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The role of liability, regulation and economic incentives in brownfield remediation and redevelopment: evidence from surveys of developers

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Abstract

We examine market-based incentives intended to promote the environmental remediation and reuse of brownfields, such as reductions in regulatory burden, relief from liability for future cleanups and subsidies. We survey real estate developers using conjoint choice questions to assess their responses to these incentives.

Conditional logit models indicate that developers find contaminated sites less attractive, and that they value liability relief. Moreover, developers with prior contaminated site experience are very responsive to government subsidies, whereas inexperienced developers are more responsive to liability and regulatory relief. These results suggest that market-based incentives and regulatory relief *can* influence land use.

JEL classification: Q28; R38
Keywords: Brownfields; Contaminated sites; Conjoint choice; Liability; Subsidies

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1. Introduction

This study examines different market-based mechanisms and other incentives intended to promote the environmental remediation and reuse of "brownfields." Brownfields are "abandoned, idled or underused industrial and commercial properties where real or perceived contamination complicates expansion or redevelopment" (Simons, 1998).

Brownfield cleanup and reuse are attractive to communities and policymakers for three reasons. First, they reduce the adverse effects of the site's soil and water pollution on human health and ecological systems. Second, they help stop the conversion of agricultural land and rural sites to urban uses and other development patterns that generate environmental problems, congestion and sprawl. Third, they promote economic growth in inner cities and are, therefore, potentially important components of sustainable growth. Investors, however, allegedly shy away from potentially contaminated properties for fear of becoming liable for the cost of cleanup under the applicable hazardous waste site legislation.

In this paper, we examine the value of interventions and policies targeting brownfields from the point of view of the key economic agents involved—private real estate developers. We ask three related questions: First, what economic incentives can be offered to developers to encourage cleanup and reuse of brownfields, and how effective are they? Second, what kind of site characteristics and available infrastructure make a parcel attractive for cleanup and reuse, and to what kind of developers? If sites or developers can be identified that are more likely candidates for development, this may allow more effective targeting of policies based on economic incentives and liability or regulatory relief. Third, do developers avoid contaminated sites even *after* they have been cleaned up?

To answer these questions, we survey real estate developers using conjoint choice questions. Our survey questionnaire presents respondents with sets of redevelopment projects, where each project is defined by site attributes (including contamination) and a mix of government policies. Our policy mix attributes consist of (a) liability relief, (b) direct financial incentives and (c) regulatory relief, in the form of fast-track approvals of plans and flexible cleanup standards. The survey was administered in person to a sample of developers and real estate professionals at the Marché International des Professionnels de l'Immobilier (MIPIM) in Cannes, France, in March 2002.

Conditional logit models of the responses to the choice questions indicate that developers find sites with contamination problems less attractive than other sites, and that they do value liability relief. Liability relief is worth about 21% of the value of the median development project (€ 7 million, or \$7 million), providing support for recent trends in US environmental policy, where the States have increasingly resorted to liability relief to promote environmental remediation of contaminated sites.

Our developers are not deterred by prior contamination, once it has been cleaned up, and appreciate subsidies. The attractiveness of subsidies varies across types of developers, and is influenced by prior experience with (and hence efficiency in taking advantage of) these incentives. Developers with prior experience with contaminated sites are more responsive than other developers, whereas the other economic incentives work better for developers without such prior experience.

The remainder of the paper is organized as follows: Section 2 provides some background information about brownfields. Section 3 describes the survey instrument, the conjoint choice questions and the administration of the survey. Section 4 presents the theoretical and econometric models, variables and hypotheses. Section 5 presents the results, and section 6 provides concluding remarks.

2. Background

The problem of brownfields is the result of two concurrent factors: the numerous plant closings and downsizing that started in the 1970s as the US and Western Europe experienced a structural change of their economies away from manufacturing, and the passage of environmental legislation holding specified parties liable for the cost of cleanup at contaminated sites.[1]

Many observers believe that the fear of liability keeps investors away from brownfield properties. Developers might shy away from properties believed to be contaminated for fear of *future* liability, and because *immediate* cleanup costs may prove too high for the development project to be viable. They may also fear that lenders deny financing for brownfield projects to avoid possible involvement in liability over contamination, or undervalue the property as a collateral for the loan. In addition, it is often speculated that current or previous contamination may raise the uncertainty about demand for or reduce the revenue from the sale of the site.

In the US, where federal legislation addressing contaminated sites was passed over 20 years ago (see Fogleman, 1992), state programs were recently established to encourage cleanup and redevelopment of potentially contaminated sites by offering (a) reductions in regulatory burdens, (b) relief from liability for future cleanups and environmental damage once certain mitigation standards are met and/or (c) financial support for regeneration of brownfields (Bartsch and Dorfman, 2000). Liability relief usually comes in the form of letters of no further action, certificates of cleanup completion or covenants not to sue.

In Europe, some countries have crafted their own Superfund-like legislation, which includes, in certain cases, an innocent landowner disclaimer (e.g., the Netherlands) and provisions for the municipality to take over remediation (De Sousa, 2000).[2] It is sometimes argued that in many European countries, the legislation that addresses cleanup

[1] The U.S. General Accounting Office (1995) estimates that there are 130,000 to 450,000 contaminated commercial and industrial sites in the US. An alternative estimate of the number of brownfields can be formed by combining the lists of contaminated sites compiled by the US Environmental Protection Agency (EPA) and state agencies under various environmental programs, resulting in 384,000 brownfields (Simons, 1998). In Europe, estimates of the size of the problem vary dramatically across countries, depending on the definition of brownfield. Giangrasso and Tassoni (2001) peg the number of sites suspected to be contaminated in Europe at the end of the 1980s at roughly 150,000, for a total of more than 100 million hectares, 20 million of which in Western Europe. Germany alone is estimated to have 35,000 contaminated sites, mostly concentrated in former Eastern Germany (Meyer et al., 1995) for a total of 128,000 ha (Grimski and Ferber, 2001).

[2] While the US Superfund was first passed in 1980, in most European countries, the relevant legislation is much more recent. For example, Italy's Decreto Ronchi was passed in 1997, Germany's Federal Soil Protection Act in 1998, the Flanders' in 1995, while the UK's Circular 02/2000 is based on a 1995 amendment of the 1990 Environmental Protection Act, which upholds the "polluter pays" principle and imposes liability for the mandatory remediation of contaminated land (Vanheusden, 2003). In the Netherlands, the cleanup legislation was first passed in 1986.

at contaminated sites is often at odds with the legal tradition and history, especially where the latter rely on Roman-based civil law, as in France, Germany, Italy and the Scandinavian countries. For example, Italy's legal tradition is very much against strict liability, retroactivity and laws that depend on judicial interpretation, as Superfund-like statutes tend to be (Trombetta and Turvani, 2003).

Recent European Union directives emphasize the Union's support for the "polluter pays" principle, and some European countries rely on voluntary cleanup initiatives that resemble voluntary cleanup programs and brownfield initiatives in the US. These voluntary initiatives exist in addition to or in lieu of cleanup legislation. In France, much of the self-regulation of the chemical industry was launched in hopes of preventing the passage of an act similar to the Superfund law during the 1990s (Lèvêque, 1996). In Italy, despite the existence of cleanup legislation (approved in 1997), at certain locales where no responsible parties can be found polluters have entered into voluntary agreements with the government (Alberini et al., 2003).

Despite claims about the effects of liability on the acquisition and redevelopment of brownfields, little empirical work has been done to assess the existence and magnitude of these effects, and the impacts, if any, of government incentives to developers for cleanup and redevelopment of brownfields. To our knowledge, no study has attempted to relate the establishment of such programs to land prices, or has sought to evaluate the impact of the various policy instruments to the number of parcels cleaned up and redeveloped.[3]

Urban Institute et al. (1997) select a mix of successful and failed redevelopment *projects* in various cities in the US, and interview the developers, consultants and public officials involved about the hurdles they faced, including environmental contamination, liability and the regulatory environment. The study reveals that once redevelopment is actually undertaken, (i) immediate contamination costs are considered more important than liability, (ii) cleanup costs are often overestimated and (iii) for the most part, developers do not believe that "contamination stigma" may hinder the profitability of redeveloping brownfields. A possible exception to (iii) is represented by industrial sites, where financing costs, and reliance on lenders, may be higher.

Urban Institute et al. conclude that other factors tend to be more important than environmental contamination in attracting or discouraging investment at previously used properties. That study, however, relies on interviews of qualitative nature and does not quantify how financial incentives and other policies alter the attractiveness of brownfields, their prices, and the redevelopment activities at these sites.

Lacking evidence about the response of developers to brownfield contamination and policies, we survey developers using conjoint choice questions. Conjoint choice experiments (Louviere et al., 2000) ask individuals to choose between two or more hypothetical

[3] McGrath (2000) examines the effects of contamination on the redevelopment of a parcel, both directly and indirectly via the price of the parcel. Howland (2000) focuses on parcels in an industrial area of Baltimore, finding that contamination reduces the sale price, but does not slow down transactions. Schoenbaum (2002) examines land values, and vacancy and turnover rates for another industrial area in Baltimore, and reports no evidence of significant differences across brownfields and non-brownfield properties. Ihlanfeldt and Taylor (2004) ask the question whether proximity to small-scale contaminated sites influences the value of commercial and industrial property. None of these studies examine directly the effect of government policies designed to encourage redevelopment and cleanup.

"commodities" described by a vector of attributes. The levels of the attributes are varied across the alternatives, so that respondents trade them off, and one of them is usually a dollar amount, which allows one to compute the marginal prices of the attributes. Conjoint choice experiments are a stated preference method, in that they rely on individuals stating what they would do under specified hypothetical circumstances (Bateman et al., 2002).

3. Structure of the questionnaire and survey administration

3.1. Conjoint choice questions

In our survey, we ask real estate developers to tell us which they prefer between two hypothetical alternative redevelopment projects, A and B, where each project is described by site attributes (e.g., location and contamination) and a policy mix.[4] The policy mix includes (a) *liability reduction* in the form of a certificate of assurance that the developer is not going to be held responsible for future cleanups; (b) *regulatory relief* in the form of a faster notice of approvals and/or flexible cleanup standards; and (c) *direct financial incentives*.

These policies may affect different component of the costs and revenues associated with redeveloping the site. Liability relief, for example, reduces or eliminates the risk of future liability for cleanup costs, as long as the developer meets certain requirements. It may, in addition, help raise the revenue from the sale or rental of the site by avoiding the "stigma" due to existing or suspected contamination. For this attribute, we consider two possible levels: (a) certificate of assurance not available, and (b) certificate of assurance available upon completion of remediation.

Faster response times by the agency to the developer's application should reduce the costs of the project, as well as the uncertainty associated with brownfield projects (Urban Institute et al., 1997). We use two levels of this attribute, setting response times within 6 months and 24 months, respectively, of the date of the application.

Direct financial incentives can take the form of low-cost loans, tax credits, and cash rebates. In our survey, however, we do not specify what form they can take, and simply tell our respondents that they are for 10%, 20% and 30% of the value of the project.[5]

The last three attributes describing a project are the presence of contamination at the site, the availability of transportation networks near the site, and the presence of a city within 20 km of the site to capture access to markets and suppliers. Regarding contamination, each alternative is characterized by one of three possibilities: (a) no contamination, (b) contamination or (c) the site was previously contaminated but

[4] As explained below, each of these choice questions is followed by another where the respondent is asked to choose between A, B and not undertaking either project.

[5] These figures were based on a review of the legislation and programs in Italy and other European countries, and are similar to the levels of public subsidies in the US. Simons (1998) examines the role of public assistance and subsidies in a number of brownfield projects in the US. He finds that the average public subsidy is 20%. For comparison, remediation costs were typically 10% of a project's total value, but some projects using innovative remediation techniques kept the remediation costs to less than 5% of the project's value. Simons concludes that public subsidies are generally too high, and tend to support development costs other than the costs of remediation.

remediation has taken place. Finally, all sites are assumed to have regular access to highways, with some alternatives also served by rail, an airport and a harbor.

In sum, each alternative is described by seven attributes: (i) contamination; (ii) cleanup standards; (iii) availability of transportation network within 20 km; (iv) certificate of completed cleanup that relieves the developer from liability for further cleanups; (v) time for approval of development and cleanup plans by the appropriate government agency; (vi) presence/absence of a city within 20 km; and (vii) government financial incentives, expressed as percentage of the value of the project.[6]

3.2. Structure and administration of the questionnaire

The interview begins with a series of screening questions intended to determine whether the respondent is a developer. The questionnaire is comprised of four sections. The first section gathers more specific information on the business of the respondent's company, such as the typical project the company is involved in and its revenue, and whether the company has ever purchased, leased or developed sites located in industrial areas, or contaminated sites.

Section 2 provides information on cleanup responsibilities, highlights the advantages and disadvantages of developing contaminated sites and describes the incentives available in some countries to encourage re-development of previously used sites. The respondent is then asked whether he is familiar with the cleanup legislation of the countries where his company does its business, and whether the company has ever benefited from financial assistance from the government for redeveloping used sites.

Section 3 is comprised of four conjoint choice exercises. Each exercise describes two hypothetical development projects (Site A and Site B). Each site is described by the above-mentioned seven attributes. In each choice exercise, Site A differs from Site B in the level of two or more attributes. For each pair, the respondent is first asked which project he finds more attractive between A and B. In a follow-up question, he is asked to choose between A, B and the option of not participating in either project. Fig. 1 displays an example of conjoint choice question. Clearly, answering the conjoint choice questions requires trading off the attributes of the alternatives under consideration.

Finally, Section 4 gathers further information about the respondent's characteristics, such as age and education, his position within the company and role in the final investment decision about real estate development projects. The respondent is then asked to report the number of employees of the company and the level of sales in 2001.

A preliminary draft of the survey questionnaire was tested on developers, real estate professionals and city planning officials in the Venice, Italy, area in February 2002 to assess respondent comprehension of the questions. In general, the questionnaire was well received and subjects indicated that they were comfortable with the conjoint questions.

The survey was administered in person by five professionally trained interviewers at the MIPIM, Europe's largest international commercial property conference, in Cannes, France,

[6] Eighteen developers in the Toronto area surveyed by De Sousa (2000) judge liability, the slowness of the regulatory process, the uncertainty related to the site-specific risk assessment and inadequate access to transportation to be important hindrances to the (re-) development of brownfields in their area.

SECTION D

Site choice
Now, we would like to ask you to choose between two hypothetical areas to develop. For each question, you will be described two hypothetical sites and will be asked to choose which one you believe is the more attractive of these two sites, based on the characteristics of the site.
In answering the following questions, please imagine that you are considering development projects of value/size similar to those of your company's typical project. The development project will be in the country or countries where your company generally does its business.
Please be assured that your answers will be kept strictly confidential.

CHOICE 1

Attributes	**SITE A**	**Site B**
Site contamination	Present	Present
Transportation network available within 20 km	Highway and railroad	Highway and railroad
Certificate of no further action	No	Yes
Oversight by government agency	Response to developer's application within 6 months	Response to developer's application within 6 months
Cleanup standards	Flexible	Flexible
City within 20 km	Present	Present
Government financial incentives as % of the value of the project	20%	10%

Which project do you find more attractive between A and B?

A☐ B☐

If you were to choose between A, B, and the option of not participating in either of the two projects, which would you choose?

A☐ B☐ Neither ☐

Fig. 1. Example of choice question.

on March 12–15, 2002. Our sample is comprised of 293 developers intercepted at the conference venue.[7] The survey instrument was available in Italian (29% of the respondents), English (57%) and French (15%).

[7] Following common practice, the interviewers were instructed to contact one person every five passing by. Our MIPIM sample is likely to be comprised of relatively large developers with international exposure. We also expect a greater proportion of developers that engage in projects at contaminated sites than in the universe of all developers.

4. The model and the data

4.1. Determinants of brownfield redevelopment

The decision to invest or not to invest in a real estate development project should depend on the revenues and costs of the project. Formally, the profit π associated with a project is:

$$\pi = R(\mathbf{C},\mathbf{X}) - E(\mathbf{C},\mathbf{Z}) - L(\mathbf{C},\mathbf{Z}) + F, \tag{1}$$

where R is net revenue, i.e., the revenue from the development project, p_{S}, minus land acquisition costs, p_{A}, and development costs, D: $R = p_{\mathrm{S}} - p_{\mathrm{A}} - D$. E represents environmental remediation (i.e., cleanup) costs, L is expected liability and F represents the government subsidy.

The arguments in Eq. (1) depend on the presence and severity of contamination $\mathbf{C}$, and on site and location characteristics $\mathbf{X}$, where $\mathbf{C}$ and $\mathbf{X}$ are vectors of continuous and discrete variables. For example, contamination and location can influence both p_{S} and p_{A}, resulting in the dependence of net revenue R on $\mathbf{C}$ and $\mathbf{X}$.

Government policies $\mathbf{Z}$ (F being an element of this vector) can influence L by offering letters of no further action, certificates of completion, or covenants not to sue that reduce or eliminate future liability risks. They can also reduce uncertainty about future changes in cleanup standards, and immediate cleanup costs E, by offering streamlined review of development and cleanup plans.

In our questionnaire, net revenue R is set to be equal to that of the firm's typical project. When asked to choose between two projects, A and B, a developer should choose the one with the higher profits. Since net revenue is held constant across projects, the difference in profits between A and B is equal to the difference between their respective cleanup costs, expected liability, and subsidies, which in turn are influenced by contamination attributes, $\mathbf{C}$, site and location attributes $\mathbf{X}$, and the policy mix $\mathbf{Z}$ offered to the developer. When the choice set also includes the option of not undertaking either investment, a developer would be expected to choose the "do nothing" option if the profits of projects A and B are negative or unacceptably low.

4.2. The econometric model

To motivate the statistical analysis of the responses, we assume that respondents select the alternative with the highest profit. We further assume that profits are a linear function of the site's contamination attributes $\mathbf{C}$, site and location attributes $\mathbf{X}$ and the policy mix $\mathbf{Z}$ offered to the developer, plus an error term:

$$\pi_{ij} = \alpha_0 + \boldsymbol{C}_{ij}\alpha_1 + \boldsymbol{X}_{ij}\alpha_2 + \boldsymbol{Z}_{ij}\alpha_3 + \varepsilon_{ij}, \tag{2}$$

where i denotes the individual and j the alternative. If the error terms ε are i.i.d. and follow the type I extreme value distribution, the probability that alternative k is selected out of K alternatives is:

$$Pr(\text{resp. } i \text{ chooses } k) = \exp(\mathbf{w}_{ik}\alpha) \Bigg/ \sum_{j=1}^{K} \exp(\mathbf{w}_{ij}, \alpha) \tag{3}$$

where $\mathbf{w}$=$[\mathbf{C}'\mathbf{X}'\mathbf{Z}']'$ and α is the vector of coefficients in Eq. (2).[8] Eq. (3) is the contribution to the likelihood in a conditional logit model.

In our survey, respondents are shown four pairs of hypothetical projects. For each pair, a forced-choice question asks them to indicate which project is judged more attractive. A subsequent question offers them an opt-out by letting them state whether they prefer project A, B or not undertaking either. This implies that for each of the four pairs of project, the size of the choice set (K in Eq. (3)) is 2 in the forced-choice question, and 3 in the subsequent question, and that each respondent contributes a total of eight choice observations.

Once model (3) is estimated, the rate of tradeoff between any two attributes is the ratio of their respective α coefficients. The marginal value of each attribute is computed as the negative of the coefficient on that attribute, divided by the coefficient on the subsidy.

To allow for heterogeneity among the respondents, the vector $\mathbf{w}$ can be augmented to include interactions between respondent or firm characteristics and the attributes of the alternatives. To further allow for heterogeneity (and relax the assumption of independence of irrelevant alternatives, IIA, implicitly imposed by the conditional logit model; see Train, 1999), we also estimate random-coefficient logit models.[9]

4.3. The choice of regressors

In our basic specification of the conditional logit, the probability of choosing a project depends only on the attributes of the alternatives, following eq. (2). In subsequent runs, we add interactions intended to test specific hypotheses about the attractiveness of the attributes to certain types of developers, and then experiment with further allowing for random coefficients.

All else the same, we expect sites at locales served by more means of transportation and sites located in the proximity of a city to be more attractive. The coefficient on the contamination dummy (CONTAM_P) should be negative, reflecting the extra costs

[8] The intercept in Eq. (3) is not identified and is therefore normalized to zero.

[9] In a random-coefficient logit, the vector of coefficients β breaks down into two components: its expectation, $\overline{\beta}$, and a vector of error terms, $\mathbf{u}_i$, that vary over respondents. The probability of choosing alternative k, given the individual-specific error $\mathbf{u}_i$, is $Pr(k|u_\mathrm{i}) = \exp(\mathbf{w}_{ik}\beta)/\sum_{j=1}^{K}\exp(\mathbf{w}_{ik}\beta) = \exp(\mathbf{w}_{ik}\beta + \mathbf{w}_{ik}\mathbf{u}_i)/\sum_{j=1}^{K}\exp(\mathbf{w}_{ik}\beta + \mathbf{w}_{ik}\mathbf{u}_i)$. To compute the (unconditional) probability of choosing project k, one must integrate this expression with respect to the joint density of the vector of error terms $\mathbf{u}$: $Pr(k) = \int \ldots \int Pr(k|\mathbf{u}_i) f(\mathbf{u}_i) \mathrm{d}\mathbf{u}_i$, where f is the joint density of the terms $\mathbf{u}$. Clearly, estimation of the random-coefficient model requires that assumptions be made about which coefficients are random, and about the joint distribution of the individual-specific errors $\mathbf{u}_i$.

associated with cleanup. Urban Institute et al. (1997) conclude that it is not the fear of liability that keeps investors away from contaminated sites, but the high costs of cleanup. We therefore formulate our Hypothesis I, that fear of liability does not matter but cleanup costs do. A negative coefficient on CONTAM_P and an insignificant coefficient on CERTIFIC, the dummy capturing whether or not a certificate of completion is offered, would provide empirical support for this hypothesis.

The coefficient on CONTAM_C (a dummy indicator denoting that contamination was present, but has been removed) should capture any deterrent effect of contamination that persists even after the site has been remediated. We do not have any prior expectations on this coefficient. While many observers believe such an effect to exist, some recent empirical studies (e.g., Urban Institute et al., 1997; Howland, 2000) refute this notion. We therefore wish to test the null hypothesis (Hypothesis II) that there is no persistent net contamination "stigma," i.e., that the coefficient on CONTAM_C is zero.

Regarding the policy instruments, ceteris paribus, we would expect direct financial incentives (INCENT), shorter response times (OVERS) by the agency to developer application and the issuance of a certificate of completion (CERTIFIC) to increase the attractiveness of a project. Flexible standards should make a project more attractive, unless developers consider negotiation with the authorities lengthy and costly. The net effect is, therefore, an empirical issue.

4.4. Specific hypotheses and interaction terms

One would reasonably expect certain attributes to be more (less) attractive to certain types of developers than to others. Testing hypotheses about different impacts of attributes on different developers requires the use of interactions between the attributes and dummies for the type of developer.

Our Hypothesis III is that the preferences of developers with contaminated site experience are different. For example, these developers may have different perceptions of cleanup costs, and their views of negotiable cleanup standards and letters of completion may reflect their experience with the government agency in charge.

We also create interactions between selected project attributes and a dummy variable denoting whether the firm is a "large" firm, i.e., its revenues are greater than the average. Our Hypothesis IV is that larger firms may have different preferences from smaller firms. Some observers believe that large firms have traditionally been the target of EPA enforcement effort over Superfund because of their ability to pay for cleanup. This might make them more reluctant to take up contaminated sites, and perhaps more accepting of liability relief. On the other hand, large firms presumably rely more on their own financing than on borrowing from banks, which might insulate them from the effects of liability through the lenders.

Developers who deal primarily with industrial and commercial sites may react to contamination to a different extent than developers who engage mostly in residential projects. This is our Hypothesis V, which could be due to the perception, discussed in Urban Institute et al. (1997), that financing costs are higher (and hence the effects of liability through the lenders more pronounced) at industrial sites, and to the expectation of

Table 1
Summary of hypotheses

Hypothesis	Description
I	Liability does not matter to developers, but cleanup costs do.
II	Past contamination does not deter development activity.
III	The effect of policy instruments and contamination is different for developers with prior experience with contaminated sites.
IV	The effect of policy instruments and contamination is different for large developers.
V	The effect of policy instruments and contamination is different for developers that engage in industrial and commercial projects.
VI	Developers who sell their development projects value contamination and liability relief differently.
VII	The respondent's familiarity with the cleanup legislation matters.

higher cash flows at more densely developed sites, like residential projects and office buildings.

We also wonder whether liability and liability relief schemes impact developers differently if they transfer the property to others (Hypothesis VI). Finally, Urban Institute et al. (1997) emphasize the importance of familiarity with cleanup legislation—our Hypothesis VII.

We summarize our hypotheses in Table 1. Table 2 summarizes the site or project attributes, and the corresponding variables in the econometric model. We note that when we estimate our conditional logits, the "neither project" option ("Which would you choose, A, B, or neither project?") is coded by setting all attribute variables to zero. This allows for each alternative to be described by three contamination dummies and four transportation access dummies, as shown in Table 2.

Table 2
Description of variables used in the econometric models

Variable	Description
CONTAM_P	The site is currently contaminated (dummy).
CONTAM_C	The site was contaminated but has been cleaned up (dummy).
CONTAM_A	The site was never contaminated (dummy).
HIGHWAY	The site is within 20 km of a (federal) highway (dummy).
PORT	The site is within 20 km of a harbor (dummy).
RAILROAD	Access to railroad is available within 20 km of the site (dummy).
AIRPORT	The site is within 20 km of an airport (dummy).
CITYPRES	The site is within 20 km of a major city (dummy).
INCENT	Subsidy offered to the developer as percentage of project revenue (continuous variable).
CERTIFIC	Certification is offered to the developer upon completion of cleanup that exempts the developer from liability (dummy).
OVERS	Number of months by which the agency must respond to the developer's cleanup plans (continuous variable).
FLEXSTDS	Flexible cleanup standards (dummy).

5. Results

5.1. Characteristics of the respondents

Because our sample consists of developers intercepted at random at a professional conference, we cannot claim that it is representative of the universe of developers. Our first order of business is, therefore, to examine the characteristics of our respondents and of their firms.

The majority of the respondents were males (82%) and the average age was 42. Ninety-four percent of the respondents are responsible for gathering information to support the decision to undertake development projects, and 79% actually participates in making the final decision.

Descriptive statistics for the characteristics of the firms are reported in Table 3. About 65% of the developers sell the final development projects, 38% keep them for their business, and 27% lease them to someone else. The most common type of projects in the last three years were commercial development projects (74%), followed by office complexes (68%) and residential projects (53%).

Roughly 58% of the companies in our sample do business in Southern Europe, 30% in Northern Europe, 62% in Western Europe, 35% in Eastern Europe, 17% in North America, almost 9% in Asia and 8% in the rest of the world.[10] As one would expect of MIPIM attendees, the respondents' companies are considerably large: The average number of employees is 3733 people, and average level of sales is about € 15,895 million. The typical project covers about 231,868 m^2, and the average size of buildings was 29,160 m^2. Median revenue was € 7 million.

Approximately two-thirds of the respondents' firms had previous experience with industrial sites, and 60% of them bought abandoned industrial areas, while 67% worked with industrial areas that are still used at the time of the acquisition. In our sample, 47% of the respondents stated having previous experience with contaminated sites. In addition, 77% of the respondents were familiar with the polluted site cleanup legislation in the countries where their company does business. Moreover, 39% of our interviewees reported to have benefited from government incentives to re-use abandoned areas.

Because an important policy question is what it takes to draw developers who have never worked with brownfields before to engage in brownfield projects, we compared the characteristics of brownfield-experienced and -inexperienced developers. The former tend to engage in projects at larger sites and with larger buildings, and their revenue per project is greater, but *t* tests indicate that the differences between the two groups are not statistically significant.[11]

[10] These percentages do not add to 100 because many firms do business in several parts of the world.

[11] For developers with prior experience with contaminated sites, the average land area of a project is 298,000 m^2, whereas for developers that have not worked with contaminated areas before the average size of a project is 137,500 m^2. Buildings at the site are, on average, 37,000 and 23,000 m^2, respectively, and the median revenue for a typical project is € 13.2 million vs. € 5.7 million, respectively. These figures are not statistically different across the two groups. The primary activity of both types of developers is commercial projects, followed by building offices, housing complexes and industrial projects.

Table 3
Descriptive statistics

	Number of observations	Sample average			
Type of projects					
Industrial (dummy)	292	0.49			
Residential (dummy)	292	0.53			
Commercial (dummy)	292	0.74			
Offices (dummy)	292	0.68			
Other (dummy)	291	0.25			
Sell (dummy)	293	0.65			
Keep (dummy)	293	0.38			
Lease (dummy)	293	0.27			
Geography					
South Europe (dummy)	287	0.58			
North Europe (dummy)	287	0.30			
West Europe (dummy)	287	0.62			
East Europe (dummy)	287	0.35			
North America (dummy)	287	0.17			
Asia (dummy)	287	0.09			
Rest of the World (dummy)	287	0.08			
	Number of observations	Sample average	Minimum	Maximum	Standard deviation
Company characteristics					
Employees	288	3733	1	150,000	16,252
Level of sales	215	€ 15,895,000	€ 42,000	1.5e13	1.42e12
Typical project					
Project land area	234	231,868 m^2	100	15,000,000	1,254,119
Project building area	209	29,160 m^2	5	1,214,100	94,758
Gross revenue of project	224	€ 666,324,069	€ 37,000	40,000 million	3,824 million
	Number of observations	Sample average			
Experience					
Experience with industrial area (dummy)	293	0.66			
Experience with contaminated site (dummy)	293	0.47			
Abandoned area (dummy)	192	0.60			
Still used area (dummy)	192	0.67			
Familiarity with legislation (dummy)	293	0.77			
Has ever received government financial incentives (dummy)	293	0.39			

Table 4
Basic model

		(1) Attributes only	(2) All interactions	(3) Interactions with firm characteristics only	(4) Interactions with experienced developer	(5) Interactions with large developer
Site characteristics	CONTAM_P	− 0.9994 (− 2.124)	− 1.5133 (− 2.986)	− 1.3146 (− 2.673)	− 1.2102 (− 2.532)	− 1.0200 (− 2.143)
	CONTAM_C	0.2848 (0.603)	0.2052 (0.439)	0.2156 (0.461)	0.2171 (0.462)	0.2652 (0.563)
	CONTAM_A	0.2524 (0.538)	0.1839 (0.396)	0.1930 (0.415)	0.1968 (0.424)	0.2350 (0.502)
	HIGHWAY	− 2.2667 (− 1.685)	− 2.5179 (− 1.848)	− 2.4094 (− 1.796)	− 2.4220 (− 1.802)	− 2.0942 (− 1.562)
	PORT	0.4095 (4.627)	0.4138 (4.577)	0.4035 (4.479)	0.2164 (4.658)	0.4086 (4.595)
	RAILROAD	1.8187 (1.453)	2.1586 (1.699)	2.0442 (1.638)	2.0647 (1.650)	1.6652 (1.335)
	AIRPORT	0.3117 (3.638)	0.2125 (3.716)	0.3274 (3.776)	0.3186 (3.697)	0.3136 (3.650)
	CITYPRES	1.0562 (14.124)	1.0696 (14.130)	1.0677 (14.124)	1.0657 (14.159)	1.0565 (14.101)
Policies	INCENT	0.0274 (6.258)	0.0199 (3.307)	0.0198 (3.291)	0.0119 (2.177)	0.0347 (6.752)
	CERTIFIC	0.5740 (7.835)	0.5621 (3.246)	0.4089 (2.884)	0.5836 (5.771)	0.6076 (6.678)
	OVERS	− 0.0423 (− 10.560)	− 0.0591 (− 7.941)	− 0.0517 (− 8.568)	− 0.0471 (− 8.765)	− 0.0472 (− 9.637)
	FLEXSTDS	0.2895 (4.119)	0.5110 (3.762)	0.3419 (3.105)	0.3513 (3.543)	0.2802 (3.242)
Interactions with contamination experience dummy	CONTAM_P × experienced with contaminated sites		0.2075 (1.255)	0.2343 (1.425)	0.2654 (1.642)	
	INCENT × experienced with contaminated sites		0.0345 (4.685)	0.0341 (4.643)	0.0335 (4.600)	
	CERTIFIC × experienced with contaminated sites		− 0.0122 (− 0.084)	− 0.0156 (− 0.107)	0.0145 (0.099)	
	OVERS × experienced with contaminated sites		0.0088 (1.170)	0.0089 (1.196)	0.0085 (1.151)	
	FLEXSTDS × experienced with contaminated sites		− 0.1537 (− 1.106)	0.0532 (− 1.148)	− 0.1444 (− 1.053)	
Interactions with large developer dummy	CONTAM_P × large firm		− 0.0792 (− 0.455)	− 0.0097 (− 0.058)		0.0142 (0.087)

	INCENT × large firm		– 0.0226 (– 2.798)	– 0.0224 (– 2.960)		– 0.0205 (– 2.767)
	CERTIFIC × large firm		– 0.0291 (– 0.189)	– 0.0861 (– 0.573)		– 0.1033 (– 0.697)
	OVERS × large firm		0.0104 (1.309)	0.0133 (1.715)		0.0144 (1.881)
	FLEXSTDS × large firm		0.1328 (0.882)	0.0532 (0.366)		0.0278 (0.193)
Interactions with familiarity of the respondent with cleanup legislation	CONTAM_P × familiar		0.2960 (1.628)			
	CERTIFIC × familiar		– 0.2478 (– 1.574)			
	OVERS × familiar		0.0104 (1.677)			
	FLEXSTDS × familiar		– 0.3057 (– 2.118)			
Interactions with developer who sells development projects	CONTAM_P × sell		0.1304 (0.768)	0.1091 (0.645)		
	CERTIFIC × sell		0.3444 (2.428)	0.3528 (2.501)		
Interactions with residential and industrial developer	CONTAM_P × residential developer		0.2166 (0.999)	0.1724 (0.811)		
	CONTAM_P × industrial developer		0.1915 (0.859)	0.1742 (0.784)		
	Log-likelihood	– 1574.78	– 1537.24	– 1542.28	– 1552.36	– 1569.67

Conditional logit model (*t* statistics in parentheses). Cleaned sample, which excludes eight respondents exhibiting possible preference reversals (e.g., choose A between A and B, choose B between A, B and neither project); 2239 observations.

5.2. The conditional logit model: effects of the attributes

The purpose of our conditional logit models is twofold. First, we wish to determine what attributes actually matter to developers, a task we accomplish by performing statistical tests of significance of the coefficients. Second, we wish to estimate the marginal prices of the attributes and policy mechanisms.

Table 4 reports results for several specifications of the conditional logit. For good measure, the sample used for estimation excludes the eight respondents who exhibited possible "reversals" (e.g., chose A over B in the forced-choice questions, but B when asked to choose between A, B and the option of undertaking neither project).[12]

Column (1) refers to a specification that includes only the attributes of the alternatives, without interactions. As expected, the coefficient on current contamination is negative and strongly significant. By contrast, the coefficient on CONTAM_C is positive but insignificant, and is not statistically distinguishable from the coefficient on CONTAM_A, the dummy indicating the absence of contamination, which is also insignificant. This has three important implications. First, when faced with the choice between a contaminated site and a site that is not currently contaminated, ceteribus paribus, a developer prefers the latter. Second, in the absence of policies and if the site is at a less desirable location, the option of not investing in a project is judged more attractive than investment at the contaminated site, confirming that current contamination deters investments. Third, all else the same, a developer finds formerly contaminated sites that have been cleaned up just as attractive as pristine sites and as the option of not investing at all. Regarding Hypothesis II, we conclude that developers do not discriminate against past contamination, once it has been cleaned up, a result that is in line with claims by Urban Institute et al. (1997) and Howland (2000).[13]

Regarding proximity to transportation, the negative sign of HIGHWAY should be interpreted to mean that a site served only by highways tends to be less preferred than undertaking no project at all. Access to railroad, an airport and a port, however, increases the attractiveness of a project, although the effect of railroad is not statistically significant. The presence of a city nearby is also deemed attractive, as shown by the positive and significant coefficient of this dummy indicator.

We were expecting the size of subsidies to the developers to be positively associated with the likelihood of selecting a project, and, indeed, this expectation is borne out in the data. The coefficient on INCENT is positive and strongly significant.

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[12] Results are very similar to those based on the complete sample. Informal debriefs at the end of the interviews suggested that respondents understood the choice task and were comfortable with it. Examination of the responses to the choice questions revealed virtually no evidence of abnormal patterns (see Alberini et al., 2003 for details).

[13] It should be borne in mind that the approach used by Urban Institute et al. (1997) differs from ours, in the sense that, while we sample developers and interview them about hypothetical projects that have not been undertaken yet, they sample actual redevelopment projects and interview developers, consultants, and state officials about them. Clearly, ex post opinions about a project that was undertaken (and hence was deemed worth the investment), may well differ from ex ante opinions. There are also differences in the nationality, background and (unobserved) propensity to work with possible contaminated sites between Urban Institute et al. and our sample.

The negative coefficient of OVERS implies that longer response times by the agency to the developer's application tend to discourage investment in a project. The coefficient on CERTIFIC is positive and strongly significant. Taken together with the negative coefficient of CONTAM_P, this result implies that developers pay attention to *both* immediate cleanup costs and future liability, and thus dispels Hypothesis I. Finally, the availability of flexible cleanup standards is deemed attractive, suggesting that on the whole developers do not necessarily associate them with lengthy and costly processes.

5.3. The conditional logit model: interaction terms

Columns (2)–(5) in Table 4 refer to specifications of the conditional logit that include interaction terms. The specification of column (2) is the broadest, including interactions between the attributes and dummies denoting (i) that the development firm has had prior experience with contaminated sites, (ii) a large firm, (iii) a residential or industrial developer, (iv) that the developer sells the development projects, rather than leasing them or keeping them for own use and (v) that the respondent is familiar with hazardous waste legislation. Likelihood ratio (LR) tests suggest that the regressors as a whole are significant (LR statistic = 1845.1, p value < 0.0001), and that including the interactions improves the fit of the model (LR statistic = 75.064, p value < 0.0001).

LR tests further suggest that contaminated site experience matters (LR statistic = 42.72, p value < 0.0001), even though only the coefficient on the interaction with the subsidy is individually significant, and that the large-firm interactions are jointly significant (LR statistic = 10.60, p value = 0.031). This provides support for Hypotheses III and IV.

We find no support for Hypothesis V: The coefficients on the interactions between CONTAM_P and dummies for developers engaging in industrial or residential development are insignificant both individually and jointly (LR statistic = 1.456, p value = 0.4828). By contrast, there is some evidence that liability relief is even more important for developers that sell their development projects (LR statistic = 7.356, p value = 0.0252), although these developers are similar to the others in terms of their reactions to contamination. This provides support for Hypothesis VI.

Finally, regarding Hypothesis VII, respondents who are more familiar with contaminated site legislation are slightly less deterred by the presence of contamination and by slower response times by the agency, but distrust flexible cleanup standards. The magnitude of the coefficients on the interaction terms, however, implies that in practice, the difference between those respondents who are and who are not familiar with the applicable cleanup legislation is very small. A LR test marginally rejects the null that the coefficients on all the interaction terms are zero at the 5% significance level (LR statistic = 10.07, p value = 0.0392). The latter findings, and the fact that we wish to make predictions for companies, rather than individual respondents, prompts us to drop this group of interaction terms, as we do in the specification of column (3), which shows little change in the estimated coefficients relative to column (2).

5.4. Experience with contamination and large developers

We focus on the importance of prior experience with contaminated sites in the specification of column (4) in Table 4, which omits other interaction terms.

Developers with contaminated site experience appear to be more sensitive to government subsidies: The coefficient on subsidies for these developers is (0.0119 + 0.0335) = 0.0454, whereas that for all other developers is 0.0119. This implies that, all else the same, increasing the incentive by the same amount raises the probability of selecting a site more for developers with experience than for developers without prior contaminated site activity. Developers with contaminated site experience also appear to be somewhat less deterred by the presence of contamination (the coefficient on this attribute is [− 1.2104 + 0.2654] = − 0.945, roughly three quarters that for all other developers), but respond to other policies like all other developers.

Column (5) in Table 4 displays the results of the model with interactions between attributes and the dummy for a large firm. Two coefficients—that on the interaction with the subsidy, and that on the interaction with response times by the agency—are individually statistically significant at the 1% and 10% level, respectively. They imply that larger firms are less responsive to subsidies: For large firms, the coefficient on the subsidy is (0.0347 – 0.0205) = 0.0142, whereas for smaller firms, it is 0.0347.

Larger firms, however, are less deterred by slower response times by the agency. Moreover, they do not value the existence of contamination and liability relief differently from smaller firms, despite their potentially larger exposure to liability. We experimented with changing the definition of large firm, finding that, when we classified as "large" a firm with revenues greater than the median, the results were qualitatively similar, but the differences between "larger" and "smaller" firms were no longer statistically significant.[14]

5.5. Other developer characteristics

Other interaction terms between attributes and characteristics of the respondent or the respondent's firm were attempted and included in additional runs of the conditional logit model. For example, in runs not reported, we examined whether respondents who have previously received incentives from the government have different preferences. We found that these developers *are* more responsive to financial incentives (their coefficient on the subsidy exceeds by 50% that for all other developers), but do not have a different

[14] To further account for heterogeneity, the specifications of columns (4) and (5) in Table 4 were re-run allowing for the coefficients of all five interaction terms to be random and independently normally distributed. We found that only one of these coefficients, that on INCENT × experience in the model with the contamination-experience interactions, should be concluded to be random. When the model is re-run imposing that the latter coefficient be random and normally distributed, and all others be non-stochastic, its expected value is estimated to be 0.0422 (S.E. 0.0092), and its standard deviation to be 0.0474. The corresponding coefficient for the remainder of developers is 0.0104. This implies that for roughly 74% of the developers with contaminated site experience the coefficient on the financial incentive is greater than that for developers without contaminated site experience, and that for 50% of the developers with contaminated site experience this coefficient is greater than 0.0422. All other coefficients are very similar to those of the conditional logit of column (4), as are the predicted probabilities of selecting one out of the two projects in a pair.

perception of the contamination problem. This suggests that they have become efficient at securing those subsidies, and that they perhaps associate them with less effort and transaction costs than developers who have not received government assistance before.

We also examined respondents who participate in making the final decision about real estate investments. We found them to be less responsive to subsidies, but more accepting of liability relief, and somewhat less intimidated by agency response times.

It is interesting to examine if preferences vary with the country where the company or the respondent is based, reflecting his or her company's experience with local agencies and policies. For example, we wondered whether developers that operate in the US—and hence face strict and joint-and-several liability, as well as the oldest such regime for hazardous waste sites—may be even more sensitive to the presence of contamination and to liability relief than developers that operate in other markets, but did not find any statistical evidence for this claim. Interactions with dummies for other countries or regions were also attempted, but we did not identify significant differences across groups, a result we attribute to the relatively small number of observations per group.

In a further effort to control for the type of liability and the legal environment that developers might face in different countries, we conjectured that developers that operate in countries whose legal system is based on common law, such as the US, the UK and its Commonwealth, and rely on tort law for addressing environmental contamination, might be even more sensitive to contamination and to the policies than developers that operate in countries with civil law systems (European countries and other countries with systems derived from Continental Europe).[15] We therefore re-ran the model of column (4) after including interactions between the attributes and a US–UK–Commonwealth dummy. The results from this run indicate that developers operating in these countries are, indeed, more sensitive to the existence of contamination (the coefficient on the appropriate interaction being -0.3913, t statistic -2.023) and slightly more accepting of liability relief (the relevant coefficient being 0.2858 with a t statistic of 1.686; regression not reported).

5.6. Magnitude of the effects

To illustrate the magnitude of the effects of the policies, we consider two sites, A and B, and compute the probability of choosing between them under various assumptions. We first assume that A is a contaminated site located close to all transportation modes and near a city, and that individual policies or combinations of them are offered at this site. By contrast, B is a pristine site with comparable location characteristics, but with no applicable brownfield policies.

The probability of choosing A, the contaminated site accompanied by the policy mix, is shown in Table 5 for various policy mixes for the entire sample and for the types of

[15] Within the common law systems, environmental contamination is addressed by the principles of the tort law case–law tradition, and by special statutes to be combined with such traditional principles, which provide for joint-and-several liability and punitive damages. By contrast, in the civil law systems, damages are generally limited to the compensation of affected parties. The two types of legal regimes also differ in how the burden of evidence is placed on the parties and on the role of the judge in assessing the evidence (Prof. Andrea Torricelli, J.D., personal communication; Van Erp, 2002).

Table 5
Probability of selecting the contaminated site vis-à-vis a pristine site

Probability of selecting A over B (%)					
Policy incentive offered at site A	(1) All	(2) Developers with contaminated site experience	(3) Developers with NO contaminated site experience	(4) Large firms	(5) Small firms
No policy incentive	22.23	24.20	19.67	22.42	22.18
10% Financial assistance	27.33	33.43	21.62	25.00	28.74
20% Financial assistance	33.10	44.19	23.70	27.75	36.33
Liability relief alone	33.67	36.74	30.50	32.37	34.35
20% Financial assistance + liability relief	46.76	59.01	35.77	38.87	51.16
Flexible cleanup standards	27.64	28.19	25.81	28.23	27.39
20% Financial assistance + flexible cleanup standards	39.79	49.33	30.62	34.32	43.02
20% Financial assistance + liability relief + flexible cleanup standards	53.98	63.91	44.17	46.39	58.09

Site A = contaminated site with policy incentives. Site B = pristine site with no policy incentives.

developers examined in columns (4) and (5) of Table 4. Column (1) shows the probability of selecting site A for all developers in our sample.

The first row of Table 5 shows that, in the absence of incentives, the probability of selecting A, the contaminated site, is only about 22%. With financial assistance for 10% of the project revenue, a developer chooses A with probability 27.33%. This probability increases to 33.10% when the subsidy is doubled, implying an elasticity with respect to the subsidy of 0.1991. Liability relief alone implies a probability of selecting A of 33.67%, which jumps to 46.76% when financial aid worth 20% of the project revenue is added. On further adding flexible cleanup standards, the likelihood of choosing the contaminated site project further increases to about 54%. It should also be noted that flexible cleanup standards alone imply a probability of selecting A of about 27%, and are thus roughly equivalent to offering financial assistance for 10% the value of the project. (The marginal effects of liability relief and flexible standards on the probability of selecting A are 0.1271 and 0.0579, respectively.)

As shown in columns (2) and (3) of Table 5, there is a substantial difference in the propensity to engage in projects at contaminated sites between those developers who already have experience with this kind of sites, and those who do not. The former have a higher probability of selecting the contaminated site at $F = 10\%$ (33.43% vs. 21.62%), and are more responsive to an increase in financial assistance. Doubling the subsidy raises the probability of opting for the contaminated site to 44.19% for developers with contaminated site experience, but has little effect on developers with no contaminated site experience, for whom the probability of project A is now only 23.70%.[16]

[16] The elasticity of the probability of opting for A with respect to the subsidy is 0.3022 for developers with prior experience with contaminated sites, and 0.0932 for developers without such experience.

On further incorporating liability relief, the probability of choosing A is 59% for developers with contaminated site experience, and 30.50% for developers without contaminated site experience. This suggests that liability experience is more important than subsidies for developers with no previous contamination experience, at least within the normal subsidy range. The marginal effect of liability relief is the same, about 0.13, for both types of firms.

The likelihood of selecting A differs by only 3 percentage points across the two types of developers when the only policy instrument is flexible cleanup standards.[17] Finally, on combining 20% financial assistance, liability relief and flexible cleanup standards, the model predicts that the two types of developers will have probabilities of selecting A equal to 64% and 44%, respectively. (All probabilities are virtually the same when we use our preferred specification of the random-coefficient logit; see Alberini et al., 2003 for details.)

Comparison between larger and smaller firms suggests that they are similar in terms of their preferences for liability relief and flexible cleanup standards. They do differ, however, in terms of their responsiveness to financial incentives. Larger firms have a lower probability of selecting A at all levels of the subsidy. When offered a policy package that includes a 20% subsidy, flexible cleanup standards and liability relief, for larger firms the likelihood of selecting project A is about 46%, whereas for smaller firms this probability is 58%.

It is also possible to compute the probability of choosing one of two *contaminated* site alternatives, A and B, where A offers a subsidy, and B offers other incentives of a non-financial nature. For example, consider a contaminated site A with 10% financial incentive. If B offers only liability relief, the probability of choosing A is 46.40% for a developer with contaminated site experience, and 38% for a developer with no experience. While it takes a financial incentive equal to 14% of the value of the project for a developer with experience for him to be indifferent between the two projects, the financial incentive must be raised to 50% before an inexperienced developer is indifferent between the two projects.

When B is a contaminated site where the cleanup standards are flexible, about 56% of the developers with prior brownfield activity would choose A, the contaminated site with 10% financial assistance, and a similar percentage of inexperienced developers would prefer B. These examples once again illustrate how developers with contaminated site experience are more easily drawn to direct subsidies, while developers who have not dealt with contaminated site before respond more to liability relief or other non-financial incentives.

5.7. Marginal prices

Table 6 displays the marginal prices of the attributes for the sample as a whole and for specific groups of developers, based on the median gross revenue of a project (€ 7 million, or approximately US$7 million at the current exchange rate). The table shows that the presence of contamination is worth € 2.5 million, in the sense that, all else the same,

[17] The marginal effects of flexible standards are 0.04 for developers with prior contaminated site experience, and 0.06 for developers without such experience.

Table 6
Marginal prices in million euros, based on the median gross revenue per project (€ 7 million)

	Complete sample	Experience with contaminated sites	No experience with contaminated sites	Larger firms	Smaller firms
CONTAM_P	2.549 (1.267)*	1.455 (0.702)*	7.119 (4.310)	5.029 (3.306)	2.081 (1.015)*
CERTIFIC	1.464 (0.302)*	0.921 (0.209)*	3.433 (1.743)*	2.521 (1.384)	1.240 (0.271)*
OVERS	0.108 (0.019)*	0.059 (0.010)*	0.277 (0.127)*	0.164 (0.076)*	0.096 (0.016)*
FLEXSTDS	0.738 (0.222)*	0.318 (0.164)	2.066 (1.172)	1.540 (1.029)	0.572 (0.204)*

Standard errors in parentheses.
* Indicates that the marginal price is significant at the 5% level.

developers would require financial assistance for € 2.5 million for a € 7 million project involving a contaminated site where remediation has not been undertaken yet. This is the full cost of contamination, which is equal to the cost of cleaning up contamination, plus liability costs (Alberini et al., 2003).[18]

An alternative interpretation is that developers would be willing to sacrifice up to € 2.5 million to obtain a pristine site. This accounts for almost 37% of the gross revenue of the project. There is, however, much variability in the value of avoiding contamination between different types of developers. Developers with contaminated site experience, for instance, would require only € 1.46 million, smaller developers € 2 million and larger developers € 5 million.

The certification of completion, which exempts the developer from future liability over contamination at the site, is worth about € 1.5 million, implying that developers would sacrifice this amount to secure a letter of completion by the appropriate government agency. This is approximately 21% of the gross revenue from the project. Developers with no experience at contaminated sites are willing to pay *more* to obtain one such a letter (€ 3.4 million vs. € 0.9 million of developers with experience).

Our model also implies that each month of delay in the approval of cleanup plans is worth € 108,000. It is interesting that developers who have previously engaged in projects at contaminated sites and smaller developers attach lower values to a delay of one month in the agency's response time (€ 59,000 and € 96,000, respectively). Finally, the marginal

[18] The value of contamination is calculated as $-\hat{\alpha}_{\mathrm{CONTAM\_P}}/\hat{\alpha}_{\mathrm{SUBSIDY}}$, where the subsidy is calculated for a project of 7 million, and corresponds to solving the equation $p_S^A - p_A^A - D - E - L + F = p_S^B - p_A^B - D$ for F, where the superscripts denote the site A and B, and A is contaminated, while B is uncontaminated. Here, it is assumed that the non-cleanup development costs D would have been the same across sites. If the respondents held the revenue, net of acquisition costs and non-cleanup development costs D, the same across alternatives, as they were instructed to do, the direct payment F required by the developer to undertake the project at the contaminated site should be equal to the full cost of contamination: i.e., cleanup costs E plus liability costs L. If the net revenue were *not* held constant across alternatives, the value of contamination would also include the difference in the sale prices and acquisition costs across the alternative projects. If the price for which the developer purchases the contaminated property lowers exactly by the amount of the cleanup costs, E, then the value of contamination is equal to the difference in the development project sale prices, plus the expected liability costs. If the sale price of project A is the same as that of B (i.e., after cleanup, the fact that it was contaminated when it was acquired by the developer no longer matters), then the subsidy F that must be given to the developer to make him indifferent between A and B is equal to expected liability.

price of flexible standards is € 738,000, implying that respondents would pay this amount to have the opportunity to negotiate the cleanup standards with the government agency. This figure represents roughly 10% of the gross revenue of the project here considered (€ 7 million).

6. Conclusions

Conditional and random-coefficient logit models of the responses to the choice questions in our survey of real estate developers indicate that developers find sites with contamination problems less attractive, and that they do value liability relief. This confirms our expectation that contaminated sites are less desirable, but refutes earlier claims (Urban Institute et al., 1997) that liability does not matter. This finding is comforting, in the sense that it provides support for state legislation and programs established in recent years in the US, which encourage voluntary cleanup in exchange for liability relief.

Our respondents are not deterred by prior contamination, once it has been cleaned up, and appreciate fast-track review of development and remediation plans, direct financial incentives and flexible cleanup standards. This suggests that these are acceptable policy tools that can be used to influence land use.

Developers with prior experience with contaminated sites are more responsive to financial assistance than the others. The likelihood of selecting the contaminated site vis-à-vis a pristine site increases by roughly 11% points for every additional 10% subsidies for developers with contaminated site experience, but by only 2% points for developers without contaminated site experience. Those developers who are not experienced with contaminated sites are relatively insensitive to subsidies and more responsive to liability relief. Perhaps this reflects different expectations with respect to the cost of remediation, or subjective perceptions about the difficulties of and the transaction costs necessary to secure the subsidies. Similar considerations hold for larger firms. Developers who sell their development projects, instead of using them themselves or renting them, value liability relief even more highly.

The fact that developers vary in their response to subsidies and liability relief also suggests that at locales where tax credits or cash rebates are offered to the developers for cleaning up and redeveloping contaminated land, one would expect these policies to attract primarily developers who have previous experience with contaminated land. This suggests that subsidies may be a relatively inefficient way of soliciting cleanup and redevelopment at locales where virtually all prospective developers have not engaged in brownfield projects before. Perhaps this is one reason why monies allocated to brownfields redevelopment have had little success in certain areas.[19]

We calculate that for a project worth € 7 million in gross revenue (the median revenue) developers need to be compensated € 2.5 million for them to accept a contaminated site (in the absence of other policies), and are willing to give up € 1.5 million to secure a

[19] For example, Schoenbaum (2002) reports that as of 2000 none of the US$1.3 million allocated by the Maryland brownfields legislation has been used for a major industrial redevelopment project.

certificate of completion that would exempt them from future liability. Each month's work of delay in obtaining approval of cleanup plans is valued €108,000, while flexible cleanup standards are valued €738,000.

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