The Impact of Land Value and Real Property Taxation on the Timing of Central City Redevelopment

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Abstract

Planners have long been intrigued with the concept of land value taxation (LVT) as a way to eliminate urban blight and sprawl. This research empirically tested the hypothesis that, compared to real property taxation, LVT will speed the rate of redevelopment in central cities. The analysis shows that from 1970 to 1987 central city redevelopment in Auckland and Wellington, New Zealand, was influenced by different population growth rates and by physical differences between the cities, but not by the taxation systems. The physical difference between the two cities, as well as low tax levels and long assessment cycles, may limit these results to this context.

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Planners and economists have long been intrigued with the concept of land value taxation (LVT) as a way to address problems of urban blight and sprawling development. Many advocates argue that LVT would encourage more efficient land use. Their argument is based on classical theories of land economics as they are applied to property taxes. As a fixed holding cost, land taxes should encourage lower land prices, higher intensity use of individual parcels, higher density development of urban areas, and faster rates of redevelopment. These influences should lead to more concentrated cities with newer and better-maintained buildings. As a development cost, improvement taxes should discourage investment in improvement, and thus constitute, in effect, a tax on redevelopment. Investors may also divert capital to other forms of investment and lower taxing jurisdictions. The land use impacts expected of taxes on improvements include fewer new buildings, lower quality building stock, and sprawling development patterns. The combination of these two taxes into a real property tax (RPT) should not only act as a disincentive to redevelop by increasing the investment costs, but also lowers a holding cost on land. As property owners focus more on land speculation than on land use, a pattern of inefficient use constrains the supply of available land. By effectively constricting the land supply, prices rise and development spreads into new areas. The collective impact of multiple underused properties shifts the interest of land users further away from these neighborhoods and accelerates the decline to blight.

Although the theoretical underpinnings supporting land value taxation have withstood the test of time, very little empirical evidence supports these claims. This lack of evidence is partly due to a lack of data because very few land value taxation cases exist. Although LVT is advocated by the Agency for International Development, International Bank for Reconstruction and Development, and the United Nations as a taxing system for developing countries, the theoretical advantages have not convinced many governments to adopt this system. In the United States and some Canadian provinces, a few individual communities practice a limited form of LVT, but only in New Zealand, Australia, and Jamaica is LVT practiced in its pure form. This limited number of cases aggravates two common problems with evaluating taxing systems. Wide variations in socio-economic systems and public policy make studies between countries difficult to model, and diversity of urban form and policy often complicates studies between municipalities. With property taxes based only on land values in Jamaica, its potential as a data based is limited. In New Zealand and Australia, both land value and real property value taxation are practiced, but uniformly within municipalities. Here, comparisons of properties subject to different taxing systems must occur between municipalities.

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Underdeveloped land and delayed redevelopment are symptoms of inefficient land use patterns. The purpose of this research is to explore land value taxation as a land use policy tool by empirically testing the hypothesis that, compared to improvement taxation, land value taxation will speed the rate of redevelopment in central cities. Available evidence does not support the hypothesis. The analysis shows that from 1970 to 1987 central city redevelopment in Auckland and Wellington, New Zealand, was influenced by differences in metropolitan population growth rates and land scarcity between the cities, but not by the system of taxation. However, the empirical evidence in this case is not totally decisive because, while the data base allowed for large numbers of both land value and real property value tax cases, physical differences between the two cities limited the ability to control for some influences on redevelopment. It is also possible that low tax levels and long assessment cycles may have allowed other factors to swamp the effects of the taxing systems. The results may thus be limited to a similar context.

■ Previous Research

The effect of property taxes on development has long been discussed by economists. Based on theories of Ricardo, Smith, and Mill, most researchers agree that improvement taxes delay redevelopment by imposing an additional cost (Netzer 1966; Becker 1969; Gaffney 1973; Bentick and Pogue 1988). However, there is less consensus on the impact of land taxes on the timing of development. The minority view is that development decisions are neutral to land taxes (Tideman 1982). The majority of theoretical models shows that land taxes hasten development (Skouras 1982; Bentick 1979; Mills 1981; Noguchi 1982; Wildasin 1982). More recent analysis suggests that the timing conclusions depend on the scope of the model and the definition of the tax base: a tax on the market value of land encourages development and a tax on the current use of land is neutral (Bentick and Pogue 1988).

Although interest in LVT persists, empirical evidence is weak. A few studies use multiple regression models and show some expected impacts of land and improvement taxes: a reduction in improvement taxes increased the intensity of improvements (Pollock and Shoup 1977) and the amount of improvements (Grieson 1974; Edwards 1984; Tanzer 1985; Bourassa 1987, 1990). Mathis and Zech (1982) found no evidence of higher development levels in cities with lower taxes on improvements, although the research design was problematic (Coffin and Nelson 1983; Liu 1985). Visual analysis has also been used to test the spatial impact of variations in land and improvement taxes, with no evidence of distinguishable effects (Woodruff and Ecker-Racz 1965; Clark 1975). Other studies have used similar methods to focus on the timing of redevelopment (Cord 1970; Archer 1972). Cord (1970) represents one of many hypothetical analyses that studied the immediate impact of a change from an RPT system to a system with a higher tax on the land value portion of the total property value. The change did not occur, so no test was ever performed. Archer (1972) argued that in Sidney, Australia, where LVT is used, accelerated commercial redevelopment was evident. Although Archer did discuss other likely reasons for the change, his empirical model did not control for any of these other causes. Thus a long standing research question remains unanswered: Does the timing of redevelopment vary between LVT and RPT systems?

■ Theory

Redevelopment is generally studied within the larger area of land use succession. One model of succession holds that properties will redevelop when the economic value of the new use is greater (after accounting for the cost of any construction) than the value of the existing use plus the cost of demolition (Ratcliff 1949; Fisher and Fisher 1954; Andrews 1980; Heilbrun 1987).[1] The necessary setting for succession to occur may be provided by two conditions. In one case, an old building becomes increasingly obsolete, thus decreasing the market value of the site in its existing use. Alternatively, demand for a new building increases, making the market value of the same site rise for a proposed use. Redevelopment is likely, due to a combination of these conditions.

Redevelopment should occur when the present value of the new use (including a normal rate of return and subtracting any redevelopment costs such as demolition, site preparation, and construction costs) exceeds the present value of the existing use. This decision rule may be expressed as follows:

$$V_t^P - IV_t^P \geq V_t^e$$

where

V_t^P = the present value of the potential use,

IV_t^P = the present cost to redevelop the site in this potential use,

V_t^e = the present value of the existing use.

Based on standard appraisal theory, land value is the residual value remaining after accounting for the value of the improvements required to develop the property to its optimum use.[2] Thus, the left side of this expression represents the present land value of the property. This identity suggests that redevelopment should occur when the land value equals or exceeds the value of the existing use of the site:

$$LV_t \geq V_t^e$$

A simple transformation of this expression shows that the ratio of land value to total property value can be used as a gauge for the redevelopment potential of the property. Dividing both sides of the expression by the value of the existing use, the expression translates into:

$$LV_t / V_t^e \geq 1$$

With unity representing the maximum level of the relationship of the land value to total property value, this ratio shows that the pressure to redevelop increases as the ratio approaches unity.

A difference in the property taxing system would influence the decision to redevelop as follows. Assuming that property taxes, as represented by T_t, would be assessed on both the potential and existing use of the property, this factor can be considered in the decision rule

$$LV_t - T_t^p \geq V_t^e - T_t^e,$$

which easily translates into

$$LV_t \geq V_t^e + (T_t^p - T_t^e).$$

A change in property taxes before and after redevelopment would influence this decision, while a tax on land value would not affect this decision. Under an LVT, the land value tax would remain constant before and after redevelopment, so that

$$T_t^p - T_t^e = 0.$$

Land value taxes are capitalized into the land values, and, with a change in the level of the tax, they should have no impact on the optimum timing. As a fixed holding cost, land taxes may add to the pressure to redevelop and discourage any redevelopment delay. Improvement taxes should delay the timing of redevelopment until the land value increases sufficiently to offset the increase in improvement taxes. A tax on the improvement value before and after redevelopment would tend to delay redevelopment by requiring a higher total property value from the potential use. If the new improvements would be more valuable than the existing improvements, the taxes would increase after redevelopment. This increase in taxes produces an economic deterrent to redevelop by effectively increasing the value of the existing improvements compared with the potential improvements:

$$T_t^p - T_t^e > 0.$$

Thus, improvement taxes should defer renewal beyond the optimal point by biasing the owner in favor of the lighter-taxed use. Because an LVT system is based on land values only, this system should not affect the outcome of the decision to redevelop. By taxing both land and improvement values, an RPT system causes a potential use to compete not only against the net return on the existing use, but also against the capital investment required for redevelopment.

A hypothetical example illustrates this rule. Suppose a property is currently occupied by a commercial midrise that has a present value of $0.5 million. An assessment of the market shows that a legally permissible commercial high-rise would produce a present value of $5 million, after a capital investment of $4.5 million to cover demolition, construction, and financial and legal costs.

A 5% LVT would not affect this decision. To maintain consistency, consider the tax as a capitalized value, using a 10% interest rate:

$$\$5 - \$4.5 - \$0.25 = \$0.5 - \$0.25.$$

This expression reduces to $0.25 = $0.25, and the test passes.

Now consider how an RPT would affect this decision. Assuming a constant revenue requirement, the tax rate might reduce to 2%, because of the shared tax base. As before, including the capitalized value of the tax, using a 10% interest rate, in the decision produces

$$\$5 - \$4.5 - \$1 < \$0.5 - \$0.1.$$

This expression reduces to - $0.5 < $0.4, and the test fails. Beyond the market competition that exists between the potential and existing use, the RPT system adds fiscal competition, in the improvement tax, to the decision to redevelop.

The relative trend in the values of these two components will influence the rate and optimal timing at which redevelopment will occur. Because the factors controlling land and improvement values are different, the relative trend in these values decides the rate and optimal timing of redevelopment. Early in the life cycle of development, improvement value is at a maximum, and subsequently declines due to deterioration and obsolescence. Aging improvements decline in value, and the land value becomes a larger portion of the total value. The stage in the life cycle can generally be measured by the ratio of land value to total property value, with higher ratios occurring at later stages in the life cycle. Property in a later stage of its life cycle would be more likely to redevelop than property in an earlier stage. Used as a measure of the stage in the life cycle of a property, this ratio shows the redevelopment potential of the property. Theoretically, redevelopment should occur when this ratio is unity.

The ratio of land value to total property value provides a measure of the stage in the life cycle of the property. Timing of redevelopment may be thought of in terms of the number of years that a use continues past a particular stage in its life cycle. A model of this relationship would be

$$\text{Time}_i = ß_0 - ß_1 \text{ Life-cycle Stage},$$

interpreting $ß_1$ as the number of years to redevelopment per unit of land value to total property value ratio. Because the life-cycle stage is never zero, $ß_0$ has no conceptual interpretation. It merely serves as a statistical term (i.e., Y-intercept).

Property taxes enter the redevelopment decision through effects on the cash flows expected from the existing development versus a potential redevelopment. If the existing development will deteriorate without additional investment, the owner would redevelop when the present value of expected net income from the potential redevelopment equals or exceeds the present value of the net income expected from the existing development. Property taxes enter this decision as an operating cost. Land value taxes remain unchanged after redevelopment, so will not affect the timing of redevelopment. Because taxes paid on improvements increase after redevelopment, net income from redevelopment decreases, thereby delaying the timing of redevelopment until the net income from existing development declines further, and/or market pressures build to increase the net income from redevelopment. Thus the research hypothesis is: Properties subject to a land value taxation system will redevelop sooner than properties subject to a real property taxing system.

■ Empirical Method

New Zealand was chosen for study because of the range of property taxing systems and a highly acclaimed property assessment system (Woodruff and Ecker-Racz 1965). Land taxation occurs in two forms in New Zealand: as a local property tax (called rating in New Zealand) and as a national wealth tax (called the land tax). Two other local property tax bases include the capital value of land and buildings and the annual value of land and buildings. Due to voter preference, most municipalities (approximately 80% in 1985) use the land value rating system (Clarke 1975). The principal local taxing system in New Zealand is local property taxes, but, similar to the United States, they only represent approximately 20% of local government revenues (New Zealand Department of Statistics 1988). National taxing systems fund many local services, including transportation, education, and welfare. Some local services, such as water and wastewater systems, are financed through usage fees.

At the national level, the land tax originated in the 1800s, but currently is based on the Land Tax Act 1976. Throughout the study period, the land tax applied to the value appearing on the government valuation roll of the an individual's accumulated land holdings that were in commercial or industrial use (Syme and Markham 1988). This Act effectively establishes a progressive system of tax levels by increasing the amount of land value subject to the fixed 2% tax as the land value increases as follows: "Holdings with a land value of less than $175,000 are exempt from the tax, while holdings with a value of between $175,000 and $350,000 receive a partial deduction of $175,000 less the amount in excess of $175,000 they are valued at.... For land holdings of an individual or company valued at over $350,000 the full 2% tax is payable" (Syme and Markham 1988). These conditions exempt most properties throughout New Zealand from being subject to the land tax. Only in the central cities of Auckland and Wellington, the largest cities in New Zealand, are the land values high enough to be affected by this tax (Bissett and Shanks 1988).

Finally, a centralized professional assessment system suggested a data base that was both valid and replicable. Valuation New Zealand, an administrative department of the national government, assesses the market value of land, improvements, and total capital value for all real property throughout the nation. The assessments are contracted by local governments to establish the local rating base, and used by the national government for the land tax base.

This study was limited to the two largest cities in New Zealand because of resource constraints and limited redevelopment activity in other New Zealand cities. The central business districts of Auckland and Wellington provided an appropriate data base for the research. Since 1927 the Wellington local taxes have been based on the land value portion of all privately owned real estate, whereas the Auckland local property taxes have been based on the total value of land and improvements since 1931 (O'Regan 1985). Both cities are located on the north Island of New Zealand. Throughout the study period, Wellington was the seat of the New Zealand national government, thus the government was a major sector of the Wellington economy. Wellington sits along a harbor surrounded by steeply rising mountains. This terrain increases the development cost of much of the land in Wellington. Although there were minor annual changes, the Wellington regional population remained around 320,000 throughout the study period (New Zealand Department of Statistics 1990). Auckland also sits along a harbor, but is surrounded by gently rolling hills that represent some of the most fertile land in New Zealand. The strength of the agricultural sector of the New Zealand economy, as well as a lack of topographic constraints, is a possible cause of the growth of the Auckland region from about 700,000 persons in 1970 to almost 850,000 in 1990 (New Zealand Department of Statistics 1990).

In 1988 the central cities of Auckland and Wellington looked very much as the theories outlined earlier predicted. The contrasting development patterns between Wellington and Auckland are striking. Wellington is a vertical city. Sites

are intensively developed with mostly high-rise offices. Most of the existing buildings in central Wellington were built after 1960, and few vacant lots existed. Compared to Wellington, Auckland shows a more horizontal pattern of development, with many two-story buildings and vacant lots distributed over a larger area than was evident in Wellington's downtown. Auckland and Wellington Valuation Departments' files also indicated a much older inventory of building stock in Auckland than in Wellington. Inspection of these records determined that most of the existing buildings in the Auckland central city were built before 1930. Auckland City represents the principal center, but only one of many municipalities in the Auckland metropolitan area. Many Aucklanders compare their city to Los Angeles. Although Auckland is smaller than Los Angeles, the similarity between the development patterns of these two cities is noticeable.

Redevelopment projects that occurred in the central cities of Auckland and Wellington between 1970 and 1988 were used to empirically estimate any difference in the time to redevelopment from a stage in the life cycle of a property. Throughout this period, land value taxation was used in Wellington, and a real property tax system (where both land and improvements are taxed) was used in Auckland. As noted, the physical settings of Wellington and Auckland are vastly different; the Wellington central city is hemmed in by steep mountains, while Auckland spreads out among rolling hills. To compensate for the physical differences between the two cities, the center of each city was defined as the area within one mile of the peak land value that was zoned for nonresidential use. This limitation caused the study area in Wellington to be smaller than in Auckland. In Wellington the downtown is a strip between the harbor and the mountains, while downtown Auckland fans out from the harbor, unconstrained by topography. These physical features were reinforced by the respective zoning regulations.

To test the hypothesis that the number of years to redevelopment for properties at similar stages in their life cycles would be shorter in Wellington than in Auckland, a sample of market-driven redevelopment projects occurring in the respective central cities between 1970 and 1988 were identified. Any property where the principal structure was demolished to ground level within the study period was defined as a redevelopment project. These data were available through demolition permit records at the building inspection offices of each city council and was cross referenced with property assessment files.

All projects involving public use and public ownership were eliminated. This limitation significantly reduced the potential sample in both cities. Both Auckland and Wellington contain a significant amount of reclaimed land. Most of this land was still owned by a public body (primarily the respective harbor authorities and city councils), but was privately used through a land leasing arrangement. These land leases tended to have very long periods between review, so they generally did not reflect market rents.

A second factor that further limited the potential sample frame was a public effort to improve the ability of the buildings to withstand earthquakes. While both cities adopted ordinances in 1970 requiring all buildings to upgrade to a minimum standard within a fixed period, only the Wellington ordinance had real meaning. Wellington lies on a fault line and has suffered considerable damage in several earthquakes. No earthquakes are known to have occurred in Auckland. Professionals in the development industry in Wellington consistently said that the earthquake ordinance did not have any direct impact on redevelopment. Several of these same professionals stated that it was the insurance ratings and premiums, set according to building design standards, that more directly influenced redevelopment (personal interviews). This increase in the holding cost of existing buildings may have hastened their replacement. However, the regulations also would increase the cost of development, so the net effect on timing is uncertain. All buildings designated as earthquake risks by the Wellington city engineer were thus eliminated from consideration.

During the study period 228 properties redeveloped in the central city of Auckland and 301 properties redeveloped in Wellington. After reducing the total number of redevelopment projects according to the two limitations noted above, a total sample of 217 projects remained (121 in Auckland and 96 in Wellington). All these remaining projects were included in the study.

Regression analysis was used to estimate the difference in the time to redevelopment for properties subject to LVT and RPT. The regression model is

$$Y = B_0X_0 + B_1X_1 + B_{z0}Z_0 + B_{z1}Z_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6$$

where B is the respective regression coefficient, and

Y = time to redevelopment for each property,
X_0 = intercept,
X_1 = stage in the life cycle of a property (ratio of land value to total value),
Z_0 = dummy variable for tax type (LVT is present, RPT is omitted),
Z_1 = interactive term distinguishing stage in the life-cycle of a property by tax type (X_1 times Z_0),
X_2 = land scarcity (population per unit of develop able central city land),
X_3 = metropolitan population growth rate (year prior to redevelopment),
X_4 = dummy variable for original land use (series of five dummy variables for specific uses),

X_5= dummy variable for ownership characteris tics (owner, renter, developer),
X_6= dummy variable for properties that were assembled.

The dependent variable is the time to redevelopment of an urban property from a known point within the life cycle of the existing improvement. Time to redevelopment was measured as the number of years that passed from the year the property was assessed to the year of redevelopment. In 1970, Valuation New Zealand assessed values on all properties throughout New Zealand on a five-year cycle. This period was later decreased to three years. Therefore, a series of land and total value assessments was available for each property at three- or five-year intervals. Because of the length of this period and the enormity of searching through 18 years of assessment records, only the last assessment prior to redevelopment was used. Therefore, the time to redevelopment could vary from zero to 5 years (actual variation was from zero to 4.8 years).

The stage in the property's life cycle (X_1) was measured by the ratio of the assessed land value to total value of each property. Assessed capital values for the land and the combination of land and improvements at the last assessment before redevelopment were determined for each property. These ratios varied between 21 and 100%.[3] Simple correlation of the independent and dependent variables was -0.08.[4] A negative regression coefficient on the life-cycle ratio variable will support the theory that a property is more likely to redevelop in the later stages of its life cycle.

To distinguish between LVT and RPT properties, the regression coefficients for the intercept and life-cycle variable were allowed to vary between these two groups. The effect of LVT on the time to redevelopment could operate in two ways. First, redevelopment could occur more rapidly in Wellington because the LVT increases the net present value of redevelopment, regardless of the stage in the life cycle of the property. In other words, LVT could speed the redevelopment process by a constant amount at any given life-cycle stage. This effect could be captured by a dummy variable (Z_0) whose coefficient would subtract a constant amount from the time to redevelopment for Wellington, relative to the time in Auckland. In the regression this amounts to an adjustment to the intercept (X_0). A negative coefficient for the dummy variable that distinguishes between the tax types (Z_0) will support the theory that, compared to a real property tax, LVT hastens redevelopment. Second, LVT could affect the time to redevelopment differentially, depending on the stage in the life cycle of the property. For example, for new properties LVT may not substantially affect the time to redevelopment. But, as properties age, the effect of the land-value-to-total-value ratio on time to redevelopment may be much greater in the city with LVT. In regression terms, this means that the coefficient on the life-cycle variable might differ between Wellington and Auckland. To capture this possibility, an interactive dummy variable between tax type and life cycle is included (Z_1). The coefficient on this interactive variable can be interpreted as the additional impact of life cycle on time to redevelopment for property located in Wellington rather than in Auckland. The interaction coefficient (B_{z1}) is therefore an adjustment to the coefficient (B_1) on the life-cycle variable (X_1).[5] For Auckland, the effect of life cycle on time to redevelopment is B_1, and for Wellington, the effect is $B_1 + B_{z1}$. A negative regression coefficient for the adjustment to the life-cycle ratio variable (B_{z1}) will support the theory that LVT hastens redevelopment compared to RPT.

To control for other influences on the time to redevelopment, several variables are added to the model. These control variables include the factors affecting the land and the improvement value of the property. Factors affecting land value are the geographic, social, economic, and legal characteristics of each parcel. Factors affecting the improvement value are the structural and social characteristics of the improvements.

Two geographic factors affecting urban redevelopment are location and land scarcity. Location involves the interrelationship of advantages or disadvantages of the potential use of a site. Location characteristics include relative accessibility, quality of neighboring uses, environmental amenities, and public services. Variation in the location could affect the time to redevelopment because of demand for the site. Sites with superior location advantages were expected to redevelop sooner than sites without these advantages. As noted earlier, location was controlled by limiting the study to a comparable neighborhood, the central business district (CBD).

Land scarcity involves the relationship between the demand for land and the available supply of land. While population growth produces an increase in demand, an available supply of suitable vacant land would reduce the immediate pressure to redevelop existing land uses. Land supply may be restricted by both physical and social forces. Natural features, such as mountains and oceans, and fabricated features, such as roads and buildings, restrict the supply of developable land. Social constraints, such as protective covenants and zoning regulations, may also limit developable land. The geographic differences between Auckland and Wellington are considerable. To control for difference in land scarcity, X_2 measured the relationship of population to available land. Annual survey and estimated population figures for the urban area of each city were divided by the urban land area, as defined by the New Zealand Statistics Department, for each year. The land area in Wellington was further reduced by 66.6% (O'Regan 1985) to account for extensive mountainous areas too steep for development. Based on the assumption that the amount of land subject to other constraints, such as covenants and

regulation, was similar in both cities, no other adjustments were made. Land scarcity represents the annual relative demand for developable land within each urban area.[6] In Auckland the land scarcity variable ranged from a low of 7.63 persons per hectare in 1970, to a high of 8.85 persons per hectare in 1988. In Wellington, land scarcity ranged from a low of 22.08 persons per hectare in 1971, to a high of 24.17 persons per hectare in 1988.

Several social and legal characteristics (X_3 through X_5) were considered. Population trends over time may influence the time to redevelopment. During periods of higher rates of growth, properties were expected to redevelop faster, while periods of population decline were expected to encourage slower redevelopment. To control for expectations resulting from population trends, X_3 is the percent change in urban area population change in each city during the previous year. The same population data was used for calculating land scarcity and population-trend variables. In Auckland, annual population growth varied from a low of -1% to a high of 4%, with an average annual growth rate of 1.6%. In Wellington, annual population growth varied from a low of -1% to a high of 3%, with an average annual growth rate of 0.6%.

The land use before redevelopment may affect the time to redevelopment for several reasons. The location advantages of the CBD cause high land values, which should encourage a higher intensity of development. Lower intensity uses, such as theaters, warehouses, and factories, should redevelop faster than more intensive commercial uses, such as offices and retail establishments (Alonso 1964), but public policy may protect these uses from market influences. In both cities, zoning was used to protect residences from redevelopment by disallowing other uses. In addition, tax immunity was used to increase the economic advantage of some uses (e.g., for churches and other nonprofits). When the data was collected in 1988 the predominant use in both central cities was commercial. A variety of land uses before redevelopment showed evidence of other historical land use patterns. To account for the competitiveness of the range of former land uses, five dummy variables (X_4) were included for churches, residences, warehouses, factories, theaters, and commercial activities.[7] Residential uses, including both single- and multiple-family residences, made up the omitted dummy variable.

Ownership characteristics may also influence the time to redevelopment. Leasehold terms may delay an existing use from redeveloping. Throughout the study period, a typical lease in either Auckland or Wellington was a triple net lease. This system requires the tenant to pay the property taxes. Thus, while renters are constrained by the lease from vacating, owners have no incentive to redevelop. Due to this condition, leasehold properties may redevelop later than owner-occupied properties. The property assessment roll listed both the owner and the taxpayer, therefore a taxpayer not listed as the owner was assumed to be a tenant. Investigation of the assessment files confirmed this information. All property rolls that listed different parties as the owner and the taxpayer were classified as renter occupied. Variations in owner value systems may also vary the time to redevelopment. Owner occupants may value their land use greater than the market value, causing them to resist change. The financial strength of the owner could enhance this inertia of owner occupants. However, not all owners share this personal attachment to their property. In particular, owners who are investors and owners who are professional developers are expected to redevelop sooner than are owner occupants. Developers were identified by interviewing persons familiar with the development industry during the sample period, these included public assessors, university faculty, and real estate developers. Ownership characteristics were included as dummy variables (X_5) for owner occupants, renter occupants, and properties owned by persons identified as developers.[8] Developer owners were the omitted category.

Finally, cost to redevelop also may pose a constraint to redevelopment. Although demolition costs are generally considered insignificant in the total cost of redevelopment, site assembly costs may present an important obstacle. Particularly in a CBD, where existing uses are often located on very small sites, a developer may require several sites. Thus, assemblage costs may prevent redevelopment in already developed areas. Properties assembled before redevelopment were distinguished from single-property redevelopment projects with a dummy variable (X_6). Properties not combined with other property served as the omitted variable.

The hypothesis was that the difference in city taxing systems would be a statistically significant determinant of variation in the time to redevelopment. If the adjustment coefficient is significant it will show that LVT properties redevelop at a different rate than properties subject to RPT. If improvement taxes delay the redevelopment of a property, relative to land taxes, then the coefficient for the redevelopment ratio should be lower, or more negative, in an LVT setting.

■ Results

Table 1 shows the results of the regression model. The base coefficient for the variable measuring the life-cycle stage is not statistically significant. This evidence provides no support for the theory that time to redevelopment declines as the life-cycle ratio increases. The coefficients for the land use category for factory (the variables for population trend, land scarcity, and the adjustment to the intercept) are all statistically significant. The coefficient for factory as a pre-existing use is positive. In both cities, factories redeveloped about nine months later than other uses. It was predicted

that factories would redevelop sooner because the central city land costs would be too high for this low-density use to compete with higher-density commercial uses. A visual survey of land use in Auckland and Wellington showed that several structures originally built for manufacturing use still existed, but had been renovated for another use.[9] In fact, these new uses tended to be commercial or high-density residential. Factory buildings are often large and have few partitions. This physical layout may be more adaptable than that of buildings designed for other uses. This adaptability may explain why factories redeveloped slower than buildings designed for other uses.

The coefficient for population growth trends is also statistically significant. As expected, the time to redevelopment decreased as the population growth rate increased. The average time to redevelopment decreased by almost three months for each 1% increase in the population growth rate in either area. It is likely that the anticipation of continued population growth stimulated redevelopment activity and shortened the time to redevelopment. A statistically significant coefficient occurred for the variable measuring land scarcity. Curiously, time to redevelopment appears to increase as land becomes more scarce in either city. Finally, the adjustment for the intercept variable is statistically significant. This result suggests inherent differences between the cities that are not explained by the model.

Multicollinearity between several variables shows a basic problem with the model.[10] Variables for land scarcity, intercept adjustment, and life-cycle stage adjustment are almost perfectly correlated with Pearson's r correlation coefficients of 0.998 (land scarcity:intercept adjustment), 0.957 (land scarcity:life-cycle stage adjustment), and 0.958 (intercept adjustment:life-cycle stage adjustment). The fundamental reason for the high correlations is that the land scarcity index (persons per hectare of developable land) for Wellington is substantially more than the index for Auckland in all time periods, and the two coefficient adjustments similarly distinguish Wellington from Auckland. Variations of the base regression model were investigated using different combinations of the three collinear variables (Table 2). As suspected, coefficients for the land scarcity variable and intercept adjustment are quite different without the influence of the other variable. Without the other variable in the model, the coefficient for the land scarcity variable decreases (variation 1), while the adjustment coefficient for the intercept increases (variation 2). Both lose statistical significance without the other included in the model, but are statistically significant when used together (base model and variation 3). One possible interpretation of these results is that land scarcity is very important in one city, but much less important in the other. Because the adjustment to the intercept is a dummy variable that distinguishes between the two cities in the model, it allows the effects of land scarcity to also be separated in the model. Separately calculating the influence of land scarcity on time to redevelopment for each city gives some evidence to this hypothesis. A comparison of the residual plots for each model suggests that the association between land scarcity and time to redevelopment may be greater in Wellington than in Auckland, but heteroscedasticity in the residuals clouds interpretation of the Wellington model.

Collinearity between the land scarcity variable and the dummy variable that distinguishes the Wellington intercept

Independent Variable	Base Coefficients for all Redevelopments (t-statistic)	Adjustment Coefficient for Wellington Redevelopments (t-statistic)
Intercept*	-4.595 (-2.71)	-12.098 (-4.53)
Life-cycle stage	0.002 (0.11)	0.001 (0.33)
Land assemblage	0.052 (0.29)	C**
Land use:		
Church	-0.706 (-1.11)	C
Commercial	0.188 (0.74)	C
Warehouse	0.308 (0.18)	C
Factory *	0.763 (1.90)	C
Theatre	-0.025 (-0.04)	C
Leaseholder:		
Owner	0.286 (1.52)	C
Renter	-0.189 (-0.86)	C
Growth rate*	-0.232 (-3.68)	C
Land scarcity*	0.771 (-4.33)	C

R^2 = .276
Regression: Degrees of Freedom = 13 Sum of Squares = 68.873
Residual: Degrees of Freedom = 183 Sum of Squares = 180.985
F = 5.36
Significance of F = .0001
*Denotes coefficients that are different from zero at the 10% level of significance
**Denotes coefficient constrained to equality in sub-samples

Table 1. Regression coefficients for influences on time to redevelopment.

also causes changes in the coefficient for the stage in the life cycle of properties in Wellington. The coefficient adjustment for life-cycle stage in Wellington is positive with both of the other variables included in the model, and takes on the sign of the excluded variable when either is left out, but is not statistically significant in any model that includes either variable (base model and variations 1, 2, and 3). This pattern suggests that the life-cycle variable serves as a proxy for either of the other two variables. Each of these variables serves to distinguish between the two cities. Further exploration confirmed that when any of these variables alone was included in the model, the coefficient was statistically significant and negative (models not included in Table 2).

While the hypothesis was that the difference in city taxing systems would be a statistically significant determinant of variation in the time to redevelopment of similar properties, other city differences were also apparent. Table 3 shows that statistically significant differences between the cities were shown in the mean time to redevelopment, the proportion of properties assembled during redevelopment, the proportion of owner occupants that redeveloped, and the scarcity of developable land. Although properties in Wellington show lower rates of assembly and higher rates of redevelopment by an owner occupant than those in Auckland, this variation may have resulted from differences not related to taxes. Land in Wellington is significantly scarcer than in Auckland. In Wellington, the land scarcity index ranged from 22.08 to 24.17 persons per hectare of developable land, whereas in Auckland the land scarcity index ranged from 7.63 to 8.85 persons per hectare. The mutual exclusiveness of the range of observations in the land scarcity index makes it difficult to measure the effect of the different tax systems. Regression analysis does not allow for extrapolating beyond the data set. While the data show that

Base Coefficients	Base Model (t-statistic)	V-1 (t-statistic)	V-2 (t-statistic)	V-3 (t-statistic)	V-4 (t-statistic)	V-5 (t-statistic)
Intercept	-4.595	2.254	2.43	-4.646	2.067	2.108
	(-2.71)*	(2.81)*	(4.78)*	(-2.86)*	(4.88)*	(4.93)*
Life cycle	0.002	0.001	-0.002	0.002	0.002	-0.004
	(0.33)	(0.12)	(-0.44)	(0.54)	(0.35)	(-0.94)
Assembly	0.052	0.101	0.094	0.052	0.102	0.136
	(0.29)	(0.55)	(0.609)	(0.29)	(0.55)	(0.73)
Land use:						
Church	-0.706	-0.798	-0.863	-0.702	-0.777	-0.510
	(-1.11)	(-1.20)	(-1.194)	(-1.11)	(-1.18)	(-0.78)
Commercial	0.188	0.190	0.129	0.192	0.207	0.373
	(0.74)	(0.71)	(0.48)	(0.77)	(0.80)	(1.49)
Warehouse	0.308	0.347	0.283	0.337	0.364	0.649
	(0.18)	(0.98)	(0.80)	(0.92)	(1.04)	(1.98)*
Factory	0.763	0.824	0.768	0.765	0.839	1.154
	(1.90)*	(1.96)*	(1.83)*	(1.91)*	(2.01)*	(2.91)*
Theater	-0.025	0.212	0.124	-0.019	0.232	0.395
	(-0.04)	(0.32)	(0.19)	(-0.03)	(0.35)	(0.60)
Leaseholder:						
Owner	0.286	0.181	0.178	0.289	0.184	0.072
	(1.52)	(0.92)	(0.91)	(1.55)	(0.94)	(0.38)
Renter	-0.189	-0.215	-0.215	-0.188	-0.230	-0.266
	(-0.86)	(0.93)	(-0.94)	(-0.86)	(-0.93)	(-1.15)
Growth rate	-0.232	-0.290	-0.277	-0.233	-0.293	-0.267
	(-3.68)*	(-4.48)*	(-4.26)*	(-3.80)*	(-4.58)*	(-4.21)*
Scarcity	0.771	-0.012	-	0.773	-	-
	(4.33)*	(-0.27)	-	(4.39)*	-	-
Coefficient adjustments:						
Intercept	-12.098	-	-0.860	-12.067	-	-
	(-4.53)*	-	(-1.29)	(-4.55)*	-	-
Life cycle	0.001	-0.003	0.005	-	-0.005	-
	(0.11)	(-0.36)	(0.62)	-	(-2.20)*	-
R^2	27.6%	19.5%	20.1%	27.6%	19.4%	17.3%

*Denotes coefficients that are different from zero at the 10% level of significance

Table 2. Comparison of coefficients of variations of the base model.

land scarcity influences time to redevelopment, it does not give any direct evidence of what would occur under different taxing systems in cities with similar land supplies. The physical difference between the cities thus limits the generalizability of these results. Similarity in the range of observations for population growth rates makes this variable's coefficient a more reliable indicator of its influence on time to redevelopment.

The Auckland and Wellington cases illustrate other generic problems in empirically testing the assertions of land value taxation theory. First, tax rates in both cities may be too low for variation in the systems to have an important or statistically significant effect on time to redevelopment. The average levels of property tax for the properties in the data base were 4.37% of value in Wellington and 2.16% in Auckland. Another common problem with the data from both cities arose from the five-year reassessment cycle. The length of this assessment cycle increased the likelihood that assessed values diverged from actual market values. Because land values generally increased in both cities throughout the study period, the delay in reassessment may have dampened any tax impact.

Other problems are not necessarily generic and could be addressed through appropriate modifications to the research design. For example, in this study it was not possible to measure differences in the quality and type of improvements. The life-cycle ratio provided only a crude measure of the relative value of different improvements. Improvements differ in quality and durability of materials, as well as in style and adaptability for reuse. It is reasonable to expect the value of different levels of improvements to decline at different rates according to variations in these factors. Another important consideration in the design of future research on LVT is the inclusion of other land use policies. For example, zoning may have influenced redevelopment patterns. The Wellington city council strictly maintained zoning with very few changes. The commercial area of the central city only expanded slightly during the 17-year study period. These changes in zoning from residential to commercial probably influenced the timing of this redevelopment. A nearly fixed downtown area existed despite the extreme space shortage. Although available land existed beyond the boundaries of the area zoned for commercial use, rezoning rarely occurred. Much of the area that could have been redeveloped into commercial use was government owned, thus reducing the influence of the market on the decision-making process. Even so, the compactness of the downtown showed an ability of the Wellington city council to withstand pressure from development interests to expand this area. On the other hand, rezoning occurred frequently and extensively in Auckland. Much of the central city did not redevelop because of a surplus of sites. The interaction of the zoning and taxing systems warrants further study.

■ Conclusions

The empirical evidence from New Zealand does not support the propositions about redevelopment drawn from either the theory of succession or the theory of property taxation. In particular, there is no empirical evidence that land value taxation speeds the process of redevelopment. In Auckland and Wellington, the stage in the life cycle of a

	Wellington				Auckland				Difference Tests		
	N	Min	Max	Proportion	N	Min	Max	Proportion	p	z	Probability
Assemble	63	0	1	0.70	89	0	1	0.83	0.8	-1.92	0.03
Church	1	0	1	0.01	2	0	1	0.02	0.0	-0.05	0.48
Commercial	62	0	1	0.69	72	0	1	0.67	0.7	0.20	0.42
Warehouse	2	0	1	0.02	23	0	1	0.21	0.2	-0.65	0.26
Factory	2	0	1	0.02	9	0	1	0.08	0.1	-0.30	0.38
Theater	2	0	1	0.02	1	0	1	0.01	0.0	0.08	0.47
Owner occupied	64	0	1	0.71	44	0	1	0.41	0.6	3.11	0.01
Renter occupied	17	0	1	0.19	22	0	1	0.21	0.2	-0.13	0.45

	Wellington					Auckland					Difference Tests	
	N	Min	Max	Mean	Variance	N	Min	Max	Mean	Variance	t	Significance
Time to redev.	90	0.00	4.83	1.83	1.57	107	0.33	4.00	2.30	0.9	-2.49	0.01
Life-cycle stage	90	35.00	100.00	83.63	354.43	107	21.11	98.20	69.90	385.6	0.26	>0.10
Growth rate	90	-1.46	2.71	0.82	1.73	107	-0.54	3.63	0.98	1.2	-0.73	>0.10
Land scarcity	90	22.08	24.17	23.55	0.27	107	7.63	8.85	8.61	0.1	489.14	0.0005

Table 3. Variation between cities.

property, as approximated by the ratio of land value to total property value, did not influence the time to redevelopment. The property taxing systems also did not influence the time to redevelopment. The pace of redevelopment was accelerated by high regional population growth rates and by higher levels of land scarcity. Redevelopment was slowed by manufacturing uses (at least in concentrations found in this study) possibly because manufacturing buildings may be converted more easily than other types of structures. Inherent differences between the cities influenced the rate of redevelopment, but land scarcity was a major factor. Because the land scarcity in the two cities was so dramatically different throughout the study period, it would be risky to extrapolate the effect of tax system differences in either city to a common land-scarcity situation. It is also possible that differences in the levels of land scarcity, together with the low tax levels and long assessment cycles, may have overwhelmed any effects of the difference in the property taxing systems. These results may thus be limited to a context with similar circumstances.

■ Notes

1. See Roakes (1991) for a more detailed discussion of succession theory.
2. See Roakes (1991) for a more detailed discussion of the basis for land and improvement values.
3. These ratios were converted to percents in the regression model to simplify interpretation of the coefficients.
4. The correlation coefficient among all the variables was calculated using Pearson's r test to determine the simple correlation between independent and dependent variables.
5. See Henneberry and Barrows (1990) for a more detailed discussion of this method.
6. Urban areas are statistical concepts defined by the New Zealand Department of Statistics as areas of unified community, economic, and social interests.
7. Commercial activities included offices, shops, services, and parking garages.
8. Over half the redevelopment in Wellington was conducted by owner occupants. In Auckland, owner occupants also represented the largest group conducting redevelopment, but developers also carried out much of this activity.
9. While this type of conversion represents one form of redevelopment, it was outside the scope of this research.
10. The correlation coefficient among all of the variables was calculated using Pearson's r test to determine multicollinearity of independent and control variables.

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