Encouraging Private Ownership of Public Goods: Theory and Evidence from Belgium*

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Abstract

We study short-run and long-run effects of a government subsidy to private non-profit ownership of public good projects. In a simple model, we show that the subsidy increases the prices of project assets in the short run; however, the effect does not persist and prices decline in the long run. This happens because the subsidy temporarily relaxes the resource constraint of non-profit organizations, which allows them to engage in supply-expanding activities. We test this prediction using a unique dataset that we have constructed from Belgian notarial land-transaction records and exploiting a policy reform in public subsidies for land purchases by non-profits aiming at creating privately-owned natural reserves. Using the MS-estimation method (Maronna and Yohai, 2000) robust to outliers, we also provide a methodological contribution to the analysis of markets with quasi-donations.

Keywords: non-profit organizations; public goods; fundraising; land markets; natural reserves; conservation.
JEL codes: L31, H41, N5, L22, Q26

1 Introduction

Non-profit organizations are key providers of public goods in modern economies. 67 per cent of in-patient hospitals in the United States are non-profits, and so are all orchestra and opera theatres in the United Kingdom and Japan (Bilodeau and Steinberg, 2006). In the OECD countries, on average, 7.5 per cent of economically active population is employed in the non-profit sector, and for some countries (Belgium, Netherlands, Canada, U.K., Ireland) this share exceeds 10 per cent (Salamon, 2010). Non-profits provide public goods in such diverse sectors as education, health, environment, social protection, arts and culture, and human rights. The key issue is, therefore, whether non-profit provision (and ownership of key assets used in provision) of public goods is socially desirable. The seminal paper by Besley and Ghatak (2001) provides the first answer to this question: they argue that the ownership of such assets should be given to the party (i.e. to the government or to the non-profit organization) that has the highest valuation of the public good, regardless whose investment increases more the value of the public-good project.

However, this general normative analysis does not provide guidance about *how* the transfer of ownership of public goods to non-profits (in case these have the highest valuation) should be organized. This is a fundamental policy question, given that governments dispose of a rich set of tools that can affect the incentives for the non-profit ownership of assets used for public good provision. These tools include, among others, subsidies for purchase of assets from private holders, direct grants to non-profits, tax exemptions to private sellers, etc. Designing an effective policy requires, first of all, understanding - theoretically and empirically - the effects of such policies on the behaviour of non-profits and the outcomes on the asset markets. Economists' current knowledge in this area is extremely limited, in particular, at the level of a market. Moreover, the insights from standard microeconomic analysis of markets (e.g. that a subsidy for purchasing assets is likely to increase the price of these assets) provide only limited answers, given that the subsidy might also have repercussions on the competition between non-profits and on the allocation of internal resources by non-profits. Even such simple instrument as a direct grant may induce non-profits to reallocate their time/staff resources and thus have large effects on public-good inputs of non-profits, as has been shown by Andreoni and Payne (2003, 2011) in their analysis of fundraising crowding-out of charities in the United States.

In this paper, we study the short-run and long-run effects of a government subsidy to

private non-profit ownership of assets used in public-good projects, on the behaviour of non-profits and on the outcomes of the market for assets. We first develop a simple model of a market for assets populated by competing non-profits, and derive the testable predictions about the effect of lump-sum and ad valorem subsidies on the price and quantity of assets exchanged, both in the short- and the long-run, as well as on the market structure on the buyers' side. The market is decentralized and finding each new potential asset requires some search (prospecting) costs. We show that the short-run response of market outcomes differs fundamentally from the long-run ones; in particular, the long-run effect on the market price is smaller than the short-run increase. This happens because the subsidy temporarily relaxes the resource constraint of non-profit organizations, which allows them to exert more effort in supply-expanding prospecting activities. At the aggregate level, this pushes out the supply schedule and effectively drives prices down in the long run.

Next, we test these predictions using a unique dataset that we have constructed from notarial land-purchasing acts in the Walloon region of Belgium. This dataset includes all the land purchases by environmental conservation non-profits in Walloon region between 1950 and 1994. Importantly, our data allows us to study the effect of the policy reform undertaken in 1986, when the regional government introduced an ad valorem subsidy to land purchase by non-profits. We find that, in accordance with the predictions of our model, the subsidy creates a large short-run increase in the (detrended) price of land, and that the price gradually declines afterwards. We argue that this occurs because the subsidy induces the non-profits to reallocate their time/human resources from fundraising to prospecting and negotiation activities, which over time increases the supply of land plots. The resulting effect is that in the long-run prices differ very little from the pre-reform prices, but that quantities exchanged increase substantially. In addition, the data also show that non-profits which operate mostly on the extensive margin (i.e. giving larger weight to the quantity of land plots managed as compared to the quality of management) gains disproportionately from the subsidy. In fact, such non-profits capture most of the market, reducing the market share of more management-oriented organisations.

Our paper also makes a methodological contribution to the empirical analysis of markets for assets with a public-good component. A broad range of markets in which non-profits represent the buyer side fall into this category: the markets for works of art, labour markets for jobs in the non-profit sector, etc. In such markets, the motivation of actors on the supply

side often consists of a mix of profit-oriented and altruistic elements, and thus such actors are often willing to sell the assets at a reduced or symbolic price or donate them. Data from such markets thus usually contain numerous observations that are considered as outliers. We show that by the use of an appropriate estimator robust to outliers (the MS-estimator, developed by Maronna and Yohai, 2000), one can estimate the trends in market outcomes much more accurately.

The structure of the rest of the paper is as follows. Section 2 presents our theoretical model of a market for assets and derives testable predictions. Section 3 describes the context from which our data is collected, provides a short history of natural reserves in the Walloon region and describes the dataset. Section 4 presents our identification strategy, the descriptive statistics and the results of the regression analysis. Section 5 discusses the interpretation of our empirical results and the methodological contribution. Section 6 highlights the broader implications of our findings and concludes.

2 Model

Consider a public-good sector with N non-profit providers, indexed with i. The mission of each non-profit is provision of the public good. The public good provided by a non-profit has the quantity and the quality dimension (e.g. the size of the natural reserve run by a environmental non-profit and the biodiversity balance in the reserve). Let us denote the quantity and the quality of the public good provided by non-profit i, respectively, with q_i and x_i. Non-profits might differ in terms of the weight that their managers give to these two dimensions: let us denote with ω_i the weight given to the quantity dimension by the manager of non-profit i.

Each non-profit manager has one unit of time that she allocates between improving the quality of the public good (x_i), conducting fundraising activities (f_i), and searching/prospecting for the assets used of the production of the public good (n_i). Moreover, given the legal non-profit status, the organizations cannot distribute the earnings amongst its members.

The optimization problem of non-profit i is:

$$\max_{\{q_i,x_i,n_i,f_i\}} \quad R(q_i, x_i; \omega_i) \qquad \text{[Objective function]} \tag{1}$$

$$\text{subject to} \quad 1 \geq x_i + f_i + n_i, \qquad \text{[Time constraint]} \tag{2}$$

$$(1-\sigma)pq_i = \mu f_i + s, \qquad \text{[Non-distribution constraint]} \tag{3}$$

$$p = \phi\left(q, n\right), \qquad \text{[Inverse supply]} \tag{4}$$

$$q = \textstyle\sum_i^N q_i, \qquad \text{[Aggregate quantities]} \tag{5}$$

$$\text{and} \quad n = \textstyle\sum_i^N n_i \qquad \text{[Aggregate prospecting]} \tag{6}$$

Here, the inequality denotes the (time) resource constraint of the organization, the first equation stands for the non-distribution constraint, and the last one specifies that supply function for the assets used for public-good production. The parameter ω_i in the generic objective function of the organization is such that it increases the marginal valuation of the quantity dimension and decreases the marginal valuation of the quality dimension. Therefore ω_i is defined such that at any equilibrium point

$$\frac{dq_i}{d\omega_i} > 0 > \frac{dx_i}{d\omega_i}. \tag{7}$$

The non-distribution constraint states that all the funds available to the nonprofit have to equal its expenditures for public good provision (i.e. the organization cannot distribute profits to its owners/members). The only expenditure item is assets purchased. Government provides the ad valorem subsidy $\sigma \in [0, 1]$ for asset purchase over the market price p. On the revenue side, the available funds are composed of donations (collected thanks to fundraising activities with the simple linear technology μf_i) and a lump-sum grant $s \geq 0$ provided by the government. Finally, the supply function describes the (positive) relationship between the price for assets and the total quantity supplied by private owners of assets (who, by assumption, do not have access to public-good provision technology). Note that this schedule also depends on the aggregate prospecting efforts ($\sum n_i$), and we assume that prospecting increases the supply of assets.

The Lagrangian of the non-profit's program is

$$\begin{aligned}&\mathcal{L}(q_i, x_i, n_i, f_i, \lambda_i, \nu_i, \iota_i, \eta_i, \zeta_i; \omega_i) = \\ &R(q_i, x_i; \omega_i) - \lambda_i \left[(1-\sigma)pq_i - \mu f_i - s\right] - \nu_i(x_i + f_i + n_i - 1) \\ &- \iota_i(p - \phi(q, n)) - \eta_i \left(q - \sum_i^N q_i\right) - \zeta_i \left(n - \sum_i^N n_i\right).\end{aligned}$$

Maximising this function and combining the resulting first-order conditions gives

$$\frac{R_{x_i}(q_i, x_i; \omega_i)}{R_{q_i}(q_i, x_i; \omega_i)} = \frac{\mu}{(1-\sigma)\left(\phi_{q_i}(q, n) \cdot q_i + p\right)} \tag{8}$$

and

$$-\phi_{n_i}(q, n) \cdot (1-\sigma) q_i = \mu. \tag{9}$$

These two conditions and the binding constraints in the optimization program jointly describe the optimal choices of the non-profit. The first condition states that at the optimum, the marginal rate of substitution of asset quantity for quality of the public good should equal the ratio of the marginal product of fundraising to the net price of assets. Intuitively, the numerator of this ratio is the opportunity cost of a unit of time spent improving the quality of the public good (i.e. foregone fundraising returns). The denominator equals the price paid for an additional unit of asset purchased by non-profit i (note that it takes into account the effect of the variation in the quantity demanded by i on the market price). Thus, the right-hand side gives the quality to quantity price ratio. The second condition states that, at the optimum, the time spent on prospecting should be such that savings realized thanks to additional prospecting (in terms of net price reduction for all the units that the non-profit buys) should equal to its opportunity cost (i.e. the donations foregone because of one unit of time less for fundraising).

From here on, we evaluate the choice variables q_i, x_i, n_i, f_i at their optimum value and use implicit differentiation to obtain all the comparative statics for the behavior of an individual non-profit. The total derivative of the objective function of the non-profit can be written as

$$R_{q_i}(q_i, x_i; \omega_i) + R_{x_i}(q_i, x_i; \omega_i) \frac{dx_i}{dq_i} = 0. \tag{10}$$

Notice that

$$\frac{\partial p}{\partial q_i} \frac{q_i}{p} = \frac{\partial p}{\partial q} \frac{\partial q}{\partial q_i} \frac{q_i}{p} \frac{q}{q} = \frac{z_i}{\epsilon} \tag{11}$$

where ϵ is the price elasticity of supply and z_i is the share of the market controlled by nonprofit i, i.e. $z_i = q_i/q$. The ratio z_i/ϵ increases as the nonprofit controls a larger share of the market and as supply becomes less elastic; it is therefore a good indicator of the nonprofit's market power. Conditions (8), (10) and (11) yield

$$\frac{dq_i}{dx_i} = -\frac{\mu}{(1-\sigma)p(1+z_i/\epsilon)} < 0. \tag{12}$$

Using the implicit function theorem, the supply function in (4) combined with (9) and (10) can be written as

$$\frac{dq_i}{dn_i} = \frac{\mu}{(1-\sigma)p(z_i/\epsilon)} > 0. \tag{13}$$

Finally, taking the total derivative of the time constraint (2) over q_i and combining the resulting expression with (12) and (13) gives

$$\frac{dq_i}{df_i} = \frac{\mu}{(1-\sigma)p} \equiv \rho > 0. \tag{14}$$

The ratio ρ gives the transformation rate of fundraising time into units of the asset at the optimum. This ratio is common to all nonprofits and appreciates as the fundraising technology becomes more efficient (higher μ) or as the net price of assets paid by non-profits decreases (lower p or higher σ).

Lemma 1 *An increase in ρ induces non-profits to re-allocate time away from fundraising and prospecting efforts towards the effort in improving the quality of the public good.*

Next, we analyze the effect of the variation in exogenous parameters of the model (including policy variables) on the quantity purchased by the non-profit. Applying the implicit function theorem to non-distribution constraint (3) and using (11) and (14), we get

$$\frac{dq_i}{d\sigma} = \frac{\epsilon}{1-\sigma}\sum_{i=1}^{N} q_i > 0, \tag{15}$$

and

$$\frac{dq_i}{ds} = \frac{1}{pq_i}\frac{\epsilon}{(1-\sigma)}\sum_{i=1}^{N} q_i > 0. \tag{16}$$

Notice that

$$d\sigma \cdot pq_i = ds = dq_i \frac{\epsilon}{1-\sigma}\sum_{i=1}^{N} q_i.$$

This implies that, irrespective of the type of subsidy (lump-sum or ad valorem), an extra euro given to the non-profit by the government has the same effect on q_i and, by extension, to all the other choice variables of the non-profit.

Finally, conditions (3), (11) and (14) jointly imply

$$\frac{dq_i}{d\mu} = \frac{f_i}{pq_i} \frac{\epsilon}{(1-\sigma)} \sum_{i=1}^{N} q_i > 0. \tag{17}$$

Equations (12) to (17) describe how the optimal quantity of assets demanded by the non-profit relates to the optimal values of the other choice variables and to all the exogenous parameters. Comparative statics results can thus be summarized as follows:

Variation in \ Effect on	q_i	x_i	n_i	f_i
α_i	+	−	+	+
σ	+	−	+	+
s	+	−	+	+
μ	+	−	+	+

2.1 Market equilibrium

A reasonable assumption is that the full effect of a change in public policies takes some time to realize. This delay might be driven by two factors. First, while the partial effect of the subsidy on the quantity of assets demanded is immediate, the re-optimization of the allocation of the non-profit's internal resources (in particular, towards prospecting) might take some time: the existing fundraising drives have to be completed, new prospectors have to be trained, etc. Second, the supply response to higher prospecting effort might come along not immediately, but with some delay: new potential assets to be acquired need to be located, bureaucratic procedures and negotiations necessary for the new purchases have to be completed, etc.

We can decompose the effect of a variation in the ad valorem subsidy on the price of assets and the quantities exchanges as follows:

$$\frac{dp}{d\sigma} = \underbrace{\frac{\partial p}{\partial q} \sum_{i=1}^{N} \frac{dq_i}{d\sigma}}_{>0} + \underbrace{\frac{\partial p}{\partial n} \sum_{i=1}^{N} \frac{dn_i}{d\sigma}}_{<0} \tag{18}$$

and

$$\frac{dq}{d\sigma} = \sum_{i=1}^{N} \left(\frac{\partial q_i}{\partial \sigma} + \frac{\partial q_i}{\partial n_i} \frac{dn_i}{d\sigma} \right) > 0. \tag{19}$$

This immediately gives us the following

Proposition 1 *The effect of an introduction of (or an increase in) the ad valorem subsidy varies over time. In the short run, higher subsidy increases both the price and the quantity of assets exchanged. In the long run, the price declines as compared to its short-run peak, whereas the quantities exchanges increase even further.*

Our model also allows us to make a prediction concerning the heterogeneous effect of the subsidy on the behavior and the market share across non-profits. Remember that we assume all non-profits to have identical technology but allow them to differ in the weight (α_i) that they give to the quantity versus quality of the public good provided. Using (7) and (15), we have

$$\frac{d^2 q_i}{d\sigma d\omega_i} = \frac{\epsilon}{1-\sigma} \frac{dq_i}{d\omega_i} > 0. \tag{20}$$

In other words:

Proposition 2 *In response to a higher ad valorem subsidy, non-profits that give a higher weight to the quantity as compared to the quality of the public good increase their purchases of public-good assets relatively more. Consequently, the market share z_i increases in $\omega_i / \sum_i \omega_i$.*

Finally, we can also predict how the degree of market competition affects the response to the variation in the subsidy. Let us express (13) as

$$\frac{dn_i}{dq_i} = \frac{(1-\sigma) p (z_i/\epsilon)}{\mu} > 0. \tag{21}$$

A unit increase in assets purchased is accompanied by an increase in prospecting activities that is stronger for a non-profit with more market power. Intuitively, this occurs because market power makes the tradable asset relatively cheaper, inducing the effort to be re-allocated away from quality-enhancing and towards prospecting. By (18) and (19), we can then state the following

Proposition 3 *The effect of an introduction of (or an increase in) the ad valorem subsidy depends on the market structure. In the long run, a more concentrated market exhibits lower*

prices and larger exchanged quantities as compared to a more competitive one. Conversely, the fall in quality-enhancing activities is smaller in more competitive markets.

In the rest of the paper, we test two of the main predictions of our model (Propositions 1 and 2) using the dataset that we have constructed from Belgian (Walloon Region) notarial land-transaction records and exploiting a policy reform in subsidies for land purchases by environmental non-profits whose main activity consists of creating and managing privately-owned natural reserves.

3 Institutional context and data

3.1 Natural reserves worldwide and in the Walloon Region

The first American national park, the Yellowstone, was established by the U.S. Congress already in 1872. In Europe, the formal institutions for the conservation of nature started somewhat later and were much more grassroot-driven. The United Kingdom and France saw the birth of private conservation charities in 1895 and 1901, respectively. These societies had the mission of protecting countryside landscapes, scenic beauty, and major natural sites (Lansley, 1996; Lepart and Marty, 2006). In the UK, the National Trust almost immediately started to buy land plots and buildings from private owners. It created several natural reserves and progressively became the main private actor of environmental policy in the UK. Thanks to its two million members, the National Trust has relieved the UK government from a substantial part of its tasks in the environmental conservation domain; in exchange, the government granted the charity with considerable fiscal advantages. In France, the *"Société pour la Protection des Paysages et de l'Ésthétique de la France"*, the oldest French environmental non-profit association chose instead a strategy focused on lobbying the government on various environmental policies. France passed its first environmental-protection laws in the beginning of the 19th century, while its first national park was established in 1913.

Currently, throughout the world, private foundations aimed at creation and protection of natural reserves play an important role both in public-good provision and advocacy. The prominent example is The Nature Conservancy, a U.S.-based global-operations environmental charity. With more than one million members, Nature Conservancy manages over 8000 kilometers of rivers and 50 million hectares of land (a surface exceeding that of California) in more than thirty countries (www.nature.org).

Belgium (and especially the Walloon Region, the Southern half of the country) exhibits a system of environmental conservation that combines certain aspects of the French mostly public sector-oriented approach with some characteristics of the British charity-based approach. In 1943, *Ardenne et Gaume*, an environmental non-profit, created the first natural park in the Walloon Region. In subsequent thirty years, the environmental non-profits kept playing the major role of environmental public good providers, by either contracting long-term leases or purchasing and managing new plots of land. Initially, the budgets of non-profit consisted mainly of private contributions and donations, complemented by small-scale commercial activities.

The national government showed interest in the natural park creation and management around 1957 and made its first acquisition of land in 1972. Political decentralization of Belgium implied that the conservation of nature fell under regional jurisdiction in 1980, and the government of the Walloon Region created a new strategy, which included a set of policies towards environmental non-profits. Most importantly, in 1986 the regional government passed a reform (with retroactive effect to January 1, 1985) introducing large subsidies to environmental non-profits. This reform essentially consisted of two sets of subsidies. The first (and by far the most important) is a subsidy for land acquisition, consisting of paying (reimbursing) 50 per cent of the price of land plots that a legally registered non-profit purchased from a private owner (with the scope of creating a natural reserve) on any date after Jan. 1, 1985. The second is a subsidy for management expenses of natural reserves, which consists of covering 50 per cent of effective ordinary management expenses (or an annual lump-sum of around 100 Euros per hectar of certified natural-reserve surface) and of fully covering the extraordinary (emergency) expenses. To qualify for these subsidies, the land plot acquired by a non-profit should obtain the status of "*Réserve Naturelle Agrée*" (RNA hereafter) from the Department of Nature and Forests of the Walloon regional government, following the decision of a council of experts. This council (composed of scientists, non-profit representatives, and public servants) is the only administrative structure that has the right to decide on the RNA status. Its main task that of verifying whether the proposed land area has a sufficiently high environmental value. This council also plays a similar role in the creation of the public counterpart of RNAs, called "*Réserves Naturelles Domaniales*" (RNDs), that are publicly owned and managed.

Given the substantial expertise of the council members, virtually all the existing nat-

ural reserves are created on the land areas with a relatively high environmental potential. Such land typically has few alternative production uses (such as intensive agriculture) but, if properly managed, can yield considerable positive externalities (protection of natural habitats and endangered species, environmental tourism, etc.). Thus, the main actors in the Walloon region on the buyer side of the market for this type of land are the legally recognized environmental non-profits (there are ten such organizations in the region) and, to some extent, the regional government. The seller side consists of a multitude of small landowners (many of whom are heirs of individuals that bought these land plots in the past mostly for extensive pastoralism or to diversify their wealth portfolios).

3.2 Data

The data that we collected comes from the archives of the branch of the Walloon regional administration that is in charge of the conservation of nature (DGO3). This branch is in charge of administering payments of subsidies to environmental non-profits both for land acquisition and for the management of the natural reserves. We construct our data using the certified copies of notary deeds of land acquisitions by non-profits from private owners, that the legally registered environmental non-profits have to provided to the DGO3 in case they receive any subsidy. Importantly, even though the policy was introduced in 1986, subsidies for ordinary management expenses are paid for natural reserves regardless of their date of creation. Provided that the land plot has a sufficiently high environmental value, conditions to fulfil in order to qualify for the ordinary-management subsidy are quite loose. This implies that for the year range 1943 to 2010, we have data on virtually all the land transactions related to creation of private natural reserves. In this paper, we restrict our analysis to the period between January 1950 and March 1994 for two main reasons: (1) there is no price deflator available for the observations before 1950, and (2) starting April 1994, the European Union started to provide additional subsidies for environmental non-profit land purchases through the LIFE program (with somewhat different eligibility conditions), which we plan to investigate in future work.

From each notary deed, we extracted (and quantified, wherever needed) information about the transaction, i.e. the date and the price at which land was purchased, identities of both parties, and precise information about land plots (geographic characteristics, cadastral number, size of the plot, and the exact location). Importantly, given that our sources are

the notary deeds, we can disregard the problems related to misreporting, which usually have to be addressed in survey-based data.

4 Empirical Analysis

4.1 Identification strategy

Our identification strategy relies on the discrete change in policy towards non-profits introduced in 1986 by the Walloon regional government, as described above. This policy change deeply modified the incentives faced by non-profits. We want to analyze the behavioral response of non-profits to this policy change, both in the short- and the long run, as compared to the behavior and outcomes before the policy reform.

We argue that this identification strategy is valid because the policy reform was unanticipated and not simultaneous with any other major change in environmental policies. The reform was carried out by a coalition government consisting of Christian-Democrats and Liberals, shortly after this government was formed. Given that the Walloon region is traditionally a stronghold of the Socialist Party, this particular government is (so far) the only regional government in the history of the Walloon region where Socialists were not in power, and for the first time, the minister of environment was a Liberal and not a Socialist. Given the Belgian political context, prior to the elections that led to formation of this government, it was thus extremely difficult to foresee the exact composition of this government and the identity of ministers' cabinet members. Moreover, the reform was not widely discussed, neither at the regional parliament, nor in the media, essentially because in that particular period, tensions between the French-speaking and the Flemish-speaking communities in Belgium occupied most of the public debates, and the environmental conservation was definitely not considered a key issue[1].

The timing of elections and of the implementation of reform also limited potential anticipation effects. The regional government was in place from December 1985 onwards, following the regional election in October 1985. The reform was then passed, in a relatively short period of time. Transactions on the land market, instead, require substantial amount of time to be concluded[2]. Thus, this timing leaves little space for the reform to have retroactive effects

[1]Reading through the major regional newspapers in the period 1985-87, we could not find any article discussing this reform.

[2]Typically, once the buyer and the seller agree on the transaction details, they sign a provisional sale agreement in front of a notary; a procedural delay of two to four months usually follows, before the final bill

on transaction prices before July 1986. For robustness, we provide additional evidence below that our findings are not driven by purchases between 1985 and July 1986. If anything, our estimates provide a lower bound, if some of the land transactions finalized after July 1986 had not yet been influenced by the reform.

4.2 Descriptive statistics

The dataset that we use for this paper consists of 938 land plots acquired by environmental non-profits between 1950 and 1994. This represents virtually the universe of such land purchases within this time period[3]. Transactions at the beginning of this period are few, given that systematic land purchase by non-profits started in the 1970s, followed by a boom in both the quantity and the size of transactions in the 1990s, as can be seen in Figure 1. 148 plots were purchased before the reform and 790 were bought after it. Twenty-one plots were purchased between January 1, 1985 (the date of retroactive effect of the reform) and the official announcement of the reform.

[Insert Figure 1 here]

The land surface purchased increased substantially: it rose from 134 hectares before the reform to 728 hectares after it. The number of environmental non-profits buying land increased as well: three non-profits were buying land before 1986, whereas after the reform this number doubled. However, the market structure became much more concentrated. Before the reform, two non-profits had relatively large market shares (71 and 27 per cent, respectively), leaving a residual market share to the third actor. After the introduction of subsidies, the largest buyer increased its market share even further (up to 93 per cent of the market), becoming a de facto monopolist (as depicted in Figure 2).

[Insert Figure 2 here]

Table 1 presents descriptive statistics of our main variables before and after the reform of July 1986. In addition, we also look at a sub-sample of observations which are potentially strongly affected by the reform and are less affected by potential unobservable variables. This restriction allows us to exclude the surge in the number of plots purchased in the early

of sale is signed in the notary's office.

[3]We lose 11 observations because of missing information on the transaction price.

1990s, where other time-varying factors might be driving this dynamics. In this sub-sample, we thus focus on 75 observations after the reform and compare them to 75 observations just before it (we also compare the post-reform observations to 75 acquisitions before January, 1 1985, the earliest purchase date to qualify for the subsidy).

[Insert Table 1 here]

In all comparisons, prices after the reform are higher than those before the reform. The difference is statistically significant only when we restrict the comparison to observations shortly before and shortly after the reform; however, notice that the variance in prices also increases considerably. Average plot size remains relatively stable (slightly below one hectare). Around half of the plots were owned by multiple sellers (these typically are multiple heirs of the landowning farmer). This share falls to less than 40 per cent after the reform. In addition, there are two large changes in the portfolio of plots purchased by the non-profits. First, there is a change in land occupation pattern of purchased plots. After the reform, non-profits seem to buy more woodlands, wetlands and pasture lands, and fewer wastelands. However, the change in the quality of land is small when we restrict our comparison to the 150-observation window (dropping the observations in the "grey" area between early 1985 and July 1986). The differences in land quality are not statistically significant in this restricted window (because point estimates are smaller and not because difference-in-means tests are less accurate in smaller sample). Finally, as shown in Figure 3, non-profits increase the geographic spread of their purchasing activity after the reform. They remain highly active at their core area in the Eastern part of the Walloon region, but start to buy plots in other provinces where land prices are, on average, higher. This might indicate that after the reform non-profits increase their search and prospecting efforts.

[Insert Figure 3 here]

4.3 Regression analysis

As explained above, our econometric analysis relies on the discontinuity around the policy reform date. We thus estimate the relationship:

$$Lnprice_i = \alpha_0 + \alpha_1 Policy_i + \alpha_2 Year_i + \alpha_3 Policy_i * Year_i + \mathbf{X}_i\beta + \varepsilon_i. \qquad (22)$$

Here, $Lnprice_i$ is log of the (deflated) purchase price of plot i, $Policy_i$ is an indicator variable that takes value 1 if the plot was purchased under the subsidy regime, and zero otherwise, $Year_i$ denotes the year of transaction, $\mathbf{X}_i$ is a vector of control variables (size of the plot, number of sellers, geographic characteristics, identity of the buyer, etc.), and ε an idiosyncratic component. Figure 4 presents the interpretation of the main coefficients. α_1 denotes the average short-term change in prices of land plots driven by the policy change (i.e. with the year of the policy change is referenced as $Year = 0$). Since our dependent variable is expressed in logs and $Policy_i$ is a binary variable, the exact predicted average change between the prices of subsidized and non-subsidized land purchases equals $e^{\alpha_1} - 1$. α_2 controls for the overall time trend in prices, whereas α_3 allows to capture the difference in time trends between the period before the reform and the one after the reform. In a linear specification, the time necessary to revert to the pre-reform trend after the policy reform is given by the ratio between α_1 and α_3, provided that these two coefficients have opposite signs.

[Insert Figure 4 here]

[Insert Table 1 here]

Table 2 reports the results of estimating of equation (22) by ordinary least squares. Point estimates of α_1 are systematically positive, relatively large but very imprecise (standard errors are clustered at municipality level); therefore, the coefficient is never significantly different from zero in any of our specifications. However, it is worth noting that estimates of both α_1 and α_3 are relatively stable when we add controls for the number of sellers, land quality (geographic characteristics), and whether the plot is located in a province where there were no purchases before 1986. Specification (5) adds controls for the identity of the buyer (i.e. non-profit fixed effects). Taking into account that only two non-profits engaged in land purchase transactions both before and after 1986, these controls purge our estimated coefficients from a potentially different market behaviour of new buyers. The estimated coefficient α_1 increases substantially, which suggests that new entrants buy, on average, at lower prices than the two incumbents. Observing the two main coefficients of interest jointly, we find some evidence in favour of an increase in prices after the introduction of subsidies; however, this increase looks temporary as suggested by a negative sign of α_3 (the coefficient of the interaction term between the time trend and the policy dummy).

The methodology used for these estimations is unsatisfactory, as clearly indicated by the coefficients of the plot area. In general, land market prices are almost perfectly proportional to the plot size; our discussions with several notaries involved in such transactions indicate that in most transactions, the purchase price is roughly calculated as the price per-hectare multiplied by the plot surface (after taking into account the land quality). Therefore, we should observe that a one percent increase of plot area should be accompanied by an increase in price by roughly one percent. Our OLS estimations suggest, instead, that the price only increases by 0.8% or less (moreover, the coefficient is somewhat unstable across specifications).

A potential explanation for this under-estimation is the public-good nature of assets that are traded on this market. The land market for natural reserves is a market where assets acquired by non-profits are used to produce public goods. Like in any other land market, buyers exchange money for land plots, and, overall, prices are determined by demand and supply. However, unlike in the usual land markets, buyers also invest substantial effort in convincing sellers to accept a lower price in the interest of the public good (or in prospecting for sellers that are more public-spirited). During our work on data, we collected anecdotal evidence concerning several landowners who were happy to sell their land for a symbolic price, provided that the buyer maintains the landscape and protects endangered animals living in the area. These benefits are non-rival and non-excludable, which means that the seller is sure to enjoy those environmental services without paying a management cost. On the other hand, non-profits are sometimes inclined to pay a relatively high price for a small plot because that plot would allow the extension of a green mesh between sites. Both types of transactions constitute outliers, and failing to take them into account biases the estimates obtained above.

More precisely, from the econometrics point of view, these transactions constitute vertical outliers for small plots with high prices and bad leverage points for large plots sold at symbolic prices. The presence of both types of outliers biases regression coefficients downwards and increases standard errors. In specification (6) of Table 2, we estimate our model including a dummy variable flagging seven most obvious quasi-donations, i.e. land plots sold for a clearly symbolic price. Four of these transactions occurred before July 1986 and the remaining occurred after. The price-surface elasticity is jumps from 0.75 to 0.82 and the t-statistic doubles. The coefficient on the policy dummy drops by about 15 per cent, whereas the R^2

reaches 0.72. This implies that correcting for less than one percent of observations has a major influence on our results. Proceeding in such a way would not be problematic if we could easily flag all the transactions with exceptionally low and high prices; however, this is quite cumbersome (given the size of our dataset) and might also involve some arbitrariness in borderline cases.

A better way of attacking this problem is to use an estimator robust to outliers. We opt for the MS-estimator proposed by Maronna and Yohai (2000) and developed by Verardi and Croux (2009). It allows for a robust and efficient estimation in the presence of outliers in a multidimensional setting, deals with dummy variables in the set of explanatory variables, and properly handles asymmetric distribution of residuals in the presence of outliers. The loss function of this estimator is a Tukey-Biweight function where the marginal change of the residuals' weight tends to 0 as residuals become large. It means that all observations have some weight in the regression but that this weight does not explode when the observation lies far away from the regression line (or, more precisely, far away from the core group of observations in a multivariate sense).

[Insert Table 3 here]

Table 3 reports estimates of the same specifications than those in Table 2, with estimations performed using the MS-method. Robust estimation does not affect the signs of coefficients. The elasticity of prices to land surface is now very close to one and is highly stable across specifications. The introduction of the subsidy has an estimated positive effect on prices of an order between 41 and 57 per cent. Therefore, for a plot valued €100, the introduction of the subsidy pushes the price up to €150 (of which €75 are paid by the non-profit recipient of the subsidy). Thus, in the short run the subsidy represents a €25 saving for the non-profit. Over time, the price steadily declines until it reaches the pre-subsidy price around nine years after the introduction of the subsidy. Given that our sample is limited to the eight years following the reform, we cannot know if the trend would have continued until subsidized prices become actually lower than non-subsidized prices or whether it would have stabilized around the trend.

The introduction of the dummy variable indicating quasi-donations in the last specification leaves our estimates virtually unchanged, contrarily to the instability of OLS estimates noted above. The regression coefficient on this dummy is unsurprisingly large, predicting a drop in the price for these plots by more than 99 per cent; however, all other coefficients

remain unaffected. This stability is a clear indication that our methodology is justified and that robust estimates adequately depict regular market conditions without being much affected by other mechanisms that drive the outliers. We also report in this table a generalized Hausman test proposed by Dehon et al. (2011). For all estimations, the ordinary least squares method (an efficient but potentially inconsistent estimation technique) systematically provides estimators which are significantly different from robust ones. Despite a somewhat lower efficiency of the MS-methodology (28.4 per cent loss in efficiency), it seems reasonable to prefer the consistent robust estimation technique.

In the Appendix, we provide two further tables with robustness checks. Table A.1 reports estimates based on the outlier-free subsample of the first five specifications of Table 2. Point estimates of the main coefficients of interest are slightly lower in absolute value than robust estimates on the full sample; however, all the results go in the same direction. Estimates of price-surface elasticity are remarkably stable. Table 3 introduces several variations in the model specification. The first column corresponds to the baseline specification estimated by the MS-estimator. The second column allows for a more flexible relationship between the price and the time trend by introducing quadratic terms in the trend. The estimated effect of the policy reform is smaller and less precisely estimated but remains economically significant. The third column reports estimates on a subsample generated by eliminating all land purchases made between January 1985 and July 1986 (i.e. transactions potentially affected by anticipating the reform). Point estimate of the coefficient on the reform dummy increases a little bit; which could indicate some (minor) anticipation of the reform. Specification (4) introduces another modification to check that the anticipation effect does not seriously affect our estimations. In this specification, we set the timing of the policy reform on January 1, 1985: this eliminates the distinction between the starting date of the retroactive effect of the reform and the date of the reform itself. Estimates remain similar in terms of the signs and sizes of coefficients, and inference is not affected much. Finally, in the specification in the last column, we impose an extremely conservative restriction on our sample: we consider only the 75 transactions preceding January 1, 1985 and the 75 transactions immediately following the policy reform. We comfortingly find effects similar to those found for the full sample, with slightly larger standard errors (despite the relatively low statistical power caused by our sample restriction), consistently with our previous findings.

5 Discussion

5.1 Interpretation of empirical results

Our theoretical model has generated three testable propositions. The first predicts the differential effect of the subsidy over time: we should observe that prices of assets bought by non-profits strongly increase in the short-run and then decrease in the long-run as compared to this short-run peak; the quantity of assets bought should increase unambiguously over time. Above, we have tested this prediction using data on land acquisitions by environmental non-profits in the Walloon region of Belgium. Properly taking into account the presence of outliers in the data (both vertical ones and bad leverage points) by using the MS-estimator, we show that the empirical results are in line with this first prediction of our theoretical framework. All the parts of Proposition 1 are confirmed: we observe a spike in prices just after the introduction of the subsidy (i.e. $\alpha_1 > 0$), followed by a progressive decline towards the initial price ($\alpha_3 < 0$). Even if the effect of the subsidy on the market price vanishes over time, the number of transactions largely increases by the end of the sample period, as shown in Figure 3. This is fully consistent with a positive demand shock followed with a long-run expansion of the supply curve.

The second testable proposition predicts a differential effect of the subsidy across non-profit types. In particular, one should observe a relatively stronger increase in land purchases by non-profits that give a relatively higher weight to the quantity than to the quality of public goods provided (captured by the parameter α_i in our model). In our data, the two main non-profits have different preferences in the quantity versus quality trade-off; these differences are made clear when one looks at their mission statements. The mission statement of the first organization (*Ardenne & Gaume*) reads:

> "[The association] has the objective of creating (and participating to the creation) and managing (and participating to the management of) natural reserves [...] and more generally of any structure, private or public, regardless of its form, that contributes to preserving nature."

For the second organization (*R.N.O.B.*), one reads:

> "[The association] is devoted to preserving and managing threatened natural habitats. To this end, the association develops a strategy of purchasing or renting

land with considerable biological interest, mainly in the Walloon and Brussels regions."

The first non-profit seems to be more open to partnerships and its mission statement mostly emphasizes natural reserve management efforts. Contrarily, the second statement makes clear that the organization's priority is on purchasing land. As displayed in Figure 2, we can see that the second non-profit (*R.N.O.B.*) is purchasing the largest number of land plots (in terms of total surface) after the reform. The market share of each of the two non-profits changes following the introduction of the subsidy in the direction predicted by our model. Consequently, the subsidy makes the quantity-driven non-profit capture virtually all the new land purchases.

This change in the market structure is consistent with the third testable proposition of the model. This proposition states that in a market with relatively few actors, one should observe that the subsidy has a relatively small effect on the long-run price and a relatively large effect on the quantity purchased, at the expense of less effort devoted to quality enhancement. Given that our empirical analysis focuses on only one market, we cannot compare its outcomes to those of a less concentrated market. However, combined with information about the context that we have discussed above, it is clear that the de facto monopsony position of the R.N.O.B., driven by its quantity-oriented mission, induced it to engage massively in supply-expanding prospecting activities, avoiding the free-riding that would plague a market with multiple small prospecting non-profits. Under these conditions, the long-run impact of the ad valorem subsidy in such a concentrated market had a huge impact on quantities of land purchased, as we have shown previously.

Policy-wise, the relatively limited effect on prices and the long-run convergence towards the pre-reform trend, combined with the large expansion in quantity purchased might seem a positive result, given that large amounts of land were traded without a massive price pass-through effect of taxpayers' money to private sellers. However, a caveat should be mentioned. As we have argued above, the less aggressive quality-oriented buyers are driven out of the market and the market is dominated by organizations that consider quantity purchased to be the priority. A negative effect of the subsidy is that quality-enhancing management effort per unit of land is predicted to decrease. Therefore, the ad valorem subsidy encouraging private ownership of public goods is an efficient policy tool only if the quantity of the public good (and not its quality) is the policy objective.

5.2 Econometric methodology

In our empirical investigation we implicitly assume that (at least) two different data-generating processes (DGPs) generated our sample. This assumption is supported by the anecdotal evidence collected during our data construction. A part of transactions on the land market for natural reserves does not fit the classical supply-and-demand framework. Some transactions are non-standard in the sense that public-good considerations, warm-glow and persuasion play a key role in shaping the prices. Our data are thus "contaminated" by these observations with potentially abnormally low prices. It is, however, impossible to disentangle the DGP of each observation *a priori*. Identification of other DGPs requires additional information (not observed, and, in some cases, unobservable). This lack of information can be overcome by using robust estimation techniques that allow to consistently estimate the main DGP. We opt for the MS-estimator for four reasons: (1) it is robust to good and bad leverage points; (2) it allows for asymmetries in outliers distribution; (3) it allows to handle categorical variables; and (4) it has a very low break-down point of 50 per cent (i.e. the estimated coefficients are consistent even when almost half of the sample is contaminated by outliers).

Once the coefficients behind the main DGP are estimated, one can consistently identify the outliers in the data as shown for instance in Figure 5. Importantly, the identification process relies on an objective statistical procedure rather than on the *a priori* of the researcher, and in case one is interested in understanding the origin of the outliers in one's data, this procedure offers a systematic basis for the case-study analysis of outliers.

[Insert Figure 5 here]

More generally, this methodology might be useful in settings where different DGPs might coexist and where other tools to grasp their co-existence are missing (provided that one DGP generates at least half of the data points). We believe that our method has numerous potential applications in the empirical analyses of non-profit sector, given that the theoretical literature agrees that the behaviour of various actors in this sector (donors, managers, volunteer workers, etc.) is driven by a mix of classic extrinsic high-powered incentives and intrinsic motivation (see, e.g., Benabou and Tirole (2003); Besley and Ghatak (2005); Bénabou and Tirole (2006)). Standard estimation techniques might miss this co-existence of DGPs and lead to inconsistent estimates.

6 Conclusion

What are the broader implications of our model and empirical findings? The framework of analysis that we have developed above applies to a large set of contexts where the provision of a public good is delegated to a non-profit organization. These are the contexts in which a certain asset or input potentially can generate substantial externalities or has a fundamental public-good nature, but is initially held by a private party that value insufficiently these externalities. At the same time, there exist agents (or organizations founded by such agents) that are intrinsically motivated and would like to internalize these externalities or release the public-good potential of the asset. Usually, however, these agents are credit-constrained (or, more generally, cannot easily monetize their intrinsic motivation; so their willingness-to-pay does not fully reflect their motivation). Thus, they can either raise funds through solicitations from other agents, or the government can assist in transferring the ownership of the asset to these motivated agents. Moreover, locating such assets implies a positive search cost.

One example of such a setting (beyond environmental conservation discussed above) is the market for art. Most private non-profit organizations devoted to artistic or cultural heritage conservation face the problem similar to the one discussed in our paper: works of art are often held by individuals that do not fully value their public-good nature, and such objects are traded in a competitive market. Government can subsidize the acquisition by non-profit museums of these works of art, but finding the art pieces that best suit the collection of the non-profit museum requires effort.

Another example is the non-profit organizations whose mission is to combat environmental pollution by, for example, properly recycling polluting second-hand appliances. There exists (relatively thin) markets for these objects. Some appliances are more polluting than others (e.g. they contain highly environmentally-hazardous substances); however, given the relatively low prices, some owners are unlikely to be willing to pay the cost of bringing them to the recycling points. Thus, the non-profits often conduct the door-to-door campaigns of searching for such appliances, which requires substantial effort. From the policy perspective, it is important to investigate the desirability of government subsidies for the purchase of such appliances by non-profits.

In addition, our empirical analysis has an important methodological implication. In applied problems of evaluating the effects of government subsidies on the market outcomes

in this kind of settings, a non-negligible fraction of data points exhibit very low prices. This occurs because some of the initial owners of the assets can also be intrinsically motivated, and these owners would sell these assets to non-profits for a price that does not correctly reflect the market value of the assets (i.e. a symbolic price). In that case, failing to treat such outliers properly might induce the researcher to underestimate the effect of the subsidy on the market price and to overestimate the effect on the quantity. Our analysis above highlights such pitfalls and illustrates the appropriate robust methodology for treating these outliers.

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Figure 1: Number of land transactions with non-profits as buyers

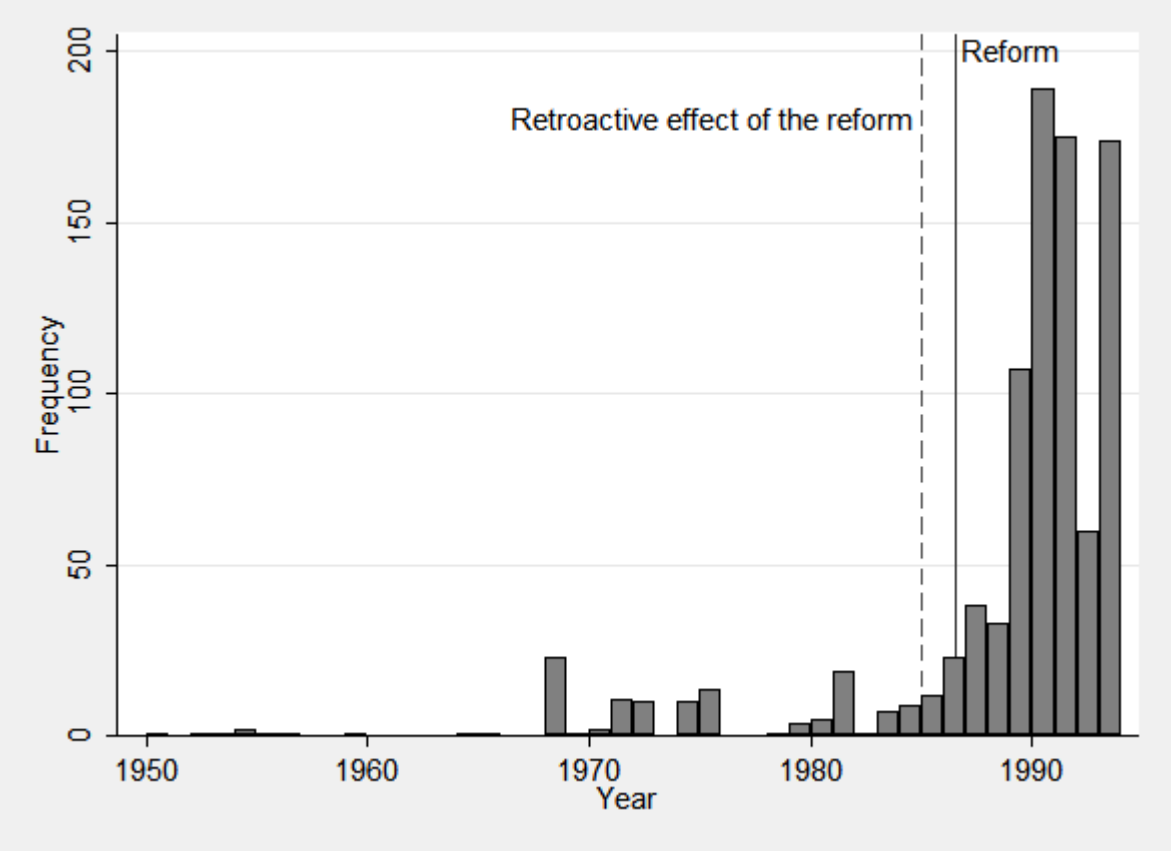

Figure 2: Land market share, by non-profit, before and after the reform

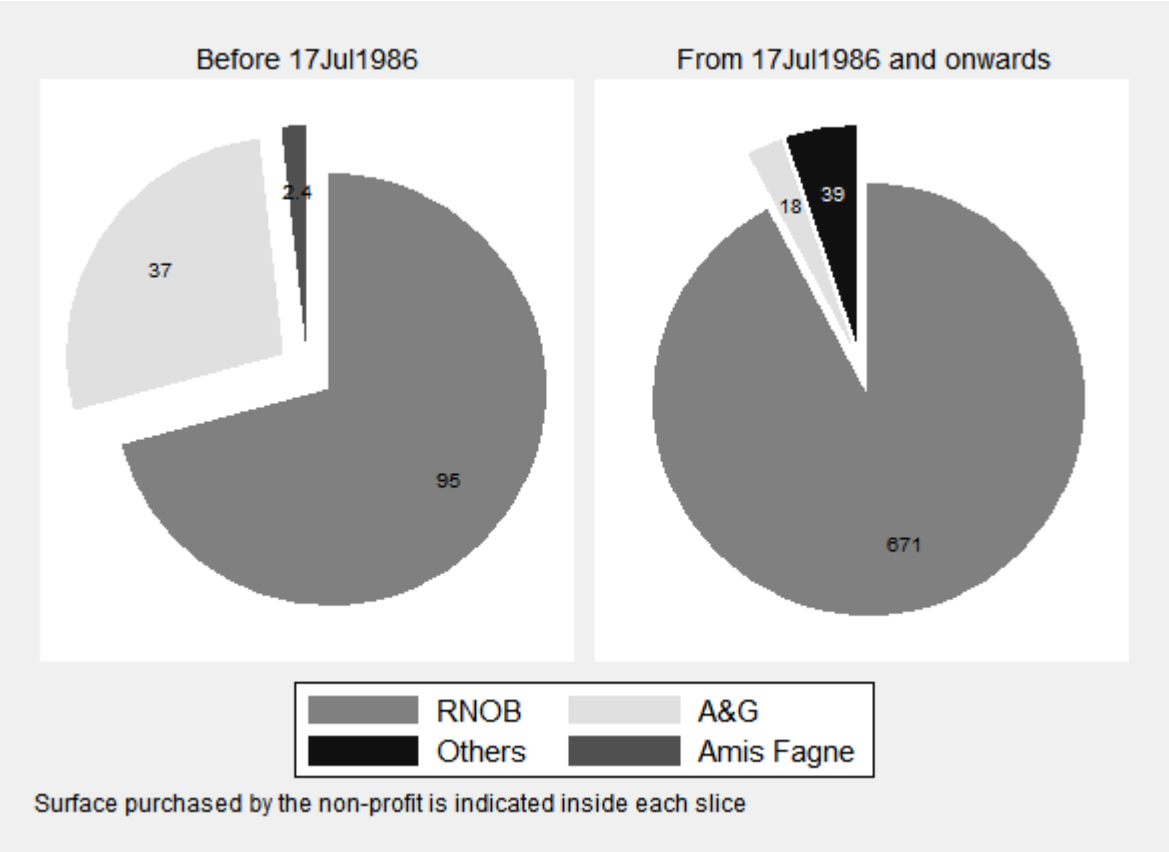

Figure 3: Location of acquisitions in the Walloon region before and after the reform

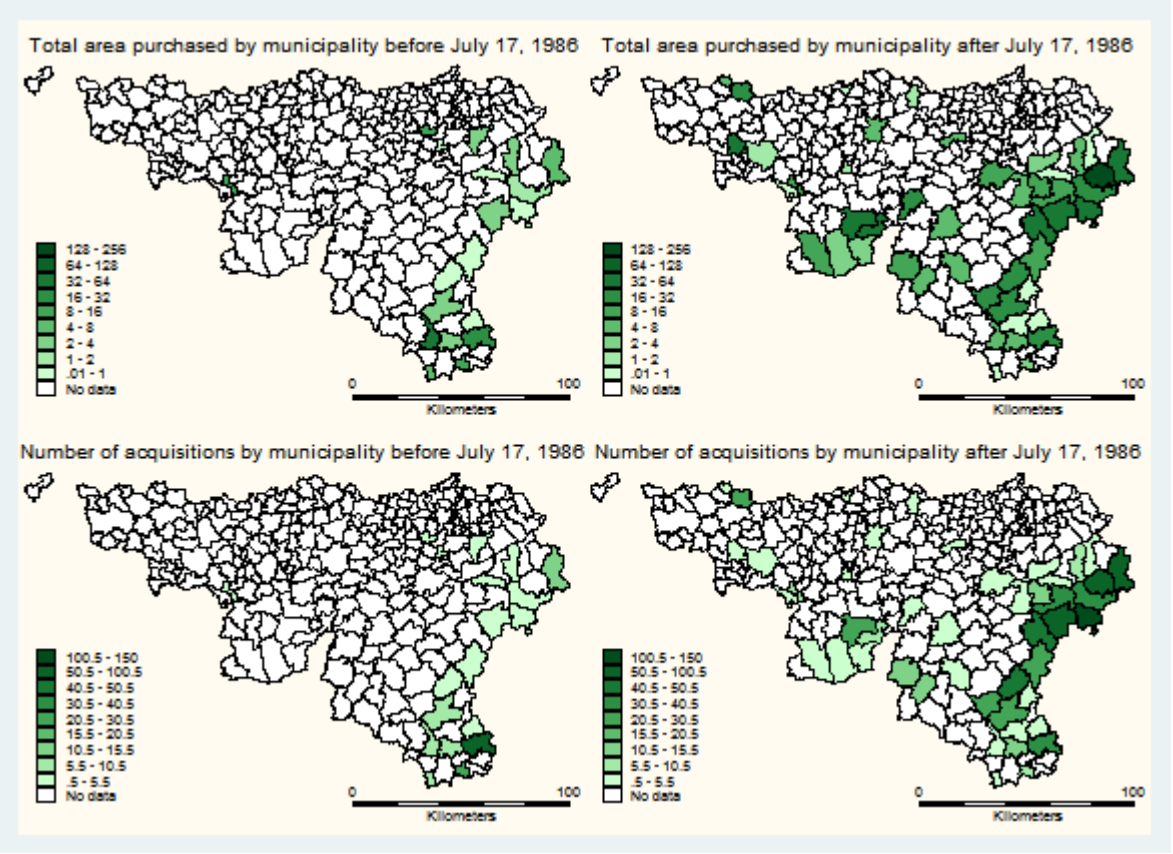

Figure 4: Interpretation of regression coefficients

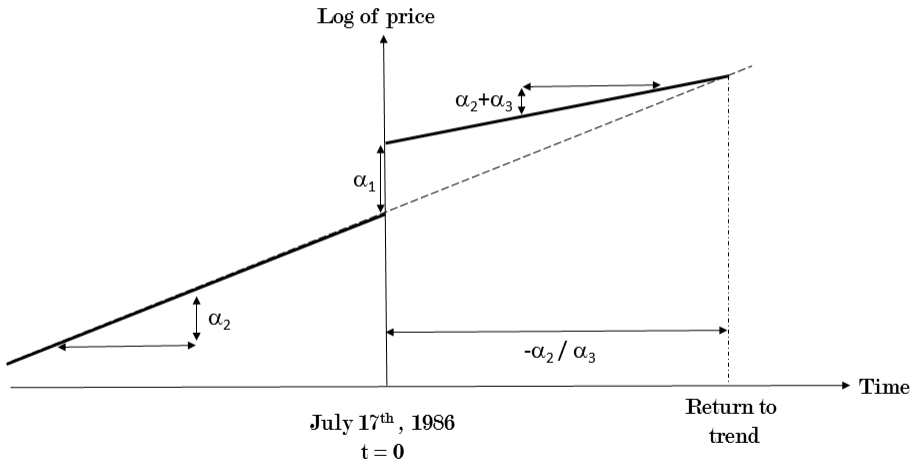

Figure 5: Outliers in specification 4 of table 3

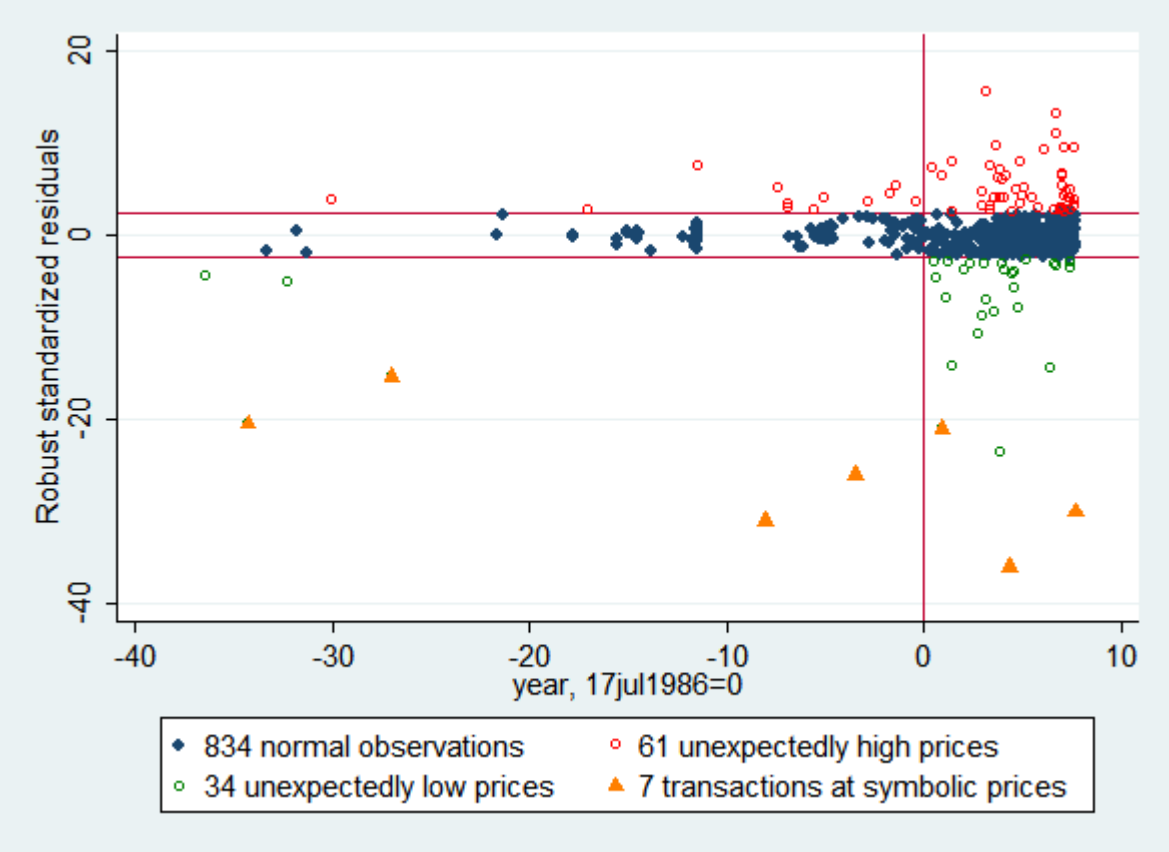

Table 1: Descriptive statistics

	Before 17Jul86		After 17Jul86	Before 17Jul86		Before 01Jan85		After 17Jul86
	mean/sd		mean/sd	mean/sd		mean/sd		mean/sd
Price	2814.95		3470.30	2654.69		2144.45	**	4188.67
	(9342.50)		(13007.01)	(4920.10)		(4581.21)		(7394.07)
Surface	0.91		0.92	0.90		0.80		0.99
	(2.72)		(3.54)	(1.79)		(1.75)		(1.39)
Price per hectare	3642.00		5111.39	4062.82		3802.83		4859.73
	(2923.65)		(19306.64)	(3763.14)		(3559.86)		(7775.41)
Number of co-owners	1.90		1.78	1.91	***	2.03	***	1.44
	(1.50)		(1.46)	(1.43)		(1.61)		(0.87)
=1 if co-owned	0.47		0.38	0.49	***	0.48	**	0.28
	(0.50)	**	(0.49)	(0.50)		(0.50)		(0.45)
=1 if waste land	0.30		0.06	0.17		0.21		0.16
	(0.46)	***	(0.24)	(0.38)		(0.41)		(0.37)
=1 if woodland	0.03		0.16	0.07		0.01	***	0.12
	(0.18)	***	(0.37)	(0.25)		(0.12)		(0.33)
=1 if wetland	0.01		0.05	0.03		0.03		0.00
	(0.12)	**	(0.22)	(0.16)		(0.16)		(0.00)
=1 if pasture land	0.55		0.67	0.67		0.64		0.56
	(0.50)	***	(0.47)	(0.47)		(0.48)		(0.50)
=1 if pond	0.00		0.02	0.00		0.00	**	0.05
	(0.00)		(0.13)	(0.00)	*	(0.00)		(0.23)
=1 if cult. land	0.11		0.12	0.09		0.09		0.13
	(0.32)		(0.33)	(0.29)		(0.29)		(0.34)
=1 if out of core area	0.01		0.15	0.03		0.01		0.12
	(0.12)	***	(0.36)	(0.16)	**	(0.12)	***	(0.33)
Observations	148	vs. after	790	75	vs. after	75	vs. after	75

*, **, *** denote significant differences between values before and after, respectively at 10%, 5% and 1%

Table 2: OLS regression results

	(1) log of price	(2) log of price	(3) log of price	(4) log of price	(5) log of price	(6) log of price
Bought after the reform	0.0143	0.0238	0.0239	0.0194	0.0884	0.0735
	[0.261]	[0.262]	[0.261]	[0.256]	[0.266]	[0.144]
Year * reform	-0.0252	-0.0262	-0.0265	-0.0320	-0.0389	-0.0113
	[0.0351]	[0.0349]	[0.0356]	[0.0339]	[0.0326]	[0.0226]
Year, 17jul1986=0	0.0188	0.0186	0.0194	0.0184	0.0144	-0.00431
	[0.0225]	[0.0225]	[0.0224]	[0.0221]	[0.0212]	[0.00884]
Log of surface	0.814***	0.812***	0.778***	0.747***	0.750***	0.819***
	[0.0783]	[0.0789]	[0.0817]	[0.0790]	[0.0794]	[0.0483]
Number of co-owners		0.0210	0.0146	0.0145	0.0180	0.0000953
		[0.0212]	[0.0207]	[0.0205]	[0.0209]	[0.0173]
Out of core area				0.431***	0.326**	0.381***
				[0.132]	[0.160]	[0.123]
Sold at symbolic price						-7.905***
						[0.869]
CONTROLS						
Land quality	N	N	Y	Y	Y	Y
Buyers identity	N	N	N	N	Y	Y
Observations	938	938	938	938	938	938
Adjusted R^2	0.432	0.432	0.438	0.449	0.459	0.726

Standard errors in brackets, clustered at the municipality level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: MS regression results

	(1) log of price	(2) log of price	(3) log of price	(4) log of price	(5) log of price	(6) log of price
Bought after the reform	0.494*	0.409***	0.570***	0.575***	0.396	0.396
	[0.272]	[0.153]	[0.127]	[0.158]	[0.261]	[0.277]
Year * reform	-0.0748***	-0.0841***	-0.0341**	-0.0354*	-0.0464*	-0.0458*
	[0.0221]	[0.0152]	[0.0164]	[0.0189]	[0.0241]	[0.0250]
Year, 17jul1986=0	-0.00535	0.000452	-0.0158**	-0.0159	-0.00296	-0.00305
	[0.0195]	[0.00966]	[0.00768]	[0.00981]	[0.0167]	[0.0179]
Log of surface	1.081***	1.067***	1.034***	1.029***	1.041***	1.041***
	[0.0235]	[0.0310]	[0.0212]	[0.0235]	[0.0255]	[0.0259]
Number of co-owners		-0.0390	0.00801	0.00877	0.00353	0.00355
		[0.0290]	[0.00831]	[0.00941]	[0.0101]	[0.00988]
Out of core area				0.0510	0.0396	0.0396
				[0.0388]	[0.0450]	[0.0456]
Sold at symbolic price						-8.211***
						[0.220]
CONTROLS						
Land quality	N	N	Y	Y	Y	Y
Buyers identity	N	N	N	N	Y	Y
Hausman's Chi-squared	20.66	25.51	37.75	59.89	82.85	220.9
Observations	938	938	938	938	938	938

Robust standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

A Appendix Tables

Table A.1: OLS regression results, without outliers

	(1) log of price	(2) log of price	(3) log of price	(4) log of price	(5) log of price
Bought after the reform	0.266*	0.240*	0.271**	0.267**	0.250*
	[0.135]	[0.135]	[0.116]	[0.118]	[0.129]
Year * reform	-0.0432***	-0.0463***	-0.0344**	-0.0361***	-0.0425***
	[0.0138]	[0.0140]	[0.0139]	[0.0134]	[0.0135]
Year, 17jul1986=0	-0.00358	-0.00183	-0.00575	-0.00624	-0.00365
	[0.00726]	[0.00724]	[0.00634]	[0.00637]	[0.00768]
Log of surface	1.064***	1.063***	1.047***	1.030***	1.035***
	[0.0177]	[0.0182]	[0.0174]	[0.0140]	[0.0129]
Number of co-owners		-0.0180**	-0.0126	-0.0130	-0.0141
		[0.00738]	[0.00850]	[0.00867]	[0.00876]
Out of core area				0.218**	0.163*
				[0.0903]	[0.0885]
CONTROLS					
Land quality	N	N	Y	Y	Y
Buyers identity	N	N	N	N	Y
Observations	844	846	843	843	843
Adjusted R^2	0.923	0.922	0.923	0.926	0.931

Standard errors in brackets, clustered at the municipality level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.2: Alternative specifications in MS-regressions

	(1) log of price	(2) log of price	(3) log of price	(4) log of price	(5) log of price
Bought after the	0.575***	0.251	0.636***		0.404***
reform (Jul. 1986)	[0.158]	[0.201]	[0.0934]		[0.121]
Year * order	-0.0354*	-0.0302	-0.0290**		-0.0590
	[0.0189]	[0.0549]	[0.0139]		[0.0372]
Year, 17jul1986=0	-0.0159	0.0219	-0.0198***		0.00373
	[0.00981]	[0.0257]	[0.00524]		[0.0135]
Year squared		0.00122			
		[0.000762]			
Year squared* reform		-0.00736			
		[0.00803]			
Bought after the				0.632***	
reform (Jan. 1985)				[0.0919]	
Year * reform				-0.0211*	
				[0.0114]	
Year, 1jan1985=0				-0.0197***	
				[0.00541]	
Log of surface	1.029***	1.035***	1.023***	1.020***	0.918***
	[0.0235]	[0.0234]	[0.0188]	[0.0184]	[0.0455]
Number of co-owners	0.00877	0.00589	0.00945	0.00884	-0.0242
	[0.00941]	[0.0149]	[0.00780]	[0.00859]	[0.0162]
Out of core area	0.0510	0.0657	0.0547	0.0565	1.015***
	[0.0388]	[0.0425]	[0.0370]	[0.0363]	[0.165]
CONTROLS					
Land quality	Y	Y	Y	Y	Y
Buyers identity	N	N	N	N	N
Hausman's Chi-squared	59.89	56.41	55.52	58.26	45.74
Observations	938	938	917	938	150
Sample	Full	Full	Full$\setminus[1985; 17Jul86]$	Full	$[-75; +75] \setminus [1985; 17Jul86]$
Timing of the break	17Jul1986	17Jul1986	01Jan1985	17Jul1986	17Jul1986

Robust standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$