Tax Incidence on Land and Property Value

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1 Introduction

Property tax is a tax levied upon the value of real estate and the associated land in which it sits on. A land value tax is a levy on the value of land without the related value of buildings, property, or real estate that sit on land. To an outsider, it may seem as though property tax is similar enough to be categorized as the same tax, but there exist nuances between the two tax structures that foster differing incentives. I will analyze the economic differences between the two tax structures, rough implementations to California, and an interesting game theory component as a summary.

2 Two Tax Structures

Property value may be defined as the value of land improvement and the land in which the improvement resides upon. For mathematical purposes, it will be defined as:

Property Value = Land Improvement + Land Value

If a tax was imposed upon a property value, the prior formula would simply be modified for tax as:

Property tax = (Land Improvement + Land Value) × Tax Rate

Land value is simply defined as the value of the value of land without regard to any improvements or property and is modeled here as:

Land value = Resources + Location;

However, for simplicity's sake and in reference to property tax, it will just be defined here as:

Land value = Land value

To analyze the difference between property tax and land value tax, it is of the utmost importance to understand the distinction between property value and land value. Land improvement is the only difference between property value and land value. As such, we will take a look at the land improvement aspect alone in this analysis.

The market for land improvement is described as supply in which the owners of the property produce buildings, paved parking areas, driveways, fences, outdoor lighting, or anything that generally is a beneficial add onto the land. Demand is illustrated as prospective investors or homeowners interested in purchasing the property value with the added land improvement component.

The supply curve function is defined as:

$Q_{Supply} = a + b \times P_{Supply}$ or in y-axis terms, $P_{Supply} = (Q_{Supply} - a)/b$

The demand curve function is defined as

$Q_{Demand} = c - d \times P_{demand}$ or in y-axis terms, $P_{demand} = (-Q_{demand} + c)/d$

This is demonstrated in the graphic below in terms of a simple linear supply and demand, only for illustrative purposes as the two demand and supply functions are a rough theoretical approximation for the market.The given inputs for these function is based on the following: a = 0, b =1, c = 2, and d = 1.

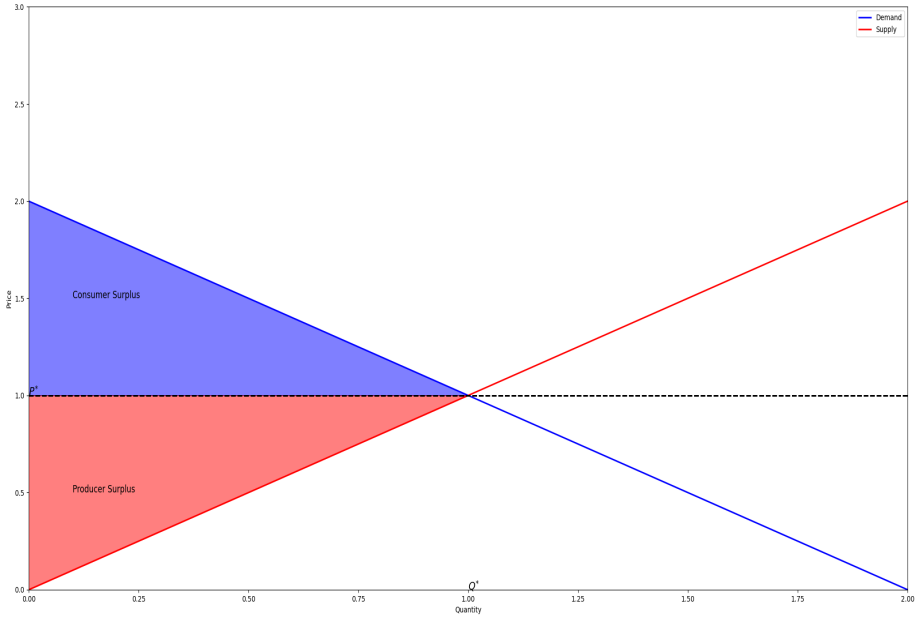

Figure 1: Demand Supply Curve for Land Improvement Market

The market equilibrium price and equilibrium quantity is computed as 1. The consumer surplus and producer surplus is .5 based on the following computations:

The consumer surplus: $\int_0^{Q*}(-Q_{Demand}+c)/d - P_{Demand}\,dQ.$
The producer surplus: $\int_0^{Q*} P_{Supply} - (Q_{Supply}-a)/b\,dQ$

Now suppose a tax incidence is imposed upon the market such that

$Q_{demand} = c - d \times P_{demand} - t$ or to put it in y-axis terms, $P = (-Q_{demand} + c - t)/d$

The graph is visualized as with the same inputs as the previous scenario but with an addition that t = .5.

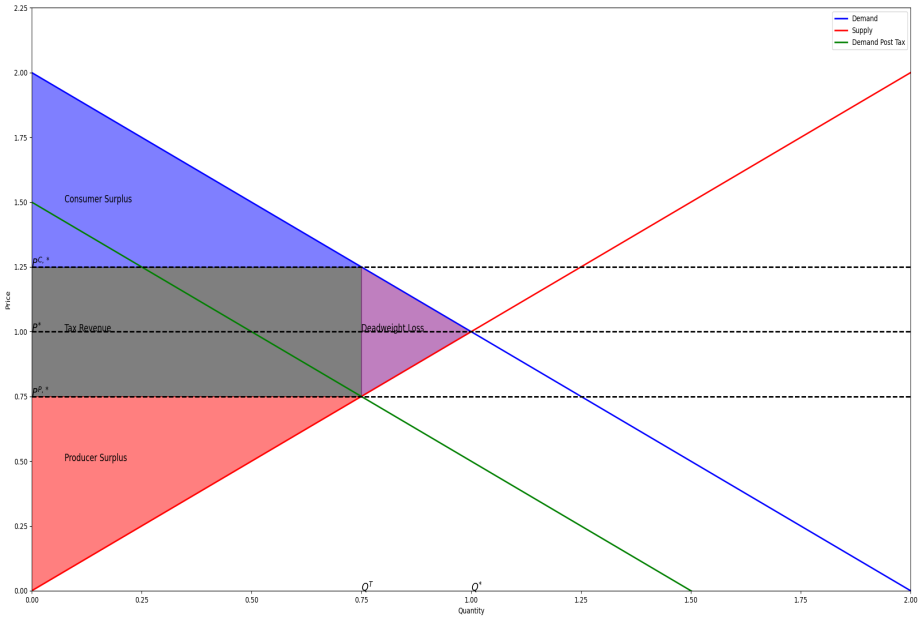

Figure 2: Demand Supply Curve for Land Improvement Market with Tax

Given the same inputs as the previous scenario, but with additional tax incidence of t = .5, a new equilibrium displaces the previous version. Consumer prices and producer prices are impacted equally due to an equivalent proportion of elasticity with one another. That is, the new consumer equilibrium price is 1.25, a .25 increase from its previous equilibrium price, and producer equilibrium price is at .75, a .25 decrease from its previous equilibrium price. This essentially means that consumers pay an additional .25 tax burden caused by the tax incidence for land improvement, while producers pay the remaining .25 tax burden as it decrease their profits.

Additionally, consumer surplus and producer surplus decreases to .281245, and a deadweight loss of .0625 is generated. However, a tax revenue of .375 is produced due to this tax incidence. The following formulas compute consumer surplus, producer surplus, tax revenue, and deadweight loss.

Consumer surplus: $\int_0^{Q_T} (-Q_{Demand} + c)/d - P_{Demand}\, dQ$.
Producer surplus: $\int_0^{Q*} P_{Supply} - (Q_{Supply} - a)/b\, dQ$.
Deadweight loss: $\int_{Q_T}^{Q*} (-Q_{Demand} + c)/d - (Q_{Supply} - a)/b\, dQ$.
Tax revenue: $\int_0^{Q_T} P_{Demand} - P_{Supply}\, dQ$.

A tax revenue of .375 was generated at a cost of .0625 deadweight loss. Ultimately, land improvement production and consumption was not fully optimized according to market forces and those resources come as a trade off for tax revenue. An effect of a property tax policy is that it causes land improvement services to be traded off as a resource for tax revenue that produce certain services for society.

Now that we have modeled out a tax incidence on land improvement and analyzed its benefits and consequences, we shall model the land market and the effect of a tax incidence upon land.

Since there is only a fixed amount of land due to its natural resource constraint, the supply curve function inherits perfect inelastic quality and is defined as:

$$Q = a$$

The demand of land will be modeled as

$Q_{demand} = c - dln(P_{demand})$, and in y- intercept terms as $P_{demand} = e^{-Q_{demand}+c/d}$

The graph below demonstrates the market for land at the given coordinates of a = 1, c = 10.0478214424784, and d = 1.

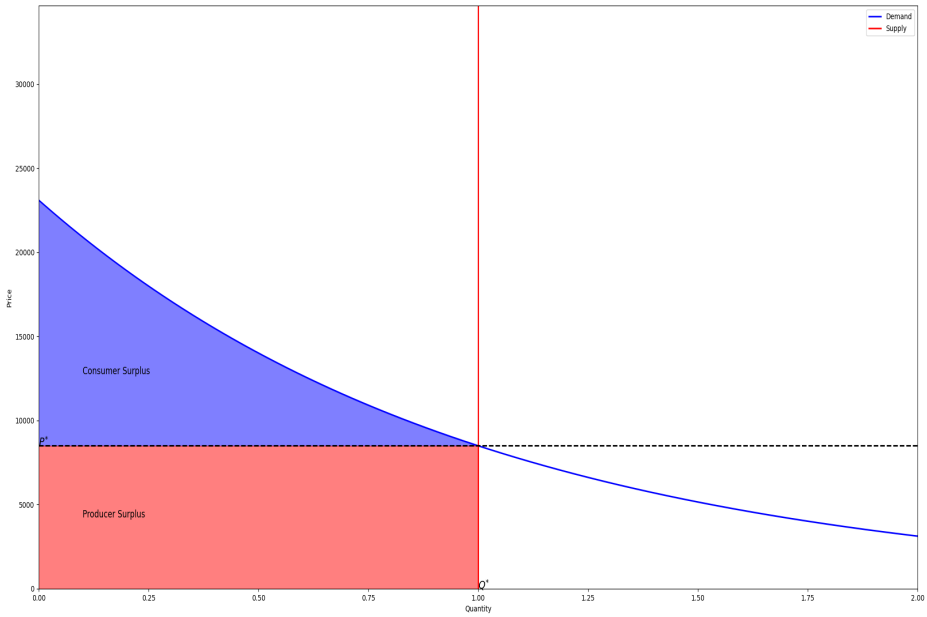

Figure 3: Land Market Without Tax

The equilibrium quantity is computed as 1, equilibrium price as 8,500, consumer surplus as 6,105, producer surplus as 8,500.

Now suppose a tax incidence of .5 is applied to this market. The graph below demonstrates the land market given the same inputs as the scenario above with an additional tax incidence.

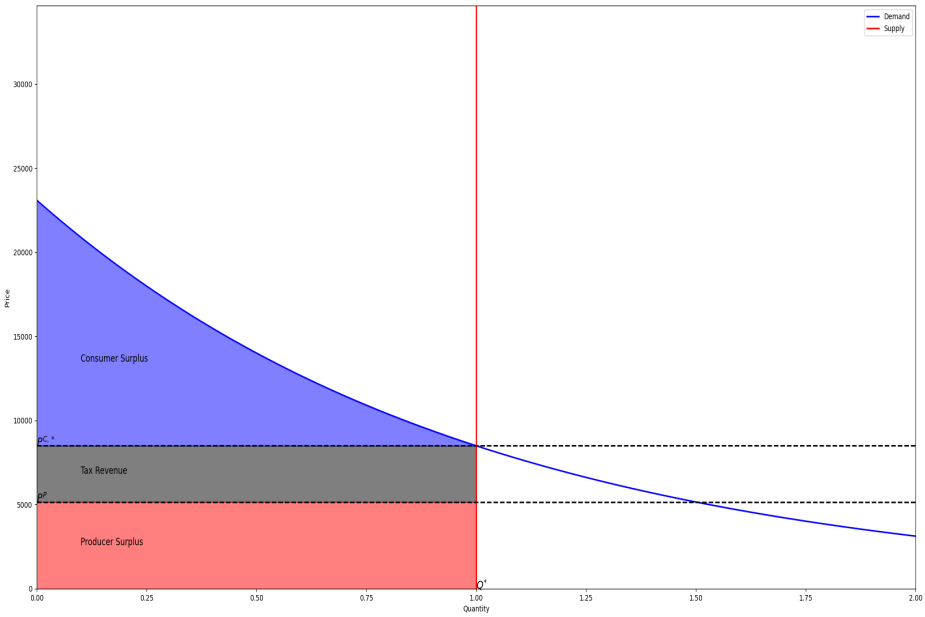

Figure 4: Land Market Tax

For this scenario, The equilibrium quantity is 1, consumer equilibrium price as 8,500, producer equilibrium price as 5,155 , consumer surplus as 6,105, producer surplus as 5,155, and tax revenue as 3,344 . Notice there does not exist any deadweight loss, meaning the optimal point of land being sold or bought would still occur given a tax incidence on the land market. Ultimately, suppliers of land incur the entire tax burden, and all tax revenue is striped from producer surplus.

This begs the question, why would property tax be utilized as a public policy instead of a land value tax if a land value tax is economically more efficient and not create deadweight loss within the market? Administratively, it is difficult to measure the market rate for a given acre of land. Typically property tax is assessed based off of a property's market value. For land value to be assessed, administrators would need to figure out a method of determining the market value of land without its respective building component. If this administrative cost is less than the deadweight loss incurred by taxation on property tax, land value tax would be a worthwhile pursuit.

Aside from this administrative inconvenience, a land value tax would incentivize participants to utilize land in such a way that is economically optimal and would cause homeowners to improve their properties more than what exists in the current public domain.

3 California's implementation

I will now go over a hypothetical implementation that replaces California's current property tax. This estimation is done at a high level for illustrative understanding and is not a recommendation of policy change.

Under the assumption that the average land price in California is $8,500 and the total acreage of land is approximately 104M, we may approximate the total land value in California as $890B.[1,2] Given that California's property tax revenue is roughly $60B with a property tax rate of .77%, it is inferred that the total value of property, including land is roughly 7.79T.[3]
From this, we infer that the additional building value or land improvement is roughly $6.9T. If we assumed the same tax revenue, total value, additional building value, and land value in our current property tax situation, then an equivalent land value tax rate would be 6.74%.

The table below demonstrates this scenario.

	Land Value	Land Improvement	Total Value	CA Tax Revenue	Tax Rate given Tax Revenue
Current CA Property Tax Rate	890B	6,901B	7,792B	60B	0.77%
Land Value Tax Solution	890B	6,901B	7,792B	60B	6.74%

Table 1: California LVT Example

Given that we may generate the same tax revenue produced under California's current property tax system with a land value tax, its potentially possible to replace property tax with a land value tax instead, which would be economically efficient. Landowners would be better incentivized to improve their lot of land, and we may expect the total value of property to increase overtime. Although the government may lose on tax revenue from these land improvements, they may apply a higher tax rate on land without disincentivizing land improvement.

4 Game Theory

That is, Let's revisit the land value formula that we defined earlier and:

$$\text{Land value} = \text{Resources} + \text{Location}$$

In a land value tax system, owners of land are taxed based off of their land value, that is specifically, the physical resources the land inherits and any intangible location feature buyers or sellers may decide upon. Unlike a property tax system, landowners are not taxed based off of their own land improvement labor. However, theoretically, landowners would be taxed according to the location in which their land resides upon. If all producers are individual, rational actors, then agents would improve upon their own lot of land given a profitable gain for each subsequent land improvement. Suppose that we mapped out pay offs and rewards according to this system.

Imagine a world where two agents are situated where they may decide to improve upon their property value or not. If one landowner decides to improve upon their lot of land and the other decides not to improve upon their lot of land, then they would not face a tax consequence according to the land value tax system. However, If both agent's improve upon their existing plot of land within the same community, that improves the location of the existing land; in effect, an improvement in the location of land would result in a subsequent tax. If an agent decides to not improve upon their land, they would not receive a subsequent payoff from that action. We may define these payoffs as the following:

[1] https://www.landzero.com/blog/how-much-for-an-acre-of-land-in-california/

[2] https://beef2live.com/story-ranking-states-total-acres-0-108930

[3] California's State and Local Revenue System, https://www.urban.org/sites/default/files/publication/102584/californias-state-and-local-revenue-system_1.pdf

Improvement$_{Tax}$ (I_T) = .5;
Improvement$_{NoTax}$ (I) = 1; and
No Improvement (N_0) = 0

		P2 α	P2 β
P1	α	I_T, I_T	I, N_0
	β	N_0, I	N_0, N_0

Table 2: Game Theory

From this, we see that both agent's dominant strategy is to improve upon their land. Ultimately, both agents would benefit from a payoff, but each individually do not receive their anticipated 1 yield. Additionally, this would mean that the location both agents live in is more desirable than if there were no improvements on the land. An interesting conclusion we find is that both agents expect not to be taxed for improving upon their land when they partake in land improvement, but if each agent has the same assumption, then the result is that they will be taxed.