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Doing Bad by Doing Good? An Empirical Analysis of the Incentives from Informal Settlements' Upgrading Programs on Urban Informality

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Cynthia Goytia
Torcuato Di Tella University

Guadalupe Dorna
Torcuato Di Tella University

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Abstract

This paper has two different aims. First, we investigate the effects of informal settlements upgrading programs through a systematic review synthesizing the information provided by evaluations of such programs in Latin America. Based on the analysis of 38 program documents from 1998 to 2016, the review provides evidence that, in all the interventions, the best results are obtained from infrastructure upgrading (sanitation and road accessibility). What are the failures? Urban integration and accessibility to the neighborhood is improved in some interventions, but the indicators used are inadequate to measure the actual degree of urban integration. On titling, the result is negligible in scale in all interventions. Environmental problems appear to be slightly reduced. What are the main gaps? There is still the need to measure the long-term effects of upgrading interventions and to shed further light on urban effects. The second aim of this study is to assess the role of upgrading interventions in Metropolitan Buenos Aires using an empirical identification strategy and an innovative data base. The context analyzed presents substantial spatial variation in upgrading interventions and formal-informal housing dynamics. The model is intended to assess whether informality is exacerbated by upgrading interventions when there is insufficient absorptive capacity of the formal housing sector because of the land use regulatory environment.

JEL Classification O17 Formal and Informal Sectors· R31 Housing Supply and Markets · R52 Land Use and Other Regulations

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About the Authors

Cynthia Goytia is professor and Head of the MSc. in Urban Economics at Torcuato Di Tella University in Buenos Aires, Argentina where she also has founded and chairs since 2012, the Urban Policy and Housing Research Center (CIPUV), one of the most prestigious urban research centers in Latin America. She has developed a relevant and influential body of academic research on urban policies, housing and land markets, published in specialized publications and books, some of them recently released in Chinese. She holds a M.Sc. in Urban Economics and a Ph. D from the London School of Economics and Political Science in the UK. She has been a Visiting Scholar at Harvard University and has lectured at the Institute of Housing Studies in the Netherlands, Cambridge University, and LSE in UK. She is a senior urban consultant to Argentina's and Latin American governments, the World Bank, United Nations Inter-American Development Bank and CAF (Banca de Desarrollo de América Latina), and fellow of the Lincoln Institute of Land Policy.

Contact: cgoytia@utdt.edu

Guadalupe Dorna is a researcher at the Research Center of Urban Policies and Housing (CIPUV) at Torcuato Di Tella University, Director of the Master in Public Policy and professor at Urban Economics Master Program in the same university. She has a M.Sc. in Public Administration and International Development from the Kennedy School of Government at Harvard University and received her BA and post graduate degree at Torcuato Di Tella University. Her research focuses on the vulnerability of the middle class and on the policy mechanisms that could be used to reduce such vulnerability. This was the theme of her thesis presented at Harvard, which received an award of excellence in research.

Contact: gdorna@utdt.edu

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Doing Bad by Doing Good? An Empirical Analysis of the Incentives from Informal Settlements' Upgrading Programs on Urban Informality

I. Introduction

Informal land and housing urbanization is today a common characteristic of most cities in developing countries. The global expansion of urban informality now poses new questions for urban and economic research, as well as predicaments for policymakers, on tools used to address them and their medium and long-term effects. While local and national governments invest heavily in land policies, ranging from strong repression and evictions in the past, to today's more popular titling and upgrading programs, there is no assessment of the impact of different policy approaches on the allocation of households across formal and informal housing markets.

There is a fervent debate with respect to the impacts of upgrading interventions on informal growth, with some authors being less optimistic when there is no formal assessment of how, and under what conditions, upgrading interventions might lead to deter or promote informal growth. This suggests that today's informal settlements pose a problem of a different nature: the multiple market and policy failures that might elevate informality as a housing option for many residents (as well as a form of poverty trap), hindering infrastructure investments and affordability, might not be resolved but augmented when upgrading interventions become the informality tool that most governments rely on.

Conceptually, there are several motivations for taking the effects of upgrading interventions seriously. First, those interventions per se might not be solving the incapacity to adjust urban growth to increases in population (combined with the addition of migration to cities) that produces rapid informal urbanization. Population growth still places intense pressure on basic services and urban infrastructure at a time when many cities in developing countries still lack proper institutions and governance to finance (and provide) them at scale.

In Brazil, Egypt, Mexico, South Africa, Thailand, and Tunisia, success was indicated in 2006 and attributed to the political commitment to large-scale slum upgrading and urbanization programs, including legal and regulatory reforms in land policy and land regularization programs (UN-Habitat 2006). However, other concomitant factors may have contributed. Other views, not so optimistically, point to the fact that inaccuracy in measurement factors would have been the central reason for that results.

More recently, data of the Atlas of Urban Expansion (2016) points to the fact that almost 30% of the residential urban development that took place in a representative sample of Latin American cities of different sizes from 1990 to 2014 has certain informal components (Goytia and Sanguinetti 2017). While it is central for policy-making to recognize what tools for responsive supply are crucial in maintaining affordability in formal land and housing markets, and even more in the face of population pressure, the role of upgrading interventions as a central land-management policy implemented to revert informality should also be reviewed and discussed.

Taking all those issues into consideration, the purpose of this paper is twofold. First, to survey and synthesize existing research on the assessment of titling and informal settlements interventions in developing countries. The second aim is to empirically assess whether upgrading interventions and regularization of informal settlements contribute to mitigate informality in Buenos Aires Metropolitan Region in Argentina, an area where in year 2016 there were 454,000 households living in 1183 informal settlements (JGM 2017).

This paper provides evidence that there are many gaps in the objectives, design and implementation of the evaluations of neighborhood upgrading interventions. There are several gaps that constrain significantly our knowledge of effects, which are discussed in this section. There are many important effects that develop over time, but all program evaluations are carried out right after implementation, which suggest a huge bias. Moreover, only the upgrading programs in Uruguay have an explicit objective not only to upgrade existing informal settlements but to prevent informality and reduce their rate of growth.

There are direct implications on program design that should be better informed based on the information generated by ex-ante cost benefit analysis, which usually indicates great valorization of plots and assets due to infrastructure upgrading and roads. Programs can establish solid baselines for applying charges for services and property taxes when upgrading interventions are implemented. [1] However, more studies of the costs of alternative (preventive) tools would provide useful lessons for policymakers in weighing upgrading investments against other public policies seeking to prevent informality.

The paper is structured as follows. The first goal of Section 1 is to build a better understanding of the evaluation of informal settlements interventions. We are interested in the methodology (i.e. whether they assess the causal effect of interventions building on rigorous methodological design), objectives (i.e. the assessment of effects on outcomes or the simple enumeration of outputs), and to what extent the effects on informal land markets have been a matter of concern in such evaluations. We begin in Section 1 with a treatment of the key issues covered by the assessment of the upgrading interventions, affecting three groups of outcomes of interest: individual, housing and neighborhood-city-region. The goal of this part of the study is to provide a unified overview of the primary effects from land regularization and upgrading interventions that occur in Latin American and other developing countries, building a coherent synthesis to provide a starting point for in-depth policy analysis. Second, the discussion turns to main gaps in empirical research and program assessments. With this background, in Section 2 our attention then shifts to identifying a methodology to assess the effects of those programs on informal development itself. We focus on the metropolitan region of Buenos Aires, where interventions have been implemented and informality has also been concurrently growing. In Section 3 we discuss salient conclusions and provide recommendations for future policy, evaluation, and the proposal for extensions.

[1] There is a shortage of fiscal instruments that should contribute to urban land markets performance (Smolka and De Cesare 2010). A more robust property tax system would potentially mitigate informality and its negative effects.

1.1 Methodology of the Review

The review assesses the expected linkages between activities, outputs, outcomes and impacts, considering the evaluations produced by IADB and World Bank financed projects, to assess the impact of the activities aimed to upgrade informal settlements in several Latin American countries.

The main objective of our analysis is to shed light on the strengths and gaps related to land markets and informality. The focus on these issues provides richer insights into interventions and on the assumptions linking upgrading activities and outputs with outcomes and impacts on land markets and informality. We reviewed evaluations done upon project implementation completion by the World Bank and IADB, covering 20 projects described in 38 reports for 8 different countries.

There are two different issues to take into consideration. First, the interventions analyzed herein are representative of the most common approaches to upgrading. Second, for the most part, the programs reviewed are implemented in Latin America. However, when there is no information available from the region, the study also reviews relevant evaluations from disadvantaged areas in other developed countries. There is also a stream of impact evaluation studies carried on by researchers all over the world. These are a most valuable source providing empirical evidence on the effectiveness of different types of interventions, albeit with very narrow objectives. [2]

The systematic review of available evaluations follows an established methodology that consists of predefining highly specific inclusion criteria, conducting a thoroughly documented and replicable search on multilateral webpages, archives and national information, and conducting a synthesis of the findings of the studies included. Accordingly, the aim of the search made in this review was to cover as many evaluations of upgrading interventions as possible, of both published and unpublished documents from multilateral organizations.

The specific set of study inclusion criteria was formulated before the search began. This was a key requirement of the systematic review methodology as it provides a clear guide for the search, bolsters the transparency of the review, and enables replicability. The inclusion criteria include:

1. Subject of interest are upgrading interventions based in Latin American countries.
2. Since there is a wide range of upgrading programs worldwide, the focus is on settlements upgrading activities, from specific local policies focused in one problem area (such as replacing the floor material of a house or providing adequate sanitation) to integral programs comprising many activities and targeting various problems at the same time (such as the Favela-Bairro upgrading program in Brazil).
3. The program evaluation was published between 1990 and June 2017 using data collected within that period and is based on an intervention that most of its implementation was within that period or had started in 1980 or later. Studies before 1980 were of less relevance to produce insights for current policymakers and practitioners, but whenever found they were carefully analyzed.

[2] See Goytia (2013) for a discussion on such studies and main results.

4. The evaluations are based on quantitative or qualitative data collected at the individual, household, plot, neighborhood or city level. Qualitative studies complement quantitative studies by providing detailed insights into the causal mechanisms (see Snilstveit 2012).
5. We look for the assessment of causal linkages between outputs and outcomes, outputs and impacts, or outcomes and impacts. Since any kind of viable causal inference cannot be made without the use of a comparison group (see Gertler et al. 2011; Khandker et al. 2010) for quantitative studies, the methodology must involve the consideration of data from a status quo ante or alternative treatment comparison group.

1.2 Informal Settlements Upgrading and Regularization Programs: A Review of the Objectives, Results and Main Gaps

This section discusses problems related to the current analysis—and gaps—of the evaluation of upgrading interventions. Governments have taken several approaches to deal with informality. The programs comprise a wide range of interventions. Since the 1980s, local and central governments have increasingly practiced the concept of in-situ neighborhood upgrading, which is based on the notion that it is both socially and economically more effective to allow residents to remain in their communities. Starting with those that dealt only with land tenure up to fully integrated programs, most include the provision of infrastructure, urban services, housing improvement, and other attributes (Brakarz et al. 2002).

Also, there are integral programs which combine interventions intended to improve the living conditions of the residents (the so-called integral approach). These interventions usually include infrastructure works, provision of urban services, activities in education and health, and community development. Relevant integral programs that progressively aggregate social components into their basic infrastructure design include the Favela-Bairro program in Brazil, in existence since 1994, and the Programa Urbano Integral (integral urban program) in Medellin, Colombia, in effect since 2002, among others. Alternatively, some local governments opt for small-scale programs that address, at the neighborhood level, specific deficiencies in water, sewage, drainage, or other deficits. Other interventions include land titling programs, that provide property rights to irregular settlers.

It is not yet clear whether these upgrades are contributing to revert informality. In fact, we don't know whether countries achieved, or are in the process of achieving, reduction or stabilization of informal urbanization growth rates. The review synthetized here shows that, in all the interventions, the best results are obtained from the infrastructure upgrading, mainly in terms of sanitation and road accessibility, within the upgraded neighborhood. Although house connections to infrastructure services are not always included in upgraded programs, those improvements can incentivize more housing investments for the construction of bathrooms and improvements encouraged by the programs that are introduced by the beneficiaries themselves.

As for titling, positive results are minimal in all interventions. Regarding environmental problems, these appear to be slightly reduced although some of them remain, such as dumps, rats and sewage (to a lesser extent). It seems necessary to emphasize that, prior to the interventions, the most urgent needs are streets within the settlement dense areas, sanitation, public lighting, the

removal of landfills and, to a lesser extent, the provision of community equipment. In other words, demand is usually focused on infrastructure and better environmental conditions.

Regarding urban integration, accessibility to the neighborhood is improved in some interventions and beneficiaries feel more integrated. However, these indicators are totally insufficient to measure the real degree of urban integration. At present, none of them include broader equilibrium effects on land markets or informality. The evaluations contain little discussion on whether programs are designed to prevent informality or to assess the interaction between upgrading interventions and the level of informal land development.

Moreover, for the above analysis to be relevant for policy discussions, the benefits need to be discussed in terms of aggregate benefits, instead of benefits to individuals alone, and in comparison, with the costs to be borne by the society. It was not demonstrated in any study that the probability of informality reduction is higher when upgrading interventions are implemented. Neither was it demonstrated that there is an increase in social welfare from upgrading or titling vis a vis other preventive strategy.

Indeed, from the analysis of different interventions that we conducted for this study, we find that only the upgrading programs in Uruguay have an explicit objective not only to upgrade existing informal settlements but to prevent informality and reduce their rate of growth. To that end, the Uruguayan upgrading program includes a Prevention Strategy (Component II), which recommends the promotion of policies and practices that reverse the generation of irregular settlements or that would contribute to their solution. The program includes a review of urban policies, a social rental program (by the implementation of a national rent guarantee fund), an institutional strengthening program for local governments and the implementation of a monitoring system. What this program shows is that housing policy—not land markets instruments—are conceived as preventive strategies when there is an explicit objective of reducing informal urbanization.

1.3 Evaluations in Practice: Methodology

1.3.1 Causality and Evaluation Design

The first important limitation on the merits and worth of these evaluations is one based on methodology. Assessing the causal effects of upgrading interventions on different outcomes is a complex task. Today, it is widely acknowledged in policy and academic circles what estimation methods are the most effective to study the problems of causality, which are important in determining the effectiveness of any upgrading or regularization intervention.

Experimental or quasi-experimental approaches are the most accurate in reconstructing the counterfactual, but they are not always possible to implement. Ideally, one needs to compare what happened to those that benefit from the intervention—using a control group which reproduces the counterfactual situation—or what would have happened in case the program had not been implemented. This is required to assess the effects at different aggregate levels of analysis, including individual/household, the neighborhood, the whole city, or the whole urban system.

To overcome the difficulties in construction of the counter factual group—the fundamental problem of causal inference (Holland 1986)—there are different techniques that attempt to recreate the most accurate counterfactual to use as a comparison benchmark. While in a rigorous experimental setting the treated and control groups are randomly selected (for example, using the roll out of the program or a lottery), it is easier to apply quasi-experimental designs in which a variety of statistical methods are used to choose a control group that can recreate the counterfactual for the non-randomly selected treatment group.

However, for most of the evaluations reviewed, the empirical assessment strategy is not usually adequate to support a firm conclusion on the magnitude of the impacts generated by the program. The review indicates that identification limitations are of the first order of relevance, since program evaluations are mostly based on measuring quantitative outputs without using the appropriate methodology design (experimental or quasi-experimental settings) to obtain a robust evaluation of impacts on outcomes.

In fact, as we explain in the following section, there are very few studies designed to facilitate the robust identification of the causal effects of interventions in informal settlements. Most evaluations compare the initial situation of the households and/or inhabitants with the situation after the intervention of the program, measuring the result obtained in relation to the goal set. The impact, which ought to quantify the difference between the current situation and the initial one, as well as treatment groups against control groups, is not usually calculated because the initial information for control and treatment groups does not exist. That's why, in most of the evaluations, the influence of other factors affecting the performance is not fully controlled in the analysis.

Moreover, the evaluation must attempt to reduce the bias in the analysis by controlling for confounding characteristics between the treatment and comparison groups. That goes beyond using regression analysis with control variables to assess outputs. [3]

What can be done to improve the evaluation methodology? Even if all the neighborhoods receive the complete package of interventions, it is unlikely that they all receive it at the same time. Project components are phased into neighborhoods with varying schedules to provide regional and time variability (i.e., at a single point in time, different communities receive different sets of treatments). An alternative could be, for example, to use regional and time variability in a phased-in design to identify causal effects. In other cases, it is possible to vary the order of the interventions across neighborhoods, so that all the neighborhoods start treatment at the same point in time, but some with one component (such as job training programs) and others with a different component (such as paving). Then, in the second phase, the interventions are completed and analyzed using a difference-in-difference approach, which enables the estimation of the relative effect of the interventions.

[3] There are several possible sources of bias that could arise when producing quantitative evidence on a land tenure intervention (Gignoux et al., 2013)

Another methodological issue is the importance of baseline information prior to the program implementation. Many programs do not have it. This type of information is very useful to understand the circumstances of the households and it can suggest adjustments that can make program components more effective. The normal practice in upgrading interventions is to conduct a baseline survey and an end line survey. Some of the studies reviewed here also include an intermediate, midterm survey. We explain in the next section that the timing of the surveys is not usually the best time to assess changes in outcomes. For example, access to urban services is detected in the short run, but health and child development effects take longer to manifest (if they ever occur).

Cost-Benefit analysis

Cost-benefit analysis is another methodology usually used, mostly in ex-ante evaluations. It is aimed to assess the opportunity cost of public investment, allowing to establish comparisons based on the economic return indicators of each program.

Given public finance restrictions, the interventions cannot address the totality of settlements and at the scale needed. Programs are expensive, therefore upgrading interventions are usually circumscribed to a sample of settlements. An example of costs from Argentina's PROMEBA indicates that average investment per lot was between $39,716 and $54,992 (equivalent to USD 9,687, and USD 13,413 as of April 2011), varying according to the geographic location of the works. [4] Other complementary costs averaged 15% of direct costs. Those costs cover infrastructure, mitigation of environmental problems, improvements in connectivity and roads within the neighborhood, but do not include any housing improvement nor the provision of in-house water and sewer connections.

Moreover, as exemplified by the Mexican upgrading programs, [5] to achieve integrality, governments need to allocate a higher investment per family. It is estimated that to cover the gaps of the entire target population in the program, an equivalent of USD 830 per family per year should be invested for three consecutive years. The evolution of the budget quadrupled during the execution of the program. With the current annual federal budget of USD 166 million, it would take 15 years to serve the entire target population. All these reasons combined result in more than 5 years to upgrade each neighborhood. Financial restrictions also limit the scope of the intervention (the Mexican program has not yet covered 43% of the target sites).

The type of analysis that is always undertaken focuses on the budget costs of program, though never accounting for the returns from upgrading components related to infrastructure and property valorization. However, upgrading interventions generate economic benefits (and costs) for the population of the affected neighborhoods and, at the same time, these benefits (and costs) often extend to the bordering areas outside the geographical scope of the settlement (i.e. the

[4] Since the values are established in Pesos, an adjustment clause was incorporated in accordance with the evolution of the Construction Cost Index reported by INDEC.
[5] IADB. 2004. *Multiphase Program for Attention to Urban Poverty (Phase I and Phase II)*. Project Number: ME0255 and ME-L1019, Loan Number: 1583 / OC-ME and 1928 / OC-ME. http://idbdocs.iadb.org/wsdocs/getDocument.aspx?Docnum=36545673

project site), or even affect society as a whole either directly or indirectly (i.e., general equilibrium effects at the city, country or regional level).

The results of several cost-benefit evaluation exercises in similar interventions reviewed for this study, suggest that all the programs achieved satisfactory rates of return, including individual–households benefit from valorization of assets due to infrastructure and neighborhood layout improvements. Among the evaluations that include ex–ante cost benefits analysis, the Quito Neighborhood Improvement Program provides evidence that road, domiciliary water and sewer connections, neighborhood parks, and training-oriented social programs achieve a positive net present value (NPV), with rates of return (TIRs) varying between 12% and 32%. [6] The same type of analysis was conducted for the interventions in Montevideo and Rio de Janeiro. In the case of PROMEBA in Uruguay, the analysis shows returns ranging from 25% to 28%, while the Program for the Urbanization of Popular Settlements of Rio de Janeiro (PROAP II) shows cost-benefit indicators for each of the favelas (to be intervened), reflecting rates of return between 13% and 71% and averaging 42%.

In Mexico, ex-post evaluations of infrastructure and accessibility programs, found that the coverage of basic services in target settlements and the value of household assets greatly increased with the interventions. An analysis of the windfall (benefits) generated in 80 polygons intervened between 2004 and 2006 showed that USD 2.8 were generated for each dollar invested in the program. This valorization corresponds to an internal rate of return (IRR) of 129% for the interventions. While the evaluations confirm an improvement in the quality of life of the areas affected (based on the improvements in valuation), there is no indication of willingness from the public sector to recover part of this value increase through land policy instruments or fees for the upgraded services.

Other programs, such as that in El Alto, Bolivia (BO-L1079), report benefits to the population accruing from increases in property values due to improvements in access to public transport, provision of new public space, and savings in travel time, among others. The results of the cost-benefit analysis in this case, show positive effects reflected in an IRR of 17.8%. Sensitivity and risk analyses confirm the high reliability of the estimate of positive performance.

What is relevant to highlight is that **the real estate valuation indicator is now considered as an acceptable "proxy" of program benefits** on specific geographic areas. The logic behind this indicator is that market prices directly reflect urban infrastructure (services, streets, etc.), quality of life, desirable in terms of demand and other relevant factors in the area where the property is located. One usual finding of these studies links direct and indirect increases in land and housing values both in the neighborhoods intervened and in areas benefiting from them. At the same time, higher real estate valuation is never used to better ascertain the ability of beneficiaries to (progressively) pay for services. In most upgrading experiences this issue receives little consideration. No attention is given to establish valuation criteria for determining user fees for services, to evaluate the sustainability of investments, nor to the implementation of progressive property taxes. Because of this, there is still great potential to use the information generated by

[6] Benefits were estimated using mainly the method of avoided costs, based on information generated through surveys.

ex-ante cost-benefit analysis **to establish clear baselines for applying charges for services and property taxes when upgrading interventions are implemented.**

The cost-benefit analyses examined include detailed assessments of changes in property values. In the case of Montevideo, the conclusion was that program interventions would result in a 154% increase in property values, mainly explained by the availability of drinking water and sanitation, flood elimination, and adequate access to roads. The economic benefits were calculated based on the expected valuation of the properties affected (directly and indirectly) by the program interventions, applying a survey to a sample of 882 households distributed in the project settlements, and others with similar characteristics that would act as control group. Information collected in the survey included: (I) value of properties (land and construction); (Ii) land and housing characterization variables; (Iii) service availability variables; (Iv) variables that characterize flood problems; (V) distance variables to community centers and social facilities; (Vi) variables of location and accessibility to the neighborhood; and (Vii) variables of socioeconomic characterization of families. With this information, the authors estimated a function to simulate the change in the price of the properties associated with each of the main works foreseen in the program.

In addition to the Uruguay example, Rio de Janeiro used a similar valuation approach, taking a sample of 143 real estate transactions in 3 areas already intervened by PROAP I (situation with program), and 3 other areas that would be intervened by PROAP II (situation without program). It was observed that those already favored by PROAP I presented a value that approximately doubled those that would be affected by PROAP II (+ 97%). In the favelas improved in the first phase of the program (indirect effect), the value of land increased by 20% and that of housing units by more than 170%. However, overall increases in housing price are sometimes mistakenly attributed to program interventions, since the quality of units in upgraded neighborhoods—and the investment that households make on their homes—is higher than that in the comparison groups.

Based on the review of such cost-benefit estimations, we want to suggest a better use of the information since the capitalization that is determined by the improvement works are not taken as a feasibility measure for implementing user fees or progressive property taxes, which can have an important effect on reducing the pervasive vicious circle of informality. Urban regularization programs need to evolve to follow principles that break this vicious circle, neutralizing speculation with regard to future upgrading when buying an informal plot. Programs need to enforce (affordable) payments for urban services and consider more appropriate titling schemes options (leasehold, land trusts, or communal ownership). Additionally, fiscal sustainability is enhanced through charges and property taxes that capture a part of the increases in land value associated with urban infrastructure improvements and the granting of legal titles (Smolka and De Cesare 2010).

Finally, the cost-benefit analysis presents the complex and challenging task of obtaining sufficient supporting information to incorporate direct and indirect effects generated by interventions. Following our comments on program alternatives and the interrelated factors interacting in spatial equilibrium, the logic of the evaluations is usually very incomplete for at least two main reasons. First, alternative factors (in addition to the upgrading) are never

considered. Second, the cost-benefit analysis does not compare upgradings with other programs, e.g. preventive interventions related to providing better access to affordable land. It neither considers broader effects beyond the originally targeted households and neighborhoods.

1.4 What Are the Evaluations Measuring? Program Objectives: from Individual Benefits to Aggregate Outcomes.

Informal settlements represent a major challenge to development. This section reviews the empirical evidence of the results of different upgrading programs and their components through the perspective of their effects, classified in three groups of outputs and outcomes usually considered in the evaluations. Current upgrading programs range from small, single-sector interventions to integral, multisector slum upgrading and titling regularization programs. Even similar programs, may have very different policy objectives, ranging from individual and households' effects (on outputs and outcomes) to neighborhood effects. At the neighborhood level, most interventions have objectives related to improving exiting settlement layout, infrastructure, and public space. Many programs have the objective of promoting the urban integration of irregular settlements. Others are more focused on quality of life of existing residents and stimulate the social integration of its residents.

1.4.1 Scope of Analysis: Outputs, Outcomes or Impacts (and for Whom)

A wide variety of indicators have been used to measure housing, neighborhood, and individual outcomes. According to the objectives of the programs, the indicators are either simple or composite (comprising multiple indicators).

The most common dimensions included in the evaluations are: tenure security (often measured by land titles that have been delivered), habitability and sanitation, environmental sustainability, urban integration and social capital, as well as the impact of the projects in three aspects: (i) reduction of poverty within the settlement (usually measured by increases in access to services by the beneficiary households); (ii) improvement in the health of beneficiary families; and (iii) improvement of habitat conditions. The most frequently employed indicators used to measure outputs, outcomes, and impacts in the context of upgrading programs are:

(i) **Individual level** (income gains, health improvements, human capital, child development, labor market insertion, etc.) These are indicators for individual outcomes which include income gains, access to labor markets, human development in health and education, and wellbeing measures.

(ii) **Housing level** (housing investments by owners, increases in housing values, access to credit, access to housing infrastructure, ownership and titling, household density, etc.) Among those are indicators of the state of the dwelling infrastructure, its services and assets, property rights, location, exposure to hazards, household size, and real estate valuation. Also, access to the banking system can be associated with housing, such as when the programs provide property rights for the land, opening the possibility of using land titles as collateral for credit.

(iii) **Neighborhood level** (improvements in urban services, impacts on security and violence, and social and urban integration). These indicators measure the availability of urban services, infrastructure (e.g., paving, street lighting, roads, parks, and community centers), integration with the formal city (transport links) and crime related variables.

One relevant issue that emerges from this analysis is the scope of the evaluation of most interventions. Most evaluations consider outputs rather than outcomes. When outcomes are considered, the most frequently used are housing, neighborhood, and individual outcomes. The overall city/region or country is never considered in this type of analysis, constrained to narrow local/neighborhoods effects.

In other words, many relevant effects that are broader than the neighborhood and the families living there, are consistently omitted. Dealing analytically with these various elements is challenging, both at the theoretical and the empirical level. The issue is extremely relevant when considering effects on land and housing markets. On the theoretical side, several interrelated factors interact in spatial equilibrium: upgrading intervention policies in a few cities—or localities—may have general equilibrium effects on other cities and rural areas by affecting the location decision of households. That's why methods aimed at understanding the effects of upgrading interventions should account for general equilibrium effects operating on interrelated formal and informal markets.

1.4.2 Measurement Issues

Indicators at individual and household level

The official program documents mention that the final evaluation of the program should measure the results achieved. The confusion between program outputs, outcomes and impacts can be illustrated with one example. A very common indicator to measure the social integration effects is to consider the growth in the number of local organizations due to the implementation of the program in relation to the initial situation. However, this measure does not consider if there were tangible movements at the level of associativity in the neighborhood. A greater number of participants in the activities does not mean, per se, increases of the social capital of the community even though it can be understood as a proxy indicator of the influence of the project. That's why an increase in the number of local groups—which does not imply greater identification with the settlement or improved social integration—is a bad designed indicator of social sustainability results.

A similar matter can be seen when some evaluations attempt to measure environmental sustainability. That is generally a composite indicator that includes a health index to measure changes in the project neighborhoods at the time of the final evaluation, compared to the baseline for the same neighborhood. The health index is intended to present a summary of the adverse ex-ante situation of households in terms of health. The indicator includes connection to the drinking water system and to sewer system or septic tank (not effective connections), garbage bulbs in public space, and lots affected by waterlogging. The expected improvements in health are verified in most of the projects (in PROMEBA, Argentina, improvements were registered in 33

of the 38 neighborhoods analyzed).

The improvements on water and sewer connections and the changes in the heating system of the houses, can certainly affect health outcomes, along with environmental sanitation interventions. However, improvement in the neighborhood health levels are also associated with other actions such as: health campaigns, improvement in the accessibility to health centers, articulation with actions of other external providers, or overall local or regional policies (like vaccination) which are not always accounted for. That's why the index may be strongly affected by external health factors, including seasonal factors for certain diseases. For all these reasons, it does not seem to be an adequate way to measure the "environmental sustainability" of the interventions, nor is it a good measure of health outcomes, since it only indicates some relevant (infrastructure) outputs.

As we explain in the following section, one conclusion related to evaluation measurement problems is the narrow household-oriented focus on outputs—not outcomes—and the lack of vision of general neighborhood and city effects on land markets and housing markets outcomes.

Evaluation timing: the lack of middle and long-term evaluation of effects

Surveys and other measurement instruments are usually done close to the completion of works. However, very important neighborhood dimensions, such as maintenance and new occupations need a longer time frame to be measured. The same is true of health effects and social capital. The short time focus prevents long-term contributions from becoming apparent, as it is the case of land and housing markets effects. Moreover, medium and long-term effects might differ even in their direction, as different time frames can show both increases and decreases in the effect of the same program component.

Since it is not common to see longer-term evaluations (at least two to three years after program completion), we identify this as another of the main problems in the way upgrading programs are evaluated. As a result, we see inadequate measures of Unsatisfied Basic Needs (UBN), morbidity, residential satisfaction, level of maintenance of buildings and public space, sustainability of the titling efforts, and level of permanence of the population, among others.

The poverty reduction assessment is a case in point. Measuring changes in poverty level requires medium-term assessment (after completion of works) to be evaluated more accurately in relation to the baseline. The contribution of the program to reduce poverty levels is usually measured by a combined-outputs indicator (in %) that includes, type of housing unit (inconvenient), overcrowding, sanitary conditions, school attendance and subsistence capacity. However, the reduction of an important part of these deficiencies depends on general and local variables which are exogenous to most upgrading interventions (see PROMEBA Argentina 2015). Moreover, the measure is an index composed of factors that identifies critical deficiencies of the population, while the direct action of the program impacts only one of the five indicators that make up the poverty assessment index. [7]

[7] Many times, the poverty levels were reduced mainly due to sanitary upgrading (incorporation of lots to the public networks of services), captured by questioning if the house has a toilet with a water discharge and if it has an internal drinking water connection.

Satisfaction indicators show another lack of measurement precision. The purpose of the Habitat Satisfaction index is to know how satisfied the beneficiary families are with the conditions and the services provided before and after the intervention. We know that improving the neighborhoods increases their living standards and their satisfaction with life. Dwellings, neighborhood characteristics, and urban amenities such as parks and cultural facilities have direct and indirect effects on life satisfaction. The results obtained could indicate that these perceptions are strongly linked to the relatively recent modifications in the neighborhood (including e.g. satisfaction with trees, public squares, quality of the environment, street signs, street lighting, rainwater drainage, sidewalks, bus stops, means of transport, garbage collection, sports facilities). So, it is hard to imagine that households that are receiving services (for free) would be dissatisfied with them. But there is also the issue of combining heterogeneous effects, making us question the extent to which it is possible to report successful outcomes by the average of those measures. [8]

Following the idea that upgrading generates satisfaction which can have a monetary equivalent value, in Uruguay, Gandelman et al. (2012) analyze various dimensions of the life satisfaction in informal settlements. Their results suggest that differences in overall happiness and in domain satisfaction are partly explained by different levels of access to public goods. The authors find a monetary equivalent value (willingness to pay for them) which is considerable for those public goods such as electricity, running water, sewer systems, drainage, waste disposal systems, street lighting, sidewalks that are in good condition, trees in the street, and the absence of air or noise pollution. However, this type of analysis is not often used to assess affordability of fees for service provision.

Maintenance is another aspect that is usually inadequately assessed. Most evaluations include an indicator of % of settlements with maintenance problems. However, an absence of maintenance problems may be also related to the time when the evaluation is carried out—at a time relatively close to the completion of most of the works. Furthermore, maintenance status assessment needs to be complemented by information on maintenance actions carried out by the local government, service providers and neighborhood organizations to evaluate the level of incorporation of the areas upgraded in the agendas of other local actors.

Title and property rights: a partial analysis and poor implementation

The definition of the conditions for transferring the land rights to the population generally goes through a lengthy process that extends through the entire period of program implementation, with very poor results in most of the cases. Whether this aspect is important or not is still a matter of discussion. In fact, evidence indicates that some of its residents prefer not to have formal property rights due to the obligations generated after receiving them.

To obtain reliable information on such matter, the Uruguay evaluation asks about the perceived benefits that households expect from receiving title deeds. Only one in four of them perceived that greater security will be provided by title deeds. Half of households perceive higher assets value (9%), ownership (30%) and asset for the children (6%), but still a significant number (¼)

[8] For example, satisfaction with the Program in Uruguay (2013), taking a scale from 1 to 10, 82% of the beneficiaries qualify with a "grade" of 7 or more and 3% qualify with 4 or less.

of them, expect no value or don't know. So, it's not surprising that in none of the projects in Uruguay residents obtained title deeds, while in Argentina's PROMEBA, only 36 % of the households obtained it.

There are several key issues involved in that result. First, the complexity inherent in the task, since titling requires carrying out censuses and records, measuring lots, as well as the consideration and resolution of a varied spectrum of special tenure situations. For example, it requires the measurement and subdivision of the blocks, the individual files of each family and the delivery of all the documentation to the agency in charge of issuing the title. Thus, even when the PROMEBA could provide resources, it has no chance of exercising control over the processing time for title delivery. However, political will, administrative bureaucracy, and the real benefits for households and government to undertake the effort of titling are other key issues that also matter.

There are also medium and long run effects of titling that no evaluation has considered yet. One of them relates to a frequently mentioned argument against individual deeds in formalization of land rights. It is possible that once in the formalized market, the new titled households might be tempted to sell their land (i.e., to larger landowners, developers or to wealthier persons). While the theoretical underpinnings of these arguments are not necessarily well founded neither in the academic literature or on empirical studies, one could conceive of circumstances where asymmetries of information and of opportunities could lead to land sales. This, it is argued, will lead to the emergence of an even larger informal market and very inefficient public expenditures.

In all those cases, the emergence of **alternative models for land registration—**such as community land trusts or the separation of land and housing rights—can be a strong reaction to this central problem related to individual title deeds, but these facts are still very unexplored in most program evaluations, which do not follow up effects through time.

Second, registration systems—and partial registration—can influence transactions in the land market. Some experts argue that the reduction of uncertainty regarding ownership is expected to enhance the level of activity in the land market, increasing overall efficiency of land allocation. However, there has been a paucity of assessment on the veracity of this proposition, and on the actual extent of land transactions under different levels of formality of property rights. Moreover, the issue of equity—which are never discussed in relation to these programs—would indeed require more detailed knowledge of the nature of increased land market activity in terms of who buys, who sells, and whether the sales are likely to increase gentrification or deprivation.

But even more important is that the assessment has not considered effects on land markets and informality. While an increasing body of literature is emerging on socioeconomic aspects of land registration systems, there has been very little rigorous documentation and analysis of the implications of the introduction of systematic upgrading interventions on formal and informal land markets and the incentives to reduce informal land development.

How urban integration is measured? Indicators related to neighborhood integration and overall city's impacts

Informal neighborhoods are in inadequate, unsafe or at-risk areas and lack urban services. These aspects motivate the design of interventions that attempt to integrate the neighborhoods with the cities. The integration is pursued by improving transportation connections, providing the same level of services (both urban and social) found in surrounding areas, and/or reducing the physical risk factors that affect overall quality of life in the informal neighborhood.

There is still no use of spatial segregation and integration measures or indicators to assess the differences and changes derived from interventions between settlements and other parts of the cities. [9] Segregation is a major problem affecting overall opportunities for the residents in informal neighborhoods. To reduce social and physical segregation, several programs have aimed to reduce both the barriers of accessibility and the physical inequality between the slums and the rest of the city. In fact, one of the reasons put forth to explain the rise of unemployment in many cities over the world (Banerjee et al. 2008) is the high search cost that the population living in informal settlements in peripheral areas of the city incurs when looking for a job. They are highly isolated due to the lack of adequate public transportation.

The most common way of measuring urban integration is by comparing urban networks and services provided to the baseline indicator. Services considered include water, sewer and electrical energy networks. Others, less frequently used, are drainage, public lighting, gas network, road network, and pedestrian areas. Of course, a fundamental goal is to provide connection to service networks to 100% of informal settlements, but many times the programs provide a lower percentage with basic public infrastructure. Further, the scope of integration in terms of transportation and accessibility is usually not well defined; neither is the extent to which the surrounding neighborhoods or regions are fully integrated.

The evaluation of the Uruguay program (2013) [10] includes innovative dimensions of analysis that are not common in any other country. One of them is measuring the transformations of the type of territorial occupation bordering the upgraded settlements. This measure refers to the percentage of the area bordering the neighborhood in which informal occupation has grew as result of the intervention. This is a very important issue since most of the time, the upgrading of a neighborhood is a powerful incentive for the growth of more informality in the surrounding area (or the densification of vacant plots), motivated by the expectation of further upgrading in the medium term.

In the case of Uruguay, the evaluation provides a classification of such effect. The neighborhoods with better qualification have smaller extension of informal residential occupation in nearby areas. This evaluation covers 4518 households, located in 13 upgraded

[9] Some examples are Marginality Index (Índice de Marginación), the "urban marginality index" (Índice de Marginación Urbana) used in Mexico to classify urban neighborhoods according to a much larger array of housing and personal attributes (Roberts and Wilson 2009) and the Dissimilarity Index.

[10] Uruguay: Neighborhood Improvement Program Evaluation (PMB) (PMB-PIBARRIOS). 2013. Loan IDB, 2052/OC-UR, Draft Executive Report (August).

neighborhoods in Montevideo and in several departments in the interior of the country. The resulting classification rated 7 interventions as very good or good (do not create much informal development nearby), 3 as regular and the remaining 3 as very deficient due to high levels of new informal development surrounding the upgraded settlements.

Density, measured by the number of dwellings per ha. in the upgraded area and its surroundings, remained unchanged after the intervention in the case of Uruguay. The new developments are as dense as they were prior to the intervention, even though upgrading generally involves a process of relocation and other actions to decrease overcrowding and density.

The analysis of the consolidation of the neighborhood and its physical integration within the city also shows very different outcomes. Among the neighborhoods upgraded (in a radio of 300 meters with respect to each one of them), 20% presented good or very good level of integration to the urban network prior to program implementation, while 40 % had integration deficiencies which the program intervention contributed to improve consolidation. However, upgrading implemented in the peripheral areas failed to influence consolidation with the surrounding urban environment.

Regarding settlement distance to streets and main roads, those located in central city areas (half of all settlements) had already good accessibility prior to program implementation. But 2/3 of the settlements had very poor accessibility to streets and main roads, and that has not changed over time. This means that **integration into the urban framework is relatively easy for settlements located in central areas while extremely difficult for** peripheral ones, since proximity to main roads and streets is essential to improve accessibility and integration.

Moving forward, it would be relevant to review the existing incentives to more effectively support municipalities in urban planning and assess those effects. One example is the upgrading programs in Mexico (BR-L1104, 1960/2), which supported better planning practices at municipal level by encouraging municipalities to modernize their planning instruments. While incentives have not been sufficient for municipalities to systematically improve their urban planning capacities, some progress has been made in planning practices at the neighborhood level, improving the provision for urban services at the level of polygons.

Missing subjects: Integral Urban Upgrading Programs evaluations

The most complete approach to neighborhood upgrading is that of integrated interventions, in which different dimensions are addressed in a complementary and synergetic manner. However, there is a gap when it comes to the rigorous evaluation of integral neighborhood upgrading programs. Most evaluations focus on certain single-sector intervention (housing improvements, land titling, and paving, for example).

However, there is qualitative evidence regarding the success of programs of this type (e.g., the Programa Integral Urbano in Colombia), based on descriptive analyses that assess the program's targets and its outcomes (e.g., number of households given access to sanitation). One such case, reviewed in UN-Habitat (2011) within Safer Cities, is the Programa Urbano Integral (PUI),

implemented by the Municipality of Medellin, Colombia, since 2002. The most salient impacts of the PUI are economic and social (UN-Habitat 2011).

No causal investigation is performed in the case of most of the integral programs. The only attempt is the evaluation of the past stages of the Favela Barrio program, which exploited quasi-experimental designs (Soares and Soares, 2005). However, the authors indicate serious data limitations due to lack of a baseline data set and absence of an ex-ante selected control group.

Favela Barrio is an important integral intervention in Rio de Janeiro, Brazil. This program started in 1994 and is now in its third phase. The first phase included infrastructure upgrading of 52 favelas and improvements in 8 irregular subdivisions. The second phase began in 2000, covering an additional 32 favelas and strengthened activities in child development, adult education, social services referral (through the Social Action and referral Centers-CRAS), as well as community development and property regularization. The third phase started in 2012 and includes the same infrastructure and social components of the previous phases and adds a component to reduce safety risks in the communities. The program has become the principal element of municipal policy to upgrade all the city's favelas.

However, the monitoring and evaluation components of Favel Barrio were delayed. Soares and Soares (2005) performed an ex-post evaluation using quasi-experimental design by recreating a matched control group from different sources of information to circumvent the problems of not having baseline data (prior to interventions). The authors report positive results from the program, especially related to an increase in the coverage of water supply and garbage collection in favelas, which was better than in the comparison groups. The impact on sewer was the most significant component at the aggregate level; an analysis by income quartile reveals that the poorest quartiles benefited most from the sewer system, while the richest quartiles benefited to a lesser extent. This heterogeneous impact is also seen with respect to water supply, rubbish collection and illiteracy. The authors do not find significant effects in the reductions of mortality due to improved sanitation conditions. Effects on housing values were not detected, though this may be due to data and methodological limitations. The results do not show improvements in income beyond the construction phase of the program. The authors suggest that a planned evaluation with necessary and timely data collection should be performed in future phases to better assess the effect of this integral program.

Finally, many governments combine infrastructure upgrading with the strengthening of a permanent police presence in the neighborhoods. This was implemented in many cities of the region, such as Rio de Janeiro and São Paulo in Brazil, and Monterrey and Ciudad Juarez in Mexico. These efforts improve immediate security. Despite evidence of their success, no evaluations of the long-term effects of this approach could be found.

II. Buenos Aires Metropolitan Area Empirical Analysis

Our review of upgrading program evaluations in Latin America, in Section I, provides evidence of one of the major gaps in that body of studies: the lack of assessment of land markets impacts, and whether policies and programs that upgrade informal settlements do mitigate or forestall the

causes of informality. This section has the objective of investigating the economic incentives concerning regularization and upgrading interventions in Argentina, assessing its effects on informal settlements formation and growth. The model allows us to assess whether informality develops independently from upgrading programs or is instead an aspect exacerbated by the path of upgrading interventions and the insufficient absorptive capacity of the formal sector determined by the land use regulatory environment.

Why informal settlements are growing despite urban upgrading interventions? Our analysis is based on the Metropolitan Area of Buenos Aires and its 40 municipalities, where there are over 1,000 informal settlements. We focus on two related questions. First, do land regularization interventions reduces (or encourages) sustained informal growth? Second, do such programs provide incentives that encourage urban informal growth under specific types of land markets; particular urban, demographic, economic and political conditions; and/or certain land use regulatory frameworks?

Our database has been built using information from several sources. It includes an innovative database—the Catastro de Asentamientos y Villas—provided by the NGO TECHO, plus national data from the Housing Sub-Secretary covering a wide spectrum of informal settlement characteristics. We also use databases based on Census georeferenced data (number of households, public services, and infrastructure) and new data CIPUV on political parties, accessibility and land prices in the formal and informal land markets, collected by the Urban Policy and Housing Research Center (CIPUV) at Universidad Torcuato Di Tella.

2.1 Literature Review: The Academic Literature and Practitioner's Controversy

We examine three dimensions of the controversy that is part of the most recent discussion on informal settlements. First, we advance the analysis of regularization program effects, which are usually focused on other dimensions, such as those reviewed in Section 1. As far as we know, there is no study on the effects of such programs to mitigate urban informality, except a working paper from Alves (2015). [11] Second, we consider the curative versus preventive views of interventions. These points of view are raised in political and practitioners' discussions, but usually not supported with academic evidence. Physical upgrading of informal settlements is today the key strategy to address low-income housing in developing countries. These issues are important, but there is more to informal settlement's formation than this. Indeed, informal settlements are the outcome of severe land policy distortions. The alternative policy view to curative interventions is focused on preventing informal land and housing development, enhancing inclusiveness by improving land policies catered to make land markets more inclusive, reframing land use regulation, and applying taxation and fiscal instruments that contribute to affordability improvements.

[11] Other empirical studies assess the effects on income, credit market access and believes, among others (see Di Tella, et al. 2007. "The formation of beliefs: evidence from the allocation of land titles to squatters." *Quarterly Journal of Economics* 122, 209–41; or Durand-Lasserve and Harris Selod. 2007. "The formalization of urban land tenure in developing countries." Processed, Paris School of Economics, or Field, Erica. 2007. "Entitled to work: Urban property rights and labor supply in Peru." *Quarterly Journal of Economics* 122:561–602. However, there is no study on the effects of such programs on mitigating urban informality as far as we know, except from a working paper by Alves (2015).

Third, several scholars have already addressed the issue of land use regulation environment and its effects (see Goytia and Lanfranchi, 2009, Biderman, 2009, Monkkonen and Ronconi, 2012, Feler and Henderson , 2008). Here we will extend our analysis of the land use regulation effects. [12]

2.2 Proposed Methodology and Data

The aim of this study is to develop a methodology to understand the causal relationship between upgrading interventions and the different typologies of changes and/or expansion of informal settlements. We will develop a causal inference econometric methodology designed to evaluate the impact of urbanization programs on expansion, inequality and segregation. Our proposal considers using matching techniques. We describe the model and the data below.

2.3 Matching Method

The matching technique involves estimating average treatment effect for the treated by constructing counterfactual scenarios for slums and informal settlements that have received urbanization programs from the pool of these that have received none. The matching procedure is based on a propensity score constructed by the probability that a given settlement has of receiving treatment based on its underlying characteristics (including location, socio-economic composition, political ties with the mayor and governor, social capital, etc.).

The model is the following. In its simplest version, we start by defining a dichotomous treatment variable D_i for each neighborhood, which can take a 0 or 1 value depending on whether the settlement has been object of an urban upgrading program (treated) or not (not treated).

$$D_i = \begin{cases} 1 & if\ neighborhood\ i\ has\ been\ subject\ to\ treatment \\ 0 & if\ not \end{cases}$$

Each neighborhood has both potential and observed results (growth or expansion of the informal settlement over the period under study). Potential results are the expected outcomes under the two possible states of treatment (treated or not treated). Consequently, the observed outcome will always be the same as one of the potential outcomes while the remaining potential outcome (that which would have occurred had treatment status been different) will remain unobserved. This is:

$$Y_i: observed\ outcome\ for\ neighborhood\ i$$

$$Y_{0i}: Potential\ outcome\ for\ neighborhood\ i\ without\ treatment$$

[12] See Goytia, C. and Ricardo A. Pasquini. 2013. "Assessing Urban Land Regulation in Argentina." Working Paper WP10CC1. Cambridge, MA: Lincoln Institute of Land Policy. (Forthcoming in *International Journal of Housing Studies*); and Goytia, C., G. Dorna, J. Cohen, and R. A. Pasquini. 2015. "The CIPUV Residential Land Use Regulatory Index: A Measure of the Local Regulatory Environment for Land and Housing Markets in Argentina's Municipalities. Working Paper WP15CG2. Cambridge, MA: Lincoln Institute of Land Policy. https://www.lincolninst.edu/pubs/dl/1810_1042_Goytia%20Pasquini%20Final.pdf

$$Y_{1i}: Potential\ outcome\ for\ neighborhood\ i\ with\ treatment$$

The relationship between observed and potential outcomes can be described as:

$$Y_i = D_i Y_{1i} + (1 - D_i) Y_{0i}$$

We will be intending to estimate the average treatment effect for the treated, this is the impact of the urban upgrading policies on the growth patterns of the informal settlements that haven been subject to these interventions. Mathematically this is:

$$\alpha_{ATT} = E[Y_1 - Y_0] | D = 1$$

Given non-random assignment of treatment, α_{ATT} can not be estimated by comparing settlements that have received upgrading to those that have not. We need to account for cofounding variables associated to both the probability of receiving treatment and the growing patterns of the settlement. The identification strategy assumes that the following two assumption holds:

- Selection on observables: $(Y_1, Y_0) \perp D|X$. This is, that once we control for the set of characteristics in X, there is no other characteristic (observable or unobservable) other than treatment that affect outcomes;
- Common support: $0 < \Pr(D = 1|X) < 1$. This is, that for all sub-groups that share cofounding characteristics, there are both treated and untreated observations.

Under these assumptions, it can be shown that controlling for a propensity score of the probability that, given the observable characteristics, a unit receives treatment is also sufficient for identification. Meaning, potential outcomes are orthogonal to treatment once controlled for this propensity score. Mathematically, $(Y_1, Y_0) \perp D|p(X)$, where $p(X) = \Pr(D = 1|X)$.

This basic framework can be extended to account for non-binary treatment variables. In the sections that follow we show that in the case at hand, treatment cannot be considered as a 0 or 1 response since urban upgrading policies take very different forms of comprehensiveness. Therefore, we will have a treatment variable that will range from 0 (no treatment) to 4 (maximum treatment) with intermediate variables that account for lower "doses" of treatment.

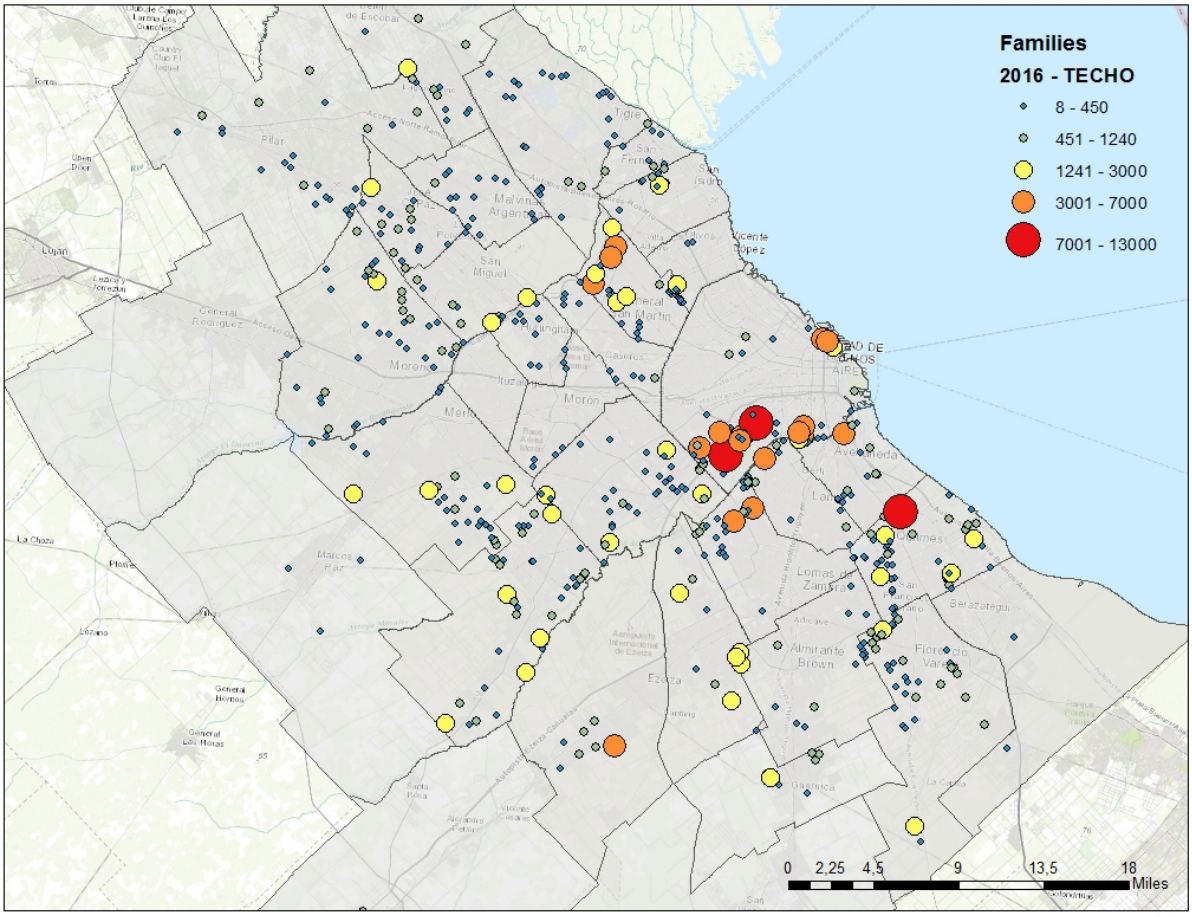
In the case where treatment is continuous, a dose response function needs to be calculated and we will follow the approach of Hirano and Imbens (2004).

2.4 Data

We constructed a database of informal settlements in the metropolitan region of Buenos Aires which is based on TECHO's informal settlements cadaster of 2016. This database is composed of 1183 neighborhoods where an estimated 454,400 families live. The database comprises data based on the information provided by a neighborhood informant who is identified by the NGO as a knowledgeable person. The data collected includes information on demographics, tenure, service provision, location and accessibility of the neighborhood, social networks and community collaboration. This database is complemented with the 2013 TECHO database that

comprises the same information and allows for intertemporal comparisons. Once we account for the settlements that are in the cadaster in both periods, we find that from the 1180 neighborhoods in 2016 only 712 were also present in 2013. These 712 informal settlements will be our universe of analysis. In these, an estimated 365,500 families live (80% of the total estimated in 2016). Graph 1 displays the distribution of households among informal neighborhoods in the region.

Graph 1: Households in Informal Neighborhoods (2016)



Source: Own estimates based on TECHO 2016.

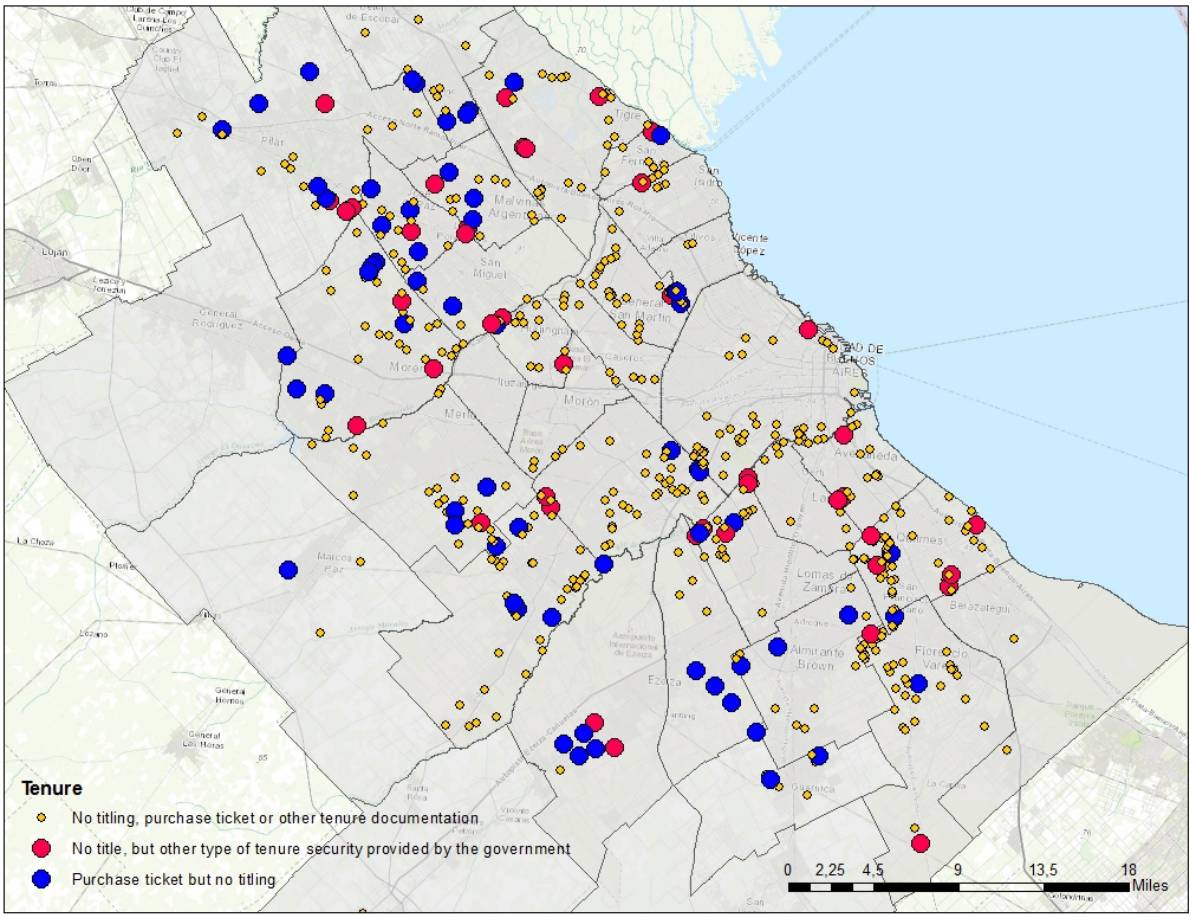
2.4.1 Identification of Effects: Definition of Treatment.

We are unable to produce a dichotomist treatment identification variable (urbanized or non-urbanized) because urban upgrading policies differ in their form: some policies are integral and provide basic services and titling for the whole settlement, while others start by servicing some parts of the neighborhood with a limited number of public services. This range of policies leads effects to vary accordingly and, consequently, slums and informal settlements subject to treatment will need to be categorized into different program approaches. Variations in the level of treatment will contribute to identify variations related to effects of these interventions.

We show below the variables to be considered for the treatment variable. First, we consider tenure condition. We find no neighborhoods where most families have formal tenure and only 7% have some sort of government issued tenure security. The great majority, 82% of all informal settlements, have no formal or informal documentation that can secure tenure.

Tenure		
No title, proof of purchase or other tenure documentation	582	81.74%
Proof of purchase but no title	79	11.10%
No title, but other type of tenure security provided by the government	51	7.16%
Formal tenure	0	0%
Total	**712**	**100%**

Graph 2: Informal Tenure: Diversity of Conditions in Informal Neighborhoods (2016)

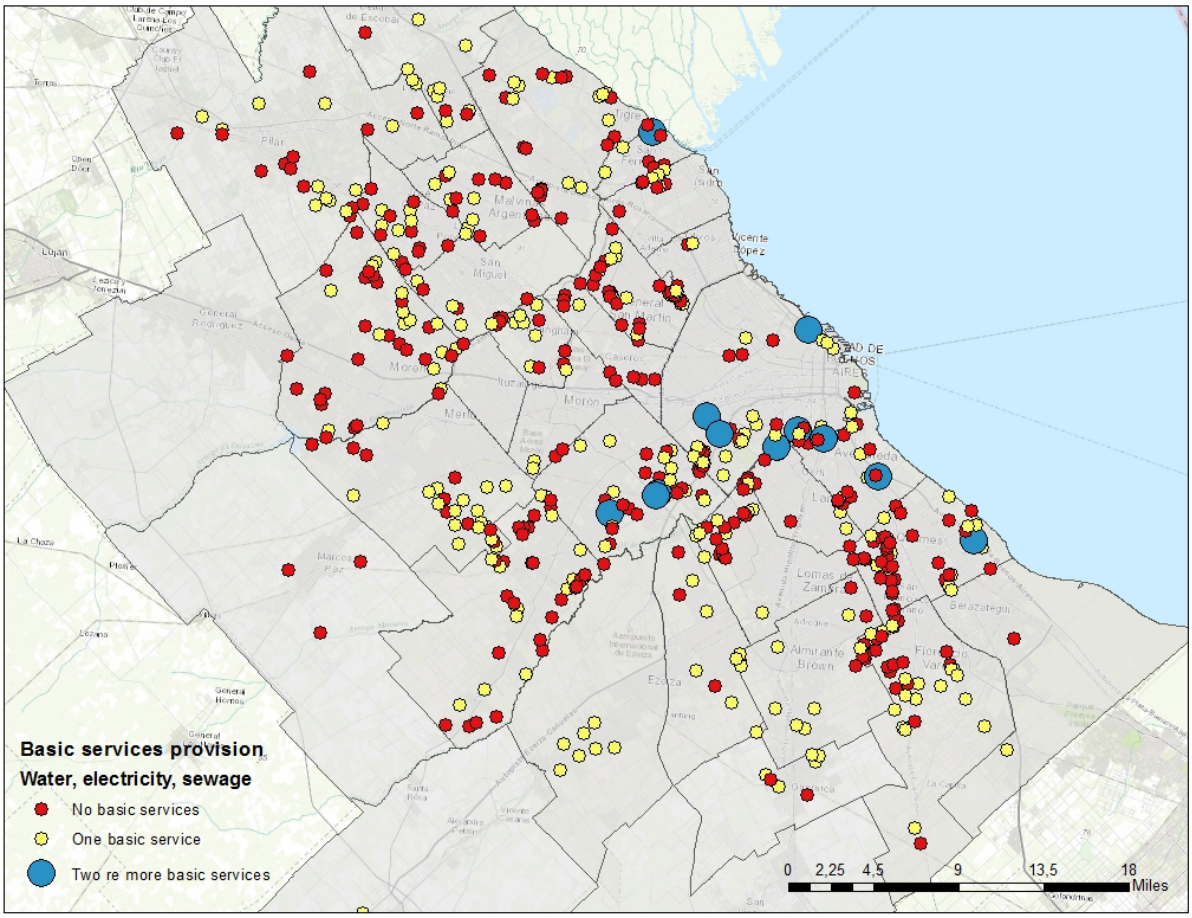


Source: Own estimates based on TECHO 2016.

Regarding access to formal services, 40% of neighborhoods have only 1 out of 3 basic services analyzed (water supply, electricity and sewer) and less than 2% (only 12 neighborhoods) have 2 or more formal services.

Neighborhoods with formal access to		share of total
Water	49	6.88%
Electricity	181	25.42%
Sewer	78	10.97%
1 service	284	39.89%
2 or more services	12	1.69%

Graph 3. Level of Access to Basic Services in Informal Neighborhoods (2016)



Source: Own estimates based on TECHO 2016.

Finally, there is a question in the database that collects information on government provided housing programs. Out of 712 neighborhoods 87 (12%) have received some sort of housing intervention.

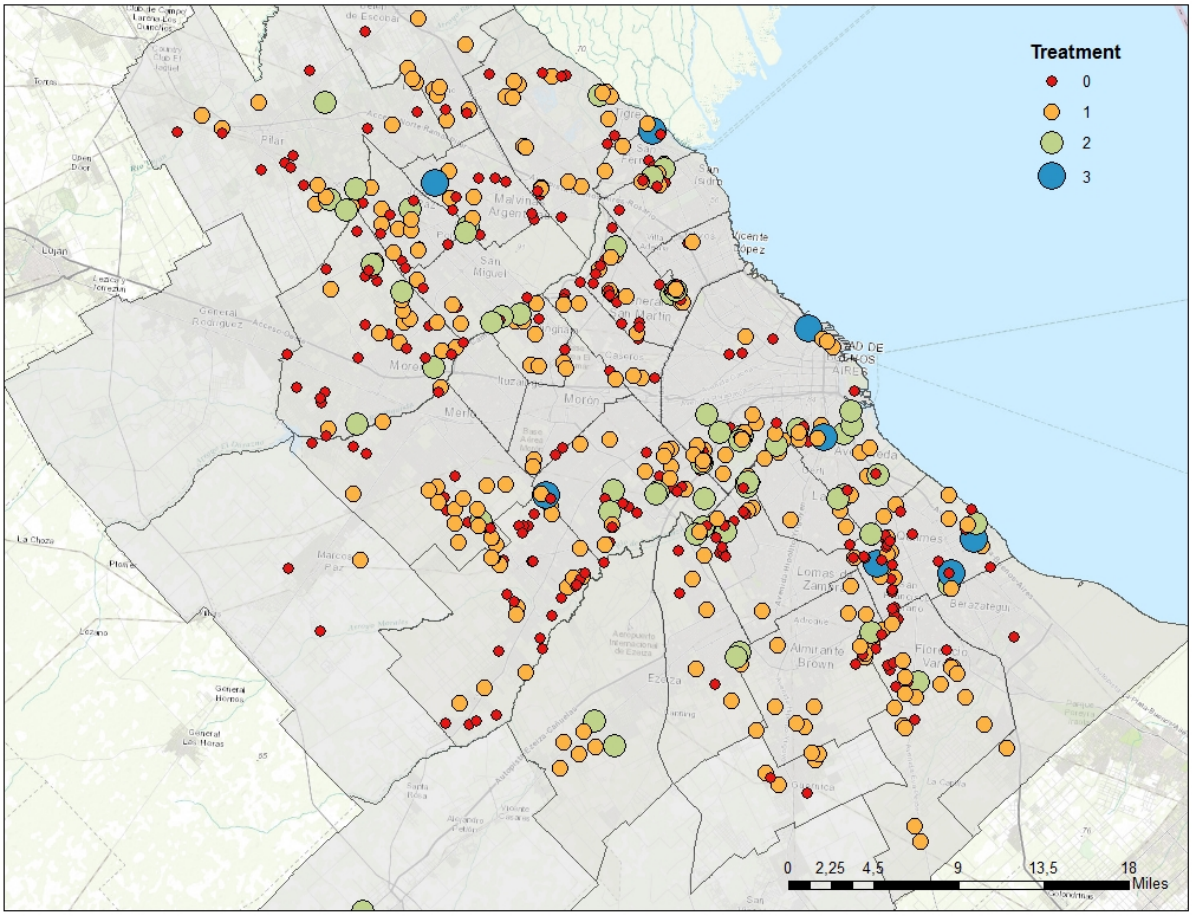
We have constructed a treatment indicator variable that considers several variables. The indicator is constructed adding points to neighborhoods that have the following characteristics:

- some sort of tenure security provided by the government: 1 point
- 2 or more formal services: 2 points
- 1 formal service: 1 point
- government provided housing program: 1 point

Thus constructed, the treatment variable will range between 0 (no treatment) to 4 (greatest level of treatment). The number of neighborhoods classified in each treatment category is presented next.

Treatment		
0	347	48.74%
1	294	41.29%
2	61	8.57%
3	10	1.40%
4	0	0%
Total	**712**	**100%**

Graph 4. Identification of Levels of Treatment



Source: Own estimates based on TECHO.

Outcome variables

To measure the impact that urban upgrading polices have had on growth we first need to define this growth. We consider five possible growth variables, the first three are calculated using the 2013 and 2016 TECHO databases. The fourth and fifth need to be calculated from 2010 and 2016 satellite imagery. The growth variables are:

- neighborhood dynamics: merges and splits of neighborhoods between 2013 and 2016,
- change between 2013 and 2016 in total number of families living in the settlement,
- change between 2013 and 2016 in total number of dwelling units (shacks) and
- change between 2010 and 2016 in built up area
- change between 2010 and 2016 in built up density

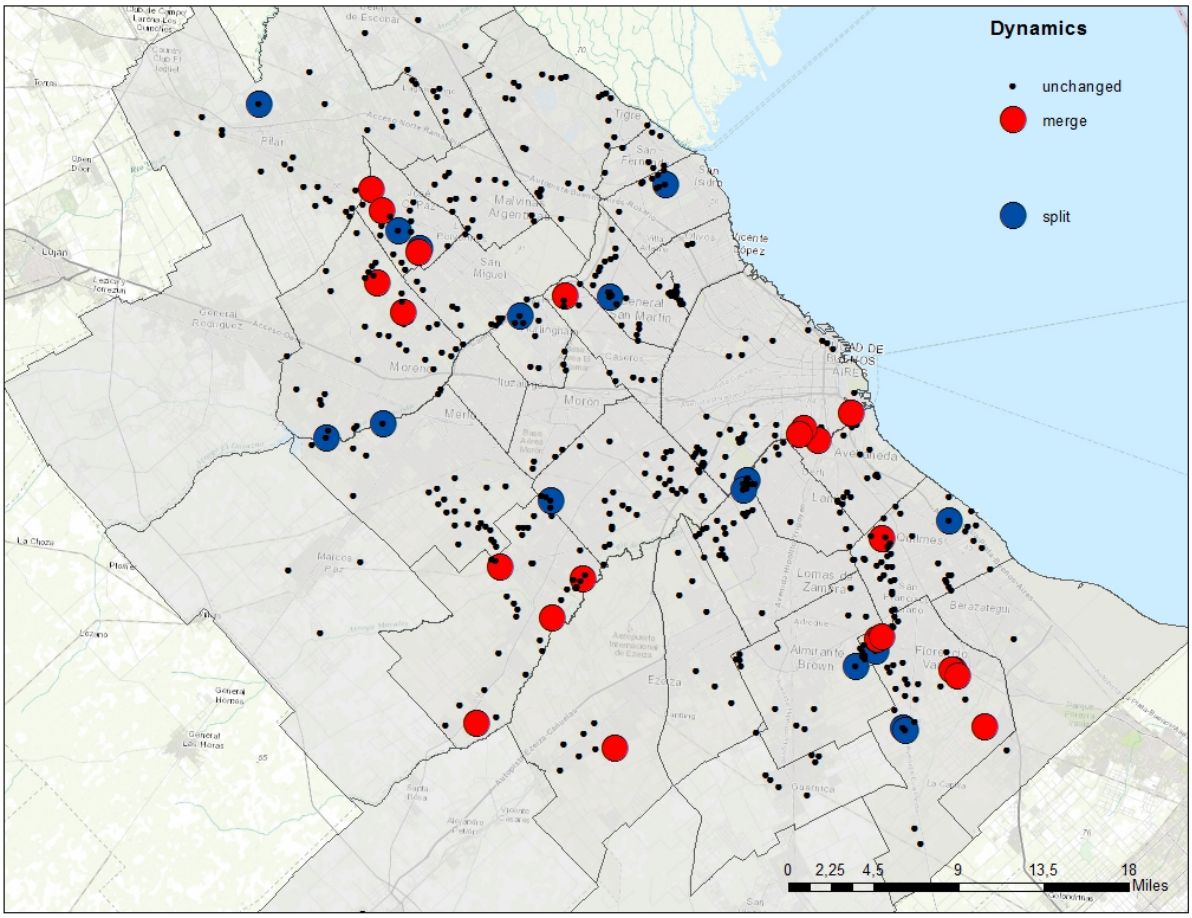
We provide below the basic statistics for the variables we can obtain from the TECHO databases and suggest how to work with the satellite imagery to produce the fourth and fifth variables.

Neighborhood dynamics

The dynamics that characterize informal settlements and slums implies constant changes to their geographical limits: new extensions, merges between neighborhoods, and divisions into smaller social groups. These occur rapidly, making it necessary to identify a typology of established settlement development over time that considers such changes. TECHO has worked to establish such dynamics between their 2013 and 2016 databases. The comparison shows that out of the 712 informal settlements, 20 have split from previously homogenous neighborhoods while 23 have merged. The number of families living in these settlements is as follows:

	Number of neighborhoods		Average number of families per neighborhood	Total number of families in neighborhoods	
		share of total			Share of total
Split	20	3%	344	6,885	2%
Merge	23	3%	1049	24,120	7%
Unchanged	669	94%	500	33,4494	92%
Total	**712**	**100%**	**513**	**36,5499**	**100%**

Graph 5. Informal Neighborhood Dynamics



Source: Own estimates based on TECHO 2011, 2013 and 2016.

Change between 2013 and 2016 in total number of families and shacks in informal settlements.

A different way to measure growth in these settlements is to account for the population growth in the number of shacks built. Both variables are in the TECHO databases for the years 2013 and 2016. However, there is an issue with the information that arises from the fact that, as mentioned before, data is collected based on the knowledge of an informant which is not the same person in both periods of time. There is no actual counting of either families or shacks. Therefore, measurement error is non-negligible and comparisons between periods need to be considered with caution. A new cadaster of informal neighborhoods has just been completed by the National Presidency of Argentina which will provide additional information.

Satellite imagery

The 2016 TECHO database has detailed information on the location and dimension of informal settlements. This information is geo-referenced, and polygons have been constructed over the territory showing the limits of the neighborhood for the year 2016. Using these polygons, we propose to analyze satellite images for two periods of time 2010 and 2016 that will allow the

construction of several growth metrics for each informal neighborhood. Analyzing the satellite images of these polygons for the years 2010 and 2016 we will be able to identify growth in terms of infill, expansion or leapfrog areas for each settlement. A preliminary assessment indicates very dissimilar patterns of growth in the informal settlements of municipalities that compose the metropolitan region of Buenos Aires. For example, while informal settlements in Moron have only expanded 4% in area between 2001 and 2010, those in Ezeiza have grown, on average, 46% over the same period. The kind of expansion that has guided their territorial growth is also very divergent. Some have grown mainly due to infill, while others have expanded their borders and grown capturing more land.

The next table shows patterns of growth of informal settlements for each municipality in the metropolitan region of Buenos Aires.

Table 1: Patterns of Growth of Informal Settlements by Municipality in Buenos Aires Metro Area

Municipality	% New developments	% extension	% leapfrog	% infill	Number of identified settlements (2011)
Moron	4%	0%	0%	4%	6
Marcos Paz	6%	0%	6%	0%	3
Tres de Febrero	7%	3%	0%	3%	12
Lanus	7%	0%	0%	7%	16
Hurlingham	9%	5%	0%	5%	14
San Isidro	11%	0%	0%	11%	9
General Rodriguez	13%	6%	6%	0%	16
Vicente Lopez	13%	13%	0%	0%	7
CABA	13%	2%	0%	11%	50
San Fernando	15%	8%	0%	6%	7
San Vicente	18%	13%	5%	0%	7
General San Martin	20%	4%	0%	16%	38
Avellaneda	20%	4%	0%	16%	26
Malvinas Argentinas	21%	6%	0%	14%	19
La Matanza 1	25%	15%	0%	9%	43
Ituzaingo	27%	21%	0%	5%	14
La Matanza	29%	25%	3%	1%	46
Quilmes	29%	7%	1%	21%	56
Jose C. Paz	29%	13%	2%	14%	24
San Miguel	29%	17%	0%	12%	14
Almirante Brown	31%	17%	1%	12%	18
Presidente Peron	31%	26%	1%	4%	10
Escobar	31%	20%	3%	8%	17
Florencio Varela	32%	20%	3%	8%	36
Pilar	32%	26%	3%	3%	28
Merlo	33%	19%	3%	10%	27
Moreno	33%	29%	3%	2%	42
Berazategui	34%	31%	3%	1%	3
Tigre	34%	22%	1%	11%	26
Lomas de Zamora	40%	10%	0%	29%	26
Esteban Echeverria	43%	24%	10%	9%	10
Ezeiza	46%	43%	0%	4%	8

Source: Estimations based on TECHO and Atlas CIPUV of Urban Expansion (2016)

Matching variables

- Neighborhood specific characteristics: size of the informal settlement, year of occupation, socioeconomic mixture in the neighborhood in which the settlement is located, etc.

- Land use regulation: one central issue to be considered in the model is the land use regulation environment in each municipal jurisdiction. Given the location of the settlements, we have access to the whole land use regulation environment and its enforcement for each municipality. The information forms part of a complete database on the land use regulatory environment, that was gathered by Goytia and her team between 2009 and 2011, as part of a research project financed by the Lincoln Institute of Land Policy and supported by Argentina's National Government. In 2014, these datasets were assembled in the CIPUV Index of Land Policy (Goytia et al., 2014). We consider not only local effects but also interactions among jurisdictions.

- Political economy: political ties between the central government, the province and the municipality might explain the provision of services (and therefore—under our definition—regularization). Thus, this information is considered in our explanatory model.

III. Conclusions. The Effectiveness of Upgrading Interventions: Doing Better? What Are the Evaluations Telling Us?

This paper aims to contribute to a better understanding of Latin America's contemporary urban upgrading processes with a focus on the evaluation of effects dimension. It does so by characterizing the way countries evaluate the programs that are implemented, and the gaps that those assessments should overcome.

As mentioned before, there are many gaps in the objectives, design and implementation of the evaluations of neighborhood upgrading interventions. Our set of conclusions from the review of program evaluations shows that the assessment of effects lags well behind what is needed today for delivering well informed policy decisions. There are several gaps that constrain significantly our knowledge of effects, as shown in Section I.

It is important to note that the scarcity of rigorous evaluations published for Latin America countries prevents a conclusive assessment of the overall effectiveness of the upgrading programs. The review indicates that identification limitations are of the first order of relevance, since few of the evaluations reviewed have a credible identification strategy. [13] The most common methodology is comparing initial goals with actual outputs by defining a set of composed ad hoc indicators. Our main recommendation is for program evaluations to include a robust methodological design and a citywide impact analysis on land markets and informality.

[13] Although randomized evaluations are feasible and can be implemented in many more contexts today than was possible in the past (Field and Kremer, 2005).

Another methodological issue relates to the generalization of results. Even though studies are internally valid (i.e., it is possible to identify causal effects), they do not necessarily have external validity (e.g., when it is possible to generalize these causal effects to other settings or populations, slums, or countries). Furthermore, external validity issues are even more difficult to assess when the effects of the interventions are heterogeneous across populations (for example, the effect of land titling on the land market will not be the same in different program locations that have differing levels of land market demand).

Despite all the above-mentioned considerations, we need to acknowledge that there is no vivid academic debate about scale and effects of interventions on urban informality, even when the scale of the programs is small compared with the actual demands. Therefore, we would like to close the paper with a few remarks on directions for future work. These are particularly relevant since the current version of the paper is preliminary and this is an ongoing project.

First, there are direct implications on program design that can be naturally derived from these evaluations, as the useful association between cost benefits analysis and the most appropriate design of user-charges and property taxes in upgraded neighborhoods. We find that this is a future line of work in case we want to improve the effectiveness of urban policies addressing informality and defray their costs while disciplining (informal) land markets. Because of this, there is still a greater potential to use the information generated by ex-ante cost benefit analysis to establish solid baselines to apply charges for services and property taxes when upgrading interventions are implemented. [14]

Second, more studies would be warranted on the costs of interventions, not only on its benefits. An empirical analysis of the costs of alternative (preventive) tools would provide useful lessons for policymakers in weighing upgrading investments against other public policies intending to prevent informality. A well-founded estimate of costs in any cost/benefit analysis and comparisons between different approaches in terms of their costs, would facilitate better decision-making on program design.

Third, from the analysis of different interventions worldwide that we conducted for this study, we find that only upgrading programs in Uruguay have an explicit objective to not only upgrade existing informal settlements but to prevent informality and reduce its rate of growth.

Fourth, all program evaluations are carried out just after the implementation finished, which suggest a huge bias. Not only results on maintenance issues—which are extremely relevant in these type of programs—are not reliably assessed a few days after the program is completed rather than in the long term, but there are also many other important effects that develop through time. Those related to land markets and transactions are some of those.

Finally, the greatest long-run challenge is an affordable and sustainable provision of infrastructure and services that contribute to prevent informal occupations. Such policy can

[14] There is a shortage of fiscal instruments that should contribute to discipline urban land markets performance (Smolka and De Cesare 2010). A more robust property tax system would potentially mitigate informality and its negative effects.

decrease the significant costs imposed by remedial public investment in areas where urban expansion was not anticipated. This is a great challenge since equalizing the level of services for the whole city and providing enough supply of serviced land at affordable prices that reduces dramatic disparities would, in principle, nullify the need for informality. The uneven degree of success of the diverse experiences—both curative and preventive—in the region, and the innovative tools that are now available to improve the functioning of land markets, calls for a greater emphasis in advancing empirical research on the critical relations between regulatory environments and informality, to better identify best practices and their sizable impacts, and share the lessons learned.

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