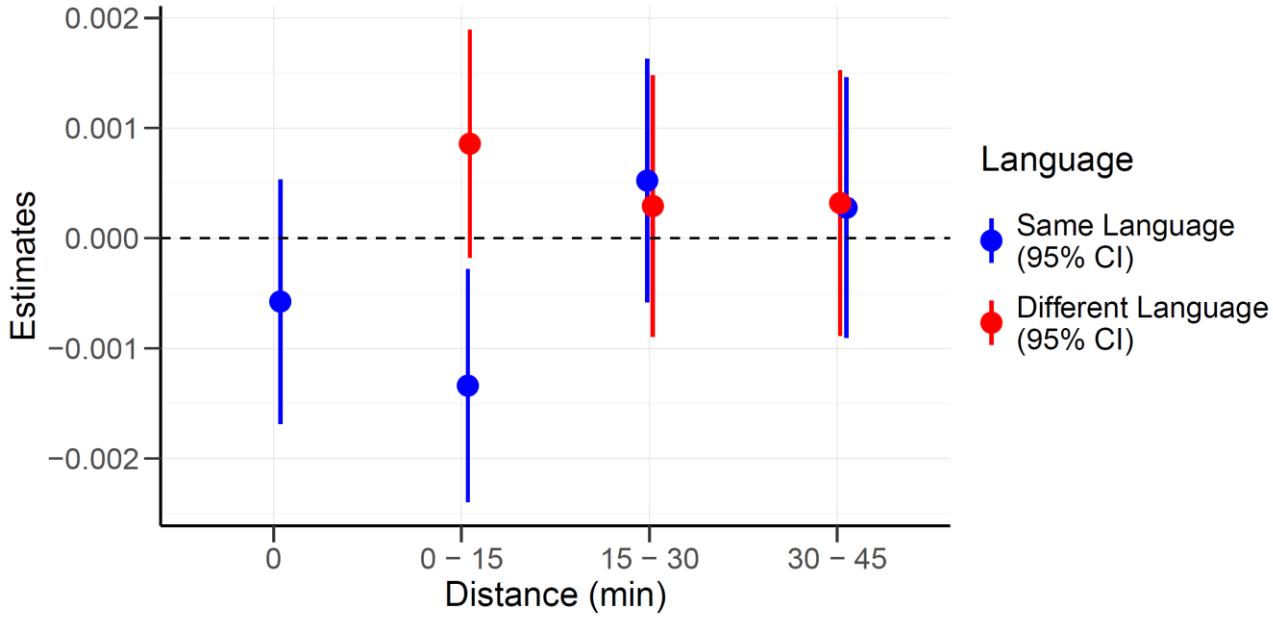
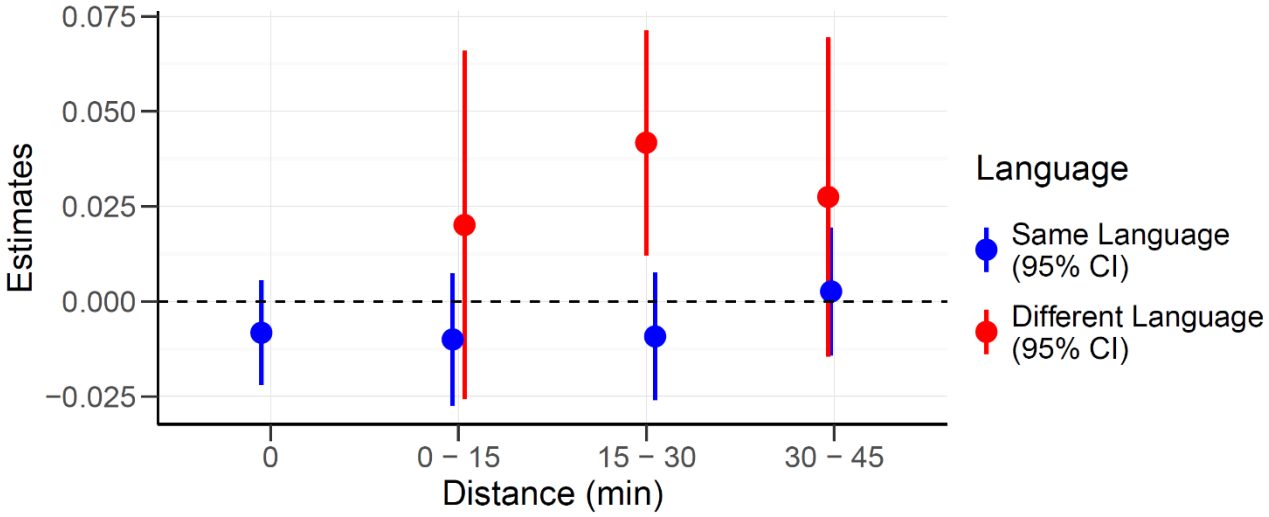


Figure 2.5 reports the results concerning diversity externalities. The direct estimate of diversity spillovers at the municipal level is not significantly different from zero. This implies that, on average, the employment growth of firms is not affected by the level of local diversity, measured as the inverse of the Hirschman-Herfindahl index. Focusing the attention on the spatial lag of diversity in the surrounding municipalities, the findings indicate that in communes located between a 15 and 30 minute travel time away, the effect is positive and statistically significant in municipalities with a different language, whereas the result is negative but not statistically significant in municipalities with the same language. Hence, employment growth at the firm level is significantly higher when

there are high levels of diversity in municipalities belonging to a different language region and located nearby. More specifically, while the differences are evident within a 15 minute travel time they are even more marked between 15 and 30 minute travel times. Beyond these travel times the results are never significantly different from zero.

Figure 2.5 – The geographical extension of diversity externalities



These results indicate that, in each case, the direct estimates at the municipal level are not significant, whereas the different types of agglomeration-spillover effects become significant in different ways at relatively larger distances, depending on the presence of a linguistic barrier, and then vanish again farther away. Given that the average size of Swiss municipalities is only 3500 people, the direct results at the municipal level are consistent with the arguments of Baldwin et al. (2010) and Harris and Moffat (2012) who suggest that congestion diseconomies generated by the agglomerations of firms might offset the benefit of these concentrations at really short distances. Similarly, the observation that specialization and competition externalities attenuate with distance are also consistent with the findings of Hoogstra and Van Dijk (2004) and Smit and De Groot (2013), while the diversity results are consistent with those of Fu (2007) who found that diversity externalities extend further and take place on a larger geographical area. As far as the authors of this study are aware, this is the first time that these effects of language borders or barriers on agglomeration spillovers have ever been observed empirically, and they also appear to be consistent with other evidence on agglomeration-spillover effects.

Robustness checks

In the second part of this section, the aim is to verify whether the results of this study, namely that linguistic differences affect the geographical extension of different types of agglomeration spillovers in different ways, are consistent across different dimensions, and are not simply a spurious

outcome of operationalization decisions. In particular, the aim of this part of the analysis is first to test the findings by considering different specifications of agglomeration spillovers, and then check whether potential problems of reverse causality affect the outcome.

Table 2.3 reports the estimates of agglomeration spillovers at various distances from their location, taking into consideration linguistic differences, for all the robustness checks above mentioned. All these robustness checks only aim at attesting whether language still affects the spatial extension of agglomeration spillovers by using different specifications along several dimensions. For this reason, Table 3 only reports the estimates of agglomeration spillovers.

In this part of the analysis, alternative indices identified by the literature to measure the various types of agglomeration spillovers[25] are also considered. Specifically, in order to measure specialization, the share of each sector in each municipality is also used (Model 2 and Model 3 of Table 3). Additionally, to measure competition, the absolute number of firms per employee in each sector in each municipality is also considered (Model 1 and Model 3 of Table 3). The results indicate that regardless of the specification used, the spatial decay of agglomeration spillovers differs significantly depending on whether the geographical extension involves municipalities with the same language or with a different language. In particular, considering the absolute number of firms per employee as index for competition this research finds similar and even stronger results. In fact, in addition to the significant difference for competition externalities between municipalities belonging to the same linguistic area and those that do not, between 0 and 15 minute travel time away, a difference in the significance for competition externalities at a distance between 30 and 45 minute travel time is also found. Moreover, considering the sectoral share as index for specialization, similar results are also found, even though slightly weaker. In fact, the significant difference for specialization externalities between municipalities belonging to the same linguistic area and those that do not, between 0 and 15 minute travel time away is no longer found, nevertheless, a difference in the significance for specialization externalities at a distance between 15 and 30 minute travel time is found.

[25] Appendix 2.A provides the formula used in the construction of these indices.

Table 2.3 – Robustness check cross-classified multilevel models on employment growth at the establishment level in Switzerland

	Model 1 - competition as absolute number of firms per employee				**Model 2** - specialization as sectoral share				**Model 3** - competition as absolute number of firms per employee and specialization as sectoral share				**Model 4** - time lag			
Specialization	-0,0004	(0,0005)			0,0035**	(0,0007)			0,0027**	(0,0008)			0,0006	(0,0009)		
Spatial lags:	*Same language*		*Different language*		*Same language*		*Different language*		*Same language*		*Different language*		*Same language*		*Different language*	
Specialization 0-15 min	0,0011*	(0,0006)	-0,0008	(0,0005)	0,0002	(0,0009)	-0,0010	(0,0006)	-0,0001	(0,0009)	-0,0009	(0,0006)	0,0022*	(0,0010)	-0,0009	(0,0009)
Specialization 15-30 min	-0,0007	(0,0006)	-0,0002	(0,0005)	0,0012	(0,0010)	-0,0016*	(0,0007)	0,0010	(0,0010)	-0,0015*	(0,0007)	-0,0001	(0,0010)	0,0003	(0,0009)
Specialization 30-45 min	0,0002	(0,0005)	-0,0003	(0,0006)	0,0009	(0,0009)	0,0013	(0,0007)	0,0008	(0,0009)	0,0014*	(0,0007)	0,0009	(0,0009)	0,0008	(0,0010)
Competition	-0,0041**	(0,0008)			-0,0001	(0,0006)			-0,0030**	(0,0008)			0,0007	(0,0010)		
Spatial lags:	*Same language*		*Different language*		*Same language*		*Different language*		*Same language*		*Different language*		*Same language*		*Different language*	
Competition 0-15 min	-0,0036**	(0,0008)	0,0019**	(0,0007)	-0,0014**	(0,0005)	0,0010	(0,0005)	-0,0038**	(0,0008)	0,0020**	(0,0007)	-0,0032**	(0,0009)	0,0005	(0,0009)
Competition 15-30 min	-0,0011	(0,0011)	0,0005	(0,0008)	0,0006	(0,0006)	0,0003	(0,0006)	-0,0007	(0,0011)	0,0005	(0,0008)	0,0011	(0,0010)	0,0014	(0,0011)
Competition 30-45 min	-0,0027*	(0,0012)	0,0003	(0,0008)	0,0003	(0,0006)	0,0002	(0,0006)	-0,0028*	(0,0012)	0,0004	(0,0008)	0,0015	(0,0010)	0,0014	(0,0011)
Diversity	-0,0069	(0,0070)			-0,0269**	(0,0080)			-0,0217**	(0,0081)			-0,0039	(0,0121)		
Spatial lags:	*Same language*		*Different language*		*Same language*		*Different language*		*Same language*		*Different language*		*Same language*		*Different language*	
Diversity 0-15 min	-0,0091	(0,0089)	0,0188	(0,0233)	-0,0103	(0,0103)	0,0141	(0,0238)	-0,0074	(0,0103)	0,0135	(0,0238)	-0,0215	(0,0155)	0,0297	(0,0413)
Diversity 15-30 min	-0,0090	(0,0085)	0,0415**	(0,0151)	-0,0224*	(0,0100)	0,0472**	(0,0159)	-0,0211*	(0,0100)	0,0463**	(0,0159)	-0,0121	(0,0147)	0,0800**	(0,0280)
Diversity 30-45 min	0,0018	(0,0085)	0,0309	(0,0213)	-0,0038	(0,0093)	0,0356	(0,0217)	-0,0044	(0,0093)	0,0362	(0,0216)	0,0169	(0,0144)	-0,0293	(0,0389)
Municipal-level variables	Yes				Yes				Yes				Yes			
Establishment-level variables	Yes				Yes				Yes				Yes			
Mundlack correction	Yes				Yes				Yes				No			
Year fixed effects	Yes				Yes				Yes				No			
Deviance	121'462				121'390				121'503				354'587			
Observations	950'176; 2'362 municipalities; 545 sectors				950'176; 2'362 municipalities; 545 sectors				950'176; 2'362 municipalities; 545 sectors				475'088; 2'362 municipalities; 545 sectors			

* $p < 0.05$, ** $p < 0.01$; standard errors between parentheses

Additionally, possible problems of reverse causality are controlled for, by estimating firm employment growth between 2012 and 2013 and using as regressors information collected for the year 2011 (Model 4 in Table 3). Even when a temporal lag between the dependent variable and the independent variables is introduced, the results highlight that the spatial effects of specialization, competition and diversity differ depending on whether there exists a language border between the considered regions.

2.6 Conclusions

In the context of Switzerland the results of this study demonstrate that language, one particular dimension of culture, shapes the economic geography of agglomeration spillovers. These particular economic geography transmission mechanisms are mediated and altered by linguistic discontinuities and this, as far as the authors of this research are aware, has not been econometrically modeled or observed before. According to these results, specialization externalities are enhanced when firms are located close to municipalities with the same language, whereas competition and diversity externalities are reinforced when firms are located close to municipalities with different languages. All effects attenuate and then disappear after distances of between 15 and 30 minute travel times, depending on the particular effect.

Exactly why these particular empirical results emerge is a different question which the authors have not sought to answer here. Localization economies tend to arise from the direct interaction among firms operating in the same sector and in the same area, and the results of this analysis suggest that linguistic differences may introduce an obstacle to more diffuse knowledge-interactions among firms operating in broadly the same field. On the other hand, these results suggest that linguistic differences, also partly reflecting cultural differences, may encourage knowledge interactions between more diverse groups of firms operating in different fields, in a manner largely reflecting the arguments of Jacobs (1969), although, at this stage these explanations can only be tentative and speculative and require further research. Importantly, and as already mentioned, in the case of Switzerland the various linguistic regions are clearly associated with different cultures (Hofstede 2001), so these findings do appear to lend support to those who argue that culture affects the economy and economic geography in distinct ways.

References

Audretsch, D. and Dohse, D., 2007, "Location: A Neglected Determinant of Firm Growth", *Review of World Economics (Weltwirtschaftliches Archiv)*, 143(1):79–107.

Bakkens, J., Mulder, P., and Nijkamp, P., 2013, "Economic Impacts of Cultural Diversity in The Netherlands: Productivity, Utility and Sorting", *Journal of Regional Science*, 53.1, 8-36

Baldwin, J., Beckstead, D., Brown, W. and Rigby, D., 2008, "Agglomeration and the geography of localization economies in Canada", *Journal of Economic Geography*, 42(1):117-132.

Baldwin, J., Brown, W. and Rigby, D., 2010, "Agglomeration economies: Microdata panel estimates from Canadian manufacturing", *Journal of Regional Science*, 50(5):915–934.

Beaudry, C. and Schiffauerova, A., 2009, "Who's right, Marshall or Jacobs? The localization versus urbanization debate", *Research Policy*, 38(2):318–337.

Bell, A. and Jones, K., 2015, "Explaining Fixed Effects: Random Effects Modeling of Time-Series Cross-Sectional and Panel Data", *Political Science Research and Methods*, 3:133-153.

Berliant, M. and Fujita, M., 2008, "Knowledge Creation as a Square Dance on the Hilbert Cube", *International Economic Review*, 49:1251–1295.

Beugelsdijk, S. and Maseland, R., 2010, "*Culture in Economics: History, Methodological Reflections and Contemporary Applications",* Cambridge University Press.

Blanchard, O., Solow, R., and Wilson, B., 1995, "Productivity and Unemployment.", Manuscript, MIT Press.

Brakman, S., Garretsen, H., Van Marrewijk, C. and Oumer, A., 2012, "The border population effects of EU integration", *Journal of Regional Science*, 52: 40–59.

Briant, A., Combes, P. and Lafourcade, M., 2008. *"Dots to Boxes: Do the Size and Shape of Spatial Units Jeopardize Economic Geography Estimations?"*, CEPR Discussion Papers 6928.

Brülhart, M. and Sbergami, F., 2009, "Agglomeration and growth: Cross-country evidence", *Journal of Urban Economics*, 65(1):48-63.

Buehler, S., Kaiser, C. and Jaeger, F., 2012, "The geographic determinants of bankruptcy: evidence from Switzerland", *Small Business Economics*, 39:231-251.

Caragliu, A., de Dominicis, L. and De Groot, H, 2016, "Both Marshall and Jacobs were Right!", *Economic Geography*, 92(1):87-111.

Carroll, G. and Hannan, M., 2000, "*The Demography of Corporations and Industries*", Princeton paperbacks. Princeton University Press.

Combes, P., 2000, "Economic Structure and Local Growth: France, 1984-1993", *Journal of Urban Economics*, 47(3):329–355.

Combes, P., Magnac. T., and Robin, J., 2004, "The dynamics of local employment in France", *Journal of Urban Economics*, 56(2):217–243.

Combes, P., and Gobillon, L., 2015, "The empirics of agglomeration economies". In *Handbook of Regional and Urban Economics (5),* ed G. Duranton, V. Henderson, and W. Strange, North-Holland, Amsterdam Netherlands.

Cooke, P., and L. Lazzeretti, 2008, "Creative cities: An introduction". In *Creative cities, cultural clusters and local economic development*, ed. P. Cooke and L. Lazzeretti, 1–22. Cheltenham, UK: Elgar.

De Bok, M. and Van Oort, F., 2011, "Agglomeration economies, accessibility and the spatial choice behavior of relocating firms", *Journal of Transport and Land Use*, 4(1):5–24.

De Groot, H. L., Poot, J., and Smit, M. J., 2015, "Which agglomeration externalities matter most and why?", *Journal of Economic Surveys*, 0(0):1–27.

Diekmann, A., Engelhardt, H., Jann, B., Armigeon, K. and Geissbühler, S., 1998, "Der Schweizer Arbeitsmarktsurvey", University of Berne.

du Gay, P. and Pryke, M., 2002, "Cultural economy: An introduction". In *Cultural economy: Cultural analysis and commercial life*, ed. P. du Gay and M. Pryke, 1–19. London: Sage.

De Jong, 2009, "*Culture and Economics: On Values, Economics and International Business*", London: Routledge.

Eberts, R. and McMillen, D., 1999, "Agglomeration economies and urban public infrastructure". In Cheshire, P. and Mills, E., editors, *Handbook of Regional and Urban Economics*, volume 3 of *Handbook of Regional and Urban Economics*, 38:1455–1495. Elsevier.

Enders, C. and Tofighi, D., 2007, "Centering predictor variables in cross-sectional multilevel models: a new look at an old issue", *Psychological methods*, 12(2):121–138.

Eugster, B, Lalive, R, Steinhauer, A and Zweimüller, J, 2011, "The Demand for Social Insurance: Does Culture Matter?", *The economic journal*, 121(556):F431-448.

Eugster, B. and Parchet, R., 2018, “Culture and Taxes”, *Journal of Political Economy*, forthcoming.

Evans, D., 1987, “The relationship between firm growth, size, and age: Estimates for100 manufacturing industries”, *The Journal of Industrial Economics*, 35(4):567–581.

Fingleton, B., Igliori, D. and Moore, B., 2005, “Cluster Dynamics: New Evidence and Projections for Computing Services in Great Britain”, *Journal of Regional Science*, 45:283–311.

Fingleton, B. and McCann, P., 2007, “Sinking the Iceberg? On the Treatment of Transport Costs in New Economic Geography”, In *New Directions in Economic Geography*, chapter 6. Edward Elgar.

Fotheringham, A. S. and Pitts, T. C., 1995, “Directional variation in distance decay”, *Environment and Planning A*, 27:715-29.

Fu, S., 2007, “Smart cafe cities: testing human capital externalities in the Boston metropolitan area”, *Journal of Urban Economics*, 61(1):86-111.

Gertler, M., 2003, “A cultural economic geography of production”. In K. Anderson, M. Domosh and S. Pile, *Handbook of cultural geography*, 131-146. London: Sage.

Goldberg, A., 2017, “*The Impact of Cleavages on Swiss Voting Behaviour: A Modern Research Approach*“, Cham: Springer.

Gordon, I. and McCann, P., 2000, “Industrial Clusters: Complexes, Agglomeration and/or Social Networks?”, *Urban Studies*, 37(3):513–532.

Graham, D., 2009, “Identifying urbanisation and localisation externalities in manufacturing and service industries”, *Papers in Regional Science*, 88(1):63-84.

Groot, S., De Groot, H. and Smit, M., 2014, “Regional wage differences in the Netherlands: micro evidence on agglomeration externalities”, *Journal of Regional Science*, 54:503–523.

Harris, R. and Moffat, J., 2012, “Is Productivity Higher In British Cities?”, *Journal of Regional Science*, 52(5):762–786.

Henderson, V., Kuncoro, A., and Turner, M., 1995, “Industrial Development in Cities”, *Journal of Political Economy*, 103(5):1067–90.

Hofstede, G., 2001, “*Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations Across Nations*”, 2nd Edition, Thousand Oaks CA: Sage Publications.

Hoogstra, G. J. and Van Dijk, J., 2004, “Explaining firm employment growth: does location matter?", *Small Business Economics*, 22(3-4): 179-92.

Jacobs, J., 1969, "*The economy of cities*", Vintage international. Random House.

Jovanovic, B., 1982, "Selection and the Evolution of Industry", *Econometrica*, 50(3):649–70.

Kochan, T., Bezrukova, K., Ely, R., Jackson, S., Joshi, A., Jehn, K., Leonard, J., Levine, D. and Thomas, D., 2003, "The effects of diversity on business performance: Report of the diversity research network", *Human Resource Management*, 42:3–21.

Lazear, E., 1999. "Globalisation and the Market for Team-Mates", *The Economic Journal*, 109(454):C15-40.

Mameli, F., Faggian, A., and McCann, P., 2014, "Estimation of Local Employment Growth: Do Sectoral Aggregation and Industry Definition Matter?", *Regional Studies*, 48(11):1813–1828.

McCann, P. and Acs, Z., 2011, "Globalization: Countries, Cities and Multinationals", *Regional Studies*, 45(1):17-32.

Melo, P. C., Graham, D. J., and Noland, R. B., 2009, "A meta-analysis of estimates of urban agglomeration economies", *Regional Science and Urban Economics*, 39(3):332–342.

Mundlak, Y., 1978, "On the pooling of time series and cross section data", *Econometrica*, 46:69-85.

Nathan, M. and Lee, N., 2013, "Cultural Diversity, Innovation, and Entrepreneurship: Firm-level Evidence from London", *Economic Geography*, 89(4):367-394.

Nijkamp, P., Poot, J., Bakkens, J., 2015, (eds.), *The Economics of Cultural Diversity*, Edward Elgar, Cheltenham

Nunziata, L. and Rocco, L., 2016, "A tale of minorities: evidence on religious ethics and entrepreneurship", *Journal of Economic Growth*, 21(2):189-224.

Pike, A., Rodriguez-Pose, A., and Tomaney, J., 2011, "*Handbook of Local and Regional Development*", Routledge handbooks. New York: Routledge.

Putnam, R., 2007, "E Pluribus Unum: Diversity and Community in the Twenty-first Century. The 2006 Johan Skytte Prize Lecture", *Scandinavian Political Studies*, 30:137–174.

Raspe, O. and Van Oort, F., 2008, "Firm Growth and Localized Knowledge Externalities", *Journal of Regional Analysis and Policy*, 38(2).

Raspe, O. and Van Oort, F., 2011, "Firm heterogeneity, productivity and spatially bounded knowledge externalities", *Socio-Economic Planning Sciences*, 45(1):38–47.

Rice, P.; Venables, A. J. and Patacchini, E., 2006, "Spatial determinants of productivity: analysis for the regions of Great Britain", *Regional Science and Urban Economics*, 36(6):727-52.

Rosenthal, S. and Strange, W., 2003, "Geography, industrial organization, and agglomeration", *The Review of Economics and Statistics*, 85(2):377-93.

Rosenthal, S. and Strange, W., 2004, "Evidence on the nature and sources of agglomeration economies". In Henderson, J. and Thisse, J., editors, *Handbook of Regional and Urban Economics*, volume 4 of *Handbook of Regional and Urban Economics*, 49:2119–2171. Elsevier.

Rosenthal, S. and Strange, W., 2008, "The attenuation of human capital spillovers", *Journal of Urban Economics*, 64(2):373-89.

Saito, H. and Wu, J., 2016, "Agglomeration, congestion, and U.S. regional disparities unemployment growth", *Journal of Regional Science*, 56(1):53-71.

Smit, M. J. and De Groot, H. L. F., 2013, "Stocking Up: The Role of Temporal and Spatial RD Stocks", *European Planning Studies*, 21(5):637-65.

Storper, M., 2013, "*Keys to the City: How Economics, Institutions, Social Interaction, and Politics Shape Development",* Princeton: Princeton University Press.

Suedekum, J., 2009, "Convergence of the skill composition across German regions", *Regional Science and Urban Economics*, 38:148–159.

Tabellini, G., 2008, "Presidential Address: Institutions and Culture", *Journal of the European Economic Association*, 6(2-3):255-294.

Tselios, V., Noback, I., Van Dijk, J., and McCann, P., 2015a, "Local Social Engagement, Satisfaction and Embeddedness in the Netherlands: Which Effects Matter and for Whom?", *Environment and Planning A*, 47.5, 1132-1154

Tselios, V. Noback, I., Van Dijk, J., and McCann, P., 2015b, "Integration of Immigrants, Bridging Social Capital, Ethnicity and Locality", *Journal of Regional Science*, 55.3, 416-441

Van Oort, F., Burger, M., Knoben, and J., Raspe, O., 2012, "Multilevel Approaches And The Firm-Agglomeration Ambiguity In Economic Growth Studies", *Journal of Economic Surveys*, 26(3):468–491.

Werlen, I., 2008, "Sprachkompetenzen der erwachsenen Bevölkerung in der Schweiz", Technical Report, Swiss National Research Project 56.

Appendix 2.A – Agglomeration economies indices

SPECIALIZATION (location quotient)

$$S_{lq} = \frac{E_{mi}/E_{m*}}{E_{*i}/E_{**}}$$

COMPETITION (relative number of firms per employee)

$$C_{rfpe} = \frac{F_{mi}/E_{mi}}{F_{*i}/E_{*i}}$$

DIVERSITY (inverse Hirschman-Herfindhal index)

$$D = \frac{\left[\sum_{i=1,\ i\prime\neq i}^{S}(E_{mi\prime}/(E_{m*} - E_{mi}))^2\right]^{-1}}{\left[\sum_{i=1,\ i\prime\neq i}^{S}(E_{*i\prime}/(E_{**} - E_{*i}))^2\right]^{-1}}$$

Where E_{mi} is employment in municipality m and industry i, E_{m*} is employment in municipality m and all industries, E_{*i} is employment in all municipalities and industry i, and E_{**} is employment in all municipalities and all industries. F stands for the number of firms.

Indices used for the robustness checks

SPECIALIZATION

- Local industrial share

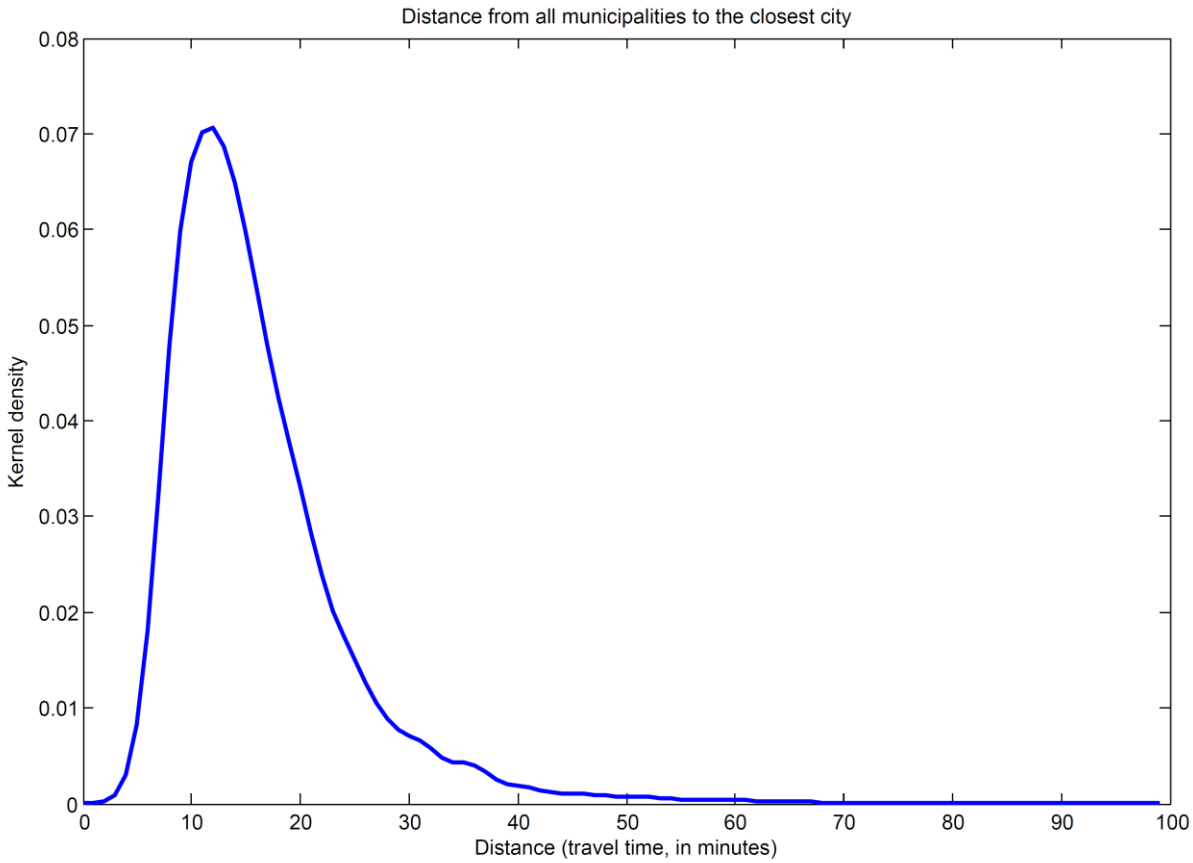
$$S_{share} = \frac{E_{mi}}{E_{m*}}$$

COMPETITION

- Absolute number of firms per employee

$$C_{afpe} = \frac{F_{mi}}{E_{mi}}$$

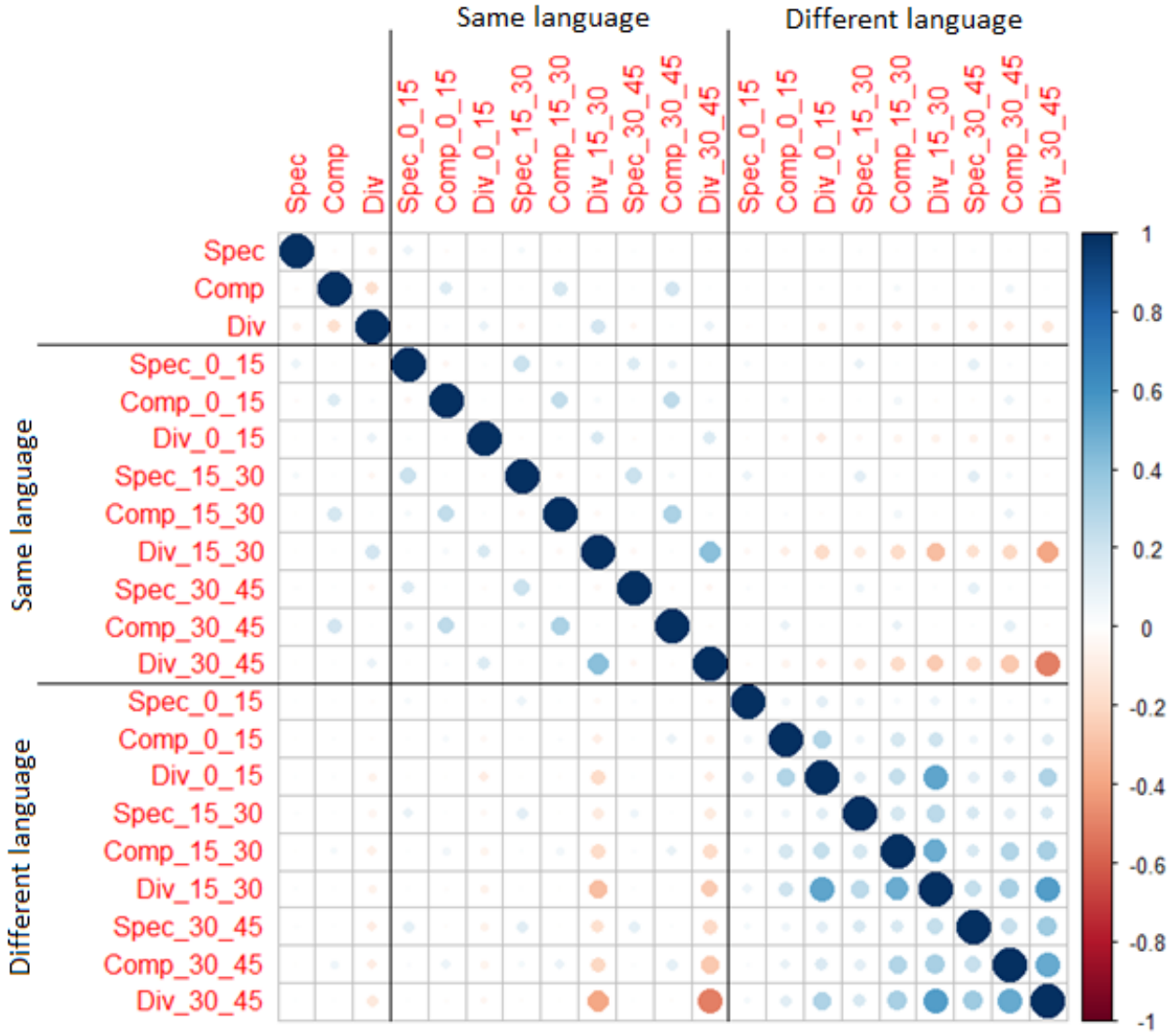
Appendix 2.B – Kernel density of distance between all municipalities and the closest city



Appendix 2.C – Descriptive statistics

	Mean	Std. Dev.	Min.	Max.
Employment growth	0	0,29	-5,41	5,57
Specialization	4,02	34,39	0	6244,8
Spatial lags same language:				
Specialization 0-15 min	1,21	2,18	0	473,49
Specialization 15-30 min	1,09	0,99	0	163,24
Specialization 30-45 min	1,06	1,03	0	202,92
Spatial lags different language:				
Specialization 0-15 min	0,06	1,73	0	665,08
Specialization 15-30 min	0,21	1,48	0	230,24
Specialization 30-45 min	0,38	1,22	0	231,62
Competition	2,02	3,67	0	328,28
Spatial lags same language:				
Competition 0-15 min	1,5	1,53	0	154,3
Competition 15-30 min	1,42	1,22	0	84,44
Competition 30-45 min	1,43	1,09	0	92,97
Spatial lags different language:				
Competition 0-15 min	0,08	0,89	0	149,52
Competition 15-30 min	0,24	0,91	0	136,05
Competition 30-45 min	0,49	1,17	0	105,38
Diversity	0,33	0,16	0,01	0,71
Spatial lags same language:				
Diversity 0-15 min	0,29	0,11	0	0,64
Diversity 15-30 min	0,33	0,08	0	0,58
Diversity 30-45 min	0,32	0,07	0	0,54
Spatial lags different language:				
Diversity 0-15 min	0,01	0,05	0	0,69
Diversity 15-30 min	0,04	0,1	0	0,69
Diversity 30-45 min	0,1	0,15	0	0,55
Observations	950'176; 2'362 municipalities; 545 sectors			

Appendix 2.D – Correlation between agglomeration economies indices and their spatial lag



Appendix 2.E – Municipal level variables

Demographic information		
Variable	Definition	Source
Population	Number of inhabitants	Statistics of the population and households (STATPOP – FSO)
Population growth	Growth rate of number of inhabitants	STATPOP – FSO
Active population ratio	Percentage of population between 20 and 64 years old	STATPOP – FSO
Population density	Inhabitants per square kilometer	STATPOP – FSO
Foreign population ratio	Percentage of population without Swiss nationality	STATPOP – FSO
Net migration rate	Difference between immigrants and emigrants divided per 1,000 inhabitants	STATPOP – FSO
Socio-economic information		
Variable	Definition	Source
Average income	Average level of income	Federal Tax Administration (FTA FSO)
Unemployment rate	Number of unemployed people divided per 100 inhabitant between 20 and 64 years old.	State Secretariat for Economic Affairs (SECO – FSO)
Cross-border commuters ratio	Number of cross-border commuters divided per 100 inhabitants	Cross-border commuters statistics (CCS – FSO)
Human capital (no post-mandatory)	Percentage of population with no post-mandatory education in the year 2000 [1]	Federal Population Census (FSO)
Human capital (post-mandatory, no university)	Percentage of population with post-mandatory education without a university or equivalent degree in the year 2000 [1] (reference category)	Federal Population Census (FSO)
Human capital (university)	Percentage of population with university or equivalent education level in the year 2000 [1]	Federal Population Census (FSO)
Level of taxation	Municipal tax rate	FTA - FSO
Social capital (voter turnout)	Turnout for the federal election in 2011	Vote and elections statistics (FSO)
Social capital (no profit employees ratio)	Number of employees in NON PROFIT organization per inhabitant	STATENT - FSO

Social capital (social assistance ratio)	Percentage of population receiving social assistance	Swiss statistics on social assistance recipients (FSO)
Social capital (crime rate)	Number of violations of the penal code per thousand inhabitants	Statistics on convictions and persons serving prison sentences (FHE - FSO)

Infrastructure investment		
Variable	Definition	Source
Investment (supply of energy)	Per capita level of investments in the construction of infrastructures related to the supply of energy	Statistic of housing and construction (FSO)
Investment (waste disposal)	Per capita level of investments in the construction of infrastructures related to the waste disposal	Statistic of housing and construction (FSO)
Investment (road system)	Per capita level of investments in the construction of road system	Statistic of housing and construction (FSO)
Investment (other transportation systems)	Per capita level of investments in the construction of other transportation systems	Statistic of housing and construction (FSO)
Investment (education buildings)	Per capita level of investments in the construction of buildings designed for educational and research activities	Statistic of housing and construction (FSO)
Investment (health care buildings)	Per capita level of investments in the construction of buildings designed for health care system	Statistic of housing and construction (FSO)
Investment (culture and free time buildings)	Per capita level of investments in the construction of buildings designed for leisure and free time activities	Statistic of housing and construction (FSO)
Investment (houses)	Per capita level of investments in the construction of houses	Statistic of housing and construction (FSO)
Investment (agricultural buildings)	Per capita level of investments in the construction of buildings designed for agricultural activities	Statistic of housing and construction (FSO)
Investment (industrial buildings)	Per capita level of investments in the construction of buildings designed for industrial activities	Statistic of housing and construction (FSO)
Investment (other infrastructure)	Per capita level of investments in the construction of other infrastructures	Statistic of housing and construction (FSO)

Infrastructure accessibility		
Variable	Definition	Source
Distance nearest city	Travel time distance between the centroid of each municipality and the centroid of the closest regional center [2]	Federal Office for Spatial Development

Distance nearest highway ramp	Travel time distance between the centroid of each municipality and the centroid of the closest municipality with a highway ramp	Federal Office for Spatial Development
Distance nearest train station	Travel time distance between the centroid of each municipality and the centroid of the closest municipality with a railway station	Federal Office for Spatial Development
Distance nearest airport	Travel time distance between the centroid of each municipality and the centroid of the closest municipality with one of the three main Swiss international airport	Federal Office for Spatial Development
Distance nearest custom	Travel time distance between the centroid of each municipality and the centroid of the closest municipality with a custom	Federal Office for Spatial Development
Industrial area rate	Ratio of industrial and commercial area divided by the total settlement and urban area	GEOSTAT - FSO
Demographic information		
Variable	Definition	Source
German speaking ratio	Percentage of population of having as mother tongue German [3] (reference category)	Federal Population Census (FSO)
French speaking ratio	Percentage of population of having as mother tongue French [3]	Federal Population Census (FSO)
Italian speaking ratio	Percentage of population of having as mother tongue Italian [3]	Federal Population Census (FSO)
Romansh speaking ratio	Percentage of population of having as mother tongue Romansch [3]	Federal Population Census (FSO)

Chapter 3: The geography of political ideologies in Switzerland[26]

Daniele Mantegazzi, Rico Maggi

Abstract

In this paper, partisan-sorting forces and income-sorting processes are hypothesized to be interrelated phenomena leading to the clustering of people having similar levels of income and political ideologies. This paper determines the predominant political ideology of each Swiss municipality and examines whether there is any spatial concentration of political ideologies. The contribution of this research is that it proposes a new way to capture social interactions, based on the geographical concentration of political ideologies, and it shows that these concentrations are correlated with income and income inequality.

JEL classification: O18, O43, P48, R1

Keywords: Political ideologies, Economic geography, Spatial cohesion, Geography of discontent.

[26] This chapter is based on Mantegazzi and Maggi (2018), The geography of political ideologies in Switzerland. Presented at the 12th RSAI World Congress, Goa. *Submitted to an international journal.*

3.1 Introduction

Geographical sorting processes are phenomena that many societies all over the world have been experiencing for centuries, usually leading to the clustering of population based on socio-economic, religious or ethnic characteristics. Following the economic literature, individual income level plays an important role in sorting processes. On one hand, income could represent a constraint in the residential decision of people, as already formalized in the bid-rent theory (Fujita, 1989, based on the pioneering work of von Thünen, 1826 and Alonso, 1964), and, on the other hand, as already highlighted by Tiebout (1956), people prefer to live close to other people who are similar to themselves, also in terms of wealth. From an alternative perspective, in the political science literature there has been an increasing interest in the phenomenon of partisan sorting, which analyzes whether individuals are nowadays more geographically sorted according to their political preferences (Bishop, 2008; Abramowitz, 2010; Abrams and Fiorina, 2012; Tam Cho et al., 2013). Moreover, the literature on voting behavior highlights how individual socio-economic characteristics are important predictor of political preferences (Meltzer and Richard, 1981; Rueda and Stegmueller, 2014). This implies that people sorting themselves based on socio-economic characteristics are also expected to share similar political ideologies. Hence, various sorting processes are hypothesized to cluster people with similar political preferences and analogous socio-economic characteristics. The clustering of people having similar political ideologies as well as similar levels of income links to recent findings on the importance of economic geography and regional differences in terms of economic welfare in explaining how people vote. The results of the Brexit referendum represent a key example, clearly showing that the level of local economy was an important driver, even after carefully controlling for individual characteristics (Los et al., 2017). This has led to the term "the geography of discontent", referring to the spatial distribution of discontent in a country, reflecting inequalities between regions in terms of economic welfare (Los et al., 2017; Rodríguez-Pose, 2017; McCann, 2018). Hence, as already highlighted by O'Laughlin et al. (1994), the spatial dimension is extremely important and needs to be considered.

The aim of this paper is to propose a new definition of spatial cohesion, representing a new way to capture social interactions, based on the geographical concentration of political ideologies. More specifically, this paper contribute to the existing literature by empirically identifying whether there is any spatial concentration of political ideologies in the context of Switzerland and determining the spatial extension of these concentrations. Moreover, this study analyzes whether this clustering of political preferences is correlated with income and income inequality. The analysis focuses on Switzerland, which represents a very interesting case because it practices a semi-direct democracy,

which allows having a rich dataset on many referenda, which is independent from short-term, candidate-related and party-related factors.

Following Hermann and Leuthold (2003), this paper analyzes the results of 312 federal referenda between 1981 and 2017 at the municipal level. This study identifies Hermann and Leuthold (2003)'s three dimensions representing the Swiss political ideology space and expressing the following political beliefs: left vs. right, liberal vs. conservative and ecological vs. technocratic. Additionally, on each of these three dimensions, this paper empirically assesses the existence of spatial concentrations of Swiss municipalities sharing the same political ideology. This result is particularly interesting because it shows that the various sorting processes leading to the concentration of people sharing similar political preferences extend beyond municipal borders. Finally, based on these results, this research finds significant differences in the level of income and income inequality of Swiss municipalities, depending on their belonging to a political ideology cluster. This result contributes and further supports the findings and claims of other scholars, related to the concept of "the geography of discontent", according to which economic geography is particularly important in understanding how people vote.

The rest of the paper is organized as follows. Section 2 presents a review of the related literature. The third and fourth sections describe the methodology and the database adopted for this research, respectively. In section five the results are presented and discussed, and the last section concludes.

3.2 Literature review

Clustering processes refer to the geographical aggregation of people, usually sharing a specific characteristic, and are often the result of spatial sorting phenomena. Spatial sorting refers to the redistribution of population groups into different neighborhoods in both urban and non-urban areas (Kawachi and Berkman, 2003) and is a key characteristic of many cities and nations across the world (Bailey et al., 2017). In fact, for centuries societies have been experiencing processes of spatial sorting, typically based on socio-economic, religious or ethnic characteristics. Economists, among others, have been studying this phenomenon for many decades. Already in the classic framework of the bid-rent theory (Alonso 1964; Beckman, 1969; Muth, 1969; Mills 1972 based on the pioneering work of von Thünen, 1826), as shown by Fujita (1989), the price for real estate, changing with the distance from the city center, shapes the residential choices of various income groups within a society, generating income sorting. In this setting, spatial sorting is the result of different willingness to pay for different income classes. Another growing body of literature in economics links sorting processes to social interactions (Schelling, 1971; Clark, 1991; Fossett, 2006), where residential decision are

driven by individual preferences for the neighborhood composition. In particular, people prefer to live in places in which other people are similar to themselves (McPherson et al., 2001; Musterd et al., 2015). The idea that people with similar preferences cluster in particular municipalities is the focus of another important stream of literature in economics, which goes back to Tiebout (1956), where, in a fiscal decentralized setting, people sort themselves according to their preferences to achieve an efficient provision of local public goods. This model has then been extended to analyze the important role of differences in income in explaining sorting processes (Ellickson, 1971; Westhof, 1977; Ross and Yinger, 1999; Schmidheiny, 2006). Hence, various theoretical frameworks analyze and give possible explanations of those sorting processes which can be found in many contexts all over the world.

From a slightly different perspective, in the political science literature, there has been a growing interest in the phenomenon of partisan sorting and there is currently a large debate on whether individuals are nowadays more sorted according to their political preferences. As highlighted by O'Laughlin et al. (1994), the spatial dimension is extremely important and needs to be considered in order to fully understand the political forces underlying this phenomenon. This is particularly relevant whenever the political power is partially decentralized (such as in a federal political system), given that various political institutions and political ideologies within the same country can generate different political contexts. Various studies find that, in the last decades, there has been an increase in the geographic polarization of voters (Kim et al., 2003; Bishop, 2008; Abramowitz, 2010; Wing and Walker, 2010; Tam Cho et al., 2013; Kinsella et al., 2015; Lang and Pearson-Merkowitz, 2015). The potential causes of this geographic polarization of voters are partisan migration, generational replacement and the fact that parties are more polarized, making it easier for voters to identify themselves with a party (Vegetti et al, 2017). Bishop (2008) argues that a potential drawback of this sorting process is that homogeneous communities might encourage extremism by ignoring differing opinions. In contrast with these results, other authors find that voters are nowadays no more geographically sorted than in the past and relativize its importance (Glaeser and Ward, 2006; Levendusky and Pope, 2011; Abrams and Fiorina, 2012; Strickler, 2016).

The vast majority of the studies analyzing the phenomenon of partisan sorting and polarization are based on presidential election in the US. As highlighted by Abrams and Fiorina (2012), data based on presidential elections are weak, because they are the result of short-term, candidate-related and party-related factors. Moreover, it is difficult to capture the complexity of the distribution of political ideologies with a single manifestation of the personal political preference, occurring only once every four years.

Additionally, the literature on voting behavior finds that socio-economic characteristics, such as income and the degree of income inequality, determine voting outcomes and are important predictors of party choice, at the individual level (Meltzer and Richard, 1981; McCarty et al., 2008, Rueda and Stegmueller, 2014).

Hence, different sorting processes are, on one hand, hypothesized to group people sharing political preferences which are very much alike, and, on the other hand, cluster people with analogous socio-economic characteristics, in particular with similar levels of income. At the same time, according to the literature on voting behavior, people sorting themselves based on socio-economic characteristics are also expected to share similar political ideologies. The implication is that partisan-sorting forces and income-sorting processes are likely to be interrelated phenomena, leading to the clustering of people having similar levels of income and political ideologies. The hypothesis of clusters of people with similar political preferences as well as analogous levels of wealth links to recent findings on the importance of economic geography and regional differences in terms of economic welfare in explaining how people vote, in particular when the vote is used as a "mean of protest". In particular, the results of the Brexit referendum, in which voters were asked whether they wished to leave or remain in the European Union, represent a key example, clearly showing that the level of local economy was an important driver (Los et al., 2017; Chen et al., 2018; Crescenzi et al., 2018). In fact, people in regions with lower levels of income who perceived to have suffered from modern globalization were more likely to vote "leave" than those from areas with higher levels of income (McCann, 2018). This has led to the term "the geography of discontent", referring to the spatial distribution of discontent in a country, reflecting inequalities between regions in a country (Los et al., 2017; Rodríguez-Pose, 2017; McCann, 2018).

This paper contributes to the existing literature by proposing a new definition of spatial cohesion, based on the geographical concentration of political ideologies. In particular, the aim of this research is to empirically identify whether there is any spatial concentration of political ideologies in the context of Switzerland in order to determine in a new way the existence of social interactions, and determine the spatial extension of these concentrations. Moreover, following the argument of "the geography of discontent", this study analyzes whether this concentration is correlated with income and income inequality.

Switzerland represents a very interesting case because it has strong institutions, it is a federal republic with highly decentralized political power and, at the same time, it practices a semi-direct democracy, in which Swiss citizens directly vote on various issues. More specifically, any constitutional change needs to be approved by a mandatory referendum. Furthermore, an optional

referendum can be demanded for any change in the Swiss law decided by the federal parliament[27]. Additionally, any Swiss citizen may propose a popular initiative to introduce amendments to the federal constitution[28]. The outcome of any vote is legally binding. Approximately, Swiss citizens vote four times a year and the most frequent topics on which they vote are healthcare, taxes, social welfare, drug policy, public transport, immigration, political asylum and education. The availability of referendum data allows overcoming the limitations of presidential election data mentioned above, and better determining the spectrum of political ideologies of voters. In particular, given that Swiss citizens directly express their opinion on various issues, the information available is independent from short-term, candidate-related and party-related factors. Moreover, the political preference is manifested several times every year. Hence, unlike the analyses on presidential elections or the Brexit referendum, this study simultaneously considers the results of several referenda, capturing the underlying long-term structure of political ideologies.

3.3 Methodology

The analysis presented in this study proceeds in three phases. The first step is to identify what is the political ideology of each municipality in Switzerland. Second, a spatial cluster analysis is performed in order to determine whether and where there is a significant geographical concentration of political ideologies. Finally, some tests are carried out to analyze whether the level of income and income inequality of municipalities belonging to different political ideology clusters are significantly different.

The first task is to establish the political ideology of each municipality. To do so, this study follows Hermann and Leuthold (2001; 2003), by considering the federal referenda collected at the municipal level in Switzerland and performing an exploratory factor analysis on them. The underlying idea is that the referenda are the observed outcome of fewer independent and unobserved dimensions characterizing the political ideology space. This hypothesis is supported by qualitative and quantitative considerations related to the data used. In particular, from a qualitative perspective, several referenda concern the same (or at least very similar) topic. One can therefore expect that the outcome of referenda on similar topics are highly correlated because are driven by the same underlying political preference. Indeed, from a quantitative perspective, the distribution of referenda shows that they are spatially associated, indicating that the variance of the referenda exhibits similar

[27] Any change to the Swiss law is subject to referendum if a minimum of 50'000 Swiss people have signed an official request to do so within 100 days.
[28] In the case of a federal popular initiative, a vote is organized if the promoter collects at least 100'000 signatures from Swiss people within 18 months.

patterns. In order to maximize the explained variance, the exploratory factor analysis is performed with VARIMAX-rotation.

The results of the factor analysis allow extracting the statistical relationship among the referenda in order to determine the underlying unobserved factors. However, as highlighted by Hermann and Leuthold (2003), in order to meaningfully interpret them and identify the related ideological content, a qualitative interpretation of the specific political objects is needed. The combination of the factor analysis with the qualitative inspection of its results allows finding the dimensions representing the Swiss political ideology space.

In the second step, in order to measure the degree of geographical concentration of the political ideology, a spatial cluster analysis is performed. Following Kim et al. (2003), Darmofal (2008), Wing and Walker (2010) and Kinsella et al. (2015), this study computes the vector of Local Moran's I statistic (Moran, 1948; Cliff and Ord, 1981; Anselin, 1995) for each factor identified in the previous phase. The Local Moran's I statistic associates a vector of observed values of a specific variable with a weighted average of the neighboring values and compares the real distribution with random spatial distributions, in order to capture significant spatial pattern. In particular, this analysis is able to establish whether a municipality has a significantly high (low) value on a specific factor and is surrounded by municipalities with high (low) values on the same factor, or whether the value of the municipality is not significantly high or low. Hence, this analysis allows determining if and where there is a significant geographical concentration of the different typologies of political ideologies identified with the previous step.

Finally, the analysis focuses on empirically testing whether there is any evidence suggesting that there are significant differences in the level of income and income inequality of municipalities belonging to different typologies of political ideology clusters. The aim of this exercise is to verify the importance of economic geography in understanding how people vote within the Swiss context, by simultaneously considering the results of several referenda, capturing the underlying long-term structure of political ideologies. To do so, Kruskal-Wallis tests are performed (Kruskal and Wallis, 1952). Similar to ANOVA, this test is used to verify whether the distribution of a specific variable is significantly different between more than two independent groups. However, differently from ANOVA, the Kruskal-Wallis test does not require the assumptions of homogeneity of variance between the groups and the normality of residuals. The result of the Kruskal-Wallis test indicates whether there are significant differences among the groups, however, it does not provide information regarding which pairs of groups are significantly different. Hence, this final phase is extended by computing the Dunn's test (Dunn, 1964), which is a post hoc pairwise multiple comparison suitable

to deepen the analysis after a rejection of the Kruskal-Wallis test. In order to account for the fact that multiple comparisons are conducted at the same time, Dunn's tests are performed with the Benjamini-Hochberg procedure (Benjamini and Hochberg, 1995).

3.4 Data

This research analyzes the results at the municipal level concerning all the 312 federal referenda between 1981 and 2017. This information is obtained from the section Politics, Culture and Media of the Swiss Federal Statistical Office (FSO)[29]. In particular, the factor analysis performed in order to identify the political ideology of each Swiss municipality is computed on the yes-share of all the 312 federal referenda considered[30]. In order to compare and combine the data in terms of geo-political unit, all the referenda are based on the 2017 municipal definition of the FSO, which includes 2240 municipalities.

As explained above, the most frequent topics on which Swiss citizens vote are healthcare, taxes, social welfare, drug policy, public transport, immigration, political asylum and education. In order to capture changes in the political ideology of each municipality through time, the factor analysis is computed on different time-subsamples of the whole dataset. In particular, the first subsample considers all the 65 referenda between 1981 and 1990, the second subsample takes into account all the 106 referenda between 1991 and 2000; the third one contains all the 82 referenda between 2001 and 2010, and the fourth subsample considers all the 59 referenda between 2011 and 2017. As the results show, given that the Swiss population periodically votes on the same topics, the factor analyses computed over different time-subsamples generate factors which are built in a very similar way, allowing comparing the results from different periods.

To perform spatial analyses, there exist different specification of the spatial dependence matrix, W. In order to take into consideration the impact of the extremely uneven topographical context of Switzerland[31] on the actual distance between two municipalities, this study considers a spatial weight matrix based on the inverse travel time between the centroids of the municipalities. Travel time data are provided by the Swiss Federal Office for Spatial Development and consider the trip by car in minutes. To keep the spatial analysis at a local level, after examining the distribution of distances between Swiss municipalities, a cutoff is imposed at a distance of 20 minutes travel time.

[29] It is possible to download the municipal-level results of Swiss referenda at the following webpage: https://www.bfs.admin.ch/bfs/de/home/statistiken/politik/abstimmungen/stimmbeteiligung.assetdetail.3362356.html
[30] The factor analysis is able to account for the fact that the wording of referenda on similar topics could be inconsistent, by giving positive or negative factor loadings.
[31] Switzerland is characterized by flat areas and regions with very high mountains.

Moreover, following the spatial econometric literature (Anselin, 1988; Kelejian and Prucha, 1998; LeSage and Pace, 2009), the W matrix has been standardized, such that each row sums to unity.

In the final part of this research, the aim is to test whether there are significant differences in the economic welfare level of municipalities belonging to different typologies of political ideology clusters. In particular, this study considers the median income and the Gini coefficient of the income distribution of each municipality. All these variables are obtained from the Swiss Federal Tax Administration. The analysis is done for each of the four time-subsample and the reference year for the economic welfare variable is the first year of the considered period[32].

3.5 Results and discussion

This section first presents the results of the exploratory factor analysis and describes the identified dimensions of the political ideology space. Subsequently, the results of the spatial cluster analysis are shown. Finally, the discussion ends focusing on the results of the tests, which aim at verifying whether there are significant differences in the income level and income distribution of municipalities belonging to different typologies of political ideology clusters.

Factor analysis

In order to be consistent with the existing literature on the identification of the Swiss political ideology structure, this study follows Hermann and Leuthold (2003) and performs a factor analysis[33] for each period identifying the same three unobserved factors they found. These three factors are able to capture between 55 and 60% of the overall variance of all the referenda, depending on the period considered. This indicates that the majority of political ideologies in Switzerland can be represented by three main dimensions. In order to give a meaningful interpretation to the resulting factors, the analysis considers from a qualitative perspective the ideological content of the referenda building them.[34]

Considering the most important referenda building factor 1 in the period 1981-1990, factor 3 in the period 1991-2000, factor 2 in the decade 2001-2010 and factor 1 in the period 2011-2017, it emerges that they are based on topics related to the protection of the workforce (e.g. the popular initiative on shortening working hours in 1988, the popular initiative for a flexible retirement age in 2000, or the popular initiative for a minimum wage in 2014), the welfare state (such as the amendment to the federal law on aged and bereaved insurance in 1995, the popular initiative "Health has to be

[32] For the third period, data on median income and Gini coefficients are not available for the year 2001. Hence, information for the year 2003 are used instead.
[33] The results of the factor analysis are reported in Appendix 2.A.
[34] The final factors are built considering all the votes whit a factor loading of at least 0.5 (in absolute terms).

affordable" in 2003, or the popular initiative for a basic income in 2016), and the national security policy (for example the popular initiative for a Switzerland without army and a comprehensive policy of peace in 1989, the popular initiative for a voluntary civilian peace service in 2001, or the popular initiative on the abolition of compulsory military service in 2013). Hence, as in Hermann and Leuthold (2003), these factors represent the "Left-Right" dimension of the political ideology space. In particular, these factors are capturing the debate between those who are in favor of the welfare state, the protection of the workforce, personal freedom and pacifism on one hand (i.e. with a left-wing perspective), and on the other hand those that have more propriety-oriented values, support the military strength and entrepreneurial freedom (i.e. with a right-wing perspective).

A different dimension of the political ideology structure of Switzerland is represented by factor 3 in the decade 1981-1990, factor 1 in the period 1991-2000, factor 1 in the decade 2001-2010 and factor 2 in the period 2011-2017. Analyzing the main referenda contributing to the construction of these factors, it appears that they link to topics related to foreign integration (such as the federal decree for a review of the procedure for naturalizing young immigrants in 1994, the popular initiative against the construction of new minarets in 2009, or the popular initiative against mass immigration in 2014), liberal economic policies (e.g. the federal decree on joining Bretton Woods in 1992, the popular initiative for Switzerland to join the United Nations in 2002, or the federal decree on extending the agreement on free movement of people to new countries of the European Union in 2005), and regulatory modernization (for example the federal law on government and administrative organization in 1996, the federal decree on a new Swiss Federal Constitution in 1999, or the federal decree on the non-introduction of public initiatives in 2009). Also in this case, the results are in line with those of Hermann and Leuthold (2003), in fact, these factors express the "Liberal-Conservative" dimension of the political ideology space. In particular, this dimension is representing the debate between those who support the opening of the country, are in favor of liberal economic policies and the modernization of institutions (i.e. with a liberal attitude), and those who are more skeptical towards changes and the opening of the country, prefer to preserve the existing regulations and mistrust the political and economic elites (i.e. with a conservative attitude).

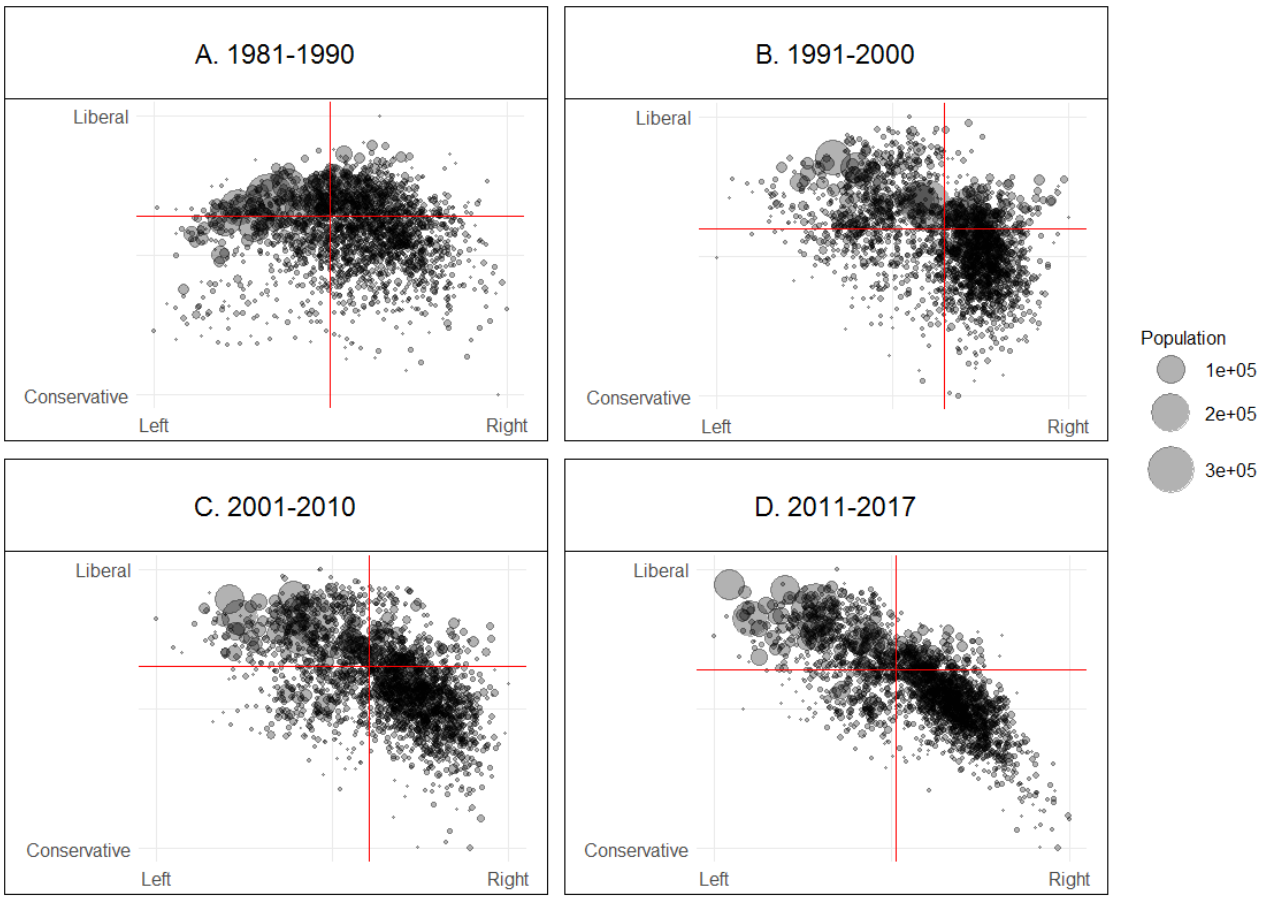
Finally, the third dimension of the Swiss political ideology space is captured by factor 2 in the decades 1981-1990 and 1991-2000, and factor 3 in the periods 2001-2010 and 2011-2017. This dimension is based on topics related to traffic (e.g. the popular initiative "Stop the concrete - for a limitation on road making" in 1990, the popular initiative for the protection of the alpine region from traffic in 1994, or the popular initiative on lowering the urban speed limit to 30 km/h in 2001), and environmental protection (such as the federal decree on varying tolls based on engine power or mileage in 1994, the federal decree on providing enhanced legal protection for animals in 2010, or

the popular initiative for the introduction of a tax on non-renewable energy in 2015). These factors represent the "Ecological-Technocratic" dimension identified by Hermann and Leuthold (2003). More specifically, this dimension expresses the debate between those who support the protection of the natural environment and are in favor of policies reducing the negative impact of human activities on nature (i.e. with an ecological attitude), and those who believe that the natural environment should be transformed to create more security and comfort, and used to generate technological progress (i.e. with a technocratic attitude).

The results of the factor analysis show that the political ideology of Swiss municipalities can be represented in a three-dimensional space, in which the three independent axes express the following political debates: left vs. right, liberal vs. conservative and ecological vs. technocratic. Figure 3.1 shows the political ideology position of Swiss municipalities on two of these three dimensions, for each considered period. In particular, the horizontal axis expresses the "Left-Right" dimension, while the vertical axis maps the position of each municipality on the "Liberal-Conservative" dimension[35]. Each dot represents a municipality, and the size of the dots indicates the dimension of the municipality, in terms of inhabitants in the first year of the considered period. The red lines show the overall national position on these two dimensions. This graphical representation allows highlighting the following two remarks. Firstly, in the first two decades the positions of Swiss municipalities are spread on all four quadrants, however, in the last two periods (in particular in the last one) the political ideology positions of Swiss municipalities are mainly concentrated in the "Left-Liberal" and "Right-Conservative" quadrants. Hence, this first graphical representation highlights a phenomenon of increasing polarization that is characterizing the Swiss political ideology space. Moreover, to better capture political preferences and the underlying political forces, it is important to consider more than a single political dimension, which, additionally, should be independent from short-term, candidate-related and party-related factors. Secondly, by simultaneously taking into considerations both these dimensions and the size of each municipality, in terms of number of inhabitants, it emerges that the position on the political ideology space is also a manifestation of the rural-urban divide. In fact, in line with Hermann and Leuthold (2003), cities and bigger municipalities are mainly positioned in the "Left-Liberal" quadrant, while smaller and rural communes are mainly found in the "Right-Conservative" quadrant.

[35] The two-dimensional graphical representation is preferred to the three-dimensional one because easier to interpret. The choice of the two dimensions to consider is based on their importance in explaining the overall variance of political preferences, as indicated from the results of the factor analysis.

Figure 3.1 – The political ideology position of Swiss municipalities



The identification of the political ideology of Swiss municipalities allows continuing the analysis with spatial cluster methods in order to empirically assess the degree of geographical concentration of political ideologies.

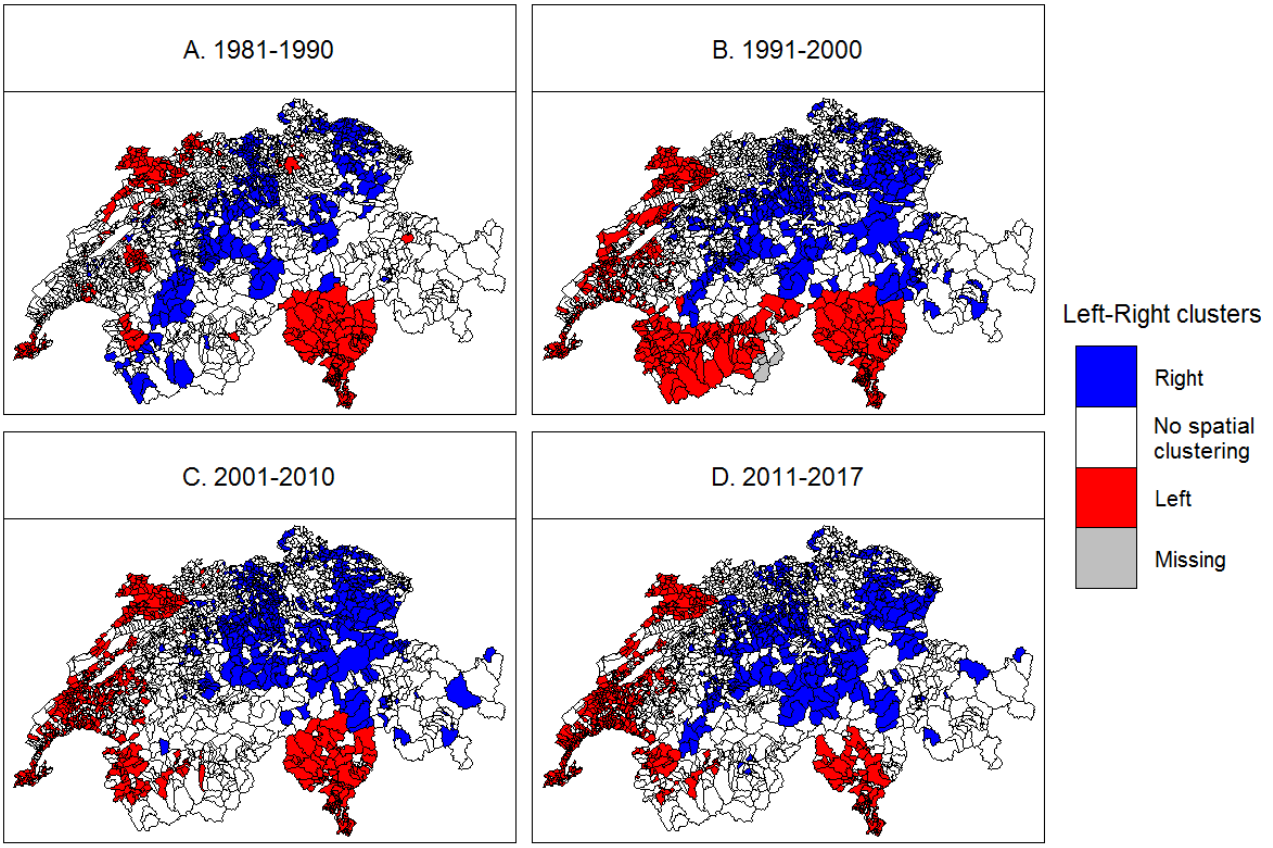
Spatial cluster analysis (Local Moran's I)

Following Kim et al. (2003), Darmofal (2008), Wing and Walker (2010) and Kinsella et al. (2015), the second phase of this analysis applies spatial cluster analysis to identify whether and where the political ideologies of Swiss municipalities are geographically concentrated. In particular, local Moran's I statistics for each of the three dimensions determined with the factor analysis are computed and then plotted in order to visualize the spatial pattern of significant concentration of political ideologies.

Figure 3.2 plots the results of the local Moran's I statistics for the "Left-Right" dimension as a set of significance maps for the four different periods. Municipalities exhibiting significant spatial clustering of the right-wing political ideology are shown in blue, while those belonging to a significant geographical concentration of the left-wing political ideology are colored in red. This graphical visualization clearly illustrates that the "Left-Right" dimension of the Swiss political

ideology space is characterized by geographical concentrations of municipalities with similar political preferences. More specifically, in line with the results of Hermann and Leuthold (2003), right-wing municipalities are predominantly clustered in the rural areas of the German speaking part of Switzerland, i.e. the center and north-east parts.

Figure 3.2 - Local Moran's I statistics for the Left-Right dimension

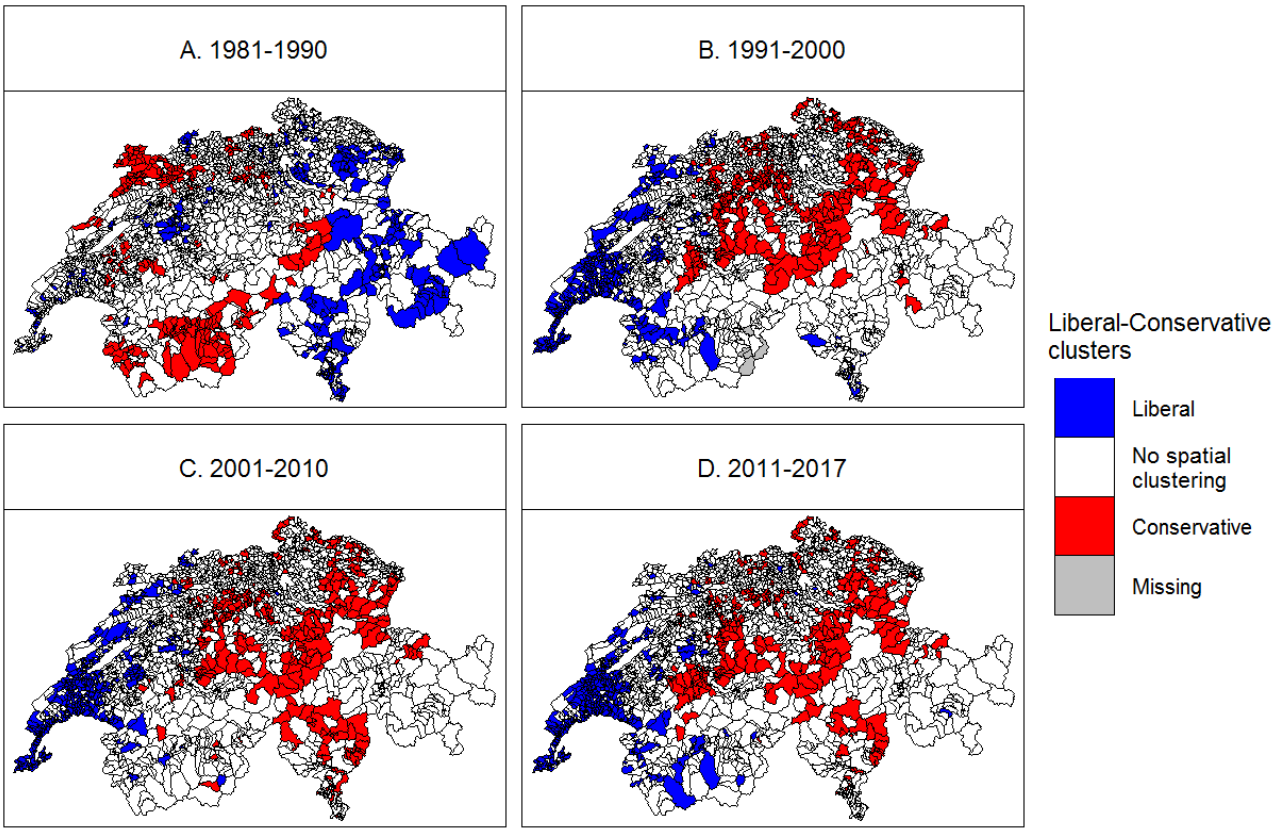


Additionally, left-wing municipalities are mainly concentrated in the Italian and French speaking part of Switzerland, i.e. in the south and in the west parts, respectively. The results also show that through time there has been some minor changes. More specifically, the geographical concentrations of right-wing municipalities are increasing in the central part of Switzerland, while the ones concerning left-wing municipalities are increasing in the western part of Switzerland and decreasing in the south, after an increase in the second period.

The results concerning the spatial cluster analysis on the "Liberal-Conservative" dimension of the Swiss political ideology space are shown in Figure 3.3. In this case, municipalities marked in blue belong to significant geographical concentrations of communes with a liberal political preference, while those colored in red are municipalities exhibiting significant spatial clustering of the conservative political ideology. The first consideration emerging from this graphical visualization is that geographical concentrations of political ideologies occurs also on the "Liberal-Conservative"

dimension. More specifically, liberal municipalities are mainly clustered around the Swiss central-western cities and in the French speaking part of Switzerland. On the other side, the conservative municipalities are mainly concentrated in the rural areas of the German and Italian speaking parts of Switzerland, i.e. in the east and in the south-east, respectively.

Figure 3.3 - Local Moran's I statistics for the Liberal-Conservative dimension

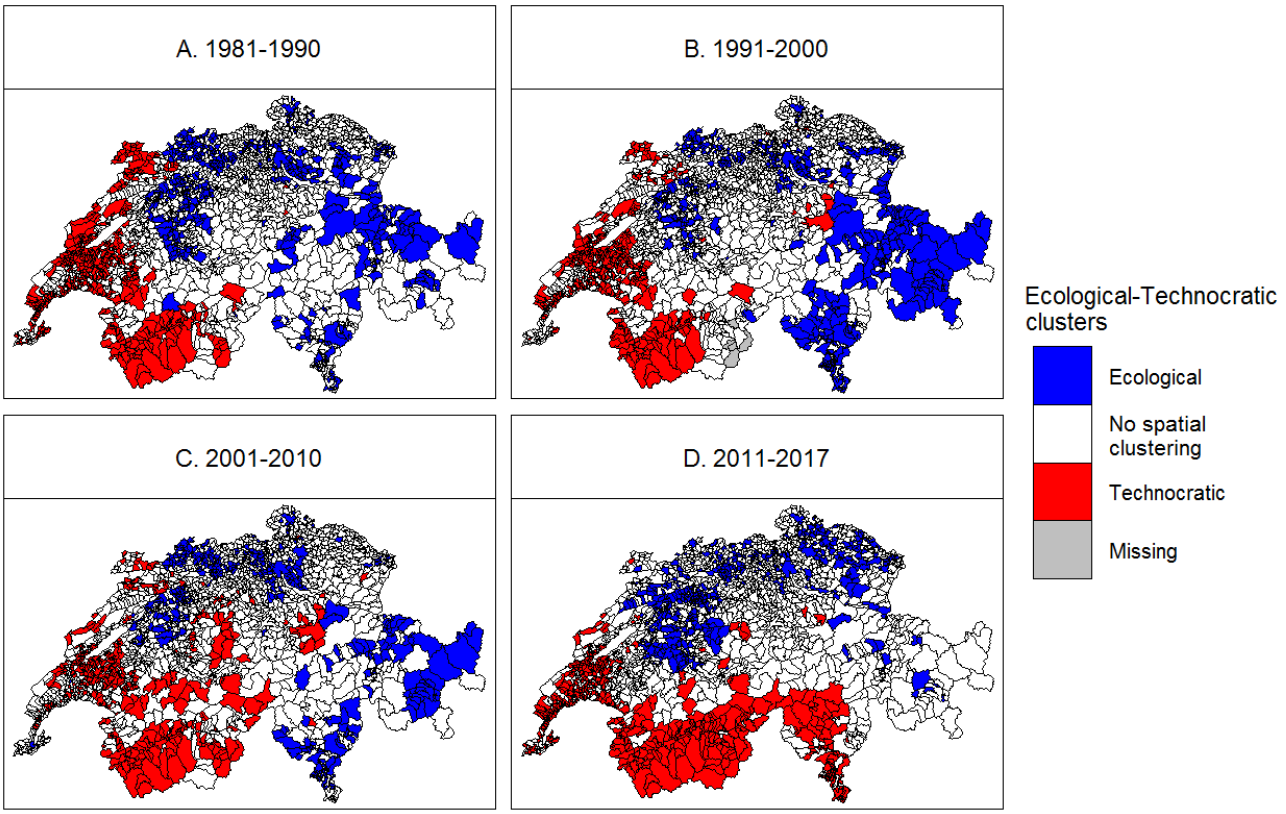


Considering the temporal evolution of the geographical concentrations of political ideologies along the "Liberal-Conservative" dimension, it clearly emerges that the first decade shows different patterns than the other three periods. As highlighted by Hermann and Leuthold (2003), this can be explained by the fact that the debate between liberals and conservatives in Switzerland became significantly important at the beginning of the nineties, when the discussion concerning the relationship between Switzerland and Europe started.

Finally, Figure 3.4 maps the results of the cluster analysis on the "Ecological-Technocratic" dimension of the Swiss political ideology space. Municipalities belonging to a significant geographical concentration of the ecological political ideology are colored in blue, while communes exhibiting significant spatial clustering of the technocratic political ideology are marked in red. Even in this case the results show that there are geographical concentrations of municipalities with similar political preferences. Ecological municipalities are mainly concentrated close to the big cities of the German speaking part of Switzerland (i.e. in the center and north-east parts) and in the rural areas in

the east and south-east. On the contrary, technocratic communes are predominantly clustered in the rural areas of the French speaking part of Switzerland (i.e. in the west). The temporal perspective allows determining that the geographical concentrations of ecological municipalities have decreased, in particular in the rural areas in the east and south-east part of Switzerland. Moreover, the spatial concentrations of technocratic municipalities have increased in the south, but diminished in the north-west.

Figure 3.4 - Local Moran's I statistics for the Ecological-Technocratic dimension



Overall, the results of the spatial cluster analysis highlight that along all the three dimensions characterizing the Swiss political ideology space there are geographical concentrations of municipalities with similar political preferences. The geographical representations of these results show that the "Left-Right" dimension is characterized by many and wider clusters, while the "Liberal-Conservative" dimension is defined by fewer and narrower concentrations. Hence, it seems that there are stronger sorting and polarizing effects along the "Left-Right" axes and weaker along the "Liberal-Conservative" one, with the dimension related to the "Ecological-Technocratic" debate somewhere in between. These results are particularly interesting because they show that social interactions, captured as the geographical concentration of political ideologies, extend beyond municipal borders and further support the importance of analyzing these clusters.

Kruskal-Wallis and Dunn tests

The results discussed above indicate that Switzerland is characterized by geographical concentrations of political ideologies along various dimensions. As mentioned above, partisan-sorting processes are expected to be interrelated with income-sorting processes, implying that these phenomena are likely to lead to the clustering of people having similar levels of income and political ideologies. This hypothesis is also supported by the literature on voting behavior (Meltzer and Richard, 1981; McCarty et al., 2008, Rueda and Stegmueller, 2014) as well as the one on "the geography of discontent" (Los et al., 2017; Chen et al., 2018; Crescenzi et al., 2018). Hence, the final phase of this analysis aims at empirically verifying whether there are differences in economic welfare among municipalities belonging to different clusters of political ideologies. In particular, Kruskal-Wallis tests are performed on the median income and the Gini coefficient of the income distribution of each municipality, to verify whether the distribution of these variables are significantly different among municipalities belonging to different aggregations of political ideologies and that do not belong to any cluster. These tests are carried out for each dimension of the Swiss political ideology space and for each period previously considered, separately, and are reported in Table 3.1, Table 3.2 and Table 3.3, along with the median value of the considered variables for each cluster of municipalities. Additionally, Dunn's tests are performed in order to exactly identify which pairs of groups are significantly different. Given that multiple tests are carried out at the same time, these tests are corrected with the Benjamini-Hochberg procedure[36].

Table 3.1 – Results of the Kruskal-Wallis tests on the "Left-Right" dimension

	1981-1990	**1991-2000**	**2001-2010**	**2011-2017**
Median income	$\chi^2(2) = 55.1$ $p < 0.001$	$\chi^2(2) = 125.3$ $p < 0.001$	$\chi^2(2) = 0.8$ $p = 0.66$	$\chi^2(2) = 62.8$ $p < 0.001$
Median "Left"	32'500 CHF	44'350 CHF	54'967 CHF	61'800 CHF
Median "Not Significant"	34'000 CHF	48'050 CHF	56'000 CHF	59'550 CHF
Median "Right"	32'250 CHF	48'500 CHF	55'925 CHF	56'600 CHF
Gini coefficient of the income distribution	$\chi^2(2) = 75.1$ $p < 0.001$	$\chi^2(2) = 23.6$ $p < 0.001$	$\chi^2(2) = 11.3$ $p < 0.001$	$\chi^2(2) = 113.0$ $p < 0.001$
Median "Left"	0.317	0.329	0.316	0.360
Median "Not Significant"	0.308	0.316	0.310	0.336
Median "Right"	0.290	0.318	0.310	0.328

Considering the "Left-Right" dimension, the results, as reported in Table 3.1 and in Tables B.1 and B.2 of Appendix 3.B, indicate that the clusters of left-wing and right-wing municipalities are

[36] The results of the Dunn's tests are reported in Appendix 3.B, along with the median value of the considered variables for each group of municipalities and for each period.

characterized by significant differences in the distributions of both median income and the Gini coefficient of the income distribution, with the exception of the decade 2001-2010 for median income.

By taking into account the median income for each cluster, it is not possible to find a clear pattern showing which cluster of political ideology is associated with higher (lower) values of median income in the four considered periods. On the other hand, the results indicate that municipalities belonging to a geographical concentration of a left-wing political ideology are characterized by a significantly higher Gini coefficient of income distribution, when compared to those with a right-wing political ideology, showing that there is a higher demand for left-wing policies where there are higher degrees of income inequality. Hence, these findings indicate that groups of municipalities with a significant left-wing ideology are characterized by significantly higher degrees of income inequality, in line with the findings of the literature on voting behavior (Meltzer and Richard, 1981; McCarty et al., 2008, Rueda and Stegmueller, 2014).

Table 3.2 – Results of the Kruskal-Wallis tests on the "Liberal-Conservative" dimension

	1981-1990	**1991-2000**	**2001-2010**	**2011-2017**
Median income	$\chi^2(2) = 105.0$ $p < 0.001$	$\chi^2(2) = 97.4$ $p < 0.001$	$\chi^2(2) = 335.6$ $p < 0.001$	$\chi^2(2) = 314.1$ $p < 0.001$
Median "Conservative"	30'775 CHF	45'650 CHF	52'200 CHF	54'200 CHF
Median "Not Significant"	33'600 CHF	47'125 CHF	55'800 CHF	59'150 CHF
Median "Liberal"	34'850 CHF	50'050 CHF	62'500 CHF	68'400 CHF
Gini coefficient of the income distribution	$\chi^2(2) = 157.9$ $p < 0.001$	$\chi^2(2) = 140.5$ $p < 0.001$	$\chi^2(2) = 120.0$ $p < 0.001$	$\chi^2(2) = 203.0$ $p < 0.001$
Median "Conservative"	0.279	0.304	0.297	0.317
Median "Not Significant"	0.304	0.322	0.311	0.337
Median "Liberal"	0.335	0.338	0.331	0.371

Focusing the attention to the "Liberal-Conservative" dimension, the results, as indicated in Table 3.2 and in Tables B.3 and B.4 of Appendix 3.B, show that among the clusters of liberal and conservative municipalities there always are significant differences in the distributions of both median income and the Gini coefficient of the income distribution.

Moreover, both the median income and the Gini coefficient of the income distribution in clusters of liberal municipalities are in each period significantly higher than those of municipalities that do not belong to any cluster, along this dimension, and even higher than those of municipalities linked to a conservative cluster. Therefore, these results show that clusters of municipalities with a significant liberal ideology are characterized by significantly higher levels of economic welfare as well as significantly higher degrees of income inequality.

Finally, considering the "Ecological-Technocratic" axis of the Swiss political ideology space, the results, as reported in Table 3.3 and in Tables B.5 and B.6 of Appendix 3.B, indicate that the clusters of ecological and technocratic municipalities are characterized by significant differences in the distributions of both median income and the Gini coefficient of the income distribution.

Table 3.3 – Results of the Kruskal-Wallis tests on the "Ecological-Technocratic" dimension

	1981-1990	**1991-2000**	**2001-2010**	**2011-2017**
Median income	$\chi^2(2) = 31.1$ p < 0.001	$\chi^2(2) = 13.7$ p < 0.001	$\chi^2(2) = 58.3$ p < 0.001	$\chi^2(2) = 7.1$ p =0.03
Median "Ecological"	34'700 CHF	48'000 CHF	58'000 CHF	58'400 CHF
Median "Not Significant"	33'050 CHF	47'400 CHF	55'925 CHF	59'400 CHF
Median "Technocratic"	33'117 CHF	45'938 CHF	53'150 CHF	60'300 CHF
Gini coefficient of the income distribution	$\chi^2(2) = 26.9$ p < 0.001	$\chi^2(2) = 128.7$ p < 0.001	$\chi^2(2) = 37.0$ p < 0.001	$\chi^2(2) = 195.9$ p < 0.001
Median "Ecological"	0.311	0.343	0.323	0.327
Median "Not Significant"	0.302	0.313	0.308	0.333
Median "Technocratic"	0.315	0.318	0.307	0.373

In addition, both the median income and the Gini coefficient of the income distribution in clusters of ecological municipalities are significantly higher than those of municipalities belonging to a technocratic cluster, with the exception of the last period, which, interestingly, shows opposite results. Hence, between 1981 and 2010, clusters of municipalities with a significant ecological ideology are characterized by significantly higher levels of economic welfare as well as significantly higher degrees of income inequality. However, in the period 2011-2017 the reverse is true, i.e. clusters of municipalities with a significant technocratic ideology have a significantly higher median income as well as significantly higher degrees of income inequality.

Overall, these results clearly indicate that there are significant differences in the level of income and income inequality of Swiss municipalities, depending on their belonging to a political ideology cluster. These findings seem to support the hypothesis that partisan-sorting processes are interrelated with income-sorting processes and further support the findings and claims of other scholars, arguing that economic geography is particularly important in understanding how people vote

3.6 Conclusions

This paper proposes a new definition of spatial cohesion, based on the geographical concentration of political ideologies, which represents a new way to capture social interactions. The application of spatial cluster analysis empirically assesses the existence of spatial concentrations of

Swiss municipalities sharing the same political ideology. This first result is particularly interesting because it shows that social interactions, captured as the geographical concentration of political ideologies, extend beyond municipal borders and further supports the importance of analyzing these clusters. Moreover, this result is valid for all the three main dimensions characterizing the Swiss political ideology space, expressing the following political beliefs: left vs. right, liberal vs. conservative and ecological vs. technocratic. Additionally, these findings seems to indicate that there are stronger clustering effects along the "Left-Right" axes and relatively weaker along the "Liberal-Conservative" one.

Moreover, a second important finding of this paper indicates that the geographical distribution of the clusters of political ideologies are also a manifestation of the rural-urban divide as well as the cultural divides among the different linguistic regions of Switzerland. In particular, geographical concentrations of left-wing municipalities are mainly located close to cities and in the French and Italian speaking parts of Switzerland, while clusters of right-wing municipalities are predominantly found in rural areas and in the German speaking part of Switzerland. At the same time, spatial concentrations of liberal municipalities are mostly situated close to cities and in the French speaking part of Switzerland, whereas clusters of conservative communes are mainly located in rural areas and in the German and Italian speaking regions of Switzerland. Additionally, clusters of ecological municipalities are predominantly found around cities and in the German speaking part of Switzerland, while agglomerations of technocratic communes are mostly located in rural areas and in the French speaking region of Switzerland. Moreover, the evolution of such divides between 1981 and 2017 seems to suggest that the Swiss political ideology space is characterized by a phenomenon of increasing polarization.

Thirdly, this study finds significant differences in income levels and income inequalities among Swiss municipalities, depending on their belonging to a political ideology cluster. More specifically, clusters of left-wing municipalities are characterized by significantly higher degrees of income inequality, when compared to aggregations of right-wing municipalities. At the same time, the results indicate that clusters of liberal communes have a significantly higher median income and a higher degree of income inequality, compared to concentrations of conservative municipalities. Moreover, with the exception of the period 2011-2017, clusters of ecological communes have a significantly higher median income and a higher degree of income inequality, compared to concentrations of technocratic municipalities.

Hence, these findings indicate that clusters of communes with a similar political ideology group either urban municipalities with relatively high levels of income and high degrees of inequality

(as in the cases of left, liberal or ecological clusters) or rural communes with relatively low levels of income and low degrees of inequality (for the cases of right, technocratic or conservative clusters). Interestingly, the empirical evidence does not show any political ideology clustering of "privileged" communes (i.e. with high levels of income and low degrees of inequality), nor "left-behind" municipalities (i.e. with low levels of income and high degrees of inequality).

In conclusion, besides identifying the political preference of Swiss municipalities, these results highlight the importance of the geography of these political ideologies, and, in particular, of their spatial concentration. This result contributes and further supports the findings and claims of the literature on "the geography of discontent", according to which economic geography is particularly important in understanding how people vote. These findings are particularly interesting because they emerge from a study simultaneously considering the results of several referenda, capturing the underlying long-term structure of political ideologies, which is independent from short-term, candidate-related and party-related factors. The existence of differences in economic welfare among municipalities belonging to different clusters of political ideologies implies that future research should consider this new definition of spatial cohesion in order to understand how and why different concentrations of political preferences are associated to different levels of welfare.

References

Abramowitz, A., 2010, "Transformation and polarization: The 2008 presidential election and the new American electorate", *Electoral Studies*, 29(4):594-603.

Abrams, S. and Fiorina, M., 2012, "'The big sort' that wasn't: A skeptical Reexamination", *Political Science and Politics*, 45(2):203-10.

Alonso, W., 1964, *Location and Land Use*. Harvard University Press, Cambridge, MA.

Anselin, L., 1988, *Spatial Econometric: Method and Models*, Dordrecht: Kluwer Academic Publishers.

Anselin, L., 1995, "Local indicators of spatial association-LISA", *Geographical Analysis*, 27(2):93-115.

Bailey, N, van Gent, W and Musterd, S., 2017, "Remaking urban segregation: processes of income sorting and neighbourhood change", *Population, Space and Place*, 23(3):1-16.

Beckmann, M., 1969, "On the distribution of urban rent and residential density", *Journal of Economic Theory*, 1:60-67.

Benjamini, Y. and Hochberg, Y., 1995, "Controlling the false discovery rate: a practical and powerful approach to multiple testing", *Journal of the Royal Statistical Society, Series B*, 57(1):289-300.

Bishop, B., 2008, *The Big Sort: Why the Clustering of Like-Minded America Is Tearing Us Apart*, Houghton Mifflin, Boston.

Chen, W., Los, B., McCann, P., Ortega-Argilés, R., Thissen, M. and van Oort, F., 2018, "The continental divide? Economic exposure to Brexit in regions and countries on both sides of The Channel", *Papers in Regional Science*, 97:25-54.

Clark, W., 1991. "Residential preferences and neighborhood racial segregation: A test of the Schelling segregation model", *Demography*, 28(1):1-19.

Cliff, R. and Ord, J., 1981, *Spatial Processes: Models and Applications*, Pion, London.

Crescenzi, R., Di Cataldo, M. and Faggian, A., 2018, "Internationalized at work and localistic at home: The 'split' Europeanization behind Brexit", *Papers in Regional Science*, 97:117-132.

Darmofal, D., 2008, "The political geography of the new deal realignment", *American Politics Research*, 36:934-61.

Dunn, O., 1964, “Multiple comparisons using rank sums”, *Technometrics,* 6:241-252.

Ellickson, B., 1971, “Jurisdictional fragmentation and residential choice”, *American Economic Review,* 61(2):334-339.

Fossett, M., 2006, “Ethnic preferences, social distance dynamics, and residential segregation: Theoretical explorations using simulation analysis”, *Journal of Mathematical Sociology,* 30(3-4):185-274.

Fujita, M., 1989, *Urban Economic Theory: Land Use and City Size*. Cambridge University Press, Cambridge

Glaeser, E. and Ward, B., 2006, “Myths and Realities of American Political Geography”, *Journal of Economic Perspectives*, 20:119-144.

Hermann, M. and Leuthold, H., 2001, “Weltanschauungen und ihre soziale Basis im Spiegel der Volksabstimmungen.“, *Swiss Political Science Review*, 7:39-63.

Hermann, M. and Leuthold, H., 2003, *Atlas der politischen Landschaften: ein weltanschauliches Porträt der Schweiz*, vdf Hochschulverlag AG, Zürich.

Kawachi, I. and Berkman, L., 2003, *Neighborhoods and Health*, Oxford University Press.

Kelejian, H. and Prucha, I., 1998, “A Generalized Spatial Two-Stage Least Squares Procedure for Estimating a Spatial Autoregressive Model with Autoregressive Disturbances.”, *The Journal of Real Estate Finance and Economics*, 17(1):99–121.

Kim, J., Elliott, E. and Wang, D., 2003, “A spatial analysis of county-level outcomes in U.S. Presidential elections: 1988-2000”, *Electoral Studies*, 22:741-761.

Kinsella, C., McTague, C. and Raleigh, K., 2015, “Unmasking Geographical Polarization and Clustering: a Micro-Scalar Analysis of Partisan Voting Behavior”, *Applied Geography,* 62(3):404-19.

Kruskal, W. and Wallis, A., 1952, “Use of ranks in one-criterion variance analysis”, *Journal of the American Statistical Association,* 47:583-621.

Lang, C. and Pearson-Merkowitz, S., 2015, “Partisan sorting in the United States, 1972–2012: new evidence from a dynamic analysis”, *Political Geography*, 48:119-129.

LeSage, J. and Pace, K., 2009, *Introduction to Spatial Econometrics*, Statistics: A Series of Textbooks and Monographs. CRC Press.

Levendusky, M. and Pope, J., 2011, "Red states vs. blue states: going beyond the mean", *Public Opinion Quarterly*, 2(75):227-248

Los, B., McCann, P., Springford, J., and Thissen, M., 2017, "The mismatch between local voting and the local economic consequences of Brexit", *Regional Studies*, 51:786-799.

McCann, P., 2018, "The trade, geography and regional implications of Brexit", *Papers in Regional Science*, 97:3-8.

McCarty, N., Poole, K. and Rosenthal, H., 2008, *Polarized America: The Dance of Ideology and Unequal Riches*. The MIT Press.

McPherson, M., Smith-Lovin, L. and Cook, M., 2001, "Birds of a feather: Homophily in social networks", *Annual Review of Sociology*, 27(1):415-444.

Meltzer, A. and Richard, S., 1981, "A Rational Theory of the Size of Government", *Journal of Political Economy*, 89:914-925.

Mills, E., 1972, *Studies in the Structure of the Urban Economy*. Johns Hopkins Press, Baltimore.

Moran, P., 1948, "The interpretation of statistical maps", *Journal of the Royal Statistical Society. Series B*, 10:243-251.

Musterd, S., van Gent, W., Das, M. and Latten, J., 2015. "Adaptive behaviour in urban space; residential mobility in response to social distance", *Urban Studies*, 53(2):227-246.

Muth, R., 1969, *Cities and Housing*. Chicago University Press, Chicago.

O'Loughlin, J., Flint, D. and Anselin, L., 1994, "The Geography of the Nazi Vote: Context, Confession and Class in the Reichstag Election of 1930", *Annals of the Association of American Geographers*, 84:351-380.

Rodríguez-Pose, A., 2017, "The revenge of the places that don't matter (and what to do about it)", *Cambridge Journal of Regions, Economy and Society*, 11(1):189-209.

Ross, S. and Yinger, J., 1999. "Sorting and voting: a review of the literature on urban public finance". In: Ceshire, P. and Mills, E. editors, *Handbook of Regional and Urban Economics*, vol. 3. North-Holland, Amsterdam.

Rueda, D. and Stegmueller, D., WP 2014, "From Preferences to Voting: Redistribution and Left Parties in Industrialized Democracies". Prepared for presentation at the 72nd Meeting of the MPSA, Chicago.

Schelling, T., 1971, "Dynamic models of segregation", *Journal of Mathematical Sociology,* 1:143-186.

Schmidheiny, K., 2006, "Income segregation and local progressive taxation: Empirical evidence from Switzerland", *Journal of Public Economics,* 90:429-458.

Strickler, R., 2016, "A 'Sorted' America? Geographic Polarization and Value Overlap in the American Electorate", *Social Science Quarterly,* 97(2):439-457.

Tam Cho, W., Gimpel, J. and Hui, I., 2013, "Voter Migration and the Geographic Sorting of the American Electorate", *Annals of the Association of American Geographers,* 103(4):856-870.

Tiebout, C., 1956, "A pure theory of local expenditures", *Journal of Political Economy,* 64(5):416-424.

Tocqueville, A., 1994, *Über die Demokratie in Amerika.* Stuttgart: Reclam.

Vegetti, F., Fazekas, Z. and Méder, Z., 2017, "Sorting your way out: Perceived party positions, political knowledge, and polarization", *Acta Polit,* 52:479-501.

von Thünen, J., 1826, *Der isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie*. Friedrich Perthes, Hamburg.

Westhoff, F., 1977, "Existence of equilibria in economies with a local public good", *Journal of Economic Theory,* 14:84-112.

Wing I. and Walker J., 2010, "The Geographic Dimensions of Electoral Polarization in the 2004 U.S. Presidential Vote". In: Páez, A., Gallo, J., Buliung, R. and Dall'erba, S. editors, *Progress in Spatial Analysis. Advances in Spatial Science (The Regional Science Series)*. Springer, Berlin-Heidelberg.

Appendix 3.A – Results of the factor analyses

Table A.1: Factor scores for the period 1981-1990

Vote	Factor 1	Factor 2	Factor 3
Federal decree on the popular initiative for gender equality (counter-proposal)	**0,72**	0,31	0,2
Federal decree on the popular initiative the protection of consumer rights (counter-proposal)	**0,67**	-0,13	0,36
Federal decree on prolonging the federal finance order	0,01	0,01	**0,62**
New federal law on foreigners	-0,42	-0,05	0,39
Amendment to the Swiss penal code	0,2	-0,43	0,49
Popular initiative for the prevention of abusive prices	**0,76**	0,24	-0,06
Federal decree on the popular initiative for the prevention of abusive prices (counter-proposal)	-0,47	0,11	0,22
Federal decree on changes to fuel tax	0,36	-0,1	**0,58**
Federal decree on the constitutional article on energy	0,18	-0,4	0,28
Federal decree on the revision of nationality law in the Federal Constitution	0,18	-0,08	**0,67**
Federal decree aiming at facilitating certain naturalizations	0,21	-0,14	0,49
Federal decree on introducing tolls for heavy goods vehicles	-0,07	**0,71**	0,24
Federal decree on introducing tolls for national routes	0,21	**0,62**	0,41
Popular initiative for a real civilian service based on a proof through demonstration	**0,79**	0,06	0,17
Popular initiative against the abuse of bank client confidentiality and bank power	-0,15	**0,8**	0,03
Popular initiative against slashing the national soil	0,15	**0,67**	0,05
Popular initiative for a future without further nuclear power plants	**0,62**	0,09	-0,05
Popular initiative for a secure, parsimonious and ecologically sound energy supply	**0,59**	0,09	-0,12
Popular initiative for an effective protection of maternity	0,05	**0,55**	**0,57**
Federal decree on the constitutional article on broadcasting	0,29	0,11	**0,76**
Popular initiative for the compensation of victims of violent crimes	**0,76**	-0,17	0,11
Federal decree on abolishing primary school fees	-0,31	0,17	**0,78**
Federal decree on abolishing the government contribution to healthcare spending	-0,35	0,07	**0,76**
Federal decree on education fees	**0,84**	0,01	-0,08
Popular initiative on extending paid leave	-0,48	0,01	**0,59**
Popular initiative "right to life"	-0,11	0,34	**0,74**
Federal decree on abolishing the cantonal share of profits from banks' stamp duty	-0,02	0,28	**0,76**
Federal decree on the taxation raised from the sale of spirits	-0,07	-0,07	-0,41
Federal decree on the abolition of grants for the self-supply of breadstuffs	0,43	-0,38	**0,5**
Federal decree on the popular initiative to co-ordinate the start of the school year (counter-proposal)	**0,78**	-0,22	0,32
Federal decree on giving small and medium enterprises an advantage in cases of innovations	**0,78**	-0,25	0,16

Amendments to the Swiss Civil Code	**0,51**	**-0,51**	0,11
Popular initiative to ban vivisection	0,07	**0,66**	0,24
Federal decree on joining the United Nations	**0,68**	-0,03	0,43
Popular initiative on culture	0,18	0,16	0,3
Federal decree on the popular initiative on culture (counter-proposal)	**0,62**	0	-0,04
Popular initiative on vocational education	**0,68**	-0,15	0,09
Federal decree on the domestic sugar economy	-0,34	**-0,51**	-0,09
Federal decree on the popular initiative for the protection of tenants (counter-proposal)	0,42	**0,58**	0,38
Popular initiative for a just taxation of truck traffic	**0,62**	0,22	0,24
Amendments to the federal law on asylum	**0,75**	0,16	-0,17
Federal law on the residence and settlement of foreigners	**0,67**	0,14	0,42
Popular initiative for the people's co-determination of military expenditure	-0,36	0,08	0,12
Federal decree on the voting system for popular initiatives	-0,19	0,04	0,29
Federal decree on the Rail 2000 project	**0,56**	0,39	-0,06
Popular initiative for the protection of fens	**0,59**	0,17	0,26
Amendment to the federal law on health insurance	0,45	-0,07	0,41
Federal decree on the constitutional principles behind a coordinated transport policy	0,2	**0,66**	0,4
Popular initiative on lowering the retirement age to 62 for men and 60 for women	**0,84**	-0,02	-0,06
Popular initiative against real estate speculation	0,19	0,47	-0,25
Popular initiative for the shortening of labor time	**0,57**	0,38	0,06
Popular initiative for limiting immigration	**0,85**	0,08	0
Popular initiative for nature-oriented farming and against animal factories	0,34	**0,73**	0,08
Popular initiative for a Switzerland without army and a comprehensive policy of peace	**0,75**	-0,04	0
Popular initiative on introducing 130 and 100 kilometers per hour speed limits	0,27	**-0,78**	-0,16
Popular initiative "Stop the concrete - for a limitation on road making"	-0,05	**0,91**	0,02
Popular initiative for a highway-free countryside between Murten and Yverdon	-0,11	**0,91**	0
Popular initiative for a highway-free Knonauer Amt	-0,02	**0,87**	-0,01
Popular initiative for a highway-free area between Biel and Solothurn/Zuchwil	0,1	**0,85**	0,01
Federal decree on viticulture	-0,29	-0,37	**0,51**
Amendment to the federal law on the organization of the federal judiciary	-0,11	**-0,67**	0,11
Popular initiative to phase out nuclear power	**0,61**	0,27	-0,05
Popular initiative to stop the construction of any new nuclear power plants	**0,52**	0,27	0,28
Federal decree on the constitutional article on energy	**0,69**	0,1	-0,05
Amendment to the federal law on road traffic	-0,06	**-0,78**	0,15

Table A.2: Factor scores for the period 1991-2000

Vote	Factor 1	Factor 2	Factor 3
Federal decree on lowering the voting age to 18	0,04	**0,74**	-0,04
Popular initiative on promoting public transport	0,48	0,08	-0,15
Federal decree on reorganizing the federal finances	0,08	**0,62**	0,26
Amendment to the military penal code	0	0,35	0,44
Popular initiative for a financially bearable health insurance	-0,17	**0,73**	0,21
Popular initiative for the drastic and stepwise limitation of animal experiments	-0,38	0,49	-0,26
Federal decree on joining the Bretton Woods system	0,12	**0,76**	-0,07
Federal law on contributing to the Bretton Woods system	0,17	**0,72**	0,09
Federal law on water protection	0,23	**0,67**	0,2
Federal decree on the popular initiative against the malpractice of gene technology on humans (counter-proposal)	0,32	**0,61**	0,2
Federal decree on creating a civilian service alternative to military service	0,46	**0,6**	0,02
Amendments to the Swiss Penal Code and the Military Penal Code on sexual integrity	**0,86**	-0,05	-0,08
Popular initiative for the recovery of our waters	**0,86**	-0,07	-0,1
Federal decree on building a transalpine rail route	-0,14	**0,58**	0,09
Federal law on the standing orders of the Federal Assembly	**0,62**	0,42	-0,12
Amendment to the stamp duty law	**0,69**	0,32	-0,18
Federal law on farmland	**0,82**	0,23	-0,14
Federal law on the expenses of members of the Federal Assembly	**0,65**	-0,04	0,12
Federal law on the salaries of members of the Federal Assembly	**0,64**	-0,07	-0,23
Federal decree on the European Economic Area	**0,84**	-0,34	-0,26
Federal law to raise fuel taxes	-0,17	**0,69**	-0,11
Federal decree on lifting the ban on gambling establishments	-0,15	**0,63**	**0,52**
Popular initiative on banning animal testing	0,35	-0,01	0,04
Popular initiative "40 military training areas are enough-environment projection at military"	0,4	0,2	**-0,67**
Popular initiative for a Switzerland without new warplanes	0,43	0,17	**-0,68**
Federal decree on the misuse of weaponry	0,06	0,47	-0,17
Federal decree on whether Laufen should be part of the Basel-Landschaft canton	**0,64**	0,25	-0,1
Popular initiative on creating a new Swiss National Day on 1 August	0,36	0,15	0,39
Federal decree on a temporary halt to increase in the cost of health insurance	0,4	0,02	0,34
Federal decree on unemployment insurance	**0,56**	-0,22	-0,29
Federal decree on the financial order	-0,05	**0,7**	0,02
Federal decree on recovering money owed to the federal government	-0,08	**0,69**	0,03
Federal decree on measures for preserving social insurance	0,35	**0,52**	0,4
Federal decree on special excise taxes	0,35	0,48	0,46
Popular initiative on the reduction of alcohol problems	**0,55**	0,41	0,46

Popular initiative on the reduction of tobacco problems	**0,53**	0,33	**0,51**
Federal decree on roadbuilding	-0,04	**0,88**	0,14
Federal decree on continuing existing truck tolls	-0,1	**0,87**	0,24
Federal decree on varying tolls based on engine power or mileage	-0,13	**0,8**	0,35
Popular initiative for the protection of the alpine region from traffic	-0,31	**0,75**	0,08
Amendment to the aeronautical law	**0,6**	-0,13	-0,01
Federal decree on the constitutional article on the promotion of culture	**0,72**	0,23	-0,42
Federal decree on facilitated naturalization for foreign youth	**0,87**	0,02	-0,05
Federal law on Swiss troops in peacekeeping operations	**0,89**	-0,01	-0,02
Federal decree on abolishing price reductions on breadstuffs	**0,57**	0,48	0,33
Amendments to the Swiss Penal Code and the Military Penal Code	**0,73**	0,37	0
Federal law on health insurance	-0,3	0,34	**0,56**
Popular initiative for a healthy health insurance	0,29	0,04	**-0,72**
Federal law on foreigners	**0,57**	-0,09	**-0,58**
Federal decree on the popular initiative for an environmentally sound and efficient peasant farming (counter-proposal)	0,44	-0,07	0,44
Federal decree on dairy farming	0,34	**-0,67**	-0,03
Amendment to the farming law	0,32	**-0,69**	0,01
Federal decree on spending	0,33	**-0,7**	0,07
Amendment to the federal law on aged and bereaved insurance	0,18	0,26	**-0,73**
Popular initiative to extend aged and bereaved and invalidity insurance	0,14	0,1	**0,8**
Amendment to the federal law on purchasing land through agents abroad	**0,76**	-0,27	-0,23
Amendment to the constitutional article on languages	0,36	0,46	0,33
Federal decree on whether municipality of Vellerat (then part of the canton of Bern) should become part of the canton of Jura	0,08	0,46	0,35
Federal decree on abolishing the cantons' responsibilities for providing army equipment	**0,65**	0,33	0,26
Federal decree on abolishing the federal requirement to purchase distilling equipment	0,47	0,12	0,06
Federal decree on abolishing federal financing of parking areas at rail stations	**0,58**	0,04	-0,27
Federal decree on the popular initiative "peasants and consumers-for a nature-oriented farming" (counter-proposal)	0,14	**0,73**	0,04
Federal law on governmental and administrative organization	**0,8**	-0,02	-0,3
Popular initiative against illegal immigration	0,14	0,23	**0,64**
Amendment to the federal law on labor in trade and industry	**-0,76**	0,17	0,23
Popular initiative "EU accession talks in front of the people"	0,4	0,43	0,38
Popular initiative for a ban on arms exports	0,42	0,22	**-0,57**
Federal decree on ending the federal monopoly on producing and selling gunpowder	**-0,6**	0,12	-0,17
Federal decree on financing unemployment insurance	-0,31	0,26	**0,71**

Popular initiative "youth without drugs"	-0,31	-0,45	-0,09
Federal decree on a balanced budget	**-0,53**	**0,6**	0,17
Popular initiative for the protection of life and environment against genetic engineering	0	0,38	**-0,51**
Popular initiative "Switzerland without secret police"	0,03	0,25	**0,77**
Federal law on truck tolls based on engine size	-0,16	**0,75**	-0,2
Popular initiative for well-priced foodstuffs and ecological farms	0,36	**0,71**	-0,14
Popular initiative "10th revision of the Aged and Bereaved Insurance without raising the retirement age"	0,29	0,02	**-0,84**
Federal decree on building and financing public transport infrastructure	-0,2	**0,62**	0,15
Federal decree for a temporary article in the Swiss Federal Constitution on grain	0,15	**0,52**	**0,51**
Popular initiative for a prudential drug policy	**0,59**	0,47	0,02
Amendment to the federal law on labor in trade and industry	0,41	0,46	-0,32
Federal decree on changes to the eligibility for membership of the Federal Council	0,3	0,4	**0,55**
Federal decree on constitutional regulations on organ transplantation	**0,65**	0,01	0,05
Popular initiative "house ownership for everyone"	-0,09	-0,12	0,28
Amendment to the federal law on spatial planning	0,39	-0,45	-0,11
Federal decree on a new Swiss Federal Constitution	**0,82**	-0,02	-0,31
Federal law on asylum	0,27	**0,7**	0,23
Federal decree on asylum and foreigners	-0,15	0,47	**0,62**
Federal decree on the medical prescription of heroin	-0,05	0,46	**0,61**
Federal law on disability	0,37	-0,13	0,11
Federal law on maternity insurance	**0,7**	-0,23	**-0,57**
Federal decree on reforming the judiciary	0,11	**0,76**	-0,04
Popular initiative for speeding up direct democracy	**-0,56**	**0,56**	0,04
Popular initiative for a just representation of women in federal authorities	**0,64**	0,36	0,2
Popular initiative for the protection of men against manipulations in procreation technology	-0,2	0,19	-0,04
Popular initiative on halving motorized road traffic	0,49	0,11	-0,47
Federal decree authorizing sectoral agreements between Switzerland and the European Union	**0,81**	-0,15	-0,01
Popular initiative on promoting solar energy	0,14	**0,73**	0,08
Federal decree on the popular initiative on promoting solar energy (counter-proposal)	0,16	**0,6**	-0,17
Federal decree on the popular initiative on energy efficiency (counter-proposal)	0,35	**0,5**	-0,06
Popular initiative for regulating immigration	-0,09	0,29	**-0,54**
Popular initiative "more rights for people thanks to referendums with counter-proposals"	**-0,75**	0,2	0,18
Popular initiative against raising the female retirement age	0	0,28	**0,8**
Popular initiative for a flexible retirement age for men and women from 62 years on	-0,22	0,04	**-0,5**
Popular initiative on economizing on military and defense-for more peace and seminal jobs	**0,59**	-0,07	**-0,65**

Popular initiative for lower hospital expenses	0,42	-0,14	**-0,77**
Federal law on federal employees	0,37	-0,18	**-0,78**

Table A.3: Factor scores for the period 2001-2010

Vote	**Factor 1**	**Factor 2**	**Factor 3**
Popular initiative on joining the European Union	-0,28	-0,2	**0,7**
Popular initiative on lowering medicine prices	0,23	0,14	**0,63**
Popular initiative on lowering the urban speed limit to 30 km/h	**0,72**	**0,52**	-0,13
Amendment to the federal law on the Swiss army I	**0,67**	-0,16	0,32
Amendment to the federal law on the Swiss army II	0,14	-0,06	0,3
Federal decree on abolishing the requirement for a permit to establish a diocese	**0,73**	-0,15	0,27
Federal decree on expenditure	0,07	0,42	**0,53**
Popular initiative for an assured Aged and Bereaved insurance - tax on energy instead of work	0,06	**0,54**	0,16
Popular initiative for an authentic security policy and a Switzerland without army	0,17	**-0,64**	0,13
Popular initiative "Solidarity creates security: for a voluntary civilian peace service"	0,4	**0,7**	0,09
Popular initiative for a capital gains tax	0,4	**0,76**	0,08
Popular initiative on joining the United Nations	**0,87**	0,22	0,15
Popular initiative to reduce working hours	0,31	**0,79**	0,06
Amendment to the penal code regarding abortion	**0,67**	0,17	0,15
Popular initiative for mother and child	**-0,6**	-0,03	-0,21
Popular initiative on adding surplus gold reserves to the country's pension fund	-0,06	**-0,54**	0,46
Federal decree on the popular initiative on adding surplus gold reserves to the country's pension fund (counter-proposal)	0,45	0,27	0,27
Federal law on the electricity market	**-0,64**	-0,11	-0,03
Popular initiative against misuse of asylum rights	0,14	**-0,7**	0,15
Federal law on compulsory unemployment insurance and compensation for insolvencies	**-0,65**	-0,43	0,04
Federal decree on reforming the referendum process	0,24	-0,11	0,37
Federal decree on changing the cantonal contribution to financing hospital medication	0,44	0,05	0,03
Federal law on the Swiss army	0	0,23	**0,6**
Federal law on civil defense	0,2	**0,65**	0,36
Popular initiative "yes to fair rents"	0,1	**0,76**	0,22
Popular initiative for one Sunday a season free from motor vehicles-a test for four years	0,18	**0,85**	0,13
Popular initiative "health has to be affordable"	**0,7**	0,1	0,12
Popular rights for equal rights for the disabled	0,21	**0,83**	0,06
Popular initiative "electricity without nuclear power"	**0,73**	0,07	0,05
Popular initiative for prolonging the ban on new nuclear power stations	0,08	**0,88**	0
Popular initiative for a sufficient provision of vocational education	0,12	**0,85**	-0,03

Federal decree on the popular initiative for safe and efficient motorways (counter-proposal)	-0,37	**-0,61**	0,42
Amendment to the Obligations law	**-0,57**	0,1	-0,03
Popular initiative "life-long custody for non-curable, extremely dangerous sexual and violent criminals"	0,16	-0,22	-0,12
Amendment to the federal law on Aged and Bereaved insurance	**0,57**	-0,06	0,36
Federal decree on financing the Aged and Bereaved insurance	0,23	**-0,72**	0,23
Federal law that would affect taxation for married couples, families, private housing and stamp duty	0,25	**-0,54**	0,18
Federal decree on ordinary and facilitated naturalization (2nd generation)	**0,8**	0,48	-0,18
Federal decree on ordinary and facilitated naturalization (3rd generation)	**0,79**	0,48	-0,22
Popular initiative "postal services for all"	**0,68**	**0,61**	-0,23
Federal law on compensating members of the armed forces for loss of earnings	-0,08	**0,75**	-0,28
Federal decree on rebalancing the financial duties of the Federation and the Cantons	**0,64**	-0,02	0,09
Federal decree on the constitutional reordering of the budget	0,26	-0,13	0,01
Federal law on stem cell research	**0,71**	0,19	-0,07
Federal decree on Switzerland joining the Schengen Area	**0,65**	-0,07	**0,5**
Federal decree on whether registered partnerships for same-sex couples should be introduced	**0,91**	0,24	0,03
Federal decree on extending the agreement on free movement of people to new members of the European Union	**0,91**	0,08	0,07
Federal decree on the popular initiative for food from an agriculture free of genetic modification (counter-proposal)	0,42	-0,39	0,49
Federal labor law related to the opening times of shops in public transport hubs	-0,11	**0,55**	-0,25
Amendment to the constitutional article on education	**0,6**	-0,06	-0,06
Popular initiative on diverting profits from the Swiss National Bank into the national pension fund	**-0,52**	**-0,68**	0,24
Federal law on foreigners	**-0,53**	**-0,69**	0,16
Amendments to the federal law on asylum	-0,13	**0,74**	0,14
Federal law on assistance to Poland and other poorer EU countries	**0,86**	0,15	0,14
Amendment to the family allowances law	0,3	**0,58**	0,01
Popular initiative for a social unified health insurance	0,26	**0,83**	-0,2
Amendment to the disability insurance law	-0,13	**-0,8**	0,09
Popular initiative against fighter aircraft noise in tourism areas	0,35	**0,61**	0
Federal law on the corporate tax reform	0	**-0,6**	-0,11
Popular initiative for democratic naturalization	-0,4	**-0,65**	0,41
Popular initiative against publicly funded information campaigns by the government	**-0,73**	**-0,52**	0,24
Amendment to the constitutional article on health insurance	**-0,72**	-0,37	0,21
Popular initiative for the elimination of the statute of limitations with respect to pornographic crimes against children	-0,15	0,01	**0,73**
Popular initiative for a flexible retirement age	0,2	-0,12	**0,68**

Popular initiative for the restriction of the right of associations to appeal against building projects	**-0,6**	0	0,28
Popular initiative for a sensible cannabis policy with effective protection of the youth	-0,01	**0,85**	-0,05
Amendment to the federal law on narcotics	-0,13	-0,39	-0,19
Federal decree on approving the renewal of the EU-Switzerland bilateral agreement on free mobility	**0,87**	0,09	-0,04
Constitutional article "Future with complementary medicine"	0,47	-0,22	0,24
Federal decree on the introduction of biometric passports	**0,5**	0,47	-0,25
Federal decree on a limited increase of the value added tax to continue financing the disability insurance	**0,75**	-0,01	0,05
Federal decree on accepting the decision not to introduce the generic popular initiative	**0,7**	0,46	0,02
Federal decree on aviation fuel taxation	**0,64**	-0,23	0,24
Popular initiative "ban on exporting war supplies"	0,41	**0,64**	0,08
Popular initiative against the construction of minarets	**-0,81**	-0,29	0,01
Amendment to the constitutional article on research on humans	0,01	0,03	**0,76**
Popular initiative on providing enhanced legal protection for animals	0,05	**-0,64**	0,07
Amendment to the federal law on Aged and Bereaved insurance	**0,79**	0,21	-0,01
Amendment to the federal law on unemployment benefits	-0,06	**-0,83**	0,17
Popular initiative for the deportation of foreign criminals	**0,53**	0	0,25
Federal decree on the popular initiative for the deportation of foreign criminals (counter-proposal)	0,1	**0,68**	0,14
Popular initiative for fair taxes	**-0,82**	-0,32	0,04

Table A.4: Factor scores for the period 2011-2017

Vote	**Factor 1**	**Factor 2**	**Factor 3**
Popular initiative for the protection against gun violence	0,49	**0,67**	0,06
Popular initiative "an end to the limitless construction of second homes"	0,31	0,04	**0,57**
Popular initiative for tax-supported building society savings to buy living space for self-use and to finance energy saving and environmental measures	**0,84**	0,07	-0,01
Popular initiative "six weeks of vacation for everyone"	0,4	**0,53**	-0,17
Federal decree on using the state earnings from gambling for the public interest	**0,69**	0,27	-0,3
Federal law on the fixed book price agreement	0,44	-0,02	**-0,62**
Popular initiative on assistance with savings for home buyers	**-0,55**	-0,06	**0,53**
Popular initiative on reinforcing popular rights in foreign policy	-0,17	**-0,71**	0
Amendment to the federal law on healthcare	0,26	0,04	**-0,53**
Federal decree on the popular initiative on promoting music lessons for youth (counter-proposal)	-0,21	-0,29	0,09
Popular initiative on secure housing in old age	0,43	0,41	0,07
Popular initiative on a smoking ban	**0,5**	0,2	-0,07

Amendment to the federal law on animal diseases	0,42	**0,65**	-0,33
Federal decree on family policy	-0,03	0,15	**0,67**
Popular initiative against rip-off salaries	0,38	-0,35	**0,53**
Amendment to the federal law on spatial planning	**0,75**	0,49	-0,24
Popular initiative on the direct election of the Federal Council	**-0,73**	-0,21	0,14
Urgent modification of the federal law on asylum	-0,09	**-0,66**	-0,03
Popular initiative on the abolition of compulsory military service	**0,76**	0,43	0
Amendment to the federal law on epidemics	-0,19	0,34	-0,17
Amendment to the federal law on labor in trade and industry	0,42	**0,6**	-0,39
Popular initiative on fair wages	-0,25	**0,51**	0,21
Popular initiative on tax credits for stay-at-home parents	**0,74**	-0,28	0,2
Amendment to the federal law on road taxation	-0,32	**-0,75**	0,06
Federal decree on the popular initiative on financing and developing the railway infrastructure (counter-proposal)	**-0,59**	**-0,6**	0,29
Popular initiative on abortion	-0,31	**-0,87**	0,09
Popular initiative against mass immigration	0,46	**0,64**	-0,21
Federal decree on the popular initiative on primary health care (counter-proposal)	**0,86**	0,06	0,18
Popular initiative on a lifetime ban on convicted pedophiles working with children	**-0,77**	-0,42	0,12
Popular initiative on minimum wages	0,41	0,47	0,04
Federal law on the procurement of the JAS 39 Gripen fighter aircraft	0,49	-0,48	**-0,55**
Popular initiative on the value added tax for the hospitality industry	**0,86**	0,21	-0,1
Popular initiative for a unified health insurance fund	0,21	-0,44	-0,3
Popular initiative for the abolition of the flat tax	0,03	-0,23	**0,8**
Popular initiative "Stop overpopulation (ECOPOP)"	-0,16	**-0,81**	0,25
Popular initiative on gold reserves	-0,08	**-0,83**	0,08
Popular initiative for the exemption of family allowances from income tax	0,03	0,17	**0,51**
Popular initiative on a non-renewable energy tax	0,44	-0,18	-0,32
Federal decree on the constitutional article on reproductive medicine	0,45	-0,02	**0,68**
Popular initiative on scholarships	**0,82**	0,28	-0,01
Popular initiative on inheritance taxes	**0,51**	**0,61**	-0,1
Amendment to the federal law on radio and television	**0,51**	**0,62**	-0,35
Popular initiative for the couple and the family - No to the penalty of marriage	**0,71**	-0,08	0,38
Popular initiative for the actual deportation of foreign criminals (implementation initiative)	**-0,61**	-0,4	0,06
Popular initiative "No speculation on food"	-0,21	**-0,91**	-0,1
Amendment to the federal law on road transit in the Alpine region	0,03	**-0,6**	-0,22
Popular initiative for the public service	0,31	**-0,52**	0,35
Popular initiative for a basic income	**0,77**	0,13	0,29
Popular initiative for fair transport financing	0,22	**0,82**	0,15

Amendment to the federal law on medically assisted reproduction	-0,19	**-0,71**	0,01
Amendments to the federal law on asylum	0,47	**0,61**	-0,39
Popular initiative for a green economy	**0,79**	0,37	0,15
Popular initiative on the retirement system	**0,86**	0,04	0,01
Federal law on intelligence	-0,03	0,36	-0,43
Popular initiative for the programmed phase-out of nuclear energy	**0,75**	0,4	0,07
Federal decree on the simplified naturalization of third-generation immigrants	**0,51**	**0,76**	-0,09
Federal decree on establishing a fund for national roads and urban traffic	-0,02	0,49	**-0,52**
Federal law on the corporate tax reform	-0,03	0,26	**-0,74**
Federal law on energy	**0,52**	**0,65**	-0,2

Appendix 3.B – Results of Dunn's tests

"Left-Right" dimension

Table B.1: Results of Dunn's tests on median income on the "Left-Right" dimension

Median income (1981-1990)

	Left	**Not Significant**
Not Significant	-3.84 p < 0.001	
Right	2.36 p = 0.009	6.97 p < 0.001

Median "Left" = 32'500

Median "Not Significant" = 34'000

Median "Right" = 32'250

Median income (1991-2000)

	Left	**Not Significant**
Not Significant	-10.21 p < 0.001	
Right	-9.69 p < 0.001	-1.37 p = 0.09

Median "Left" = 44'350

Median "Not Significant" = 48'050

Median "Right" = 48'500

Median income (2001-2010)

	Left	**Not Significant**
Not Significant	-0.87 p = 0.57	
Right	-0.75 p = 0.34	-0.02 p = 0.49

Median "Left" = 54'967

Median "Not Significant" = 56'000

Median "Right" = 55'925

Median income (2011-2017)

	Left	**Not Significant**
Not Significant	4.24 p < 0.001	
Right	7.91 p < 0.001	5.23 p < 0.001

Median "Left" = 61'800

Median "Not Significant" = 59'550

Median "Right" = 56'600

Table B.2: Results of Dunn's tests on the Gini coefficient of the income distribution on the "Left-Right" dimension

Gini coefficient of the income distribution (1981-1990)

	Left	**Not Significant**
Not Significant	1.96 p = 0.02	
Right	7.70 p < 0.001	7.91 p < 0.001

Median "Left" = 0.317

Median "Not Significant" = 0.308

Median "Right" = 0.290

Gini coefficient of the income distribution (1991-2000)

	Left	**Not Significant**
Not Significant	4.85 p < 0.001	
Right	3.09 p = 0.002	-1.14 p = 0.13

Median "Left" = 0.329

Median "Not Significant" = 0.316

Median "Right" = 0.318

Gini coefficient of the income distribution (2001-2010)

	Left	**Not Significant**
Not Significant	3.34 p = 0.001	
Right	2.39 p = 0.01	-0.49 p = 0.31

Median "Left" = 0.316

Median "Not Significant" = 0.310

Median "Right" = 0.310

Gini coefficient of the income distribution (2011-2017)

	Left	**Not Significant**
Not Significant	8.56 p < 0.001	
Right	10.15 p < 0.001	3.64 p < 0.001

Median "Left" = 0.360

Median "Not Significant" = 0.336

Median "Right" = 0.328

“Liberal-Conservative” dimension

Table B.3: Results of Dunn’s tests on median income on the “Liberal-Conservative” dimension

Median income (1981-1990)

	Conservative	**Not Significant**
Not Significant	-9.29 p < 0.001	
Liberal	-9.39 p < 0.001	2.96 p = 0.002

Median “Conservative” = 30’775

Median “Not Significant” = 33’600

Median “Liberal” = 34’850

Median income (1991-2000)

	Conservative	**Not Significant**
Not Significant	-4.65 p < 0.001	
Liberal	-9.66 p < 0.001	7.55 p < 0.001

Median “Conservative” = 45’650

Median “Not Significant” = 47’125

Median “Liberal” = 50’050

Median income (2001-2010)

	Conservative	**Not Significant**
Not Significant	-9.58 p < 0.001	
Liberal	-18.11 p < 0.001	13.51 p < 0.001

Median “Conservative” = 52’200

Median “Not Significant” = 55’800

Median “Liberal” = 62’500

Median income (2011-2017)

	Conservative	**Not Significant**
Not Significant	-9.77 p < 0.001	
Liberal	-17.59 p < 0.001	12.73 p < 0.001

Median “Conservative” = 54’200

Median “Not Significant” = 59’150

Median “Liberal” = 68’400

Table B.4: Results of Dunn's tests on the Gini coefficient of the income distribution on the "Liberal-Conservative" dimension

Gini coefficient of the income distribution (1981-1990)

	Conservative	**Not Significant**
Not Significant	-7.20 p < 0.001	
Liberal	-12.48 p < 0.001	9.17 p < 0.001

Median "Conservative" = 0.279

Median "Not Significant" = 0.304

Median "Liberal" = 0.335

Gini coefficient of the income distribution (1991-2000)

	Conservative	**Not Significant**
Not Significant	-9.45 p < 0.001	
Liberal	-11.55 p < 0.001	5.03 p < 0.001

Median "Conservative" = 0.304

Median "Not Significant" = 0.322

Median "Liberal" = 0.338

Gini coefficient of the income distribution (2001-2010)

	Conservative	**Not Significant**
Not Significant	-7.55 p < 0.001	
Liberal	-10.93 p < 0.001	6.36 p < 0.001

Median "Conservative" = 0.297

Median "Not Significant" = 0.311

Median "Liberal" = 0.331

Gini coefficient of the income distribution (2011-2017)

	Conservative	**Not Significant**
Not Significant	-8.27 p < 0.001	
Liberal	-14.19 p < 0.001	9.89 p < 0.001

Median "Conservative" = 0.317

Median "Not Significant" = 0.337

Median "Liberal" = 0.371

“Ecological-Technocratic” dimension

Table B.5: Results of Dunn’s tests on median income on the “Ecological-Technocratic” dimension

Median income (1981-1990)

	Ecological	**Not Significant**
Not Significant	5.57 p < 0.001	
Technocratic	3.59 p < 0.001	-1.21 p = 0.11

Median “Ecological” = 34’700

Median “Not Significant” = 33’050

Median “Technocratic” = 33’117

Median income (1991-2000)

	Ecological	**Not Significant**
Not Significant	0.71 p = 0.24	
Technocratic	3.34 p < 0.001	3.37 p = 0.001

Median “Ecological” = 48’000

Median “Not Significant” = 47’400

Median “Technocratic” = 45’938

Median income (2001-2010)

	Ecological	**Not Significant**
Not Significant	3.52 p < 0.001	
Technocratic	7.52 p < 0.001	5.90 p < 0.001

Median “Ecological” = 58’000

Median “Not Significant” = 55’925

Median “Technocratic” = 53’150

Median income (2011-2017)

	Ecological	**Not Significant**
Not Significant	-2.01 p = 0.03	
Technocratic	-2.64 p = 0.01	-1.20 p = 0.12

Median “Ecological” = 58’400

Median “Not Significant” = 59’400

Median “Technocratic” = 60’300

Table B.6: Results of Dunn's tests on the Gini coefficient of the income distribution on the "Ecological-Technocratic" dimension

Gini coefficient of the income distribution (1981-1990)

	Ecological	**Not Significant**
Not Significant	3.97 p < 0.001	
Technocratic	-0.25 p = 0.40	-4.26 p < 0.001

Median "Ecological" = 0.311

Median "Not Significant" = 0.302

Median "Technocratic" = 0.315

Gini coefficient of the income distribution (1991-2000)

	Ecological	**Not Significant**
Not Significant	11.34 p < 0.001	
Technocratic	6.87 p < 0.001	-2.46 p = 0.007

Median "Ecological" = 0.343

Median "Not Significant" = 0.313

Median "Technocratic" = 0.318

Gini coefficient of the income distribution (2001-2010)

	Ecological	**Not Significant**
Not Significant	5.85 p < 0.001	
Technocratic	4.90 p < 0.001	0.43 p = 0.33

Median "Ecological" = 0.323

Median "Not Significant" = 0.308

Median "Technocratic" = 0.307

Gini coefficient of the income distribution (2011-2017)

	Ecological	**Not Significant**
Not Significant	-4.40 p < 0.001	
Technocratic	-13.02 p < 0.001	-11.74 p < 0.001

Median "Ecological" = 0.327

Median "Not Significant" = 0.333

Median "Technocratic" = 0.373

Conclusions

As the world becomes more and more globalized, by connecting national and local economies and creating a single world economy, the relevance of geographical proximity increases, despite some having claimed that spatial distances would no longer represent an obstacle. In fact, in the last decades there has been an increase in the urbanization process, in which people and economic activities are more and more concentrated in cities, and spatial proximity has become even more important in processes of knowledge spillovers and agglomeration externalities. This is due to the fact that traditional globalization, characterized by trade relationships over long distances and involving countries producing different types of goods, has evolved into modern globalization, characterized by trade relationships between neighboring countries with similar economic systems. The general perception about globalization is that it is based on the competition over the costs of inputs. Nevertheless, although this was true for traditional globalization, modern globalization is based on adding value into the production process, which crucially depends on knowledge exchange, especially through face-to-face interactions. As the importance of knowledge increases, so does the need for concentration, because of productivity gains due to clustering, proximity and economies of scale. However, although the evidence demonstrating the growing importance of geographical proximity keeps increasing, various actors in the society argue that this is not true and support a view in which the world is flat and distances are no longer important. Narratives built on these incorrect arguments might have significant consequences and make it difficult to build serious debate within a society.

This thesis proposes three essays on the importance of geographical concentrations and aims at enriching the current discussion on the relevance of spatial proximity by providing empirical evidences demonstrating that geographical distance still matters in various and specific contexts. In particular, this thesis deals with topics regarding firm's credit accessibility, the interaction between culture and agglomeration externalities, and the interaction between political ideologies and economic welfare.

In the first chapter, the analyses empirically verifies whether agglomeration spillovers affect a particular indicator of firm performance, namely firm solvency, which, in turn, determines firm's ability to borrow. While most of the past analyses on agglomeration economies focus on their effects on self-reported indicators of firm performance, such as employment growth or productivity, this study offers an analysis on these effects on firm solvency, which is computed from an external and standardized perspective. Moreover, this variable is accessible to everyone and helps financial markets to reduce asymmetries in information faced when deciding whether to grant credits to firms.

The results show that agglomeration mechanisms shape firm's credit accessibility, along with the characteristics of the firm itself and geographical information. As highlighted by the economic literature, this has in turn implications on firm's investment possibility and therefore on their ability to strengthen their productivity. Additionally, by simultaneously analyzing firm- and regional-level data and applying spatial multilevel techniques, the results indicate that the geography of agglomeration mechanisms not only is important per se, but it also differently shapes the transmission mechanism of other effects.

The second chapter empirically examines whether the spatial scale of different types of agglomeration spillovers shape and/or are shaped by cultural and soft institutional discontinuities, as reflected by linguistic differences between localities. Traditional analyses generally do not include issues of culture, thereby neglecting whether and how various cultural environments may impact on the externalities arising from the concentration of firms. This study contributes to the literature by investigating whether the existence of language barriers, expressing underlying cultural differences, has an impact on the geographical extension of the benefits that firms might gain from being located near to other business activities.

The findings of this study demonstrate that the economic geography of agglomeration spillovers is mediated and altered by linguistic discontinuities and this has not been modelled nor considered before. More specifically, the results indicate that specialization externalities are enhanced when firms are located close to municipalities with the same language, whereas competition and diversity externalities are reinforced when firms are located close to municipalities with different languages. These findings support other scholars, who argue that culture influences also other aspects of economic geography.

Finally, the third chapter proposes a new definition of spatial cohesion, based on the geographical concentration of political ideologies, which represents a new way to capture social interactions. Moreover, this study investigates whether there is any spatial concentration of political ideologies and verifies whether these concentrations are correlated with income and income inequality. The underlying hypothesis is that partisan-sorting forces and income-sorting processes are interrelated phenomena leading to the clustering of people having similar political ideologies and analogous levels of income.

The results of this study indicate the existence of spatial concentrations of Swiss municipalities sharing the same political ideology, showing that, interestingly, this type of social interactions extends beyond municipal borders. Additionally, this research finds significant differences in the level of income and income inequality of Swiss municipalities, depending on their

belonging to a political ideology cluster. This result contributes and further supports the findings and claims of other scholars, according to which economic geography is particularly important in understanding how people vote.

In general, the findings of the analyses contained in this thesis contribute to the current discussion on the importance of geographical proximity, by empirically demonstrating that distance still represents an obstacle for various processes in economics, against the view that the world has become "flat". These results further support the findings and claims of other scholars, arguing that, along with the rise of globalization processes, spatial proximity has become even more important. More specifically, the findings of this thesis shed light on unexplored aspects of agglomeration processes and demonstrate the importance of geographical proximity in the cases of firm's credit accessibility, the interaction between agglomeration externalities and language barriers, expressing underlying cultural differences, and the interaction between political ideologies and economic welfare. Hence, the results of this thesis indicate that clustering forces involving people and firms shape and are shaped by the working of social aspects like trust, culture and political ideologies.

These findings are particularly interesting because they emerge from the Swiss context, a small open economy in which globalization processes have always had great impacts and where distances are notably small. It seems therefore logical to assume that if spatial proximity matters on a small scale, it also does on a large one. In fact, this hypothesis is supported and demonstrated by an increasing number of studies. Hence, spatial proximity still matters.