Approaches to Brownfield Regeneration:

The Relative Value of Financial Incentives, Relaxed Mitigation Standards and Regulatory Certainty

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Abandoned and derelict lands exist in virtually all countries. Polluted or environmentally suspect sites often become the responsibility of the national or local state because they are not attractive market prospects for private investment or because their owners do not want to bring them to market for fear of incurring legal obligations or costs associated with past contamination (Meyer, Williams and Yount 1995). In such instances, some state intervention may necessary to bring sites to market and/or attract private capital to finance reclamation and redevelopment. In the interest of both overall economic efficiency and of attaining the greatest environmental improvements from the expenditures of limited environmental agency budgets, public sector and quasi-public bodies continue to search for (or, at least, *should* seek) the most cost-effective means of attracting private sector interest in such sites. This paper addresses the intervention alternatives available, discusses their characteristics and impacts in principle, and provides some preliminary evidence on the efficiency, effectiveness, and distributional impacts of efforts to date in different institutional settings.

We begin with an overview of generic types of interventions, building from the experience in the United States and then moving to the more direct state interventions and efforts that can be found in member-states of the European Union. Next, we turn to the decision-making logic of the key actors in the brownfield redevelopment process: private investors, in order to model the accounting processes that state action may affect. We then examine the impact of the possible interventions on the private rate-of-return calculations to address potential responses to the state actions, moving from models to examples of actual impacts. We conclude with

consideration of the relative value and effects of the different state actions, taking into consideration the diversity of institutional settings in which they may take place. As a result, we do not attempt fully generalized findings, but, rather, address contextual factors that may shape the relative value of different interventions.

I. Types of State Actions to Promote Brownfield Redevelopment

Four broad classes of direct intervention have been used to promote clean up and reuse of brownfield sites:

Regulatory relief from current legal obligations could take the form of less stringent or otherwise modified cleanup standards and/or faster notice and greater certainty of approvals for site mitigation plans. In many instances, standards for site mitigation already can vary to some degree, depending on existing or future zoning or other land use restrictions. Such 'institutional controls' (which can be deed restrictions, deed notices, easements, or take other forms) have become the *sine qua non* in the United States for providing adequate protection at sites with residual contamination, yet they are not without their own difficulties vis-à-vis enforcement, funding, regulatory authority, monitoring, and implementation (ASTSWAMO 1996; Fogelman 1992; Gaspar and Van Burik 1998; Meyer 1999b; Wernstedt and Hersh 1998). Relief may also be provided through relatively simple mechanisms for provision of regulatory certainty: written cleanup standards, timetables for decisions by regulatory bodies, and other measures that, while not affecting standards or undermining state powers, raise expected investment returns simply by eliminating some of the need to make allowances for uncertainty.

Liability reduction, lowering the potential for public or private claims requiring payments and/or cleanup actions that undermine returns on investment, may be provided privately, at least in the U.S., now that three different types of environmental insurance have become more readily available from private vendors (Yount 2000).[1] State-imposed liability is far greater in the US under its 1980 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) than has been common in other countries. However, the UK's Environment Act 1998 now has imposed similar joint and several retroactive and prospective liabilities for further cleanups or environmental damage. Similarly strengthened assignment of responsibility to previous site owners or operators for past pollution may be expected to arise in other nation-states as efforts to privatize cleanups by making past polluters actually pay are implemented both as a matter of principle and as a means of reducing state expenditures on site mitigations. If the potential costs, and uncertainties, of liability are high, then selective reduction of those risks can make certain sites more attractive relative to others.

Direct financial support for regeneration of brownfields may just be targeted traditional economic development efforts such as loans, grants or tax relief, but it also can take the

[1] Vendors, mostly insurance companies that operate internationally, have indicated an interest in expanding their European markets. The less onerous liability provisions in non-US markets, however, may limit the value of coverage to developers, and thus the expansion of this sort of private provision of relief.

form of assistance for transaction costs such as site environmental condition assessments, which would increase interest in brownfields rather than simply improving the returns on a brownfield investment already under consideration. In some instances, the assistance may be little more than symbolic, such as with reduced interest rates on laons held for relatively short periods of time as sites are redeveloped for sale. However, there is sometimes an additional 'comfort level' provided by such state participation, since developers may feel that the threat of future enforcement actions demanding additional cleanups or claiming environmental damage is reduced if they have a public 'partner.

Site reclamation by the state, whether undertaken by a municipality, a region, or some public-private agency acting on behalf of a local authority or other body, may be undertaken to deliver a "clean" property to market for private developers. This form of intervention may be undertaken to reduce investor concern over uncertainties associated with the cleanup processes. If liability for any future damages or additional cleanup needs is accepted by the state, then this action can also reduce the perceived exceptional risks to returns on redevelopment on brownfields that investors would otherwise have to accept. Thus, even if the dollar costs of land acquisition and site preparation (mitigation or containment of contamination) are recovered by the agency reclaiming a property — and even if there is a surcharge to allow for future liability risks — the state intervention can contribute to increasing the attractiveness of a brownfield site by reducing the uncertainty facing a prospective redeveloper.

In practice, these incentives are often offered simultaneously, in part because different agencies or levels of the state are responsible for the different types of support, with the result that excessive subsidy may be offered, potentially at a loss to overall public well-being.

A fifth intervention is often very significant, but often overlooked in discussions of efforts to reclaim contaminated sites:

Constraints on new developments on greenfield sites raise the costs of real estate investment in the land that competes with brownfields within any given land market. These limits may take the form of urban growth boundaries or urban service area boundaries (the dominant constraints in the US, although they are rare), designations of greenbelts (such as those in the UK), limits on agricultural land conversions (as exist in the Netherlands and other nations), or designations of park lands that cannot be converted for private development. Beyond prohibitions, however, there is an array of policies that can add costs to new construction on open land, and thus make brownfield reclamation more attractive to investors choosing sites for development within a real estate market. These policies and practices include: development 'exactions' — special tax assessments for infrastructure expansion, concurrency and adequate public facilities requirements, density controls, special use zoning and other land use requirements limiting the type of development that can be undertaken, road pricing schemes that raise costs of commuting and lower desirability of housing outside city centres, constraints on parking or driving in cities that channel development toward areas already served by mass transit, and the like.

The constraints may, however, be undermined by implicit or explicit subsidies to land conversion that are undertaken for reasons not related directly to either environmental conservation or reclamation or even local economic development. It appears that, across industrialized countries,

the expansion of public services financed by the national state has provided facilities to populations in low density areas that the local state has historically been unable or unwilling to offer its citizens. This pursuit of equality in public facilities may have the inadvertent effect of subsidizing conversion of greenfield sites to urbanized uses at the expense of abandonment of previously development sites.

II. The Private Developers' Investment Decision Logic

The real estate investment decision in the absence of exceptional uncertainties can be expressed in a simple discounted net income stream calculation.[2] Basically, the present value of the net income from a project is dependent upon income and cost projections and a discount rate reflecting time preference, the time value of money and risk.

A fundamental difference between brownfield projects and those pursued on undeveloped greenfield sites lies in the perceived risks associated with the investments. These risks complicate investment decisions, so their role needs extensive examination. The empirical real estate appraisal literature in the US stresses the need for a higher time discount rate to address risks, suggesting that, while the discount rate on never-contaminated sites might be the prime or corporate bond rate, the 'junk bond' (exceptionally high risk) rate might be appropriate for previously polluted sites, even if fully cleaned to state and federal standards, (Chalmers and Roehr 1993; Meyer and Reaves 1998). On a more theoretical level, Boyd, Harrington, and Macauley (1996) modeled the effects of the US CERCLA liability exposures on brownfield redevelopment decisions that examined differential buyer and seller risk aversion, asymmetric information about liabilities, and the incomplete information available to all parties about actual environmental conditions. More recent empirical evidence suggests weakness in their underlying assumptions, but their treatment of possible warranties (and associated moral hazard problems) and the value of various forms of indemnification provides a possible platform for further conceptual development.

Brownfield sites, that require some analysis of the likelihood or extent of contamination as part of the investment decision, pose higher initial transaction costs that so-called greenfields, with no prior on-site construction, do not pose. Thus even the suspicion of possible pollution may deter investment. Moreover, any tendency toward undervaluation of possible returns on brownfield projects creates a further barrier: If a potential developer does not consider it likely that a particular parcel of land may provide an adequate return on investment, it may be dismissed out of hand and never examined if greenfield alternatives are available (Meyer 1999a; Yeager and Meyer 1994; Yount and Meyer 1999). The increased costs associated with examination of possible returns on brownfields, relative to greenfields, include:

[2] This discussion is based on models and evidence from the United States. In the context of globalization of investment, however, the investment logic described is applicable in other nation-states as well. Especially in the context of real estate investment, a favorite sector for superannuation and retirement plans because of perceived stability of returns, the issues of risk and uncertainty addressed here are relevant to virtually all market economies.

(a) Environmental assessment fees associated with determining the presence and extent of possible contamination — a cost which, even for sites as small as 0.25 acre (0.1 hectare), can exceed US$10,000 (Strayer 1992);
(b) Project delays, since site assessments take time to complete — and the time involved is not predictable unless existing conditions on site are known (Bartsch, *et al.* 1991);
(c) Potentially higher fees for loan origination since lenders anticipate a higher, proportion of wasted underwriting expenditures on contaminated sites developers do not pursue; and,
(d) Additional legal expenses, associated with (i) legal counsel to ascertain that due diligence requirements for minimizing liability exposures have been met, and (ii) regular reassessments of regulatory requirements at both the federal and state levels that have been constantly changing in the US as case law continues to evolve (Fogelman 1992).

The probability of a positive investment decision must be high enough to warrant incurring these higher transaction costs for a project to attract any developer's attention, and the return on investment in the event of a "go" decision must cover these costs as well as project expenditures.

In this context, the uncertainties associated with brownfields, exemplified by the many factors that could reduce returns on investments, pose substantial barriers to investor interest in redevelopment. These potential negative impacts on the returns to a completed redevelopment can arise from:

(a) Unexpected costs for property mitigation, even after completion of all site assessment studies and regulatory approval of cleanup plans (Pepper 1997);
(b) Property stigmatization, associated with publicity over having been contaminated or having required environmental mitigation and perceptions of sites as "polluted" even after cleanups are certified as having met all regulatory standards (Meyer 1999a; Mundy 1992);
(c) Post-cleanup monitoring requirements that could continue for several decades, require recorded easements and other deed restrictions that limit the future development and use of the affected property (Fogelman 1992);
(d) Lender and other investor-imposed or demanded deed restrictions and/or restrictive covenants intended to limit their liability and that of possible future owners of a previously contaminated site (O'Brian 1989), and institutional controls on possible site uses imposed under state programs that permit retention of on-site contaminants as a means of reducing cleanup costs (Bartsch, Collaton, and Pepper 1996; Meyer 1999b);
(e) Conflicting and changing standards for mitigation over time as governments alter requirements and regulations. Additional accounting set-asides to cover uncertain and unanticipable risks of costs incurred for additional clean-up effort are thus instituted (Bartsch, *et al.* 1991; Yount 2000); and,
(f) Improved contamination detection and mitigation technologies that historically have resulted in more stringent standards, leading investors to reduce their expected returns from development projects to allow for future mitigation expenditures (Bartsch, *et al.* 1991).

Chalmers and Roehr (1993: 31) provided a good framework for understanding the way in which the discounted income stream from a real estate investment shifts when investors must address the risks associated with contamination. They describe the brownfields appraisal in terms of Equation (1), modified here for clarity in nomenclature:

$$V_c = \sum_{t=1}^{T} \frac{NOI_t - (LC_t + RC_t + IC_t)}{(1 + i_C)^t} \qquad (1)$$

where:

V_c	=	Present Value of the property as contaminated
NOI	=	Net Operating Income of the property as uncontaminated in year *t*
LC	=	Lost income resulting from Contamination in year *t*
RC	=	Remediation costs resulting from Contamination in year *t*
IC	=	Indemnification costs resulting from Contamination in year *t*
i_C	=	Risk-adjusted discount rate appropriate to a contaminated property
t	=	Year
T	=	Time horizon used in project planning

Their formulation involves first subtracting expected costs related to contaminated properties (LC, RC, and IC) from the net operating income (NOI) on the property if it were clean. The discount rate is also raised to incorporate the additional risk associated with brownfields. Thus, the costs of risk exposure appeared to be double-counted by their inclusion in the expected values of LC, RC and IC while the discount rate is also raised. Equation (1) can avoid double-counting only if the expected values in the numerator include *known risk*, while the modified discount rate, i_C, is adjusted only for the unknown element, *uncertainty*.

Equation (1) provides the foundation for determining the expected returns on investment, but does not address the issue of developer willingness to even consider a brownfield project. The higher transaction costs associated with such an investment pose another barrier, as suggested by Equation (2):

$$VT_0 = \frac{(VP_\tau)*P(go)}{(1+d)^\tau} - \sum_{t=0}^{\tau} \frac{TC_t}{(1+d)^t} \qquad (2)$$

where:

VT_0	=	Value of the investment at the transaction decision point
$VP\tau$	=	Result of Equation (1) taken at time τ
P(go)	=	Probability of a 'Go" decision, given the value of $VP\tau$
TC_t	=	Transaction Costs in year t
d	=	Discount rate
τ	=	time period by which all site assessment and other transaction costs have been undertaken and findings delivered

Obviously, the first step toward a brownfield project, that is, investment in determining if the development has any potential investment attractiveness, will only be taken if (VT_0) exceeds zero. High TC could doom a project even if it had an above-market $VP\tau$; traditional economic development support — most commonly some set of market-based incentives — or policies lowering risk reductions and thus raising $VP\tau$ thus may not stimulate investment on brownfields without some regulatory reform that also reduces the transaction costs. Moreover, to the extent that TC_t is not divisible, small brownfield sites, the majority of environmentally suspect parcels,

may not be able to attract any investor interest without regulatory actions to reduce transaction costs. Thus the most important interventions may be those that affect the level of TC_t, regardless of the impacts on overall return on investment.

To more closely examine the key issues of risk and uncertainty that are central to clarification of Equation (1), we can borrow from long-standing and proven methods used by the insurance industry, specifically the protocols for generating experience modification factors from partially known data on risk exposure (Parry and Math 1993; Perryman 1937). We adapt the logic used for experience modification for US workmen's compensation policies (insuring against workplace injuries or death) to integrating the nominally certain and the extremely uncertain exceptional costs associated with brownfield development into the investment decision logic. In the ideal, adequate experience can eliminate uncertainty, but limited knowledge about actual risks requires that a "modification factor," M, be introduced to incorporate uncertainty into the calculations in a consistent fashion. Parry and Math (1993) offer the following formulation for modifying an insurance rating for uncertainty:

$$M = \frac{A_p + B + W*A_e + (1-W)*L_e}{L + B} \qquad (3)$$

where:

	A_p	=	The actual primary losses experienced industry-wide
	B	=	The 'ballast' or expected 'normal' firm-specific loss differences
	W	=	The credibility weight assigned to past actual excess losses
	A_e	=	The actual excess losses experienced in the past
	L_e	=	The expected excess losses in the future
	L	=	The total expected losses

This formulation was originally intended to apply to individual companies, with W and B reflecting the attitudes and perceptions of individual firms being rates for insurance risk. In the context of the brownfield investment decision, reliable data on W and B can only be obtained from a mix of projects involving many developers, since no one firm will have sufficient project experience to permit derivation of statistically defensible values. However, since, in most instances, developers are under no obligation to publicly disclose their financial expectations and actual returns, the equation is not directly estimable with any reliability from available data.

Equation (3) nevertheless suggests the directions that policy may need to take to generate additional private sector interest in brownfield projects. The formulation of greatest interest in modeling the real estate investment decision in a context of uncertain environmental and regulatory risks and liabilities is the treatment of the knowledge about "excess losses." In greenfield real estate development projects, the actual and expected excess losses would be negligible to nonexistent: 'Primary losses,' A_p, would be those factors reducing investment return that are routinely incorporated into discounted income stream projections and expected values. The ballast term, B, would reflect the overall project size relative to the excess losses, A_e, presumably swamping the latter for most projects. However, the excess losses can overwhelm the total project costs if unanticipated environmental problems are found on a given plot of land

proposed for development, if regulatory processes impose excessive delays, or if regulatory processes raise the uncertainty associated with the investment.

The impact of policy changes on the expectations of the potential developers and other investors thus are central to any assessment of alternative state interventions. The so-called 'availability heuristic,' leading to the most memorable events being presumed to be most common, may generate overestimates of the risks to which brownfield investments are regularly exposed (Kahneman and Tversky 1973; 1979; Lichtenstein, *et al.* 1978). News media coverage of development projects abandoned upon discovery that expensive mitigation actions are required attracts attention. Discussions at business organization gatherings are likely to turn to such events, especially if they have been frequent or involved large sums of money, so the cases of high costs become memorable, while successful projects involving comparable risks may attract no attention at all. Arguably, many of the new 'Voluntary Cleanup Programs' promulgated by the individual states in the US may have accomplished more through generating positive changes in perceptions through publicity about state support for brownfield redevelopment than they have through any real changes in regulatory processes or the provision of financial assistance (Meyer 1996; 1999b). Alternatively, heightened debate about the problems posed by contaminated land and the need for new state initiatives to implement the polluter pays principle, such as has occurred in some EU member-states, may substantially raise fears and thus developers' perceived uncertainty, even in the absence of any actual policy shifts.

III. State Interventions and Private Responses

We can examine the expected impacts on investment decisions of the different state interventions in greater detail by returning to critical parameters and variables in the decision equations. Tables 1 through 3, one for each equation, summarize the impacts of the five different interventions on key decision elements. The Tables may be examined in order, although the third equation actually feeds back into the first equation, and, through it, the second. Impacts (positive [+] and negative [—]) are identified as D, direct, or I, indirect. Only those effects that act directly on expenditures or expectations of developers; indirect effects are those that result from the impacts of public sector actions on other parties to the redevelopment.

As Table 1 illustrates, no one public action successfully contributes unequivocally to an improved value of all the variables or parameters in the Equation (1). That is, while all may contribute to a higher value for V_c, the present value of the site recognized by developers looking for investment properties, none does so uniformly for all the elements of the equation. In fact, there is a substantial variation that depends on two key state policy variables that cannot be distinguished in this generalized overview:

- Regulatory relief may have very direct effects on actual costs associated with site remediation or mitigation, but, if the public does not accept the pollution mitigation or containment standards used, then a negative effect could emerge, resulting in a reduced value for NOI that could undermine the gains on other variables.

- Liability reduction does not, in itself, improve the financials for an investment, except in so far as it reduces indemnification costs or the uncertainty and perceived risk facing

financiers, thus reducing the costs of capital or increasing access to debt financing, and in possibly lowered the applicable discount rate applied to the project net income stream.

- Direct financial support, by contrast, has a major impact on key financials, specifically NOI and RC, but does not, despite state participation, necessarily affect the risk and uncertainty elements, that are critical to brownfield project valuations.

- Site reclamation by the state may be a major contributor, but much of the impact of this contribution depends on the price at which remediated sites are made available for redevelopment. If the state recoups its costs in the prices charged, then the only effects are really on perceived uncertainty, if the state, as site mitigator, ends up accepting future liability for possible overlooked or unremediated contaminants.

- Constrained greenfield redevelopment is relevant to brownfield decisions only to the extent that state policies effectively limit alternatives to reclamation of previously used sites. Except in the case of absolute provisions on conversion of open land to development, these policies promote brownfields only to the extent that they effectively deter greenfield conversions, which would proceed despite added costs so long as the private costs to clean brownfields exceed those of expanding urbanization of greenfields.

Given very different costs associated with the intervention alternatives, no one policy can be determined to be preferable. The dependence on state decisions about cost recovery for expenditures on site mitigation efforts and on the extent, not just the presence, of constraints on greenfield development means that policies and practices with respect to public ownership of land and development rights may be more important in explaining cross-national differences in policy impacts and choices than the calculations of development investors, which may be expected to be the same across most countries. A further issue affecting the role of different interventions is the capacity of a private greenfield developer or brownfield redeveloper to make exceptionally high profits on property investment through increased land values. In any national context in which such value gains are captured by the state, whether through taxation, state controls on land prices, or any of a variety of state controls over land and land uses, many of the potential increases in the attractiveness of brownfields reported here if the sites are reclaimed by the state or made more desirable due to constrained greenfield conversions to urban uses may dissipate.

Table 1
IMPACTS OF PUBLIC ACTIONS ON PRIVATE BROWNFIELD REDEVELOPMENT DECISIONS

Decision Parameter or Equation Variable	***Regulatory relief***	***Liability reduction***	***Direct financial support***	***Site reclamation by the state***	***Constraints on new developments on greenfield sites***
NOI - Net Operating Income after cleanup	?? [depends on public acceptance of the site mitigation	0 [except if interest is lowered on loans as a result]	+ (D) [if taxes or interest rates are reduced]	?? [depends on the price charged after cleanup is done]	+ (I) [if demand for brownfield sites rises due to fewer options]
LC – Lost income due to Contamination	— (D) [fast approvals]	0	0	— (I) [if site not sold until clean]	0 [but might be higher if NOI is raised, so lost rents are increased]
RC – Remediation cost due to Contamination	— (D) [low cleanup cost]	0	— (D) [if funds are for cleanup]	— (I) [if site not sold until clean]	0
IC – Indemnification costs due to Contamination	0	— (D)	0	— (I) [if state accepts all liability]	0
i_C – Risk-adjusted discount rate	— (D) [if the public action offers more certainty]	— (I) [if lenders' uncertainty appears to decline]	0 [but — if state shares liability for any future costs or claims]	— (I) [since state accepts liability for any future costs or claims for the mitigation]	0
T – Time horizon	0	0 [but + if site is held longer]	0 [but + if loan terms are longer]	0	— (I) [if demand for brownfield grows fast, then developers may be able to take profits earlier]
V_c – Present Value of the property while still contaminated	+(D) [unless public rejects mitigation	+ (D and I)	(D) [plus I impact if state shares liability]	+ (I) [depends on state site disposal practices, charges]	+ (I) [improved competitiveness of brownfields due to reduced availability of alternatives]

Whatever the calculation on the present value of the investment, the transaction costs associated with even considering a brownfield site and its exceptional risks and uncertainties may preclude redevelopment that would, if pursued, have positive returns on both the public and private balance sheets. That is, if it costs too much to engage in the effort to adequately quantify risks and rewards in order to decide whether or not to incur an investment risk, then the project will not even be considered. Equation (2) offers the logical construct for the 'should be consider' decision, and the impacts of the different interventions are displayed in Table 2.

The first row of Table 2 is simply a restatement of the summary finding from Table 1 — the net impact on the present value of the project, if pursued. That return then is weighted by the likelihood that, in the current investment climate, a given return on investment, $V_{p\tau}$, will result in a decision to pursue redevelopment, the P(go). This probability may be raised if alternative investments are not available. The real key lies in the transaction costs themselves. As a result, most interventions have only minor impacts on the willingness to incur the transaction costs, other than through their effects in Equation (1) on the expected returns on the investment, $VP\tau$:

- Regulatory relief may be expected to have major impacts, since the policy is explicitly directed at transaction costs, especially provisions that limit the time and developer-supplied data requirements for state decisions on site mitigation plans.

- Liability reduction may increase the willingness to consider brownfields, first through an indirect effect on financiers, who may be more willing to provide funds, and, second, by possibly eliminating the time and other costs associated with negotiating insurance coverage for liability risks. (Note, however, that the risks associated with pollution cleanup or containment efforts themselves themselves are not eliminated, so insurance may still be pursued.)

- Direct financial assistance may be available for investigation of site conditions and the preparation of remediation plans. Such support may be of significant direct value in stimulating consideration of brownfield redevelopment projects.

- Site reclamation by the state can reduce liability and permit the private developers to avoid assessment costs since that will have been done by the public entity conducting the reclamation. Those costs, however, may be recovered in the price of the land — or accepted as public charges in return for constraints on possible types of new developments, so the overall impact on private may, in fact, be negative.

- Constraints on greenfield developments have no impact on willingness to consider brownfield sites, unless developers' financiers are constrained to local real estate markets and have their alternatives to brownfields eliminated. Given increasingly global capital flows, this possible positive impact is not very likely to arise.

From this summary, it appears that direct actions to reduce transaction costs may be the most cost-effective state interventions. It may even be possible to recover some of those public expenditures from investors in successful redevelopments, an issue to which we will return.

Table 2
IMPACTS OF PUBLIC ACTIONS ON PRIVATE WILLINGNESS TO CONSIDER BROWNFIELD INVESTMENTS

Decision Parameter or Equation Variable	***Regulatory relief***	***Liability reduction***	***Direct financial support***	***Site reclamation by the state***	***Constraints on new developments on greenfield sites***
VPτ -Result of Equation (1) taken at time τ	+(D) [unless public rejects mitigation]	+ (D and I)	(D) [plus some I impact if state shares liability]	+ (I) [depends on state site disposal practices, charges]	+ (I) [improved competitiveness of brownfields due to reduced availability of alternatives]
P(go) - Probability that redevelopment will be undertaken, given VPτ	0 [unless risk falls, and, with it, investment return needs]	+ (I) [lower risks lead capital to become available]	0	0 [may be + if the state accepts more future liability risks]	+ (I) [if potentially more attractive investment options are eliminated, then a somewhat lower return will be accepted]
TC_t - Transaction Costs in year t	— (D) [the intent of such actions]	0 [— if no insurance is sought]	— (D) [if the support is for transaction cost]	— (I) [state action eliminates site assessment need]	0
d - Discount rate	0	0	0	0	0
τ - time period for TC to be expended, completed	— (D) [the intent of such actions]	0 [— if no insurance is sought]	0	— (I) [state action eliminates site assessment need]	0

Thus far, we have not paid close attention to the elements that enter risk perceptions and the role in brownfield decisions of efforts to quantify uncertainty. Equation (3) addresses these matters directly, and Table 3 reviews the impacts of the alternative state interventions on the variables that shape risk and uncertainty perceptions and calculations. The 'findings' in this table are more tenuous than those reported previously, in part because data are exceedingly difficult to obtain on actual losses and the extent to which they may be 'excess,' that is, greater than expected, either for the industry as a whole, or for individual developers. Moreover, there is a question about what constitutes the 'industry' referent for the baseline A_p primary losses: is it the redevelopment sector as a whole, the brownfield redevelopment sector alone, only those brownfield sites with particular known characteristics (steel mills as compared to dry cleaners, for example), or is it specific to geographic location, since the liability exposures may vary from state to state or nation to nation?

The data gaps derive from the unwillingness of any of the stake-holders in brownfield investments to disclose possible errors in judgement — such as not anticipating sufficient losses. Reports thus may falsely raise B and lower A_e, so as not to reveal unexpected or excess losses on past projects. More significantly, no reports may be filed, since most activity does not involve publicly traded firms, other than lenders (who normally report only some forms of aggregate loan losses, not losses by specific types of project).

Given these caveats, some comment is possible on the relative impacts of the different state interventions on the perceptions of the exceptional risks associated with brownfield projects. One uniform finding is that a key variable, the actual past excess losses, A_e, will not be affected, at least in the near term. Beyond this, there is variation impacts across the different interventions:

- Regulatory releif may create false hopes in the short term: relaxation of standards is taken to lower risk, while it really may raise uncertainty due to unknown community responses.

- Liability reduction is specifically intended to affect expected risks, and it may be expected to do so, but the adjustment to the new policies is not necessarily very short term.

- Direct financial support can in no way be expected to have any effect on perceived risks.

- Site reclamation by the state is no better at reducing perceived risks than other forms of financial aid, unless the state publicly accepts responsibility for future liabilities.

- Constraints on greenfield developments, by contrast, may have significant impacts on perceived risks since they may be taken as state actions against brownfields' competitors, thus permitting exceptional profits on the previously contaminated sites to cover any unanticipated risks.

Obviously, the data problem that may exist in actually calibrating Equation (3) is compounded by the fact that any changes in the key parameters, B, W, and L_e, are clearly a matter of perception, requiring some form of investor interview data — and the sample of developers and financiers needed to control for contextual variation in such a calibration effort is simply not available.

Table 3
IMPACTS OF PUBLIC ACTIONS ON PERCEIVED/ANTICIPATED EXCESS RISK

Decision Parameter or Equation Variable	***Regulatory relief***	***Liability reduction***	***Direct financial support***	***Site reclamation by the state***	***Constraints on new developments on greenfield sites***
A_p - Actual primary losses industry-wide	0 [standards do not affect actual risks]	— (D) [the long run intent of the intervention]	0	0 [in short run, prior to experience accumulating]	0
B- 'ballast' - expected firm-specific losses	0	— (D) [the long run intent of the intervention]	0	— (I) [if state takes on liability after the cleanup]	0
W - Credibility weight for past excess losses	— (D) [new policies negate past problems]	— (D) [new policies negate past problems]	0	0	0 [but — if developers expect brownfields to become more competitive over time]
A_e - Actual past excess losses experienced	0	0	0	0	0
L_e - Expected excess losses in the future	— (D) [false hope that risks fall as a result]	— (D) [the short term intent of the intervention	0	— (I) [if state takes on liability after the cleanup]	— (I) [if developers come to expect higher returns, less risk, as brownfields become competitive]

IV. On the Impossibility of Generally 'Preferred' Forms of State Intervention

Summarizing the overall effects of state interventions, we see clear limits to the possibility of simple cross-national or even cross-state policy replication in the sensitivity of findings to contextual considerations. Different approaches to the recapture of expenditures on state conducted site mitigations or on the right of the private sector to make speculative gains on property investments can result in diametrically opposite outcomes for levels of private investment in brownfields from the same state interventions. Similarly, liability reduction is far more important in nations with extensive private litigation rights against the state or other private parties, and exceptionally significant in only one country, the United States, the most litigious nation on earth. The preliminary observations on the importance of contextual factors in evaluating contaminated land policies made by Meyer, Williams and Yount (1995) are borne out in this more detailed examination of alternative state interventions.

Whether within a single political jurisdiction or not, it also is clear that different interventions are not simple substitutes for each other. The discount rate, d, reflecting the time value of money in Equation (2), is independent of the brownfield-specific interventions in land markets. However, the risk-adjusted rate in equation 1, i_C, and the various loss expectation elements entering into determination of M in Equation (3), the uncertainty modification factor needed to arrive at i_C, respond very differently to the various state policy alternatives. Whatever their profit potential, the exceptional transaction costs associated with investment decision-making on brownfields may lead to them being overlooked by investors. Table 2 suggests that the relatively inexpensive state interventions associated with reducing such decision-making costs may actually have more effect on brownfield regeneration than far larger direct subsidies intended to increase investment returns. Similarly, regulatory relief that provides timing and decision certainty may be more significant than the far more environmentally risky regulatory alternative of reductions in cleanup standards for contaminated sites.

In the US, with its relatively low population density and vast array of open space, effective constraints on greenfield conversions that really shift comparative advantage to brownfield reclamation are far more difficult to implement than in nations with very limited land. The Netherlands can thus constrain greenfield conversions far more readily that the US (and, for that matter, Germany, or France, or the UK). Within the US, it is not surprising that Maryland, one of the smallest states with all its rural areas threatened by expansions from Baltimore in the north and Washington DC in the south, was the first state to pursue state-wide growth management. New Jersey, hemmed in by New York City in the north and Philadelphia in the south, came next. Neither has really stopped urban expansion, but they have channeled it, and contributed to somewhat higher density of new development than would otherwise have occurred.

The inability of New Jersey and Maryland to stop expansion and really channel investment toward brownfields is in part a matter of limited political will. Such a problem may face the larger member-states of the EU with relatively lower population densities. A further unique constraint in the US case derives from its national constitutional and traditional limits on the right of states to take land for public purposes, regardless of the amount of compensation paid to private landowners. Germany, by contrast, can decide on a formal objective of reducing the number of new hectares taken per day for new settlements and transportation from 120 to 30, and

the laender and the national state have the power to pursue this goal (Kmoch and Hoffman 2000). No such action, which could substantially raise the economic value of brownfields, is possible in the US context.

The US frontier traditions in many ways demonize the city and high population densities. These values can be supported by the high land area of the country, provided the costs of transportation do not escalate too much.[3] The constrained land areas of even the largest EU member states, on the other hand, result in far higher public costs (and, to some degree lower private returns) to low density, inefficient non-agricultural land uses. As a result, the economic incentives for brownfield regeneration start out at a higher level, for both the state and individual land owners, in Europe than in the United States (or Canada or Australia).

Two further advantages that many European countries enjoy are: (1) A high level of political commitment toward preservation of farming as a way of life, evident in WTO trade conflicts emerging from policies designed to protect farmers; and (2) Traditions that venerate old buildings and historical sites, and thus high levels of commitment to the urban areas that house many of them, as illustrated by application of advanced technologies to restore and rebuild old facades and street patterns to pre-war conditions after the destruction in World War II. Such restoration of 'inefficient' transportation infrastructure as narrow or twisting streets would undermine the economic potential of adjacent land in the US, while it increases property values in most European contexts.

These few simple examples should help to illustrate that any effort to derive 'optimal' state intervention strategies for a range of countries has to greatly expand the private decision equations above. It would be necessary to include new parameters that reflected the differences across nations and populations on a range of matters, only a few of which we have touched on here. The parameters would have to reflect variations such as:

- ☞ relative land valuations (urban and rural) attributable to population density and total land area constraints;
- ☞ attitudes towards historic preservation and other critical traditions governing state actions;
- ☞ non-land cost factors, notably the costs of fossil fuels and other sources of transportation power;
- ☞ materials costs and recycling policies affecting the costs of new construction relative to rehabilitation and restoration of buildings;
- ☞ public policies and traditions regarding charges for provision of infrastructure to new sites and newly urbanizing or developing areas;

[3] This comment ignores other environmental and public costs of sprawled, low-density development. It is not intended to imply that these factors are irrelevant, but they are not central to this argument.

- ☞ public policies regulation relocation of firms, especially as regards compensation paid to local political jurisdictions that may be abandoned;
- ☞ population mobility and frequency of household relocations; and,
- ☞ the nature of the financing of the local state, including its reliance on taxation of real estate, the extent of inter-local competition for revenues for the local fisc, and policies for local governments that provide incentives or disincentives for pursuit of dense development, and the capacity to offer mitigated properties at subsidized prices for transfer to private developers.

Finally, two other key parameters must be addressed: (1) the degree of economic desperation in the local job market, which is probably a good measure of the capacity of the local economy to attract capital for any purpose, not just brownfield regeneration, and (2) the size, in population and area of the local authority, which measures the local public capacity to shape real estate conditions, regardless of the actions of the national or regional state. These statistical measures of capacity should probably be used as the first building blocks to expanded models, since they constitute data that are already available for calibration.

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