Evaluating Decentralization Reform and Its Links to Economic Development and Improved Public Service Provision.

A thesis

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of

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by

Juan C. Taborda Burgos

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Dissertation Committee

Katrina Burgess Ph.D.

(Committee Chair)

The Fletcher School at Tufts University

Jenny Aker Ph.D.

(First Reader)

The Fletcher School at Tufts University

Steven Block Ph.D.

(Second Reader)

The Fletcher School at Tufts University

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Curriculum Vitae

Education

The Fletcher School at Tufts University *Medford, MA*

Ph.D. Candidate in International Relations *Aug. 2014 - Present*

- Concentration: Development Economics & International Political Economy

Hertie School of Governance *Berlin, Germany*

Master of Public Policy *2011*

- Concentration: Public Management

Los Andes University *Bogota, Colombia*

Bachelor of Arts *2009*

- Major: Political Science
- Concentration: Colombian Politics & International Relations

Los Andes University *Bogota, Colombia*

Law Degree *2008*

- Concentration: Public Law
- Minors: Economics & History

Other Training

ICPSR Summer Program in Quantitative Methods *2017*

- University of Michigan

IQMR Summer Program in Qualitative and Multi-Method Research *2016*

- Syracuse University

Experience

Tufts University – The Fletcher School, Econometric Impact Evaluation *Medford, MA*

Econometric Impact Evaluation T. A. & Co-teaching Fellow for Professor Jenny Aker Ph.D. *Spring & Fall 2017*

- Taught laboratory session to assist with problem sets and Stata assignments
- Helped students clarify their concepts and correctly apply methods to complete their assignments
- Held and designed weekly office hours for Stata consultations and learning of Stata coding

Tufts University – Experimental College, Latin America: Development & Policy-Making *Medford, MA*

Instructor of Record *Spring 2017*

- Instructor of record for Undergraduate level course teaching on Latin America development policies and policy-making process
- Developed syllabus and course content, including exams and final projects, with a mix of academic and practitioner literature

Tufts University – Community Health, Quantitative Research Methods using Stata *Medford, MA*

Quantitative Research Methods Teaching Assistant for Professor Andrea Acevedo, Ph.D. *Fall 2017*

- Lectured two sessions and contributed in the designing, delivering, and evaluation of the course
- Held weekly office hours and review sessions to discuss students' assignments and final projects

Tufts University – Sociology Department, Quantitative Research Methods *Medford, MA*

Quantitative Research Methods Teaching Assistant for Professor Jill Weinberg J.D., Ph.D. *Fall 2016*

- Taught laboratory session for 18 students each week
- Assisted teacher with classroom instruction, exams, record-keeping, and other miscellaneous projects
- Held weekly office hours and review sessions before exams

Tufts University – Fletcher School Ginn Library *Medford, MA*

Instructor for Stata & LaTeX Workshops *Sept. 2016 - Present*

- Teach workshops introducing students to Stata and its basic commands to perform statistical analysis
- Teach workshops introducing students to LaTeX and its basic environments and document classes
- Help students in one-on-one sessions to troubleshoot their questions about Stata and their own research projects
- Design the workshops, agenda, workshop code, and tools to assess learning outcomes

Tufts University – Geospatial Technology Services & Tisch Library *Medford, MA*
Geospatial Technician & Data-Lab Assistant *May 2015 - Present*
- Provide GIS and statistical software consultations to Tufts students and faculty
- Perform geospatial analyses, statistical analyses and other informational techniques on geographical data

Colombian National Planning Department (DNP) *Bogota, Colombia*
Advisor Level 3/3 *Oct. 2011 - July 2014*
- Served on project teams working with international partners including the OECD and the World Bank
- Co-drafted and supervised the implementation of territorial planning and development policies
- Provided technical and methodological assistance to strengthen the capabilities of local governments
- Coordinated with national and regional entities to produce policy advice, reports or regional analyses, and reviewed and drafted legal and public policy documents for decision making and policy implementation

Los Andes University – AECOM – USAID *Bogota, Colombia*
External Consultant *June 2013 - Sept. 2013*
- Researched and drafted guidelines to help with the implementation and operation of the Colombian Restorative Justice System
- Introduced criterion and methodologies to characterize territorial entities, enabling the drafting of differential public policies that respond to the endogenous attributes of each region

Mejor en Bici *Bogota, Colombia*
External Consultant *Aug. 2011 - Sept. 2011*
- Reviewed the NGO's strategy and business plan and produced a report with a road-map towards an improved strategic management system
- Recommended and designed a proposal to draft a new strategic plan to introduce public management tools to monitor the NGO's performance

Hertie School of Governance *Berlin, Germany*
Research Assistant for Professor Mark Hallerberg *May 2010 - June 2011*
- Assisted project related to Political Systems, Institutional Design and Fiscal Policies in Latin America between 1986 and 2010, funded by the Inter-American Development Bank
- Elaborated, coded, and cleaned databases both in Excel and Stata for research projects

Grants, Scholarships, & Awards

2017	**Hitachi Center for Technology and International Affairs for Graduate Student Research**, Awarded grant to conduct Quantitative Methods training and dissertation research	*Medford, MA*
2017	**Fletcher Educational Enrichment Fund**, Awarded grant to conduct Quantitative Methods training and dissertation research	*Medford, MA*
2017	**Tufts Graduate Institute for Teaching**, Awarded grant to provide training for students seeking university-level academic careers	*Medford, MA*
2016	**Robyn Gittleman Teaching Fellow**, Awarded grant to provide training for graduate students developing teaching skills	*Medford, MA*
2016	**Institute for Qualitative and Multi-Method Research**, Awarded grant to participate in the summer session training in sophisticated qualitative research designs	*Syracuse, NY*
2014-2015	**Tufts University Provost Fellow**, Awarded grant aimed at recognizing and retaining Tufts University best doctoral applicants	*Medford, MA*
2014	**Colfuturo – Colciencias**, Awarded scholarship to pursue doctoral degree in the U.S.	*Bogota, Colombia*
2013	**Fulbright – Ecopetrol**, Awarded scholarship to pursue doctoral degree focusing on Regional Development Studies in the U.S.	*Bogota, Colombia*
2009	**International Institute of Human Rights**, Awarded scholarship to attend the 40th session	*Strasbourg, France*
2009	**Kettering Foundation – Best Study in Democracy**, Awarded prize for best thesis	*Bogota, Colombia*

Publications

Taborda, J. C. (2016, October 7). *"Was the Colombian plebiscite result foreseeable?"*
Retrieved from https://www.jctaborda.com/research

Castrellón, M., Taborda Burgos, J. C. y Vargas Gómez, J. (2015). *"Los retos de los comités territoriales de justicia transicional en la implementación de la Ley de Víctimas."* Revista de Derecho Público, 34. Universidad de los Andes (Colombia). ISSN1909-7778

Aguilar, C. et. al. (2015)*" Tipologías Municipales de Colombia: Herramienta para la consolidación de regiones desarrolladas."* Boletín Regional, Úrbano y Ambiental. IPEA . – n. 1– Brasilia. ISSN: 2177-1847

Taborda, J.C. (2011) *"What matters for Education: The effect of Performance Management, Fiscal and Budget policy reforms in PISA."* MPP Master Thesis.

Bermúdez, F., & Taborda, J. C. (2009). *"Los estados de excepción en Colombia: ¿Un diseño institucional adecuado para el balance de poderes?"* Documento CESO N 164. Bogotá: Ediciones Uniandes. ISSN: 1657-4508

Professional Affiliations

**International Studies Association; Latin American Studies Association;
Inter-university Consortium for Political and Social Research (ICPSR) Summer
Program Alumni; Institute for Qualitative and Multi-Method Research Alumni;
Fulbright Foreign Program Student & Alumni; Becarios Colfuturo**

Peer Refereeing

Journal of African Economies

Conference Presentations & Seminars

Latin American Studies Association – Annual Convention   *Lima, Peru*
Paper presenter: Linking Decentralization and Economic Development   *May 2017*

Theorizing (Dis)Order – World Peace Foundation Seminar   *Somerville, MA*
Panel Discussant for Decentralization, National and Sub-National Governance panel   *March 2017*

International Studies Association – Annual Convention   *Atlanta, GA*
Paper presenter: Decentralization as a Peacebuilding Mechanism in Colombia   *March 2016*

New England Council of Latin American Studies – Annual Meeting   *Medford, MA*
Paper presenter: Linking Decentralization and Economic Development in Colombia: a proposal to
evaluate if decentralization is conditional on endogenous characteristics of territories   *Nov 2015*

Languages & IT Skills

- Spanish (Native)
- English (Native)
- French (Intermediate)

- Microsoft Office Package
- Stata Statistical Package
- R
- Python
- JAGS & WinBUGS
- LaTeX
- ArcGIS

- QGIS
- GEODA Geospatial Analysis
- MIC-MAC Prospective Analysis Software
- ENVI + IDL
- Google Earth Pro

Abstract

During the last three decades, decentralization reform has been a leading trend in policy-making reform. The recurrent argument is that decentralization is linked to increased economic development and improved public service provision. This dissertation attempts to evaluate the validity of this assumption. To do so, it uses a three-paper approach to evaluates the outcomes of decentralization reform from different perspectives and on different dimensions.

The first paper uses a geographic regression discontinuity design to estimate that on average a higher level of decentralization at a border implies an average decrease in annual GDP growth. These findings evidence a negative relationship between decentralization and annual GDP growth which are both statistically and economically significant at the one percent level. These results invite a rethinking of decentralization's effects and its implementation process.

The second paper focuses on the impact of decentralization reform on Colombia's agricultural extension services. The paper argues that decentralization reform introduced significant changes in the sector. Borrowing from Evans, Hirschman and Snyder, it proposes a framework to explain why the institutional reform led to heterogeneous effects on different products and types of farmers within the sector. Integrating these changes into traditional narratives leads to a better understanding of the last twenty-five years of decline of the Colombian agricultural sector.

The third paper is an impact evaluation of a public bicycle sharing system. Public transport systems, like bicycle sharing schemes, are typically under the control of local authorities —due to decentralization designs. Hence, this impact evaluation assesses if a private actor can provide a quasi-public good in the absence of action

by the local authority. This paper presents an impact evaluation with a difference-in-difference quasi-experimental design that allows identification and estimation of the treatment effect of a bicycling encouraging intervention. Furthermore, in an attempt to evaluate the effect that a bicycle sharing intervention can have on workers' productivity or well-being, this paper presents an instrumental variable design informing future research on the effect of active commuting by bicycle.

Approaching decentralization from these very different perspectives allows a better understanding of the intricacies of decentralization and the way these processes contribute to economic development or better public service provision.

Dedication

To my parents, family, and friends, for all their love and support.

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Many people played an instrumental role in helping me develop the ideas that resulted in this dissertation and the culmination of my doctoral studies. I must begin by acknowledging the contribution of my dissertation chair, Professor Katrina Burgess. She assisted me in navigating throughout my Ph.D. studies and always provided critical advice and support during the writing stage of this dissertation. Another notable influence was my first reader, Professor Jenny Aker. Her mentorship guided me through this process and pointed me to the skills I was looking for when I enrolled in the Ph.D. program. I would also like to extend my thanks to Professor Block, who as a second reader always provided valuable feedback and insight. I am extremely lucky to have the support of such a great committee, and hope that some day I live up to their example as exceptional teachers and rigorous researchers.

Aside from the members of my committee, I wish to mention Professors Bulutgil and Shaffner at the Fletcher School, Professors Florance and Srinivasan at Tufts, Professor Paarlberg at the Kennedy School, and Professor Eaton at UC Santa Cruz. Their classes or general expertise in specific topics were fundamental in making this document come to its final version. Besides these specific acknowledgments, I wish to thank the many professors I had during my Ph.D. studies who provided me with useful skills and knowledge that were fundamental in developing this research. I also wish to thank the staff of the Fletcher School and Ph.D. Director Jenifer Burkett-Picker for their support. I would like to acknowledge Ann Marie Decembrele at the Registrar's Office and the teams at the Admissions Office and Ginn Library. Their work made getting into the program, passing comprehensive exams, conducting my

out with this research endeavor. I am truly sorry that he has not lived to see me graduate, although I hope that he would be proud of this dissertation.

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Chapter 1

Introduction

The widespread assumption that decentralization promotes development has motivated the push for decentralization since the 1980s, even with little supporting empirical evidence. As Eaton and Connerley (2010, 9-10) explain this assumption is based on two key arguments: i) that decentralization improves the mix and quality of goods provided by the government; and ii) that decentralization under certain conditions can encourage growth-promoting behaviors by competing sub-national governments, thereby generating higher economic development. This dissertation presents three independent articles, all of which address the need to better evaluate and analyze decentralization processes. By taking three very different approaches, the research designs in this dissertation allow a holistic understanding of the impact of decentralization reform on both economic development and public service provision.

1.1   A Working Definition of Decentralization

The first challenge in studying decentralization is defining what decentralization means. The most simple definition is one that frames the concept as a devolution of power, authority, and responsibility for public functions from the central government to intermediate and local authorities (Lipset (1995), O'Neill (2003), Oxhorn et al. (2004) and OECD and KIPF (2013)). Some authors criticize this definition in that it assumes the process of decentralization is a one-time static game that is always initiated by the central government (Riker (1964), Wunsch and Olowu (1989),

Rodden (2004), Ziblatt (2006), Falleti (2010), Smoke (2010), or Dickovick (2011)). These authors explain that decentralization is instead a process where authority shifts within the levels of government, across multiple dimensions. They also argue that the process or demand for decentralization can be initiated both at the national or at the local level. This dissertation does not aim to add to the ongoing debate on what constitutes decentralization. Instead, its contribution is to present empirical evidence on the effect of decentralization on economic development and propose an analytic framework that allows an understanding of divergent outcomes of the implementation of decentralization.

Consequently, this dissertation assumes a working concept of decentralization, that is generally in line with the prevalent definition. For the purpose of this dissertation, and the papers that compose it, decentralization is defined as a type of institutional reform that involves the transfer of competences between different levels of government in three policy areas: administrative, fiscal, or political. Furthermore, I assume that while decentralization always requires the devolution of competences to the local level, under certain circumstances it does not increase the autonomy or power for sub-national governments. Finally, this working concept recognizes that decentralization is a multidimensional term that affects different sectors of public policy and that its outcomes reflect preferences and asymmetries between different actors at different levels of government.

1.2   Overarching Research Questions

This dissertation is trying to answer three overarching research questions:

1. Does decentralization have an impact on economic development and public service provision?

2. How does decentralization reform modify the political economy of public policy making, and do shifts in the political economy have an impact on public policies?

3. How can public service provision be modified by the introduction of private

actors under a scenario of decentralization reform?

Given the nature of these overarching research question, this dissertation is itself a stepping-stone to the broad discussion of decentralization and development. Furthermore, each of the papers contributes individually and as a whole in the extensive literature of decentralization.

1.3 Scholarly Contribution of Individual Papers

1.3.1 Paper 1: Linking Decentralization and Economic Development

The first article will focus on a grand scale approach to understanding the link between decentralization processes and economic development. To evaluate this relationship the paper uses a geographic regression discontinuity to evaluate the causal effect between the variables of interest. This large N analysis studies local governments of 39 countries along 35 unique international borders, resulting in a methodological solution overcoming the issue of endogeneity that traditionally plagues quantitative studies related to decentralization. Furthermore, the paper generates new data for economic development that allows for a robust cross-country comparison at the local level. Consequently, one of the scholarly contributions of the paper is to utilize remote sensing techniques to have an outcome variable for economic growth at the sub-national level that is comparable across countries. Furthermore, by combining these new data with a quasi-experimental design it is possible evaluate the effect decentralization has on economic development of border municipalities. The key finding is that, on average, a higher decentralization at the border is associated with a decrease of GDP growth, evidencing a negative relationship between decentralization and economic development which is both statistically and economically significant at the one percent level. Providing empirical evidence on the relationship between decentralization and economic development for border territories, and discussing mechanisms that explain these results, allows for a better understanding of how the impact of decentralization is conditional upon

the underlying characteristics of a given sub-national authority.

1.3.2 Twenty-five Years of Agricultural Decline: Does Decentralization Reform Explain the Decline of Agricultural Extension Services in Colombia?

The second paper of the dissertation focuses on agricultural development policy in Colombia, and how the decentralization process affected the institutional design of the sector. Studies of the Colombian agricultural sector tend to rely on two traditional explanations for the sector's decline in the last decades. However, these traditional narratives —i) liberalization reform of the 1990s, and ii) the side-effects of armed conflict and drug trafficking— fail to explain why there are heterogeneous performances among types of farmers, departments, and products. The paper argues that it was precisely decentralization reform what helps explain the generalized decline of agriculture and, more importantly, its varied outcomes. The article proposes a framework, drawing on concepts by de Waal, Evans, Hirschman, and Snyder, that illuminates the unintended consequences of decentralization reform on the agricultural sector, and particularly on the provision of extension services. Using the proposed framework, the paper explains the divergent outcomes of the decentralization reform, leading to an understanding and clarification of the heterogeneity in the performance of different farmers, departments, and crops. An additional substantive contribution of this paper is that the analytic framework proposed should also be able to be used to evaluate the effects of decentralization in other countries or other public policy sectors.

1.3.3 It really is Mejor en Bici: An Impact Evaluation of a Bicycle Sharing System in Bogota, Colombia

The third paper provides an impact evaluation of Mejor en Bici$^{\text{TM}}$— a private bicycle sharing system in Bogota. Within a framework of decentralization, local authorities are free to determine the type of public service provision in their jurisdiction. When focusing on transport and public mobility, municipalities have the autonomy

to choose different arrangements as to how they provide these quasi-public goods to people. Some cities will design and run their transport system relying only on the local public transport authority. Others will coordinate with private actors and privatize the operation, the design of parts, or the totality of the system. Finally, there are cities who choose not —or are not able— to exercise their local competences, allowing private actors to intervene in the provision of quasi-public goods.

In the evaluation of the intervention of Mejor en Bici, the research studies how privatization can play a role in the provision of quasi-public goods. Mejor en Bici's business model operates and is possible, given the absence of a public bicycle sharing system in Bogota, and the incapacity of the city to provide reliable and convenient transport alternatives to its citizens. Furthermore, this third paper contributes to other fields of study related to the literature on sustainable transport and active commuting as a mechanism to improve health conditions. To my knowledge, this paper is the first to present an impact evaluation of a bicycle sharing system that allows for identifying and estimating a treatment effect of a bicycle encouraging intervention. Moreover, in an attempt to evaluate the secondary effects of bicycle sharing systems, the paper proposes an instrumental variable design that informs future research on the impact active commuting by bicycling has on productivity and well-being of individuals.

1.4 Addressing the Gaps in the Literature of Decentralization

The key motivation for this dissertation was addressing a gap in the literature that is evidenced by the lack of empirical evidence sustaining the relationship between decentralization and development. This gap is explained because of three factors. The first is related to the lack of reliable measures for decentralization. Decentralization is a concept that is hard to grasp and evaluate. When aggregate measures or indicators have been compiled, they usually evaluate decentralization's outcomes at the national level. This is particularly problematic given that decentralization is a reform that intends specifically to impact sub-national levels of government. Hence,

evaluating the reform process with a national lens risks omitting the underlying impacts at the sub-national level. Addressing this particular issue motivated the creation of a sub-national outcome variable that allows for a cross-national comparison in paper one, which in turn allows to compare the cross-country effects of decentralization.

The second issue is that some decentralization literature imagines the process as a set reform. Hence, there is an assumption that once the institutional reform is designed and formally adopted, the implementation follows both the intent and spirit of the reformers. While this vision has been widely criticized, advocates of decentralization push decentralization reform without a deep comprehension of the underlying political economy that determines the outcomes of the process. This dissertation draws attention to this flaw in decentralization reform implementation by studying the Colombian agriculture sector. This case study evidences how the implementation of the reform was reinterpreted by local actors, restructuring provision of extension services and modifying the outcomes of the sector.

The last flaw in most studies of decentralization is the lack of reliable data and methodological designs that addresses the issues of endogeneity or reverse causality. Papers one and three present rigorous methodological approaches that take into account these issues and allow the evaluation of the effect of decentralization reform on outcomes from a service that is provided thanks to the autonomy granted by decentralization.

Approaching decentralization from these different perspectives will lead to a better understanding of the intricacies of decentralization processes and the way these contribute to economic development or public service provision. Addressing the issue through three papers also informs the complex topic of decentralization from different perspectives.

1.5   Structure of the Dissertation

The rest of this dissertation will proceed as follows: Chapter 2 presents paper one of the dissertation, which evaluates the link between decentralization and economic

development. While the results are constrained to the sample of municipalities being analyzed ,this provides an large scale approach to evaluate the links between the variables of interest. This paper also includes the discussion of mechanisms that can explain the empirical results. Chapter 3 contains the second paper which performs an in-depth case study of the Colombian agricultural sector. This paper also develops the analytic framework on the effect decentralization reform can have on public service provision, and how changes in the political economy of a sector can happen due to decentralization. Comprehending the framework and the shift in political economy allows for an understanding of why decentralization can have heterogeneous outcomes across sectors or sub-national authorities. Chapter 4 presents paper number three which evaluates the impact of a bicycle sharing system. This evaluation shows how private actors can play a role in providing a public service in a scenario of decentralized autonomy at the local level. Finally, Chapter 5 summarizes the overall theme of the dissertation, the results from each individual paper, and the results of the papers taken as a whole.

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Chapter 2

Paper 1: Linking Decentralization and Economic Development

Abstract

Linking decentralization and development was the common assumption that motivated the push for decentralization during the last decades of the 20th century. Yet, there is little empirical evidence that supports this assumption. This paper uses a geographic regression discontinuity design that estimates that on average a higher level of decentralization at a border implies an average decrease in annual GDP Growth that ranges between 0.19 and 0.42 percentage points —depending on the model specification. These findings evidence a negative relationship between decentralization and annual GDP growth which are both statistically and economically significant at the one percent level. These results invite a rethinking of the decentralization process. The underlying idea, as with other models of policy diffusion, is that one-size-fits-all models should be sidelined and institutional designs should acknowledge internal characteristics of sub-national authorities.

2.1 Introduction

The question of how decentralization reform can produce a positive impact on democratization, economic development, or peace building is recurrent in the fields of Development Economics, International Political Economy, and Comparative Politics. It is also an unanswered question. Even though decentralization reform is one of the leading trends during the last few decades, there is little empirical evidence as to how it affects the social, political, and economic development of sub-national authorities.

There are multiple reasons for the lack of empirical evidence sustaining the relationship between decentralization and development. As Siegle and O'Mahony (2010, 142) explain, reliable cross-national analyses on decentralization are seriously constrained by the shortage of comparable measures across a sufficiently large sample of countries to make generalizations. Furthermore, measuring the outcomes of decentralization processes at the sub-national level is problematic since there are few comparable data at the local administrative level. Moreover, even when data are available, the issue of endogeneity challenges the validity of some empirical methods.[1]

Nevertheless, the claim that decentralization and development are linked has been treated as a stylized fact by multilateral organizations or actors who support this type of institutional reform. Eaton and Connerley (2010, 9-10) explain that these organizations have presented two key arguments to justify this claim. First is the argument that decentralization improves the mix and quality of goods provided by the government. Second, decentralization under certain conditions can encourage growth-promoting behaviors by sub-national governments who compete among themselves, thereby generating higher economic development. But as Eaton and Connerley (2010) state, there is still a gap in the literature that looks at decentralization from a cross country perspective. Even van Houten (2013), who argues in favor of the positive effect decentralization has on economic development, acknowl-

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[1]Some of the economic development literature has advanced on this regard providing theoretical models or evaluating the effect decentralization has on economic development. For example, see Bardhan (2002), Besley and Coate (1997), or Hoffmann et al. (2017).

edges the need for further research to explore how territorial organization of the state affects the emergence and performance of sub-national economic clusters and districts (van Houten, 2013, 150).

This paper attempts to bridge these gaps in the literature by using a geographic regression discontinuity design to evaluate the causal effect between the variables of interest. This methodological solution allows overcoming the issue of endogeneity that tends to plague quantitative studies related to decentralization. It also uses new data that allows for robust cross-country comparison.

Given that a key challenge of studying decentralization is the lack of comparable data at the sub-national level, the paper relies on remote sensing techniques to have an outcome variable for economic growth that is comparable across countries. Remote sensing is the acquisition of information about an object using satellite or high altitude aircrafts. In this case, the paper uses satellite imagery of Lights at Night —as utilized by Henderson et al. (2012)— to provide a proxy for economic growth. The research also uses remote sensing to acquire information about baseline or control variables required to satisfy the quantitative method's identifying assumption. To measure decentralization, the paper uses the Regional Authority Index as operationalized by Marks et al. (2008) and Hooghe et al. (2016). This measure has been accepted by the literature as a valid cross-country indicator of decentralization. For example, in *Measuring Fiscal Decentralization* the `OECD` shows how the Regional Authority Index highly correlates with traditional measures for decentralization (OECD and KIPF, 2013). This paper finds that on average a higher decentralization level at the third level governments at the international border is associated with a decrease of GDP growth ranging from -0.19% to -0.42%. These findings evidence a negative relationship between decentralization and annual GDP growth which are both statistically and economically significant at the one percent level.

The remainder of the paper is organized as follows. Section two presents an overview of the methodological approach of the paper, including detailed explanations of the identifying assumption for the regression discontinuity design, and the

data used. Section three introduces the main empirical findings, including a more in-depth analysis on South America —the region where more borders of interest are located— and a discussion of possible mechanisms that explain the results. The paper concludes with a brief discussion of the results and relevant policy implications.

2.2 Methodological Approach

A regression discontinuity design is an econometric method that takes into account the existence of an arbitrary threshold that causes similar observations to be distinguished from each other. The argument is that, near the arbitrary cutoff, the level of treatment received by individual observations can be considered as if randomly assigned. The underlying idea is that the discontinuity introduced by the thresholds results in similar observations having very dissimilar results. This method has also taken advantage of geographic discontinuities. The justification is that administrative borders arbitrarily divide local administrative units in a way such that entities close to the boundary are statistically indistinguishable from their counterparts on the other side of the border.

There are multiple examples of geographic regression discontinuities evaluating a wide variety of topics. Ferwerda and Miller (2014) explore how devolving governing powers to local authorities decreased levels of resistance across the German Vichy border.[2] Michalopoulos and Papaioannou (2011) also use a geographic regression discontinuity to explore the effect of local institutions on economic development in countries in Africa. Aker et al. (2014) use the geographic discontinuity to examine the additional costs incurred in cross-border trade or ethnically distinct markets. Finally, Ali et al. (2014) use a geographic regression discontinuity design to estimate the effect of a land tenure regularization program in Rwanda. All of these examples rely on the same assumption, that at a small distance on both sides of the border, administrative authorities, markets, or households can be treated as equal.

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[2]In "What's a line" Kocher and Monteiro (2015) contest the identifying assumption of Ferwerda and Miller, arguing that in fact Vichy dominated communes were significantly different from their German counterparts particularly because of disparities in the availability of strategically valuable targets. Hence, it is this disparity that defies the identification assumption and that leads to higher violence levels.

2.2.1 Data

The unit of observation for this paper are administrative level 3 authorities from 39 countries. These are equivalent to Counties in the United States, or Municipalities in Mexico or Colombia. The data for the Regional Authority Index (RAI) are available for the years between 1950 and 2010. Once the countries of interest were identified, the paper uses the GADM spatial dataset from Boundaries Without Limits (2015). This dataset provides the polygons of the world's administrative areas (or administrative boundaries). The reduction from the original 81 country sample from the Marks et al. (2008) dataset is due to the focus on contiguous borders, as the regression discontinuity design requires the disruption introduced by the boundary.[3] Finally, of the 51 countries that were left, the analysis focuses only on borders where a country with high level of decentralization neighbors a country with objectively low levels of decentralization — dropping 12 additional countries from the data. The justification to restrict the sample to this set of countries is to make sure that the comparison at the border is really looking at countries with different levels of decentralization. Following the RAI documentation, countries with scores under 11 points are considered to have objectively low decentralization.

Taking into account the borders between countries available in the RAI dataset, and the restrictions to fulfill the research design, administrative level 3 entities that are within five kilometers of those boundaries were selected. This process resulted in the selection of 1,718 administrative units of interest distributed in 35 unique borders.[4] Map 2.1a represents the boundaries of interest in Central America. Map 2.1b shows the borders of interest in South America. Map 2.1c presents the borders of interest in Europe, and Map 2.1d shows the borders of interest in South East Asia.[5] On average there are 49 local entities per border, but borders vary widely ranging from five (Peru - Chile) to 383 (Spain - Portugal) entities per border.

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[3]Aside from the 30 countries that were eliminated because that do not have contiguous neighbors, five additional countries were eliminated from the data given that they clearly fail to pass the identifying assumption (like the border between Dominican Republic and Haiti or where the relative level of decentralization between countries changes during the time period).

[4]When the model includes institutional variables the number of level 3 entities decreases to 1,610 authorities due to data constraints.

[5]For the legends in all Maps the first country in the border of interest represents the country with higher level of decentralization in the border. All maps created by author.

Figure 2.1: Borders of Interest

(a) Map of North & Central America

(b) Map of South America
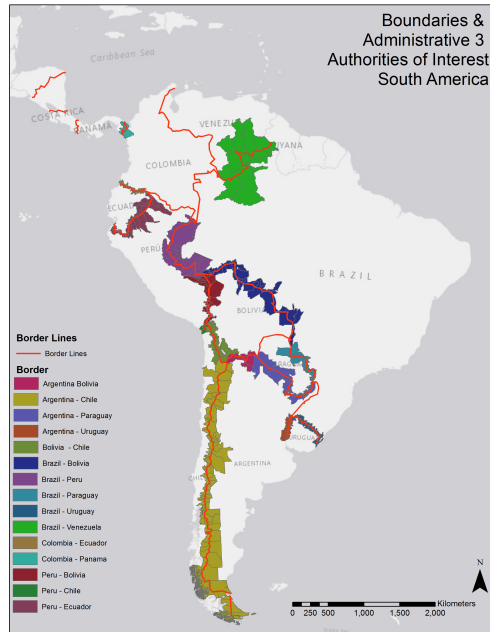
(c) Map of Europe
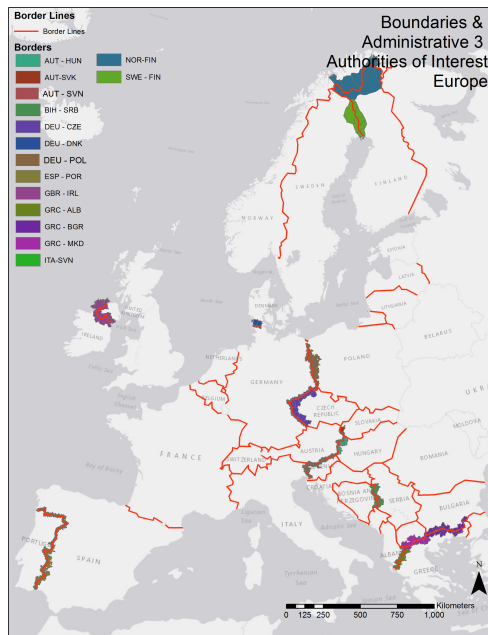
(d) Map of South East Asia
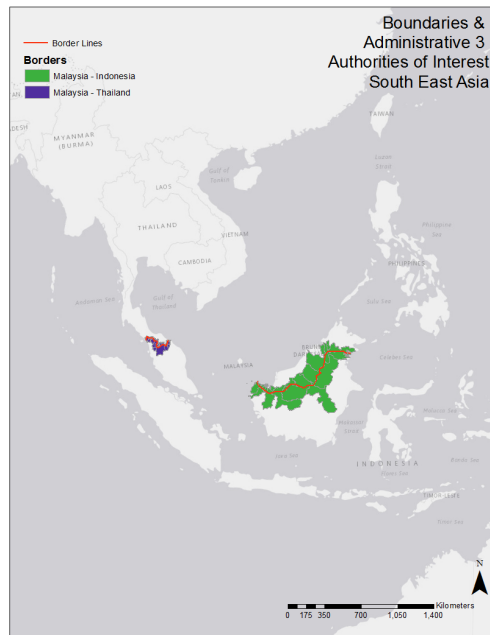
For the outcome variable —economic growth— the data used is the Lights at Night (LaN) Dataset from the National Oceanic and Atmospheric Administration. These data recorded by the Defense Meteorological Satellite Program-Operational Linescan System, provides a time series between 1992 and 2013. Cloud-free composites provide nighttime obsevations of lights and combustion sources worldwide.[6] Henderson et al. (2012) show how it is possible to estimate a proxy for GDP growth from these images. Furthermore, both Henderson et al. (2012) and Hodler and Raschky (2014) have shown that the relationship between the log of regional GDP and the log of average nighttime light intensity is linear and similar for country groups with different incomes. While the authors acknowledge the data is not as precise as GDP calculation, it offers a valid proxy for economic development that is comparable for sub-national authorities across countries.

Additionally, for country specific control variables model (3) also includes six variables from the World Bank Worldwide Governance Indicators project (Bank, 2016). The report constructs aggregate indicators of six broad dimensions of governance including: (i) Voice and Accountability, (ii) Political Stability and Absence of Violence/Terrorism, (iii) Government Effectiveness, (iv) Regulatory Quality, (v) Rule of Law, and (vi) Control of Corruption. These indicators are based on 31 underlying data sources reporting the perceptions of governance of a large number of survey respondents and expert assessments worldwide. The time period of the study (1996-2010) results from the intersection of these time series —the RAI index, the LaN dataset, and the World Bank WGI.

To test for heterogeneous effects the paper uses World Bank (2017) country by income classifications and by region. Finally, to generate the baseline test characteristic comparisons, the research relies on multiple sources as noted in the Data Appendix.

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[6]For more on this dataset see NOAA (2017).

Identifying Assumption

The identifying assumption for the regression discontinuity is that after controlling for border specific and country year effects, local administrations close to the border are indistinguishable from each other, except for different levels of decentralization. Therefore, to fulfill the identifying assumption the paper must show a discontinuity in GDP growth that happens at the border, and then determine which level of administrative authorities are comparable.

A McCrary (2008) test was used to evaluate the statistical significance of the discontinuity at the border. Graph 2.2 presents the result of the Mc Crary test using distance to the border as the running variable. The forcing variable xstar is distance in Km. to the border.[7] The value of the discontinuity is -0.19 with a standard error of 0.008. A two-tail t-test that evaluates the null hypothesis of continuity provides a t-statistic of -24.347. Hence, it is possible to reject the null hypothesis, suggesting that there is a discontinuity at the threshold. This implies there is a jump in GDP growth at the border, which is consistent with the results of previous research like the one done by Michalopoulos and Papaioannou (2011) or Pinkovskiy (2017).

Figure 2.2: McCrary Test
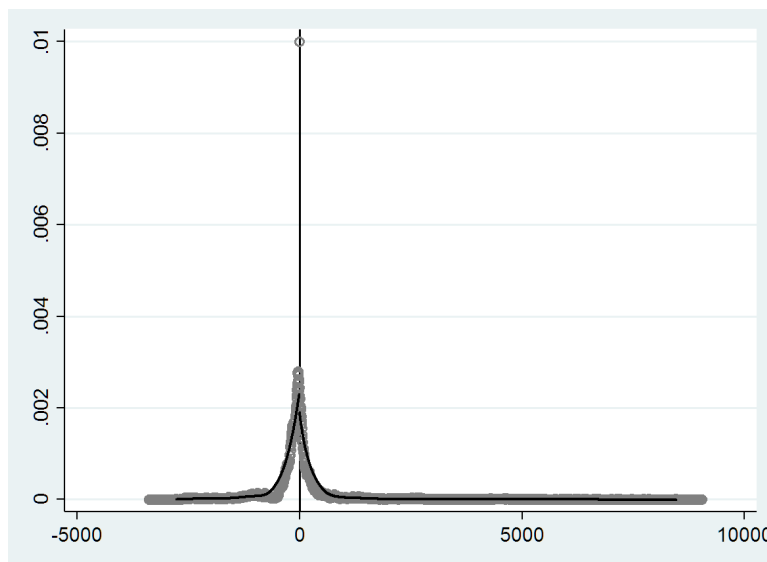
A traditional geographic regression discontinuity design would then proceed to

[7]The negative distance is the distance of Admin. 3 level authorities that have lower levels of decentralization at the border.

use distance to the border as a forcing variable, and evaluate how at different distances observations are comparable or not. Regression discontinuities recognize that, on average, observations at each side of the threshold are different. However, given the assignment rule, the design can identify a bandwidth close to the decision rule —in this case the border— where observations are as similar to each other as if randomly assigned. The literature on geographic regression discontinuity designs usually looks at distance to the border as the forcing variable, traditionally using bandwidths of 5 to 40 Kms. to select the observations to compare. In the case of this paper, the selection process follows a slightly different approach. First, it identifies the level of sub-national authority to compare, and then it determines the bandwidth of closeness to the border to choose the sub-national authorities.

Data for the paper are available at the second administrative level (equivalent to States in the U.S., Provinces in Argentina, or Departments in Colombia) and at the third administrative level — which is the next administrative level under the equivalent of states or departments. The first attempt was testing if at the second level, states or departments contiguous to the borders were similar to each other as if randomly assigned. On average second level authorities were significantly different at each side of the border. This happens due to the size of their jurisdictions, that includes territories that are too far away from the border. Hence, it is clear that the unit of observation must be the third administrative level which are local levels of government in the sense of counties or municipalities.

Table 2.1 presents an overview of different characteristics of local level administrations. Of the variables compared, local administrations that have higher levels of decentralization tend to have lower GDP (as measured by LaN in 1996), lower number of migrants, higher average precipitation and higher drought risk.

Aside from these differences local administrations are indistinguishable in levels of GDP or Population in 1990[8], area, risk of flooding events, average temperature, or elevation. Given the differences in baseline characteristics, some models will include controls for baseline level of economic growth and institutional capacity, and —by

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[8]The significant reduction in the sample of observations for GDP in 1990 and Population in 1990 is due to the pixels of the raster and the impossibility to extract unique information to polygons that have such a small area.

including country year fixed effects— it will control for time invariant characteristics like drought risk or average precipitation.[9] These results are consistent with findings presented by Pinkovskiy (2017), who concludes that discontinuities in economic growth are mainly driven by national policies, and not by special sets of borders, geographic or climatic conditions, or local variations on public goods like roads, railroads or utility lines.

Table 2.1: Balance Test Administrative Level 3 Characteristics

VARIABLES	Higher [†] Decentralization Coeff (s.e.)	Lower Decentralization Mean (s.d.)	Observations
GDP 1990	0.179	1.026	215
(Billions US$ PPP)	(0.989)	(3.175)	
GDP growth 1996	-1.779***	-2.445	1,278
(as measured by LaN)	(0.681)	(2.129)	
Population 1990	100,951	196,272	215
(Inhabitants)	(245,534)	(570,299)	
Area	-0.211	0.174	1,695
(sq. Km.)	(0.180)	(0.529)	
Average Precipitation	30.18*	116.448	1,710
(For January in Mm.)	(15.58)	(64.583)	
Migration	-3,995***	-247.165	1,710
(Net Migrants)	(1,457)	(7,005)	
Flood Risk	-0.427	5.884.	1,265
(Index units 1-10 range)	(0.780)	(2.866)	
Drought Risk	2.739***	3.429	783
(Index units 1-10 range)	(1.039)	(3.481)	
Average Temperature	-0.412	11.588	1,710
(For January in °Celsius)	(0.990)	(10.472)	
Elevation	-42.28	698.941	1,695
(MAMSL)	(209.9)	(826.581)	
Number of Borders	34		
Number of Countries	39		

†All regressions control for country year and border fixed effects. Robust standard errors are presented in parentheses. *** p<0.01, * p<0.05, * p<0.1

As explained before the same balance tests were run including level 3 authorities that are not contiguous to the border, that would be equivalent to a larger

[9]While temperature and precipitation vary on a yearly basis, the available data provides average yearly temperatures and precipitations for "contemporary" climates.

bandwidth (up to 40 km. to the border) and level 2 authorities, finding statistically significant differences between observations and violating the identifying assumption. For this reason, the sample for the regression discontinuity design consist exclusively of municipalities that are contiguous to the border.

2.3 Empirical Findings

2.3.1 Estimation Strategy

The geographic regression discontinuity design used by this paper relies on national boundaries where countries with higher level of decentralization converge with countries with objectively low levels of decentralization. By focusing only on local administrations close to the borders and accounting for how they differ on the level of decentralization it is possible to observe a local Average Treatment Effect of a higher level of decentralization.

This paper begins by using three regression specifications to determine the effect of decentralization on economic growth. The main variation between models relates to the inclusion of border specific fixed effects and the inclusion of control variables for country institutional quality. All these are fixed effect data transformations.

Equation 2.1 includes the basic specification of the model where ΔGDP_{it} is the growth of GDP as measured by the LaN data[10], $Higher\ Decentralization_i$ is a dummy variable that identifies which side of the border has a higher decentralization level according to the RAI dataset. As explained before all observations coded one have at least a score of 11 in the RAI index, and all observations coded zero have a RAI score lower than 11. Finally, θ_i are geographic fixed effects at the country level.

$$\Delta GDP_{it} = \beta_0 + \beta_1 Higher\ Decentralization_i + \theta_i + \varepsilon_{it} \qquad (2.1)$$

Model 2, whose estimation is described in Equation 2.2, also includes α_i which are

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[10]Following Hodler and Raschky (2014) the nightlights as prediction for ΔGDP are measured as the $ln(\frac{Light\ Intensity + 0.01}{Area})$ where *Light Intenisty* is a value between 0 and 63, as coded in the original LaN Data.

fixed effects at the border level, understanding that borders have unique characteristics that differentiate them from each other.

$$\Delta GDP_{it} = \beta_0 + \beta_1 Higher\ Decentralization_i + \theta_i + \alpha_i + \varepsilon_{it} \qquad (2.2)$$

The third model described by Equation 2.3 includes similar specifications as model two with regards to border and country-year fixed effects. However, it also includes $GDP\ 1996_i$, to control for differences in the initial economic levels of development and $Inst1996_i$ to control for difference in initial institutional capacity. The measure for institutional capacity is the average of the six variables from the World Bank Governance Indicators project in 1996.

$$\Delta GDP_{it} = \beta_0 + \beta_1 Higher\ Decentralization_i + \beta_2 GDP1996_i + \beta_3 Inst1996_i + \theta_i + \alpha_i + \varepsilon_{it}$$
$$(2.3)$$

Finally, the fourth model controls for varying institutional capacity by including $\mathbf{X}'$ which are variables that describe the institutional capacity of each country as measured by the six variables from the World Bank Worldwide Governance Indicators project.

$$\Delta GDP_{it} = \beta_0 + \beta_1 Higher\ Decentralization_i + \beta_2 GDP1996_i + \beta_3 Inst1996_i + \mathbf{X}' + \theta_i + \alpha_i + \varepsilon_{it}$$
$$(2.4)$$

All models will estimate a local Average Treatment Effect, and to that extent it is important to note that the results presented here, while informing the debate on the relationship of decentralization and development, have an embedded lack of external validity.[11]

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[11]For more on this debate on the relevance of experimental or quasi-experimental methods, and the validity of regressions discontinuity designs see: Lee and Lemieux (2009) or Imbens (2010).

2.3.2 Results

The results of the quantitative analysis are reported in Table 2.2. In all model specifications a higher level of decentralization at the border shows a statistically significant negative effect on economic growth. Overall, administrative level 3 authorities that had higher decentralization had on average lower economic growth.

The necessary question that follows is whether these are economically significant results. Following Henderson et al. (2012) and Hodler and Raschky (2014) estimations, it is possible to transform the coefficient in the models to estimate the equivalent to regional GDP growth, assuming the elasticity to be 0.3. Hence, the coefficient of -0.638 in model (1) translates to a $\Delta GDP\%$ of -0.19%. Model (2) suggests an average GDP growth difference of -0.32%, model (3) implies an average GDP growth difference of -0.32%, and model (4) implies a GDP growth difference of -0.42%. Given the average growth rates for the countries in the sample it is safe to state that these results are both statistically and economically significant.

With regards to the other coefficients included in the model, having a higher GDP in 1996 (as measured by LaN), predicts an on average higher GDP growth throughout the period. A more interesting case are the coefficients on the baseline institutional capacity, which suggests higher scores lead to lower economic development. These results call for future research that allows better understanding of how national institutions are related to local institutions. However, because of data constraints, it is hard to find alternative measures of institutional capacity to validate these findings.

These results are also consistent under different model specifications, like when using the component of the Regional Authority Index that focuses only on local administration's self-rule or when using the institutional depth dimension that evaluates whether the local government is autonomous rather than deconcentrated . The findings are also robust at the administrative level 2, but the identifying assumption is not fulfilled since states are significantly different at each side of the border.

Table 2.2: Regression Analysis for the Effect of Higher Decentralization on Economic Growth from 1996 to 2010

VARIABLES	(1) Δ GDP (measured by LaN)	(2) Δ GDP (measured by LaN)	(3) Δ GDP (measured by LaN)	(4) Δ GDP (measured by LaN)
Higher Decentralization	-0.638*	-1.064***	-1.064***	-1.401***
	(0.3424)	(0.3911)	(0.3911)	(0.4704)
GDP 1996			0.463***	0.490***
			(0.0483)	(0.0557)
Inst 1996			-0.773***	-1.007***
			(0.1937)	(0.3066)
Control of Corruption				0.129
				(0.1353)
Rule of Law				-0.054
				(0.1936)
Regulatory Quality				-0.162
				(0.1148)
Government Effectiveness				0.210*
				(0.1160)
Political Stability				-0.098
				(0.0958)
Voice and Accountability				-0.033
				(0.1710)
Country-Year Fixed Effects	✓	✓	✓	✓
Border Fixed Effects		✓	✓	✓
Observations	24,585	24,585	24,545	19,594
R^2	0.552	0.583	0.583	0.592

Model (1) includes country year fixed effects. Model (2) and (3) control for country year fixed effects and border fixed effects. Robust standard errors in parenthesis.

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

2.3.3 South America

To try to better understand the empirical findings this section will focus exclusively on South America[12], which is the region where most borders of interests are located, as can be observed in Table 2.3.

Table 2.3: Local Authorities per World Region

World Region	Number of Borders of Interest	Number of Level 3 Administrative Authorities
South America	15 (42.86%)	536 (31.20%)
Eastern Europe	10 (28.57%)	524 (30.50%)
Western Europe	7 (20.00%)	538 (31.32%)
South East Asia	2 (5.71%)	75 (4.37%)
Central America	1 (2.86%)	45 (2.62%)

First, it is relevant to note that restricting the model for only South American borders produces robust results to those presented previously as it can be seen in table 2.4.[13] For the case of South America, having a higher decentralization level at the border predicts on average a decrease on GDP growth ranging between 0.18 and 0.41 percentage points. Also, as observed above, both baseline measures for GDP and institutional capacity in 1996 have statistically significant coefficients. To unpack these findings it is relevant to describe both the levels of decentralization and economic growth of the South American countries and some broad descriptions of the borders that are being studied.

Among the countries in South America, there are varying profiles of decentralization. Figure 2.3 presents the different scores of decentralization of each of the South American countries. There are countries like Argentina, Brazil, and Colombia which have maintained high levels of decentralization and local autonomy through the time of the study. Argentina and Brazil have long lasting histories of federalism and decentralization that have resulted in strong authority at the sub-national levels. Colombia, while being a unitary state, ranks highly on different measures of

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[12]While Panama is not a South American country its border with Colombia is considered as one of the borders of interest located in the continent, and therefore the country is included in this analysis.

[13]As does if one restricts the analyses to Western Europe, Eastern Europe, South East Asia, or Central America.

Table 2.4: Regression Analysis for the Effect of Higher Decentralization on Economic Growth from 1996 to 2010 in South America

VARIABLES	(1) Δ GDP (measured by LaN)	(2) Δ GDP (measured by LaN)	(3) Δ GDP (measured by LaN)	(4) Δ GDP (measured by LaN)
Higher Decentralization	-0.633*	-1.074***	-1.074***	-1.391***
	(0.3449)	(0.3934)	(0.3934)	(0.4761)
GDP 1996			0.790***	0.850***
			(0.1703)	(0.2441)
Inst 1996			-1.005***	-1.275***
			(0.2048)	(0.6096)
Control of Corruption				0.149
				(0.3471)
Rule of Law				0.387
				(0.4623)
Regulatory Quality				0.125
				(0.3541)
Government Effectiveness				-0.496
				(0.4440)
Political Stability				0.021
				(0.2045)
Voice and Accountability				-0.154
				(0.3967)
Country-Year Fixed Effects	✓	✓	✓	✓
Border Fixed Effects		✓	✓	✓
Observations	7,133	7,133	7,133	5,672
R^2	0.126	0.210	0.210	0.216

Model (1) includes country year fixed effects. Model (2) and (3) control for country year fixed effects and border fixed effects. Robust standard errors in parenthesis.

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

decentralization since the constitutional reforms of the 1980s and the beginnings of the 1990s.

A more complicated story is the one of Bolivia, Peru, Uruguay and Venezuela. These countries have varying levels of decentralization between 1996 and 2010. Because of this variation, and to fulfill the methodological assumptions, some of the borders of these countries have no observations for some years. For example, observations for the borders between Brazil and Peru, Argentina and Uruguay, or Brazil and Uruguay are only valid for years where Peru or Uruguay had scores with objectively low levels of decentralization. Bolivia changed from a centralized unitary country to a plurinational unitary state that granted higher autonomy to the local level. Venezuela experienced an opposite process changing from a decentralized federalist country to a highly centralized federalist country, which also results in some observations being dropped of the analysis.

Within the region there are also countries like Chile, Ecuador, Panama, or Paraguay which have institutional designs that remain highly centralized for all the period of observations. All these countries are unitary presidential republics, that have long-established traditions of centralism where the national government remains the key player both in fiscal and administrative policies. Some of these experienced a move towards political decentralization at the local level, but by comparative standards remain highly centralized entities.

With regards to economic growth, South America is a region that experienced volatile economic development between 1996 and 2010. The nineties were characterized by high levels of economic volatility including the mid 1990s "tequila crisis" which affected the currencies of Brazil and the Southern Cone countries, and the aftermath of the Russian and Asian crises that led to generalized fiscal crises throughout the region. The 2000s were marked by the boom in commodities that favored most of the countries in South America, providing stable growth up to 2007 when the economies suffered in the aftermath of the 2008 Financial Crisis.

The national and estimated gdp growths for South American countries and borders can be observed in graph 2.4. Two relevant issues should be noticed on the

Figure 2.3: Decentralization Profiles in South America

Graphs by Country. Red line is threshold for high or low levels of decentralization.
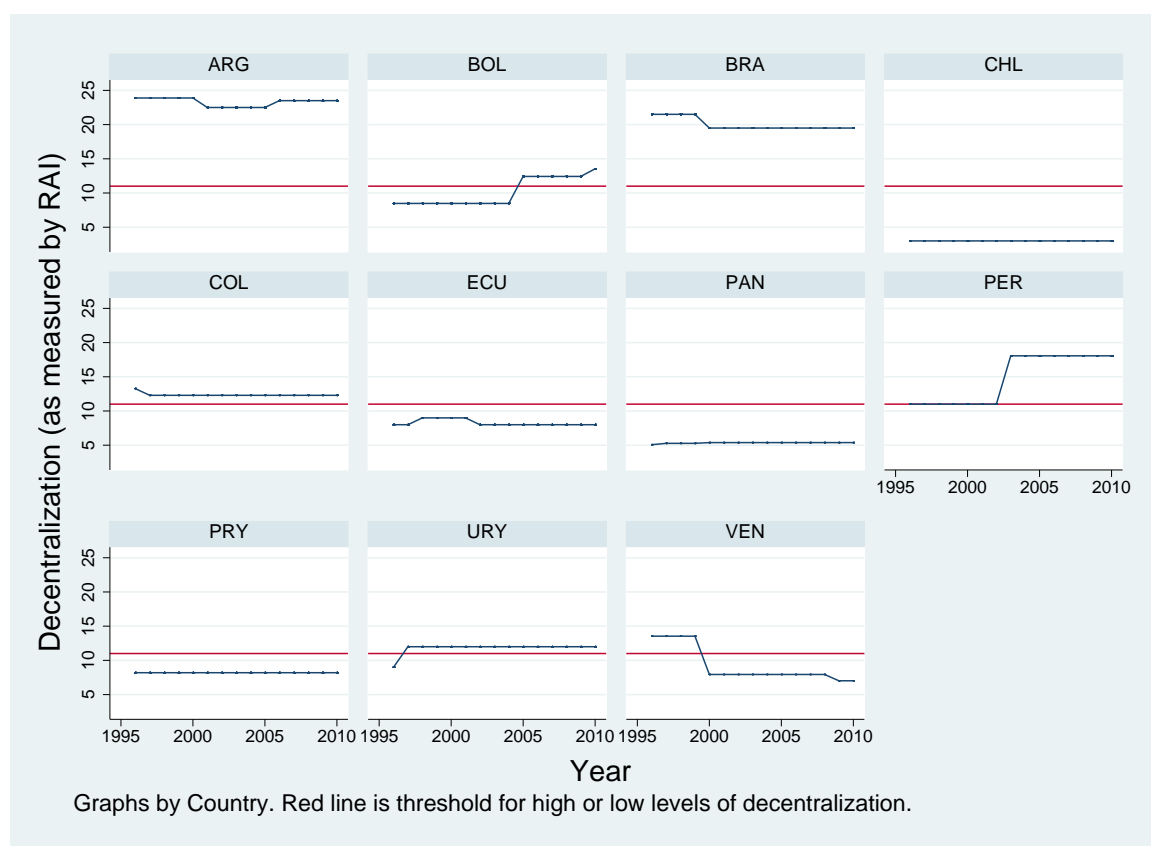
graph. First is that the results of the model are not explained by the trends in performance of high or low level decentralization countries. Second, and perhaps more important to understand the results, is the apparent disconnect between the national GDP growth and the GDP growth at the borders. I will argue that this disconnect is related to the type of local authorities that are present at the borders of interest.[14]

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[14]An alternative explanation to the disconnect between national GDP and the GDP growth at the borders of interest (as measured by LaN) is that most of the local authorities observed in South America are mainly agricultural producers. This paper acknowledges that using LaN to measure GDP growth of sub-national authorities that specialize in agriculture is problematic, but due to the data constraints it is hard to find alternatives to estimate cross-country GDP growth measures at the sub-national level that satisfy the methodological assumptions. Furthermore, even for the borders of interest in South America, it is unclear that the leading sector of the economy is agriculture. A quick overview of the leading sectors of these regions shows how other economic activities drive local development, like extractive industries in the borders between Peru and Ecuador or Peru and Chile, or industrial corridors between Argentina, Brazil, and Uruguay —see for example the motivations and regional characterization for the development of the Initiative for the Integration of the Regional Infrastructure of South America (UNASUR, 2017). To unequivocally make the statement on the key sectors that drive economic growth at each border would require an in-depth study of each border and its economic profile that goes beyond the scope of this research.

Figure 2.4: GDP Growth Profiles in South America

Graphs by Country. National GDP growth estimates from World Bank data.
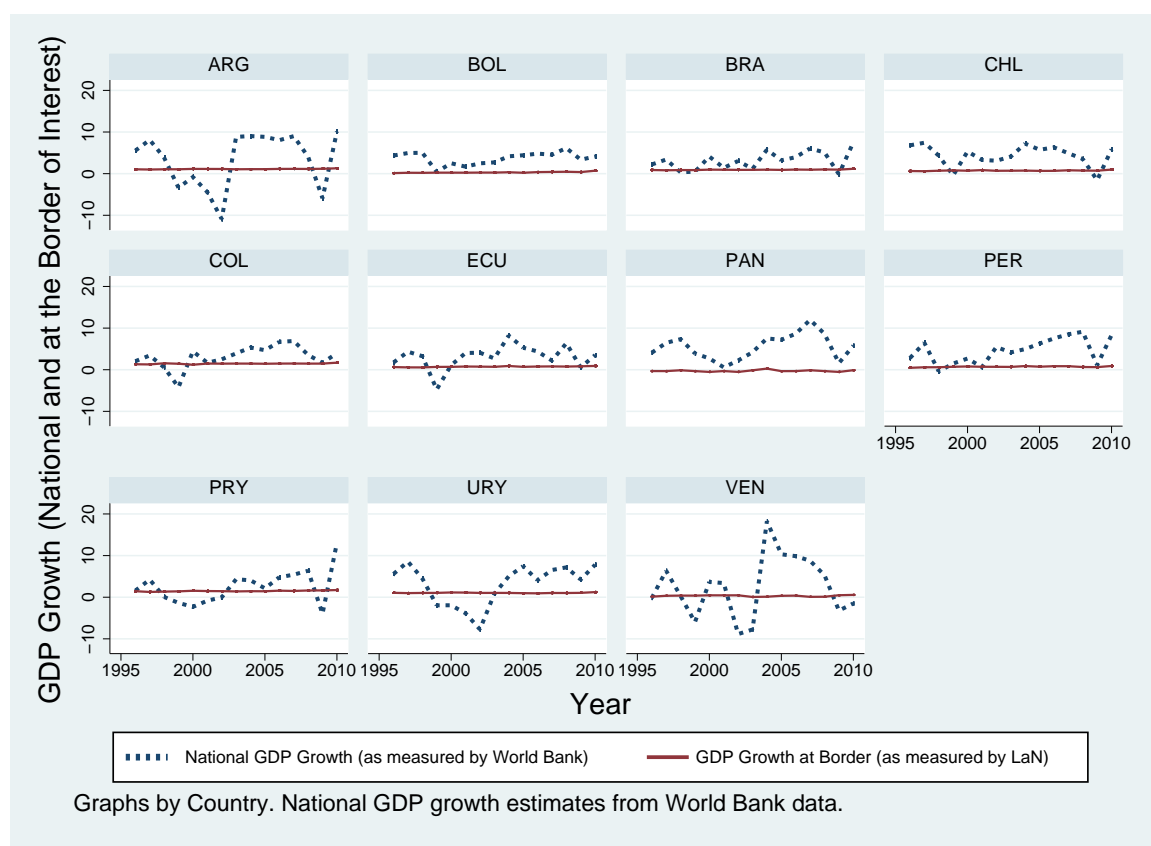
Because of its geography and ecosystems, South America has been characterized by a lack of inter-country connectivity. Most of the borders of interest are located in remote areas across the Amazon Rain-forest or through the Andes Mountain range. Furthermore, given the center-periphery development trajectory of most countries in Latin America it is not surprising that some of these remote local authorities fail to be the drivers of economic development. However, this is not unique to South America. Through the Regions at Glance series the OECD has consistently stated that most of GDP growth is generated in metropolitan areas. For example between 2000 and 2013 metropolitan areas contributed to 62 % of GDP growth of the OECD area (OECD, 2016, 52). Similarly, the previous edition of Regions at a Glance found that 10% of the sub-national authorities contributed to 38% of the total GDP (OECD, 2013, 58). Of the borders of interest in this paper, only a few third level authorities fall into the OECD definition of a metropolitan area.[15]

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[15]The classification of TL3 regions of the OECD is equivalent to the unit of observation of this

Hence, after comparing the overlap between the local authorities that the OECD finds are the drivers of GDP growth and the borders of interest in this paper, it is not surprising to find the mismatch between national GDP growth and the GDP growth measured using the Lights at Night data.

2.3.4 Discussion of Mechanisms

This section will discuss possible mechanisms that explain the relationship between higher decentralization and lower economic development, some of which are drawn from the study of the Colombian decentralization process —that I present elsewhere. Three arguments can potentially explain why higher levels of decentralization can lead to lower levels of economic development: i) lack of capacity to take advantage of decentralization reform, ii) lack of a local development strategy and redistribution mechanisms, and iii) capture of local authorities by corruption or illegal actors.

Unequal Capacity to Take Advantage of Decentralization Reform

A recurrent argument that explains the diverse outcomes of decentralization reform on economic development is related to the capacity of local authorities to take advantage of the autonomy granted through the decentralization process. The issue is that decentralization reforms deal only with the redistribution of power between levels of government, but does not imply assuring the capacity for the local authorities to exercise this autonomy. Hence, while decentralization always produce the devolution of competences to the local level, this does not necessarily result in an increase in the autonomy for those local authorities. For example, as Falleti (2010) points out, administrative and fiscal decentralization may or may not lead to sub-national governments' empowerment, while political decentralization always strengthens lower levels of government. Therefore, some processes of decentralization might strengthen local authorities, but when institutional capacity and political autonomy are not assured, states or municipalities can find themselves overwhelmed by the increasing responsibilities and a lack of financial or technical assistance to exercise their delegated competences.

paper.

The unequal capacity at the local level, leads to the dichotomy between municipalities that take advantage of the increased autonomy and those who are unable to benefit of the reform. Data suggests that on average only sub-national authorities are the drivers of economic development and can gain from the reform. On the other hand, most sub-national authorities will lag behind being unable to take advantage of decentralization. It is this lack of capacity at the local level —particularly noting that the local authorities this paper is focusing on are usually remote rural entities— what could explain why decentralization is linked to lower economic development. This municipalities are usually ill-equipped to generate growth and therefore it is not surprising that they might also be ill-equipped to deal with the increased autonomy that decentralization entails. If municipalities at both side of the borders are similar in the different factors that explain economic development, and they tend to fall into the category of having low institutional capacity, it is foreseeable that those who pertain to a centralized state will receive a higher level of support from the national government to foster economic growth.

Lack of Development Strategy and Redistribution Mechanisms

A second argument that illustrates why decentralization fails to increase economic development is related to the lack of a local development strategy or redistribution mechanisms. As explained above, due to the changes introduced by decentralization it is foreseeable to find different outcomes in the provision of public goods or public services within different countries. A few local authorities will gain from the reform and provide the required factors to spur economic development creating their own development strategies. This idea of the economic benefits of decentralization can be traced back to Tiebout's (1956) pure theory of local expenditures, where the underlying assumption is that policies that promote residential mobility and increase the knowledge of the consumer vote will improve the allocation and outcomes of government expenditures. However, this is a double edged sword since this process will be accentuated as the better performing sub-national governments are better-off and attract more resources and human capital, while ill-equipped sub-national

authorities lag behind and are unable to generate their own development strategies or the factors economic development requirements.

As before, decentralization reform implies the distribution of competences, but not the creation of institutions that lead these public policies. With regards to development strategies, macro-economic decisions and long term strategic planning tends to remain at the national level while local development policies are reallocated to the local authorities. However, there is no element in the decentralization reforms that assures local development policies will emerge at the local level or that there is a coordination between national and local development strategies. Even more problematic, as the gaps between sub-national governments increase, the cycle is reinforced, and then local authorities that are lagging behind are more likely to remain stay behind in their development processes. A solution the literature has provided to overcome this problem is to introduce redistribution mechanisms that assure that sub-national authorities that are better-off contribute to the development of least developed municipalities.[16] Assuming that these mechanisms are created with the introduction of decentralization is incorrect, and in fact the lagging effects of economic development in municipalities can be a symptom of the lack of local development strategies or redistribution mechanisms that secure the resources to fund them.

Capture of Local Authorities by Corruption or Illegal Actors

A last mechanism the literature proposes to understand why higher levels of decentralization could produce lower economic development or public goods quality is related to Eaton's (2006) argument of the capture of local authorities. Eaton argues that when political and economic resources are transferred to sub-national governments in countries experiencing internal armed conflict, local authorities can be captured by illegal actors and decentralization can end up expanding armed clientelism. For this reason, in the context of a decentralization process where local authorities are captured by corruption or illegal actors, most of the resources that could be destined to local economic development may never reach their pur-

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[16]For example see Smoke (2010).

pose, but in fact contribute to declining security conditions that hamper economic development.

2.4 Conclusions

Decentralization reform remains an important issue in the public policy agenda. However, is not always a reform that increases economic development at the sub-national level. This paper explores the relationship between decentralization and economic development and finds that for administrative level authorities close to a border, a higher decentralization level usually entails lower economic development. The quantitative methods suggest that this is a relationship conditioned by the institutional capacity of the local authority. The research also proposes three mechanisms that explain why on average a higher decentralization level might imply lower economic development at the local administrative level. These are (i) lack of capacity of local authorities to take advantage of the decentralization reform, (ii) the lack of a development strategy and redistribution mechanism embedded in the decentralization reform, and (iii) the risk of capture of local authorities by corruption or illegal actors.

Like many quasi experimental designs, the generalizability of these results might be limited. The study explores the discontinuity introduced by borders and as such the estimated treatment effect is a local Average Treatment Effect. This implies that it might be a mistake to generalize these assumptions to other administrative level authorities that are not close to the border of interest. However, as stated throughout the paper, the main objective of this study is to explore the relationship between decentralization and economic development, and to explain plausible mechanisms that link these variables. On this topic, the research does provide substantial answers. The quantitative methods evidence the causal negative link between decentralization and economic development, for a specific sub-population of local authorities. These results are both statistically and economically significant at the one percent level. They imply that, on average, higher decentralization levels imply a decrease in GDP growth that ranges between 0.19 and 0.22 percentage

points. These findings should motivate further analysis on these mechanisms for case studies or through other large-N analyses.

This is not to say that decentralization is always negative for economic development. In fact, a recurrent argument in the literature is that municipalities that managed to take advantage of the increased autonomy accompanying the reform were able to exploit their new competences to support higher economic development.

These results should invite a rethinking of the need for decentralization processes, particularly when the sub-national authorities lack the capacity to exercise their increased autonomy. Furthermore, these findings should underline the need for redistributive policies within decentralized institutional designs. While decentralization and autonomy should be encouraged for sub-national authorities that lead the economic development of nations, redistributive mechanisms should be designed so that weaker sub-national authorities do not lag behind in the development process.

Adding this complexity to the understanding of decentralization will allow better comprehension of the effects of reform. This can encourage practitioners and advocates of decentralization to rethink the design of the decentralization processes. The underlying idea, as with other models of policy diffusion, is that one-size-fits-all models should be sidelined and that institutional designs should acknowledge endogenous characteristics of the different sub-national authorities.

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Chapter 3

Paper 2: Twenty-five Years of Agricultural Decline: Does Decentralization Reform Explain the Decline of Agricultural Extension Services in Colombia?

Abstract

The competition introduced by the liberalization reform of the 1990s and the aftermath of armed conflict and drug trafficking are the two traditional narratives used to explain the decline of the Colombian agricultural sector. This paper argues that while these two issues partially explain the decline of agriculture, decentralization reform introduced significant changes in the sector. It did so by allowing new actors to join the political market of extension services and modifying the policies and resources related to its regulation. Borrowing from de Waal, Evans, Hirschman and Snyder, this paper proposes a framework to explain why the institutional reform led to heterogeneous effects on different regions, products, and types of farmers within the sector. Integrating these changes into traditional narratives leads to a better understanding of the last twenty-five years of decline of the Colombian agricultural sector.

3.1 Introduction

During most of the second half of the XXth century, Colombia had one of the strongest agricultural sectors in Latin America. Dominated by coffee and banana exports and a strong internal market guarded by high levels of protectionism, agriculture showed stable growth rates and high levels of productivity. Between 1965 and 1990 the average sector growth was 3.75% per year. However, from 1990 to 2014, at a time when the economy was growing at almost 4%, the sector grew only at a 2.2% annual rate.[1] The traditional explanations the literature provides to justify the decline are the liberalization reform of 1990s and the side-effects of a prolonged armed conflict and drug trafficking. Yet these traditional narratives of competition, conflict, and coca production fail to sufficiently explain why there are heterogeneous outcomes between municipalities, farmers, and products.

Indeed, most studies agree that problems of the sector go beyond the shock introduced by liberalization reform or the aftermath of the armed conflict.[2] These studies claim that the main drawbacks that affect competitiveness are: (i) stagnation in productivity due to limited technology transfers, (ii) high costs of access to market and transport, (iii) limited access to credit, and (iv) minimal investments in land improvement and irrigation systems. All of these issues are related to extension services and agricultural policy-making, and all were substantially affected by an underlying structural issue: decentralization reform.

The decline of the Colombian agricultural sector challenges the assumption that decentralization reform leads to improved public service provision. This paper argues that it was precisely decentralization reform that explains sector decline. The article will propose a framework, drawing from concepts developed by de Waal, Evans, Hirschman and Snyder, that illuminates the unintended consequences of decentralization reform in the Colombian case. This framework will be applied to the in-depth case study of the changes experienced in the Colombian agricultural sector during the time of the decentralization reform. Specifically, it will argue that decen-

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[1]For more on evidence on this decline see among others: Ludena (2010); DNP (2015); Food and Agriculture Organization of the United Nations (2018).

[2]See for example Balcázar (2003), Berry (2003), Stads and Romano (2008), Arguello et al. (2014), and DNP (2015).

tralization restructured the agricultural sector in Colombia, redrawing the political economy of the sector, affecting extension services[3] at the local level, and modifying the way the sector was funded. Additionally, acknowledging that decentralization allowed new actors to join the political market of extension services and modified associated resources and regulatory policies leads to an understanding of the heterogeneous effect that institutional reform had on farmers and products. With this in mind, the proposed framework also attempts to explain the elements that determine divergent outcomes of policy reform.

As noted above, this paper argues that the decentralization reform affected the agricultural sector and the provision of extension services in Colombia through different mechanisms. It is, however, impossible to disentangle the effect of the reform from other trends happening during the same time period. Due to the difficulty of isolating the effect the reform had from other processes (like the internal conflict or market liberalization), the paper will resort to qualitative methods —mainly semi-structured interviews and literature review— to try to understand how the decentralization reform partially explains the twenty-five years of decline of the Colombian agricultural sector.

Section 6.3 consolidates the list of interviews performed to inform this document. Most of the list consists of experts on the agricultural sector including six former ministers or deputy ministers of agriculture, key decision makers on the Colombian decentralization process, former and current extension service agents, and academics who have studied both decentralization, the agricultural sector, or the way the Colombian conflict has affected the rural territories of Colombia. Some of the interviewees work at the national level, while others, like Perry Rubio or Sánchez López, work with grassroots or local organizations.

Aside from the information collected from the semi-structured interviews, this paper relies heavily on the information provided by three comprehensive studies of the agricultural sector: i)*Mision Rural*[4], DNP (2015); *Censo Nacional Agropecuario 2014*, DANE (2016); and *Desarrollo de la agricultura Colombiana*, Fedesarrollo-

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[3]This paper uses the terms technical assistance and extensions services interchangeably.

[4]The "Rural Mission" was a comprehensive evaluation of the agriculture sector led by the National Planning Department between 2013-2015.

Junguito et al. (2014).

3.2 Traditional Narratives of Agricultural Decline in Colombia

The first traditional narrative to explain agricultural decline in Colombia is the liberalization reform. After Colombia opened its market in 1990, the agricultural sector faced a decline in the face of competition with foreign products. However, when looking at the data it is evident that there was actually more heterogeneity in the sector than is generally acknowledged. Some farmers and products remained highly productive and competitive despite increased competition. For example, as can be seen in figure 3.1, cereals' yields kept increasing despite the decline of the sector. Also as shown in table 3.1, in 2012 Colombia had higher yields per hectare for sugarcane, bananas, soybeans, or sorghum than Brazil or the United States — world market leaders.[5] It also had higher yields than the competing countries of Argentina and Ecuador in three of those four products. These data present a problem for the traditional narrative of agricultural decline due to liberalization reform.

Table 3.1: Comparative Crop Yields (ton./ha.) - 2012

Country	Rice	Sugarcane	Bananas	Coffee	Corn	Potatoes	Soybeans	Sorghum	Wheat
Argentina	6.7	54.9	20.1	-	6.4	31.4	2.3	4.7	2.7
Brazil	4.8	74.3	14.3	1.4	5.0	27.4	2.6	2.9	2.3
Colombia	**3.9**	**81.6**	**24.8**	**0.7**	**2.9**	**18.2**	**2.7**	**3.8**	**1.5**
Ecuador	4.2	77.5	33.3	0.1	2.7	8.3	1.6	1.5	0.8
Peru	7.7	127.8	30.8	0.8	3.3	14.3	1.8	3.6	1.5
USA	8.3	80.1	19.5	1.3	7.7	45.8	2.7	3.1	3.1
World	4.5	70.5	21.2	0.9	4.9	19.1	2.3	1.5	3.1

Source: FAO data, quoted by DNP (2015, 15)

While it is impossible to reproduce the whole series of harvested area, yields, and production for other products due to data constraints (as was done on figure 3.1), figures 3.2 and 3.3 show the total harvested area and production for the most relevant agricultural products in Colombia between 1995 and 2016.[6] It is important

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[5]As the DNP (2015) notes, it is important to state that sorghum and soybeans are not key products among the national production and are only marginally produced in some Colombian regions.

[6]Data for years 1995- 2006 are from DNP (2009). Data for years 2007-2016 are from Base Agrícola EVA from Ministerio de Agricultura (2018). Data for Banana was dropped due to irrecon-

to note that the decrease in harvested area for cereals is not explained by a shift to other products (see Appendix B). The decrease in harvested area leads to a decrease in production for most products, even if yields keep increasing. Of the products reviewed only African palm tree, cacao, coconut, rice, and sugarcane increase the number of hectares and production since 1995, but the increase in these products does not overcome the decline of the beginning of the 1990s. For graphs with harvested area, yields, and production for each of these products see Appendix B.

It is also relevant to note that, since 1984, Colombia experienced a change in the typical size of its farms. This change was particularly relevant for large farms. In 1984, farms that had more than 500 hectares represented about 23.3% of the total harvested area of the country (IGAC et al., 2012, 74). By 2014, farms that had more than 500 hectares represented over 34.5% of the total harvested area (UPRA, 2016, 107). However, this increase in harvested areas does not relate to an increase in landowners for those types of farms. In 1984 they represented 0.4% of all farm owners in Colombia, but by 2014 they only represented 0.3% of all farm owners in the country (IGAC et al., 2012; UPRA, 2016).

These trends beg three important questions that the traditional narrative of competition fails to answer. First, what are the exceptional characteristics of the products where harvested area and production are growing despite the declining sector? Second, for the products where harvested areas are decreasing, how is it possible that yields keep increasing and production does not decrease proportionally to the decrease in land? Third, why have larger farmers gained a more prominent role in agricultural production? The proposed framework in this paper will show how the political economy of agriculture leads to differential access to extension services and therefore explains i) the increase in harvested areas and production in some crops; and ii) how some large farmers managed to maintain production despite decreasing harvested areas. Ultimately, I will argue, it was the lack of access to extension services and not the increased competition that explains how some

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cilable differences in measurements between the two datasets. Crops included in total production: African palm tree, barley, beans, cacao, coffee, cotton, coconut, fique, maize, peanuts, potatoes, plantain, rice, sesame seed, sorghum, soy, sugarcane, sweep, tobacco, wheat, yam, and yuca. All values are in metric tons (tonnes).

Figure 3.1: Colombian Cereal Production 1961 - 2014
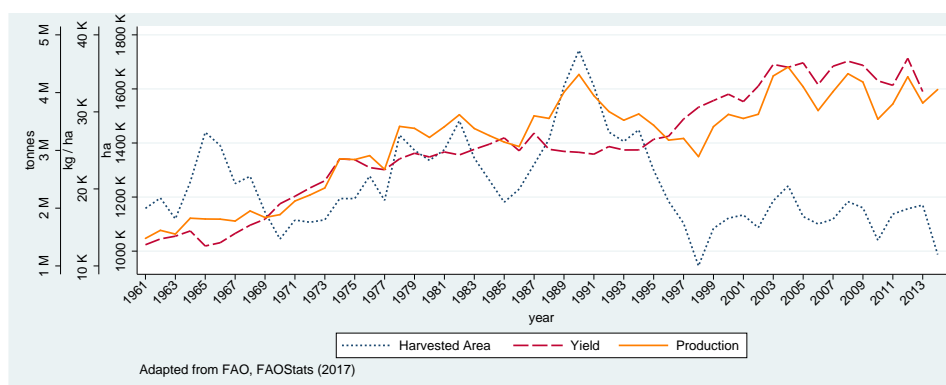
Figure 3.2: Colombian Total Harvested Area in hectares 1995 - 2016
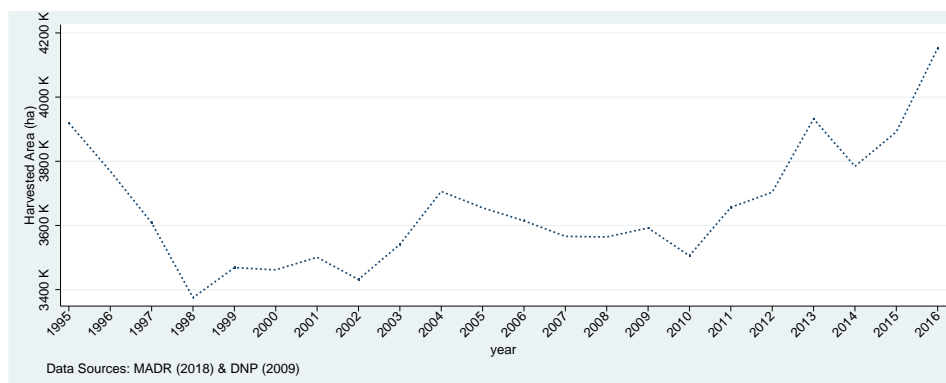
Figure 3.3: Colombian Total Production in tonnes 1995 - 2016
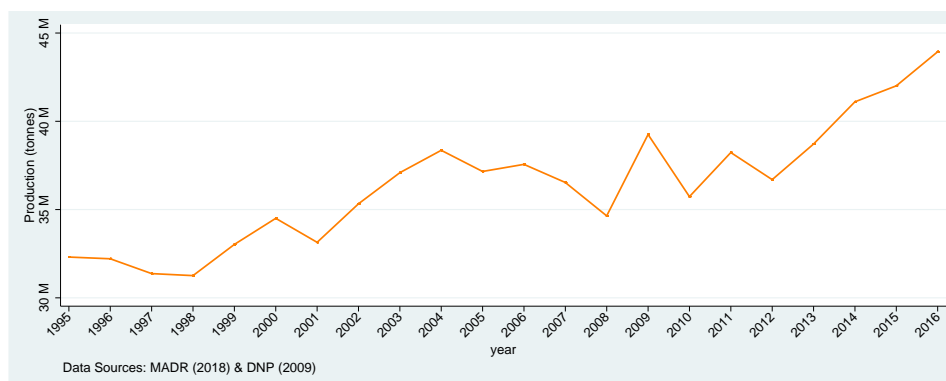
products remained competitive and why only specific types of farmers exited the sector.

The second traditional narrative points to the armed conflict and the production of coca as drivers of agricultural decline. While there are good arguments that show decreasing investments (both by private and public actors) because of the armed conflict, the decline in productivity seems too steep to be explained only by security concerns. Also, as García Trujillo explains, the conflict was dynamic and was concentrated in different regions at different moments (García Trujillo, 2017). Therefore, a focalized conflict that affected specific regions in different periods fails to explain the generalized decline of the sector during the last twenty-five years. Furthermore, as shown in table 3.1 and graphs in Appendix B, some products and sub-sectors maintained or increased their productivity despite the conflict.

Similarly, the effect of coca production is also concentrated in too few municipalities to explain the generalized decline of the sector. As the United Nations Office on Drugs and Crime (UNODC) report on Illicit Drugs Monitoring has reiterated since its first edition in 2001, coca tends to represent a small proportion of the total arable land in Colombia. For example, for 2015, the total hectares planted with coca occupy 0.1% of the arable land of the country (UNODC, 2016, 19).

If the conflict was the key issue that explains the decline of the sector, all farmers would have similar declining performances during the last twenty-five years. However, large scale farmers and some middle and small scale farmers maintained or increased their productivity and their crop yields despite the conflict and the narcotics production, while other farmers lagged behind. Therefore, the conflict also fails to fully explain the heterogeneous outcomes in the agricultural sector.

3.3 Traditional Narratives on Decentralization

There is an extensive literature on the effect of decentralization on public goods provision. The usual conclusion is that under most conditions decentralization improves the provision of the goods or service.

Faguet (2004) studies how the Bolivian decentralization process increased the investments in public goods provision for municipalities. His empirical analysis shows that increased investment was more responsive to local needs, usually focused on human capital and social services. To this extent, he argues public goods provision improved once decentralization reform was implemented, mainly because subnational governments were better at recognizing the needs of their constituencies. Seabright (1996) evaluates how the decision of centralization and decentralization involve differential costs and benefits for public good provision and government accountability. With regards to decentralization he concludes that decentralization can improve public goods provision, if there is homogeneity between local authorities, given that it tends to increase accountability of local government.

The literature on the Colombian decentralization process presents a more nuanced view of the outcomes of the reform, given that these vary widely across sectors. There is a general agreement in the literature that prioritized social sectors improved in the provision of their services. For example, Falleti (2010, 148) states that "literacy and educational coverage rose during the 1990s, and there were improvements in the general quality of education." Falleti also explains, quoting Sánchez & Chacón, that there were improvements in access to water and sewage services. Similarly, using capacity to generate its own resources —as a measure for fiscal decentralization— Ramírez et al. (2014, 28) find that fiscal decentralization had a strong causal effect over multidimensional deprivation and that government transfers for education, health, and water are associated with reductions of poverty.[7]

Therefore, according to the literature, improvements in these sectors were driven by ear-marked transfers from the central government and the better monitoring mechanisms setup to evaluate their performance. However, there are different opinions of how these results evidence a success of the decentralization reform. For some former politicians or academics that have studied decentralization, the results are indisputable evidence that the reform worked in providing improved public services

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[7]Ramírez et al.'s (2014) main finding is that while decentralization contributed to decreasing extreme poverty, these results would have been larger if the reform had recognized endogenous characteristics of Colombian municipalities.

for the prioritized sectors.[8] Others are more critical about claiming the increase in coverage as a success.[9] They argue that while there was an increase in coverage, it was not accompanied by a quality improvement in the provision of the service, invalidating the value of the gains. For example, Perry Rubio states that one cannot argue that decentralization was successful for rural or small municipalities in Colombia (Perry Rubio, 2012, 2017). His claim is that while indicators and quality might have improved in intermediate or large cities, there are few advancements in most rural municipalities, which one fails to see when focusing only on the aggregate data.

Perry's opinion points exactly to a key issue of the reform, which relates to the mixed outcomes in public service provision. Most studies, even the ones quoted, recognize a heterogeneity of results among Colombian municipalities. It is also relevant to note that the positive effect of decentralization tends to be circumscribed to democratization efforts or to social sectors that were prioritized by the reform. Moreover, the common narrative is that only a few municipalities —usually the largest cities— have been able to take advantage of the increased autonomy decentralization provided. Aggregate indicators might improve at a national level, but the gaps in service provision and quality keep widening between those municipalities taking advantage of the reform and those municipalities that cannot or do not.

This paper focuses specifically on the effect decentralization reform had on the agricultural sector in Colombia, a topic that has not yet been explored by the literature. The effects of decentralization reform on the agricultural sector challenge the traditional expectation of improved public goods or public service provision. Therefore, this paper aligns more closely with the literature that finds decentralization can lead to mixed outcomes, and goes beyond that literature in proposing a framework that explains the heterogeneous outcomes in the agricultural sector.

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[8]Information from semi structured interviews conducted with Castro Castro (2016); Gaviria Trujillo (2016); Maldonado Copello (2016); Ocampo Gaviria (2016); Velásquez Ospina (2017).

[9]Information from semi-structured interviews with Cano Blandon (2016); Perry Rubio (2017); Zafra Roldán (2016).

3.4 Conceptual Framework to Understand the Heterogeneous Effects of Decentralization on Agriculture

The framework for analyzing heterogeneous effects of decentralization presented in this paper is adapted from Snyder's (1999) framework on the politics of reregulation of the coffee market in Mexico after the introduction of neoliberal reforms. Snyder illustrates why neoliberal reforms did not lead to unregulated coffee markets, but instead resulted in the formation of new institutions for market governance that varied across states. He proposes that different outcomes of reregulation processes initiated by politicians in Mexico can be explained by studying the factors that frame the way politicians initiate reregulation projects and the factors that explain how societal groups respond to these proposals (Snyder, 1999, 177). His framework assumes that politicians attempted to preserve or expand their power by taking control over policy areas vacated by state downsizing (Snyder, 1999, 176). As will be explained, decentralization reform similarly allows politicians to pursue strategies to control policy areas that are being redistributed within the state. The dispute here is not over regulatory projects, as in the Mexican coffee case, but over the provision of extension services. However, as with Snyder's framework, politicians cannot unilaterally impose their preferences on farmers, and the different outcomes in the market for extension services depend on the mediation between these two sets of interests. Therefore if one identifies the factors that determine changes in the market for extension services and the factors that condition farmers' response, it is possible to explain the different outcomes of the sector in ways the traditional narratives on agricultural decline cannot.

Of the factors proposed by Snyder, a particularly relevant concept for updating the framework is the concept of *policy repertoires*. Snyder (1999) defines policy repertoires as coherent frameworks of believes, values, and ideas that prescribe a course of policy choice and implementation. This concept encompasses the idea of applied knowledge, where politicians analyze different strategies to pursue political survival while bounding their policy decision based on their accumulated experience in government and potentially distorted interpretations of experts' prescriptions

(Snyder, 1999, 181).

A good model for thinking about the interaction of politicians and farmers in their dispute over the extension services market is the one proposed by de Waal (2015) in his development of the concept of the political marketplace. As de Waal (2015, 16-34) explains, the political marketplace is a system of governance in which politics are conducted as the exchange of political services or loyalty for payment or license. The political system involves interpersonal bargaining in which rewards are exchanged for cooperation, and where politicians seek to increase their revenue while limiting their costs.

Using the political marketplace to understand disputes over extension services reveals that politicians will try to build loyalty by acting as managers of and gate-keepers to extension services. Hence, they will bargain with farmers who demand extension services, trying to maximize the benefit they can obtain by controlling the provision of these public goods. However, their bargaining power will be limited —as in Snyder's framework— by the factors that determine farmers response, and the political budget they can control.

The framework proposed here also draws on Evans and Hirschman to better understand the ways in which farmers and politicians interact. Snyder's (1999) framework focuses on politicians but also considers their interaction with other actors or societal groups. However, his analysis does not provide a conceptual structure to understand why societal groups choose to oppose or support the proposals of politicians, or why some actors choose to engage and try to modify politicians' proposals while others choose to ignore them. To that extent, his framework lends little to understanding societal groups' behavior across different types of countries. However, I argue that we can unpack what Snyder (1999) calls "relative societal group power" and expand his framework to other states by understanding actors' interactions and societal groups' response using the theoretical proposals of Evans and Hirschman.

Evans's (1995) concept of embedded autonomy is useful in understanding the way actors interact given the characteristics of the state. As he articulates, nations vary with regard to the independence of their bureaucracy and the coordination

governments reach with societal groups. In order to achieve development, governments and private actors must coordinate societal goals so that they are matched by policy. Weberian autonomy assures that the bureaucrats operate in accordance with rules and established norms, performing their tasks prioritizing the developmental goals of the state over individual opportunities of exploitation Evans (1995, 49). The concept of embeddedness is related to the existence of external networks that connect the state and civil society, allowing the state not to be isolated and pursue policy goals that are relevant and appropriate for the demands of private actors Evans (1995, 50). Taking into account the level of coordination with the private sector and the Weberian autonomy of the bureaucracy to prioritize societal goals, Evans identifies three ideal types of states.

In what Evans (1995, 50) calls developmental states there are high levels of Weberian autonomy and embeddedness. The high level of embeddedness assures the existence of a joint project of development that is shared by societal groups and the state, and the Weberian autonomy secures an independent bureaucracy. The opposite of developmental states are what Evans defines as predatory states. In this ideal type, bureaucracies are not independent of private interests, and the state preys on its citizens providing few services in return (Evans, 1995, 45-47). While Evans explains that this type of states are perhaps the most autonomous among its ideal types, he clarifies this autonomy could not be qualified as Weberian autonomy. The main difference here is that while predatory states are autonomous to make arbitrary decisions to favor an elite they do not have an independent public service that is autonomous to pursue and defend the best interest of the state. For this reason, while the predatory states might be autonomous in making decisions, this does not imply their bureaucracies are autonomous in the Weberian sense of the word. Evans' theory also articulates a category of intermediate states:

> "Meaning, there is some semblance of bureaucratic organization, but
> not to the degree of corporate coherence enjoyed by developmental states.
> Consequently, the contradictory balance of embedded autonomy will be
> hard to maintain. Imbalance could take the form of either excessive

clientelism or an inability to construct joint projects with potential industrial elites. Inconsistency is another possibility. Joint projects may be possible in certain sectors or certain periods but degenerate into clientelism or isolated autonomy in other sectors or other periods." (Evans, 1995, 60)

This implies that the reactions of actors to policy proposals of local politicians will depend on the level of embeddedness and the Weberian autonomy of the state where the reform is taking place. Hence, to expand Snyder's framework, one just needs to look at Evans' ideal types and forecast the expected interactions between actors. Figure 3.4 explains the type of interactions between actors by country types, and figure 3.5 predicts the actors' response to politicians proposals depending on the ideal type of state.

Snyder (1999, 182) argues that societal groups have a decisive impact on the institutional outcomes of reregulation processes, and that the impact is mediated by the strengths and strategies of social groups which determines their "relative societal group power". However, the determinants of the strengths and strategies of those societal groups are unclear, which is why using Hirschman's (1981) concepts of *exit* and *voice* can inform the proposed framework. Hirschman argues that individuals have two options when they are unhappy with the organization or state. They can either voice their complaint while continuing as members of the organization or they can exit (or emigrate from) the organization or state. However, exiting the sector or the market of extension services comes with a price. While the idea of exit might resemble the logic of a free market, the mechanism of exit is not one that is truly free, and the ability to exit is one that is unequally distributed (Hirschman, 1981, 252).

Figure 3.4: Interactions Given Types of States

Embeddedness

Developmental State
<u>Coordinated interactions</u>
· Autonomous decision making by bureaucracy coordinated with politicians and societal groups
·Corporate coherence

Intermediate State
<u>Varied interactions</u>
· Depending on sector politicians or bureaucracy decide
·Some corporate coherence but also varied bargaining strategies and clientelistic practices

Predatory State
<u>No interactions</u>
·Politicians decide without bureaucracy or societal groups

Weberian Autonomy

Source: Created by author based on Evans (1995)

Figure 3.5: Actors' Responses Given Types of States

Developmental State
Agree ⟶ ·Due to coorporate coherence no response is needed
Disagree ⟶ ·Response is communicated and dealt through formal mechanisms. Bureaucracy decides if updating policy is in societal interests

Intermediate State
Agree ⟶ ·In sectors with corporate coherence no response needed
⟶ ·In sector with no corporate coherence clientelism or isolated autonomy
Disagree ⟶ ·Response is communicated and dealt through formal mechanisms. Bureaucracy decides if updating policy is in societal interests
⟶ ·In sector with no corporate coherence diverse bargaining strategies or clientelistic demands to change behavior

Predatory State
Agree
Disagree
·No institutional negotiation with societal groups
·"Departicipation"
·No possibility of joint projects

Source: Created by author based on Evans (1995)

3.4.1 Updated Framework for Local Implementation of Decentralization Reform

The framework proposed in this paper —figure 3.6— as adapted from Snyder, and integrating concepts from de Waal, Evans, and Hirschman, presents a model of the local implementation of decentralization reform. The top section of figure 3.6 illustrates the flow process of how decentralization can impact outcomes of the agricultural sector. The logic is that once the decision to implement decentralization happens, the first step to its reinterpretation happens by local politicians, who propose changes to the extension service provision. These policy proposals can result in four types of extension service provision (ESP) (lower section of figure 3.6). Given these types, farmers will respond based on the size and products farmed. Some farmers will then remain in the public extension services market, while others will decide to leave the agricultural sector or access private extension services. The outcomes for agriculture will depend on the type of ESP that result after local politicians and farmers bargain for the characteristics of the extension service markets. This section explains the factors that determine actors behavior in the updated framework.

Factors that Determine Politicians' Proposals

New Fora of Discussion for Agricultural Public Policy

Decentralization leads to shifts in jurisdictions and responsibilities among different levels of government. Hence, it implies the relocation of discussions for policy mak-

Figure 3.6: Framework to Explain Change in Agricultural Sector

Implementation of Decentralization Reform		Politicians Change the Market of Extension Services		Types of Farmers' Response		Resulting Outcome for Agriculture Sector
	➔	Factors explaining change in extension service market: 1. New fora of discussion for public policy 2. Reshuffle of actors 3. Policy repertoire	← ➔	Factors explaining farmers' response: 1. Size of farmers 2. Products being farmed	➔	

	Types of Extension Service Provision (ESP)	**Types of Responses**
	1. Ideal Extension Services 2. Low Quality of Extension Services 3. Sophisticated Clientelistic Practices 4. Limited Clientelistic Practices	1. Voice 2. Exit (from): a. Sector b. Public market for extension services

Source: Adapted by author based on Snyder (1999, 178)

ing. To that extent, a key factor that will determine how politicians can reshape the agricultural sector is the forum where each of the public policies is drafted and implemented. With regards to the decentralization of the agricultural sector, local politicians will be able influence the provision of extension services after the retreat of the national authority. However, some element of the agricultural policy will remain under control of national politicians, who on their own terms will mediate with interest groups that wish to determine national public policies. In the end, local politicians will be able to modify aspects of the agricultural policy related to extension services markets because these were reallocated to their jurisdiction, adding to their political budget. This factor will determine politicians' options but will not determine the elements that they decide to change within the extension service markets.

Reshuffle of Actors

The second factor that determines how local politicians change extension services markets are the actors present in their jurisdictions. Decentralization reshuffles the power among traditional actors, and creates opportunities for new actors to join the extension services market. Hence, local politicians will try to limit the access of actors who contest their control of the market for extension services and adjust their bargaining strategies with actors who they are unable to keep away from the market.

As de Waal (2015, 25) explains, in the most commodified political marketplaces politicians will take care of their own security and political needs and then spend whatever is left on public goods. The model can be applied in the case of extension services where politicians will first try to satisfy their political needs and provide only the minimum extension services required to bargain with actors demanding this type of public goods.

Nevertheless, in the context of a decentralization process it is unlikely that local politicians are able to fill out the gap left by the national level. This happens because of either state capture by illegal actors or lack of capacity to exercise the

newly allocated responsibilities. Hence, new actors will join the market and local politicians will cooperate and coordinate with them, or ostracize them, to secure their control over public extension services.

Altogether, decentralization reform reshuffles the composition of the extension services market, introducing and strengthening actors with whom politicians need to interact. While local politicians would desire to keep exclusive control over the extension market, they are unable to do so due to their lack of capacity or the co-option by illegal actors. Therefore, politicians will need to adjust their bargaining strategies, to maximize their control over extension services while negotiating with new and traditional actors who demand or are involved in the provision of extension services.

Policy Repertoire

In the case of decentralization reform, local politicians' policy repertoire will include both constraints on how they implement a particular policy, like provision of extension services, or on how to deal with the reallocation of power across different levels of government. However, the interpretation of local politicians of how to implement decentralization might not match the intentions of the reform. For example, while the objective of decentralization might be to empower local communities, local politicians might try to replicate the previous center-periphery dynamics at the local level. Hence, by acting as the new center they might keep a top-down approach that does not allow the local construction of public policy as the reform intended. It could also be the case that while decentralization reform tries to increase accountability at the local level, politicians perpetuate traditional clientelistic and patronage mechanisms, if it is the way they believe loyalty is secured in the political market.

The effect this has on the extension services market is that local politicians will reinterpret the new autonomy they receive from decentralization as a new alternative to pursue political survival. Hence, the way the politicians try to control the market will also depend on the level of autonomy granted by the decentralization reform

and on the mechanisms in which they are constrained by other levels of government. For example, in the Colombian case, mayors were able to use budgets for extension services in a more discretionary way compared to other sector budgets that, while decentralized, remained monitored by the national government.

Clearly, policy repertoires help explain heterogeneous results across sectors that were decentralized and municipalities; as well as how the reform failed to address traditional political practices, despite the objectives that were set. Therefore, decentralization will change the extension services market depending on how local politicians believe they can use their increased autonomy for political gain and how other levels of government monitor or limit this increased autonomy.

3.4.2 Actors' Interaction and Farmers' Response

For the case study below it is useful to think about Colombia as an intermediate state. In this context, actors' choices are dictated not only by the possibility of coordination through a national policy, but also by the private appropriation of public resources, through corruption, patronage, or clientelism. Furthermore, for the case of agricultural extension services, given that is a sector with low corporate coherence, one can expect clientelistic practices or isolated autonomy of bureaucracy.

In the framework I propose actors, and specifically farmers, can either voice their complaints while continuing in agriculture or exit. Their exit can manifest by them migrating to a different area of the economy (or in some cases physically migrating to urban environments), or by them exiting the public extension services market — i.e. accessing extension service through private providers or not accessing extension services at all. As Hirschman explains, some characteristics of the actors determines their ability to exit or voice complaints. For extension services, the two determinant factors that will condition farmers' behavior are precisely farm size —which usually correlates with wealth— and the products that are being farmed. Farmers with higher income or wealth might negotiate reform with local politicians, migrate to other sectors, find alternatives for the provision of the inputs needed for agricultural development, or physically migrate to cities. Small and medium farmers might not

enjoy these privileges, remaining in a less productive agricultural sector unable to reform the politicians proposal. Therefore, this small and medium farmers are those who are unable to exit or exercise voice to demand better public extension services.

3.5 The Effect of Decentralization Reform: The Case of Colombian Agricultural Sector

With the evolution of decentralization between 1986 and 1993, the national government devolved the responsibility of most service provision to municipalities. The expectation of those who drafted the reform and the technocrats who supported it was that it was going to improve services provision and increase accountability at the local level.[10] However, the decentralization of agricultural policies, and specifically of extension services, failed to fulfill those expectations. Rather than optimizing the extension services provision, by addressing particular local needs of farmers, the reform led to heterogeneous results in the access to extension services of farmers.

From the supply side perspective, decentralization allowed local politicians to reform the market for extension services, resulting in differences in the results of the provision of the services. In some cases politicians co-opted extension services and in others they were unable to exercise the transferred competencies. From the demand side, differential access to extension services among producers is explained by their size and the products they were farming. Large producers were able to maintain access to extension services by coordinating with politicians or utilizing third parties that moved into the local markets to fill the vacuum left by the central state. Small and medium-sized farmers were usually forced to join clientelistic networks, just as politicians preferred. However, the differential access to extension services is not only explained by size. Some small and medium sized farmers managed to maintain access to extension services without clientelistic ties through their growers' associations. This section will use the proposed framework to understand the determinants of disparities in the access to extension services.

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[10]For more literature on the Colombian decentralization process and its objectives see, among others: Castro Castro (2003) , Eaton (2006), Bland (2010) , Falleti (2010), Maldonado (2011), de la Cruz (2011), Ramírez et al. (2014), or Ocampo Arango (2014).

3.5.1 Decentralizing Extension Services

To understand the process of decentralization of extension services it is important to provide some background on how these were provided prior to the reform. Before 1989, extension services provision was mainly a responsibility of the national government. Agricultural extension services were provided by *Instituto Colombiano Agropecuario* (ICA), a semi-autonomous agency created in 1962 and housed in the Ministry of Agriculture. It was created to integrate agricultural research, extension, and education (Stads and Romano, 2008, 2). There are mixed views of the quality of the extension services ICA provided, but a generalized view is that prior to the 1980s there was at least a coordinated agricultural policy for extension services guided from the center to the periphery.[11] Aside from the public extension service provided by ICA, some growers associations also provided extension services to their members, and a few even created their own research centers to provide technological transfers. The most representative example of this type of association is the Colombian Coffee Growers' Federation, which created its own research center in 1938. Another example of a growers' association that provided technical assistance before 1986 was the sugarcane associations (both with Asocaña and Fedepanela) which based their organization on the Coffee Growers' Federation model. While both Asocaña and Fedepanela were created during the 1930s, their provision of extension services was only institutionalized with the creation of their research center in the 1970s.

In the pre-decentralization reform context the political economy of extension services was quite different. Extension services provision was a task where isolated autonomy prevailed, meaning that technical officers directed the public policy for most of the products. Hence, the key actors that determined extension services were bureaucrats or technical officers and the farmers and clients who received the services (Castro Guerrero, 2016; Bernal Eusse, 2016). Beyond the bounds of the centralized extension services only farmers of certain products were able to receive technical assistance through parallel private markets provided by their growers as-

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[11]See Bernal Eusse (2016), Castro Guerrero (2016), Perry Rubio (2017) or Stads and Romano (2008).

sociations (mainly coffee, banana, and sugarcane producers). These growers associations worked parallel to the extension service system, bargaining directly with the central government to secure policy provisions that aligned to their members' interests. Local politicians were not as relevant to the extent that they could not count extension service provision as an asset in their political budget.

The main flaws of the pre-decentralization system were that it failed to reach most farmers and it was unable to provide differential services that recognized the endogenous characteristics of different Colombian regions (Perry Rubio, 2017). Only some technology transfers eventually reached most farmers —primarily related to seed improvement and access to credit (Castro Guerrero, 2016). Recognizing these flaws and in the spirit of the decentralization reform of the 1980s, the national government transferred to the municipalities the responsibility to provide extension services. This shift happened through the 1989 creation of UMATAs at the municipal level.[12] These entities, controlled exclusively by mayors, were responsible not only for characterizing the productive systems existing at each municipality, but also identifying the specific challenges farmers faced. Furthermore, they were also responsible for planning the agricultural sector at the municipal level, and in general for providing the skills, technologies, and information required to assist farmers' profitability.

The decentralization of agricultural policy led to a redistribution of competencies in the agricultural sector and the reshuffle of powers and introduction of new actors in the local political markets. What the Colombian case depicts is that after decentralization took place, mayors tried to control agricultural policies in general. However, they were unable to do so because the decision making process of some policies —like subsidies to production— remained at the national level. Furthermore, even for the policies that were fully decentralized, mayors had to deal with new or strengthened actors, which implied a reshuffle of their power in relation to both farmers or growers' associations, or with their lack of technical capacity or funding to exercise the decentralized responsibilities. Hence, these factors explain why local politicians focused on changing the market of extension services to fulfill their needs.

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[12]The decrees that created UMATAs were *Decreto 77 de 1989* and *Decreto 1946 de 1989.*

These changes should have affected all farmers in homogeneous ways, but instead data shows that the access to extension services and to the public provision of these varied depending on products and the size of farmers. Large farmers and members of strong growers' associations were able to maintain extension services despite the low capacity of municipalities to provide them.

Policies That Do Not Add to the Political Budget of Local Actors

Once decentralization of agriculture happened, the national government had to redefine the role it played in determining agricultural policy. Perry Rubio explains that there was an intentional decision by the central government to shift from a strong agricultural policy to a policy that was focused on providing subsidies to production. Given the autonomy granted to the local level, the national government was discharged of the obligation of providing public goods and extension services at the local level. The reform included the responsibility to assist municipalities in building their technical assistance capacity, but as academics and former public servants recognize, the government did not assume this task to the extent it should have. Instead, the central government shifted from a comprehensive agricultural policy to a policy that prioritized providing subsidies.

While local politicians would have preferred to administer and allocate these subsidies independently, they were unable to add these to their political budget because it was not a responsibility that was transferred to their jurisdiction. In a decision that was politically motivated, the allocation of subsidies to production, mainly distributed through growers associations, remained at the national level. This evidences a gain of power by these associations that will be further discussed in section 3.5.2. While the political economy of the subsidy policies is quite interesting —and deserves a full study of its own— for the purpose of this paper it is sufficient to understand that local politicians could not determine alone this area of agricultural policy. Research done for this paper suggests mayors were unable to contest the coalition that included members of congress, agriculture lobbyists, large agricultural producers, and growers' associations. Instead they chose to focus on extension

markets, which was an area where they had received full autonomy and jurisdiction.

Subsidies to production are a good example of how the first factor that conditions politicians' behavior is the fora in which decision-making takes place. Contrary to subsidies, extension services were transferred to their fora of control, and this is precisely why they choose to intervene in them. But understanding how local politicians change the market of extension services at the local level requires that we focus on two additional factors: actors and policy repertoires.

A Reshuffle of Actors and Policy Repertoires at the Local Level

As explained previously, local politicians decide to implement decentralization reform mainly by modifying extension services markets. Mayors favored the autonomy they had received, which allowed them to control the budget and the provision of extension services. It also allowed them, in some cases, to strengthen their clientelistic networks. However, local politicians could not arbitrarily decide all elements of the extension services market because they were operating in the framework of an intermediate state. Hence, their interactions with new actors and the policy repertoire available to them determined the way in which they proposed to adjust the extension service market.

The local market for extension services was modified by the arrival of private actors —growers' associations, extension service agents of agribusinesses, or external consultants— who charged in to fill the vacuum left by the national government. It would be incorrect to state that all private actors were new, but decentralization allowed them to gain more power to interact with local politicians. Table 3.2 summarizes the key actors that intervene in the agricultural policy making process, specifically with regards to extension services. Italicized actors in the table, such as mayors or rich growers' associations[13], are those who gained power or joined the

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[13]Some growers' associations are considered rich by academics and political actors, given that are allowed to charge para-fiscal contributions. These contributions, as explained by the president of the Colombian Farmers' Association, are "mandatory taxes that affect a specific social group and are used for the benefit of the sector that provides them, which implies a direct consideration to the group of taxable people" (Mejia López, 2004). In the case of growers' associations, these mandatory taxes are charged to growers of specific products, and transferred directly to the associations so that they invest these resources in extension services. Among experts consulted for this paper Restrepo Salazar, Ocampo Gaviria, and Sánchez López identified the Colombian Coffee Growers'

local market after decentralization reform.[14]

Table 3.2: Key Actors for Agricultural Policy-Making

1. Politicians
1.1 President's Office — national politicians
1.2 *Congressmen*
1.3 *Mayors — local politicians*
1.4 Governors — department level politicians
2. Bureaucracy
2.1 Technocrats at Ministry of Agriculture (or ascribed entities) or DNP
3. Farmers
3.1 Large scale farmers
3.2 *Medium or small scale farmers (members of rich growers' associations)*
3.3 Medium or small scale farmers (not members of rich growers' associations)
4. Private extension service providers
4.1 *Rich growers' associations*
4.2 Poor growers' associations
4.3 *Agribusiness*
4.4 *Private extension agents*
5. Third-sector actors
5.1 Academia
5.2 International consultants (FAO, UNDP, international cooperation agencies)
6. Civil Society
6.1 Rural constituencies
6.2 Urban constituencies

Source: Created by author with information from literature and interviews.

In adjusting the extension services market, local politicians had to bargain with other actors who had gained power from the decentralization reform. But why were local politicians willing to cede their control over the extension markets to these external actors? Why did they not impede these private actors from joining a market they controlled? Initially, municipalities tried to fill the vacuum left by the state, but municipal public provision could not be exclusively managed by mayors for two reasons. In the best case scenario, it was due to a lack of technical capacity and a shift in resource allocation required to provide the service. In a more cynical interpretation of local politics, they were captured by clientelistic networks and

Federation, Augura, Asocaña, Asocolflores, Fedepalma, Fedepanela, and Fedearroz as the "rich" growers' associations. Of these only Asocolflores does not receive para-fiscal resources, despite their attempt to pass several laws through Congress creating them. It is also worth noting that while there are other growers' associations that receive para-fiscal taxes, experts explained that these are the only products where one can really talk about in-house provision of extension services.

[14]Congressmen gained power mainly as political brokers mediating between local and national levels of government. Research done for this paper hints that this is evidenced especially in the case of subsidies to production. However, because this topic is not addressed in this in this paper their role in framing the local extension market will not be discussed.

corruption. More likely the heterogeneity of outcomes of the supply side of extension service provision is a mixed result of both scenarios, which fall into mayors' policy repertoires.

Capture:

There is clear evidence of state capture in some Colombian municipalities. For example, in her ethnography of power and politics in Colombia, Ocampo Arango explains how sub-national regional powers, clientelist networks, and the state have been intertwined since the second half of the XXth century. She explains that in the state of Cordoba:

> "the synergies between regional powers, political parties and clientelism make up the link between the region and the political center, giving rise to a relationship scheme based on the exchanges between the regional electoral power (votes) and the central distributive power (the state resources)." (Ocampo Arango, 2014, 32)

In theory, decentralization would allow for accountability mechanisms at the local level which would in turn decrease corruption or clientelism. However, as Ocampo Arango explains for the Cordoba case, against the expectations of what should have happened, the decentralization reform strengthened the validity of clientelism, and permitted the emergence of local or sub-national networks controlled by local electoral barons.

This view of the capture of local institutions is also shared by Londoño Botero. Focusing on public records offices and public notaries (her area of expertise due to her research on land tenure), she explains how there was a systematic capture of local institutions by both illegal armed actors and local politicians. Capturing these institutions allowed them to appropriate land, consolidate their own privileges, and structure clientelistic networks. In an interview with the author, she explained how it is foreseeable to trace similar mechanisms of capture in the UMATAs of some municipalities (Londoño Botero, 2017).

In this way, the mechanisms through which local politicians capture the state

fall into the policy repertoires they had at hand. While decentralization intended to boost local accountability, it actually allowed mayors to implement clientelistic networks and capture the state, since, consistent with de Waal's theory, the service provision fell into their political budget.

Lack of Capacity:

Where the extension services were not captured by clientelistic networks or corruption, there was a generalized lack of capacity to provide these services, which also falls into the calculation that local politicians make when considering the available policy repertoire. The promoters of the decentralization reform intended for extension services to be provided with a strong local component. However, they failed to understand that there was a lack of capacity at the local level to take over this responsibility. As Bernal Eusse commented: "there were not enough extension agents in the country to fill out the positions created within the UMATAs [and] only some municipalities from departments like Antioquia, Valle, or Santander received some orientation or formal education" (Bernal Eusse, 2016). García Trujillo also mentions this lack of capacity and states:

> "We gave all the responsibility of technical assistance to the regions, but there is really no budget for the agricultural sector. The mayor can barely afford to pay the extension service agent's salary and transportation cost for this public servant, and there you go, that's what we claim are extension services!" (García Trujillo, 2017)

Given the restrictions of human capital, the creation of the municipal extension system required the assistance from both departments and the national level. However, training was very limited and even when there was training, there was a lack of continuity in public servants or the technical recommendations provided to farmers (García Trujillo, 2017). Therefore, mayors must adjust their proposal to reform the extension services market in a way that best benefits their interests. Given limited capacities to provide a good service that will secure loyalty from farmers they have greater incentives to use extension services as a mechanism to secure clientelistic

networks or prioritize sectors aside from agriculture that will secure loyalty from more relevant constituencies. In the end, given the different levels of capacity inherent in Evans' formulation of intermediate states, heterogeneous inter-regional and inter-municipal results are inevitable.

Changes in Resource Allocation & Monitoring:

The changes in budgets for agriculture brought by decentralization reform also played a role in determining local politicians' policy repertoire. An unintended result of decentralization reform was that agriculture was no longer a prioritized sector for the Colombian government. While the decentralization reform implied the transfer of resources for the provision of extension services at the local level, the reality is that the budget for agriculture was reduced compared to other sectors.[15] This change must be attributed mainly to an increase in security spending and the prioritization of social sectors —mainly education, health, and water and sanitation— in the *Sistema General de Participaciones* (SGP).[16] Excluded from these prioritized sectors, the budget for agriculture inevitably declined in comparison after the passing of decentralization reform. But this reduction in budgets was also accompanied by a reduction in the monitoring of the agricultural sector.

Education and health serve as good counter-factuals to compare with agriculture given that these were prioritized by the laws and jurisprudence that regulates fiscal transfers and competencies. The prioritization of these sectors meant municipalities received earmarked transfers to invest in the service provision. Furthermore, because of their prioritization, evaluation systems were put into place to design outcome indicators and monitor their performance. In contrast, for agriculture, there were no earmarked transfers from the central government. Instead, municipalities received resources from the central government bundled with non-earmarked funds. Hence,

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[15]See among others: Olivera (2010), Junguito et al. (2014), or DNP (2015).

[16]SGP is the Colombian fiscal transfer system (Sistema General de Participaciones, for its Spanish acronym) through which the central government transfers earmarked funds to municipalities and departments. The decision to prioritize social sectors can be traced back to the Colombian 1991 constitution, and development by Congress and the Colombian Constitutional Court of articles 151, 288, 356, and 357 of the constitution. See specifically *Ley 60 de 1993* and *Ley 715 de 2001*, and the following decisions of the Colombian Constitutional Court: Herrera Vergara (1994), Moron Diaz (1995), Martínez Caballero (1995) and Beltrán Sierra and Córdoba Triviño (2002).

aside from funding for at least one public servant at the UMATA there were few responsibilities or obligations for the mayors.

When changing the local extension services market, politicians need to take into account their new budgets and associated monitoring. The often lower agricultural budget at the disposal of local politicians could be explained by an urban bias in public spending (Junguito et al., 2014). Arguably, this urban bias is integrated into local politicians' policy repertoire and reinforces their choice to prioritize sectors like health or education. In an alternative scenario, politicians update their policy repertoire to use the budget for agriculture in a more discretionary way. The idea here is that local politicians recognize the reduced budgets, and more importantly the reduced monitoring from the central government, and allocate the budget into isolated projects, permitting different bargaining strategies with different actors. Both DNP (2015) and Junguito et al. (2014) explain that uncoordinated projects allow neither for leveraging resources to achieve better policy, nor for realizing economies of scale for extension services provision. They are, however, a valuable currency in the political budget of local politicians. Hence, the decision to atomize the budget of agriculture in isolated projects might be explained by an interpretation of the new autonomy granted to local politicians.

In any of these scenarios, local politicians' policy repertoire is updated to acknowledge the changes introduced by the decentralization reform. The lack of prioritization of extension services is either the result of an urban bias that guides their implementation of decentralization or the result of a savvy use of political capital that results in atomized budgets. In any of these setups the policy repertoire is among the factors that explains change in the extension services market.

The abovementioned factors are mainly under local politicians' control or administration and therefore help explain inter-regional or inter-municipal heterogeneity of extension services provision. Bluntly put, this explains why the outcomes in extension services in some municipalities of departments like Antioquia, Huila, or Santander might differ to outcomes in municipalities of departments like Córdoba, la Guajira, or Sucre. Figure 3.7 further explains how the different factors led to

different types of extension services markets. To determine which department falls into each quadrant, the data collected from semi-structured interviews was complemented with indicators that evaluate different departments in each of the three dimensions. For levels of state capture, most data takes into account components of the *Tipologias Departamentales y Municipales* by DNP (DDTS, 2015) and the reports by Corporación Transparencia por Colombia(Corporación Transparencia por Colombia, 2017b,a, 2015). For the Capacity of local government and the coordination with Central Government the key indicators used are the again the *Tipologias Departamentales y Municipales* index, the *Índice de Desempeño Integral* and *Índice de Desempeño Fiscal* by DNP, and the analyses on the use of resources transferred through SGP. Finally, to corroborate the results the data was verified with the available data for the 2014 agricultural census (DANE, 2016).

Figure 3.7: Types of Extension Service Provision Depending on Policy Repertoires at Local Level

Capture of Local Government

Resource Change and Coordinated Monitoring with Central Government

Source: Created by author with data from interviews, DANE (2016), and Corporación Transparencia por Colombia.
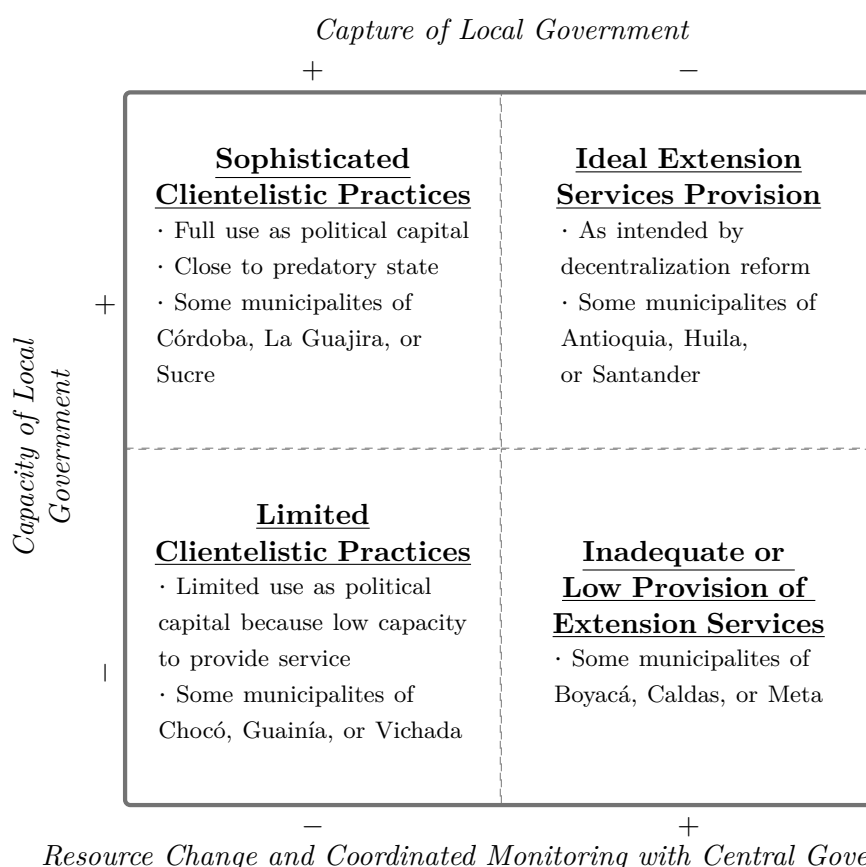
Only a few municipalities fall into the top right quadrant of figure 3.7, while most municipalities fall into any of other three quadrants. Therefore, it is not surprising that under the interpretation local politicians made of decentralization reform, the capacity to provide extension services was severely dampened. According to DANE, only 16,5 % of the farms in Colombia received technical assistance in 2013 (DANE, 2016, 108).[17] While there is no comparable data for periods prior to the decentralization reform —the last agricultural census happened in 1970 and did not include questions related to technical assistance— different experts consulted agree that technical assistance decreased after the reform (Castro Guerrero, 2016; Bernal Eusse, 2016).

The factors described in this section frame the extension services markets proposed by local politicians which results in different types of public extension service provision. These help explain why extension services in Colombia decreased on average, and why they decreased in a differential way across local governments. However the factors explored so far fail to explain *intra*-regional or *intra*-municipal differences in extension services. To understand this variation we need to examine farmers' response.

3.5.2   Farmers' Response

So far, the application of the framework presented explains heterogeneous variation *between* different municipalities and departments, but fails to explain variation *within* across different producers. One could claim that the difference in farmers' outcomes did not emerge due to the decentralization reform, but was always present in the Colombian agricultural sector. This paper argues that, while the intra-municipal variation is not new, it was accentuated after the decentralization reform. This happened because after each local politician was able to introduce his preferences to the market of extension services he then needed to bargain with the farmers. In bargaining with these farmers and —mainly— strong growers' as-

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[17]The official report states this number, but according to the accompanying census data, of the farms that answered the question about technical assistance only 13.5 % reported they received technical assistance. It is also relevant to state that this agricultural census only applies to rural dispersed areas dend not municipal urban areas.

sociations, the policy proposals of politicians change. In some products and with some farmers, they will manage to extend their preference to use extension service as part of their political capital. However, they will not be able to align all farmers to their preferences and this will lead to some farmers leaving the public market of extension service. Those who leave are left with three alternatives: i) accessing technical assistance through their growers associations, ii) remaining in the sector with low technical assistance, or iii) exiting the agricultural sector.

Negotiating with Local Politicians

Given the possible types of extension services provision in figure 3.7 it is reasonable to assume that local politicians have one of two paths. They will try to add extension services to their political budget by using them to support clientelistic practices, or they will try to gain loyalty from farmers by providing adequate extension services. Given the four alternatives identified, and the particularities of an intermediate state, figure 3.8 maps the possible responses of farmers to politicians policy proposals.

As observed in figure 3.8, there is only one scenario of eight where farmers will receive adequate extension services free of clientelistic ties. This illustrates the truly limited access to ideal extension services in the Colombian case. Furthermore, in the worst case scenarios, where farmers disagree with the policy proposal of local politicians, they are forced to either i) exit the public market of extension services, or ii) bargain through informal, sometimes illegal, practices. This occurs because voicing their complaints is less likely to produce their desired policy changes. As shown in figure 3.8, this event occurs in three out of the total eight scenarios (three out of four scenarios where farmers disagree with local politicians).

As was explained in the framework presented in this paper, the two factors that determine both farmers' voice and capacity to exit the public extension services markets are size and product. Size as a determining factor is quite straightforward, as it usually correlates with wealth or power. Larger farmers tend to have the capacity to mediate with local politicians, either through formal or informal mechanisms

Figure 3.8: Farmers' Responses Given Types of Extension Services Provision

Ideal Extension Service Provision
- Agree → ·Remain in sector and receive extension service
- Disagree → ·Use voice to request change in extension services, but exit if bureacracy denies change in extension services

Inadequate or Low Extension Service Provision
- Agree → ·Remain in sector receiving inadequate extension services
- Disagree → ·Use voice to request change in extension services, but most likely leave public extension services that will not improve

Sophisticated Clientelistic Practices
- Agree → ·Join clientelistic network and receive public extension services
- Disagree → ·Bargain for change or exit public extension services market

Limited Clientelistic Practices
- Agree → ·Join clientelistic network and receive inadequate extension services
- Disagree → ·Bargain for change or exit public extension services market

Source: Created by author

and succeed in demanding the change they require of extension services. When they are unable to access the public market for extension services or when their voices were not strong enough to change the extension services proposal of local politicians, large farmers also have the resources to access private providers from agribusinesses or private extension agents. This is not exclusive to the Colombian case study. Bates shows how this is also the case in other developing countries, where large farmers consume most of the publicly provided benefits of agricultural programs (Bates, 2014, 55). This is how large farmers were able to keep improving their yields and productivity despite the declining quality of extension services markets. As Lizarralde Montolla (2016) expressed "the only farmers who receive extension services are those who can afford it."

Data supports the point that larger farmers were able to maintain the provision of extension services. Using a logit model to assess technical assistance on better agricultural practices in the 2014 agricultural census, farms larger than 500 hectares, were 1.03 times more likely to receive technical assistance than smaller farms, and these results are significant at the one percent level.[18] Additionally, and of im-

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[18]These are the results of a logistic model where the dependent variable is a dummy variable equal to 1 if the farm received technical assistance or zero otherwise, and the independent variable is a dummy variable equal to 1 if the farm is larger than 500 hectares. $\beta = 0.03$, odds ratio $= 1.03$, $z = 3.45$, $N = 2,913,163$. Data for this model are from the DANE (2016).

portance to note, these larger farms were 1.14 times more likely to pay for those extension services. Again these results are signficant at the one percent level.[19]

However, there are certain products where size does not fully explain the capacity of farmers to voice demands or find alternatives to the provision of extension services. It is still possible to find products where even small and medium sized farmers maintained access to extension services. The explanation for this different result lies in the strength of growers' associations.

As explained, some growers' associations gained relevance after the decentralization reform. Once the central state retreated, some growers' associations decided to copy the Coffee Federation model and provide in-house technical assistance to its members. Providing technical assistance made their members more dependent on their services. In becoming the voice of their members, some growers' associations also became brokers of power with the capacity to influence local politicians or at least create a parallel service that secured the provision of extension services to their members.

Table 3.3: Growers' Associations that Provide Technical Assistance

Product	Name of the Association(s)	Research Center Associated	Research Center Prior to 1986
Coffee	Colombian Growers' Federation	Cenicafe	Yes (1938)
Sugarcane	Asocaña Fedepanela	Cenicaña	Yes (1978)
Banana	Augura	Cenibanano	Yes (1985)
Cacao	Fedecacao	Fondo Nacional del Cacao	No
Cattle	Fedegan	Fondo Nacional del Ganado	No
Flowers	Asocolflores	Ceniflores	No
Rice	Fedearroz	Fondo Nacional del Arroz	No
Oil Palm Tree	Fedepalma	Cenipalma	No

Source: Created by author with information from literature and interviews.

This is how for some products, farmers of all sizes managed to maintain their productivity and remain competitive in a struggling sector. The strong or rich

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[19]Again, these are the results of a logistic model where the dependent variable is a dummy variable equal to 1 if the farm paid for the technical assistance or zero otherwise, and the independent variable is a dummy variable equal to 1 if the farm is larger than 500 hectares. $\beta = 0.13$, odds ratio $= 1.14$, $z = 7.62$, $N = 328,382$. Data for this model are from the DANE (2016).

growers' associations that provided in-house technical assistance to their members are consolidated in table 3.3.[20] To this point, former Minister Ocampo Gaviria mentioned:

> "There is a diversity of experiences with the UMATAs, with some successful experiences and multiple failures. The other model attempted by the Ministry or by municipalities contracting service entities for technical assistance has also not been more successful than UMATAs. What really works best in Colombia is the technical assistance provided by some growers' associations." (Ocampo Gaviria, 2016)

Medium and small-sized farmers who did not belong to strong growers' associations were unable to find mechanisms to voice their political preferences at the local level. This group of actors had only minor representation and did not have the tools to promote their policy preference. Consequently, these small and medium-sized farmers were likely to fall into clientelistic practices or are kept away from the public market of extension services. It is precisely this group of farmers who lag in their competitiveness or end up leaving the agricultural sector.

Understanding how farmers respond as a function of their size and the crop they produce leads to an understanding of why some products maintained or gained competitiveness despite the decline of the sector, and furthermore explains heterogeneous outcomes within municipalities and across crops.

3.6 Conclusions

The liberalization reform of the 1990s and the escalation of the armed conflict and drug trafficking have been the traditional narratives to explain the decline of the agricultural sector. I argue that while these are valid concerns, the implementation of decentralization reform also played a key role in transforming the sector. As with neoliberal reforms, decentralization vacates policy areas and reshuffles actors in a

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[20]While it is clear that these are the growers' associations that managed to bring extension services to their members, it is not clear what are the characteristics that differentiate them from other growers' associations that did not create the extension services capacity. As it will be explained in section 3.6, this is precisely a topic for future research.

way that restructures local political markets. This paper adapts and expands Snyder's framework and attempts to explain the political economy of decentralization. However, the theoretical framework proposed could apply to other decentralized policy sectors.

The advantage of using this theoretical framework is that it allows for an understanding of the heterogeneous outcomes of the implementation of decentralization reform. Reforms are not always implemented as reformers intended. In fact, local political actors will reinterpret and adapt them to their own interests and benefits. But politicians cannot just impose their will over other actors that share the same political marketplace. Hence, they are required to bargain and adopt different implementation strategies depending on the context, actors, and policy repertoires available to them. Furthermore, by complementing Snyder's framework with Evans and Hirschman, it is possible to better understand farmers' response.

The application of the framework to the Colombian agricultural sector shows how decentralization reforms can be reinterpreted at the local level, producing sub-optimal policy designs. From a local politicians' perspective, the type of extension market they will provide will depend on the fora of discussion for public policy, the actors involved in the political market, and the policy repertoire. Taking into account these factors, local politicians can provide extension services that work adequately by becoming isolated autonomous bureaucracies, or they can provide extension services that solidify sophisticated or limited clientelistic practices. Given the actors and available policy repertoire, data suggest that most mayors will try to use extension services markets as a mechanism to expand their clientelistic networks. This happens because they are constrained by low capacity and decreasing budgets to provide these public goods. Overall, this would suggest a decrease in the quality of extension services provision that the traditional narratives fail to take into account.

With regards to farmers' response, the application of the framework shows how larger farmers and members of strong growers' associations were able to overcome the declining quality of extension services. As a function of these factors, some farmers were able to renegotiate with local politicians and demand a different type of

extension services market that aligned better with their preferences. Alternatively, when their voice was not strong enough to change the system, they were able to access technical assistance through private providers, exiting the local public extension services market while maintaining technical assistance. Hence, applying the framework also explains heterogeneous intra and inter-municipal results that the traditional narratives fail to explain.

3.6.1 Implications for Agricultural Policy in Colombia

This paper finds that most medium and small-sized farmers were the actors that lacked the technical assistance to remain relevant in the agricultural sector. Hence, addressing the decline of the sector requires the integration of these farmers into an adequate extension service system.

It is worth emphasizing that the ideal mechanism to do so is not through a re-centralization scheme. Instead, the proposed framework, the literature, and most interviewees agree that this should be done by strengthening capacity at the local level. Strengthening capacity of UMATAs and building up associative schemes that integrate policies from national actors, growers' associations, private agribusinesses, and municipalities is a legitimate strategy for increasing the productivity of small and medium farmers. The argument is that through better extension services provision at the local level that is free of clientelistic ties, small and medium farmers will gain the resources to implement technology innovations. This will also contribute to overcoming issues with information asymmetries, technology transfer, and lack of access to competitive markets, which are key constrains these actors encounter today.

3.6.2 Future Research

There are multiple loose ends that provide alternatives for future research. First, it would be interesting to apply this framework to other decentralized sectors. In the case of Colombia, it would be particularly interesting to evaluate the sectors of health, education, or water and sanitation, given that they were sectors prioritized

by the decentralization reform.

A second question is related to the disparity between growers' associations. Some growers' associations were able to contest local politicians proposals and mobilize their influence to secure resources to provide extension services to their members. However, the particular differentiating characteristics that allow some growers' associations to secure resources for extension services provision remain unclear.

In parallel to a review of growers' associations there is a much needed evaluation of the effect of para-fiscal transfers on extension services by these private organizations. As was explained in this paper, some associations were able to build in-house extension services, but there is still the question of whether this alternative for extension services provision is more cost-effective than one that relies on funding public actors.

Addressing these additional research alternatives will allow for a better understanding of the agricultural sector and how extension services have changed during the last twenty-five years in Colombia. This will lead to a more comprehensive understanding of the effects of decentralization, strengthening the traditional narratives of a decline due to lack of competitiveness or security concerns.

Finally, the analytic framework proposed should work in other countries that implemented decentralization reform to their agricultural sector, or to other sectors. The framework should help predict the outcomes of the reform conditional on the type of state, and the factors that determine politicians and farmers response. The application of this analytic framework to different countries will also provide a better understanding of how decentralization reforms can be reinterpreted at the local level producing heterogeneous policy outcomes.

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Chapter 4

Paper 3: It Really is Mejor en Bici™: An Impact Evaluation of a Bicycle Sharing System in Bogota, Colombia.

Abstract

Despite the increase in commuter cycling and bicycle sharing systems, there is little rigorous evidence on their impact on bicycle usage. This paper presents an evaluation of Mejor en Bici's $SIBUC$ —a non-citywide bicycle sharing system operating in Bogota, Colombia. Aside from evaluating the impact of $SIBUC$, the paper presents a review on the history and evolution of bicycle sharing systems and adds much needed empirical evidence to this topic. The impact evaluation uses a difference-in-difference design that allows for the identification and estimation of the treatment effect of this bicycle encouraging intervention. The findings presented in the paper hint to an improvement in bicycle usage and perception of bicycling to work, with statistical results of the latter. The paper also presents findings on the impact of active commuting by bike on times and costs of commutes, and on self-reported measurements of productivity and well-being.

4.1 Introduction

Increasing commuter cycling is a leading public policy in urban environments. From the sustainable transport perspective, commuter cycling —and specifically bike sharing systems (BSS)— provide a solution to concerns about global climate change, air and noise pollution, energy security, congestion, and unstable fuel prices (Martens, 2007; Shaheen et al., 2010). Commuting cycling also addresses traditional transportation issues like the "last mile" problem, which refers to the short distance between the start (or end points) of commutes and public transit or transit stations (Zhang et al., 2016, 1).

From a public health perspective, commuter cycling also presents likely benefits. As Stewart et al. (2015, 2) explain "active commuting would apper to be one means by which physical activity might be increased and maintained." In independent studies, Oja et al. (1998) and Shephard (2008) explain that commuter cycling has been found to be of sufficient intensity to meet the weekly energy expenditure needed to fall into the cardio-respiratory training zone of young adults. Hence, increasing active commuting through biking offers substantial potential as a health-enhancing measure for working-age populations (Oja et al., 1998, S93). Cervero et al. (2009) also explain that active commuting might make significant contributions to promote physical activity and a fit lifestyle, particularly for poorer individuals who exercise less for leisure and recreation. In reviewing the existing literature, Pucher et al. (2010) conclude that the combined evidence indicates the benefits of bicycling far exceed the health risks from traffic injuries therefore contradicting the widespread misperception that bicycling is a dangerous activity in urban environments. Moreover, as bicycling levels increase, injury rates fall, making bicycling safer and providing even larger net health benefits (Pucher et al., 2010, S106).

Not surprisingly, initiatives that encourage bicycling have increased during the last years. BSS have spread throughout the world. By 2010 —in what is likely to be an underestimation— Shaheen et al. (2010, 159) identified the existence of 100 bikesharing programs in approximately 125 cities worldwide. However, this

expansion in bicycling infrastructure or bicycling-encouraging initiatives has not been followed by empirical analyses evaluating the success of the schemes or their outcomes.

While the literature on bicycling as a means for active commuting has expanded, multiple studies fall short of producing reliable data that quantifies the effect of these initiatives both on transport and well-being outcomes. This happens due to data constraints or methodological problems. For example, in their review of studies about bicycling interventions, Pucher et al. (2010, S121) find that a crucial limitation of the literature is to address the direction of causality, meaning that it is unclear whether interventions lead to increased levels of cycling, or whether bicycling demand leads to an increase in investments in infrastructure or interventions geared towards bicycling. Most studies lack adequate before-and-after measurements of the treatment; or experimental (or quasi-experimental) designs that allow for identification of a possible treatment effect for the intervention. For example, BSS studies generally use data from only the users of the system, so there is no control group surveyed to compare the outcomes observed. Studies that use experimental designs like randomized interventions tend to focus on communicating the existence of the system or on random allocation of bicycling infrastructure (for example additional bicycle parking). Therefore, these research designs can hardly identify true controls for the BSS or adequate assessments of the causality link and end up evaluating the effect of the communication strategy or the randomly assigned infrastructure.

To my knowledge, this paper presents the first impact evaluation using a quasi-experimental design that allows for identification and estimation of a treatment effect from a bicycling-encouraging intervention that includes a BSS. The intervention was the introduction of Mejor en Bici's BSS —called $SIBUC$— in companies and universities in Bogota, Colombia. Aside from implementing the BSS, Mejor en Bici provides additional services to encourage cycling as the active commute alternative for employees — these will be described in section 4.3.

Mejor en Bici had baseline data for seventeen companies or universities it approached between 2015 and 2016, six of which contracted $SIBUC$. Follow-up data

for the same companies or universities was requested, using similar surveys. Of the companies or universities that had baseline data, six decided to participate in the follow-up data collection. Of these, four companies had contracted Mejor en Bici and two had not installed a BSS on their campuses. Using a difference-in-difference approach, this study evaluates the effect of Mejor en Bici's $SIBUC$ on multiple outcome variables like the percentage of commutes that are done by bicycle or the effect that this choice of transport has on commute times and costs for employees at these companies.

Furthermore, in an attempt to evaluate the effect that a bicycle sharing intervention can have on workers' productivity or well-being, some questions related to these topics were added to the follow-up survey. Using these questions and an instrumental variable design it is possible to compare whether there are statistically significant differences between workers who bike to work and those who do not. While this second analysis is not fully identified because of problems with the data generation process, the results provide a methodological approach and interesting questions that can feed future research on the effect that active commuting through bicycling has on the productivity and well-being of individuals.

Overall, this paper shows that implementing Mejor en Bici's $SIBUC$ increases the amount of employees or students who use bicycles as a means for active commuting. On average, Mejor en Bici's intervention led to a increase ranging from one to eight percentage points in the employees bicycling to work or school. However, due to problems which I argue are related to the data generation process, these results are not statistically significant a the ten percent level. There is some evidence, of improved perception of the idea of bicycling to work. On this question some models find increases up to 23 percentage points, with statistically significant results at the ten percent level. As before, these findings should be taken with caution because issues with the data.

Furthermore, data shows that individuals who bike to work are associated with savings of up to $3,000 pesos and decreases of up to 25 minutes in their morning commute. These results are economically and statistically significant at the one

percent level. The results are robust even when controlling for commutes shorter than 30 minutes or for the distance in kilometers of the commutes. Individuals who bike to work also tend to have higher scores on self reported measures of productivity and well-being. For the productivity measure significant gains were identified in four of the five measures of productivity (statistically significant increases of up to 0.40 z-scores). For measures of well-being biking to work is related to an improvement of over 0.56 z-scores on the PANAS Positive Affect Score which is also significant at the one percent level. While these are only correlations, because there is only end-line data available, these results are promising and call for further research using objective measures for productivity and well-being.

An important section of this paper will be devoted to the issue of attrition and the quality of the data collected in this paper. It is relevant to be aware of the issues with the data generating process when interpreting the results of this research. Bluntly put, attrition in the data is a mayor concern, in that many of the companies in the control group chose not to answer the follow-up survey. Furthermore, one of the control group companies that did participate in both rounds of data collection, changed the method of distribution of the survey. Having said that, I still believe that the process to evaluate a BSS presented in this paper and the findings reached are relevant and contribute to understanding the effect of active commuting through bicycling.

The remainder of the paper proceeds as follows. Section 4.2 presents a review on BSS and the context in which Mejor en Bici is framed, introducing some background on bicycle usage in Bogota and describing what Mejor en Bici is and how it operates. Section 4.3 presents the experimental design of the intervention to evaluate. Section 4.4 describes the data and the measurements selected, including the justification for the selection of the modules to evaluate workers productivity and well-being and the issues with the data generating process. Section 4.5 describes the estimation strategy, and section 4.6 presents the main econometric findings. The paper concludes with a brief discussion of the results and alternatives for future research.

4.2 Context

4.2.1 Bicycle Sharing Systems

Types of Bicycle Sharing Systems

BSS are a scheme where individuals share a fleet of bicycles on an as-needed basis without assuming the costs and responsibilities of bike ownership (Shaheen et al., 2010, 159). The system provides the users short-term access to bicycles meant for daily mobility by offering a sustainable alternative mode of transportation. While some BSS operate on a citywide basis, other systems restrict usage to individual members of an institution —like a university or a company. This distinction — citywide vs. non-citywide— will determine key components of the systems and their operation, such as objectives and coordination with the local transport authority, characteristics of the service, business model, and costs and revenue sources. Figure 4.1 summarizes the different types of BSS.

Figure 4.1: Types of Bicycle Sharing Systems
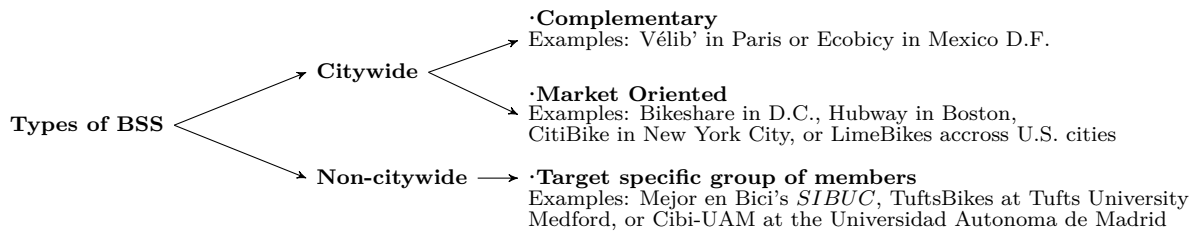
Source: Created by Author

All BSS have the common key objective of encouraging bicycle usage as a sustainable transport alternative for their users. In addition to this primary objective, citywide systems tend to pursue one of two goals. In the first case, some systems are designed as an extension of the transport network, filling out pockets that traditional public transport cannot reach. Systems that pursue this goal are trying to address the "last mile" problem of public transportation. Hence, this type of system complements rather than compete with, traditional public transport alternatives. This does not constrain complementary systems from having stations that serve traditional routes or areas covered by public transportation, but their key

objective is adding to the existing system. Examples of these are citywide systems owned by local administrations like Vélib' in Paris or Ecobicy in Mexico City. In this typical design, the systems coordinate perfectly with or are run directly by local administrations.

In the second type are citywide systems that are more market oriented, serving only routes and areas of the city that are profitable. They still focus on increasing bicycling, but not as a complementary measure to traditional transportation alternatives. To that extent, while they often address the "last mile" problem, they do not try to overcome shortcomings of the local public transport system. Not surprisingly, these systems tend to be privatized and operated by private for-profit or non-profit companies that win a concession or contract with the local authority to provide the service. Hence, they tend to have only partial coordination with local governments or the community, leading to a public-private system. To the extent that these systems are not trying to expand the reach of the public transport network, they do not focus on areas under-served by traditional public transport. Instead they use a data driven approach to determine the optimal location for bicycle share stations that secure the financial stability of the system (Motivate, 2018). Examples of these are systems operated by Motivate[1] in the United States like Capital Bikeshare in D.C., Hubway in Boston[2], or CitiBike in New York City.

Non-citywide systems tend to have little or no coordination with local authorities. Their key objective is to provide access to a BSS to a specific group of members. Contrary to citywide systems, these tend to provide the service only to a small community from a university or a company. Therefore, users only have access to the shared bicycles or docking stations at their institution. These systems focus on overcoming the lack of ownership of a bicycle or the costs and responsibilities of bike ownership for a specific community. Users will typically rent the bicycle at the location of their employer or institution, use it during some hours or use it to commute home and return it the next morning. Examples of this type of system

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[1]Motivate is the parent company that operates some of the largest citywide bicycle sharing systems in the United States. The company is involved in the planning and launching of the system, but also its operation and maintenance.

[2]Hubway recently changed its name to Blue Bikes due to new corporate sponsorship, but the operation of the system remains under the control of Motivate.

are $SIBUC$ —the bikesharing system evaluated by this paper— or university initiatives like TuftsBikes at Tufts University in Medford or Cibi-UAM at the Universidad Autonoma de Madrid.

History of Bicycle Sharing Systems

Shaheen et al. (2010) identify four generations of citywide BSS. Table 4.1 shows the key characteristics that define each generation. The evolution of citywide sharing systems is one that focuses on the introduction of theft deterrent mechanisms (Generation 1 $\rightarrow$ Generation 2), the introduction of technology in the user interface (Generation 2 $\rightarrow$ Generation 3), and the introduction of bicycle redistribution mechanisms to satisfy demand peaks (Generation 3 $\rightarrow$ Generation 4). I complement Shaheen et al.'s (2010) approach with a fifth generation which comes with the emergence of dockless bicycle sharing systems.

Non-citywide BSS have also followed a similar evolution. The key difference is that they tend to be smaller in size so the requirement to redistribute bicycles to respond to users' demand tends to be limited. Most of them rely on users to take and return bikes at the same docking station. Hence, they do not require the rebalancing element, key to the fourth generation of citywide systems.[3] Their reduced size also allows some non-citywide systems to have more flexibility in their operations, not requiring the implementation of IT for user interface or automated docking stations. Not surprisingly, due to differences of scale non-citywide systems tend to be managed with lower operational costs than city-wide systems.

Citywide and non-citywide systems also differentiate by their ownership, business model, and revenue sources. As briefly explained, some systems are owned and operated by local authorities or by the public agency responsible for public transportation services. Other citywide systems are privately run by for-profit companies or non-profit entities that win concessions or contracts to operate the system. Most non-citywide systems are operated by for-profit companies, non-profit entities, or member-run organizations within the institutions where they operate. Conse-

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[3]Rebalancing is the exercise of redistributing bicycles assuring bicycles and docks are available to respond to costumers' demand.

Table 4.1: Generations of Citywide Bicycle Sharing Systems

	First Generation: White Bikes Systems	Second Generation: Coin-deposit Systems	Third Generation: IT-based Systems	Fourth Generation: Demand-responsive Systems	Fifth Generation: Dockless Systems
Components	1. Bicycles	1. Bicycles 2. Docking stations	1. Bicycles 2. Docking stations 3. Kiosk or user interface technology	1. Bicycles 2. Docking stations 3. Kiosk or user interface technology 4. Bicycle distribution system	1. Bicycles 2. User interface (app) technology 3. Limited bicycle distribution system
Characteristics	1. Distinct bikes 2. Bicycles located haphazardly through area 3. Bicycles unlocked 4. No charge for use	1. Distinct bikes 2. Bicycles located at specific docking stations 3. Bicycles with locking devices	1. Distinct bikes 2. Bicycles located at specific docking stations 3. Bicycles with locking devices 4. Smart technology for check-in and check-out 5. Theft deterrents 6. Programs paid by a membership fee	1. Distinct bikes 2. Bicycles located at specific docking stations 3. Bicycles with locking devices 4. Smart technology for check-in and check-out 5. Theft deterrents 6. Programs paid by a membership fee or linked to public transit smartcard 7. Bicycle redistribution system	1. Distinct bikes 2. Bicycles located haphazardly through area 3. Bicycles with locking devices 4. Smart technology for check-in and check-out 5. Theft deterrents 6. Programs paid by a membership fee or by ride 7. Limited redistribution system
Examples	- White bikes (Amsterdam, NL) - Vélos Jaunes (La Rochelle, FR)	- Bycyklen (Copenhagen, DK) - Yellow Bikes (Twin Cities, US)	- SmartBike (Rennes, FR) - Vélib' (Paris, FR) v1 - SmartBike (D.C., US) v1	- SmartBike (Rennes, FR) v2[†] - Vélib' (Paris, FR) v2[†] - SmartBike (D.C., US) v2[†] - Hubway (Boston, US) - Ecobicy (Mexico D.F., MX)	- LimeBike (Multiple cities, U.S.) - Mobike (Founded in Beijing, China) - Ofo (Founded in Beijing, China) - Spin (San Francisco, US)

† Represents systems that have evolved to a fourth generation system with a rebalancing mechanism to address customer demand

Source: Created by author with data from Shaheen et al. (2010)

quently, the business model of each type of system varies significantly depending on the ownership structure. Most citywide systems charge usage fees, and receive additional funds from advertising, government subsidies, or public or private partnership funding. Non-citywide systems differ in that they might not charge usage fees to all their users —they do however take advantage of advertisement or government subsidies to diversify their revenues. When they do not charge fees to their users, these non-citywide systems tend to charge the companies or institutions for the service they provide to their members.

Finally, the different types of systems differ as to cost of technology implementation and operations. Controlling for their size and the technology and quality of bicycles utilized, most systems have similar maintenance costs.[4] The key difference in operational costs between citywide and non-citywide systems tends to be related to rebalancing, which is not a significant cost for most non-city wide systems. It is perhaps the concern of rebalancing costs what has lead to the emergence of dockless systems worldwide.

Operation costs of citywide and non-citywide systems also differ in the stability of their business models. For example, investments in technology (like automated biking docks) require a long-term commitment, which is not the type of relationship some non-citywide system have with their clients. Public and public-private schemes can take over these costs because their contracts or concessions provide stability in the provision of the service, assuring sufficient return to justify the investment in technology.

Evaluation of Bicycle Sharing Systems

As mentioned in the introduction, the literature evaluating outcomes of BSS and their effect on active commuting through bicycling is widely problematic. A typical approach to evaluate BSS is by comparing data of the systems. An example of this type of research is work done by Mátrai and Tóth (2016), who review the existing

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[4]While some non-citywide systems can use non-specialized bikes, the maintenance costs and risk of theft of typical commercial bicycles is too high. For these reasons larger systems will make the investment of specialized bicycles (not to be confuses with the brand), that are sturdier, require less maintenance, and are less likely to be stolen. The assumption of similar maintenance costs is contingent on systems utilizing bicycles specifically designed for bikesharing.

literature on BSS and perform a comparative assessment of six citywide schemes. However, their descriptive analysis compares the systems by looking at the number of users, stations, fees of usage, and area covered without truly assessing the impact of the systems on bicycle usage or well-being of the users.

Another approach in the literature is utilizing system users' surveys or transport surveys and assuming that changes in bicycle or automobile trips are caused by the introduction of the system. An example of this approach is the NICHES policy report which presents anecdotal evidence of changes in transport habits in European cities that introduced public BSS (Bührmann, 2007). The issue with this type of research is that it is impossible to identify the causal link between the introduction of the systems and the changes in transportation habits. It is possible that other variables changed in the cities that chose to implement these systems, like bicycling infrastructure or attitudes toward active commuting. Therefore, assuming a causal link and evaluating BSS without an adequate research design might provide deceiving assessments about the effect of the systems.

Due to this gap in the literature, this paper proposes a quasi-experimental design to conduct an econometric impact evaluation of a BSS in Bogota. The research design, once identified, allows to address the question of causality and estimate the treatment effect of Mejor en Bici's $SIBUC$ on bicycle usage.

4.2.2   Bogota: Bicycle Usage

Bogota, a city of over 8 million inhabitants, has been a pioneer in promoting the use of bicycling as a sustainable transport alternative. This commitment to bicycling is evidenced by the continuous implementation of bicycling encouraging policies for over forty years. Examples of these programs are Ciclovia[5], which on every Sunday and public holiday restricts car usage on over 120 kilometers of the city's streets; the "Día sin Carro" (car-free day) which since the year 2000 has restricted the use of private automobiles at least one day per year; or the network of more than 392

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[5]Ciclovia was created in 1974, and has been operating continuously since 1975. For more on Ciclovia see IDRD (2018).

kilometers of bike-paths that expand across the city.[6]

Not surprisingly, the magnitude of interventions geared towards the encouragement of bicycle usage and the strong bicycle culture has motivated researchers to focus on Bogota as an interesting case study for bicycling. Montezuma (2005) describes how Bogota's mayors during the 1990s invested in urban mobility by building bicycle lanes and introducing bicycling campaigns as a key strategy to discourage the use of particular motorized vehicles. Parra et al. (2007) perform a comprehensive review of peer-reviewed and non-reviewed studies about policy and built environment changes in Bogota. Among their findings is evidence of increased physical activity by women who participate in Ciclovia and the effect of bike-lanes on promoting bicycle usage.[7] Cervero et al. (2009) evaluate the effect built environments have on both utilitarian —as a method of active commute— and leisure bicycling. They find that for the case of Bogota only street density and bicycle ownership have a significant impact on utilitarian bicycling. Furthermore, they state that "increasing bicycle ownership or access could very well promote utilitarian cycling at least as much as building cycleways or making other changes to the built environment" (Cervero et al., 2009, 219). Concerning leisure cycling, they find that more active neighborhoods and the proximity to Ciclovia encourage citizens' participation and stimulate physical activity. Finally, Ríos Flores et al. (2015) evaluate the existing bicycling infrastructure, and conclude that Bogota is a leading city in Latin America in the implementation and strengthening of bicycling encouraging policies and infrastructure.

Aside from the studies quoted —which are representative of the existing peer-reviewed literature— two additional institutional studies have evaluated the evolution of transport, bicycling, and bicycle infrastructure over the last decade. One is the "Observatorio de Movilidad" which is a joint effort between Bogota's Cham-

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[6]For more on Bogota's bicycle infrastructure and bicycling encouraging policies see among others Montezuma (2005); Parra et al. (2007); Cervero et al. (2009); Ríos Flores et al. (2015); Lew et al. (2016); Alcaldía Mayor de Bogotá et al. (2016); Cámara de Comercio de Bogotá and Universidad de los Andes (2017b).

[7]While Parra et al. report these findings they are cautious to warn of the methodological flaws they might contain. For example, after discussing the bicycle lanes evaluation they state "unfortunately, reliable data on the prevalence of bicycle use prior to implementation of the Ciclorutas are not available." (Parra et al., 2007, 345).

ber of Commerce and Los Andes University. This effort has assessed the evolution of public transportation since the year 2007, creating reliable data for the sector. With regards to bicycle usage, the study finds that there has been an increase of 105% in the number of bicycle rides since 2005 (going from 281,135 to 575,356 daily commutes in 2016) (Cámara de Comercio de Bogotá and Universidad de los Andes, 2017a). This increase in bicycle rides led to a five percent increase in bicycle usage as a means of transportation between 2008 and 2016 (although the report states that other surveys show an increase of only 1.9%). This implies that between 4.5% and 8% of daily commutes[8] in Bogota in 2016 were made by bicycle (Cámara de Comercio de Bogotá and Universidad de los Andes, 2017b, 60). This number shows a consistent trend with the 2015 report that indicated that 4.5% of daily trips were made by bicycle (Cámara de Comercio de Bogotá and Universidad de los Andes, 2016, 13).

The other institutional study that monitors transport evolution is the Secretaría de Movilidad's Mobility Survey. This survey that takes place every four or five years and traces the evolution of means of transportation and commutes in Bogota. In its most recent edition (2015) the study compares the evolution to 2011 data, finding that 4.83% of commutes in Bogota are made by bicycle, an increase of 38.5% rides since 2011 (Alcaldía Mayor de Bogotá et al., 2016, 26). The differences in the Observatorio de Movilidad data are due to the difference in the samples of each survey, and the fact that the Mobility Survey study also takes into account contiguous municipalities of what could be considered Bogota's metropolitan area.[9]

It is possible to conclude that Bogota is a pioneer city with a strong bicycle culture. However, most of the studies presented only provide descriptive analysis of bicycle usage without identifying the specific intervention that led to the change in commuting habits. As with the literature of bicycling reviewed, it is hard to evaluate interventions that encourage bicycling given that there are often multiple policies being implemented in parallel. Even so, there are two important notes

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[8]These data are for daily commutes that are longer than 15 minutes. For commutes that are shorter than 15 minutes, there is only data available for 2015, and the percentage of commutes done by bicycle drops to 4% (Cámara de Comercio de Bogotá and Universidad de los Andes, 2016, 28).

[9]While there is a *de facto* metropolitan area, this figure has not been created as an administrative unit. For more on this topic see Guzman et al. (2017).

about Bogota's context that are relevant for the research design of this paper. First, the literature and policy reviewed shows no external shock or policy intervention between 2015 and 2018 that could affect or distinctly encourage bicycle usage in companies that hired Mejor en Bici compared to those that did not. This detail is fundamental for the identification of the difference-in-difference strategy which relies on the parallel trend assumption to hold. The second note is related to the absence of a citywide system that could substitute the service provided by Mejor en Bici for those companies that did not contract $SIBUC$.[10] Again, this information is relevant to identify the parallel trends assumption, but more on this topic will be discussed in section 4.5.

4.2.3   Mejor en Bici

Mejor en Bici[11] is a private company that was a pioneer in administering non-citywide BSS in Colombia. The company started as a non-profit in 2010, with the objective of incentivizing the use of bicycles as a sustainable transportation alternative. Since then it has turned into a for-profit business, providing a variety of services related to bicycle sharing and bicycling as the means of active commuting to individuals, companies, universities, and cities. Among the multiple services that Mejor en Bici provides, this evaluation will focus on their implementation of $SIBUC$ —BSS for companies or universities— in Bogota.

This research is made possible by the fact that Mejor en Bici is a data driven company. Prior to implementing $SIBUC$, Mejor en Bici conducts an assessment of the characteristics of the client in order to customize the services they provide. A key element of this assessment is a prospective users survey, collecting demographic

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[10] There was a small bicycle shared program operated by the Mayor's office between 2012 and 2016. This program benefited about 300 users and was restricted to three isolated corridors that averaged a length of 1.8 km. The system did not utilized specialized bicycles or automated docking stations, and was thought only as a mechanism to promote leisure cycling. The program was shut down in 2016 after a new administration questioned its efficiency. For more on this program see IDRD (2014); Dinero (2016). Aside from this program a contract was adjudicated to implement and operate a citywide BSS in 2015. However, there were serious questions with relation to the consortium that won the contract —given the members had little to no experience in the implementation of BSS. After two years of breach of the contract where no actions to implement the system were made, the Mayor's office declared the termination of the contract in 2016. For more on this case see Téllez (2015); Dulce Romero (2017).

[11] For more on Mejor en Bici see Mejor en Bici (2017); Pilon (2015); Suárez Rueda (2010); Ospina Castro (2016).

data and data on commutes of employees. It is this survey that serves as baseline information for the difference-in-difference design. It is also relevant to note that Mejor en Bici performs the survey on all potential clients, and the results of the survey do not condition the adoption of $SIBUC$. Mejor en Bici offers the sharing system service to all companies independent of the results of the survey and will only share the survey results with the client once they have contracted Mejor en Bici's service to avoid jeopardizing the sale (Ospina Castro, 2016).

For the purposes of this paper it is helpful to note two additional details. First, a key assumption behind Mejor en Bici's mission is that their success is not exclusively measured by the usage of $SIBUC$. They believe that the implementation of $SIBUC$ also encourages other employees to commute to work using their own bicycles. For this reason the docking stations are designed to allow other users to park their bicycles, and mechanic services are also provided for personal bicycles. Hence, it is expected that bicycle usage increases more than usage of the shared system. Second, while Mejor en Bici operates multiple BSS for companies in Bogota —using similar packages and technology— it is important to note that systems are not interconnected. To illustrate this point, assume both company A and company B have BSS operated by Mejor en Bici. If a registered user from company A rents out a bike at the docking station at their employers site, he cannot return this bike to, or use a bicycle or dock from company B. This is consistent with Mejor en Bici's business model and cuts down on operational costs (due to costs of rebalancing).

4.3   Experimental Design

4.3.1   Treatment

In collaboration with Mejor en Bici, the objective of this paper is to perform an impact evaluation on the implementation of $SIBUC$. The intervention can be described as a package that includes multiple components. First, the company provides all the required elements to set-up a non-citywide BSS. Mejor en Bici provides custom bicycles, docking systems, and the technological package for the user interface. Second, the company provides operational support, taking the responsibility

of managing and maintaining the system, and when the client has multiple docking stations, the rebalancing of the fleet. A fundamental component of the package includes the promotion of bicycle as an alternative for active commute, which includes introductory workshops and videos related to urban bicycling, travel awareness programs, and safe-route programs.[12] Finally, Mejor en Bici also provides companies with reports about the system implemented and bicycle usage withing the company.

Mejor en Bici offered $SIBUC$ and performed baseline surveys on 17 companies or universities in Bogota between the second semester of 2015 and the first semester of 2016.[13] Data collection was done through electronic surveys which were delivered directly by the human resources team at each company or university. The advantage of this distribution mechanism is that, as Andrews et al. (2003, 191) explain, higher response rates for electronic surveys can be expected when there is a work group cohesiveness. This was also the traditional way in which Mejor en Bici collected their user data.

Of the 17 institutions for which there is baseline data, only six companies decided to contract a bicycle sharing system with Mejor en Bici, leaving six companies in the treatment group and 10 companies in the control group. A description of the characteristics of these companies and their employees will be provided in section 4.4.

Assignment to the treatment is at the company level. As explained before, the results of the survey do not determine the implementation of $SIBUC$, given that this is a decision that remains in control of each potential client. In fact, no information of the survey results are shared with the potential clients prior to their decision to contract $SIBUC$. It also does not appear that the decision to hire Mejor en Bici was driven by the demand of company employees or university students. Finally, no additional incentives were provided to survey respondents and no additional benefits

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[12]Safe-route programs are designed to help first-time users feel safe while commuted by bike. The program consists of pairing first-time riders with experienced riders from Mejor en Bici for most of their daily commute, so that new bikers feel safe and accompanied as they get used to urban biking.

[13]Mejor en Bici has additional clients where $SIBUC$ was implemented but their survey data are not compatible to that collected between 2015 and 2016. Additionally, while there was information for $SIBUC$ systems outside of Bogota their data was omitted. A pilot of the survey was also tested on Mejor en Bici employees, but these data are also omitted for the analysis on Mejor en Bici's impact.

outside of the ones included in the intervention package were granted to users of $SIBUC$.

After reviewing the existing survey with Mejor en Bici, follow-up data was collected. To gather information related to users' well-being and productivity two additional modules were added to the survey. Follow-up collection was performed on a total of six institutions during spring 2018 resulting in baseline and follow-up data for both the treatment and control groups.

4.4 Data

4.4.1 Measurement

This paper uses data collected by Mejor en Bici between 2015 and 2018. The baseline data includes the online surveys performed on 17 companies between the fall semester of 2015 and the spring semester of 2016. These surveys were designed following the guidelines and proven instruments of the Observatorio de Movilidad de Bogotá and the "Guide for the development of business plans for sustainable mobility" (Bocarejo Suescún et al., 2011). The surveys were distributed through the human resources department at each company. Mejor en Bici collected all the data and produced a report only after the clients had decided whether or not to contract $SIBUC$. The survey included questions related to basic demographic characteristics of the respondents like age or sex. Other questions are related to employees typical commute habits, including information on the means of transportation used, the time of entry to the office, the length of the commute and the average daily cost. Finally, there are some questions related to the use of bicycle as a means for active commute and the possibility of using the bicycle as an alternative for commuting.

Table 4.2 summarizes the number of responses per company, also identifying those clients who contracted Mejor en Bici. Company or University names were anonymized to comply with IRB requirements. The sample is comprised of 17 companies or universities working from different areas. The sample represents a wide range of activities, including public and private institutions, some universities, and companies from different sectors like tourism services, architecture and engineering

services, financial or insurance services, health providers, manufacturing and automotive industries, fitness service providers, and logistic solutions providers. At the baseline, clients who hired Mejor en Bici had 993 survey responses, while clients who did not hire Mejor en Bici had 705 responses —this is omitting Company Q due to its sample size.[14] At the follow-up, companies in the treatment group had 213 responses, roughly equivalent to a 9.21% response rate given the estimated size of the companies that answered the follow-up, compared to 79 in the control group (excluding Company Q), which is roughly equivalent to a 10.6% response rate.[15]

Aside from the difference in number of responses, tables 4.3 and 4.4 compare other baseline demographics characteristics that are different between treatment and control groups. Using all the data, companies that received the treatment have on average older employees who enter work earlier in the day. Without Company Q, the only additional demographic difference is that the treated companies tend to have more female employees or students. At the baseline, clients that hired Mejor en Bici, had less employees who usually commute by bicycle and less employees who thought about using a bicycle to commute to work. Bicycle ownership is also significantly lower when including Company Q, but is not statistically different when excluding the data from this Company.

Follow-up data used similar questions and methods of collection to the baseline surveys. The main modification between the questionnaire was changing the way time of commute and daily expenses in commute were collected, the introduction of a question to assure that no other transport related intervention had happened at the clients' location, and the inclusion of two modules related to productivity and well-being.

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[14]It is hard to estimate number of employees per client given that Mejor en Bici did not ask for these data prior to conducting the baseline survey, and available data adds up all branch offices in different locations —most of which did not have access to the treatment. A rough estimate for company size, using company websites, Linked-In profiles, or brief interviews with human resources teams shows that on average clients who received the treatment had 2,189 employees compared to 521 employees in companies who did not contract $SIBUC$ (again Company Q is excluded for this analysis). It is interesting to note that even with these estimates, response rate was higher in companies on the control group (15.8%) compared to companies in the treatment group (10.5%).

[15]To calculate this response rate I use the estimated company size for Company L (742 employees). These differential response rates evidence the issue of attrition and issues related to data from Company Q which will be discussed in section 4.4.3.

Table 4.2: Data by Company and Mejor en Bici

	Baseline Mejor En Bici			Follow-up Mejor En Bici		
Company	**No**	**Yes**	**Total**	**No**	**Yes**	**Total**
A	32	0	32			
B	40	0	40			
C	130	0	130			
D	50	0	50			
E	53	0	53			
F	100	0	100			
G	84	0	84			
H	64	0	64			
I	0	262	262			
J	0	222	222			
K	0	28	28	0	19	19
L	98	0	98	79	0	79
M	0	47	47	0	67	67
N	0	300	300	0	21	21
O	54	0	54			
P	0	134	134	0	106	106
Q	1363	0	1363	23	0	23
Total	**2,068**	**993**	**3,061**	**102**	**213**	**315**
Excluding Company Q	**705**	**993**	**1,698**	**79**	**213**	**292**

Source: Created by author with data from Mejor en Bici

Table 4.3: Employee Baseline Characteristics (all data)

	Mejor en Bici		
	Yes	**No**	**Observations**
Female	0.0249	0.498	3,051
	(0.0193)	(0.0110)	
Age			
Age group dummy (18-25)	-0.345***	0.545	3,051
	(0.0181)	(0.0103)	
Age group dummy (26-35)	0.137***	0.258	3,051
	(0.0176)	(0.0100)	
Age group dummy (36-45)	0.139***	0.12	3,051
	(0.0141)	(0.00805)	
Age group dummy (>46)	0.0698***	0.0767	3,051
	(0.0115)	(0.00655)	
Entry Time			
Enter workplace 8:00 am - 8:59	-0.247***	0.319	1,627
	(0.0181)	(0.0139)	
Enter workplace before 8:00 am	0.247***	0.647	1,627
	(0.0195)	(0.0150)	
Enter workplace after 9:00 am	-0.0283***	0.0283	1,627
	(0.00537)	(0.00411)	
Usual Transport			
Usually commutes by bicycle	-0.0227**	0.0798	2,955
	(0.0102)	(0.00580)	
Usually commutes by walking	0.00979	0.0432	2,955
	(0.00825)	(0.00471)	
Usually commutes by car	0.144***	0.134	2,955
	(0.0149)	(0.00850)	
Usually commutes by public transport (not Transmilenio)	0.0112	0.219	2,955
	(0.0163)	(0.00933)	
Usually commutes by motorcycle	0.0244***	0.0442	2,955
	(0.00871)	(0.00497)	
Usually commutes by company bus	0.0195***	0.00753	2,955
	(0.00458)	(0.00261)	
Usually commutes by Transmilenio	-0.231***	0.457	2,955
	(0.0186)	(0.0106)	
Usually commutes by taxi or Uber	0.0446***	0.0146	2,955
	(0.00655)	(0.00374)	
Bicycle Related			
Thought about using a bicycle to commute	-0.0667***	0.604	2,750
	(0.0199)	(0.0115)	
Owns a bicycle	-0.0732***	0.400	2,750
	(0.0196)	(0.0113)	

Column 1 reports the coefficient from a regression of the demographic characteristic on a dummy variable for the treatment: $SIBUC$. Robust Standard Errors reported in parenthesis.

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

Source: Created by author with data from Mejor en Bici

Table 4.4: Employee Baseline Characteristics Without Company Q

	Mejor en Bici		
	Yes	No	Observations
	(1)	(2)	
Female	0.045*	0.479	1,688
	(0.0247)	(0.0189)	
Age			
Age group dummy (18-25)	-0.015	0.215	1,688
	(0.0200)	(0.0153)	
Age group dummy (26-35)	-0.075***	0.47	1,688
	(0.0244)	(0.0187)	
Age group dummy (36-45)	0.070***	0.189	1,688
	(0.0207)	(0.0159)	
Age group dummy (>46)	0.020	0.126	1,688
	(0.0171)	(0.0131)	
Entry Time			
Enter workplace 8:00 am - 8:59	-0.247***	0.319	1,627
	(0.0181)	(0.0139)	
Enter workplace before 8:00 am	0.247***	0.647	1,627
	(0.0195)	(0.0150)	
Enter workplace after 9:00 am	-0.028***	0.028	1,627
	(0.00537)	(0.00411)	
Usual Transport			
Usually commutes by bicycle	-0.025**	0.082	1,643
	(0.0126)	(0.00962)	
Usually commutes by walking	0.016	0.037	1,643
	(0.0105)	(0.00805)	
Usually commutes by car	0.062***	0.216	1,643
	(0.0217)	(0.0166)	
Usually commutes by public transport (not Transmilenio)	-0.0033	0.234	1,643
	(0.0212)	(0.0162)	
Usually commutes by motorcycle	-0.009	0.078	1,643
	(0.0130)	(0.0099)	
Usually commutes by company bus	0.020***	0.00735	1,643
	(0.00680)	(0.00521)	
Usually commutes by Transmilenio	-0.105***	0.331	1,643
	(0.0221)	(0.0169)	
Usually commutes by taxi or Uber	0.045***	0.015	1,643
	(0.00985)	(0.00754)	
Bicycle Related			
Thought about using a bicycle to commute	-0.125***	0.663	1,547
	(0.0253)	(0.0194)	
Owns a bicycle	-0.023	0.350	1,547
	(0.0244)	(0.0188)	

Column 1 reports the coefficient from a regression of the demographic characteristic on a dummy variable for the treatment: $SIBUC$. Robust Standard Errors reported in parenthesis.

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

Source: Created by author with data from Mejor en Bici

4.4.2 Data on Productivity and Well-being (*PANAS*)

A key challenge this paper encountered was finding valid measures of productivity and well-being that could be collected through online surveys. While using objective measures for productivity or health would have been ideal, it was prohibitively expensive for Mejor en Bici. Collecting this type of data was also problematic given that it raised ethical issues related to taking and handling anthropometric data. To overcome these challenges the suggestion was to use validated instruments for self-reporting productivity and well-being.

This paper used Pransky et al.'s (2006) work performance questionnaire for reporting productivity.[16] This questionnaire includes three basic questions. The first two questions validate that the respondent is taking the survey during a typical workday. The third question requires the employee to rate on a 0 to 100 scale how he performs in aspects related to productivity in comparison with his most productive day at work. The question specifically asks the worker to rate his concentration, the precision with which he is performing his tasks, the time it has taken him to perform this task, his capacity to deal with the workload, and his capacity to work without errors.

The Positive and Negative Affect Schedule (PANAS) was used to measure well-being. This instrument provides a validated measure for self-reported psychological well-being that can be included in online surveys. Created by Watson et al. (1988), this instrument evaluates in a reliable and succinct manner two important dimensions of mood that are related to respondents' psychological well-being.[17] It asks participants to rank on a 1 to 5 Likert Scale twenty terms related to positive and negative affect leading to a score for each dimension of mood —Positive Affect and Negative Affect. Positive Affect reflects the extent to which a person feels enthusiastic, active, and alert; while Negative Affect is a general dimension of distress and unpleasurable engagement that subsumes a variety of aversive mood states, including anger, contempt, disgust, guilt, fear, and nervousness (Watson et al., 1988,

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[16]For more on self-reported measures of productivity see: Allen and Bunn (2003); Beales et al. (2017); Gokhan Kocer (2014); Pransky et al. (2006); Burton and Organization (2010).

[17]For more on the PANAS instrument see: Watson et al. (1988); Crawford and Henry (2004); Watson and Clark (1999); Dufey and Fernandez (2012).

1063). There are Spanish translations of PANAS that have been used in other Latin American countries, indicating the validity of the instrument for contexts similar to those of Bogota and populations similar to the one in this study (Dufey and Fernandez, 2012; Medrano et al., 2015).

4.4.3   Data Concerns and Attrition

Key limitations of this study arise from three elements of the data generation process: i) the online survey instrument, ii) the issue of self-reported data, and iii) attrition. This section describes limitations up front, because I believe the most relevant contribution of this study is the one of the process to evaluate a BSS and not the results obtained by this evaluation.

Online Survey Instrument

Most of the issues with the online survey instrument are related to sample and participant selection, and the low response rates that are usually associated with this type of data collection. As Andrews et al. (2003) explain, these are structural concerns that all online instruments share by design and hence are difficult to overcome. Efforts were made for follow-up data collection to surmount these issues. For example, the survey was piloted with Mejor en Bici employees, and the questionnaire shortened to ease data collection. With regards to low response rates, the research relied on human resources offices to deliver the survey directly to employees, given that this was the most promising method to increase response rates and was also consistent with the way baseline data was collected. The response rates for this research were actually close to the usual response rates expected from online surveys mentioned by Andrews et al. (2003). Roughly estimated response rates average 10.5% for the treated group and 15.8% for the control group at the baseline and 9.2% for the treated and 10.6% for the control group at the follow-up.

Issues related to the online instrument remain, limiting the interpretation of the results of this study. For example, there are differences between online and offline populations that online surveys cannot overcome. The data collected might not

be representative for the entire workforce of Mejor en Bici's clients or the control group. Therefore, all results should be considered relevant for the sampled online population. It is possible, however, that bias introduced by this difference between online and offline populations actually leads to an underestimation of the results, because according to multiple studies on Bogota (some presented in section 4.2.2), usage of bicycle for commute is more prevalent for lower income populations. If we assume that workers disproportionally not taking the survey due to lack of access to a computer at their workplace or because their work does not require an online presence are more likely to be lower income, then these workers may also be more likely to use a bicycle as a means of active commute to work.

Self-reported Data

In a similar way, the research tried to overcome some concerns related to self-reported data. The main solution was to rely on validated instruments. To that extent the review of Mejor en Bici's survey and confirmation that it was developed following the guidelines of Observatorio de Movilidad de Bogotá and the Guide for the development of business plans for sustainable mobility, was fundamental. Furthermore, only validated instruments were used to measure productivity and well-being. Still, this study should be replicated using data that collected by direct observation or supplemented with complementary data. As Baird and Özler (2012) explain in a study that evaluates the use of self-reported data in measuring school participation, "if appropriate for the study design, impact evaluations should try to collect school participation data through direct observation: even though this will be more expensive in most cases, it is also likely to be money well spent." (Baird and Özler, 2012, 93). It is for this reason that section 4.7.1 explores the possibility to replicate this study using directly observed data.

Attrition

A key issue with this research is attrition. From the original sample that sent the survey to employees only four treated companies and two control companies agreed

to participate in the follow-up data collection. Table 4.5 reports differential attrition assuming that the number of baseline responses were the total obtainable responses at follow-up, and table 4.6 reports attrition rates excluding the data from Company Q.

Table 4.5: Differential Survey Response

	Mejor en Bici		Control	
	(1)	(2)	(3)	(4)
Round 1: Baseline	993	100 %	2,068	100 %
Round 2: End-line for treatment and control groups	213	21%	102	5%

Source: Created by author with data from Mejor en Bici

Table 4.6: Differential Survey Response (without Company Q)

	Mejor en Bici		Control	
	(1)	(2)	(3)	(4)
Round 1: Baseline	993	100 %	705	100 %
Round 2: End-line for treatment and control groups	213	21%	79	11%

Source: Created by author with data from Mejor en Bici

There are multiple explanations for this differential attrition. first some human resources teams were hesitant to send the survey to employees or students at their institutions. Most companies or universities did not see any practical benefit of sending out the surveys, or were concerned that sending out the survey would conflict with their own planning instruments. Another concern expressed by companies who chose not to answer the follow-up was related to the privacy of data and sharing personal information of their employees. This complication is due to cultural and institutional differences in human subjects research and IRB requirements. It was difficult for human resources teams to grasp that in U.S. universities, IRB protocols prohibit the misuse of the data and require the anonymization of participants and their information. Finally, there were concerns from control group companies that the survey might be a mechanism through which Mejor en Bici was trying to promote

their service, or of generating false expectations of the implementation of such system among their members. It was because of these arguments that many companies in the control group chose not to collaborate with the study.

A more problematic issue impacting attrition is related to Company Q. After talking with the team of Mejor en Bici and the human resources team at Company Q it was clear the distribution mechanism changed from baseline to follow-up data. At the baseline, the survey was sent to all campuses of this institution, leading to an exceptionally large number of responses. During the follow-up, the survey was sent only to one of the campuses, explaining the large difference in the number of responses. This generates clear differences in the response rate, particularly taking into account that this was one of the observations that had most responses in the baseline data. It is for this reason that all the results of this paper will be presented in three ways: i) including all data, ii) excluding the observations of Company Q, and iii) excluding from the baseline companies that did not answer the follow-up surveys.

A key question that follows in presenting the issue of attrition is related to how it affects estimation of the coefficients. Aside from the issue with Company Q, most of the attrition of the data is related to companies refusing to distribute the follow-up survey to their employees, and not from attrition of the respondents within each of these companies. If the data is restricted to only the companies who have two rounds of data collection, as presented in table 4.7, it is clear that attrition generates less concern, particularly given that it was larger for the treated group in comparison to the control group. Therefore, it is important to understand how attrition affects the results of this study. For this reason, each time coefficients are presented, special attention will be made explaining how attrition can bias the coefficients and the direction of this bias —if it can be identified.

Table 4.7: Differential Survey Response (without Company Q and including only companies with 2 rounds)

	Mejor en Bici		Control	
	(1)	(2)	(3)	(4)
Round 1: Baseline	509	100 %	98	100 %
Round 2: End-line for treatment and control groups	213	42 %	79	81 %

Source: Created by author with data from Mejor en Bici

4.5 Estimation Strategy

4.5.1 *SIBUC* Impact Evaluation

The main objective of this paper is to estimate the impact that $SIBUC$ has on outcome variables related to bicycle usage. Hence, I am interested in the the change on $Y_{i,t}$ before and after the intervention. The main dependent variable of interest will be whether respondents usually commute by bicycle. Aside from this variable, the evaluation will also explore if $SIBUC$ affects the willingness to use a bicycle for active commute. The regression model is the following:

$$Y_{i,t} = \beta_0 + \beta_1 SIBUC_i + \beta_2 Time_t + \beta_3 SIBUC_i * T_t + \mathbf{X}'_{j,t} + \theta_i + \varepsilon_{it} \qquad (4.1)$$

Where $SIBUC_i$ is a binary variable equal to 1 if the company received the intervention or 0 otherwise. $Time_t$ is a binary variable equal to 1 in the post period and 0 in the baseline period. $SIBUC_i * Time_t$ is an interaction term between the two prior variables. $\mathbf{X}'_{j,t}$ is a vector of demographic variables of the employees or students that affect bicycle usage, and θ_i are company fixed effects.[18]

For outcome variables of interest related to specific length (in minutes) and expenses (in pesos) related to the morning commute, the regression model will be restricted only to follow-up data, given the way data was collected at baseline.

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[18]Following Bertrand et al. (2004) and more specifically Cameron et al. (2008) and Colin Cameron and Miller (2015), I attempted the use of a wild cluster bootstrap-t, to adjust the estimation of the errors. However, due to singularities of the data it was not possible to correct the standard errors. For this reason I chose the specification with company fixed effects and robust standard errors clustered at the company level.

Equations 4.2 and 4.3 describe the specific models for this analysis as follows:

$$Minutes_j = \beta_0 + \beta_1 Uses\,Bicycle_j + \beta_2 Distance_j + \varepsilon_j \tag{4.2}$$

$$Money_j = \beta_0 + \beta_1 Uses\,Bicycle_j + \beta_2 Distance_j + \varepsilon_j \tag{4.3}$$

In these set of equations, $Minutes$ is the average time in minutes of the morning commute and $Money$ is the average cost in pesos of the morning commute. $Uses\,Bicycle$ is a binary variables equal to 1 if the respondent usually bikes work during the morning commute or 0 otherwise, and $Distance$ is a variable that estimates the linear distance between the self-reported home address of the respondent and his place of work or study. To estimate this variable, a python script to geocode self-reported addresses and the distance to work was created. To control for length of commute some models replace $Distance$ with $Commute < 30\,Min$, which is a binary variable equal to 1 if the morning commute is shorter than 30 minutes or 0 otherwise. After estimating these results the impact of Mejor en Bici will be used to estimate if there is an effect on these outcome variables, by replacing $Uses\,Bicycle_j$ with $SIBUC_i$. However, it is important to clarify that because there is only data for the follow-up round, the analyses on length (in minutes) and expenses (in pesos) can only show correlation between these variables and $Uses\,Bicycle_j$ or $SIBUC_i$. For all equations presented so far analysis subscripts i represent observations at the company level and j represent observations at the individual level.

A key element to identify the difference-in-difference method is to assure that the parallel trends assumption holds. The parallel trend assumption states that in the absence of the intervention the outcome in the treatment group would have moved in tandem with the outcome in the comparison group (Gertler et al., 2016, 100). As explained in section 4.2.2 no known external shocks or interventions happened in Bogota that could explain differential effects of the intervention on treatment and control groups. Furthermore, as explained in section 4.4, an additional question was asked in the follow-up data to control for other transport interventions related to bicycle mobility at control clients. None of the respondents of the control reported to

receive any interventions related to encouraging bicycling or changing their commute habits. Finally, to provide more evidence that the parallel trends assumption holds, the difference-in-difference regression was estimated using the same treatment and comparison groups but different outcome variables that could not be affected by the treatment (like age groups or the time respondents took to answer the survey) finding no statistically significant results.

4.5.2 Evaluation on Correlation of Bicycling with Productivity and Well-Being

The key issue with the existing research on bicycle usage and its effect on productivity and well-being is the issue of causation. It is likely that there are inherent characteristics of people who choose to bike to work and their self-reported measures of productivity and well-being that are different from those who do not bike to work. To overcome this issue of selection bias, the methodological solution is to instrument bicycling to work with the $SIBUC$ variable. Equation 4.4 represents the first stage regression:

$$Biked\,to\,Work_i = a + bSIBUC_i + v_i \tag{4.4}$$

Where $Biked\,to\,Work_i$ is a dummy variable equal to 1 if the respondent bicycled to work the day he answered the survey or 0 otherwise, which is instrumented by the $SIBUC_i$ variable. The second stage, described in equation 4.5, evaluates the effect of the instrumented $Biked\,to\,Work_i$ variable on self-reported productivity or well-being (for simplicity equation 4.5 only references productivity).

$$Productivity_i = \gamma + \alpha Biked\,to\,Work_i + u_i \tag{4.5}$$

Unfortunately, as reported in column 1 of table 4.13 $SIBUC_i$ is not a strong instrument for $Biked\,to\,Work_i$. I still present the results of this analysis given that I believe that this instrument does fulfill the restriction assumption, and with better data, it could provide interesting insights into the effect bicycling has on measures

of productivity or well-being. Regardless, due to limitations of the data generating process I am unable to fully identify this analysis.

4.5.3 Hypothesized Mechanisms

The expectation of the impact evaluation on Mejor en Bici is that the implementation of $SIBUC$ will increase bicycle usage in companies or universities that adopted the BSS. The treatment does so through two mechanisms. First, it overcomes the problem of bicycle ownership, which was identified by (Cervero et al., 2009, 219) as "the strongest single correlate of utilitarian cycling" in Bogota. Second, due to the "conformity and peer effect" (de Geus et al., 2007; Elvik, 2009; Fukuda and Morichi, 2007; Martens, 2007), $SIBUC$ has the potential to increase bicycling in a non-linear way. This implies that once the first employees start using the shared system for cycling to work, others will follow. For this reason, the analysis should not only measure the number of trips in the BSS, but the total number of commutes by any bicycle.

Concerning the relationship between bicycling and measures of productivity and well-being the expectation is that people who bike to work will have higher self-reported productivity and well-being than those who do not use cycling as a means of active commute. As explained previously, there is evidence in the peer-reviewed literature that active commuting through cycling has sufficient intensity to meet minimum exercise requirements for work-age populations (Oja et al., 1998; Shephard, 2008). However, there is no study that estimates the effect of biking on productivity or well-being because of the endogeneity problem between the two variables of interest. The expectation is that this instrumental design overcomes the issue of endogeneity providing evidence of the causal relation.

4.6 Main Econometric Results

4.6.1 Evaluation on Mejor en Bici

Effects of $SIBUC$ on Bicycle Usage

Results of the effect Mejor en Bici has on bicycle usage are presented in table 4.8. In line with what was presented in the baseline tables, companies who hired Mejor en Bici all started with lower bicycle usage. While all the estimates for the treatment effect hint that the implementation of $SIBUC$ led to higher bicycle usage, ranging from one to eight percentage point increases, none show statistically significant effects at the ten percent level (t values are: (1) $t = 1.24$ (2) $t = 0.64$ (4) $t = 0.83$ (5) $t = 0.43$ (7) $t = 0.28$ (8) $t = 0.40$). These results are robust even when controlling for individual characteristics that impact bicycle usage, like being female, having a short commute, or being a member of the 18-25 age group (t values are: (3) $t = 0.64$ (6) $t = 0.45$ (9) $t = 0.42$). To understand these results in their context it is relevant to remember that the control group for most of the models is driven by data from Company L, which had a high bicycle usage for both rounds of data collection (6.38% at the baseline and 10.12% at the end-line).

To further evidence the predicted impact of $SIBUC$ it is perhaps useful to observe the trend graphically. Figure 4.2 presents the predicted estimates at both baseline and end-line data for the treated and control group (using all data). This graphical display allows for a better understanding of the likely effect of Mejor en Bici's $SIBUC$. However, due to the issues with the data generation process and the results of the econometric analysis, more research is needed before concluding the effect of Mejor en Bici's $SIBUC$ as a mechanism to encourage active commuting through bicycling.

Effects of $SIBUC$ on Perception of Bicycling to Work

Aside from analyzing the effect of $SIBUC$ on bicycling to work the research also analyzed whether the perception of bicycling to work had changed at the treated companies. The results of this analysis are presented in table 4.9. Again, all coeffi-

Table 4.8: Regression Analysis for the Effect of Mejor en Bici on Bicycle Usage

VARIABLES	Percentage of employees who usually commute by bicycle								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$SIBUC$	-0.02**	-0.21***	-0.16***	-0.03*	-0.16**	-0.16***	-0.00	-0.08	-0.10
	(0.010)	(0.047)	(0.040)	(0.013)	(0.067)	(0.039)	(0.027)	(0.051)	(0.051)
$Time$	0.01	0.01	0.03*	0.02	0.04***	0.05***	0.04	0.04	0.05***
	(0.029)	(0.024)	(0.017)	(0.036)	(0.000)	(0.003)	(0.042)	(0.006)	(0.006)
$SIBUC * Time$	0.05	0.08	0.07	0.04	0.05	0.05	0.01	0.05	0.05
	(0.037)	(0.118)	(0.109)	(0.042)	(0.116)	(0.108)	(0.049)	(.)	(0.114)
$Female$			-0.08***			-0.07***			-0.08*
			(0.012)			(0.019)			(0.030)
$Commute < 30\ min.$			0.09***			0.10***			0.13*
			(0.017)			(0.026)			(0.052)
$Age\ group\ 18 - 25$			0.03**			0.02			0.02
			(0.009)			(0.019)			(0.030)
Constant	0.08***	0.19***	0.16***	0.08***	0.19***	0.15***	0.06**	0.06***	0.08***
	(0.006)	(0.000)	(0.009)	(0.011)	(0.000)	(0.014)	(0.025)	(0.000)	(0.010)
Company Fixed Effect		✓	✓	✓	✓	✓	✓	✓	✓
Observations	3,264	3,264	3,256	1,929	1,929	1,921	865	865	857
R^2	0.003	0.021	0.066	0.005	0.036	0.083	0.007	0.022	0.080

Models (1) (4) and (7) present robust standard errors in parentheses. All other models present robust standard errors at the company cluster level. Models (1), (2), and (3), include all the data. Models (4), (5), and (6) omit data from Company Q in both rounds. Models (7),(8), and (9) omit data from Company Q and data from companies who did not participate in the follow-up. *** p<0.01, ** p<0.05, * p<0.1

Figure 4.2: Predicted Impact of $SIBUC$ on Bicycle Usage
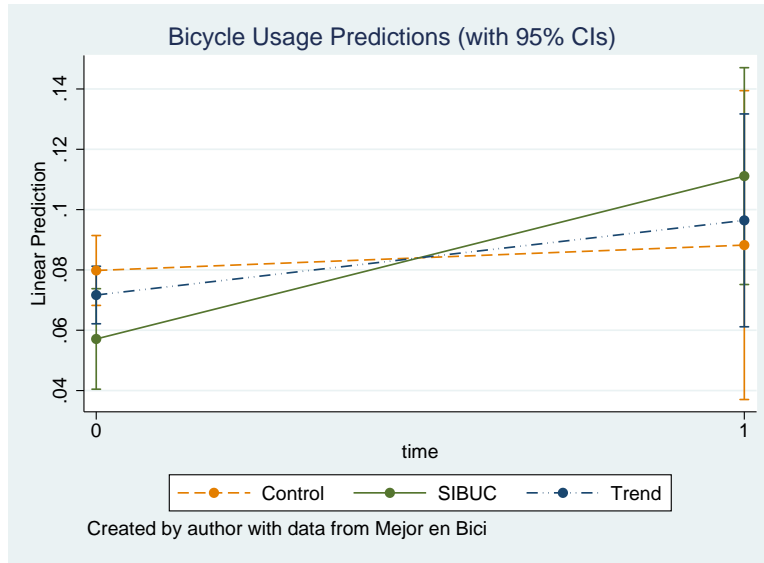
cients except one show an improved perception toward biking to work and models (4), (6), and (7) show statistically significant results. Model (4) predicts an average increase of 15 percentage points in respondents from the treatment group who would consider biking to work compared to the control group (excluding Company Q) and is significant at a five percent level ($t = 2.11$). Model (6) predicts an average increase of 16 percentage points in respondents who would consider biking to work in the treatment group compared to the control group (excluding Company Q) significant at the ten percent level ($t = 1.82$). Finally, model (7) predicts an average increase of 23 percentage points in the respondents who would consider biking to work in the treatment group compared to the control group (excluding Company Q and other companies that did not participate in the follow-up) significant at the one percent level ($t = 2.67$). While these results hint that Mejor en Bici might change the perception of bicycling to work the results should be taken cautiously given the issues with the data generation process.

Correlation of Bicycling to Work and $SIBUC$ on Times and Costs of Morning Commutes

The idea for these analyses is to first assess if usually bicycling to work is correlated with the length and costs of morning commutes of individuals, and then test if these

Table 4.9: Regression Analysis for the Effect of Mejor en Bici on Thinking of Using a Bicycle

VARIABLES	Percentage of employees who would consider commuting by bicycle								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$SIBUC$	-0.07***	-0.12*	0.10***	-0.13***	0.01	-0.02	-0.20***	-0.03	-0.07
	(0.020)	(0.066)	(0.033)	(0.025)	(0.044)	(0.047)	(0.052)	(0.048)	(0.043)
$Time$	0.01	-0.02	0.03	-0.11*	-0.17***	-0.13***	-0.17**	-0.17***	-0.13***
	(0.049)	(0.140)	(0.159)	(0.059)	(0.000)	(0.005)	(0.073)	(0.000)	(0.011)
$SIBUC*Time$	0.03	0.03	-0.00	0.15**	0.18	0.16*	0.23***	0.18	0.16
	(0.063)	(0.179)	(0.183)	(0.071)	(0.113)	(0.087)	(0.084)	(0.122)	(0.090)
$Female$			-0.18***			-0.21***			-0.20**
			(0.028)			(0.033)			(0.070)
$Commute < 30\ min.$			0.15***			0.19***			0.24***
			(0.034)			(0.024)			(0.041)
$Age\ group\ 18-25$			0.10***			0.07***			0.03
			(0.023)			(0.024)			(0.041)
Constant	0.60***	0.68***	0.61***	0.66***	0.68***	0.60***	0.73***	0.73***	0.79***
	(0.011)	(0.000)	(0.010)	(0.019)	(0.000)	(0.012)	(0.047)	(0.000)	(0.030)
Company Fixed Effect		✓	✓		✓	✓		✓	✓
Observations	3,050	3,050	3,048	1,824	1,824	1,822	819	819	817
R^2	0.004	0.018	0.071	0.013	0.033	0.104	0.016	0.027	0.104

Models (1) (4) and (7) present robust standard errors in parentheses. All other models present robust standard errors at the company cluster level. Models (1), (2), and (3), include all the data. Models (4), (5), and (6) omit data from Company Q in both rounds. Models (7),(8), and (9) omit data from Company Q and data from companies who did not participate in the follow-up. *** p<0.01, ** p<0.05, * p<0.1

effects hold for treated companies. To better understand this correlation, controls for commute length and approximate distance of the commute are included in some models. It is important to reiterate that the analyses in this section only evidence correlation between the variables, given that there is only one round of data and therefore the difference-in-difference approach is not applicable. To frame the results of this correlation, the average morning commute in the sample is 55.32 minutes ($s.d. = 30.09$) and it costs \$ 4,545 Colombian pesos ($s.d. = 17,116$). The length in minutes of the morning commutes is close to the findings from the "Observatorio de Movilidad" which estimate that average commute in Bogota lasts 60.6 minutes (Cámara de Comercio de Bogotá and Universidad de los Andes, 2017b, 15).

Table 4.10 presents the impacts on the time in minutes of the morning commutes. These results show that on average usually biking to work makes the morning commute shorter by 25 Minutes (column 1), which is a result that is both economically and statistically significant at the one percent level ($t = -5.69$). The results are robust when controlling for commutes shorter than 30 minutes (column 2, $t = -3.83$) or when controlling for the distance (in kilometers) of the commute (column 3, $t = -4.49$). Focusing on the effect of $SIBUC$ it is possible to see that the commute times are also shorter, compared to those on the control group. All the results are statistically significant at the ten percent level, and predict reductions of 12 minutes without controlling for time or distance (column 4, $t = -2.30$), 9 minutes when controlling for commutes shorter than 30 minutes (column 5, $t = -2.05$), and 12 minutes when controlling for the distance of the morning commute (column 6, $t = -2.38$).

Table 4.11 presents the findings of the correlation between biking to work or $SIBUC$ and the costs of the morning commutes. At the time of the survey, a one-way fare for *TransMilenio* (Bogota's rapid bus transit system) was \$2,300 Colombian pesos.[19] The findings are not surprising in showing that, on average, bicycling as a means of commute is correlated with savings that range from \$2,600 to \$3,000 Colombian pesos compared to the cost of other means of transportation. These

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[19]To better understand the savings in money it is useful to think that during the time of the survey one U.S. Dollar was roughly equivalent to \$2,800 Colombian pesos.

Table 4.10: Correlation between Biking to Work or $SIBUC$ and Commute Length in Minutes

VARIABLES	Morning Commute Length in Minutes					
	(1)	(2)	(3)	(4)	(5)	(6)
$Usually\ commutes\ by\ bike$	-25.92***	-14.18***	-20.87***			
	(4.557)	(3.702)	(4.649)			
$SIBUC$				-12.93*	-9.38*	-12.39*
				(5.630)	(4.585)	(5.196)
$Commute < 30\,min.$		-40.26***			-43.76***	
		(4.574)			(3.019)	
$Distance$			2.29***			2.46***
			(0.518)			(0.488)
Constant	59.07***	63.96***	38.32***	64.94***	69.23***	42.97***
	(4.299)	(3.880)	(3.954)	(4.848)	(4.478)	(5.373)
Observations	318	318	318	303	303	303
R^2	0.092	0.319	0.280	0.041	0.309	0.268

Robust standard errors clustered at the company level in parenthesis.

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

results are economically and statistically significant at the one percent level (column 1, $t = -4.31$), even when controlling for a commute shorter than 30 minutes (column 2, $t = -4.66$) or the distance of the morning commute (column 3, $t = -3.97$). When evaluating the correlation between $SIBUC$ and the morning commutes all predictions show that individuals at companies that have $SIBUC$ averaged a more expensive commute than individuals in the control group. However, these results are not statistically significant.

4.6.2   Relationship between Bicycle Usage and Productivity or Well-Being

Having studied the correlation between bicycle usage or $SIBUC$ and length or costs of morning commutes it is possible to proceed to the final set of results related to the relationship between active commute by bicycle and self-reported measures of productivity. As in the previous section, the analyses that follow will only use end-line data. Basic statistics for this restrictive sample are presented in table 4.12.

The results of biking to work on the day of the survey, usually biking to work, and being member of an institution where $SIBUC$ was implemented with self-reported

Table 4.11: Correlation between Biking to Work or *SIBUC* and Commute Costs in Pesos

VARIABLES	Morning Commute Costs in Colombian Pesos					
	(1)	(2)	(3)	(4)	(5)	(6)
Usually commutes by bike	-3,094***	-2,649***	-3,067***			
	(717)	(568)	(773)			
SIBUC				973	1,200	979
				(1,025)	(938)	(1,005)
Commute $< 30\,min.$		-1,500**			-2,311**	
		(603)			(681)	
Distance			11			31
			(44)			(38)
Constant	4,981***	5,193***	4,873***	4,014***	4,241***	3,731***
	(766)	(773)	(1,080)	(207)	(164)	(444)
Observations	319	315	319	304	301	304
R^2	0.004	0.005	0.004	0.001	0.003	0.001

Robust standard errors clustered at the company level in parenthesis.

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

Table 4.12: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Biked to work	315	0.09	0.29	0	1
SIBUC	315	0.67	0.47	0	1
Self-reported Productivity					
Concentration	298	81.21	14.94	16	100
Precision	295	82.38	16.06	13	100
Speed	297	81.19	15.84	11	100
Managing workload	298	83.61	15.04	20	100
No mistakes	298	81.11	16.26	13	100
PANAS - Self-reported Well-being					
Positive Affect Score	294	36.77	7.62	10	50
Negative Affect Score	294	13.52	4.73	10	34

Created by author with data from Mejor en Bici

measures of productivity are presented in figure 4.3. As can be seen, individuals who biked to work on the day of the survey or usually bike to work, reported higher measures of self-reported productivity on all scales compare to individuals who use other means of transportation. For self-assessments on concentration, speed with which they are performing their tasks, and capacity to manage their workload bikers

report increases ranging from 0.34 to 0.40 z-scores compared to non bikers. For these three measures, results are also statistically significant at the five percent level (concentration: $t = 2.33$ and 2.27, speed: $t = 2.49$ and $t2.68$, workload: $t = 2.28$ and 2.76 respectively). For the question related to the capacity of the respondent to work without mistakes, usually biking to work predicts an increase of 0.29 z-scores compared to users of other means of transportation and this result is statistically significant effect at the 5% level ($t = 2.16$). These results hint to an actual gain in self-reported productivity for individuals who chose biking as a means to active commute. As will be explained in section 4.7.1, these finding are promising and call for an assessment with objective productivity measures. The results of $SIBUC$ show no significant difference with the control group for measures of productivity.

Figure 4.3: Predicted Impact of Bicycling on Self-reported Work Productivity
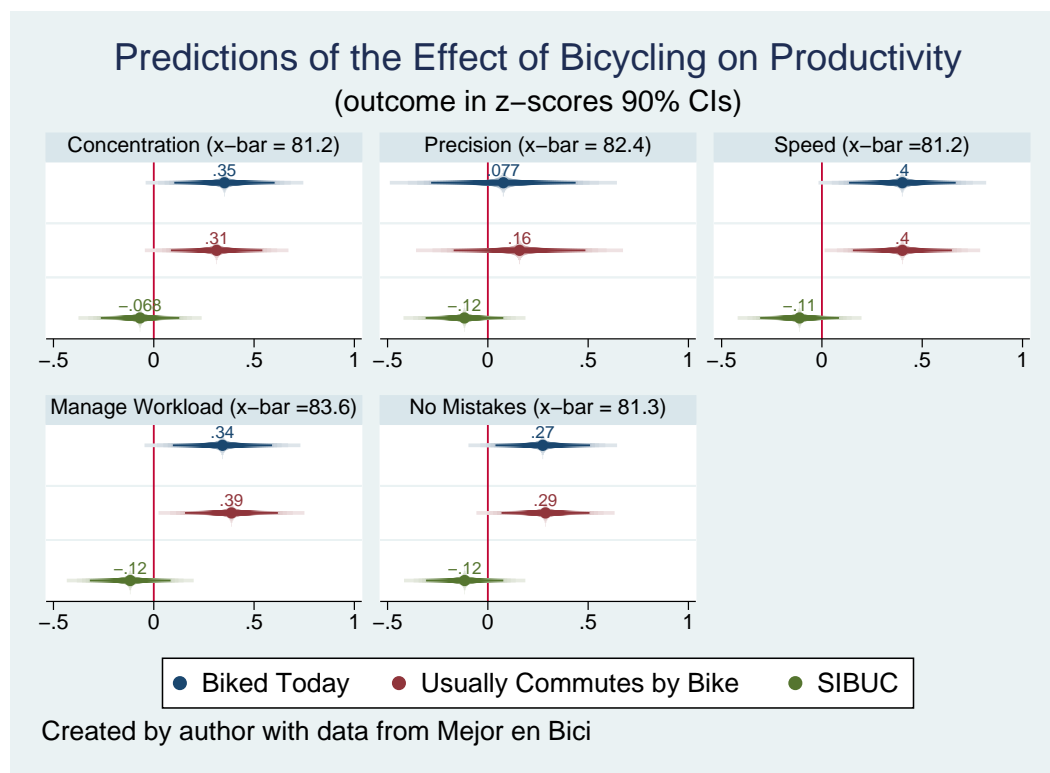
Results for the correlation with self-reported well-being are presented in figure 4.4. When focusing on the measures of well-being it is possible to see that biking to work has a similar trend. For the PANAS Positive Affect Score, biking to work on the day of the survey and usually biking to work predicts an increase of 0.61 z-scores and

0.56 z-scores, respectively compared to respondents who did not bike to work. These results are statistically significant at the one percent level($t = 3.04$ and $t = 2.94$). For the PANAS Negative Affect Score, biking to work predicts a lower score than the mean, indicating improved well-being, but these results are not statistically significant at the five percent level, hinting no differences with respondents who use other transportation methods. As with the case of productivity, given that $SIBUC$ is not a good predictor for biking to work on the day of the survey or usually biking to work, the results are not statistically significant.

Figure 4.4: Predicted Impact of Bicycling on Self-reported Well-being
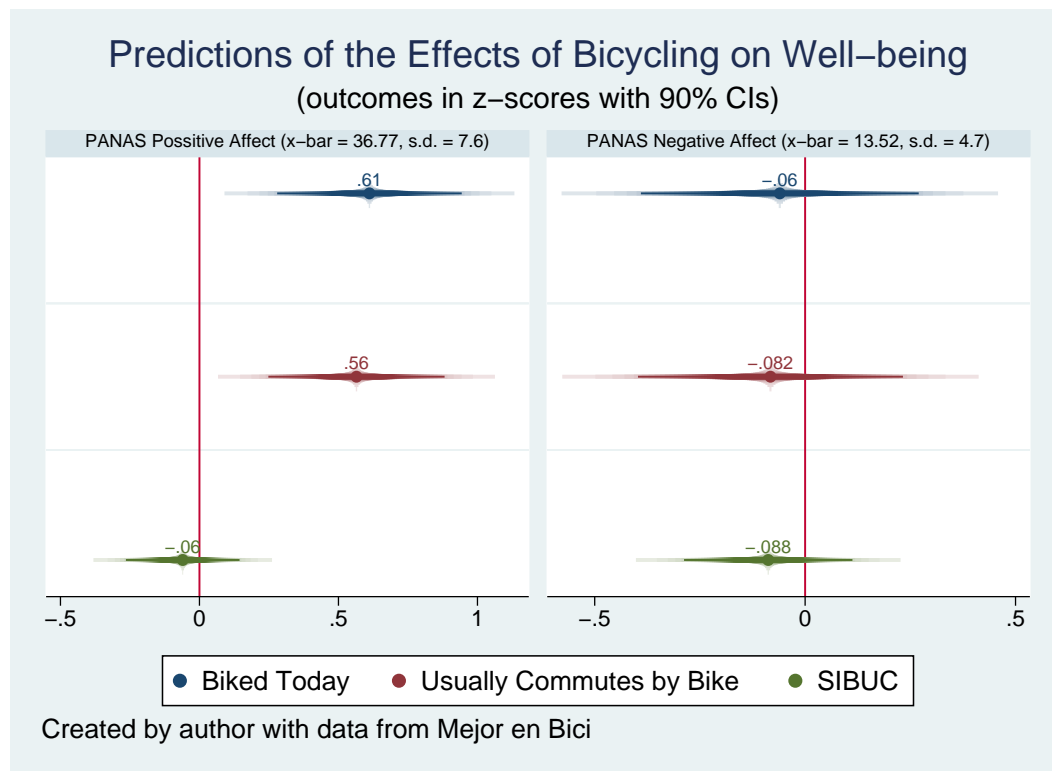
Finally, for academic purposes, table 4.13 presents the results of the impact of bicycling to work on the PANAS Positive Affect Score. However, given that $SIBUC$ is not a strong instrument for $Biked\,to\,work$ the results are not statistically significant. However, I argue that with better data, $SIBUC$ could work as an instrument for biking to work —in a similar way to the instrument used by Devoto et al. (2012). This would overcome the question of causality, making it possible to assess the impact active commute through bicycling has on individual productivity

Table 4.13: Regression Analysis for the Effect of Biking to Work on PANAS Positive Affect Score

VARIABLES	First Stage (1) Biked to Work	(2) PANAS Possitive Affect (z-score)
Panel A. ITT Estimation		
treat	0.00	
	(0.065)	
Panel B. Instrumental variable estimation:		
Biked to work instrumented with *SIBUC*		
Biked to work		-10.91
		(138.235)
Constant	0.09***	0.97
	(0.016)	(12.247)
Observations	315	294
R^2	0.000	

Robust standard errors clustered at the company cluster level in parenthesis.

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

and well-being measures.

4.7 Conclusions

Increasing commuter cycling in urban environments will remain a trend in urban policy planning. The support for this alternative means of transportation has solid ground in the literature on sustainable transportation and urban planing, and in evidence from the literature on public health. It is a solution that promises multiple advantages not only for urban mobility but for individuals' health and well-being. However, it is important for the fields of literature that address this question to close the gaps with empirical evidence on commuter bicycling. This paper attempts to add to our knowledge on bicycle commuting by presenting a review of the existing bicycle sharing systems, and then performing a rigorous evaluation on a non-citywide BSS. The paper also proposes two methodological approaches to overcome the issue of causality. First, it uses a difference-in-difference approach to evaluate the

performance of $SIBUC$ and how it has impacted bicycle usage or perception of bicycle usage in the companies where it was implemented. Second, it proposes an instrumental design that could serve to better understand the impacts of bicycling on productivity or well-being.

The paper finds that, on average, the implementation of $SIBUC$ increased the percentage of employees or students who bike to work. While the results are not statistically significant at the ten percent level, I argue the results show a trend that would be evident if better data were available. Despite of the issues with the data generation process, the paper does find that Mejor en Bici significantly affects the perception of bicycling to work ranging from 15 percentage points to 23 percentage points. All the findings on perception are statistically significant at least at the ten percent level. The paper also shows evidence of the relationship between biking to work and lengths and costs of morning commutes. While I can only speak of correlations between these variables, I find that biking to work is associated with reductions of 14 to 25 minutes on the morning commute, and savings between $2,600 and $3,000 pesos. Finally, findings presented here also indicate improvements in measures of productivity or well-being. While data used in this paper is self-reported data, it calls for the need of repeating a similar study with directly observed objectively measured data. These findings are still promising and should serve as a strong encouragement to try to address this gap in the literature. An instrumental approach like the one suggested here could prove useful to perform that task.

However, these findings must be taken with caution. As explained throughout the paper there are considerable issues with the data generation process for this investigation. Differential attrition and the way some of the data in the control group was collected, calls for prudence when analyzing these results. If anything, for most of the results it would be better to think that the coefficients estimated for the treated group are to be compared to results in Company L (the only control company that adequately collected follow-up data) and not the large set of companies that were part of the control group at the baseline.

The research also gives important takeaways for Mejor en Bici. While it seems that their service is contributing to increase the number of employees or students who bike to work at companies or universities where $SIBUC$ was installed, awareness should remain an issue to keep present. Among respondents of companies that were assigned to the treatment, 16.2 % state that they are not aware of the availability of a BSS at their workplace. This hints to the need of Mejor en Bici to keep encouraging users to bike to work, aside from the occasional interventions that happen when launching the service or every year close to the "Día sin Carro". Furthermore, introducing regular yearly surveys to assess improvements in the usage could serve as an interesting tool to improve their service, and generate data to evaluate their own performance. While some of their clients might oppose to general surveys sent to all their employees, particularly given the experience this research had during the end-line data collection, Mejor en Bici could benefit from yearly surveys sent directly to their users, acknowledging the bias in that data.

Finally, a fundamental issue remains. Mejor en Bici's model is profitable and viable as long as there are no citywide systems available in Bogota. However, with the increase of BSS and the imminent arrival of fourth or fifth generation citywide BSS (operated by the city or another private actor), $SIBUC$ might turn irrelevant. It is for this reason that Mejor en Bici should think of a strategy to adapt to a changing environment. Perhaps, their alternative should be to make the leap by changing $SIBUC$ into their own citywide system. The literature and data reviewed for this paper indicate that the question is not *whether* a citywide system will arrive, but a question of *when* it will arrive.

4.7.1 Future Research

To conclude it is relevant to point out to opportunities for future research. The most evident opportunity for future research that emerges of this study is to repeat the analysis overcoming the data collection issues. To do so, it is relevant both to address the problem of attrition and to collect data for productivity or well-being through direct observation. With better data and rigorous methods it will

be possible to test whether bicycle encouragement schemes work. If they work in improving bicycle usage, then it will be possible to use them as instruments and overcome the causality concerns that usually trumps research on active commuting through bicycling.

This paper also raises questions related to decentralization and the provision of public goods or quasi-public goods by private actors. This questions will gain even more relevance when a citywide BSS finally comes to play in Bogota. Even today multiple cities across the world are dealing with the challenges in the use of public space and public infrastructure of the new emerging fifth generation systems. As competition increases and the BSS market starts to saturate, local level authorities will have to decide how they will regulate the sector. Research should anticipate to the need of information of those regulators, and rigorously assess the benefits and impacts of the different alternatives available. Failing to understand the side-effects of the saturation of BSS markets, might lead to a disbelief of the benefits of bicycle commuting.

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Chapter 5

Conclusion

The research presented in this dissertation was driven by inquiry regarding decentralization, and how its implementation can impact economic development and public service provision. This chapter summarizes the broad themes and reflections from this dissertation, general conclusions that can be drawn from each paper contributing to the scholarly and professional research and practice on decentralization, and individual conclusions of each of the papers.

5.1 Implications of the Results of Papers to the Field of Decentralization Research and Practice

Decentralization has been a trend in public policy making and multiple institutions have presented it as yet another silver bullet to solve the issues of development and political participation. However, like many other policy reforms diffused from one country to another, or promoted as magic cures to policy problems, the research on the effects of decentralization has lagged behind its implementation. This dissertation attempts to address this gap in the literature by contributing new empirical evidence. Approaching the topic through three papers allowed for the generation of qualitative and quantitative data that informs questions about the effect of decentralization reform.

It is also relevant to reflect on the intent behind this dissertation. The objective was not to prove whether decentralization is "good" or "bad". As with other policy reforms, the key determinant of success lies behind the design or implementation.

Instead, the purpose of this research was to add more nuance to the study of decentralization so that practitioners can review the way in which decentralization is promoted. Of particular interest was to show the need to start evaluating decentralization where it matters: at the local level. Most evaluations of decentralization found in the literature look at national aggregate indicators or aggregate national sectors. However, decentralization is a reform that has a local approach and focuses mainly on the sub-national level of government. Hence, the risk of looking only at aggregate national indicators is that we may miss out on important processes happening at the local level.

Studying the Colombian case is a good example of how an analysis of decentralization might be misleading if its only observed at the national level. When one looks at aggregate indicators of economic development or national indicators of public services that were decentralized, it is possible to see significant improvements since the decentralization reform came into place in the 1990s. However, if one looks closely at sub-national level data, it is possible to see that it is only municipalities managing to take advantage of the increased autonomy that are driving improvements in these indicators. It is these large cities and some high-capacity municipalities that have increased access to public service provision or have generated increased economic growth. The reality for most municipalities is that they are unable to cope with the new responsibilities and obligations that were transferred, or that there was capture by illegal actors or corruption disrupting their possibility of development. This unequal capacity to take advantage of the autonomy granted by decentralization reform has generated increased gaps in social and economic indicators between municipalities. Those municipalities that were able to benefit from the reform continue improving in their economic development and social indicators, but most small rural municipalities are still lagging behind.

Understanding the relevance of studying decentralization at the sub-national or local level provides justification for choosing the units of observation or variables of interest in each paper. Accordingly, paper one creates an outcome variable at the sub-national level; paper two looks at the sub-national effects of decentralization in

the agricultural sector; and paper three evaluates the impact of Mejor en Bici, a local provider of a quasi-public service.

Another topic this dissertation aims to draw attention to is related to the implementation of policy reform. More often than not, academics studying decentralization think of its implementation as a set decision. They assume the decentralization process occurs only at one point in time —usually after the passing of legislation or after constitutional reform. Research on decentralization also tends to assume that the goals and intents of the reformers remain unchanged as decentralization is implemented. The reality is that decentralization does not occur in a single, swift moment. Instead, it is a dynamic process that materializes over a long period of time through the passing of multiple legal and constitutional changes. It is in the course of this dynamic process that decentralization modifies the political economy of the different sectors it reforms. With shifts in the political economy, a redistribution of power happens between existing and new actors, which will redraw alliances that determine policy decisions. It is these intervening actors, at the local or at the national level, who will reinterpret the reform and adjust it so that it aligns with their interests. It is for this reason that the analytic framework presented in paper two looks at how local politicians reinterpreted their new granted autonomy in the agricultural sector.

The third topic this dissertation attempts to address is related to the unintended effects of decentralization reform. While this argument is not new —as shown, for example, in Eaton (2006)— advocates of decentralization rarely think of the unintended consequences that can result of the implementation of decentralization. Institutional reform often plans to change service provision in specific ways, but more often than not these changes generate unintended consequences in other policy sectors. The three papers of this dissertation address this particular topic. In paper one, a proposed mechanism to explain the quantitative findings is that decentralization reform failed to recognize the characteristics and capacity of municipalities prior to granting them obligations and responsibilities. In a context of low institutional capacity, a higher level of decentralization can result in weak

local authorities being unable to boost economic development without the assistance of a central government. Paper two explores how an unintended result of the Colombian decentralization process was the decline in quality of technical assistance and the privatization of some extension services. This decline was not a purpose of decentralization reform, but is instead explained by the reintrepretation of the reform by local politicians. Paper three evaluates a private bicycle sharing scheme whose business model would struggle if the local government of Bogota had created a public bicycle sharing system. While this paper does not exactly look at a case of privatization, it does evaluate how a private actor provides a quasi-public good in the absence of action by the local government. All these examples invite advocates for decentralization reform —in academia or in their role as practitioners— to reevaluate how these processes can impact, in a positive or negative way, other policy sectors.

5.2 Implications of Individual Paper Results

5.2.1 Paper 1: Linking Decentralization and Economic Development

This paper uses a quasi-experimental design to evaluate if there is a relationship between decentralization and economic development. The underlying assumption is that close to administrative borders, local authorities at both sides of the boundary are indistinguishable in their determinants of growth. Therefore, the key characteristics that drive their economic growth are related to their institutions or policies. Moreover, focusing on borders where countries with objectively high levels of decentralization neighbor countries with objectively low levels of decentralization, and controlling for country specific characteristics and institutional capacity, allows for an assessment of the relationship between decentralization and economic development.

The paper finds that on average a higher decentralization level at the border is related to a decrease in GDP growth that ranges between 0.19 and 0.22 percentage

points —depending on the model specification. These results are both economically and statistically significant a the one percent level. To better understand these results the paper proposes three mechanisms that may explain why, on average, higher decentralization could be linked to lower economic development. First, the negative relationship could be explained by the unequal capacity of local authorities to take advantage of decentralization reform. The argument behind this mechanism is that in a scenario with high decentralization, local authorities that have low institutional capacity will be unable to generate greater economic growth on their own. If we assume that borders are composed mainly by local authorities with low capacities, it is foreseeable that those that receive more support from the central government are better in encouraging economic development, compared to those that have to depend on their own capacity to spur economic development.

The second proposed mechanism that could explain the results is related to the lack of a development strategy and a redistribution scheme that is embedded within the decentralization reform. Again, the argument here is one related to the increasing gaps that emerge between local authorities when there are no redistribution mechanisms present. If only municipalities that take advantage of decentralization are receiving increasing resources, one can anticipate that municipalities lagging behind will continue lagging behind as decentralization progresses. As with the first mechanism, if municipalities at the border are those that traditionally are unable to take advantage of decentralization reform, it is not surprising that on average they have lower economic growth than their peers across the border, because without balancing mechanisms they will continue to receive decreasing resources.

The last mechanism that is suggested is related to Eaton's (2006) argument of local authority capture. The idea is that when higher resources and autonomy is granted to local authorities in countries experiencing armed conflict or with high levels of corruption, a higher level of decentralization might allow illegal actors to capture those local governments. This impedes resources destined for local development from fulfilling their purpose, and in fact contributes to declining conditions that hamper economic development. Given this mechanism, if municipalities of the

sample are located in countries experiencing armed conflict or at a periphery where they are more prone to be captured by illegal actors, it is more likely that they have lower economic development.

It is important to note an important caveat of these results, which relates to the fact that the geographic regression discontinuity design estimates a local average treatment effect. This means the generalizability of these results is limited, and one should not assume that the results will remain for other local authorities that are not close to the administrative borders. However, these results do inform the debate on the link between decentralization and economic development, and allow for a better understanding of how these two variables are connected to each other. This is not to say that decentralization always leads to lower economic development. While this might be true on average for this sample, the literature recurrently shows that local authorities that do take advantage of their increased autonomy are able to use their new competences and support higher economic development. These results also call for a better understanding of decentralization processes and rethinking their implementation. One-size-fits-all models should be sidelined and decentralization reforms should acknowledge that the way they impact sub-national authorities and service provision will depend on the endogenous characteristics of those local governments.

Finally, an important contribution of paper number one is related to presenting a methodology that allows for the creation of an outcome measure for economic development at the sub-national level. While this is not a new contribution in the field of development economics, bringing the methodology to the fields of political science or comparative studies, and the literature that studies decentralization is innovative and can feed future research on the topic.

5.2.2 Twenty-five Years of Agricultural Decline: Does Decentralization Reform Explain the Decline of Agricultural Extension Services in Colombia?

Paper two uses a qualitative research design to evaluate the way decentralization reform impacted the provision of extension services in Colombia. This paper shows

that traditional narratives that explain the decline of the Colombian agricultural sector fail to clarify the heterogeneous levels of decline among farmers, products, and departments. The article shows how understanding the effects of decentralization reform on the sector illuminates and explains these heterogeneous results.

The paper analyzes the agricultural sector, focusing mainly on extension services, and borrowing concepts from de Waal, Evans, Hirschman, and Snyder, proposes an analytic framework that explains the political economy changes that initiate due to decentralization reform. This analytic framework also explains how different actors bargain in the new political market, and identifies factors that determine actors' behavior. Applying the framework to the Colombian extension services market allows for an understanding of why there was a decline in the quality of technical assistance for some products in some departments, ultimately contributing to an understanding of the generalized decline of the agricultural sector.

However, the academic contribution of this paper goes beyond explaining the changes in the Colombian extension services market that were introduced by decentralization. In fact, I argue that with minor adaptations this analytic model could be used to understand political economy changes that happen in other sectors in Colombia. Furthermore, the analytic framework proposed could also work in other countries that introduced decentralization reform to their agricultural sectors or to other sectors. The application of this analytic framework to other countries would be conditional on the type of state and the factors that determine politicians and farmers' (or other stakeholders') response. Applying this analytic framework to different case studies will provide a better understanding of how local actors reinterpret decentralization reform producing heterogeneous policy outcomes.

5.2.3 It really is Mejor en Bici: An Impact Evaluation of a Bicycle Sharing System in Bogota, Colombia

Paper three adds to the literature on active commuting using bicycles and the literature on the provision of bicycle shared systems by private actors. It begins by summarizing and adding to the general knowledge on bicycle commuting by

presenting a review of the existing bicycle sharing systems. Then it performs an econometric impact evaluation on $SIBUC$ —a private non-citywide bicycle sharing system operating in Bogota. The paper's main contribution is presenting methodological alternatives to adequately assess the impact bicycle sharing schemes have on bicycle usage. First, it uses a difference-in-difference design to assess the impact $SIBUC$ has on bicycle usage and perceptions toward biking to work, in employees at companies or universities where the system was implemented. Then it proposes an instrumental design that could serve to better understand the impact of bicycling on productivity and well-being.

All estimates for the treatment effect of $SIBUC$ on bicycle usage, hint to an increase in the percentage of employees biking to work. The effect ranges from one to eight percentage point increases, but none of the results show statistically significant effects at the ten percent level. I argue that the lack of significance is due to the data generation process and not to lack of impacts of $SIBUC$. However, more research with improved data is needed before concluding that $SIBUC$ is a proven mechanism to encourage active commuting through bicycling. When focusing on the perception of employees towards biking to work, the evaluation finds statistically significant improvements under three model specifications. The predicted improvements range from 15 to 23 percentage points compared to employees or students of companies in the control group. While these results hint that Mejor en Bici might change the perception of bicycling to work the results should be taken cautiously given the issues with the data generation process.

The paper also shows that individuals who bike to work are associated with savings of up to $3,000 Colombian pesos and decreases of up to 25 minutes in their morning commutes compared to individuals who use other means of transportation. These results are economically and statistically significant at the one percent level. The results are even robust when controlling for distance or for commutes that are shorter than 30 minutes. Similarly, paper three presents evidence on the correlation between bicycling and improved self-reported measures of productivity or well-being for individuals who bike to work, compared to those who use other means of trans-

portation. While these are only correlations, because there is only end-line data available, these results are promising and call for further research using objective measures for productivity and well-being.

Finally, a last contribution of paper three is presenting a methodological approach that would allow for an evaluation of the effect that bicycling has on productivity or well-being, that can actually claim causality between the variables of interest. While the data collected for this dissertation did not allow for that assessment to be made, the methodology is presented and hopes to feed future research. Having said that, I still believe that the process to evaluate a BSS presented in this paper and the findings reached, are relevant and contribute to understanding the effect of active commuting through bicycling.

5.3   Possibilities for Future Research

While this dissertation has presented new evidence in the study of decentralization, each of the papers points to questions or topics for future research. The evidence presented in this dissertation does not pretend to close the question about the link of decentralization and development or public service provision. Instead, the key finding is that both academics and practitioners need to reflect more and keep studying decentralization, prior to its continued implementation in across the globe. Decentralization is a policy reform that has the potential to transform public service delivery as long as reformers and key actors are able to tailor it so that it recognizes endogenous characteristics of the sub-national governments it aims to strengthen. More empirically based research should be welcomed —taking advantage of both experimental designs (like the work done by Hoffmann et al. (2017)) or by taking advantage of improvements made in measuring decentralization, like Hooghe et al.'s (2016) Regional Authority Index. However, quantitative methods will only take us so far. As such, mixed-method designs or qualitative research needs to complement and inform the mechanisms quantitative research presents. Specifically we need to think of how to better evaluate whether decentralization is linked, or not, to higher economic development for all sub-national authorities —and not only border

authorities (like presented in paper one). Answering this question while addressing the endogeneity concern remains an academic challenge.

Future research should also focus on outcome variables that measure decentralization at the sub-national level. All of this requires the improvement of the quality of data and its availability at the sub-national or local level. Efforts like the ones done by the OECD in creating PISA[1] point to the right direction. However, decentralization and its careful implementation is more relevant for countries that are not currently being evaluated by these kind of studies. In fact, future research on decentralization should be focused on how the new wave of decentralization will be implemented through Africa and South-Asia.

Another specific area of future research that emerges from this dissertation is related to the analytic framework presented in the second paper. As stated in the paper, the use of this model to evaluate other sectors that were decentralized in Colombia, or decentralized sectors in other countries, opens a direct line of research that will contribute to a better understanding of decentralization. As mentioned, the model might need minor adaptations, but in general it should allow for an understanding of heterogeneous effects in other sectors as it does for Colombian extension services.

Aside from the general application of the framework in other sectors or other countries, paper two leaves at least three additional research questions on the agricultural sector in Colombia unanswered. The first is related to the particular differentiating characteristics of some growers' associations that allowed them to secure funding and provide extension services to their members in comparison to the growers' associations of other products that were unable to fill out the vacuum left by the state. Future research could explore why some growers' organizations were successful while others failed. Research in this dissertation hints that it might be related to funding they received, the nature of the products being farmed, or the tradition of the organization. However, exploring these characteristics further or others not mentioned here might help illuminate what makes these growers' associations suc-

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[1]The Program for International Student Assesment is a triennial international survey which aims to evaluate educational systems worldwide by testing skills and knowledge of 15-year-old students (OECD, 2018).

ceed in providing technical assistance. A second question for future research that emerges from paper two is related to para-fiscal contributions and the efficiency of privatizing extension services in Colombia. From the data collected it is not clear that para-fiscal contributions are more cost efficient than strengthening extension services by public institutions at the local level. However, further research is needed to assess which is a better alternative to provide good quality technical assistance to most farmers. Finally, paper number two does not address the issue of subsidies in the agricultural sector. This is an interesting topic that could be analyzed with the same framework focusing on national politicians —given that this is the fora for this policy— however it demands an investigation of its own that went beyond the scope of paper two.

Finally paper three raises multiple topics that could inform future research. The first set of questions relate to decentralization and the provision of public goods or quasi-public goods by private actors. This paper was not able to answer these questions, given the focus on the impact evaluation of Mejor en Bici, but it is interesting to consider whether the nature of the public goods provided, or the quality of these goods changes when they are provided by a private actor. Additional questions are related the work of Mejor en Bici and its impact in encouraging active commuting. Data presented in this paper hints that the intervention leads to an increase in bicycle usage and the perception of bicycle usage for individuals in treated companies. Evidence also points to improvements in time and costs of employees and students at companies where $SIBUC$ was implemented. However, as it was extensively discussed in paper three, due to the flaws in the data generation process these results should be taken with caution. Finally, the question on the effect of active commuting through bicycling on productivity and well being also remains unanswered. As explained in paper three, due to the data generating process, it is not possible to identify the instrumental variable design. However, the research does provide interesting information on the work of Mejor en Bici and the impact bicycle sharing schemes can have on active commuting, and as a side effect, on productivity or well-being of individuals. Properly designed research on the implementation of

BSS (like $SIBUC$) with better participation and that could use objective measures of productivity or well-being are needed , given their potential to provide results on the benefits of bicycle sharing systems and active commuting through bicycling.

Chapter 6

Appendices

6.1 Appendix A: Data Appendix for Paper 1

Lights at Night Dataset

Lights at Night (LaN) Dataset from the National Oceanic and Atmospheric Administration. These data recorded by the Defense Meteorological Satellite Program-Operational Linescan System, provides a time series between 1992 and 2013. Cloud-free composites provide nighttime observations of lights and combustion sources worldwide.

Source: NOAA (2017). Image and Data processing by NOAA's National Geophysical Data Center. Defense Meteorological Satellite Program data collected by the US Air Force Weather Agency.

Regional Authority Index

Data for the Regional Authority Index (RAI) are in two datasets: one with annual scores for 231 regional governments/tiers in 65 countries for the period 1950-2010, and one aggregating these scores to the country level plus with country-level scores for an additional 16 countries that do not have regional governments.

Sources: Marks et al. (2008) and Hooghe et al. (2016)

Global Administrative Areas

Global Administrative Areas is a spatial database of the location of the world's administrative areas (or administrative boundaries) for use in GIS and similar software. Administrative areas in this database are countries and lower level subdivisions such as provinces, departments, bibhag, bundeslander, daerah istimewa, fivondronana, krong, sous-préfectures, counties, and thana. GADM describes where these administrative areas are (the "spatial features"), and for each area it provides some attributes, such as the name and variant names.

Source: Boundaries Without Limits (2015). The version used is 2.8 (November 2015) which delimits 294,430 administrative areas.

Worldwide Governance Indicators

Aggregate and individual governance indicators for 215 countries and territories over the period 1996–2015, for six dimensions of governance. The WGI measure six broad dimensions of governance:

1. Voice and Accountability (VA) – capturing perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.

2. Political Stability and Absence of Violence/Terrorism (PV) – capturing perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism.

3. Government Effectiveness (GE) – capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.

4. Regulatory Quality (RQ) – capturing perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

5. Rule of Law (RL) – capturing perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

6. Control of Corruption (CC) – capturing perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.

Source: Kaufmann et al. (2010)

6.1.1   GDP 1990

The Global Gridded Geographically Based Economic Data (G-Econ), Version 4 contains derived one degree grid cells of Gross Domestic Product (GDP) data in GRID and ASCII formats for both Market Exchange Rate (MER) and Purchasing Power Parity (PPP) for the years 1990, 1995, 2000 and 2005.
Source: Nordhaus and Chen (2016)

6.1.2   Population 1990

Gridded Population of the World, Version 3 (GPWv3) consists of estimates of human population for the years 1990, 1995, and 2000 by 2.5 arc-minute grid cells and associated data sets dated circa 2000.
Source: Center for International Earth Science Information Network - CIESIN - Columbia University et al. (2005)

6.1.3   Area

Area in Kilometers calculated using ArcGIS from the GADM Dataset.
Source: Boundaries Without Limits (2015). The current version is 2.8 (November 2015) which delimits 294,430 administrative areas.

6.1.4 Migration Data

The Global Estimated Net Migration by Decade: 1970-2000 data set provides estimates of net migration over the three decades from 1970 to 2000. Because of the lack of globally consistent data on migration, indirect estimation methods were used. The authors relied on a combination of data on spatial population distribution for four time slices (1970, 1980, 1990, and 2000) and sub-national rates of natural increase in order to derive estimates of net migration on a 30 arc-second ($\sim$ 1km) grid cell basis.

Source: de Sherbinin et al. (2015)

6.1.5 Risk of Flooding Events

Global Flood Hazard Frequency and Distribution is a 2.5 minute grid derived from a global listing of extreme flood events between 1985 and 2003 (poor or missing data in the early/mid 1990s) compiled by Dartmouth Flood Observatory and georeferenced to the nearest degree.

Source: Center for Hazards and Risk Research - CHRR - Columbia University and Center for International Earth Science Information Network - CIESIN - Columbia University (2005)

6.1.6 Risk of Drought Events

Global Drought Hazard Frequency and Distribution is a 2.5 minute grid based upon the International Research Institute for Climate Prediction's (IRI) Weighted Anomaly of Standardized Precipitation (WASP). Utilizing average monthly precipitation data from 1980 through 2000 at a resolution of 2.5 degrees, WASP assesses the precipitation deficit or surplus over a three month temporal window that is weighted by the magnitude of the seasonal cyclic variation in precipitation. The three months' averages are derived from the precipitation data and the median rainfall for the 21 year period is calculated for each grid cell. Grid cells where the three month running average of precipitation is less than 1 mm per day ae excluded.

Source: Center for Hazards and Risk Research - CHRR - Columbia University and

Center for International Earth Science Information Network - CIESIN - Columbia University (2005)

6.1.7 Average Precipitation & Temperature

WorldClim is a set of global climate layers (gridded climate data) with a spatial resolution of about 1 km2. These data can be used for mapping and spatial modeling. For the purpose of this paper the averages selected are those of the month of January.
Source: Hijmans et al. (2005)

6.1.8 Elevation

Shuttle Radar Topography Mission (SRTM) suite of elevation data sets provide global coverage from 60 degrees north to 56 degrees south latitude at 1 arc-second and 3 arc-second resolutions.
Source: NASA (2017) Shuttle Radar Topography Mission courtesy of the U.S. Geological Survey.

6.1.9 World Bank Category by Income

World bank category by income is defined on a yearly bases by a specific GNI per capita, using the World Bank Atlas Method.
Source: World Bank (2017)

6.2 Appendix B: Paper 2 - Harvested Area, Yields, and Production for Other Products

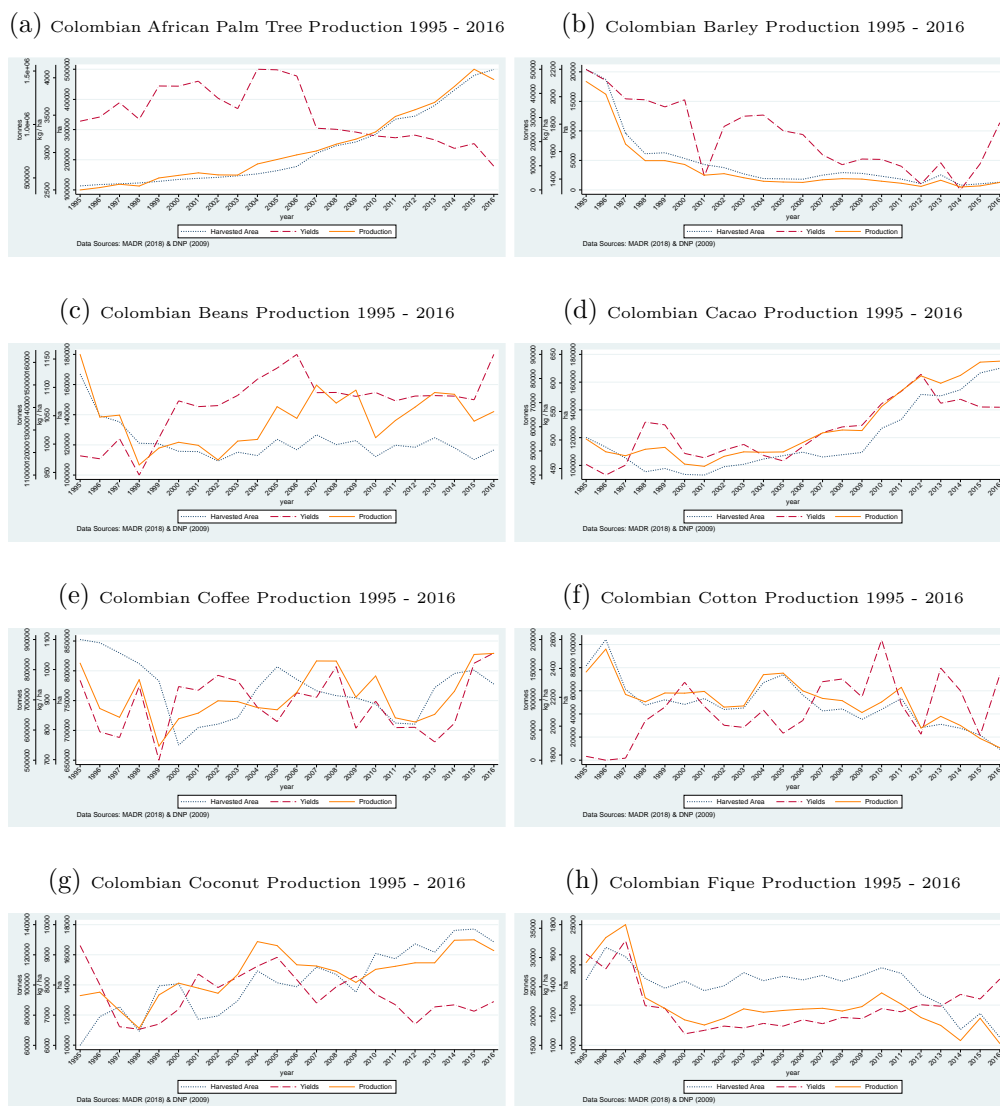Figure 6.1: Harvested Area, Yields, and Production for Other Products

(a) Colombian African Palm Tree Production 1995 - 2016   (b) Colombian Barley Production 1995 - 2016

(c) Colombian Beans Production 1995 - 2016   (d) Colombian Cacao Production 1995 - 2016

(e) Colombian Coffee Production 1995 - 2016   (f) Colombian Cotton Production 1995 - 2016

(g) Colombian Coconut Production 1995 - 2016   (h) Colombian Fique Production 1995 - 2016

Figure 6.2: Harvested Area, Yields, and Production for Other Products (ii)

(a) Colombian Maize Production 1995 - 2016

(b) Colombian Peanuts Production 1995 - 2016

(c) Colombian Potatoes Production 1995 - 2016

(d) Colombian Plantain Production 1995 - 2016

(e) Colombian Rice Production 1995 - 2016

(f) Colombian Sesame Seed Production 1995 - 2016

(g) Colombian Sorghum Production 1995 - 2016

(h) Colombian Soy Production 1995 - 2016

(i) Colombian Sugar Cane (refined sugar) Production 1995 - 2016

(j) Colombian Sugar Cane (honey) Production 1995 - 2016

Figure 6.3: Harvested Area, Yields, and Production for Other Products (iii)

(a) Colombian Sugar Cane (raw sugar) Production 1995 - 2016

(b) Colombian Sweep Production 1995 - 2016

(c) Colombian Black Tobacco Production 1995 - 2016

(d) Colombian Blonde Tobacco Production 1995 - 2016

(e) Colombian Wheat Production 1995 - 2016

(f) Colombian Yam Production 1995 - 2016

(g) Colombian Yuca Production 1995 - 2016
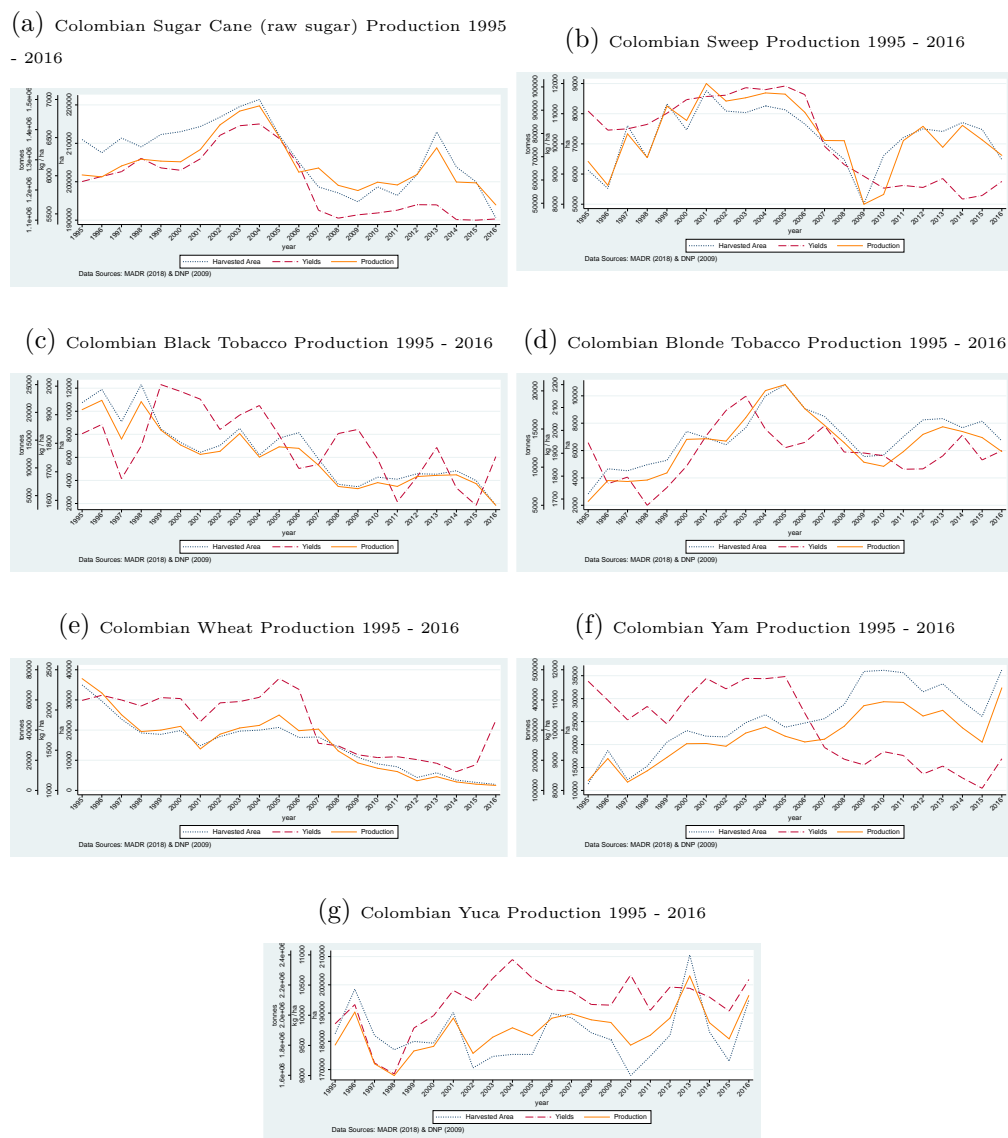
6.3 Appendix C: Semistructure Interviews List of Interviewees & Questionnaire

6.3.1 List of Interviewees

Table 6.1: Semi-Structured Interviews Conducted for Papers 1 & 2

Interviewee	Position - Affiliation
Alberto Maldonado Copello	Academic - Universidad Nacional de Colombia Former National Planning Advisor
Andrés Garcia Trujillo	Former Advisor to the High Commissioner for Peace Office (responsible for responsible for rural topics in Colombian Peace Agreement Negotiation)
Arcesio Valenzuela Ordóñez	Academic - Pontificia Universidad Javeriana Section Coordinator - Finance Ministry
César Gaviria Trujillo	Former Colombian President (1990-1994) Former Finance Minister (1986-1987) Former Interior Minister (1987-1989)
Claudia Dangond Gibsone	Academic - Pontificia Universidad Javeriana
Dario Indalecio Restrepo Botero	Academic - Universidad Nacional de Colombia Former Advisor Health Ministry
Gustavo Castro Guerrero	Former Minister of Agriculture (1983-1984 & 1995-1996) Former Minister of Economic Development (1984-1986)
Gustavo Zafra Roldán	Member of the 1991 Constitutional Assembly Academic - Pontificia Universidad Javeriana
Jaime Castro Castro	Former Interior Minister (1984-1986) Former Mayor of Bogota (1992-1994) Member of the 1991 Constitutional Assembly
Javier Bernal Eusse	Former ICA Advisor
José Antonio Ocampo	Former Executive Secretary CEPAL (1998-2003) Former Finance Minister (1996-1998) Former Agriculture Minister (1993-1994)
Mauricio Velásquez Ospina	Academic – Universidad de los Andes
Ricardo Sánchez Lopez	Former Deputy Agriculture Minister () Current OECD and World Bank Consultant on Rural Development
Rocio Londoño Botero	Academic – Universidad Nacional de Colombia Director of the Report on Land Ownership and Rural Conflict of the National Center for Historical Memory
Rodolfo Cano Blandón	National Planning Department Advisor
Rubén Darío Lizarralde	Former Minister of Agriculture (2013-2014) Former President of Fedepalma
Santiago Perry Rubio	Director of Corporación PBA Former Deputy Agriculture Minister Former Director of ICA

Table 6.2: Semi-Structured Interviews Conducted for Paper 3

Interviewee	Position - Affiliation
Diego Ospina	Mejor en Bici^{TM}- CEO
Ricardo Arango	Mejor en Bici^{TM}- $SIBUC$ Manager
Diana Galarza	Mejor en Bici^{TM}- Former Employee (Survey and Data Collection)

6.4   Semi-structured Interviews Questionnaires

Decentralization Reform in Colombia – Taborda
Public Servants

Interview Questions

Study title: Evaluating Decentralization Reform and its Links to Economic Development and Improved Public Service Provision.

Investigator: Juan Taborda Burgos

<u>**Note to IRB:**</u> As discussed in the protocol there are two types of interviews in this exemption request. The questions below correspond to questions to former public sector who played an instrumental role in the design and implementation of decentralization during the 1990s. Most of the information requested is public, and some of the interviewees have written extensively on the topic.

1.   What is your knowledge of the decentralization reform that was designed during the end of the 1980s and implemented during the 1990s in Colombia? Were you directly involved with the process of design or implementation of the reform?

2.   Can you identify key actors who pushed for the reform to be designed and implemented? If you manage to identify these actors, do you think they were mainly actors from the central government, the local government, or from international organizations?

3.   Do you think the reform was a center-periphery lead reform (also thought of top-down approach), a periphery-center lead (bottom-up approach), or a coordinated effort from different levels of government?

4.   Can you identify "winners" or "losers" of the decentralization reform? Were there any particular groups it favored or affected disproportionately?

5.   Do you know of the motivations to implement the reform?

6.   The literature suggests three main reasons to implement a decentralization reform. The first related to political decentralization in the context of a democratization process. The second related to increase economic development and take advantage of regional capacities through a public sector provision that is more responsive to local realities. The third is related to a peace-building process and the augmentation of rights to local minorities who dispute authority with the center. Do you consider any of these perspectives is in line with the motivations that lead to the decentralalization process in Colombia? If not what other alternative explanations do you think are relevant?

7.   What do you think were the main objectives the decentralization reform was trying to address?

8. Taking into account the objectives of the decentralization reform, how successful do you consider its design was?

9. Taking into account the objectives of the decentralization reform, how successful do you consider the implementation of the reform was?

10. Do you think the decentralization reform had a positive or negative impact on the economic development of Colombia or its subnational authorities?

11. Do you think the decentralization reform had a positive or negative impact on the public sector provision in Colombia or its subnational authorities?

12. Talking specifically about the agricultural sector, do you think the reform changed significantly the institutional design of the agricultural sector with regards to the provision of public goods (roads or irrigation systems), extension services or technology transfers, or research and development useful to the agricultural sector?

13. Talking specifically to the agricultural sector do you think the changes in the institutional design of the agricultural sector introduced by the decentralization reform had any effects on the productivity of the sector?

14. In a widely quoted article, Kent Eaton argued that the decentralization process in Colombia allowed illegal groups in Colombia to capture the state. Do you agree with this argument, or think it is not necessarily adequate for the Colombian scenario?

15. The two programmatic plans (Planes de Desarrollo) of the Santos administration warned about territorial disparities between municipalities and departments. Do you believe the characterization of these documents, signaling a widening gap in development and social indicators between municipalities and departments is accurate? Do you think this is the result of the decentralization reform design or its implementation? If not, what other mechanisms do you think explain this gap?

16. Is there any other information you consider relevant to understand the design and implementation of the decentralization reform in Colombia?

17. Is there someone else you recommend I speak to as part of my research on the decentralization reform in Colombia?

18. Are you comfortable to be contacted with follow-up questions if these emerge?

19. Would you like me to get in touch to share the key insights and results of this research once these are available?

Interview Questions

Study title: Evaluating Decentralization Reform and its Links to Economic Development and Improved Public Service Provision.

Investigator: Juan Taborda Burgos

<u>Note to IRB:</u> As discussed in the protocol there are two types of interviews in this exemption request. The questions below correspond to questions to current owners and staff of Mejor en Bici.

1. Do you mind stating your role in Mejor en Bici and the time you have been affiliated with the organization?

2. From your perspective what is the main strategic goal or objective of Mejor en Bici?

3. Taking into account Mejor en Bici is a for profit enterprise do you know what is the key determinant in selecting where the bicycle sharing systems are provided and who has access to them.

4. From your perspective what is the highest operational cost Mejor en Bici faces?

5. What do you think is the main motive companies contract Mejor en Bici to operate their bicycle sharing systems?

6. What do you think is the main motive users utilize the public bicycles provided?

7. Do you think if the end users (each bicycle user) would change their bicycle usage if they had to pay directly for the service?

8. Do you know if Mejor en Bici coordinates with the local government or local transport authorities in determining how it operates it bicycle sharing system? If you know of coordination, how do you think this coordination happens? Does the government regulate the provision of the service, or is Mejor en Bici autonomous in operating its system?

9. If Mejor en Bici does not coordinate with the local government or transport authority, do you think it should coordinate the operation of its bicycle sharing system with the local transport authority? Would this be beneficial for Mejor en Bici's costumers (both companies who contract the service and bicycle end-users)?

10. Do you think Mejor en Bici would be viable if there was and extensive public sharing system?

11. If you think about the companies who contract Mejor en Bici, do you think he gains more of a bicycle sharing system as the one provided by Mejor en Bici or from an extensive public bicycle sharing system that is managed and run by the public transport authority? What would be the advantages and disadvantages of each alternative for each user? Which of these systems do you think will encourage more bicycle usage?

12. If you think about the end user (bicycle user), do you think he gains more of a bicycle sharing system as the one provided by Mejor en Bici or from an extensive public bicycle sharing system that is managed and run by the public transport authority? What would be the advantages and disadvantages of each alternative for each user? Which of these systems do you think will encourage more bicycle usage?

13. Is there any other information you consider relevant to understand the design and way Mejor en Bici operates the bicycle sharing system in Bogota, Colombia?

14. Is there someone else you recommend I speak to as part of my research on bicycle sharing systems and their implementation in Bogota, Colombia?

15. Are you comfortable to be contacted with follow-up questions if these emerge?

16. Would you like me to get in touch to share the key insights and results of this research once these are available?

6.5   Appendix D: Survey Conducted by Mejor en Bici

Encuesta Movilidad, bienestar y productividad

Q1 Estamos realizando una investigación sobre los desplazamientos cotidianos de los empleados/estudiantes. El objetivo de la investigación es analizar cómo diferentes alternativas de movilidad elegidas por individuos repercuten en su bienestar y productividad.

Tenga en cuenta que toda la información que proporcione a través de esta encuesta es absolutamente confidencial. Así mismo, para realizar los análisis estadísticos la información que usted proporcione será anonimizada, eliminando cualquier referencia a su identidad.

Contestar esta encuesta no le tomará más de 10 minutos, y solo puede responder la encuesta una vez.

Q2 ¿Cuál es el nombre de la empresa en la que usted trabaja o la universidad donde estudia?

○ Advantis (1)

○ Atrápalo (2)

○ Aviatur (3)

○ BNP Paribas (4)

○ Bodytech (5)

○ Bolsa de Valores de Colombia (6)

○ Consorcio Canales Nacionales Privados (7)

○ Corona (8)

○ Daimler (9)

○ Findeter (10)

○ Grupo Sala (11)

○ MedPlus Group (13)

○ Mejor en Bici (14)

○ Ministerio de Transporte (20)

○ Seguros Sura (15)

○ Transportes Pre (16)

○ Uniempresarial (17)

○ Universidad Santo Tomás (19)

○ Otra (18)

Q3 Si eligió "otra" por favor especifique:

_____

Q4 Indique la sede de la empresa/universidad donde labora (si aplica):

○ Sede Principal (1)

○ Nombre de la sede, si no es la principal. (2)
_____

○ No aplica (3)

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Q5 Las siguientes preguntas hacen referencias a sus características demográficas:

Q6 Género:

○ Femenino (1)

○ Masculino (2)

○ Otro (3)

○ Prefiero no responder (4)

Q7 Indique su rango de edad en años cumplidos:

○ 18 - 25 (1)

○ 26 - 35 (2)

○ 36 - 45 (3)

○ Mayor de 45 (4)

Q8 ¿Qué cargo desempeña en la entidad?
(Por favor conteste la opción que mejor se aproxime, en caso de no ser empleado conteste No Aplica)

○ Presidente (1)

○ Vicepresidente (2)

○ Gerente (3)

○ Director (4)

○ Jefe (5)

○ Analista (6)

○ Profesional (7)

○ Secretario/a (8)

○ Auxiliar administrativo o Mensajero (9)

○ Otro (10) _____

○ No Aplica (11)

Q9 Aproximadamente, ¿cuál es su salario mensual actualmente?
(en caso de no ser empleado conteste No Aplica)

○ Salario en pesos (no incluya $, puntos o comas) (1)
_____

○ Prefiero no contestar (2)

○ No Aplica (3)

Q10 Indique su direccion de residencia o la dirección desde donde inicia su desplazamiento. Por favor siga el siguiente formato:

Calle 100 #7-50, Bogotá.

Alternativamente si prefiere no dar su dirección exacta indique el cruce de calle y carrera donde inicia su desplazamiento

◯ Dirección (1) _____

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Q11 Las siguientes preguntas están relacionadas con sus desplazamientos habituales desde su hogar hacia su lugar de trabajo o estudio.

Q12 Indique la hora habitual de entrada a la oficina/ universidad:

○ Antes de las 7:00 am (1)

○ 7:00 am - 7:30 am (2)

○ 7:31 am - 8:00 am (3)

○ 8:01 am - 8:30 am (4)

○ 8:31 am - 9:00 am (5)

○ 9:01 am - 9:30 am (6)

○ Después de las 9:30 am (8)

○ Otra (7) _____

⤨

Q13 ¿Qué medio de transporte utiliza generalmente para ir desde su casa al trabajo/universidad? Si utiliza más de uno seleccione el medio de transporte en en el que viaja la mayor distancia.

○ A pie (1)

○ Moto (2)

○ Taxi (3)

○ Transmilenio (4)

○ Bicicleta (5)

○ Auto particular (6)

○ Bus, Buseta o Colectivo (7)

Display This Question:

If ¿Qué medio de transporte utiliza generalmente para ir desde su casa al trabajo/universidad? Si ut... = Bicicleta

Q20 ¿Se desplazó hoy en bicicleta al trabajo/universidad?

○ Sí (1)

○ No (2)

Q14 ¿Cuántas veces a la semana utiliza este medio de transporte para desplazarse a su lugar de trabajo/universidad?

○ 1 (1)

○ 2 (2)

○ 3 (3)

○ 4 (4)

○ 5 (5)

○ 6 (6)

○ 7 (7)

✳ ⤧

Q15 Seleccione los factores más importantes que tiene en cuenta para elegir su medio de transporte
(marque las 3 más representativas)

☐   Es cómodo (1)

☐   Es rápido (2)

☐   Es limpio (3)

☐   Hay menor riesgo de que lo roben (4)

☐   Hay menor riesgo de accidentes (5)

☐   Es económico (6)

☐   Es más saludable (7)

☐   Es menos contaminante (8)

☐   Me permite compartir el modo de transporte con otros compañeros de trabajo (9)

☐   Contribuye a que haya menos trancones en la ciudad (10)

☐   No tenía otra opción disponible (11)

Q16
¿Cuántos minutos gasta en promedio en un viaje desde su hogar hasta el trabajo/ universidad (un solo sentido) ?
Indique el tiempo del recorrido en minutos

(ej: No escriba media hora, escriba 30)

_____

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*

Q17 ¿Cuánto dinero gasta en transporte en un día típico para llegar de su casa al trabajo/universidad? Por favor haga un estimado incluyendo gasolina, parqueaderos, peajes, buses, taxis y los demás medios de transporte que utilice a diario (un solo sentido).

Indique el valor en pesos (no incluya $, puntos o comas)

_____

Q18 Indique la hora habitual de salida de la oficina/universidad:

○ Antes de las 5:00 pm (1)

○ 5:00 pm - 5:30 pm (2)

○ 5:31 pm - 6:00 pm (3)

○ 6:01 pm - 6:30 pm (4)

○ 6:31 pm - 7:00 pm (5)

○ Despues de las 7:00 pm (6)

○ Otra (7) _____

Q19 ¿Qué medio de transporte utiliza generalmente para ir desde su trabajo/universidad a su hogar? Si utiliza más de uno seleccione el medio de transporte en en el que viaja la mayor distancia.

○ A pie (1)

○ Moto (2)

○ Taxi (3)

○ Transmilenio (4)

○ Bicicleta (5)

○ Auto particular (6)

○ Bus, Buseta o Colectivo (7)

Q21 ¿Cuántas veces a la semana utiliza este medio de transporte para desplazarse de su trabajo/universidad a su hogar?

○ 1 (1)

○ 2 (2)

○ 3 (3)

○ 4 (4)

○ 5 (5)

○ 6 (6)

○ 7 (7)

✳

Q22
¿Cuántos minutos gasta en promedio en un viaje desde su trabajo/universidad hasta su hogar

(un solo sentido) ?

(ej: No escriba media hora, escriba 30)

_____

*

Q23 ¿Cuánto dinero gasta en transporte en un día típico para llegar de su trabajo a su hogar? Por favor haga un estimado incluyendo gasolina, parqueaderos, peajes, buses, taxis y los demás medios de transporte que utilice a diario (un solo sentido).

Indique el valor en pesos (no incluya $, puntos o comas)

_____

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Q24 Las siguientes preguntas hacen referencia al uso de la bicicleta como alternativa habitual de transporte.

Q25 ¿Ha contemplado la posibilidad de utilizar la bicicleta para desplazarse de su casa a la oficina/universidad y viceversa?

○ Sí (1)

○ No (2)

Q26 ¿Tiene bicicleta disponible y en buen estado para desplazarse a su trabajo/universidad?

○ Sí (1)

○ No (2)

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[*] [⤬]

Q27 ¿Cuáles de los siguientes aspectos representan una BARRERA para que considere la bicicleta como medio de transporte habitual para desplazarse al trabajo?
(marque las 3 más representativas)

☐   No tengo bicicleta (1)

☐   No hay cicloparqueadero en la oficina (2)

☐   La distancia es muy larga (3)

☐   Inseguridad por riesgo de accidente (4)

☐   Inseguridad por riesgo de robo (5)

☐   La contaminación de la ciudad (6)

☐   Falta de infraestructura (ciclo ruta o vías con preferencia al ciclista) (7)

☐   Supone un gran esfuerzo físico (8)

☐   Afecta la presentación personal (9)

☐   Sudor (10)

☐   Factores climáticos (lluvia, frío, etc.) (11)

☐   No conozco la ruta para llegar al trabajo (12)

☐   Otro (13) _____

Q28 ¿Cuál es el aspecto más importante a solucionar para que use la bicicleta como medio habitual de transporte? (una sola respuesta)

○ No tengo bicicleta (1)

○ No hay cicloparqueadero en la oficina (2)

○ La distancia es muy larga (3)

○ Inseguridad por riesgo de accidente (4)

○ Inseguridad por riesgo de robo (5)

○ La contaminación de la ciudad (6)

○ Falta de infraestructura (ciclo ruta o vías con preferencia al ciclista) (7)

○ Supone un gran esfuerzo físico (8)

○ Afecta la presentación personal (9)

○ Sudor (10)

○ Factores climáticos (lluvia, frío, etc.) (11)

○ No conozco la ruta para llegar al trabajo (12)

○ Otro (13)

Q29 Si eligió "Otro" por favor especifique:

_____

Q30 ¿Si se solucionara el punto anterior, estaría dispuesto a utilizar la bicicleta como medio habital de transporte?

○ Sí (1)

○ No (2)

Q31 ¿Cuántas veces a la semana utilizaría la bicicleta?

○ 1 (1)

○ 2 (2)

○ 3 (3)

○ 4 (4)

○ 5 (5)

○ 6 (6)

○ 7 (7)

Q32   ¿Cuáles de   los siguientes aspectos le motivarían a usar la bicicleta como medio habitual   de transporte?
(marque las 3 más representativas)

☐   Ahorro de tiempo (1)

☐   Mejorar mi calidad de vida (2)

☐   Mejorar mi salud (3)

☐   Bajar de peso (4)

☐   Ahorro de dinero (5)

☐   Aportar al medio ambiente (6)

☐   Aumentar mi productividad (7)

☐   Contribuir a mejorar el problema de movilidad de la ciudad (8)

☐   Ninguna de las anteriores (9)

Q33 ¿Hay un sistema de prestamo de bicicletas en su lugar de trabajo/universidad operado por Mejor en Bici?

◯ Sí (1)

◯ No (2)

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Q34 ¿Ha utilizado el sistema de prestamo de bicicletas operado por Mejor en Bici?

○ Sí (1)

○ No (2)

Q42 ¿En el último año ha recibido por parte de su empresa/universidad alguna información o algún tipo de capacitación que haya modificado sus hábitos tradicionales de transporte?

○ Sí (1)

○ No (2)

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Q35 Las preguntas que siguen a continuación se enfocan en su productividad en su espacio laboral o en sus estudios.

Recuerde que toda la información que proporcione en esta encuesta es confidencial y será anonimizada, eliminando cualquier referencia a su identidad.

Q36 ¿Está contestando esta encuesta en un día laboral o dia de clases?
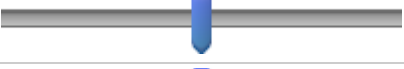
○ Sí (1)

○ No (2)

Q37 Entre las actividades que ha desempeñado hoy durante su jornada laboral o su jornada educativa: ¿ha realizado actividades diferentes a sus funciones/tareas habituales?

○ Sí (1)

○ No (2)

Q38 Comparado con su día más productivo en el trabajo/estudio, por favor califique su jornada laboral o su jornada educativa de hoy en una escala de 0 a 10, siendo 0 su peor desempeño y 10 su mejor desempeño:

Desplace la escala de acuerdo a su calificación

0   10   20   30   40   50   60   70   80   90   100

Concentración ()	
Presición en el desempeño de sus labores ()	
Velocidad con la que ha desempeñado sus tareas ()	
Capacidad para manejar la carga laboral/educativa ()	
Capacidad para trabajar/estudiar sin errores ()	

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Q40 La pregunta que sigue a continuación se enfoca en su bienestar.

Recuerde que toda la información que proporcione en esta encuesta es confidencial y será anonimizada, eliminando cualquier referencia a su identidad.

※

Q39 Esta escala consiste en un número de palabras que describen diferentes sentimientos y emociones. Lea cada ítem y luego marque la respuesta adecuada en el espacio próximo a cada palabra, con base en lo que usted siente en estos momentos.

Utilice la siguiente escala para registrar sus respuestas:

1 - Muy levemente o nada
2 - Un poco
3 - Moderadamente
4 - Bastante
5 - Extremadamente

○ Interesado (1) _____

○ Molesto (2) _____

○ Entusiasmado (3) _____

○ Enojado (4) _____

○ Fuerte (5) _____

○ Culpable (6) _____

○ Asustado (7) _____

○ Hostil (8) _____

○ Optimista (9) _____

○ Orgulloso (10) _____

○ Irritable (11) _____

○ Alerta (12) _____

○ Avergonzado (13) _____

○ Inspirado (14) _____

○ Nervioso (15) _____

○ Decidido (16) _____

○ Atento (17) _____

○ Intranquilo (18) _____

○ Activo (19) _____

○ Temeroso (20) _____

Q41 Agradecemos su colaboración.

Esta encuesta se realizó en el marco de una investigación sobre los desplazamientos cotidianos de empleados o estudiantes. El objetivo de la investigación es analizar cómo diferentes alternativas de movilidad elegidas por individuos repercuten en su bienestar y productividad.

Adicionalmente, la investigación está evaluando el efecto que tiene un sistema de bicicletas compartido ofrecido por Mejor en Bici.

Si tiene algún comentario u observación respecto a esta encuesta puede incluirlo a continuación.

_____

_____

_____

_____

_____

End of Block: Default Question Block

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