Long-term Public Leaseholds in Poland: Implications of Contractual Incentives

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Abstract

Long-term land leaseholds are contracts that contain within them a redevelopment option. The structure of the contract influences the incentive to redevelop. We employ real option pricing techniques to evaluate the timing and intensity of the redevelopment decision by lessees in alternative contracts. We consider a contract similar to '*perpetual usufruct*,' the public long-term land leasehold system in Poland as well as the typical North American long-term ground lease. We also consider a lease in which extension is automatic if redevelopment occurs. Our research suggests that the system of *perpetual usufruct* is superior to a system employing the typical North American contract when the redevelopment outcomes of these alternatives are measured against the first best outcome that results in a system with fee ownership. The research also suggests that public land-leasehold systems will result, over time, in development densities that are lower than would arise under fee ownership systems.

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Long-term Public Leaseholds in Poland: Implications of Contractual Elements

by David Dale-Johnson and W. Jan Brzeski 6/02/00

Introduction

The long-term ground lease or land leasehold is a type of interest in real property that, in one form or another, is used in many countries around the world. The form of ground lease used in Poland, known as *'perpetual usufruct'* is another variation that is somewhat unique and peculiar to an economy in transition. Land is leased for up to 99 years and the lessee owns the improvements that are built on the leased land. Existing improvements must be purchased by the lessee upon granting of the lease. In Poland today, this form of leasehold can only be created by the State or a local government, typically a municipality. Similar contracts within the private sector have been proposed and debated but are not legally possible at this time. Private land leaseholds exist, but are for shorter periods and lessees may not have an ownership interest in the improvements. Also, the interest itself is not a real property right reflected on the title record of property, as is the case with the *perpetual usufruct.*

During the transition of the 1990s in Poland, long-term ground leases have been debated in both political and legislative realms. Some have argued for their elimination as 'relics of the socialist system,' which have no place in a modern market economy. Others have wanted to preserve them because they are 'in the public interest'. This debate has, for the most part, been devoid of economics and there has not been an attempt to provide an economic justification for the long-term ground lease or to determine if it makes sense to consider alternate structures of this instrument in the interests of economic development. It seems appropriate that the economic rationale for such contracts be examined before the contract is eliminated as a result of uninformed debate.

Some moves, pushed by residential lessees have already been made to reduce the use of perpetual usufruct in the residential sector. In the late 1990s, the Parliament, under the pressure of individual lessees, adopted a law allowing the lessees to buy out 'their' land for minimal compensation provided the land had been developed. As a result, local governments lost residential land assets that were producing a sizable portion of their revenues that could not be replaced by the area-based property taxation system in place. Given the state of the nascent zoning regulatory structure, local governments simultaneously lost an effective planning instrument. Non-individual (institutional or corporate) owners of residential land did not benefit

from this legislation. Recently, this law was declared unconstitutional because it infringed on local government land ownership rights. This has led to a lengthy political process to reconcile the situation.

Nevertheless, municipalities have retained the right to grant new leaseholds, which cannot be bought out by the lessees. Recently, the Ministry of Housing and Urban Development has started to emphasize the role of land leaseholds in land use policy, urban development and development financing. Consequently, there has been impetus to improve rather than eliminate long-term land leaseholds. Similar debates have been occurring in other transition countries.

This paper seeks to inform the debate regarding long-term public leaseholds in transition economies, as well as contribute to a global review by the Lincoln Institute of Land Policy. We focus on contractual and economic aspects of land leasing in the transition process, as well as on improving land leasehold instruments in terms of their effect on redevelopment timing and intensity. These issues are critical for the land use component of urban redevelopment strategies that are part of broader economic transition strategies.

The paper is organized as follows. Section I of the paper starts with a discussion of the legal and contractual elements of *'perpetual usufruct.'* To provide a baseline for comparison, Section II follows with a description of the typical structure of long-term land leaseholds in North America. In Section III we focus on the importance of real estate markets in transforming economies and describe ten benefits or advantages of long-term land leaseholds during the transition process. We also discuss incentive problems with respect to the redevelopment decision during the life of the long-term land leasehold contract. In Section IV, we review the relevant literature. Section V discusses our approach to shedding light on the debate associated with the long-term land lease in transforming economies. Section VI develops a model that determines the value of the development option to the ground lessee in the case of a single development opportunity. The model allows the determination of the timing and intensity of redevelopment in each of several contractual arrangements between lessee and lessor. In Section VII we describe the analysis and results followed by a discussion of conclusions and the implications for urban form in Section VIII.

I. The Structure of Perpetual Usufruct in Poland

We begin by describing the contractual terms of 'perpetual usufruct' as defined by law in Poland.[1] In the case of improved land, the granting (establishment) of a *perpetual* land leasehold *(usufruct)* has to be linked with the sale of improvements to the leaseholder (lessee). It follows that nobody else can be the owner of improvements but the leaseholder. If the lessee wants to sell the improvements, he has to sell also the *perpetual land usufruct* rights with it. In case of sale of condominium apartments (by the State or a municipality) what is sold is the condominium unit with a concurrent granting of a land leasehold right to a fraction of the land parcel under the condominium building.

The granting of the leasehold takes place in one step through a Civil Law contract executed by a notary public. In order to be enforceable, the *perpetual land usufruct* right needs to be registered at the land title registry (called 'constitutive registration') and the effective date is the date of the application to register the contract.

The granting of a perpetual leasehold interest requires that the State agency or local government impose competitive tender procedures requiring a 21 day public notice. The public tendering procedures may be waived in cases where:

- persons have statutory priority to obtain leasehold of particular land;
- there is a transfer between two government agencies;
- the lessee is engaged in specific activities such as charitable, custodial, cultural, health care, educational, scientific, R&D, sports and recreation;
- there is an exchange or gift;
- the subject property improves the use of the adjacent property;
- the land is an in-kind contribution to formation of a company or foundation;
- the lessee is acquiring the land after having developed it;
- the land is to be used for housing purposes (buildings, infrastructure) by non-profit organizations pursuing the goals of housing provision.

The highest price bid for the land is then used as a basis for establishing the 'initial payment' ranging from 15 to 25% of the land price that may be paid in installments. In addition the new

[1] The two main sources of law are the Civil Code and the Real Estate Act. The theoretical notion of the leasehold is embodied in the Civil Code, which codifies this property right allowing it to be registered in the land title registry in the same way as the freehold right. Consequently, it is an alienable, transferable, inheritable and mortgageable right, and thus even subject to possible subordination. This right can be established only on State and municipal land. The Real Estate Act regulates how this right is to be exercised by the State and local governments.

lessee pays, beginning the year after the granting of the lease, an annual ground rent (usually between 1-3%) that is a fixed percentage of the land price/value.

The ground rent percentage rate depends on the type of land use stipulated in the lease. For land uses connected with national defense, state security, fire protection, religious uses, charity goals and activities of cultural, medical, educational, scientific and R&D character the percentage rate is not less than 0.3% of the land price. For land uses connected with housing purposes, technical infrastructure and sports/recreation the percentage rate is not less than 1%. Finally, for other land use purposes (mostly business) the percentage rate is not less than 3%. In case of an approved land use change the percentage rate changes accordingly. There are further possibilities of granting special discounts to these payments as motivated by, for example, income or heritage building criteria.

The ground rent percentage rate does not change over the term of the leasehold (40-99 years). In the first year the lessee (tenant) pays ground rent based on the price, but in later years the value of the land can be changed by the landowner if warranted by market changes or inflation. These changes can take place as frequently as every year, although practice shows that municipalities have not used this right annually. The changes may be requested by the lessee or made by the landowner. In both cases an official appraisal by a state-licensed appraiser are required. The lessee may appeal the new ground rent through a tribunal and ultimately in court.

The leasehold agreement specifies what kind of land use is permitted. If the goal is to develop the land with permanent improvements, the agreement has to specify:

(a) the date of commencement and completion of building activity;
(b) the type of buildings and other improvements;
(c) the duty to keep them in proper condition;
(d) terms and conditions for rebuilding in case of damage and demolition of buildings/improvements; and
(e) compensation to the lessee for buildings/improvements upon termination/expiration of the leasehold.

The agreement stipulates the type of land use, which the tenant is to implement. If the land use implies construction, the agreement has to stipulate the date of commencement or completion of the building activity. These terms may be extended if events beyond lessee's control take place. Upon violation of stipulated dates the landowner may impose additional penalty ground rents

equivalent to 10% of the initial land price (upon granting of the leasehold) for each calendar year of delay.

These contractual provisions are revealed in title registration records, which means that these covenants are binding not only on the initial lessee, but they run with the land thus obligating every successive lessee.

The initial leasehold may have a term of 40 to 99 years and can be extended for another term of 40 to 99 years. A valid public purpose is the only reason the State or municipality may not grant an extension. The Civil Code is silent on the issue of further extensions. Termination of the perpetual land usufruct right may be sought by the State or municipality prior to the contractual termination date through a judicial procedure if there is a violation of contractual provisions. Upon termination of the leasehold, either due to expiration or as a result of legal action, the landowner has to compensate the lessee (tenant) for the value of land improvements, as of the termination date. Early termination of the leasehold right may take place if the lessee does not comply with stipulated land use and/or does not complete the stipulated land improvements in time. In this case the landowner returns the initial payment and the amount of ground rents prepaid (if any) for the period beyond the date of termination. The prepaid ground rents are to accrue interest but the total amount of money returned to the lessee cannot exceed the value of the leasehold right at the date of termination.

In 1998 a new law was passed, allowing individuals who are leaseholders to request conversion of their leasehold rights into freehold rights prior to the end of the year 2000. Conversion requires payments by the lessee. If the lease has been in place less than five years, the first payment must be made within 14 days followed by the equivalent of 15 annual payments. If the lease has been in place more than five years and less than 20 there is an equivalent of 10 annual payments. And for leases in place more than 20 years there is an equivalent of 5 annual payments. There are various exceptions to these payment arrangements. Note that although the contemporary perpetual land usufruct rights were created for the sitting tenants in 1990, the first property rights construed as perpetual leaseholds were granted as early as in 1961 thus explaining the existence of leases which have been in place longer than ten years. This law has recently been challenged in the Constitutional Court as alienating the rights of the State and the local governments.

II. The Structure of the Typical North American Long-term Ground Lease

Most public and private long-term land leases in North America have the following structure. Land is leased by the landowner to a tenant usually for a period of at least 50 years. That 50 year term is usually comprised of an initial ten or twenty year term with options for two or three ten year renewals. The lease, including options to renew, may be as long as 99 years. Longer leases (over 99 years) are viewed as sales from a tax perspective in the US and are seldom used.[2]

The length of the lease allows sufficient time for return of capital invested and amortization of debt in the case that leasehold improvements are financed with debt. Lenders are reluctant to finance improvements on ground-leased property unless the term of the lease including extension options does not exceed the amortization period associated with the debt.

The landowner will typically agree upon (and may even dictate) the nature of development before finalizing the lease. In fact, in many cases, the landowner will seek proposals from competing developers. While the landowner is usually in the end a 'silent' partner, at the time the development program is determined, the landowner will be heavily involved as it is at this time that the parameters that determine the revenue stream from the lease are determined. Usually the ground lease will assess penalties if the development does not occur as planned or when planned. Often, there will be a date at which the lease can be terminated if the ground tenant/developer has not performed.

The typical forms of rent include: (1) a holding rent that is typically a fixed dollar amount paid until commencement (or completion) of construction; (2) a base rent that is a fixed dollar amount adjustable at specified intervals (usually every five or ten years) using an agreed upon approach or formula; and (3) a percentage rent that is determined as a percentage of the rents received from and/or gross sales by the occupying tenants payable annually in the amount, if any, by which percentage rent exceeds the minimum rent. The key attribute of the participation is that the effective ground rent fluctuates with the revenues generated by the property or the sales of occupants of the property. This is a way for the lessor to ensure that the rental stream 'matches' the performance of the property. If the base rent adjusts only every ten years, a participation clause allows rents to increase periodically provided the gross income from the property or sales

[2] Sale treatment would normally cause the lessor to pay capital gains tax on the imputed sales price even thought the lessor retained the fee interest thus incurring an unnecessary tax obligation.

of tenants in the property are increasing.

In North America, this type of lease has been commonly used by public agencies including ports, airports and local governments, specifically, redevelopment agencies. Such contracts provide revenues, albeit risky, not affected by changes in the law or tax base. Also, the lease permits a degree of long-term control during operations. This may allow a public agency to recoup subsidies, including the write-down of land, over time without unduly burdening the project during the development and start up periods when cash flow may be critical to the project. Thus ground leases are viewed as an effective tool in public/private partnerships.[3]

Similar leases are employed by private landowners who want long term revenue from land but lack the interest or expertise to develop and manage the improvements to the land.[4] These and other owners may use the ground lease to defer paying a capital gains tax on land with a low historic basis. Non-developer owners may choose to ground lease developable land rather than sell as that approach allows them to generate an ongoing income stream without personal responsibility for development while deferring the tax on any capital gain far into the future. A tax-free exchange would accomplish the tax deferral goal, but would leave development of the new site in the hands for the taxpayer. So for investors in developable parcels, tax deferral alone seems to provide a rationale for the existence of long-term ground leases.[5] On the other side of the transaction, ground leases provide an alternative to finance the land component of a development transaction so for some developers a ground lease may present, at some price, a preferable mechanism for financing a development.

The holding rent is designed to facilitate development and reduce out-of-pocket costs of the ground lessee during the pre-development, development and construction periods. The base rent

[3] The difficulty of effective contracting is an ongoing debate. Some observers argue that the difficulties of contracting are so profound that joint ventures between land-owners and developers are preferred where feasible.

[4] Many heirs to the families granted lands by the King of Spain in what is now California today receive ground lease revenue from land developed in this century that was originally acquired as part of a rancho during the late 1700s or early 1800s. Much of this land is now in urban locations.

[5] Other options for tax deferral include an installment sale. If at least one payment is received in a subsequent tax year, any capital gains tax obligation may be paid pro rata based on the portion of the sale price deferred to the future period. Prior to the Installment Sales Revision Act of 1980, at least 30% of the sales price had to be received during the year of the sale and there had to be at least two payments. Another option is the 1031 exchange. In this case, a property is simply exchanged for another property and the tax basis of the original property is transferred to the new property. Thus the capital gains tax is deferred however, the reduced basis impacts the ability of the taxpayer to reduce taxable income through the depreciation expense on any improvements to the property

is the least risky ongoing revenue source for the ground lessor. This component of the rental stream should yield the equivalent of a relatively low risk return for the term of the lease. The actual payment is often computed on a notional amount equivalent to the land value in highest and best use (presumably the existing use) at the time the lease begins. Since the market value is unobservable, an appraisal is required periodically to determine the expected market value. In practice, such appraisals to determine lease rates are costly and are employed only at long intervals. Thus the base rent may adjust periodically (usually every five or ten years) when triggered by a change in the value of the land. Such changes in value are normally determined by an appraisal although some creative draftsmen have tried to finesse the need for valuation to trigger changes in the base rent.[6] Other indexing mechanisms or participation clauses may serve to index the lease revenue to the inflation rate or property performance. However, there is no reason to expect changes in such revenue streams to be proportionate to changes in 'highest and best use' land values.[7]

Landlords cannot unreasonably withhold transfer an assignment of the ground lease by the developer to successors. However, the contract may permit the landlord to renegotiate the terms of the lease. At a minimum, the landlord will require that the transferee have an acceptable credit rating.

If the highest and best use changes, many North American leases are silent about what should happen. It may be presumed that the lease will be re-negotiated but without a clause addressing this issue in a lease, there is no mechanism to bring about re-negotiation let alone optimal redevelopment. The ground lease represents an unusual allocation of property rights. Hart (1995, Chapter 2) develops a simple property rights model which allows him to conclude that a party is more likely to own rather than rent an asset if that party is expected to have an important investment decision with respect to the productivity of the asset. The redevelopment decision is such a decision. As well, he argues, highly complementary assets should be under common ownership. Land and buildings are complementary assets. Hart's focus is on determining the

[6] The interest rate (yield) should be determined by adding a spread to an equivalent maturity risk free rate. The value of the land is the notional amount against which the rate is applied to determine the actual lease payment. That value should be a value of the land in highest and best use not the existing use. Some leases, particularly those having participation rents, have used the average of the last few years gross ground rental income (e.g., over three years) to determine the new base rent. This process, of course, may bear no relationship to the ground rent that might be determined through a valuation process. However, it has the advantage of being easy and cost effective to implement.

[7] Indexing land lease payments to the CPI can squeeze lessees as payment obligations may continue to rise even though the property is performing poorly.

boundaries of the firm. It would seem that the ground lease has to provide contractually for activities that in a perfect world would be undertaken by the same entity.

III. Long-term Land Leaseholds: Their Role in the Transition Process and Potential Problems

In Poland, real estate markets are being increasingly integrated into broader capital markets as well as becoming a useful tool in the management of urban growth and redevelopment. The long-term ground lease can be viewed as an additional financial instrument allowing market participants another contractual mechanism to meet their particular requirements. The leasehold instrument, however designed, should not only supplement the basic freehold property right granted by the state, but it should also be extended into private market allowing private entities to grant long-term leaseholds if there is a market.

The extension of the right to grant a leasehold interest on privately held land is consistent with the goals of market oriented governments that aim to remove legal and bureaucratic barriers to market innovation. In financial markets there has been spectacular growth in the number of instruments allowing significant choice in the market. Similar evolution should be encouraged in real estate markets facilitating sale as well as development, financing and leasing. Below, we describe the attributes of long-term land leaseholds that are particularly relevant in a transitional economy. Our presumption is that more contractual alternatives are better than less and that debate should be focused on contract design. We are particularly interested in the issue of redevelopment decisions by lessees faced with the prospect of lease termination and the forfeiture of building capital.

In an economy in transition where the economic and political processes are critically inter-related, the ground lease may be an important tool for facilitating higher urban productivity, land-use based urban redevelopment, stronger urban governance and autonomous local government finance. Here, the long-term public leasehold may be a pragmatic resolution to the problem of institution building.

1. Where local land use planning systems may not be in place, the long-term ground lease provide a mechanism for local governments to influence directly the land use of key parcels owned by the state (while still placing the parcels under the effective control of the private sector);

2. Where local governments have responsibility for building local infrastructure but lack sources of revenue due to limited local taxation systems (i.e., the area based property tax versus a value based property tax), the public leasehold system provides local governments a critical revenue source;
3. The public leasehold system also allows local governments to benefit from the growth in land values that they, in part, facilitate through the creation of infrastructure;
4. If the availability of equity capital is limited and mortgage markets are in their early stages, the public leasehold system permits local government to finance the use of land for private purposes (creating a capital market where one does not exist);
5. Where land is transferred to local government to provide a source of wealth as a basis for building urban infrastructure, a public leasehold system provides a means of benefiting from that wealth given that capital markets are just beginning their evolution and property tax systems are likely not in place;
6. Public leasehold systems allow local governments to have a significant role in determining the future pattern of land use and to be proactive regarding changes in the pattern of land use that is the legacy of the prior economic system;
7. The public leasehold system may be a more flexible land disposition instrument allowing a local government to postpone sale until more stable market conditions evolve;
8. Public leasehold systems may provide a more politically palatable mechanism for making land available to non-resident investors for needed urban development;
9. Public leasehold systems can employ contracts similar to those employed in mature market economies, allowing the contracts to be readily understood by international investors while enhancing the choice of instruments; and
10. While the public leasehold system may be viewed by some as a unnecessary relic of centralized or planned economies, long-term ground leases have a long history in many market based economies.

While there seem to be numerous practical reasons for public leasehold systems in transitional economies, research has suggested that long-term ground leases are long-term contracts that, unless carefully drafted, create the potential for significant divergence of incentives between lessor and lessee during the life of the lease. See Dale-Johnson (2000). Thus, one must question whether the potential benefits of public leasehold systems in transitional economies are offset by negative externalities resulting from the divergence of incentives problem.

First, it would be helpful to fully understand the divergence of incentives problem. Ground leases are long term contracts where there is significant uncertainty as to the future outcomes that may influence the value of the contract to the parties involved. While ‘perpetual usufruct’ requires the ground tenant to own the improvements, in many other systems, at the end of the lease, the improvements revert to the landowner (ground lessor) who has the residual claim. Who owns the residual interest in the improvements turns out to play a critical role on the behavior of the lessee during the life of the lease. In order to appreciate fully the impact of ‘perpetual usufruct’ on the

behavior of the lessee, we will compare the typical North American ground lease to perpetual usufruct. In the former, at the termination date of the lease, the land and the improvements revert to the landowner. In the latter, the improvements are owned by the lessee. Where improvements are in place at the inception of the lease, the lessee must buy them.

The property rights associated with ground leases yield the leaseholder less value than fee simple ownership. The lessee has no rights to the land at the termination of the lease. Thus the terminal value of the land to the lessee is zero. As of the same date, the value of the land to the owner of the fee simple interest is the present value of the future cash flow associated with the land. Regarding the improvements, a North American ground lease yields the leaseholder no terminal value for the existing structure or any redevelopment. Perpetual usufruct, on the other hand gives the leaseholder the right of ownership to the improvements (or any subsequent redevelopment undertaken during the term of the lease) at the termination of the lease. Moreover, any subsequent lessee must purchase the improvements.

The option to redevelop provides value to whoever controls the improvements and the right to redevelop and the consequent cash flow stream. The redevelopment option has more value the longer the time frame over which the option can be exercised and the longer the time frame that the owner of the option can benefit from the redevelopment cash flows. In the case of the North American lease, the redevelopment option is less valuable to the lessee because any capital expenditure has zero terminal value. See Capozza and Sick (1991). The redevelopment option is worth more if the lessee has a residual claim equal to the value of the improvements and any associated capital expenditure as is the case with 'perpetual usufruct.'

Usually when a ground lease is initially negotiated, it is in the interests of both the landlord and the ground tenant for the property to be developed to the highest and best use. That is, the use that yields the highest land residual or the most profitable use. The landlord has the leverage to have the site developed at highest and best use because the landlord can withhold from agreeing to a contract with any party that will not commit to the development the landlord believes is the highest and best use. However, once the site has been developed, time has passed and market conditions have changed, depending on the terms of the contract, redevelopment may not be optimal for the ground tenant even if there is a higher and better use for the site. Sometimes redevelopment may be optimal but not at the scale that would be optimal for the fee owner. The motivations of the ground tenant will be driven by the terms of the ground lease. Most ground

leases are silent about the issue of redevelopment even though during the thirty or more year term of a typical contract, the likelihood that a higher and better use will arise is very real.

IV. Literature

Williams (1991) uses the option pricing approach with both analytic and numerical techniques to determine the optimal timing and density of development and timing of abandonment of a property. Cash flows and construction costs are stochastic and the cost of developing density is Cobb-Douglas. Capozza and Sick (1991) examine the value of long term ground leases relative to fee ownership. They find, using option pricing theory, that the discount in the value of a ground lease relative to the fee is not just the result of the termination value of the lease to the ground tenant, but also the result of the reduced redevelopment opportunity afforded the lessor as a consequence of the foreseeable termination of the lease. Thus, as noted earlier, a ground lessee will redevelop sooner and at a lesser intensity than a fee owner would in the same economic circumstances. The redevelopment is at lower density because the ground tenant does not benefit from the revenues after the termination of the lease and occurs sooner so the ground tenant can benefit from the enhanced revenues for a longer period of time. Note that this behavior is non-optimal from the point of view of the lessor as the present value of the ground lease revenues will be lower than they would have been had the lessee built at the same time and to the same scale as would have the landlord. Capozza and Sick consider the possibility of one redevelopment opportunity for either the fee owner or the ground lessee. Construction is Cobb-Douglas and rents are stochastic. The fee simple values are determined analytically and the lease values are solved for using numerical methods.

In these early papers, the redevelopment option can be exercised only once. Others that have explored once only exercise of the development option include Titman (1985), Clarke and Reed (1988), Capozza and Schwann (1990), Williams (1993) and Capozza and Li (1994).

Unlike financial options, the development option can be 're-exercised.' Amin and Capozza (1993) explore sequential development under certainty. Williams (1997) analyzes the redevelopment option under uncertainty when sequential redevelopment opportunities are permitted. He finds that relative to the standard solution, redevelopment is more frequent, at less intensity and results in higher market values of the property. Independently, Childs, Riddiough and Triantis (1996) explore repeated redevelopment with mixed uses and find that the mix of two possible uses makes a property more valuable and that the incremental value is greater if the

growth paths of the cash flows from each use are less correlated. In both papers, the cash flows are stochastic and construction costs are Cobb-Douglas; Williams' solutions are primarily analytic and those of Childs et al. are numerical. Grenadier (1998) has explored the impact on the value of the redevelopment option of the 'time-to-build' issue. The delay imposed by the construction period at the time of redevelopment imposes considerable additional risk on the developer. Grenadier models the negative impact of this delay on the value of the redevelopment option.

It is clear from the literature that the prospect of redevelopment along with the loss of the residual value at the termination of the lease causes the value of ground leased land to be less than the value of the fee simple. However, none of the authors have focused on the nature of the contractual arrangement between lessor and lessee. Dale-Johnson (2000) extends the work of Capozza and Sick to examine alternative ground leases contracts in which there is an option to extend if redevelopment occurs. As well, the author considers a lease contract where the residual claim to the improvements may be owned by the lessee as in the case of Poland's 'perpetual usufruct.' In both these cases (lease extension and residual sharing), the value of the leasehold is enhanced as a consequence of the enhanced value of the redevelopment option. Thus, in this remainder of this paper we examine perpetual usufruct as one of a number of contractual options and discuss some of the implications of the results for transforming economies.

V. Redevelopment, Ground Leases, Second Best and Our Approach.

A landowner would, in a perfect world, like to negotiate a ground lease that yielded to him a rental stream consistent with the value of the underlying asset (the land) in highest and best use. This would be the first best outcome. As we have discussed, there are a number of reasons why the lessee's incentives might diverge from the lessor over time. Exploring alternative contractual arrangements may allow us to come closer to the second best alternative.

In a real estate development environment, the value of a property is a function of the expected path of rents, the development technology, the expected interest or discount rate and the expected cost of construction plus any option value related to future redevelopment. The optimal development decision involves choosing the optimal time and intensity of development. In our paper, we build upon the approach employed by Capozza and Sick (1991) with some exceptions. First, our model includes a value or rent for both the land and the improvements (building). This

permits the building to be treated as an asset separate from the land. Thus at termination of the lease, the value of the building can flow to the lessee (as is the case with 'perpetual usufruct') or to the lessor (as is the case with a typical North American ground lease).

Thus, the rental stream generated by a property is comprised of building rent and land rent. Both building rent and land rent are stochastic but land rent adjusts to its theoretical market value at the time of redevelopment.[8] We employ Monte Carlo sampling and a genetic search algorithm to determine the optimal values of the fee simple and the lease contracts and the related timing and intensity of redevelopment for both landlord and ground tenant. Starting rents, interest rates, lease terms, construction costs, conversion technology (efficiency) and building and land growth rates and volatilities are fixed parameters. We do not consider multiple or sequential redevelopment alternatives at this point. However, we do consider the possibility of lease extension.

The model for each lease contract is created to simulate the redevelopment decisions faced by a ground tenant. The ground tenant leases the land from the landlord and then leases the building to the space users. When the current land use is no longer at its highest and best use, the ground tenant needs to decide if and when it is optimal to redevelop (convert) the land to its best use. Even though the property may not be at highest and best use, the lease contract may not provide the same incentives for the ground tenant to redevelop the property as in the case of the fee owner.

We seek to identify contractual alternatives that would be preferred by both the lessor and lessee. Rational redevelopment by a fee owner would create value. The present value of the future incremental revenue would exceed the costs of redevelopment. In the case of a land leasehold, the incremental benefit would be shared between lessee and lessor.

Monte Carlo techniques combined with simulation can be used to estimate the current value of a development option by simulating many sample paths of development, finding the maximum value in each sample path and then averaging the present discounted value of the maxima over all the sample paths to yield an expected value. In the case of possible redevelopment, that expected value less the value in the current use is an estimate of the value of the development option.

Boyle (1977) was the first to employ numerical techniques to value financial options and, subsequently, numerous others have employed these approaches particularly for model specifications where partial differential equations are difficult to solve analytically. See, for example, Capozza and Sick (1991) and Childs et al. (1996). Childs et al. solve the problem by finding numerical solutions using a backward dynamic programming approach. A three-dimensional lattice involving the two stochastic variables and time is constructed. At each point in the lattice, the present value of baseline development in each of several possible mixes is compared to all alternative values net of redevelopment costs. If redevelopment is optimal the new present value replaces the old. This process starts at year 50 (the terminal year) and is repeated in a backwards fashion moving to the present. The final present value computed is the value of the baseline development plus the redevelopment option.

We employ an alternative approach, a combination of Monte Carlo sampling and a genetic search algorithm to simulate alternative outcomes in order to choose the optimal behavior of the lessee or the fee owner in the case of each contract or fee ownership, respectively. Genetic algorithms optimize the results of a procedure (e.g., determining the value of a contract) by repeatedly trying alternatives through changing predetermined choice variables and reproducing and mixing the components of the better solutions to maximize or minimize a target variable (the value of the contract). If properly specified, the process converges to an outcome where subsequent changes in the choice variables do not lead to improvement in the outcome (the statistic describing the target variable). Goldberg (1989) and Holland (1992) summarize the evolution of genetic algorithms and provide a number of illustrations of the application of their use in economic, search and mathematical optimization problems.[9] This approach has been employed to price financial options. See Chidambaran et al (2000) and Keber (2000).

The choice variables in our model are development timing and intensity and the target variable is the present value of the contract with the goal being to choose combinations of development timing (choice of time τ) and density (the quantity of rentable space $q(k)$ or capital K) that maximize $NPV(R_L, B, \tau, K; T, \Omega)$ where T is the terminal date of the contract, Ω defines the terms of the ground lease contract and R_L and B are the market rent flows. The growth rate in building rents R_L and the growth rate in land rents B, are stochastic. We assume that the two growth rates

[8] This means that the rent attributable to the land takes on a value consistent with the most profitable use at the time of redevelopment.

(g_1 and g_2) are perfectly correlated.

The key variables are the target variable that is the present value of the contract, the choice variables that are the time and intensity of development and the uncertain variables that are the periodic rents. A number of other parameters are fixed. The optimization process can be described by referencing two stages. In the first stage, a time of development and intensity of development are chosen by the analyst and are provided as inputs to the model. The model randomly assigns rents to each year of the analysis where the choices, are governed by pre-specified distributions. The growth rates = g_1 and g_2 each have lognormal distributions with standard deviations = σ_1 and σ_2. The model iterates using a search algorithm to identify new combinations of τ and K and the resultant contract value. This process continues until there is convergence. A number of search algorithms can be chosen based on assumptions about how τ and K might vary. We employ a process where τ and K can vary independently. In other words, we don't presume that higher τ 's would automatically require higher expenditure of K. The choice of the new combination of τ and K is also governed by the crossover and mutation rate. These exogeneously parameters of the algorithm influence the scope of search in choosing the new set of choice variables. *C*onvergence determines the present value for the subject contract and a combination of τ and K for that simulation. A new simulation then begins with the choice of a new combination of τ and K as a starting point along with a new set of randomly assigned rents drawn from the pre-specified distribution. Each simulation determines a combination of *PV,* τ and K that is saved. Multiple simulations are undertaken and the procedure repeats itself until the statistics of interest converge (in this case, the mean present value of the contract reaches a maximum). The combination of τ and K consistent with the mean of the individually maximized simulations is the optimal τ and K for the contract..

The use of genetic algorithms to solve difficult optimization problems is common. We chose to use this approach here to allow flexibility to adjust the nature and, particularly, the complexity of the contract. For example, we were not confident that we could devise an approach to solve the lease extension problem using the backward dynamic programming approach employed by Childs et al (1996).

[9] We implement the approach using RISKOptimizer, an Excel-based software package designed by Palisade Corporation for solving optimization problems involving uncertainty.

VI. The Model

In describing our model, a number of variables and parameters have been identified. A formal statement of the model follows. The growth rate for market land rent (R_L) and market building rent (B) each follow lognormal distributions (Wiener processes). The 'growth rate' for land rent is positive and that for building rent is also positive. Thus

$$dR_L / R_L = g_1 dt + \sigma_1 dz \quad (1)$$

and

$$dB / B = g_2 dt + \sigma_2 dz \quad (2)$$

where dz is a standard Wiener process. We expect that there will be a strong relationship between g_1 and g_2 . In fact, we would expect that in a competitive environment, the two drifts would move in tandem. However, this would be the case with respect to new properties. In our simulations, we include depreciation so that after accounting for depreciation, g_1 may not equal g_2 or the effective growth rate after depreciation may be $g_2 - \varepsilon$.

The ground tenant pays contractual ground rent to the landlord, which may or may not be equal to the market land rent depending on the lease structure Ω. The rest of the rent flows are the income to the ground tenant. We assume for the purposes of this paper that building rents 'mark to market.' That is, lease contracts between the ground lessee (the owner of the ground leasehold) and his or her tenants (occupants of the building) mark-to-market.[10]

Assuming the ground rent specified by the lease defined by Ω is R_S, then the rent flow or income to the ground tenant is equal to:

$$R(t) = R_L(t) + B(t) - R_S(t). \quad (3)$$

It is assumed that after redevelopment (conversion), where new construction is homogenous,[11] both land rent and building rent increase by the same multiple. If the redevelopment occurs at time τ, the rent flow after the redevelopment becomes:

$$R'_L(\tau) = q(k)\, R_L(\tau) \quad (4)$$

$$B'(\tau) = q(k)\, B(\tau) \quad (5)$$

[10] This is a strong assumption. However, relaxation of this assumption would unnecessarily complicate the model without providing further insight into the structure of the ground lease.
[11] The expenditure of capital increases density, not quality.

The rent multiple is determined by a Cobb-Douglas type production function such as:

$$q(k) = K^{\gamma} \quad (6)$$

where γ is the capital elasticity of substitution, K is the amount of capital per unit of land and $q(k)$ is the resulting rentable space per unit of land.[12] The cost of applying a unit of capital is c so:

$$\{[K^{\gamma} \cdot B(\tau)] / (i-g_1)\} + \{[K^{\gamma} \cdot R_L(\tau)] / (i-g_2)\} - K \cdot c \quad (7)$$

is the value of conversion at any period τ. Note that the land rent (land residual rent) increases with the ability of the property to generate income that results from increases in the FAR.

In both models of certainty and uncertainty, the ground tenant tries to maximize the net present value of the project at time 0 given the opportunity to redevelop at some point τ in the future, where $0<\tau<T$. The NPV consists of four elements: rent flow before and after the redevelopment, the cost of redevelopment (c per unit of space), and the compensation value or the residual value (m), if any, when the lease expires.

Assuming the property is redeveloped at time τ to a density q, then the present value of the leasehold at time 0 is

$$NPV(R_L, B, \tau, K; T, \Omega) = PV(R_L, B, \tau) + q(k)PV(R_L', B', T - \tau) - PV(kc) + PV(m) - PV(R_S) \quad (8)$$

where T is the term of the lease. Here, the formula to calculate the present value (PV) is the standard discrete one.

$$PV(R) = \sum_{t=1}^{N} \frac{R_t}{(1+r)^t} \cdot \quad (9)$$

Therefore in a single certainty scenario, the optimal timing and the optimal scale (density) of the redevelopment is the solution to the following problem

$$\max_{\tau,k} NPV(R, \tau, k; T) \text{ for each contract of form } \Omega. \quad (10)$$

This problem can be solved using numeric optimization techniques.To find the optimal solution

[12] The space per unit of land is usually called the FAR or floor area ratio.

under uncertainty, we employ Monte Carlo sampling and a genetic algorithm to simulate each contract as discussed in the prior section.

The following table summarizes the exogenous variables, derived parameters and endogenous variables in the model. The exogenous parameters include:

1. Interest rate, cost of capital;
2. Starting land rent, its growth rate and "sigma";
3. Starting building rent, its growth rate and "sigma";
4. The building depreciation rate;
5. Production efficiency; and
6. Correlation coefficient between the land rent and the building rent.

The derived parameters include:

1. Land value;
2. Real building rent growth rate;
3. Building value;
4. Rent multiple; and
5. Capitalization rate.

The results of the analysis include:

1. Conversion year (redevelopment timing); and
2. Conversion scale (redevelopment intensity).

We can also further describe each outcome with the following information:

1. Rent multiple;
2. Period zero value of the asset assuming no redevelopment;
3. Period value of the asset (when redeveloped);
4. Period zero value of asset assuming redevelopment occurs at the optimal time and with the optimal intensity; and
5. Period zero value of the leased fee when optimal redevelopment has occurred.

To implement the model, we apply the depreciation rate only to the building rent. Thus, the real growth rate used in the Wiener Process for the building is the market growth rate less the depreciation rate. To determine asset value, a capitalization rate is derived from the land rent growth rate and the interest rate.

Thus the capitalization rate[13] is constant throughout the lease term. The building value and the

[13] This is based on the Gordon growth model or growing perpetuity model where asset value is equal to CF/r-g. The denominator is equal to the overall capitalization rate.

land value are both calculated by dividing the current rent by the capitalization rate. The same method is employed to determine the residual value of the building at the termination of the lease.

The landowner's position must also be considered as the contractual arrangements are changed. In order for the landowner to consider negotiating an alternative contact, the landlord must be better off that he or she would be with the original contract as well. In other words, there must be a joint optimization process. In this analysis we simply compute the value of the leased fee and demonstrate that under some of the alternative contracts, the landlord or the owner of the leased fee is better off than in the case of the baseline contract.

VII. The Analysis and Results

In the paper, we explore the contractual structure of two types of long-term land leaseholds. We consider the typical North American ground lease as well as a form of public leasehold contract used in Poland, 'perpetual usufruct'. Since one of the objectives is to simulate how lessees would behave with respect to redevelopment opportunities, we also consider a leasehold extension that would be coincident with any redevelopment undertaken by the lessee. Behind this exercise is idea of determining an optimal structure for a long-term land lease in which the lessee would be motivated to act as would a fee owner (in the absence of a ground lease). A first best or optimal outcome for the landowner would be redevelopment at a time and intensity identical to that which the fee owner would undertake if the fee were not subject to a ground lease. The model described in the prior section is employed to determine values for the redevelopment scale and year for each of the contractual alternatives below

The following are specific alternatives we consider:

1. **Baseline Case – North American Ground Lease (50 Years)**
   This lease is a standard North American ground lease with a fifty year term and no residual claim for the lessee.

2. **Perpetual Usufruct – Polish Public Leasehold (50 Years)**
   This lease is modeled after perpetual public land leasehold in Poland. A fifity year term is assumed for comparison purposes.

3. **Lease extension (step-up rents, no residual claim)**
   In this case the lessee may redevelop at any point in the first fifty years (the initial lease term) but may extend the lease by the number of years expired in the initial lease. E.g., if lessee chooses to redevelop in year 40, the lease is extended 40 years becoming a 90 year

lease.

4. Fee ownership
In this case the land owner is presumed to own the property in perpetuity.

The Baseline Case

The baseline case assumes a land rent of $16.00 and an equivalent building rent. The growth rate for values and rents of land and buildings is assumed to be 1%. Buildings are depreciable so we assume that the 1% building growth rate is the net result of a 2% market growth rate and a 1% depreciation rate. Depreciation is assumed to influence rents as well so rents grow at the rate of 1% rather than 2%. The variance of the land growth rate is 0.30 and the variance of the building growth rate is 0.20. The interest rate is assumed to be 5% and the cost of capital $100.00. With an interest rate of 5% and a growth rate of 1%, the appropriate capitalization rate is 4% resulting in an initial value of $800.00 for each square foot of leasable space. Since the production efficiency γ is 0.50, Equation (6) indicates that an additional square foot of leasable space can be generated with 1 unit of capital. However, two square feet of additional space would require four units of capital. In other words, a marginal expenditure of $100.00 would be required to create an additional square foot of leasable space on a square foot of land. A marginal expenditure of $400.00 would be required to create two additional square feet of leasable space.

To provide perspective for the analysis of the ground lease contracts we compare ground lease contractual outcomes with fee simple outcomes using similar market assumptions. That is, if the building rent growth rate is assumed to be 2% with a depreciation rate of 1%, we determine the optimal redevelopment timing and intensity for both the ground lessee and the fee owner (the lessor) under the same circumstances. Table 1, Case 4 reports the results and parameters for a fee simple (fee owner) scenario. Specifically, Case 4 involves a fee owner with a 100 year horizon who may redevelop only one time during the 100 year period. Depreciation of the building is assumed. Redevelopment occurs in year 46 at a scale of 26.98 with a resulting rent multiple of 5.19. Scale refers to the units of capital expended. The redeveloped property has a new floor area ratio (FAR) of 5.19 equivalent to the rent multiple. Thus, the new rent generated is 5.19 times the old rent. The scale and rent multiple appear in the second column of Table 1. The third column reports that the initial value of the land is $400.00 and the present value of the eventual redevelopment is $731.67. Thus the redevelopment option is worth $331.67. The present value of the project in year 46, at the time of redevelopment is $3357.20. This outcome is also plotted in

Figure 1 and appears as the darkest line that slopes upward to the right with one step-up in the 46^{th} year.

Now we can proceed to evaluating the outcomes for the alternative ground lease contracts. Our parameterization of the model results in dramatic difference between the intensity of redevelopment that would be undertaken by the fee owner and that which would be undertaken by the ground lessee in the baseline case. A discussion of the latter follows.

Table 1 illustrates all of the input assumptions and key parameter values as well as the outcomes associated with each case. The outcomes describe the timing and intensity of redevelopment. Specifically, Column 2 in Table reports for each case, the intensity of redevelopment and the rent multiple. Remember that $q(k) = K^{\gamma}$ from Equation (9). That is, the rent multiple is equal to the capital applied per unit of land raised to the power γ, where γ is the capital elasticity of substitution or the production efficiency. We assume that $\gamma = 0.50$ in most of our runs. Column 4 in Table 1 reports the timing of redevelopment. Column 3 of Table 1 reports respectively, for each case: (1) period zero value of the asset assuming no redevelopment; (2) period τ value of the asset (when redeveloped); and (3) period zero value of asset assuming redevelopment occurs at the optimal time and with the optimal intensity. Column 13 reports the period zero value of the leased fee when optimal redevelopment has occurred. The remainder of the table reports input parameters or attributes of the contract.

In Case 1 (the typical North American ground lease) of Table 1, we see, as was demonstrated by Capozza and Sick , that the lessee redevelops at less intensity than would the fee owner. Redevelopment by the lessee occurs in year 29, before redevelopment in the fee owner scenario. As well, the value of the leasehold declines to zero at the date of the termination of the lease. The scale of development by the fee owner is much greater than in the case of the lessee. The ground lessee would only apply 2.93 units of capital per square foot of land resulting in a rent multiple of 1.71 compared to the fee owner's 26.98 units of capital and 5.19 rent multiple. The rationale, as suggested by Capozza and Sick, is that since the ground lessee has no residual claim it makes sense to redevelop at a lower intensity than would the fee owner. The finding that the lessee redevelops sooner than the fee owner is also consistent and reflects the lessee's desire to earn the enhanced income over as long a period as possible. A grey line is used to plot this outcome in Figure 1. Case 1a is included as it is identical in all respects to Case 2 (no depreciation). Redevelopment occurs sooner and at higher density than Case 1.

Case 2 is meant to illustrate perpetual usufruct (the Polish public leasehold structure). Since one of the challenges facing the ground lessee is the recovery of capital investment when the passage of time foreshortens the recovery period, giving the ground lessee a residual claim to the value of the improvements should reduce if not eliminate this problem. At the same time, the lessor retains the residual interest in the land. In the analysis we assume no depreciation of the improvements. At lease termination, the lessee receives a payment from the lessor or the new lessee equal to the value of the redeveloped building. The lessee redevelops sooner (in year 22) and at less intensity (21.07 units of capital) than would the fee owner. It is clear from this result that giving the ground lessee a residual claim (ownership of the improvements) has a significant effect on the lessee's behavior. In particular, redevelopment occurs at higher intensity more in line with that which would be undertaken by the lessor. As well, redevelopment occurs sooner. This result is plotted in Figure 1 (the dashed line).

Case 3 demonstrates the impact of providing the ground lessee the option to extend the lease at the time redevelopment occurs. We assume that the extension permitted is equal to the period of time that has already passed in the existing fifty year lease. For example, if the ground lessee wished to redevelop in year ten, the lease could be extended a further ten years so that the original lease would then have a life of 60 years. As we previously noted, the fee owner would redevelop in year 46 using 26.98 units of capital to generate a rent multiple of 5.19 in the case of a one hundred year horizon. Remember that the fee owner owns the residual rights to the property forever. On the other hand, we have parameterized our model so that the ground lessee is normally subject to a fifty year limitation on his right of use. We found in Case 1, that the ground lessee would only apply 2.93 units of capital in year 29. With the ability to extend the lease as described above, the ground lessee chooses to apply 27.5 units of capital in year 38 to generate a rent multiple of 5.25. The result in Case 3 is plotted in Figure 1 (the light solid line).

Note that in column 13 we report the value of the leased fee in the case of redevelopment at the intensity and time determined by the simulation of the ground lessee's alternative contract. In the baseline case (Case1), the value of the leased fee, assuming redevelopment occurs in year 29 at an intensity (scale) of 2.93, is $500.58. In all other cases (Cases 2 and 3), the value of the leased fee exceeds the baseline value of $500.58. Thus, it appears that in all of the alternative contractual

arrangements, the owner of the leased fee is better off than in the baseline case. [14]

VIII. Urban Form and Redevelopment Decisions: Implications and Conclusions

These results have some interesting implications with respect to land use in communities in which long-term land leaseholds are ubiquitous. If there is uncertainty about the ability to extend the lease and if the lessee has no residual claim to the value of the improvements, redevelopment will occur sooner and at less density than would be the case if the land were owned in fee. This means that land use densities will be less in cities where public leasehold is common and the contractual arrangements are as described above. In the case of Poland and *'perpetual usufruct,'* the clear definition of the ownership rights of the lessee with respect to the improvements significantly changes the outcome. While redevelopment will still occur sooner and at less density than in the case of fee ownership of the land, density is much great (at least based on the parameterization of the model in this paper). Moreover, in Poland, the likelihood of the extension of the leasehold is also high (since a valid public purpose is the only reason to refuse such an extension). Our results suggest that if the extension is tied to the decision to redevelop, the outcome is even closer to the fee outcome. Certainly, the combination of a residual claim and the extension option would create a second best outcome.

In Section III we have noted that there are clear pragmatic economic benefits to long-term land leasehold systems in transforming economies. Many of the benefits fade away as capital markets evolve, alternative sources of local public revenue are developed and as land planning and regulatory systems are put in place. Given the expediency of public leasehold systems we focus on the nature of the contract itself with the goal of enhancing what seems to be a necessary institution.

Thus, in this paper, we consider alternative contractual arrangements for long-term land leaseholds. The key alternatives we consider are the sharing of the residual claim at the termination of the lease and the option to extend the lease. An example of the former is if the lessee owns the improvements as is the case in the public leasehold system in Poland. In the former case, we consider entitling the ground lessee to a payoff equal to the market value of the improvements to the land (the building). Thus when the improvements are redeveloped, the lessee

[14] Another alternative would be to maximize the aggregate value of the leased fee and the leasehold and permit the two parties to bargain regarding the split of the cash flows and the costs. We leave consideration

owns the redeveloped asset. In the latter case, we propose a contract that is automatically extended by the number of years elapsed if redevelopment occurs. We find that both these alternatives enhance the value of the redevelopment option to the ground lessee and result in redevelopment that is more consistent with that which the fee owner would have undertaken. Note that in the US, most leases are silent about the issue of redevelopment.

The results of this research are promising in that they suggest that the contractual terms of a long-term land lease have significant implications with respect to the behavior of the lessee during the life of the lease. In private lease transactions, this has implications of the value of the asset delivered to the lessor at lease termination and the size of the lease payments during the life of the lease. We presume in this analysis that more intensive uses by the lessee generate higher revenues to the lessor if and when they occur. In public leasehold environments, particularly where leaseholds dominate the scene, the contractual terms potentially have significant implications for urban form and for revenues to local governments. If lessees redevelop at lower density, cities will evolve at lower density if the leaseholds are North American style. While the local government can capture public leasehold revenue from a 'flatter' city by simply expanding the city boundary, there may be significant incremental cost to providing the infrastructure for that flatter city.

The nature of the long-term land leasehold is such that the landowner cedes control of the asset to the lessee for a significant period of time usually in excess of forty years. In a growing city, the probability that the highest and best use of a particular site will change is relatively high over that long time frame. Thus, ground lease contracts should provide incentives that encourage lessees to behave more like fee owners. 'Perpetual usufruct' as it has been implemented in Poland has attributes that allow it to approach the first best outcome with respect to the redevelopment decision. Thus, if long-term public leasehold systems are critical to facilitate transfer of land use to private entrepreneurs, to generate local government revenue and to facilitate land planning, 'perpetual usufruct' is an expedient measure as these institutions evolve.

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of this alternative for later research.

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Table 1 – Comparison of Alternative Lease Contracts

1. Case	2. Scale (Rent multiple)	3. Period 0 Value (NPV at τ) Mean NPV	4. Year	5. Lease escalation 0=mark-to-market (m-t-m) n= yrs until step-up	6. Land Growth Rate	7. Land Growth Rate Variance	8. Market Building Value Growth Rate	9. Building Value Growth Rate Variance	10. Option to extend	11. Depreciation Rate = x%	12. Residual Claim	13. PV to lessor Value of the leased fee.
1 North American Lease	2.93 (1.71)	346.37 (515.59) 331.48	29	0 m-t-m	1%	.30	2%	.20	No	1%	No	500.58
1a. North American Lease	4.90 (2.21)	346.37 (776.92) 477.35	13	0 m-t-m	1%	.30	2%	.20	No	0%	No	793.82
2 Perpetual Usufruct Poland	21.07 (4.59)	346.37 (1532.8) 858.8	22	0 m-t-m	1%	.30	2%	.20	No	0%	Yes	780.67
3 Automatic Lease Extension (3ND)	27.5 (5.25)	383.81 (2522.15) 897.08	38	0 m-t-m	1%	.30	2%	.20	Yes*	0%	No	852.34
4 Fee Owner	26.98 (5.19)	400.00 (3357.20) 731.67	46	NA	1%	.30	2%	.20	NA	1%	Yes (Fee Owner)	NA

* Lessee has option to extend the lease by the number of periods that have passed if redevelopment occurs.

Interest rate = 5%
Capitalization Rate = 4%
Production Efficiency $\gamma = 0.50$

Figure 1 – Graphical Comparison of Alternative Lease Contracts