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Post-Corona Balanced-Budget Super-Stimulus: The Case for Shifting Taxes onto Land

Michael Kumhof, Nicolaus Tideman, Michael Hudson and Charles A Goodhart

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Post-Corona Balanced-Budget Super-Stimulus: The Case for Shifting Taxes onto Land

Abstract

The post-Corona economic environment puts a premium on finding fiscal means to stimulate the economy while continuing to finance current levels of expenditures and debt. We develop and carefully calibrate a model of the US economy to show that an increase in the tax rate on the value of land, balanced by decreases in the tax rates on the incomes of capital and labor, can meet this need. We find that the US share of land in total nonfinancial assets is more than 50%, so that the tax base is very large. This is corroborated by very high quality OECD data for other industrialized economies that, almost without exception, find land shares of between 40% and 60%. Our baseline proposed tax reform is an increase in the tax rate on the asset value of land from its current 0.55% to 5.55%, accompanied by reductions in tax rates on capital and labor incomes of 28 and 10 percentage points, respectively. In a representative household model, this increases welfare by 3.4% of steady state consumption, and increases output by almost 15% relative to trend. In an economy with separate groups of workers, capitalists and landlords, the output gain is the same, while the welfare gain increases to 6.4% on average across the three groups. Welfare and output gains for a wealth tax that raises the same revenue, and which increases the tax rates on capital and land equally, are only half as large as the baseline. Welfare and output gains for an optimal tax reform, under the assumption that the tax rate on the value of land is capped at 20%, are approximately twice as large as the baseline. This reform raises 55% of all tax revenue through land taxes, with the remaining 45% raised through consumption taxes, while all income taxes are abolished.

JEL Classification: E62, H21, H61

Keywords: Land asset value taxation, land rental value taxation, Capital income taxation, labor income taxation, Balanced Budget, fiscal stimulus, Rent, unearned income

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1. Introduction

The 2020/2021 lockdowns around the world have caused a drastic plunge in employment and economic activity. Fiscal authorities have responded with measures to support struggling businesses and individuals. The emergency has put severe strains on public finances that were still suffering from the aftermath of the 2008 Global Financial Crisis (GFC). Fiscal policies that not only permit the continued financing of existing expenditures and debt, but that in addition provide much needed economic stimulus, would be very helpful at this stage. This paper suggests that there is a fiscal policy that can accomplish this, a tax reform that shifts much of the burden of taxation away from productive labor and capital, and onto land, while maintaining a balanced budget. The UK Wealth Tax Commission (Advani et al. (2020)) propose that a tax reform should be as non-distortionary as possible, as fair as possible, and able to raise significant revenue. Our proposal reform performs very well by each of these criteria. The key reasons are that both the tax base for a tax on land and the stimulative effects of reductions in other taxes are very large.

In a representative household model calibrated to the US economy and to US fiscal parameters for the 2010s, we show that a baseline policy that increases the tax rate on the capitalized asset value of land from around 0.55% at present to around 5.55% over a period of 20 years – assuming corresponding balanced-budget tax cuts on asset and labor incomes – would spur output gains of 14.8%, as well as welfare gains of around 3.4%. In a similar model that replaces the representative household with separate groups of workers, capitalists and landlords, the output gains remain the same, but average welfare gains rise to 6.4%. These are extremely large numbers by the standards of the literature. We compare this baseline to a much more commonly discussed wealth tax that increases taxes on both land and capital asset values in equal measure while raising the same revenue, and find that output and welfare gains are much smaller at 6.9% and 1.9%. Targeting wealth taxes to land alone therefore has very large payoffs. Finally, we compare our baseline to an optimal or utility-maximizing tax reform, which increases taxes on land asset values by as much as may be politically feasible, while consumption taxes raise the needed additional revenue in the least distortionary way possible. Specifically, when constraints put a cap of 20% on the land tax rate, the required consumption tax rate equals 12.2%, and the output and welfare gains equal around 26% and 5.2%. Under this regime the land tax raises about 55% of total tax revenue.

Even our much more modest 5.55% land asset value tax baseline would represent a very large tax reform, but it would not be unprecedented by historical standards. As shown by Wallis (2000), the US has experienced three major and very different systems of government finance, and one of them, over an entire century, in fact corresponded quite closely to what we propose in this paper. Furthermore, the transitions between these systems happened quite rapidly at times of major economic upheaval, specifically in response to the depressions of 1839 and 1933, and the aftermath of COVID-19 has at least the potential to become a similarly large turning point. Wallis (2000) shows that government finance in the period before 1839 was dominated by state governments that financed themselves predominantly through land sales (and through chartering corporations), the period between 1839 and 1933 was dominated by local governments that financed themselves predominantly through property taxation, and the period after 1933 was dominated by the national government that financed itself predominantly through income taxes.[1] The middle period is of most interest to this paper, and by 1902 property taxes had come to account for 73% of all local revenues (which in turn dominated overall revenues), 57% of all state revenues, and 42% of overall revenues.

[1] During this period, state governments financed themselves predominantly by income and sales taxes, and local government by property and sales taxes.

As documented by Einhorn (1991), local governments managed to match their property taxes to the beneficiaries of the expenditures that were financed with those taxes, by bundling increases in property taxes with improvements in service delivery.

Our paper carefully distinguishes between **land rental value taxation (LRVT)** – a tax on a flow, the annual rental value of land, which excludes gains due to price appreciation – and **land asset value taxation (LAVT)** – a tax on a stock, the capitalized value of future after-tax rental values, which includes gains due to price appreciation.[2] The assumption that a LRVT does not tax gains due to price appreciation is meant to reflect current practice in taxing rental incomes. The LAVT, but not the LRVT, is therefore a tax on Haig-Simons comprehensive income (Haig (1921), Simons (1938)), the sum of current income and appreciation gains.[3] Given the often very large size of price appreciation in land markets, this assumption is a key difference between LAVT and LRVT, with LRVT having a much more limited tax base, and therefore also a lower potential to replace other taxes and thereby stimulate the economy.[4] LRVT also causes a much larger drop in the capitalized value of land for any given economic stimulus. After demonstrating this, we focus our remaining analysis on LAVT.

We acknowledge that the term "value" in "rental value" and "asset value" is problematic in the context of incomes from land, because the classical concept of "value" is linked to a corresponding cost or effort, such as labor effort or saving. Land however bestows a property right to a part of economic output without any corresponding cost or effort, so that rents represent unearned income.[5] We will nevertheless continue to use the terms "rental value" and "asset value" of land because their use is so widespread.

A key input into our analysis is the share of land and other non-produced assets in the overall value of physical assets, which in addition include produced physical assets, mainly man-made structures and capital goods. We approximate this figure for the US by subtracting the Bureau of Economic Analysis (BEA) measure of the stock of physical capital (defined as produced physical assets, including software and intellectual property) from the Fed Flow of Funds net worth of households and nonprofit organizations. By this measure, in the US land accounts for 51.1% of the stock of nonfinancial assets – and several percentage points more if we take into account the additional issues discussed in Section 7.1. This means that the tax base for US land taxation is very large.

This figure can be corroborated by reference to economies outside the US that produce data of much higher quality and detail. The OECD has compiled a database that allows for the computation of the land share in about ten large or medium-sized industrialized economies. For Japan and South Korea, the data are extremely detailed and bottom-up, partly because land taxes are already an important component of their tax structures. Good data also are available for Australia, Canada and a small number of additional economies. The evidence shows that, for virtually all countries

[2] We deliberately avoid the terminology land capital value taxation (LCVT) to avoid the erroneous inference that land is a form of capital.

[3] Appreciation gains are income for the same reason that depreciation losses are deductible from income (for tax purposes).

[4] It is important to understand that, at the upper limit of taxation, no land tax can collect more than the rental value of the land, because if all of the rental value were collected, the asset value of land would be zero. However, when a LAVT collects less than all of the rental value of the land, so that land has a positive asset value, any given tax rate collects more from land that is rising in value than from land with the same current rental value that is not rising in value.

[5] Unless one wishes to count, as Frank Knight (1924, p. 592) does, "the cost of buying off or killing or driving off previous claimants".

covered except Germany (where the land share is below 40%), the land share lies somewhere between 40% and 60% of total physical assets. We cannot use the OECD database for the US because it only contains US data for the household sector, not for the overall economy.

In light of this evidence, and to assess whether our results are robust to our assumed land share, we simulate our tax reform experiments with the baseline 51.1% calibration as well as with alternative 40% and 60% calibrations. We find that, while a lower land share can make an appreciable quantitative difference, the benefits of our simulated tax reforms remain very large. In our baseline with an assumed 40% instead of 51.1% land share we obtain output gains of 13.4% instead of 14.8%, and welfare gains of 2.6% instead of 3.4%.

Policymakers can consider a range of different *sizes* of land tax reforms. We show that the relationship between the land tax rate and the resulting gain in output is monotonically increasing but tapers off as the tax rate rises. In other words, the greatest incremental benefits of a 1 percentage point increase in the tax rate are realized at today's very low rates, but for the case of LAVT they remain large up through a tax rate of around 10%. Policymakers will of course trade off these economic gains with political considerations, because very high tax rates may be difficult to implement. But in this trade-off, a key consideration is that the output gains of the reform would become so large in due course, and that therefore the number of winners and the size of their gains would be so large, that some relief for deserving losers would then become quite easy to finance.

Policymakers can also consider a range of different *implementation speeds* of land tax reforms. We will discuss several reasons why the introduction of a shift of taxes onto land ought to be gradual, including a smoother adjustment of land prices on impact, the need to avoid large windfall gains to owners of capital due to immediate drops in taxes on capital, and perhaps most importantly, the need to ensure that the cash flows of landholders are initially not greatly impacted, thereby allowing them to continue to service and ultimately repay previously incurred loans.

Nevertheless, short-term concerns cannot be entirely eliminated, because the increases in output and income invariably take time to develop, as shown in Section 8, while the immediate drop in land values can be moderated but not entirely eliminated by a slower implementation speed. The fact that our proposed reform has initially moderate cash flow effects, and that it balances the increased LAVT by cuts in taxes on income and capital, is therefore essential to maximize political support. But beyond this, the shift to a significantly higher LAVT would probably also need to be accompanied by relief for a small share of taxpayers that experience cash-flow problems, an issue that we will discuss in Section 5.3.

There are, however, considerations that make facing up to such transitional costs more than usually worthwhile at the current economic juncture. One is that virtually all tax increases face transitional costs at their time of introduction, and this reform has better longer-term prospects than virtually any other, and would furthermore reduce many of the costs associated with the current tax system, as we will discuss in Section 5.4. Furthermore, projections for future fiscal deficits and public sector debt are now worrying in many economies, and this reform provides a realistic medium- and longer-term prospect for overcoming such difficulties.

The rest of the paper is organized as follows. Section 2 studies the history of the idea of land taxation. Section 3 discusses the key theoretical ideas. Section 4 presents US and international data on land values. Section 5 discusses practical experiences with land taxation. Section 6 lays out the theoretical model. Section 7 presents its calibration. Section 8 quantitatively evaluates various tax reforms using this model. Section 9 concludes.

2. History

2.1. The History of Land Ownership and the Ethics of Land Taxation

Linklater (2013) finds that throughout most of recorded history, and in most societies, people have held the belief that owning rights to the earth was subject to duties and obligations to god, monarchs, families, clans and communities - ultimately, the earth was deemed to belong to its creator. The disruption of this pattern by Europeans, exported worldwide through colonialism, is the great revolution of the last few hundred years. Its distinctive feature is the belief that it should be possible to individually own the earth (Winchester (2021)), which justifies allowing individuals to profit from the land, regardless of the consequences to the community. Locke (1690 [1947]) is often credited with providing the economic rationale for individual land ownership. However, this is a gross misinterpretation, as Locke's argument was not grounded in economic notions but in notions of fairness and justice. This led him to make statements such as these: *"As Justice gives every Man a Title to the product of his honest Industry, and the fair Acquisitions of his Ancestors descended to him; so Charity gives every Man a Title to so much of another's Plenty, as will keep him from extreme want, where he has no means to subsist otherwise."* Further: *"[N]o man could ever have a just power over the life of another, by right of property in land or possessions, since it would always be a sin in any man of estate to let his brother perish for want of affording him relief out of his plenty ... God the lord and father of all has given no one of his children such a property in his peculiar portion of the things of this world but that he has given his needy brother a right to the surplusage of his goods."* Locke (1690 [1947], Sec. 27) argued that natural opportunities should be freely available to anyone when they were not scarce, but not when land was scarce.

It is therefore precisely on the foundations of Locke (1690 [1947]) and a "liberal universal ethic" that Foldvary (1999) constructs the ethical foundations of land value taxation. He begins by explaining that the Lockean premise of equality among human beings implies that no individual can own another individual, and that therefore each individual owns his or her own self. This principle of self-ownership extends to labor and the products of labor, including physical capital, so that the government should only tax wages and returns to capital under strict conditions, including democratic majority support across income classes. But self-ownership does not extend to land, since land is not produced by labor. The Lockean premise of equality then implies that human beings are in an equal moral position with respect to the benefits of land, the common heritage of humanity. For one person rightfully to claim more than others of these benefits would put him or her in a superior, unequal, and therefore unethical position. To establish equal benefits from land, it is sufficient to establish equal ownership of its natural rent, which can be achieved by requiring that those who have exclusive access to valuable land pay for that privilege into a common fund through land taxation. This is then not a redistribution of earned incomes from the private owners of factors, but instead a return of unearned incomes from the private owners of a property right to its proper owners, the community.[6] At the same time, to establish equal benefits from land, rights of control (use and exchange) of land, and therefore of its efficient improvement through individual labor, can be left to the individual. This means that the owner retains the right to the return on

[6] Interestingly, the royal "Clean Slate" proclamations of ancient Babylonia and in Leviticus (Hudson (2000, 2018)) were a religiously motivated acknowledgement of the same ethic. They called for the periodic restoration of land which had been forfeited for unpaid debt, and were part and parcel of a coordinated structure designed to secure to each family and generation the equal right to the use of the land, of which the gods or God, as the case may be, were recognized as the sole absolute owner.

capital investments, so that this reform would be compatible with the important role of property rights for productive investments in physical capital (North (1991, 1994)).

Ethical considerations are also behind perhaps the most common counterargument against taxing land, which is that established institutions have long ago assigned land rights to individuals, and that the tax-based reduction of land values and therefore part of the value of these land rights (excluding control rights), after the investor had bought the land in good faith, is discriminatory and represents confiscation. In this view, it should therefore either be avoided altogether, or compensation should be paid to the losers.

However, the first argument, that the land taxes should be avoided altogether, can be made against any change in public policy, which almost invariably entails winners and losers. Such thinking would therefore have left us with many other economic arrangements that represent "moral accidents", and it was indeed once used in defense of the maintenance of slavery (Gaffney and Harrison (1994)). Therefore, Tideman (1988, 1994b) argues that "Requiring compensation for takings protects property from potential appropriation by executive power or democratic majorities, but in doing so it perpetuates any injustices that exist in the initial distribution of entitlements. When through an evolution in our moral understanding we begin to realize that a class of entitlements is unjustly held, courts may begin to deny protection to those entitlements before we reform their holding through legislation. This pattern held in the past in slavery cases ..." Specifically, "The fifth and fourteenth amendments to the U.S. Constitution forbid the taking of property without just compensation. And yet the thirteenth amendment abolished slavery and prohibited any state from compensating those who had been called the owners of slaves. These provisions are consistent with the idea that any new understanding of the requirements of justice that eliminates all of the value of some assets can be implemented only through the constitutional process, with its greater guarantees that the change truly is a new understanding and not merely a rent-seeking success." Finally, "The idea that nearly all the rent of land can and should be collected publicly rather than privately involves a rearrangement of perceptions into a new conception of a harmonious social order."

The second argument, that compensation should be paid, is considered by Advani et al. (2020) and Tideman (1994b). The former argue that reliefs and exemptions should be strictly limited, as evidence from around the world shows that they can seriously undermine the tax base and create scope for avoidance. The latter argues that if, despite the "moral accident" argument above, compensation is to be paid at all, strict principles should apply to ensure justice and prevent rent-seeking. First, compensation should be based on net losses, not gross losses, and on this basis the vast majority of individuals would not have any compensation claims. Second, compensation should not apply to gifts and inheritances, because they did not involve effort on the part of the individual concerned. Third, past gains from land sales during the lifetime of the individual should offset compensation claims, because they represent past unearned incomes; if large enough, they should finance compensation of losers. Fourth, compensation should be limited to current possessors, and should exclude all future possessors, unless there are additional future unanticipated changes in the tax rate on land. Fifth, compensation should be periodic rather than lump-sum, because many of the offsetting benefits from the removal of other taxes emerge over time. Sixth, there should be a monthly upper limit on compensation payments.

2.2. The History of the Economics Literature on Land Taxation

2.2.1. The Early Literature Until Henry George

It was probably the Physiocrats who brought the efficiency of land taxes to Adam Smith's attention. These members of the French nobility recognized the damage that was being done to the French economy in the eighteenth century by the numerous taxes levied on productive activity. They saw how much better things could be if the king would just send them a bill, so they advocated an *impôt unique*, a single tax on land. François Quesnay (1963 [1756], p. 232) wrote: "*That taxes should not be destructive or disproportionate to the mass of the nation's revenue; that their increase should follow the increase of the revenue; and that they should be laid directly on the net product of landed property, and not on men's wages, or on produce, where they would increase the cost of collection, operate to the detriment of trade, and destroy every year a portion of the nation's wealth.*"

Adam Smith (1937 [1776]) wrote: *"Both ground-rents and the ordinary rent of land are a species of revenue which the owner, in many cases, enjoys without any care or attention of his own. Though a part of this revenue should be taken from him in order to defray the expenses of the state, no discouragement will thereby be given to any sort of industry. The annual produce of the land and labour of the society, the real wealth and revenue of the great body of the people, might be the same after such a tax as before. Ground-rents, and the ordinary rent of land, are, therefore, perhaps, the species of revenue which can best bear to have a peculiar tax imposed upon them."*

David Ricardo (1911 [1817]) wrote: *"A land-tax, levied in proportion to the rent of land, and varying with every variation in rent, is in effect a tax on rent; and as such a tax will not apply to that land which yields no rent, nor to the produce of that capital which is employed on the land with a view to profit merely, and which never pays rent; it will not in any way affect the price of raw produce, but will fall wholly on the landlords."*

James Mill (1824) wrote: *"It is sufficiently obvious, that the share of the rent of land, which may be taken to defray the expenses of the government, does not affect the industry of the country. The cultivation of the land depends upon the capitalist; ... To him it is a matter of perfect indifference whether he pays the surplus, in the shape of rent, to an individual proprietor, or, in that of revenue, to a government collector."*

John Stuart Mill (1884) wrote: *"Suppose that there is a kind of income which constantly tends to increase, without any exertion or sacrifice on the part of the owners: those owners constituting a class in the community, whom the natural course of things progressively enriches, consistently with complete passiveness on their own part. In such a case it would be no violation of the principles on which private property is grounded, if the state should appropriate this increase of wealth, or part of it, as it arises. This would not properly be taking anything from anybody; it would merely be applying an accession of wealth, created by circumstances, to the benefit of society, instead of allowing it to become an unearned appendage to the riches of a particular class."*

Henry George (1960 [1879], particularly Book VII, Chapter 1 and Book VIII, Chapter 2) agreed with these economic rationales, but added to this the ethical rationales discussed in the previous subsection. He argued that only human effort could create a right of ownership, so that all should have equal rights to the value of land, which exists independently of the effort of its owner. His view was that there has never been a power capable of granting just title of exclusive ownership of the revenues (as opposed to control) of land, that the vast preponderance of land titles were originally

granted by unjust coercion, and that collecting taxes on land is the righting of an injustice, of a "moral accident". He therefore argued that while the rights of control over land should remain vested in the individual, that the rights to its rent should belong to the community rather than the person who happens to hold its title, and that this can be implemented by way of a tax on the rental income, or on its capitalized value, that indemnifies those denied access to the land. The revenues of this tax should be shared with all citizens as their birthright, with the government acting as their agent, in order to defray the necessary expenses of the community. See Andelson and Gaffney (1979) and Blaug (2000) for very good summaries of George's thought.

Partly under the influence of such classical and Georgist thought, a comprehensive system of land taxation came close to becoming reality in the UK in the early 20th century. Lloyd George's "People's Budget" of 1909 proposed, among other land-related items, the introduction of a 20% tax on increases in land value payable each time land changed hands, with the intention of capturing the "unearned increments in land". The budget, supported by Liberals and Labour, was ultimately passed in 1910, despite resistance by the House of Lords, which was dominated by Conservative aristocratic landowners, leading to a constitutional crisis and a general election (Dolphin (2009)). The reason why the tax was eventually aborted in 1920 is that the required valuation of all British land was still incomplete at the outset of World War I, and changing political coalitions after the war made it impossible to complete it (Douglas (1999)).

2.2.2. The Literature Since Henry George

Gaffney (1994, 2009) and Gaffney and Harrison (1994) argue that whereas classical economists, including Smith, Ricardo, and the Mills, had described output as the product of three factors, land, labor and capital, towards the end of the 19th century the then new school of neoclassical economics (most prominently John Bates Clark) used static analytical frameworks where the supply of capital is fixed, and thereby merged land into capital.[7] This had the effect of obscuring the proposal of Henry George (1879) that taxes should be concentrated on land.[8] Analytically this is still the dominant approach used today, both in economic theory and in the national accounts, and this continues to obscure very important insights. One example is Stiglitz (2015a), who suggests that if one wishes to understand why wealth has grown so much more rapidly than investment in recent decades, one must understand the influence of the rent of land, the rent from opportunities that are not competitive, and intellectual property. Another example is OECD (2012), which shows that the inclusion of high-quality statistical information on land as a third factor of production, in this case for South Korea, can have major implications for estimated decompositions of real growth.

[7] In a dynamic economy, the combining of land and capital into a single factor of production would be justified only if the elasticity of substitution between the two were extremely high. If this were true, then the ratio of the price of land to the price of capital goods would not increase as the economy grew. But in fact, the ratio of the price of land to the price of a standardized bundle of capital goods has grown rapidly, indicating that land and capital are far from perfect substitutes.

[8] However, this tendency was far from universal even among mainstream neoclassical economists. For example, Alfred Marshall (1890) and Léon Walras (Jolink (1996)) supported Ricardian rent theory. The former supported Lloyd George's "People's Budget" of 1909, and the latter advocated land nationalization. More recently, many other leading economists have made supporting statements - Blaug (2000) cites the examples of Paul Samuelson, Milton Friedman, James Tobin, James Buchanan, and Robert Solow.

Ramsey (1927), who had been mentored by Pigou (see Pigou (1928)), published his rule for avoiding excess burdens in taxation, which is that taxes should be inversely proportional to elasticities, whether of supply or demand. This rule leads directly to capital as the worst tax base (Judd (1985), Chamley (1986)), because of its infinite long-run elasticity (this includes the possibility of capital flight in an open economy), and land as the best tax base, because of its zero long-run elasticity. Stiglitz (1986) explains that the Ramsey tax rate is proportional to the sum of the reciprocals of the elasticities of supply and demand, which again leads directly to a high tax rate on land. These results are closely related to the concept of ATCOR - all taxes come out of rents. The three key assumptions underlying ATCOR are that the supply of land is fixed within every tax jurisdiction, the supply of capital is perfectly elastic (at the world real interest rate) in the long run, and finally labor is also quite elastic in the long run. Together this implies that ultimately most taxes, not literally all due to the finite elasticity of labor,[9] are shifted to landowners. Therefore, when taxes on labor, capital and consumption are lowered, the revenue base is not lost, but shifted to land rental values and land capital values, which can then yield more taxes. Because of ATCOR, Gaffney (2009) sees personal and corporate income taxes, as well as capital gains taxes, as being in large part rent taxes. He lists a large number of examples (including New York city in the 1920s) where untaxing buildings while uptaxing land resulted in a better allocation of land and therefore in higher rather than lower land prices. A related concept to ATCOR is EBCOR - excess burdens come out of rents. This states that removing excess burdens adds to taxable rents and land prices. As argued by Gaffney (2009), this goes beyond marginalist arguments, because removing excess burdens entails quantum leaps from lower to higher uses of land (e.g. parking lots to skyscrapers) that are not present in marginalist analysis. In practice this argument is likely to be extremely relevant, and because our own analysis is marginalist, it may understate the benefits of shifting taxes onto land.

In the modern literature there has been relatively little inquiry into the effects of shifting taxes from labor and capital onto land. In the policy-oriented literature, many important contributions do not explicitly study land taxes at all, but instead only discuss property taxes (taxes on the combined value of land and structures) or wealth taxes (taxes on the combined value of land, structures and machinery and equipment). This is despite the fact that taxes on any form of wealth other than land are known to be highly distortionary.[10] For example, Boadway et al. (2010) do mention the advantages of land taxes in principle, but in their policy proposals they only advocate very limited property taxes. In the words of reviewer Martin Weale (2010), "(t)he main argument against seems to be that the only good taxes are old taxes". And the report of the UK Wealth Tax Commission (Advani et al. (2020)) only discusses wealth taxes, and does not mention the possibility of a land tax at all. In the wake of recent UK fiscal developments, it advocates a credibly one-off (non-recurring) net wealth tax (NWT) that may be capable of raising significant revenue without creating massive distortions or excessive unfairness.

In the academic literature, Tideman et al. (2002), in the spirit of the current paper, separate land and capital as two different factors of production. They conclude that a tax that collects 90% of the rental value of land would produce an initial net benefit equal to 14.6% of net domestic product, with even greater increases over time, as the capital stock increases. Brueckner (1986) studies the effects of simultaneously increasing the tax rate on unimproved land and reducing the

[9] It can be shown that, with an infinitely elastic labor supply, even the owners of land would be better off with a single tax on land.

[10] Note however that a well-designed property or wealth tax could approximate a land tax, through an exemption for the depreciated value of future investments.

tax rate on improvements to maintain a balanced budget. He finds that this policy change will increase the density of development (reduce sprawl). As for the price of land, if a single community makes this change, land values will rise despite the increase in land taxes, due to the elimination of deadweight losses. But if the change is made in the entire metropolitan area, the price of land will drop. Stiglitz (2015c) finds that land taxes can increase real wages and real output, while contributing to reducing inequality. Bonnet et al. (2021) conclude that land taxation would be beneficial. Their paper and ours are similar in their object of study, but are different in terms of the analytical framework. Bonnet et al. (2021) use a Judd-Chamley model with capitalists and workers (Judd (1985), Chamley (1986)), while our paper uses a neoclassical growth model with a representative household. In Bonnet et al. (2021) output is produced using capital and labor, but only capital is in endogenous supply, and land enters utility functions rather than the production function, while in our paper output is produced using capital, labor and land, with both labor and capital in endogenous supply. Bonnet et al. (2021) assume that it is not possible to assess the rental value and the asset value of land, while our paper, based on an extensive review of the literature, takes the opposite view. Our focus is on a careful calibration of the US production and tax structure, in order to capture the likely magnitude of the efficiency gains of shifting taxes from capital and labor incomes to the value of land. In our baseline model the distributional implications of different tax policies stressed by Bonnet et al. (2021) are absent, while our alternative model distinguishes not only capitalists and workers but also landlords.

3. Theory

3.1. Basic Concepts

In this paper, as in the literature on the subject, land is taken to mean the entire material universe excluding people and their products, including surface land, water, air, sunlight, the electromagnetic spectrum, etc. Like the Mirrlees Review (Institute for Fiscal Studies and Mirrlees (2011)), the most comprehensive and rigorous review of UK taxation undertaken for many decades, we propose that both business land[11] and residential land should be subject to a land tax, and will therefore not distinguish between them in most of our discussion.[12]

The starting point of any analysis of taxes on land is either the annual flow income value or the capitalized stock value of a developed site, which consists of a combination of the value of land as defined above and of the value of the overlaying produced immovable capital. We will use the terminologies property or real estate to denote the combination, the terminologies structures, buildings or improvements to denote the produced immovable capital,[13] and the terminology land to denote the entire non-produced material universe excluding people and produced immovable capital. In the following discussion we will initially assume that the value of the combination can be decomposed into the values of land and structures with sufficient accuracy, and will later discuss the existing methods for performing this decomposition.

[11] This includes agricultural land. However, see the qualifications in Section 3.7.5.

[12] In addition, Institute for Fiscal Studies and Mirrlees (2011) advocates an annual tax related to the consumption value of residential buildings net of improvements.

[13] Total capital includes produced movable capital such as machinery and equipment in addition to produced immovable capital.

Like Tideman (1999), we distinguish two distinct concepts related to the return to land and the value of land. The **net return (or rental) of land** is the actual income realized by a particular owner, and will be at best equal to, but generally less than, the **rental value of land**, which is the opportunity cost of leaving an unused site unused, or alternatively, the flow rental income that is available from a site if it is put to its "highest and best use", independently of its actual use.[14] Similarly, the "present value of planned net income" (**PVPNI**) is the present discounted value of net returns of land from the particular, and possibly suboptimal, development project chosen, while the **asset value of land** is the present discounted value of future rental values of land, or the market value of land in its highest and best use. The rental or asset values of land are proper bases for a tax on land, because the highest and best use of a site is independent of the actions of the taxpayer, thereby making the tax a lump-sum tax. With taxes that depend on the actions of the taxpayer, such as taxes on labor, capital, or consumption, taxpayers can escape taxation by not working, not saving, or not spending, and this is what gives these taxes their excess burdens. The net return or rental of land and the PVPNI also depend on the actions of the taxpayer, and should therefore not be used as tax bases. The fixity of land supply together with the lump-sum nature of the tax on land ensures that the tax does not affect the total rental paid by users of land to its owners, it only affects the division of this rental between payments to the landlord and payments to the government and thereby to the community. This neutrality property applies equally in models of homogenous and heterogeneous land. Finally, the **economic depreciation** of structures is the change over a period of time in the sale value of structures, where the sale value of structures is defined as the sale value of the property minus the asset value of the land. Much of the depreciation of structures is due to locational and other obsolescence rather than physical wear and tear. If land was taxed and structures untaxed, there would be no need to know the magnitude of depreciation when assessing taxes.

The concept of "highest and best use" requires further elaboration. For economic values obtained in private commercial and residential uses, it refers to the most profitable economic use, conditional on all present related states of affairs, including zoning laws, state of the infrastructure, taxes, etc., and could therefore change quite dramatically if those conditions change. But downward adjustments to the tax base may need to be made to take account of wider social and non-pecuniary values obtained in other uses, for example in the case of religious buildings, thereby limiting the tax payments required of such establishments, permitting them to continue to discharge their important social functions.

3.2. The Value of Land

There are three principal sources for the value of land that are independent of the effort of a private titleholder, and that therefore represent rent or unearned income. The first is the *inherent natural productivity and limited quantity* of land. When land is primarily agricultural, this refers to the qualities of land that make it agriculturally productive and accessible to markets. When land is primarily urban, nature provides rivers, harbors, vistas, bedrock for foundations, sources of water, as well as the pure scarcity value of locations on a finite planet. Taxing those who have

[14] The rental value of land for the coming year should be measured as the difference between the net profit from optimally using the land today, if it were vacant today, and the net profit from optimally using the land beginning one year from today, if the land were to be vacant one year from today. This definition is also how much an informed, competitive bidder would bid for the use of the land for the coming year, if he knew that in every future year he would need to pay the rent of the land at that time, determined in the same way.

exclusive use of the land that nature endows with these benefits distributes the benefits of nature to the community as a whole. The second is *public services.* Services such as schools, parks, paved streets, water works, sewers, police and fire protection add value to surrounding land. Taxing the beneficiaries for this uplift in land values is called value capture (Medda (2012)), and can pay for the costs of the services that made rents increase (Smolensky et al. (1970), Arnott and Stiglitz (1979)).[15] The third is growth of communities and *nearby private development.* Taxing the beneficiaries while rewarding the private developers with Pigouvian subsidies (Gould (1973)) would be equitable while motivating efficient land use and raising all land values.

3.3. Rent and Taxes on Rent

Varian (2006) defines economic rent as "those payments to a factor of production that are in excess of the minimum payment necessary to have it supplied". A number of studies go into much more detail by distinguishing different categories of rent, including Schwerhoff et al. (2020), Tideman and Mecherikunnel (2021), Stiglitz (2015a), and Gaffney (2009).

Schwerhoff et al. (2020) generalize Varian (2006) to "those benefits to an agent that are in excess of the minimum necessary for the agent to accept the transaction", and distinguish six types of economic rent that are well understood in the literature. Of these, political rents (Stigler (1971)), investment rents (Bresnahan et al. (1997)), and to some extent (regulated) natural monopolies (Baumol (1977)) and rents resulting from market power can be addressed by non-tax policies such as regulatory and competition policy. Regulation rents result from deliberate welfare-increasing government intervention, which can take the form of taxation, such as taxes that internalize externalities ("sin taxes"). When market power rents occur, taxation can be applied after they have been separated from other components of profits (Griffith and Miller (2014)), and doing so is non-distortionary (Judd (2002), Coto-Martinez et al. (2007)). The same is true for scarcity rents due to bounded supply (Hotelling (1931)). Quantitatively very important cases of market power rents are the tech conglomerates (Kurz (2017)) and the financial sector,[16] while the quantitatively most important case of scarcity rents is land rents.

Tideman and Mecherikunnel (2021) discuss the optimal taxation of six different asset categories that are either entirely or partly derived from unearned income. They argue that three asset categories should be heavily taxed, including land and other useful privileges, mineral deposits, and the profits of unregulated natural monopolies (for taxation of such profits, see Diamond and Mirrlees (1971)). This is because they share the characteristic that restricted access to them is efficient while there is a source of value other than human effort. For three asset categories there should be prizes for discovery paid out of public revenue, including intellectual property, mineral deposits, and unregulated monopolies. This is because they generally share the characteristic that part of their value comes from specialized effort that needs sufficient incentives, rather than coming simply from saving. The exception is profit opportunities that arose without productive effort, and that instead represent the result of rent-seeking.[17] As a quantitatively particularly

[15] Examples include London's Jubilee Line and New York City's 2nd Avenue subway extension, which sharply increased land prices all along the route. The entire cost could have been recaptured by taxing away the windfall gains of landlords. Instead, land taxes were not increased, the landlords received a windfall, and labor and business were taxed to provide the services that created the windfall.

[16] This includes rents from implicit government bailout guarantees due to too-big-to-fail (Admati and Hellwig (2014)), externalization of costs (Di Tella (2019)), and market manipulation (Putniņš (2012)).

[17] See Krueger (1974). Bessen (2016) finds that since 2000 most of the increase in US corporate profits has been

significant example of an unregulated monopoly, the Silicon valley tech giants are like gold mines and intellectual property rights, and their market valuation includes several trillion dollars worth of what Kurz (2017) calls monopoly-derived excess asset value. For all three cases (intellectual property, mineral deposits, and unregulated monopolies), the reward goes to the person who finds it first, and because it is efficient to have only one, there is a lack of competition that would bring their asset value down to cost, making it optimal to collect all of the resulting excess asset value apart from an appropriate reward for discovery. Analytically, the prize is like a wage after taxes, in analogy with Saez and Stantcheva (2018). Two asset categories, useless privileges (import quotas, taxi medallions, etc.) and intellectual property, could either be heavily taxed or abolished completely, with the latter incentivized entirely by prizes. Capital should, to a first approximation, not be taxed at all (Atkinson and Stiglitz (1976); for qualifications of this result see Conesa et al. (2009)[18] and Saez and Stantcheva (2018)), because in the long run capital is in infinitely elastic supply.

Stiglitz (2015a) adopts yet another classification scheme of what he calls ownership claims giving rise to rents that are capitalized into wealth. The first and most important of these is land. The second is other inelastically supplied factors, including depletable natural resources and positional goods. The third is exploitation rents, including through the exploitation of the monopoly power of non-financial firms based on network externalities and economies of scale, and through the exploitation of the monopoly power of financial firms that use abusive practices, vis-a-vis both their customers and the government. The fourth is information rents. And the fifth is intellectual property rents, through what Boyle (2003) refers to as the enclosure of the knowledge commons.

Gaffney (2009) offers a detailed decomposition specifically of land rents. He emphasizes that the concept of taxes on land rents is far broader than the traditional property tax on real estate excluding buildings. The reason is that any kind of franchise with a territorial component represents a share of the bundle of rights to land within that territory. Examples include user charges for crowded streets (congestion charges, parking meters, fuel taxes, bridge tolls), water severance taxes (Gaffney (1992)), natural resources severance taxes, taxes on the radio spectrum,[19] satellite orbits, littoral space,[20] and fishing rights.[21] Gaffney (2009) provides a wealth of evidence and examples that the taxation of these franchises is currently, with few exceptions, extremely light and subject to multiple forms of evasion. Other sources of rent as a base for public revenue include environmental externalities, where Pigouvian taxes[22] are "Georgist" in that they make polluters pay a price for polluting publicly owned air and water, and licenses to practice professions or run businesses that are thought, rightly or wrongly, to require public supervision or certification. Of course several of these taxes, like natural resource severance taxes and Pigouvian taxes, are not lump-sum taxes like a pure land tax, but like the land tax they do have a territorial component, a large revenue potential, and no excess burden. Some improve allocations when properly assessed.

explained by growing political rent seeking.

[18] Conesa et al. (2009) discuss conditions (tight borrowing constraints, uninsurable idiosyncratic income risk, life-cycle income) under which the Judd-Chamley result of an optimal capital income tax rate of zero ceases to apply.

[19] Calabrese and Snider (2003) estimated the value of the US spectrum at $750 billion in the early 2000s.

[20] Gaffney (2009) lists many examples of the vast value of littoral docking rights and commercial space.

[21] In the US, 50% to 75% of the catch generally go to holders of Individual Fishing Quotas, whose economic position is essentially the same as that of a landlord on dry land. In other words, 50% to 75% of the catch is rent.

[22] Barnes (2001) estimates the revenue potential of carbon taxes alone at 3% of GDP, or $228 billion, in 2001, and points out that public revenues from other pollutants would greatly add to the total.

3.4. The Simple Analytics of Taxing Land

The simple analytics presented in this subsection can be found in several sources, including Oates and Schwab (2009) and Gaffney (2009). We start with the observation that the asset value of land is the present discounted value of its rental values. Assume that one period represents one year, that the net real interest rate r is constant,[23] that land rental values y_t become available at year-end and grow at the constant annual rate g, and that taxes also become due at year-end. Thus, in the absence of taxes, the asset value of land at time t is given by[24]

$$V_t = \sum_{s=0}^{\infty} \frac{y_{t+s}}{(1+r)^{s+1}} = \sum_{s=0}^{\infty} \frac{y_t (1+g)^s}{(1+r)^{s+1}} = \frac{y_t}{r-g} = \frac{y_t + gV_t}{r} \,. \tag{1}$$

If land is subject to an annual asset value tax (LAVT) at a rate of τ, then we have instead:

$$V_t = \sum_{s=0}^{\infty} \frac{y_{t+s} - \tau V_{t+s}}{(1+r)^{s+1}} = \frac{y_t}{r+\tau-g} = \frac{y_t + (g-\tau) V_t}{r} \,. \tag{2}$$

A key observation in these two expressions is that the rental value of land y_t is not at all affected by the introduction of a LAVT. This is because a properly administered LAVT is levied on the asset value of land alone in its highest and best use rather than in its actual use.[25] The LAVT is therefore a lump-sum tax that does not entail a deadweight loss as long as the tax is less than the rental value of the taxed asset. If the proceeds of the tax are in addition used to reduce taxes that are distortionary or to provide valued local public services, its introduction leads to additional efficiency gains whereby y_t grows from y_{pre} to y_{post}.

In practice the accurate determination of the asset value of land, and therefore the accurate determination of the required tax payments, can require some effort. While inaccuracies may be an issue for justice and distribution, because these difficulties might affect the tax burdens of different land parcels differently, they are much less important for excess burdens and efficiency, where it is sufficient that land users are confident that the tax will be independent of their actions and less than the rental value of their land. This only requires that the assessors use a methodology that values land independently of its current or planned use. In that case the only effect of the LAVT is that the owners of the land, on the day such a tax is announced, suffer a windfall loss, while after the announcement there is no further burden on any new site owner (Foldvary (2005)). The windfall loss, the difference between the pre-tax asset value in (1) and the post-tax asset value in (2), can easily be shown to equal the present discounted value of government tax receipts.

The tax revenue equals τV_t, and therefore the effective tax rate on the asset value V_t is τ, while the effective tax rate on the rental value y_t is $\tilde{\tau} = \tau / (r - g + \tau)$. In a dynamically efficient economy it must be true that $r > g$. The effective tax rate on the rental value is therefore always an increasing function of τ. In other words, even though incremental tax revenue gains decrease as the tax rate is increased, the Laffer curve of this tax does not have a downward-sloping portion, until the point where the tax bill exceeds the rental value, where it suddenly drops to zero.

[23] We interpret this as the return to equity rather than the return to government securities, which is generally lower.

[24] Note that the asset value of land itself rises over time because the passage of time brings higher future rental values closer to the present.

[25] Taxable land value under LAVT systems may include so-called merged improvements, that is, the value added by clearing, leveling, or draining, which may have taken place a very long time ago and can therefore be hard to distinguish from "unimproved land".

The effective tax rate $\tilde{\tau}$ also reduces the pre-tax asset value of the land by the same share. To see this, note that the pre-tax value of the land equals $V_{pre} = y_t/(r-g)$, the post-tax value equals $V_{post} = y_t/(r-g+\tau)$, and the ratio $\Delta_V = (V_{pre} - V_{post})/V_{pre}$ equals $\tau/(r-g+\tau)$. The introduction of a LAVT is therefore economically equivalent to the government appropriating an equity share in the asset value of the land. To bring the price of land down to zero would require an infinite tax rate. If the frequency of payments is increased, $r-g$ approaches 0, and therefore the τ that is needed to drive the land price to any given value decreases. However, τ still needs to go to infinity, or the frequency with which a finite τ is imposed must become infinite, for the land price to go all the way to zero.

While this is of theoretical interest, in practice it would be preferable to not have the price of land approach zero. The reason is that landowners would abandon land with old buildings whose demolition cost exceeds their residual value, or if they fell behind on their taxes. A positive price of land therefore serves as a kind of deposit that discourages bad behavior. With a positive though modest price, there is no difficulty in letting people run up tax obligations and pay them only periodically.

When the imposition of a LAVT is accompanied by a reduction in distortionary taxes elsewhere, the Laffer curve tilts up further, and the ratio of pre- to post-tax asset values equals $\Delta_V = \tau/(r-g+\tau) - \Delta_y (r-g)/(r-g+\tau)$, where $\Delta_y = (y_{post} - y_{pre})/y_{pre} > 0$. In our baseline quantitative simulation, we will propose an increase in the LAVT tax rate from 0.55% to 5.55% per year, balanced by decreases in distortionary taxes. This both increases the pre-LRVT rental value of land and reduces the LRVT tax rate on that rental value.[26] As a result, Δ_y is significantly larger than zero, and land prices drop by significantly less than suggested by the simple formula with $\Delta_y = 0$.

Finally, to show that a LAVT taxes both current rental income y_t and the current unearned increment (unrealized gains due to price appreciation) gV_t as they accrue, and at the same rate (see Gaffney (2009)), we can rewrite (2) as

$$V_t = \frac{y_t + gV_t}{r+\tau} \,. \tag{3}$$

3.5. Efficiency Effects of Taxes on Land

3.5.1. Allocative Neutrality Propositions

The discussion in the previous subsection has shown that the classical Georgist land tax, a tax on the asset (or rental) value of land, independently of its actual use, is allocatively neutral as long as the annual tax is less than the rental value. Its only effect is to reduce the asset value of land upon enactment (though this can be wholly or partly offset by beneficial effects of tax cuts or spending financed by the tax). This result does not depend on the tax being assessed accurately, it depends only on the tax being independent of the owner's actions. The literature suggests that there are at least two other ways to make property taxes neutral.

[26] There is no separate LRVT tax in the simple analytics of this subsection, but there will be in the full model.

The first, due to Gaffney (1971), is to use a modified income tax that adds price appreciation and deducts price depreciation of land from income when they accrue, and which treats any difference between rental value and actually received rental as taxable consumed income. In other words, it puts the full rental value of land into the tax base of the income tax. This makes the income tax, insofar as it falls on income derived from land, much like a tax on land. However, it makes the same requirements on the accuracy of land appraisals as the classical land tax, and it is in fact identical to it if it amounts to a separate income tax, with its own tax rate, on the rental value of land. And if it does not do this, and is instead simply added to the tax base of the otherwise allocatively non-neutral progressive income tax, it thereby ceases to be allocatively neutral.

The second, due to Arnott (2005), distinguishes unimproved land, improvements, and post-development residual site value (the combined value of unimproved land and improvements minus the value of improvements). Arnott (2005) shows that neutrality can be achieved by (i) not taxing unimproved land, (ii) taxing post-development residual site value at a rate sufficient to meet revenue requirements, and (iii) subsidizing improvements. However, these results require a strong set of assumptions, including perfect competition, zero rent of unimproved land, no possibility of redeveloping improved land, and knowledge of the future path of the rental income from structures. The motivation behind Arnott (2005) is that he is skeptical of being able to estimate the asset value of land, and of taxing land with no income. We will discuss below that it is feasible, and with new methodologies is becoming increasingly feasible, to assess the asset value of land. Furthermore, there are major efficiency advantages to collecting taxes from land that yields no income.

3.5.2. Better than Neutrality?

In the economics literature, Feldstein (1977) studies an overlapping generations (OLG) closed economy where land and capital serve as inputs into production and are the only available assets. He finds that a land tax, independently of alternative uses of the tax revenue, increases steady state capital, output, consumption and welfare, by diverting saving away from land and towards capital. Calvo et al. (1979) demonstrate that these findings depend on the non-Ricardian OLG assumption, and that when households value the utility of their children and make bequests, and when the proceeds of the tax are returned to households in either generation, the land tax is fully capitalized into the land price and no effect on capital accumulation occurs, as in the original results of Ricardo (1817). Kotlikoff and Summers (1987) show that the Ricardian results can also be obtained in an OLG setting if current and future consumption are perfect substitutes in households' utility functions. Eaton (1988) studies a small open economy version of the Feldstein (1977) OLG environment, and finds that, following the introduction of a tax on land rentals, saving is not diverted towards capital but towards foreign assets, leaving domestic output unaffected but raising consumption and welfare. Petrucci (2006) adds endogenous labor-leisure choice to the small open economy OLG setting, and finds that the consequences now critically depend on how the tax revenues are used.

As argued in the present paper, land taxation has several potential positive effects through the fiscal budget. A balanced budget increase in land taxes permits a reduction in distortionary types of taxation, and this stimulates output gains. Furthermore, it gives rise to a positive fiscal feedback loop, as the stimulus reduces the need for government transfer payments, or at least reduces them relative to GDP, thereby allowing for an even greater reduction in distortionary taxes. Banks (1989b) is an early contribution that studies a related question. He considers the stimulative effects of cuts in distortionary taxes on labor, capital and consumption, and he argues that while

such cuts are stimulative through substitution effects, to the extent that their objective is to be stimulative through disposable income effects, their effectiveness can be largely negated because higher incomes bid up rents payable to landlords, and thereby land prices, leaving real disposable incomes at or near their former level. This leakage has in fact been identified as a serious obstacle to supply-side programmes; see e.g. Gilder (1981). Therefore, to be effective, a tax-cutting fiscal strategy requires a mechanism for neutralizing the capacity of land-owning rentiers to appropriate the gains. A tax on the rental value or capitalized value of land is the most obvious mechanism that would accomplish this. Therefore, inverting the thought experiment of Banks (1989b), using a tax on land to fund cuts in distortionary taxes must have beneficial effects for the level of output through both substitution and income effects. Separately, cuts in distortionary taxes increase the demand for more compact cities, and this can reduce urban sprawl (Gaffney (1964), Foldvary (2005)).

Taxes on land can also be better than neutral by reducing inefficient land speculation, thus making land effectively more abundant, and thereby lowering costs of production. Brown (1927) lists several reasons why speculators may prefer to hold land out of use with a view purely to speculative price appreciation gains. He then shows why a land tax would reduce, ceteris paribus, the incentives for such speculation. Tideman (1994a, 1999) updates these arguments. He shows that land taxes reduce the return to investments into discovering which land will rise in value. They also lower the value of land to those with low discount rates and easy access to credit, relative to its value to those with high discount rates and less access to credit, who are likely to make more intensive use of the land, and whose creditworthiness is furthermore increased by raising their after-tax incomes. Land taxes also disproportionately reduce the value of land to those with extreme beliefs about its future value, thereby making some land more valuable to persons who wish to develop it immediately than to the land speculators who would otherwise be the highest bidders for it.[27] Returning to the concern with urban sprawl, by increasing the holding costs of land, land taxes put pressure on holdout and wasteful landowners by depleting their income and wealth if they do not put their land to its highest use, or sell to someone who will.

Foldvary (2005) makes another argument for why land taxes can be better than neutral, an argument that may be especially important for small open developing economies. This is that such economies, in the face of more and more mobile flows of labor, capital and money, are subject to intense international competition, and may have too few options for viable tax bases, while they may have a need to fund at least a minimum of public infrastructure, and to minimize distortionary taxes, to build a competitive economy. Because land cannot flow abroad, it is both a reliable and a non-distortionary tax base for such economies. Land taxes also increase international competitiveness by preventing the credit-based capitalization of high land rents into high real estate prices while permitting the reduction of other taxes, thereby reducing the cost of doing business. See Dwyer (2003), who attributes the success of Hong Kong to a combination of high taxes on land and low taxes on capital and labor. The key point is that economic rent is the excess of market price over socially necessary cost of production, where the latter include returns to labor and capital, so that economies that minimize rent are more competitive on price.

[27] The idea that it is socially costly to concentrate land in the hands of those who believe that future land rents will be highest is a variation on the theme of the winner's curse.

3.6. Inequality Effects of Taxes on Land

Gaffney (2009) notes that taxes based on land rental values and land asset values are progressive in their impact and incidence, thereby minimizing the number of true hardship cases, while at the same time they are pro-incentive in their allocative effects, as well as stimulating in their macroeconomic effects. This combination of virtues is unique. It belies the neoclassical cliché that policymakers must always choose between equity and efficiency in taxation.

A growing literature tries to explain recent trends in advanced economies' income and wealth inequality. But with few exceptions this literature relies on the traditional framework whereby output is produced using only labor and capital. For example, Karabarbounis and Neiman (2014) attribute the worldwide retreat of the labor share in gross income to a coinciding fall in the relative price of capital goods, and Piketty and Zucman (2014) attribute the retreat in the share of labor income in gross income to a rise in the quantity of capital from the increasing accumulation of physical savings and the resulting higher capital-to-income ratios. However, as pointed out by Harrison (2014), who uses the analysis of Bonnet et al. (2014), in the US, Canada, UK, Germany and France, residential housing wealth (which furthermore excludes non-residential real estate wealth) accounts for at least 63% (Canada) of the increase in capital-to-income ratios since the middle of the twentieth century, and in France and Germany it accounts for more than 100%. This is also stressed by Rognlie (2015). Knoll et al. (2017) trace that surge in housing wealth back to land prices rather than the quantity or price of structures. This price channel is conceptually different from the capital accumulation channel stressed by Piketty (2014) as an explanation for rising wealth-to-income ratios and is in fact consistent with the capital-to-income ratio staying constant. In fact, this is what we find for the US for the period 2010-2018 - a nearly constant capital-to-income ratio and a sharply rising land-to-income ratio as the economy recovered from the 2008 crisis. Our results are therefore consistent with Knoll et al. (2017), who, however, arrive at their results using data that were created using the land-residual method for determining land prices, whose shortcomings and tendency to produce underestimates will be discussed below. Therefore, even their estimate that 84% of the rise in house prices between 1950 and 2012 can be attributed to rising land prices may be too low.

Stiglitz (2015a) revisits and updates the Kaldor (1961) stylized facts on growth and distribution, noting today's coexistence of stagnating wages, a steady return to capital, an increasing capital share, and a strong increase in the wealth-to-income ratio. He finds that it is impossible to reconcile this with the data using a traditional neoclassical framework that equates wealth with physical capital, and that assumes a production function in capital and labor and the competitive determination of factor returns. Instead, it is necessary to expand the specification of the production function, and the definition of wealth, to include rents that are capitalized into wealth, most importantly but not exclusively land rents (see Section 3.3 above). Based on this, Stiglitz (2015a,c) argues that land taxes can contribute to reduced wealth inequality while increasing wages.

There are other studies (sometimes on property taxes rather than strictly land taxes) that reach similar conclusions. For example, Sennoga, Sjoquist and Wallace (2008) apply a CGE model to developing economies to study the distributional effects of property taxes. They find them to be progressive, because land and capital are owned predominantly by higher-income individuals.

3.7. Other Considerations

3.7.1. The Financial Sector

Hudson (2012, 2018) has shown that most land rent is paid out as interest to banks. and that bank credit is a major driver of increases in housing prices ("real estate is worth whatever the bank will lend against it"). Further empirical support is offered by Favara and Imbs (2015), and La Cava (2015) finds that this can explain the increase in the share of housing in capital income studied by Rognlie (2015). Ryan-Collins et al. (2017) and Turner (2017) argue that a self-reinforcing cycle between bank lending and land value increases has caused a shift in bank lending from business loans to mortgages and the inflation of land prices, and this has impaired financial stability, as also argued in Keen (2017). Schwerhoff et al. (2020) argue that land taxation at a high rate would in the long run improve financial stability, by substantially reducing the value of land and thus its ability to fuel lending booms as collateral. Holders of land, instead of paying their unearned income as interest to banks, would pay it as land taxes to the government, with credit much reduced.

Gaffney (2009) and Hudson (2018) argue that a private mortgage is a de facto sale of rents by the borrower to the lender. In countries with developed public records, it would be administratively feasible and enforceable to put mortgages into the property tax base and then tax the lender,[28] with the tax on the borrower reduced by the amount of the tax on the lender, so that the total amount of taxes collected would not depend on the amount of lending. The land tax would be paid entirely by the borrower if the mortgage was less than the value of the improvements, because in that case the lender's interest can be described as only an interest in the improvements. If the mortgage was greater than the value of the improvements, the tax would be shared between the borrower and the lender in proportion to their interests in the land. The borrower would be responsible for a share equal to the ratio of the property value minus the mortgage (his equity, deemed to represent land) to the property value minus the value of improvements (the mortgage minus the value of improvements representing the land deemed to be financed by the mortgage). In other words, his tax responsibility would be in proportion to his interest in the land, with the lender being responsible for the remainder. For existing mortgages with interest rates fixed by contract, the tax on the lender would be a lump-sum tax and therefore neutral. For new mortgages, any tax on lenders would be mostly shifted to borrowers in the form of higher interest rates, the supply of mortgage funds being highly elastic, since lenders can make alternative loans.

Any reform would have to ensure that banks that have extended mortgages retain the ability to service their existing liabilities. This can be ensured, in part, by allowing banks and any other parties that have promised to service liabilities with the proceeds of mortgages to pass the land tax on to those to whom the rent has been promised, and in part by phasing the tax in gradually, as proposed in this paper. With phasing-in, while collateral values would immediately drop considerably, the cash flows of borrowers would initially be little affected, so that borrowers could continue to make their loan payments. Of course, over time banks would become much less inclined to lend against land, but that would be part of the desired outcome. The land will have the same (new, lower) value to a potential buyer who plans to get a mortgage, whether he pays the tax himself or pays a higher interest rate to compensate the lender for paying the tax. Having the lender pay is a way of assigning the tax to those who are collecting the rent.

[28] When the mortgage holder goes to the Courthouse to ensure that the property cannot be sold unless the mortgage is cleared, he is declaring himself to be the rightful recipient of the rent. He would therefore in principle be the rightful recipient of a land tax bill when the mortgage exceeds the value of the improvements.

What this means for banks in the longer run is not a loss of profitability measured by the return on equity or the return on assets, but a loss of size measured by balance sheet size, and even that is not a necessary outcome if banks replace their mortgage lending with business lending in an economy that has started to thrive due to much lower taxes on businesses and consumers. The alternative to this manageable "loss" of banks is a continued loss for the rest of the economy due to far suboptimal real activity. The point is that failure to tax land, as the classical economists would have wanted, has progressively led to land rent being pledged to banks and ultimately their bond- and shareholders, who are ultimately the largest rent recipients, or rentiers, in modern societies. This has massively indebted society while burdening labor and industry, instead of the rentiers, with taxes. In this view, modern financialized economies, unless they change this dynamic, face debt deflation, de-industrialization and depression. The taxation of land, together with a re-orientation of banks' business towards lending to industry, seems like a very small price to pay to escape from this dynamic. In fact, as we will show, it could be a recipe for a spectacular economic resurgence.

3.7.2. Outright Sales of Land

There are several reasons why it may be worse for a government to sell land outright at auction for a one-off sum, without any further taxation, than leaving it in private hands and taxing it periodically. For the government itself, other than in countries where it starts off as the owner of all or most of the land, it would have to acquire and then auction off vast tracts of land, which would be logistically very difficult. For potential buyers with limited access to credit, a large up-front payment would be far less affordable than annual land rent payment to the government, thereby making land use far less accessible to those who do not have high credit scores. Speculation could resume soon after the initial sale, with the potential for large unearned gains unless future growth was perfectly anticipated by the sales price. Risks would be far greater and would tend to depress sales prices, because it is difficult to perfectly anticipate future rental payments at the time of the initial sale. The risk for the taxpayer is that the sales price turns out to be too low, while the risk for the new owner is that it turns out to be too high. This uncertainty is of very little consequence when land is taxed periodically instead, because future payments will be determined by future conditions. Finally, intergenerational equity would be harder to maintain, because it is more just that future rents of land should be captured by future generations.

3.7.3. Uncertainty

Vickrey (1999) and Feder (1994), as summarized in Helm (2012), stress that the benefits of a land tax go beyond steady state efficiency gains. This is because the tax allows for the pooling of idiosyncratic risks from land price fluctuations. This risk plays a very important role in modern economies, because real estate risk is of immense importance to the typical owner (Caplin et al. (2003)), and because most of the volatility in real estate prices is attributable to their land component (Bostic et al. (2007), Zhou and Haurin (2010), Bourassa (2009)). The pooling argument is that land is an asset with large undiversifiable and uninsurable risks, which in turn engenders harmful behavior including speculation, rent seeking and costly planning disputes. A land value tax effectively pools land-value risk, by reducing the private value of the risky component (land) of the property asset, and transferring it to the whole community. These efficiency gains from reducing harmful behavior are not neutralized by negative incentive effects, with adverse selection absent because pooling is a compulsory tax rather than an opt-in arrangement, and moral hazard absent

because the extent of land value fluctuations is not under the control of the landowners who bear the risk. Also, the risk-pooling is solely a consequence of asset price devaluation, not of distributing the revenues in any particular way. The effect on the landowner is akin to that of a shared-equity mortgage. In the limit, in a system with very high land tax rates, capitalization of the expected tax liabilities would cause land values to be so small in comparison to building values that real estate would trade for an amount not much greater than the value of the building or other improvements, and fluctuations in land values would have a negligible influence on a property owner's total wealth, thereby providing nearly complete insurance against this risk.

Lutz (2008) studies the business cycle properties of property taxes, and finds them to be less volatile than other tax sources, for two reasons. First, the elasticity of property tax revenue with respect to house prices equals 0.4, which indicates the policymakers tend to offset around 60% of house price changes by moving the tax rate in the opposite direction. Second, there is a three-year lag between house price changes and property taxes, because property value assessments are backward-looking, the fact that assessed values lag market values, and the presence of caps on tax increases.

3.7.4. The Environment

The value of land depends on how well it can provide individuals with a livelihood. Land areas that cannot support human activity, such as the Sahara Desert or the Greenland ice cap, have zero value, while the value of land in the center of thriving cities can be enormous. But to provide support for productive human activity, land needs continuous protection and maintenance, otherwise it can lose value. One implication is that a land tax can go hand-in-hand with environmental considerations, and can indeed share important characteristics with environmental taxes.

The literature has considered this connection. In an early contribution, Harrison (1989) argues that the failure to make people pay rent for access to, or possession of, natural resources is at the heart of all major environmental problems. Beck (1999) emphasizes that balanced-budget land value taxation, which combines an increase in land value taxes with a decrease in taxes on productive activity (including taxes on improvements) shares many characteristics with ecological tax reform (ETR), which combines an increase in taxes on consumption of natural resources with a decrease in taxes on productive activity.[29] Both land value taxation and ETR discourage idle land speculation, and the underuse, waste, and sprawling development of sites. In other words, land value taxation is a natural ally for the environmental agenda. For an earlier statement of the same idea, see Gaffney (1976). At a more philosophical level, the same argument is made by Harrison (2012): "When the community's revenue - the rents paid to use and sustain the commons - was hijacked [through privatization of the free gifts of nature], the rent seekers incubated a process of cannibalization that devoured natural habitats." Harrison refers to this process as "a general theory of cheating".

3.7.5. Agricultural Land

When land is subject to deterioration, such as mining, cutting virgin forest, and allowing land fertility to decline, neutral taxation requires a "severance tax" equal to the present value of the reduction in future taxes that results from the deterioration. When land increases in value from investments in ploughing, fertilizing, hedging, drainage, ditching, and grading, there is an opposite

[29] For an in-depth treatment of ETR, see Hamond (1997).

problem of taxation leading to a discouragement of investment. A solution is to provide either an assessed value that excludes the value of such improvements, or a subsidy equal to the present value of the increase in future taxes that results from including the investments in the tax base. For the latter, if the tax is designed to take 60% of the pre-tax value, then the subsidy should be 60% of the value of the improvements.

Land and agricultural maintenance has positive externalities for future generations. The reason is that a tidy and well-cultivated landscape provides a sustained increase in agricultural output and/or an improved public amenity, and the discount rate of mortal humans will inevitably be higher than that which would be optimal for society as a whole, including the as yet unborn. Especially high tax offsets or subsidies might be appropriate in the case of public parks, fields with public access footpaths, reforestation, or additional lakes. Many agricultural subsidy systems are already moving in this direction. What is true of rural land is to some extent also true for urban land. The preservation and upkeep of the exterior of buildings and the upkeep of gardens and sidewalks should have a subsidy or an offset against the land tax, and there should be fines for allowing unused buildings and spaces to become derelict.

4. Data

Two key objections against land taxes concern the tax base, the value of land, namely that it is either unobservable, or observable but too small. This section uses the best available data from an OECD database and an extensive presentation of available estimation methods to argue that these objections are not valid. While some effort is necessary to obtain good data, this has been done in many jurisdictions, with modern methods that are constantly improving. And these data show that the tax base is in fact very large, as it accounts for approximately half of the value of physical assets in many leading economies.

4.1. OECD Land Shares: Data

The annual data that we examine in Figures 1-5 were obtained from the OECD statistical database, Table 9B, Balance Sheets for Non-Financial Assets.[30] This database makes the following classifications. First, it divides **assets** into financial assets (which correspond to other agents' liabilities) and non-financial assets (which do not). Second, it divides **non-financial assets** into produced assets and non-produced assets. Third, it divides produced assets into the principal categories of buildings, machinery and inventories, and **non-produced assets** into the principal categories of land and mineral and energy reserves. Where mineral and energy reserves are separately listed by the OECD, we include them in Figures 1-5. For most countries they are not listed or are extremely small. This implies a risk that the overall quantity of non-produced non-financial assets represents an underestimate. Our main object of interest is the ratio of non-produced assets to total non-financial assets.

The figures are reported for the total economy and, where available, also broken down into non-financial corporations, financial corporations, general government, and households including non-profit institutions serving households. We will define the private sector as the sum of non-financial

[30] Available at https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE9B.

corporations, financial corporations, and households including non-profit institutions serving households. For many countries coverage is incomplete. Most importantly, several countries only have entries under households including non-profit institutions, and in some other cases only two lines are reported, namely fixed assets under produced assets and land under non-produced assets. However, for several important countries the table contains much more detailed information.

The historical background of this database is the creation of a joint Eurostat-OECD Task Force in June 2012, with the objective of producing better sectorial balance sheet data for non-financial assets. One of its central concerns was the difficulty for most countries of separately identifying the value of the land underlying a structure and the value of the structure, where the latter also includes land improvements. This is one of the key concerns of this paper. Our discussion is based on Eurostat-OECD (2015), which summarizes the recommendations produced by that Task Force.

4.2. Estimation Methods for Land Shares

Eurostat-OECD (2015) and Kim (2008) discuss four different methods for estimating the value of land. Method 1 is the direct cadastral approach, which takes a physical inventory of parcels of land and multiplies the area of each of them by an appropriate price per unit of area. The remaining methods are indirect approaches. Method 2 is the land residual approach, which subtracts the value of the structure, mostly estimated by the permanent inventory method (PIM), from the combined value of a property. Method 3 is the land-to-structure ratio (LSR) approach, which derives the value of the land indirectly by multiplying the value of the structure by the LSR. Method 4 is the hedonic approach, which uses a hedonic regression model to estimate a price index for land, and derives the total value of land by multiplying the price index by the area of land.

Two of the indirect approaches require as their starting point an estimate of the combined value (CV) of all land and structures. There are two principal methods for estimating the CV. The *appraisal method* is a bottom-up approach, where each individual unit is specified in great detail (location, size, age, etc.), its CV is estimated, and the individual units are then added up. In many countries, official government assessments are available for this purpose, because such data are required for real estate taxation. The advantage of this approach is full coverage, but the disadvantages include infrequent updating, the fact that appraisals tend to lag true sales prices, and systematic underestimation if the value of real estate is declared by the owner for tax purposes, with insufficient or no inspection by the tax authority.[31] The *quantity times price method* (QtP) is a top-down approach that is sometimes used for residential real estate. It most commonly involves the use of average values of dwellings derived from sales data as price data, and population and housing-census-based estimates of the number of dwellings as quantity data.

[31] IMF (2013) notes some potential for self-assessment schemes where taxpayers themselves are allowed to declare a value, but are then required to accept bids for some specified amount in excess of the declared value. Such a scheme has been used in Bogotá, Colombia.

4.2.1. Direct Cadastral Approach

This approach[32] requires the greatest amount of data. It is used for all land types by several economies, including most extensively by Japan and South Korea (very detailed volume and price data),[33] but also by Finland (intermittently), Australia (some land types, excluding residential land), and France (cadastral data in conjunction with other data). For estimating the value of land without structures, this is the dominant method worldwide. Because this approach is not as sensitive as other methods to key assumptions, it tends to lead to smoother results over time.

South Korea represents an excellent case study, and we will therefore dwell on it at some length. South Korea uses two main sources of land price data, the system of publicly notified prices (PNP) of real estate and the reporting system of actual transaction prices (ATP) of real estate. In the PNP, around 500,000 parcels of land, constituting around 1%-2% of the total number of parcels, are sampled by over 1,000 public appraisers at the beginning of each calendar year. The prices of all other, unappraised parcels of land are then computed by reference to the prices of nearby publicly appraised parcels, and by reference to a land price conversion index that takes into account several attributes of the unappraised parcels of land. The PNPs of individual parcels are finalized after verification by the appraisers, possible appeals by the landowners, and deliberations of the real estate valuation committees of the municipality. However, despite this thorough approach, the PNP does not fully reflect market prices, because its basic purpose is taxation rather than statistical information. The ATP is used to correct for this. In 2006 it became mandatory for South Korean real estate agents to report ATP data to the local government. These data are compared with PNP data and used to value the stock of land at market prices. However, in doing this conversion, a factor of 0.9 is applied to avoid the possibility of overvaluation due to the small size of the sample of transaction prices. Despite this conservative conversion, the total ATP-based value of land has typically ranged between around 125% and 140% of the PNP-based value.

4.2.2. Land Residual Approach

This is the most commonly used approach, both for taxation purposes and for purposes of official statistics, because it is practically comparatively easy to implement. However, it has major conceptual flaws, which we will revisit in Section 4.6 below.

The land residual approach uses the CV obtained by either the appraisal or QtP methods and deducts from it the depreciated cost CO of the structure. Because the CV is hard to calculate for property traded on thin markets, this approach is more frequently used for land underlying residential dwellings and for some types of more frequently traded non-residential buildings. The cost of the structure, at market prices, is generally estimated by the PIM, with possible biases due to incorrect calibrations of the PIM (service lives, depreciation rates). Inaccurate estimates of CV and/or CO can and have in some cases led to negative values of land. As reported in Kim (2008), both the US and Denmark stopped reporting estimates of land values for that reason.

[32] Another alternative is the direct census and survey approach, which is used by the Czech and Slovak Republics. However, as discussed in Kim (2008), this method is not more widely used because survey respondents generally have difficulties reporting accurate market values.

[33] Another country that uses this approach, and that historically used a land value increment tax to capture around 20% of price appreciation gains on land, is Taiwan Province of China. See Lam and Tsui (1998) for details. This case is not contained in the OECD database.

4.2.3. Land-to-Structure Ratio Approach

The land-to-structure ratio (LSR) approach has similarities with the land residual approach, in that it relies on derived values of depreciated structures. It can therefore only be used to estimate the value of land underlying structures. The LSR approach is recommended when available data sources permit the derivation of a higher quality estimate for a representative set of LSRs, compared to an estimate of a set of CVs. The derivation of a detailed set of LSRs that captures relevant differences among different property types relies on the availability of data on the value of structures and land components for a clearly defined and sufficiently representative sample set of properties. One strength of this approach is that the main data requirements are likely to be met by many countries. Also, the LSR approach avoids the potential issue of negative land values that arises with the land residual approach. Potential weaknesses are a lack of representativeness of the sample, lags in the availability of needed data for LSR, and the fact that this method is only applicable to developed land. The main country in the Eurostat-OECD data that uses the LSR approach is Canada. Germany uses LSR to estimate the stock of land underlying structures for households.

4.2.4. Hedonic Approach

This approach is based on a set of hedonic regressions that use observations on sales of real estate properties. The dependent variable is the combined value of a piece of property CV_i, and the independent variables are the size of the property's structure in square meters S_i and the size of its land in square meters L_i. Denoting the age of a structure by A_i and the depreciation rate by δ, a typical specification for a cross-sectional regression is

$$CV_i = p^S \left(1 - \delta A_i\right) S_i + p^L L_i + \epsilon_i \ ,$$

where i indexes a combination of time period, land use and location. The regression outputs are price indices for structures and land p^S and p^L, which are estimates of representative prices for one square meter of land and one square meter of structure for a given time period, land use, and location. The reliability of the estimation improves if the sample is subdivided into a sufficient number of subgroups with similar characteristics. A significant advantage of this approach is that the estimation returns values for land and structures that match with the total price of a piece of real estate. Possible disadvantages include the technical difficulty, the data intensive nature of the approach, multicollinearity issues, and the fact that the estimated figures for buildings would most likely not be consistent with PIM capital stock figures for buildings that are used in the national accounts. In practice, the hedonic approach has not yet been used nationwide by any country. But it has been used in many individual studies and at the sub-national level.

4.3. OECD Land Shares: Results

Figures 1-5 display the shares of total non-produced assets in total non-financial assets for 16 economies. For 10 of these economies we have sufficient data to display three different shares, for the total economy, the private sector, and the household sector. For the remaining 6 economies, which include the US, the data are only sufficient for the household sector.

Figure 1 displays the data for Australia, Canada and the UK. The data for Australia[34] and Canada are based on very detailed estimation methodologies. For both countries there is a sizeable difference between the value of non-produced assets and the value of land that principally represents mineral resources. In the case of Canada, these resources are mainly allocated to the private sector, while in the case of Australia they are allocated to the government sector. In both cases there has been a large increase in the share of land in total non-financial assets since the early 1990s, from around 30% to around 40%-45%. As we will see, this is a widespread but not universal phenomenon that may be due to increasing bank lending over this period. When we include the value of resources, the share of non-produced assets in both cases reaches 50% towards the end of the sample period, both for the total economy and for the private sector. For households, the share of land is even higher, reaching around 55% in Canada and 65% in Australia.[35] These are macroeconomically very significant numbers. The reason is that, on the common assumption that the rates of return on all valuable assets, non-produced and produced, are roughly equalized, then half of the returns that are usually deemed to be received by "capital" are in fact received by non-produced assets. This has major implications for income distribution, and more importantly for this paper, for optimal taxation. Very similar developments can be observed for the UK, but here the shares of land are far higher. For the total economy they start at around 40% in the mid-1990s and end close to 60% prior to the 2008 GFC and again more recently, after a dip during the crisis. The level and pattern for the overall private sector is very similar. For households the share of land is extremely high, at over 70% in recent years.[36]

Figure 2 shows data for Japan and South Korea, which probably have the most highly developed estimation methodologies for land values. In these two countries significant taxes are already being levied on land, and this is one of the reasons why their data are as good as they are. In South Korea, for both the total economy and the private sector, the share of land in non-financial assets is very high, having fluctuated around 55% between the mid-1990s and today. For households the share is again much higher at over 70%. Japanese land shares are also very high, but here the development over time is the opposite of most other major economies, due to the deflation of its property bubble that started in the early 1990s. At that time the share of land for the total economy and the overall private sector was around 60%, and for households it was at 80%. Since then it first declined and then stabilized, at a little under 50% for the total private sector and a little under 70% for households. The land shares for both of these economies imply a major potential for shifting the tax burden towards land. Furthermore, because land taxes are already being levied in these countries, and because higher land taxes imply lower land prices, the shares in Figure 2 are likely to understate the potential of land taxation for an economy that currently taxes land very lightly or not at all.

Figure 3 shows data for Germany and France. The data for Germany are different from those of other major economies. First, the share of land is comparatively low, at well under 30% in the 2000s for the total economy and around 35% for households. Second, the increase in the share of land is only a very recent and not very sizeable phenomenon, with values reaching 30% and 40% for the total economy and households. The reason for this pattern may be that Germany has experienced a much smaller initial level and subsequent increase in bank lending against real estate than in many other countries. The French pattern is also unusual, but in this case we have to take

[34] Australia has a state-based annual land tax on unimproved land values (Lunde and Whitehead (2021)).

[35] We will observe that the share of land is highest for households for the majority of countries.

[36] The overwhelming importance of land for the level and growth of UK wealth is also emphasized in Government Office for Science (2015) and Office for National Statistics (2018).

into account that our data series for France, which starts in 1978, is far longer than for almost all other economies. We observe a declining share of land of around 10 percentage points in the 1980s and 1990s, which is followed by a very rapid increase of around 30 percentage points starting in the late 1990s. Recent land shares have fluctuated around 45%, with a slight downward trend since the GFC. Unlike the case of Germany, these are very high levels, suggesting a substantial base for a land tax.

Figure 4 shows data for the Netherlands, Sweden and Austria. The recent values for the first two are slightly smaller than for France, reaching around 40%/55% for the total economy/households in the Netherlands, and 35%/50% in Sweden, with a recent upward trend. Austria by contrast has only recently stabilized a downward trend in the share of land, and the levels are low, similar to Germany, with 30%/45% for the total economy/households.

Figure 5 shows data for six economies for which the database only contains data for the household sector, so that the picture for the overall economy is not known. Perhaps of most interest is the US, which has recently observed a comparatively low share of household land in the total value of non-financial assets of around 40%.[37] Land shares are much higher in the larger Southern European economies, including 50% in Italy and 75% in Spain. The remaining shares are 60% in Belgium, around 40% in Denmark,[38] and around 55% in New Zealand. The information for European economies is consistent with the results reported in Figure 4.2 of Eurostat-OECD (2015) for the euro area, which is based on the methodology of Balabanova and van der Helm (2015) for calculating the value of household dwellings, and which uses the land residual method. The conclusion is that between 1999 and 2013 the share of land in household housing wealth in the euro area has fluctuated around 50%.

To summarize, and concentrating only on the large economies for which we have complete and high quality data covering the total economy, we observe that land and other non-produced non-financial assets in the majority of cases account for 50% (Australia, Canada, Japan) or more (UK, South Korea) of total non-financial assets. France is a minor exception at 45%, and the only major exception is Germany at 30%. The potential for shifting the burden of taxation from labor and produced assets to non-produced assets is therefore very large. In some of the smaller economies the potential is smaller, but the land share is never less than 30%.

4.4. Other Empirical Studies

There have been several other attempts to determine land shares in total nonfinancial assets, land rent shares in GDP, and the tax revenue potential of land taxes, without the benefit of the higher-quality data now available from the OECD. For the UK, Banks (1989a) estimates land rents as a share of national income in the mid to late 1980s at between 20% and 30%, in other words at least half of the share of combined capital and land in the national accounts.

For Australia, Dwyer (2003) finds that, as of 1999, land-based tax revenues would have been sufficient to permit the total abolition of company and personal income taxes. He argues that this

[37] For 2006 Davis and Heathcote (2007) obtain a 46% estimate for the share of land in US residential home values. This is virtually identical to the OECD estimate shown in Figure 5. Note however that all US data rely on variants of the land residual method, which is likely to seriously underestimate land shares. See Section 4.6 for details.

[38] Denmark is one of the few countries that has a pure (municipal) land tax. The recent average rate was 2.7%, and the tax accounts for just under 3% of total annual tax proceeds in Denmark.

would be advisable on grounds of international tax competition. Kavanagh (2007) updates Dwyer's estimates, and finds that by 2005 land rents accounted for 32% of Australian GDP, enough to replace all other taxes at all three levels of Australian government. Putland (2013) also updates Dwyer's (2003) estimates, and comes to the same conclusion. Putland (2018) finds that land rentals plus smoothed capital gains equal 20% of 2017 Australian GDP. Prosper Australia (2013) show that in 2012 economic rents accounted for 23.6% of Australian GDP, and that taxes on rents and sin taxes would be almost sufficient to abolish all other types of taxes. They propose taxes on land rents (54% of tax revenue), natural monopolies (25%), resource rents (11%), and sin taxes (8%).

For the US, early studies for the 1950s and 1960s show that even during that period the US land share fluctuated between 40% and 50% (Netzer (1966), Manvel (1968)), and this continued to hold for the 1990s (Rybeck (2000)). Gaffney (1970a) finds that the site value is generally at least half of real estate value, while Cord (1985) and Miles (1990) put land rent at around 20% of GDP, again around half of the share of combined capital and land in the national accounts. Davis and Palumbo (2008) estimate the land share in large US cities in 2004 as 50%. Kuminoff and Pope (2011) estimate the land share in large U.S. cities over the period 1998 to 2008 using a hedonic estimator, and find it to be greater than 60% on average. Larson (2015) estimates the value of land in the US using a micro-level hedonic approach, and values total US land at $23 trillion at current 2009 prices, which is not far from our own estimate below. Davis et al. (2017) estimate land shares in the DC Metro area from 2000 to 2013 by applying the land-residual method to a property-level dataset. They find land shares between 30% and 70% depending on the zip code, with an average around 50%, and with a large peak prior to the 2008 crisis.

4.5. Data Problem 1: Incomplete Coverage of the Tax Base

Gaffney (2009) is a seminal contribution to the literature on land taxation. He provides a long list of reasons why commonly used US data sources are downwardly biased in estimating rental values and asset values of land, and cites studies that attempt to quantify the significance of individual missing items. While not all of his critiques apply to all countries equally, many of them apply to various countries. Of course we are at present unable to quantify the overall effect, except to say that it is highly likely that the tax base of taxes on land, and even more so of taxes on all unearned incomes, is grossly underestimated.

For market values, the main issues (out of 31 in total) listed by Gaffney (2009) are: (1) Failure to apply the building-residual method instead of the land-residual method (see the next subsection). (2) Assessment on the assumption that current (often suboptimal) uses will be permanent. (3) Lag of assessments behind rising land and falling building values. (4) Use of the capitalized income method for assessing business properties, despite them not being in their optimal or any use (e.g. vacant lots and downtown parking lots).

For rental values, the main issues are: (1) Excessive depreciation, including multiple re-depreciations after sales to new owners (see Gaffney (1970b), O'Connell (1985)). (2) Classifying the resulting excess of sales prices over remaining undepreciated values as (low-tax) capital gains rather than hidden rents.[39] (3) Depreciation of land (which does not depreciate) as well as buildings because of arbitrariness in the allocation of land and building values. (4) Omission of imputed rents on owner-occupied residential land. (5) Misposting of all internalized rents on owner-occupied commercial

[39] On the relationship between rents and capital gains see Hudson and Feder (1997a,b).

land as profits rather than rents. (6) Underreporting of capital gains. (7) Reporting of mortgage interest as interest rather than rent. (8) Reporting of all corporate profits as returns to capital rather than rent.

Data for rent shares from the US BEA, European and other national income statistics, and World Bank statistics, do not perform any of the calculations that are needed for a proper accounting of land and natural resource shares, and can thus lead to highly misleading conclusions, a point also emphasized by Assa (2016). Nevertheless, mainstream economics textbooks have been relying on these official data sources. For example, Krugman and Wells (2006) quote official BEA figures whereby rents in 2004 only account for 1% of US national income.

4.6. Data Problem 2: Inadequacy of the Land Residual Method

4.6.1. The US Data

The US Flow of Funds, Federal Reserve Statistical Release Z.1, Table B.101, reports households' and nonprofit organizations' overall value of real estate and, as a memo item, the replacement cost value of structures, which are indexed to a construction cost index. The only way to determine land values from this is to use the land-residual method, by deducting the memo item from the overall value of real estate. Hudson (2001, 2010, 2012) argues that this method fails on several counts, and as a result gives rise to a serious downward bias in estimated land values.[40] First, it cannot generate *spatially* uniform and homogenous valuations of either land or buildings - for example, in reality land prices rise and fall equally for parking lots and skyscrapers in the same neighborhood. Second, its explanation of real estate prices *over time* is asymmetric, such that building prices seem to be mainly responsible for booms, while land prices seem to be mainly responsible for declines, to the point where land values can drop below zero. Third, and most importantly, it misattributes the *source* of changes in real estate values. Such changes are mainly driven by demand for site values ("location, location, location") that are in turn bolstered by surrounding public and private infrastructure investment and by the availability of mortgage credit. They are not mainly driven by construction costs ("replacement cost, replacement cost, replacement cost" is not a slogan known in this industry). In practical terms, the question is whether real estate investors bid up the price of properties mainly because the structures have been built in the past at lower cost than what it would take to duplicate them today, or because of an increase in their site value due to improved amenities or easier credit, often accompanied by an intention to tear down the old buildings and build new ones.

The picture is even worse when trying to use US data to determine land rental values. The BEA National Income and Product Accounts (NIPA) merely report the income that individuals whose major business is not real estate declare on their tax returns as being paid by tenants, after subtracting depreciation and interest. Commercial real estate investors are defined as earning profits, not rents, again after subtracting depreciation and interest. See the discussion by Gaffney (2009) above.

Hudson (2001, 2010, 2012) argues that the US real estate industry advocates the land-residual method because higher estimates for building relative to land values serve its financial interests.

[40] However, note that Hudson (2021) finds that, even using these downwardly biased data, growth in US land values has far outstripped growth in US GDP in recent decades.

First, higher building values give more leeway to depreciate buildings, which reduces income tax liabilities. This is not only because buildings can be depreciated very fast, but also because upon each sale the building can be re-valued by its new owner at its acquisition price, and then depreciated again. Second, higher building values also maximize the scope for attributing gains due to price appreciation to cost price inflation rather than to land price appreciation, thereby providing a rationale for taxing such gains at a lower rate than the returns to labor and capital. The US commercial real estate sector therefore benefits from both large site value gains that are subject to low tax rates, and from large depreciation allowances that have permitted the almost complete elimination of income taxes (Hudson (2012)).

4.6.2. The Problem

Hudson (2001, 2010, 2012) explains the difference between the alternative land-residual and building-residual methods of land valuation. Both start out by estimating the overall property's market value. The land-residual method then subtracts the value of buildings (measured by way of construction costs) to obtain the value of land as a residual, while the building-residual method subtracts the value of land in its highest and best use to obtain the value of buildings as a residual.

The main problem with the land-residual method is that it attributes a value to structures fixed to a particular location according to their construction costs. The reason for doing so is that their value is not observable in a marketplace since, by its nature, the structure cannot be removed and traded. However, this attribution misses the crucial distinction between cost of production and value in use. Although profit motives will generally drive these two to be equal to each other for new structures, sub-optimal development decisions or unforeseen changing circumstances over the long life of a structure give rise to locational obsolescence, whereby the growing value of the underlying site for recycling has cannibalized part of, or more than part of, the residual building value. As a result, cost of production exceeds value in use, often by a large margin, leaving little land value when land value is defined as the residual, even though a physically excellent building on such a site can be economically obsolete and therefore worthless.[41] A particularly salient example is the widespread conversion of US cities' centrally located commercial structures to residential structures in recent decades. This dynamic implies economic depreciation of structures that has little to do with their physical wear and tear, and that increases with increases in land values. Crucially, BEA data do not account for this added economic depreciation, even though in percentage terms it has a far greater effect on the relative values of land and buildings than wear and tear (Gloudemans (2002)).[42]

The key observation is therefore that structures cannot be attributed any value independently of their location, so that to decompose the value of a land-structure combination meaningfully, the land value must be estimated first, with the value of structures *in that location* being given as a residual. Another way of arguing this point is to note that to ask what a site would sell for if bare, and to define site value accordingly, is not a hypothetical question, since that state can be achieved. In contrast, a definition of the value of fixed structures based on what they would fetch if they were *not* fixed, a quantity which in practice is approximated by construction costs, is one

[41] In fact, when land values are known to be rising over time, efficient construction of long-lived structures requires buildings that are initially overbuilt, initially yielding sub-normal returns and an excess of cost of production over value in use. As land values rise, the same buildings become underbuilt and lose value from year to year.

[42] It is, of course, not easy to estimate by assessors, see Eckert (1990).

based on an entirely hypothetical question. The land-residual method thereby moves away from the notion of market value, because the services provided by structures may or may not be related to the cost of constructing a substitute structure. The only sensible definition of the value of a structure, therefore, is that of its value in its current location - that is, what the structure adds to an independently-determined value of the land it occupies.

As early as 1920, Alfred Marshall (1920) put this as follows: "*... the aggregate site value of any piece of building land is that which it would have if cleared of buildings and sold in a free market. The 'annual site value' ... is the income which that piece would yield at the current rate of interest.*" According to Richards (1989), the land-residual method "*... assumes that all properties are developed to their full potential. Any property which is not must yield an annual rent which depresses ... its residual land value. But, as asset strippers know, land value cannot be depressed in this way. Its open market value depends on the best alternative permitted use of the land ... One would therefore expect aggregate land value to be considerably under-estimated.*" Tideman and Plassmann (2018) attempt to quantify locational obsolescence. They find that increases in land value generally lower the value of existing buildings by amounts roughly proportional to the square of the difference in size between the existing building and a new building of optimal size. In a world of growing values of real estate, the land residual method therefore systematically, and increasingly as time goes by, undervalues land and overvalues buildings.

In other words, the building-residual method is conceptually sound, and correctly estimates the asset value of land, while the land-residual method is not sound, and tends to underestimate the asset value of land by a large margin. Because a LAVT should be levied on the asset value of land, it should therefore not be based on the land-residual method. Vickrey (1999) and Helm (2012) emphasize that a LAVT is a lump-sum tax *only if* it is levied on the asset value of land, because in that case the tax is independent of the actual use of the land. By contrast, as argued by Tideman (1999), a tax on the present value of planned net income (PVPNI) uses as its tax base the discounted rental income from the particular, and possibly suboptimal, development project chosen. In practice, this would involve a land value assessor estimating the value of *developed* land according not to what it would fetch if it were free of buildings, but according to the net present value of the future returns from the particular development project in place, and assigning a land value after attributing a portion of these returns to the buildings in line with their construction costs. It would also, counter-intuitively, require land assessors to assess the value of *undeveloped* land not according to its market value, but with regard to the particular plans of the owner for its later development. Given the durability of buildings and locational obsolescence, the value of a site developed in a sub-optimal way is highly likely to be underestimated. In practice this incorrect method of determining the tax base amounts precisely to the land-residual method, and it makes a tax levied on such land value estimates what Tideman (1999) calls a PVPNI tax. Such a tax is clearly not lump-sum and therefore not allocatively neutral.

Helm (2012) provides an illustrative example: Consider a property which, if the site was in optimal (highest rent) use with a particular building costing $100,000, would be valued at $200,000 - that is, it would generate discounted returns to the property owner of this amount. If the land were (hypothetically) sold bare it would tend to trade at a price of $100,000, which represents the highest discounted rent achievable from this land. Suppose now that the land is currently sup-optimally developed, with a different building also costing $100,000. Suppose also that because the land is not in its highest-rent use, it generates discounted returns of only $150,000, meaning the developed property trades for this amount. Using the land-residual method, the value of the land in sub-optimal use is underestimated at $50,000, rather than the $100,000 which is the market value of

the undeveloped land. This also implies that a land tax based on this value assessment would tax owners of sub-optimally used land a smaller proportion of the true land value than owners of optimally used land.

Hudson (2001, 2010, 2012) mentions two alternative building valuation methods that attenuate the weaknesses of the land-residual method without replacing it with the building-residual method. The first is to use the depreciated value of buildings, which produces a lower building estimate and therefore a higher land estimate. The second is to use the intermediate measure of historical cost, based on the approximation that depreciation and obsolescence offset rising replacement costs of buildings. However, none of these estimates are market prices, so that subtracting any of them from the overall property's market price produces a residual called "land" that is hybrid in nature. By contrast, the building-residual method starts by estimating the asset value of land directly.

4.6.3. The Solution

A sizeable literature has found that, in spite of the difficulty of disentangling the value of land from the value of buildings, it is possible to determine land values with satisfactory accuracy, see Gloudemans (2000), Bell et al. (2009), Henry et al. (2009) and Institute for Fiscal Studies and Mirrlees (2011). As documented in Brunori and Carr (2002), mechanisms for the separate valuation of land and improvements are mostly already in place in the US. They find that 29 states legally require that land and improvements be valued separately, and that 220 out of 226 local taxing authorities (including in states that were not legally required to perform separate valuations) valued land and improvements separately. There are around 20,000 U.S. licensed local assessors that perform separate valuations for land and improvements, and the principle of valuing land according to its highest and best use is well understood by them (Bourassa (2009)). The valuation techniques are very well established, and have long been summarized in manuals for land appraisers. The most modern techniques combine attributes of the building-residual and hedonic approaches. Gwartney (1999) and Bell et al. (2009) present comprehensive summaries, and references to the relevant manuals. Minimum assessment standards are presented in International Association of Assessing Officers (1997). Early studies include Ward et al. (1999, 2002), who focus on improving location variables for computer assisted mass appraisal (CAMA) regression methods, which measure the contribution of each different attribute to total value. Essential tools in this technique are sales comparison data (sales prices of actual nearby bare land, and sales prices of property where the buildings are subsequently demolished) augmented where necessary by sales proxies produced by experienced appraisers, together with geographic information systems (GIS), which is computer software to manipulate spatial information, and global response surface analysis (GRSA), a mathematical technique that uses GIS to measure the distance to multiple sold properties. Ward et al. (2002) suggest using the building residual method, which can be further refined by using residual building values as the dependent variable in an econometric model. Bell et al. (2009) advocate what they call the contribution value method, which uses a statistical model that explains the sales prices of individual properties as a function of the attributes of land, most importantly the different aspects of location, and improvements. Kuminoff and Pope (2011) and Larson (2015) use hedonic methods. The last decade has seen the rapid development of mass valuation techniques (McCluskey et al. (2013), Almy (2014)), and also of comprehensive international support for land administration (Enemark et al. (2014)). Previous arguments against land value taxation based on administrative costs (Skinner (1991)) therefore appear outdated - see also Section 5.4. The end product of such work for a geographical area is a smooth land value

map that can be used to value any site within the boundary of that area. In an ideal outcome, a land-price and rental-value map smoothly rises toward transportation centers and then falls away, but is higher around parks and museums. There is an active literature on land value maps - recent examples include Kolbe et al. (2015) and Cellmer et al. (2018).

While a combination of the building-residual and hedonic methods offers the best available approach, even this tends to underestimate the potential tax base of land taxes. The reason is the very slow turnover in property markets, of 5% or less, compared to goods markets where turnover is 100% or more. This means that 95% or more of landowners in effect sell or rent to themselves, while assessors need to rely on the small active market to estimate the value of the whole. The problem is that this active market records the willingness to pay (WTP) of buyers faced with sellers that for various reasons are unable to hold out, and that this WTP is generally far lower than the willingness to accept (WTA) among holdout landowners - see the literature review in Gaffney (2009). This has two implications. First, even a diligent assessment of land values based on recorded transactions is likely to significantly underestimate the value of land to the average owner. And second, raising land taxes will not suddenly flood the market with distress sellers.

5. Practice

5.1. Empirical Studies

Arnold (2008), Arnold et al. (2011), and OECD (2010) rank different forms of taxation by their harmful effects on growth, and find that corporate taxes are most harmful, followed by personal income taxes and consumption taxes, with recurrent taxes on immovable property being least harmful. In their empirical analysis, using a panel of 21 OECD countries over 34 years, they conclude that the most effective tax reform would shift taxation from taxes on personal and corporate income to taxes on consumption and immovable property, and that a shift equal to 1% of overall tax revenue would increase the long-run level of GDP by between 0.25% and 1%. This is broadly consistent with our model-based analysis. Empirical evidence that land taxes reduce house price volatility is provided by Blöchliger (2015), Muellbauer (2005), and Oxley and Haffner (2010). Empirical evidence from countries or regions where land value taxation is being used shows that it leads to more efficient land use and faster development - for Australia, see Lusht (1992), and for Pennsylvania municipalities, see Cohen and Coughlin (2005) and Tideman and Plassmann (2000). The latter find that, in municipalities where land was taxed at a higher rate than improvements, a difference of one percentage point in the tax rates on land and improvements led, on average, to a 16.8% annual increase in construction.

5.2. Country Experiences

A comprehensive, if now slightly dated, compilation of country experiences with land taxes is provided by Andelson (2000). He finds that the use of land taxes in place of distortionary taxes on improvements or on income has been associated with higher capital investment and more compact land development, that site value rating is not prohibitively difficult and has been operated successfully in many jurisdictions, and that land taxes and/or leases of public land facilitate low-rent public housing programs that have greatly improved the international competitiveness of economies.

Dye and England (2009), which is summarized in Dye and England (2010), also lay out country experiences and potential problems of land taxation. They conclude that land taxes, while they have to be very carefully designed, are a realistic policy option.

Major policy institutions have also produced surveys of country experiences with wealth, property, or land taxes. They include IMF (2010, 2013), Norregaard (2013), another IMF study, and Blöchliger (2015), an OECD study. All are supportive of an increase in property taxation as the tax best placed to boost growth in the post-GFC period. Norregaard (2013) presents a categorization of four different property valuation systems that are used to determine tax bases around the world. Land value systems correspond to our LAVT. They define the tax base as the open market value of land alone, and are used in Australia, South Africa, Denmark, and New Zealand, among others. Rental value systems define the tax base as the rent that can reasonably be expected in fair market transaction, and are used by a number of former British colonies. Because the rent is paid on combined land and structures, this does not correspond to our LRVT, which applies to the rental value of land alone. Capital value systems define the tax base as the market value of the combined land and structures, and are used in most OECD and Latin American countries. Area-based systems tax each parcel of land and structures at a specific rate per area unit, and are used in many African, Asian and transition countries. Their advantage is easy administration, and also efficiency if taxes are independent of actual use and therefore lump-sum, and low enough so that no land goes out of use. However, area-based systems are not considered fair, and they tend to leave much potential revenue uncollected. Norregaard (2013) emphasizes that land taxes can contribute to more efficient land allocation and more generally resource allocation. This includes preventing over-investment in housing and land speculation and under-investment in industry and agriculture. His real-world examples include the 0.75% agricultural land tax in Namibia to encourage more efficient use of scarce agricultural land, and the Chinese and Singaporean property taxes to curb excessive property speculation.

In the UK, the recently formed All-Party Parliamentary Group on Land Value Capture (2018) advocates taxing land because this will enable housing development, allow the recovery of the cost of public works, stabilize house prices and thereby the business cycle, incentivize downsizing for (mostly older) property owners, and reduce income and wealth inequalities. It proposes four pillars of a good reform, first that all UK land should be subject to the tax, second that structures/equipment and domestic dwellings should be exempt, third that the tax should fall on the owner rather than the occupier, and fourth that the basis of the valuation should be the optimum permitted use. Their study frequently refers to the Mirrlees Review (Institute for Fiscal Studies and Mirrlees (2011)), which argues that the taxation of land is the most economically efficient form of taxation, the least open to evasion and avoidance, and the most relevant to contemporary needs. It concludes as follows: "This is such a powerful idea, and one that has been so comprehensively ignored by governments, that the case for a thorough official effort to design a workable system seems to us to be overwhelming." Ryan-Collins et al. (2017) argue that public policy needs to urgently address the problems associated with land, including a housing affordability crisis, rising household debt, financial instability, and growing inequality. Finally, Financial Times (2021), in an editorial board commentary on the housing crisis, advocates a tax proportional to land value, regularly updated valuations, and the capitalization of the tax for elderly residents, with the balance paid out of the estate.

5.3. Obstacles and Solutions

Slack and Bird (2014) (see also Brys (2011)) discuss typical practical obstacles to a successful property tax reform, and ways to overcome them. The overarching issue is that bridging the gap between economic efficiency and political acceptability requires extensive public consultation, education, and communication. This should include short, accessible and realistic examples of the effects of the reform on different types of taxpayers, which for the vast majority will show that the gains from lower taxes elsewhere will far outweigh the losses from higher land taxes. Below we discuss a short list of specific obstacles, and how the literature has proposed to deal with them.

Salience of the Tax: A property or land tax is highly salient, because it is typically not withheld at source and in small amounts. However, this can be remedied. For example, Ireland allowed taxpayers the option of having the tax withheld in small installments from employment or pension income. The salience of the tax is also less problematic if there is equal salience of the associated benefits, which suggests bundling of increases in property taxes with either improvements in service delivery or, as in this paper, decreases in other taxes. The latter would make it clear that while the reform would involve a loss of land wealth, it would also involve a gain of other kinds of wealth.

Cash-Flow Problems for Some Taxpayers: In our simulated policy experiments we find that a LAVT has overwhelmingly positive effects for households whose main income comes from supplying labor or capital. The only group that suffers losses, despite the very large increase in overall wealth, is households whose actual and imputed income comes overwhelmingly from land. Lewis (1980), Geisler (1993, 1995), and Bucks et al. (2006) give some idea as to how large this group is in the US. First, the top 5% of US landowners own 75% of privately owned land, while the bottom 78% of landowners own only about 3%. Second, for the top 10% of the wealth distribution, real property holdings account for only about 15% to 20% (and landholdings therefore for less than 10%) of their wealth, while real estate is typically the largest component of wealth for the bottom 90% of the wealth distribution. Therefore, while the very wealthy would pay the vast majority of land taxes, they are mostly well diversified, so that gains from labor and capital earnings would in most cases offset their losses from land taxes. The main concern would therefore be a group that accounts for only a small share of total landholdings, landowners in the bottom wealth brackets who are not diversified (the famous cash-poor widow), where land taxes represent a taxation of unrealized gains due to price appreciation that is not accompanied by a comparable growth in income. The literature has discussed a number of policies to deal with such cases. Tax deferral schemes are not popular because they leave property encumbered for the occupants' heirs (Bird and Slack (1978)). Tax reductions or waivers for liabilities that exceed some specified percentage of income are suggested by Johannesson-Linden and Gayer (2012).[43] Universal homestead exemptions grant every family or every person an exemption from the property tax or the land tax of some specified value.[44] Finally, phase-in is almost invariably politically necessary to cushion the impact of the reform on some groups of taxpayers (Blöchliger and Vammalle (2012)). For any of these measures, because the affected landholdings would be so small, the fiscal cost would be very limited.[45]

[43] To avoid properties being shifted into the name of the retired old for tax avoidance, such waivers/reductions should not be available to households that did not own the property for some specified number of years.

[44] This is, in effect, a basic income guarantee for families that own property. Making a homestead exemption refundable for families that do not own property would turn it into a true basic income guarantee.

[45] However, also recall the arguments in Section 2.1 as to why exemptions and compensation should be strictly limited.

Lack of Tax Elasticity with Respect to Income: Property or land taxes are in practice often inelastic with respect to income, which can present difficulties for tax collectors during economic booms, and difficulties for taxpayers during economic recessions. The most efficient way to address this is annual updates of assessed property values. These are costly relative to revenue raised when property taxes only account for a small share of tax revenue, but would be much less so if they were to become the principal or at least a major source of tax revenue (see Section 5.4).

Volatility of the Tax: Property taxes can be volatile for individual tax payers, especially during periods of rapidly rising house prices. One remedy is again annual updates of assessed property values, because this smooths out the increases. But in addition, a much higher average level of land tax rates, accompanied by lower taxes elsewhere, would reduce not only the level but also the absolute volatility of property values.

Presumptive Nature of the Tax: A property or land tax is inherently a presumptive tax, and thus always arguable. This again emphasizes the need for a substantial investment in a fair system of public assessments.

Legal Problems: Coe (2009) studies the legal and constitutional framework as it concerns land value taxation in the US. He concludes that in most jurisdictions constitutional barriers to the enactment of LAVT appear to be substantial, due to potential violations of constitutional uniformity, equality and proportionality provisions. The solution in all these cases would be a state constitutional amendment granting the legislature the power to enact a land tax.

5.4. Would Land Taxation Be Too Costly to Administer?

It is sometimes argued that a system that is heavily based on land taxation would be prohibitively costly. It is true that a fair and efficient system of land value taxation would require a considerable investment. However, to complete this argument one needs to consider not only the cost but also the opportunity cost.

5.4.1. Opportunity Cost: How Costly Is Our Current System?

The current tax system is highly complex and subject to high costs of its own (Foldvary (2005)). Fortunately, several studies are available that allow us to quantify that cost. Government Accountability Office (2005) estimates the US tax compliance burden for personal and corporate income taxes alone, and finds it to equal around 1% of GDP. This study also notes that other studies estimate costs closer to 1.5% of GDP. A report by Tax Foundation (2005) estimates that compliance costs are closer to 2.5% of GDP, and that this excludes the costs of tax planning and tax litigation. These are very large numbers, and therefore potentially allow very large savings when existing taxes are replaced by land taxes.

5.4.2. Cost: How Costly Would Land Taxation Be?

The main cost of developing a system of land taxation is the need for an adequate appraisal system. For example, the UK Wealth Tax Commission (Advani et al. (2020)) recommends significantly increased investment of resources to obtain better wealth data by ONS and HMRC. For a land tax

there would be the added requirement that the appraisal system must separately determine a site's land and structures values. However, in the US this is something that professional real estate developers do routinely - see the discussion in Section 4.6.3 and in Foldvary (2005). This is because it is generally required by tax authorities, among other reasons to calculate depreciation allowances, by insurers, because improvements can be damaged while land (mostly) cannot, and by banks, for mortgages. The incremental or marginal costs are therefore low, at least for the United States. Elsewhere, Institute for Fiscal Studies and Mirrlees (2011), Boadway et al. (2010) and Dye and England (2009) argue that while an efficient system of land valuation would require additional resources, the difficulties would not be insurmountable, pointing to the experience of several countries that are operating such a system. Finally, International Property Tax Institute (2007) finds that, for existing property (not land) tax systems in industrialized countries, administrative costs are on average 1.35% of taxes collected. This is somewhat higher than for most major taxes, but this is not surprising, given economies of scale in collection and the generally very modest revenue collected by such taxes. Namely, as documented by Lunde and Whitehead (2021), property taxes in OECD countries in 2018-2019 on average equalled only 1.9% of GDP and 5.6% of total tax revenue. A switch to a much heavier reliance on land taxes can therefore be expected to significantly reduce the ratio of administrative costs to tax collection.

6. Model

The model economy consists of either a single representative household or representative workers, capitalists and landlords, together with a representative firm and a government. One period represents one year. The economy grows at the exogenous and constant gross rate of technological progress $x = T_t/T_{t-1}$, where T_t is the level of technology. We normalize all growing variables by technology, with an inverse hat above a variable indicating the normalized variable. The price of output is the numeraire.

6.1. Single Representative Household

Households consume c_t, supply labor ℓ_t to firms, and hold physical capital k_t and land a_t. Their income consists of after-tax wages, the after-tax returns to physical capital and land, and net lump-sum transfers Υ_t. The wage rate is denoted by w_t, the rentals of capital and land by r_t^k and r_t^a, and the relative price of land by p_t. Households are subject to six different taxes that we will match to US data. The tax rates on the values of capital and land are $\tau_{p,t}^k$ and $\tau_{p,t}^a$, the marginal tax rates on labor and on the rentals of capital and land are $\tau_{\ell,t}$, $\tau_{k,t}$ and $\tau_{a,t}$, and the marginal tax rate on consumption is $\tau_{c,t}$.

The marginal tax rates on labor and on the rentals of capital and land are allowed to exceed the respective average tax rates. To implement this, we assume that the marginal tax rate is only levied on the portion of income that exceeds the calibrated thresholds $\tilde{\ell}_t$, $\tilde{k}_t$ and $\tilde{a}_t$, which are taken as given by households. It is assumed that fiscal policy is designed such that these thresholds automatically change in proportion to the respective tax base, such that the ratio of marginal to average tax rates stays constant at all times. The marginal tax rate on labor is levied on $w_t\ell_t - \tilde{\ell}_t$, and the threshold is $\tilde{\ell}_t = \psi_\ell w_t \ell_t$. Similarly, the marginal tax rate on capital is levied on $\left(r_t^k - \delta - \tau_{x,t} - \tau_{p,t}^k\right) k_{t-1} - \tilde{k}_t$, where δ, $\tau_{x,t}$, and $\tau_{p,t}^k$ are allowances deducted from the rental

of capital in accordance with the tax code, with δ the rate of physical depreciation, $\tau_{x,t}$ the rate of excess depreciation allowance, and $\tau^k_{p,t}$ the tax rate on the value of capital. In this case, the threshold is given by $\tilde{k}_t = \psi_k \left(r^k_t - \delta - \tau_{x,t} - \tau^k_{p,t}\right) k_{t-1}$. Finally, the marginal tax rate on land is levied on $\left(r^a_t - p_t \tau^a_{p,t}\right) a_{t-1} - \tilde{a}_t$, with no allowances for depreciation but an allowance for the tax rate on the value of land $\tau^a_{p,t}$. In this case, the threshold is given by $\tilde{a}_t = \psi_a \left(r^a_t - p_t \tau^a_{p,t}\right) a_{t-1}$.

Households maximize lifetime utility subject to a sequence of budget constraints. The utility function takes the Greenwood et al. (1988) form, which are commonly referred to as GHH preferences. These preferences have been used extensively in the business cycle literature to match a series of empirical regularities (see e.g. Raffo (2008) and Schmitt-Grohe and Uribe (2008)). See Diamond (1998) for an early example of the use of GHH preferences in literature on optimal taxation. We have the following lifetime utility maximization problem:

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{u_t^{1-1/\sigma}}{(1-1/\sigma)} \quad , \quad u_t = c_t - \kappa T_t \frac{\ell_t^{1+\frac{1}{\theta}}}{1+\frac{1}{\theta}} \ , \tag{4}$$

with $\check{u}_t = \check{c}_t - \kappa \ell_t^{1+\frac{1}{\theta}} / \left(1+\frac{1}{\theta}\right)$. This utility function features an intertemporal elasticity of substitution in consumption of $\sigma u_t / c_t$ and a labor supply elasticity of θ. The representative household's time t budget constraint is

$$\begin{aligned} k_t + p_t a_t \quad = \quad & k_{t-1}\left(1-\delta-\tau^k_{p,t}\right) + r^k_t k_{t-1} - \tau_{k,t}\left(r^k_t - \delta - \tau_{x,t} - \tau^k_{p,t}\right)\left(k_{t-1} - \tilde{k}_t\right) \\ & + p_t a_{t-1}\left(1-\tau^a_{p,t}\right) + r^a_t a_{t-1} - \tau_{a,t}\left(r^a_t - p_t\tau^a_{p,t}\right)\left(a_{t-1} - \tilde{a}_t\right) \\ & + w_t \ell_t \quad - \tau_{\ell,t} w_t \left(\ell_t - \tilde{\ell}_t\right) \\ & + \Upsilon_t - c_t\left(1+\tau_{c,t}\right) \ , \end{aligned}$$

and capital accumulation is given by

$$k_t = (1-\delta)\, k_{t-1} + I_t \ , \tag{5}$$

where I_t is physical investment, and where $\check{k}_t = (1-\delta)\left(\check{k}_{t-1}/x\right) + \check{I}_t$. We denote the multiplier of the household budget constraint by λ_t. Then the first-order condition for consumption is given by

$$\left(\check{u}_t\right)^{-\frac{1}{\sigma}} = \check{\lambda}_t \left(1+\tau_{c,t}\right) \ , \tag{6}$$

where $\check{\lambda}_t = \lambda_t T_t^{\frac{1}{\sigma}}$. The first-order condition for labor supply is

$$\left(\check{u}_t\right)^{-\frac{1}{\sigma}} \kappa \ell_t^{\frac{1}{\theta}} = \check{\lambda}_t \check{w}_t \left(1-\tau_{L,t}\right) \ .$$

The previous two equations can be combined to obtain an expression for the marginal rate of substitution between consumption and labor:

$$\kappa \ell_t^{\frac{1}{\theta}} = \check{w}_t \frac{1-\tau_{L,t}}{1+\tau_{c,t}} \ . \tag{7}$$

The first-order condition for land is given by

$$1 = \beta x^{\left(1-\frac{1}{\sigma}\right)} \frac{\check{\lambda}_{t+1}}{\check{\lambda}_t} \frac{\check{p}_{t+1} + \check{r}^a_{t+1} - \tau^a_{p,t+1}\check{p}_{t+1} - \tau_{a,t+1}\left(\check{r}^a_{t+1} - \check{p}_{t+1}\tau^a_{p,t+1}\right)}{\check{p}_t} \ , \tag{8}$$

while the first-order condition for physical capital is

$$1 = \beta x^{\left(-\frac{1}{\sigma}\right)} \frac{\check{\lambda}_{t+1}}{\check{\lambda}_t} \left(1 - \delta + r^k_{t+1} - \tau^k_{p,t+1} - \tau_{k,t+1}\left(r^k_{t+1} - \delta - \tau_{x,t+1} - \tau^k_{p,t+1}\right)\right) \ . \tag{9}$$

6.2. Heterogeneous Households: Workers, Capitalists, and Landlords

For this model variant, using the subscript $z \in \{a, k, \ell\}$ to denote quantities pertaining to landlords, capitalists and workers, we have lifetime utility maximization problems

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_z^t \frac{u_{z,t}^{1-1/\sigma_z}}{(1-1/\sigma_z)} \quad , \quad u_{z,t} = c_{z,t} - \kappa_z T_t \frac{\ell_{z,t}^{1+\frac{1}{\theta}}}{1+\frac{1}{\theta}} \, . \tag{10}$$

Workers do not hold either capital or land and only supply labor, capitalists hold all of the economy's capital and supply labor, and landlords hold all of the economy's land and supply labor. Each group receives equal hourly wage rates, and equal per capita lump-sum distributions from the government. The optimality conditions for consumption and labor are identical across the three groups:

$$(\check{u}_{z,t})^{-\frac{1}{\sigma_z}} = \check{\lambda}_{z,t} \left(1 + \tau_{c,t}\right) \, , \tag{11}$$

$$(\check{u}_{z,t})^{-\frac{1}{\sigma_z}} \kappa_z \ell_{z,t}^{\frac{1}{\theta}} = \check{\lambda}_{z,t} \check{w}_t \left(1 - \tau_{L,t}\right) \, , \tag{12}$$

$$\kappa_z \ell_{z,t}^{\frac{1}{\theta}} = \check{w}_t \frac{1 - \tau_{L,t}}{1 + \tau_{c,t}} \, . \tag{13}$$

Note that we allow for different σ_z, to allow us to calibrate identical steady state intertemporal elasticities of substitution despite differences in steady state consumption and labor, and different κ_z, to allow us to independently calibrate each group's steady state labor supply. The first-order condition for land, which only applies to landlords, is given by

$$1 = \beta_a x^{\left(1-\frac{1}{\sigma_a}\right)} \frac{\check{\lambda}_{a,t+1}}{\check{\lambda}_{a,t}} \frac{\check{p}_{t+1} + \check{r}_{t+1}^a - \tau_{p,t+1}^a \check{p}_{t+1} - \tau_{a,t+1}\left(\check{r}_{t+1}^a - \check{p}_{t+1}\tau_{p,t+1}^a\right)}{\check{p}_t} \, , \tag{14}$$

while the first-order condition for physical capital, which only applies to capitalists, is

$$1 = \beta_k x^{\left(-\frac{1}{\sigma_k}\right)} \frac{\check{\lambda}_{k,t+1}}{\check{\lambda}_{k,t}} \left(1 - \delta + r_{t+1}^k - \tau_{p,t+1}^k - \tau_{k,t+1}\left(r_{t+1}^k - \delta - \tau_{x,t+1} - \tau_{p,t+1}^k\right)\right) \, . \tag{15}$$

For firms and government, the model remains unchanged.

6.3. Firms

Firms choose optimal inputs for a nested CES production function in hours h_t, capital K_t and land A_t. There is both labor-augmenting and land-augmenting, or land-saving,[46] technological progress. We will assume that both types of technology grow at the same rate x. This ensures the existence of a balanced growth path for this economy, and it ensures that a large part of the return to land consists of gains due to price appreciation that are driven by land-saving technological progress.

There is an important connection between the optimizing behavior of firms and households and the ideal that land taxes should be based on the highest and best use of the land. In the model, a tax on land falls on the actual rental or the actual market price. However, with optimizing firms and

[46] Investigations of land-saving technological progress are common in the economic history and agricultural economics literatures (see Gurgel et al. (2011), Bustos et al. (2016), Wilde (2013)). For another example, see Stiglitz (2015b,c).

households, the actual rental (or market price) equals the rental value (or asset value), meaning rental values (or asset values) in land's highest and best use. Under a system of land taxation firms would still be taxed according to rental value if they behaved sub-optimally, but in the model they have no incentive to do so.

The capital-labor aggregate m_t is given by the Cobb-Douglas form

$$m_t = (K_t)^{\alpha} (T_t h_t)^{1-\alpha} \ , \tag{16}$$

where $\check{m}_t = \left(\check{K}_t\right)^{\alpha} (h_t)^{1-\alpha}$. The aggregate production function for aggregate output y_t is

$$y_t = \left((\omega)^{\frac{1}{\xi}} (T_t A_t)^{\frac{\xi-1}{\xi}} + (1-\omega)^{\frac{1}{\xi}} (m_t)^{\frac{\xi-1}{\xi}} \right)^{\frac{\xi}{\xi-1}} \ , \tag{17}$$

where $\check{y}_t = \left((\omega)^{\frac{1}{\xi}} (A_t)^{\frac{\xi-1}{\xi}} + (1-\omega)^{\frac{1}{\xi}} (\check{m}_t)^{\frac{\xi-1}{\xi}} \right)^{\frac{\xi}{\xi-1}}$. The optimization problem of firms is to maximize the difference between the real value of output y_t and the real value of input costs $w_t h_t + r_t^k K_t + r_t^a A_t$. We obtain the following normalized optimality conditions for hours, capital and land:

$$\left(\frac{(1-\omega)\, \check{y}_t}{\check{m}_t} \right)^{\frac{1}{\xi}} \frac{(1-\alpha)\, \check{m}_t}{h_t} = \check{w}_t \ , \tag{18}$$

$$\left(\frac{(1-\omega)\, \check{y}_t}{\check{m}_t} \right)^{\frac{1}{\xi}} \frac{\alpha \check{m}_t}{\check{K}_t} = r_t^k \ , \tag{19}$$

$$\left(\frac{\omega \check{y}_t}{A_t} \right)^{\frac{1}{\xi}} = \check{r}_t^a \ . \tag{20}$$

6.4. Government

Government spending on physical goods and services g_t and government transfers Υ_t are exogenous and grow at the constant rate of technological progress. Government spending equals a fixed fraction of steady state output:

$$\check{g}_t = s_g \bar{y} \ . \tag{21}$$

Government tax revenue in normalized form is

$$\begin{aligned} \check{\tau}_t \ = \ & \tau_{k,t} (1-\psi_k) \left(r_t^k - \delta - \tau_{x,t} - \tau_{p,t}^k \right) \left(\check{k}_{t-1}/x \right) \\ & + \tau_{a,t} (1-\psi_a) \left(\check{r}_t^a - \check{p}_t \tau_{p,t}^a \right) a_{t-1} + \tau_{\ell,t} (1-\psi_\ell)\, \check{w}_t \ell_t \\ & + \tau_{c,t} \check{c}_t + \tau_{p,t}^k \left(\check{k}_{t-1}/x \right) + \tau_{p,t}^a \check{p}_t a_{t-1} \ . \end{aligned} \tag{22}$$

The government adjusts the different components of this tax revenue to ensure budget balance in each period. The government budget constraint in normalized form is therefore

$$\check{g}_t + \check{\Upsilon}_t = \check{\tau}_t \ . \tag{23}$$

In our simulations, the government carries out tax reform by exogenously varying either the tax rate on land rental income $\tau_{a,t}$ (LRVT) or the tax rate on land market value $\tau_{p,t}^a$ (LAVT). In our baseline we assume that the government maintains budget balance by adjusting the tax rate on the

capital rental $\tau_{k,t}$, with the tax rate on labor adjusting proportionally, with the parameters φ_ℓ as a policy choice:[47]

$$\frac{\tau_{\ell,t} - \bar{\tau}_\ell}{\bar{\tau}_\ell} = \varphi_\ell \frac{\tau_{k,t} - \bar{\tau}_k}{\bar{\tau}_k} \ . \tag{24}$$

6.5. Market Clearing

The market clearing conditions for labor/hours, capital (normalized) and land are

$$h_t = \ell_t \ ,$$

$$\check{K}_t = \check{k}_{t-1}/x \ ,$$

$$A_t = a_{t-1} = \bar{a} \ ,$$

where $\bar{a}$ is an exogenous constant because land is in fixed supply. The normalized market clearing condition for output is

$$\check{y}_t = \check{c}_t + \check{I}_t + \check{g}_t \ , \tag{25}$$

while GDP equals output plus consumption taxes:

$$\check{y}_t = \check{c}_t(1 + \tau_{c,t}) + \check{I}_t + \check{g}_t \ . \tag{26}$$

In our simulations we will show a Fisher-weighted index of GDP. This removes the effects of time variation in the consumption tax rate on real output.

For the model with heterogeneous households, we need to keep track of two of the three budget constraints of workers, capitalists and landlords, with the third redundant by Walras' Law. Furthermore, we need to add the following market clearing conditions:

$$\check{c}_t = \psi_a \check{c}_{a,t} + \psi_k \check{c}_{k,t} + (1 - \psi_a - \psi_k)\check{c}_{\ell,t} \ , \tag{27}$$

$$\ell_t = \psi_a \ell_{a,t} + \psi_k \ell_{k,t} + (1 - \psi_a - \psi_k)\ell_{\ell,t} \ , \tag{Mclrg-l}$$

$$\check{k}_t = \psi_k \check{k}_{k,t} \ , \tag{28}$$

$$a_t = \psi_a a_{a,t} \ . \tag{29}$$

6.6. Welfare

The welfare criterion is the compensating consumption variation (CCV) based on the lifetime utility either of the representative household or of workers, landlords and capitalists. In the latter case we use the population-weighted average CCV of the three groups. For the representative household case the lifetime utility generated by a tax reform implemented at time t is given by

$$\check{\mathcal{W}}_t = \check{u}_t^{\frac{\sigma-1}{\sigma}} / \frac{\sigma - 1}{\sigma} + \beta x^{\frac{\sigma-1}{\sigma}} \check{\mathcal{W}}_{t+1} \ , \tag{30}$$

and the CCV η is given by the percentage increase in initial steady state consumption that would make the household indifferent between that steady state and $\check{\mathcal{W}}_t$.

[47] In some simulations we assume the same type of rule for consumption taxes, with parameter φ_c.

7. Calibration

The calibration of the model is based on US data. The time unit is one year. The calibration of preferences and some aspects of technologies relies on the literature. The calibration of asset stock data is partly based on the FRED database of the Federal Reserve Bank of St. Louis, while the calibration of other asset stock data and of tax rates, the core of our exercise, is based on data from the Bureau of Economic Analysis (BEA). We have obtained annual FRED and BEA data for the years 2010-2018. We use the November 2020 vintages of these data. The calibration is, for internal consistency, based on a single year, 2015. However, in the appendix we present the entire time series for the key calibrated magnitudes over the period 2010-2018, to demonstrate that our choice of the year 2015 is representative of the entire decade. The main results will be derived using a model with a single representative household. However, one experiment studies the model with workers, capitalists and landlords. The calibration section is accordingly subdivided into the considerations applying to these two model variants. In both variants, the steady state real growth rate is calibrated at 2% per annum ($x = 1.02$), approximately equal to its average value for the US between 2010 and 2018. For cyclical government tax policy, the taxation rule proportionality factors φ_ℓ and φ_c are set to different values depending on the experiment.

7.1. Single Representative Household

For preferences, the parameter κ is adjusted to normalize steady state labor supply to 1. We calibrate the parameter σ to obtain a steady state intertemporal elasticity of substitution in consumption $\sigma\bar{u}/\bar{c}$ of 0.5, a common value in the business cycle literature. We set the labor supply elasticity θ to 0.75, which is between the value of 1 frequently used in the business cycle literature, and the value of 0.5 frequently arrived at in microeconomic studies (Reichling and Whalen (2012)). We will conduct sensitivity analysis with respect to σ and θ.

For technologies, the stock of land $\bar{a}$ is adjusted to normalize the steady state price of land to 1. The elasticity of substitution between physical capital and labor is discussed in the literature survey of Chirinko (2008). He reports a wide range of estimates, with the majority below 1 but several above 1. Based on this, Rognlie (2015) experiments with several values centered around 1. Because our focus is primarily on the role of land, we will maintain our calibration of this elasticity at 1 throughout. The elasticity of substitution between land and capital/labor ξ is also discussed in Rognlie (2015), who refers to the literature survey by Thorsnes (1997). Thorsnes (1997) reports that estimates, mostly in the urban economics literature, have generally been in the range between 0.5 and 1. However, similar to the more recent paper by Ahlfeldt and McMillen (2014), he argues that some of these estimates may be biased downwards due to measurement error, and that the true elasticity may not be much below 1. Rognlie (2015) therefore chooses a compromise value of $\xi = 0.8$. We adopt the same calibration, which also matches the value chosen by Tideman et al. (2002). We will conduct sensitivity analysis with respect to ξ.

Our model contains six marginal tax rates, one each on the incomes of labor, land and capital, one each on the values of land and capital, and one on consumption. The consumption tax and the taxes on the value of land and capital are proportional taxes, while the income taxes are progressive taxes. Therefore, we need to calibrate both the marginal and average tax rates on the incomes of labor, land and capital. This allows the exercise to be consistent with two sets of evidence. First, marginal tax rates affect the economic incentives to supply labor and capital and thereby output

and growth while average tax rates do not (Padovano and Galli (2002)). Second, average tax rates need to reflect the actually observed amounts of tax revenue, and average rather than marginal tax rates affect the scope for shifting the tax burden between different tax categories.

Tax Revenue Data: Data on the revenue from different taxes come from the National Income and Product Accounts, Tables 3.2 and 3.3. We use these tables to allocate tax revenue among our six taxes in accordance with Table 1. Not shown in Table 1 are excise taxes. They are allocated to non-taxes, which is appropriate if excise taxes reflect negative externalities that are internalized by the taxes. Also absent are taxes from the rest of the world, on the ground that they come from a base that is not part of the model, and Federal Reserve profits, based on the idea that these are essentially seigniorage profits, which are also not part of our model. The description of Social Insurance payments as partial labor income taxes is based on the fact that benefits rise with payments, but not in the amount of payments - more on this below.

Table 1. US Tax Revenue by Source in 2015 (in billion US dollars)

(Source: NIPA Tables 3.2 and 3.3)				
Source	**Federal**	**State& Local**	**Total**	**Allocation**
Individual Income Tax	1,532.6	374.5	1,907.1	Labor, Land & Capital Income
Sales Tax		374.2	374.2	Consumption
Property Tax		490.4	490.4	Land & Capital Value
Corporation Income Tax	329.1	56.2	385.3	Land & Capital Income
Customs Duty	38.1		38.1	Consumption
Social Insurance	1,190.8	19.2	1,210.0	Labor Income (partial tax)

National Income Data: The next step is to divide National Income into components that serve as tax bases. The components of 2015 US National Income are shown in Table 2.

Table 2. US National Income by Component in 2015 (in billion US dollars)

(Source: NIPA Table 1.12)		
Component	**Amount**	**Line in the Table**
National Income	15,784.6	1
Employees' Compensation	9,699.4	2
Proprietors' Income	1,423.0	9
Rental Income	649.0	12
Corporate Profits	2,060.5	13
Net Interest & Miscellaneous	585.8	18
Taxes on Production and Imports	1,275.2	19

Table 3 shows how to use these data to calibrate the model. The first step is to match the sum of the major components of national income and the capital consumption allowance, which equals \$18,604.3 billion, to GDP, which equals \$18,238.3 billion. The difference of -\$366.0 billion, which in the data consists of the individually small items net income from rest of the world, subsidies, business transfer payments, surplus of government enterprises, and statistical discrepancies, is allocated proportionally among asset income, proprietors' income and capital consumption allowance.

The reasons include that the latter are measured with less precision than the labor component of National Income, and that net receipts of labor income from abroad are likely to be far smaller than net receipts of capital income. The second step is to proportionally allocate proprietors' income between asset income and labor income, a common procedure that is also adopted by Rognlie (2015). These calculations result in GDP being divided in the proportions 26.4% for asset income, 58.3% for labor income, and 15.3% for the capital consumption allowance.

Table 3. Construction of Labor and Asset Income from National Income (in billion US dollars)

(Source: Authors' Calculations)					
Category	**Reported**	**Match GDP**	**Adjusted for GDP**	**Match PI**	**Adjusted for PI**
Rental Income	649.0				
Corporate Profits	2,060.5				
Net Interest & Miscellaneous	585.8				
Taxes on Production & Imports	1,275.2				
Total Asset Income	4,570.5	-187.8	4,382.7	424.7	4,807.3
Labor Income	9,699.4		9,699.4	939.8	10,639.2
Asset + Labor Income	14,269.9		14,082.1		15,446.6
Proprietors' Income (PI)	1,423.0	-58.5	1,364.5		
Capital Consumption Allowance	2,911.4	-119.7	2,791.7		2,791.7
Total	18,604.3	-366.0	18,238.3		18,238.3
Discrepancy	-366.0				
GDP	18,238.3				18,238.3
Discrepancy Allocation Total	8,904.9				

Values of Land and Capital: The value of total private fixed assets, which includes both produced and non-produced fixed assets, is taken from the Fed's estimate of private net worth in the FRED database, "Households and Nonprofit Organizations; Net Worth, Level, Billions of Dollars, Quarterly, Not Seasonally Adjusted".[48] Because this stock value will be related to various flow values for 2015, we compute the average stock between the ends of 2014 and 2015, which equals $89,086.6 billion. The value of private fixed capital assets is estimated by the Bureau of Economic Analysis in the National Income and Product Accounts, Table 5.10, "Changes in Net Stock of Produced Assets (Fixed Assets and Inventories)", where the average stock between the end of 2014 and 2015 equals $43,562.1 billion. The difference between private net worth and private fixed capital assets of $45,524.5 billion is our estimate of the value of land, and accounts for 51.1% of the value of total private fixed assets. This is in fact an underestimate, for three reasons. First, the value of US net foreign liabilities over 2015 averaged $7,202.2 billion. Using this to calculate an adjusted total value of assets (partly held by foreigners) of $96,288.8, our estimate of the value of land would change to $52,726.7 billion, and its share in total assets would change to 54.8%. Second, the Fed's estimate of private net worth excludes the wealth of the richest families. In 2015, according to Fortune, the wealth of the 400 richest families equalled $2,338.0 trillion. Using this to calculate an adjusted total value of assets (partly held by foreigners and partly by the richest families) of $98,626.8, our estimate of the value of land would change to $55,064.7 billion, and its share in total assets would change to 55.8%. The third reason is not readily quantifiable but could

[48] The net worth of financial and non-financial corporations is reflected in this measure through the equity and net corporate debt holdings of households and nonprofit organizations.

easily be much larger than the first two. This is that the BEA uses the land residual method, which as explained in Section 4.6 underestimates the value of land. We nevertheless choose the unadjusted and most conservative figure of 51.1% for the land share. This estimate happens to be consistent with the calibration of Knoll et al. (2017), who argue that 50% is a reasonable assumption, and with the estimates recently produced for the US residential housing sector by the American Enterprise Institute (2020). Figure 6 shows the evolution of this measure of the US land share between 1952 and 2018.

The implied 2015 ratios of land and capital to GDP equal 249.6% and 238.8%.[49] The model is made to match these values by adjusting the parameters ω (land quasi-share in production) and β (intertemporal discount factor). Note that we therefore do not calibrate the equilibrium real interest rate, which depends on β, directly. Rather, we match the income and asset stock to GDP ratios, along with the tax rates, found in the data, and allow the model to determine the steady state equilibrium real interest rate (see below). To obtain the depreciation rate of 6.41%, we take the ratio of the capital consumption allowance from Table 3, after allocation of the statistical discrepancy, to the value of the capital stock. This corresponds to setting $\delta = 0.0641$ in the model.

Allocation of Taxes to the Six Model Categories: We begin with consumption taxes. Personal consumption expenditures are found in NIPA Table 1.1.5, line 2. They equal $12,297.5 billion, which includes consumption taxes paid. The ratio of pre-tax consumption to GDP therefore equals 65.17%, and the model parameter s_g is fixed to match this ratio in steady state. Consumption taxes, as shown in Table 1, are taken as the sum of sales taxes and customs duties. The steady state consumption tax rate is calculated as the ratio of consumption tax collections to personal consumption expenditures minus consumption tax collections and equals 3.47%. In the model, this implies $\bar{\tau}_c = 0.0347$.

The detailed derivations for the remaining taxes, which are highly interrelated, are shown in Table 4. In this table the yellow shaded entries are either taken directly from 2015 data or from the intermediate calculations in Tables 1-3. The orange shaded entries are calculations pertaining to the allocation of total taxes between taxes on labor and taxes on assets, which are performed going from top to bottom in the first three data columns of the table. The red shaded entries are calculations pertaining to the allocation of taxes on assets between taxes on capital and land, and are performed going from bottom to top in the remaining two data columns. The green shaded entries are the computed model inputs for our calibration.

We start with GDP of $18,238.3 billion. Using the adjusted figures computed in Table 3, we first subtract the capital consumption allowance of $2,791.7 billion to obtain factor cash incomes of $15,446.6 billion, and then divide these into $10,639.2 billion for labor and $4,807.3 billion for assets. The combined income share of land and capital equals 41.67%, and the model parameter α is adjusted to match this ratio.

The taxation of assets begins with property taxes, or taxes on the value of land and capital. As shown in Table 1, these total $490.4 billion, which is allocated between land and capital in proportion to the value of each, $250.6 billion for land and $239.8 billion for capital. The implied tax rates, which are calibration targets, are 0.55%. Therefore, in the model we have $\bar{\tau}_p^a = \bar{\tau}_p^k = 0.0055$.

[49] These values are in line with the OECD estimates for other major economies that we presented in Section 4.3. For example, our estimate of the land value to GDP ratio of around 250% is very close to the values for Australia, Canada, France and South Korea.

To allocate income taxes between labor income and asset income (orange shaded entries), we need to first subtract from the gross income of both categories the items that are outside the income tax base. Subtracting property taxes of $462.2 billion from the return to assets leaves $4,316.9 billion. Excess depreciation is taken from NIPA Table 7.6, line 3, and equals $245.3 billion. The rate of excess depreciation therefore equals 0.56% of the value of capital, or $\bar{\tau}_x = 0.0056$ in the model.[50] Subtracting this from the taxable return to assets yields $4,071.6 billion, which is the base for the corporation income tax of $385.3 billion. Net asset income after the corporation income tax then equals $3,686.3 billion. On the labor income side, we need to adjust the tax base for employers' social insurance payments, which are included in compensation of employees and therefore in the $10,639.2 billion figure, but which are not subject to the income tax. Employers' social insurance payments are taken from NIPA Table 2.1, line 9, and equal $569.4 billion. This leaves a labor income tax base of $10,069.8 billion.

To allocate individual income taxes between labor and assets, we need to take account of the fact that income tax rates on the owners of assets are generally greater than income tax rates on labor, because the income tax is progressive, and the owners of assets have higher-than-average incomes. Tideman et al. (2002) found, in a study of data in Statistics of Income for 1998, that the average tax rate on asset income was 62% greater than that on labor income. Therefore an adjusted income tax base is calculated by multiplying the asset tax base by a factor of 1.62. This yields a total tax base of $16,041.7 billion and an asset income tax base of $ 5,971.8 billion. Using these adjusted tax bases, the individual income tax of $1,907.1 from Table 1 is allocated between labor and assets in proportion to labor income and adjusted asset income, yielding income taxes on labor income of $1,197.1 billion and income taxes on asset income of $710.0 billion.

Labor income is subject to additional social insurance taxes, which, as shown in Table 1, raised revenues of $1,210.0 billion in 2015. Social insurance taxes in 2015 consisted of a 10.6% tax for old-age social insurance OASI, a 1.8% contribution to disability insurance DI (with the sum of these two referred to as OASDI), and a 2.9% contribution to hospital insurance HI (Medicare), for a total tax rate of 15.3%. Above a 2015 income threshold of $118,500, only the 2.9% hospital insurance contribution applies. As documented in Social Security Administration (2015, 2016), about 83% of earnings in covered employment have been taxable at the full 15.3% rate, with the remaining 17% only taxable at the 2.9% rate. Hospital insurance needs to be fully accounted for as a tax, because future individual benefits do not increase with tax payments. We also fully account for disability insurance as a tax, because future individual benefits do not increase with tax payments, and are instead dependent on the claimant having paid the tax in at least 5 of the preceding ten years. But OASI payments are not entirely taxes, because to some extent future benefits increase with tax payments. Based on work by Feldstein and Samwick (1992), Tideman et al. (2002) estimated that, on average, only 68.9% of OASI payments are taxes. We approximate the share of OASI payments in total social insurance payments by the ratio (0.83*0.106)/(0.83*0.153+0.17*0.029)=0.667. The share of total insurance payments that are taxes is therefore approximated as 0.667*0.689+(1-0.667)=0.793, so that social insurance payments that are taxes equal $959.0 billion. Subtracting the sum of income taxes and the tax portion of social insurance payments from labor income yields the actual return to labor of $8,483.1 billion.

[50] Our implied marginal tax rates are contingent on this value for excess depreciation. However, this represents an underestimate, see Section 4.6. The tax system is therefore more distortionary than what it appears, because in reality marginal rates are higher than what we calculate on the basis of a very small excess depreciation.

Table 4. Allocation of Taxes - 2015 US Data

(Source: Authors' Calculations)

	Total	Labor	Assets	Land	Capital
Gross Domestic Product	18,238.3				
- Capital Consumption	2,791.7				
= Factor Incomes	15,446.6	10,639.2	4,807.3	1,805.4	3,001.9
- Property Taxes	490.4		490.4	250.6	239.8
= Return after Property Taxes	14,956.2	10,639.2	4,316.9	1,554.8	2,762.1
- Excess Depreciation	245.3		245.3		245.3
= Corporation Income Tax Base	14,710.9	10,639.2	4,071.6	1,554.8	2,516.8
- Corporation Income Tax	385.3		385.3	147.1	238.2
= Return after Corporation Income Taxes	14,325.6	10,639.2	3,686.3	1,407.7	2,278.6
- Employers' Social Insurance	569.4	569.4			
= Individual Income Tax Base	13,756.2	10,069.8	3,686.3	1,407.7	2,278.6
(Adjusted Individual Income Tax Base)	16,041.7	10,069.8	5,971.8		
- Individual Income Tax	1,907.1	1,197.1	710.0	271.1	438.8
(Total Social Insurance)		1,210.0			
- Tax Portion of Social Insurance		959.0			
= Accounting Return after All Taxes			2,976.4	1,136.6	1,839.8
+ Land Gain and Excess Depreciation			1,155.8	910.5	245.3
= Actual Return after All Taxes	12,615.2	8,483.1	4,132.1	2,047.1	2,085.1
Asset Stocks / GDP				249.6%	238.8%
Marginal Return to Assets				4.18%	4.18%
Property Tax Rate				0.55%	0.55%
Income Tax Base		10,639.2		1,554.8	2,516.8
Individual Income Tax					
Collections		1,197.1		271.1	438.8
Average Tax Rate		11.25%		17.44%	17.44%
Marginal Tax Rate		18.00%		27.90%	27.90%
Corporation Income Tax and Soc. Ins. Tax					
Collections		959.0		147.1	238.2
Average Tax Rate		9.01%		9.46%	9.46%
Marginal Tax Rate		8.65%		9.46%	9.46%
Total Income Tax Marginal Rate		26.65%		37.36%	37.36%
Income Tax Revenue / GDP		11.82%		2.29%	3.71%

Returning to assets, asset income after individual income taxes equals $2.976.4 billion. To compute the final return to assets, we first need to add back the excess depreciation allowance of $245.3 billion. But in addition, we need to add gains due to price appreciation on land. Reliable data on nationwide land price appreciation are very difficult to obtain. We therefore calibrate land price gains in a model-consistent way, as the product of the 2% net real growth rate of the economy and the stock of land, yielding a 2015 gain of $910.5 billion. Land gains at the rate of real economic growth tend to underestimate actual land gains during periods of easy credit. To the extent that this is the case here, our calibration will understate the share of the return to land derived from (low- or zero-tax) gains due to price appreciation and overstate the returns coming from (high-tax) land rentals. This in turn will affect our conclusions about the revenue potential of LRVT. We will comment on this below. Adding back the excess depreciation allowance and the land gain yields the actual return to assets after all taxes, of $4,132.1 billion.

The next step is to allocate asset income and taxes on assets between capital and land (red shaded entries in Table 4). In this case we work from the bottom of the table back up to the top. The return to assets is allocated in proportion to asset values, but with an adjustment to account for the fact that the returns computed so far have been based on average tax rates, while returns to assets should be equalized based on marginal tax rates. The allocation formula for the $4,132.1 billion return to assets is therefore based on equating the marginal returns to land and capital, with correct marginal–tax-based formulas for both. To compute the correct allocation, we therefore need to first discuss the calibration of marginal tax rates, which we will do below. To anticipate the result, we obtain after-tax land income (including gains due to price appreciation) of $2,047.1 billion and after-tax capital income of $2085.1 billion, at an equalized rate of return on both asset classes of 4.18%.

Subtracting land gains and excess depreciation from these incomes yields the accounting incomes of $1,136.6 billion for land and $1,839.8 billion for capital. Allocating individual income taxes between land and capital in proportion to these totals yields individual income taxes of $271.1 billion for land and $438.8 billion for capital. Adding these amounts to the after-tax incomes yields pre-tax incomes of $1,407.7 billion for land and $2,278.6 billion for capital. Allocating the corporation income tax between land and capital on the basis of these amounts yields corporation income taxes of $147.1 billion for land and $238.2 billion for capital.[51] Adding these amounts to income after corporation income taxes yields incomes before corporation income taxes of $1,554.8 billion for land and $2,516.8 billion for capital. Adding back the excess depreciation allowance yields capital income after true depreciation of capital of $2,762.1 billion. Adding back property tax payments yields income before property taxes of $1,805.4 billion for land and $3,001.9 billion for capital.

We are now able to calculate average income tax rates. The average individual income tax rate on labor is the ratio of labor income tax collections to labor income, which equals 11.25%. The average social insurance tax rate is the ratio of the tax part of social insurance to labor income, or 9.01%. By similar calculations, the average individual income tax rates on land and capital equal 17.44%, and the average corporation income tax rates on land and capital equal 9.46%, which leads by summation to average overall income tax rates on land and capital of 26.90%.

The next task is to calculate marginal tax rates. For individual income taxes, we follow Prescott (2004), who multiplies average individual income tax rates by a factor of 1.6 to obtain marginal individual income tax rates, based on the fact that this results in the marginal income tax rate

[51] Incidentally, this calibration exercise makes it clear that the corporation income tax is not a textbook example of a tax on capital income, a highly inefficient tax. In fact around 40% of it is a rent tax, a highly efficient tax.

obtained using the Feenberg and Coutts (1993) methodology for the US.[52] The implied marginal individual income tax rates are 18.00% for labor income and 27.90% for land and capital income. We treat the corporation income tax as a proportional tax, so that marginal corporation income tax rates on land and capital equal average corporation income tax rates. Due to the simplicity of its rate structure the marginal social insurance tax rate can be computed directly, rather than with reference to average tax rates. First, social insurance taxes are not payable on the full \$10,639.2 billion in the table, but rather on the sum of wages and salaries, which equal \$7,859.5 billion, and the labor income share of proprietors' income, which we approximated above as \$939.8 billion. The social insurance tax rate that applies to the full \$10,639.2 billion therefore contains a factor (7,859.5+939.8)/10,639.2. Second, the hospital insurance tax of 2.9% is payable on the entirety of this income, and represents a tax without offsetting marginal benefits. Third, the disability insurance tax of 1.8% is only payable on 83% of all income, and also represents a tax without offsetting marginal benefits. Fourth, the OASI tax of 10.6% is only payable on 83% of all income, and on average only 68.9% of OASI payments are taxes, with the remainder matched by future benefits. Our formula for the marginal social insurance tax rate is therefore ((7,859.5+939.8)/10,639.2)*(0.83*0.689*0.106+0.83*(0.018+0.029)+0.17*0.029), which equals 8.65%. This is quite close to the average social insurance tax rate of 9.01%.

This allows us to calibrate the remaining six tax-related calibration targets of our model. First, the steady state marginal tax rates on labor income, land income and capital income are obtained by summing up the above marginal tax rates, to obtain 26.65%, 37.36% and 37.36%. For the model this implies $\bar{\tau}_\ell = 0.2665$ and $\bar{\tau}_a = \bar{\tau}_k = 0.3736$. The value for $\bar{\tau}_k$ is made consistent with a balanced budget by adjusting the steady state level of lump-sum transfers $\bar{\Upsilon}$. Second, we match the ratios of labor, land and capital income taxes to GDP, which equal 11.82%, 2.29% and 3.71%, by adjusting the average-to-marginal proportionality factors ψ_ℓ, ψ_a and ψ_k.

7.2. Heterogeneous Households: Workers, Capitalists and Landlords

For preferences, the parameter κ_ℓ is adjusted to normalize the steady state labor supply of workers to 1. For all three household groups $z \in \{\ell, a, k\}$, we calibrate the parameters σ_z to obtain steady state intertemporal elasticities of substitution in consumption $\tilde{\sigma}_z = \sigma_z \bar{u}_z / \bar{c}_z$ of 0.5, and we calibrate labor supply elasticities θ_z at 0.75. For technologies, the stock of land $\bar{a}$ is adjusted to normalize the price of land to 1. Parameters that remain identical to the representative household model are the unitary elasticity of substitution between physical capital and labor, the elasticity of substitution between land and capital/labor ξ, the depreciation rate δ, the excess depreciation rate $\bar{\tau}_x$, and the six tax marginal rates.

The ratio of land to GDP of 249.6% is again matched by adjusting the parameter ω, while the ratio of capital to GDP of 238.8% is matched by adjusting the discount factor of capitalists β_k. The discount factor of households β_ℓ is set to equal β_k. The discount factor of landlords β_a is adjusted to ensure that in steady state the after-tax returns to land and capital are equalized. The implied difference between β_a and β_k is very small. The model parameter α is adjusted to match the combined income share of land and capital of 41.67%, and the model parameter s_g to match

[52] This methodology uses a representative sample of tax records to compute the marginal tax rate on labor income by determining how much tax revenue increases if every household's labor income is changed by 1 percent. The total change in tax receipts divided by the total change in labor income is their estimate of the marginal income tax rate. Note also that, in a study of Statistics of Income for 1998, Tideman et al. (2002) found a factor of 1.75.

the ratio of pre-tax consumption to GDP of 65.17%. Steady state transfers $\bar{\Upsilon}$ are adjusted to be consistent with a balanced budget. The ratios of labor, land and capital income taxes to GDP are matched by adjusting the average-to-marginal proportionality factors ψ_ℓ, ψ_a and ψ_k. We calibrate transfers to the three household groups to ensure equal per capita transfers.

The four remaining parameters are the population shares ϕ_a and ϕ_k and the labor supply parameters κ_a and κ_k of landlords and capitalists. In our model landlords and capitalists own the entirety of fixed assets. In the data,[53] the top 20% of US income earners own the vast majority of fixed assets, and account for around 60% of total income. We therefore adjust the population share parameter ϕ_k to fix the combined population share of landlords and capitalists at 20%, and we adjust the labor supply parameter κ_k to fix the combined steady state income share of landlords and capitalists at 60%. Because we do not have detailed information to allow us to distinguish between landlords and capitalists, we make two reasonable symmetry assumptions. First, we adjust the labor supply parameter κ_a to equalize their steady state per capita labor supplies, and second, we adjust the population share parameter ϕ_a to equalize their steady state per capita pre-tax incomes.

The resulting steady states have a number of interesting features that will be helpful in the interpretation of our results. First, the implied population shares of landlords and capitalists are 7.5% and 12.5%, with workers at 80%. Second, steady state per capita labor supplies of landlords and capitalists equal 290% of those of workers. Because the hourly wage in our model is equal for all labor types, the preference parameters κ_a and κ_k therefore represent the role of quality-adjusted labor, with landlords and capitalists earning almost three times as much as workers per hour worked, and with the income of landlords and capitalists further enhanced by their earnings on land and capital. Third, steady state per capita consumption of landlords and capitalists equals 450% and 380% of those of workers. As a result, marginal utilities, evaluated using the utility functions (10), differ greatly across agents, with that of workers ten times that of capitalists, and 16 times that of landlords. This plays an important role in the welfare evaluation of different tax policies.

8. Results

Our quantitative analysis is divided into four subsections. Figures 7-17 show the simulation results for a number of different tax reforms, and Table 5 gives an overview of the key quantitative results. Section 8.1 and Figures 7-9 study the impact of a 60 percentage point increase in land rental value taxes LRVT, under three different assumptions about the incidence of the balanced-budget tax cuts. We conclude that the real effects of such a reform are large and highly beneficial in welfare terms, but that they require extremely high tax rates that, once they approach 100%, drive the price of land towards zero. Section 8.2 and Figures 10-13 study the impact of an increase in land asset value taxes LAVT, under three different assumptions about the size of the LAVT increase and the incidence of the balanced-budget tax cuts. We conclude that for a baseline experiment of a 5 percentage point increase in LAVT accompanied by tax cuts concentrated on capital they can generate output gains (+14.8%) and welfare gains (+3.4%) that are as large as for a nearly 100% LRVT. Furthermore, land prices drop by less than 40% instead of nearly 100%. Section 8.3 and Figures 14-15 perform sensitivity analysis for this baseline experiment. We find that with a higher elasticity of labor supply both output and welfare gains increase very strongly, and that with heterogeneous household groups the output gains are the same but the welfare gains are much higher

[53] See the World Inequality Database, available at https://wid.world/.

(+6.4%). Section 8.4 and Figures 16-17 compare the baseline experiment to two very important alternative benchmarks, a wealth tax that raises the same amount of revenue but that increases taxes on both physical capital and land at the same rate, and an optimal tax that maximizes household welfare subject to the (presumed political) constraint that the maximum feasible LAVT tax rate equals 20% of the value of land, which in turn equals 5% of the pre-reform value of land. We find that for a wealth tax output and welfare gains drop by around half relative to the baseline, while for an optimal tax, welfare increases by around 50% more than in the baseline and output by almost 100% more. In this case land taxes are able to raise 55% of all tax revenue, with consumption taxes at a rate of 12.2% raising the remainder, while for all other reforms considered in this paper land taxes raise around 35%-40%.

Table 5. Key Quantitative Results

	Welfare	**Output**	**Land Price**	**Land Tax Share**
LRVT				
+60pp & lower $\tau_k, \tau_\ell, \tau_c$	+2.7%	+10.9%	-94.3%	35.8%
+60pp & lower τ_ℓ	+2.0%	+8.0%	-94.6%	34.1%
+60pp & mainly lower τ_k	+3.4%	+15.0%	-94.0%	38.2%
LAVT				
+5pp & lower $\tau_k, \tau_\ell, \tau_c$	+2.8%	+11.1%	-44.7%	36.1%
+10pp & lower $\tau_k, \tau_\ell, \tau_c$	+3.5%	+14.0%	-63.6%	43.0%
+5pp & mainly lower τ_k	+3.4%	+14.8%	-37.9%	38.2%
Sensitivity Analysis				
Labor supply elasticity = 1	+4.5%	+20.8%	-32.0%	41.2%
Heterogeneous households	+6.4%	+14.8%	-37.9%	38.2%
Alternative Benchmarks				
Wealth Tax	+1.9%	+6.9%	-17.0%	27.4%
Optimal Tax	+5.2%	+26.0%	-74.4%	55.2%

In each case the tax reform is phased in linearly over 20 years, to reflect its likely gradual implementation in practice.[54] The simulations are very long-term, covering 80 years from the initial implementation of the tax reform. This is necessary because the reallocation implied by such a reform, especially the accumulation of fixed capital in response to much more favorable tax rates, takes many years to be fully reflected in the capital stock, and therefore also in labor and output.

In all simulations except Figures 13 and 14 the black solid lines represent our baseline calibration of the land share of 51.1%. In a number of figures we use thin red lines to represent the case of a land share of 40%, and thick green lines the case of a land share of 60%. Together these three cases cover almost the entire empirically relevant range of land shares that we have found in the OECD and US data.

In each figure the first column shows the six marginal tax rates of the model in levels. The second column shows the ratios of the six tax revenues to GDP in percentage point deviations. The third and fourth columns show key real variables, prices, and rates of return, in percent or percentage point deviation from the initial steady state. The after-tax returns to land and capital are arbitraged at all times, and the latter, in this real model, equals the real interest rate.

[54] For an argument supporting gradual implementation see Weale (2010).

8.1. Land Rental Value Taxes (LRVT)

Figure 7 simulates an increase in the marginal tax rate on the rental income of land, from its initial steady state value of 37.4% to a final value of 97.4%, with the increase taking place over a period of 20 years. The tax rates on the values of land and capital are left unchanged, while the tax rates on capital income, labor income and consumption are reduced in proportional fashion ($\varphi_\ell = \varphi_c = 1$) to balance the budget. The tax rate on capital income eventually drops from 37.4% to less than 25%, the tax rate on labor income from 26.7% to less than 18%, and the consumption tax rate from 3.5% to less than 2.5%. The tax cuts of around 8% of GDP are balanced by increased tax revenue from the LRVT (5% of GDP), and by the fact that spending is held constant relative to trend while GDP increases strongly (3% of GDP). Because of the eventually nearly 100% tax rate on the land rental income, the price of land drops by almost 95% in the long run. The real effects of this tax reform are very large, with pre-tax consumption eventually rising by 13.5%, investment by 21.5%, and output by 10.8%, relative to trend. The welfare gain of this reform for the representative household equals 2.7%, a very large number by the standards of this literature. While in Figure 7 three taxes are reduced in proportion to balance the budget, it is well known that the incidence of the offsetting tax cuts matters a great deal for the results. Figures 8 and 9 explore this aspect.

In Figure 8 only the labor tax rate is reduced to balance the budget, to eventually less than 15%. The welfare and output gains in this case are significantly smaller, at 2.0% and 8.0%, while the decline in the land price is very similar. The reason is the absence of tax cuts on capital income, which are known to have larger welfare and output effects than tax cuts on labor income. Figure 9 therefore studies the case where the budget is mainly balanced through cuts in the capital income tax rate, with no change in the consumption tax rate, and with cuts in the labor income tax rate just large enough to avoid negative capital income tax rates. The welfare and output gains in this case are significantly larger, at 3.4% and 15.0%, but the decline in the land price still reaches almost 95%.

8.2. Land Asset Value Taxes (LAVT)

Figure 10 studies a 5 percentage point increase in the LAVT rate, from 0.55% in the initial steady state to 5.55% after 20 years, a 10-fold increase.[55] The tax rate on the value of capital is left unchanged, while the tax rates on labor income, capital income, land income, and consumption are reduced in proportional fashion to balance the budget, as in Figure 7 for the LRVT case. There are reasons why a decrease in taxes on land income (as opposed to land value) should be part of the tax reform. One is practicality, because in this case it would not become necessary, for purposes of tax assessment, to allocate asset income between the incomes of capital and land, which potentially opens up possibilities for tax arbitrage, manipulation, and fraud. But another reason is that a reduction in this tax rate increases the value of land, thereby increasing the tax base for the LAVT. In this tax reform, the tax rates on capital income and land income eventually drop from 37.4% to less than 25%, the tax rate on labor income from 26.7% to less than 18%, and the consumption tax rate from 3.5% to less than 2.5%. These are very similar numbers to the 60 percentage point increase in the LRVT analyzed in Figure 7. The welfare (+2.8%) and output (+11.1%) effects are

[55] The magnitude and phasing-in of this experiment is quite similar to what Institute for Fiscal Studies and Mirrlees (2011) suggest for the replacement of UK business rates, which apply to the combined value of business land and structures. They argue that to approximaly replace business rates on a revenue-neutral basis would require a LAVT rate in the region of 4% per annum, and suggest that this could be introduced gradually, starting at 0.5% per annum.

also of a very similar magnitude to Figure 7, in fact they are slightly larger. Pre-tax consumption eventually rises by around 14% and investment by around 23%. The main difference to the LRVT tax reform is that the price of land only drops by around 45% in the long run.

By contrast with Figure 7, however, the potential gains from further LAVT increases is not nearly exhausted at a 5.55% tax rate. Figure 11 therefore explores the case of a 10 percentage point increase, to eventually 10.55%. In this case, the tax rates on capital income and land income eventually drop from 37.4% to around 20%, the tax rate on labor income from 26.7% to less than 15%, and the consumption tax rate from 3.5% to less than 2.0%. In this case the price of land drops by around 64% in the long run. The welfare (+3.5%) and output (+14.0%) effects are much larger than in Figure 10. Consumption eventually rises by around 18% and investment by around 29%.

However, we conjecture that an annual LAVT increase as large as 10% may be politically harder to implement, despite the trade-off with the higher overall gain. Figure 12 therefore returns to the case of a 5 percentage point increase in the LAVT rate, but in this case accompanied, as in Figure 9 for the LRVT, by tax cuts that are concentrated on capital and land income taxes, with no changes in consumption taxes and smaller changes in labor income taxes. In this case, the tax rates on capital income and land income eventually drop from 37.4% to less than 10% in the baseline (close to 0% in the case of a 60% land share), and the tax rate on labor income from 26.7% to less than 17%. In this case the price of land drops by only around 38% in the long run. Despite its smaller size, the welfare (+3.4%) and output (+14.8%) effects of this tax reform are very similar to or, in the case of output, larger than for the 10 percentage point LAVT rate increase in Figure 11. Consumption eventually rises by around 18% and investment by around 38%. In fact, this type of tax reform, with a 5 percentage point increase, can be shown to achieve the same output effects as a 13 percentage point LAVT tax reform with proportional cuts in tax rates on labor income, capital income, land income and consumption, while land price drops are significantly smaller. For the remainder of our analysis we will therefore treat the tax reform combination in Figure 12 as our baseline simulation.

Figure 13 shows the relationship between different long-run LAVT tax rates, on the horizontal axis, and three fiscal and economic outcomes, on the vertical axes. The solid upward-sloping line in the top panel shows the long-run increase in LAVT tax revenue[56] in the presence of proportional reductions in all income and consumption tax rates, as in Figure 10. The dashed horizontal line shows the tax revenue gain achieved by the baseline tax reform, as in Figure 12. The middle and bottom panels of Figure 13 shows the corresponding relationships between LAVT rates and the gain in output and the drop in the land price. The top panel of Figure 13 shows an initially steep but then flattening LAVT Laffer curve. The flattening is due to reductions in the land price that reduce the tax base. This reduces the increments in LAVT revenue that can be applied towards further reductions in the other distortionary tax rates. Because the latter are responsible for the output gains following the tax reform, output gains mirror the Laffer curve, with initially rapidly rising output gains at low LAVT rates, and increasingly smaller gains per percentage point increase in the LAVT rate at high LAVT rates. Land price drops are sharpest for the initial increases in the LAVT rate, and then become smaller as the LAVT rate increases further. The baseline tax rate policy of Figure 12 achieves output gains that approximately correspond to a 13 percentage point increase in the LAVT rate under proportional tax cuts, while realizing a land price drop that approximately corresponds to only a 4 percentage point increase in the LAVT rate under proportional tax cuts.

[56] LAVT tax revenue is in this case scaled by pre-reform GDP for easier interpretation of the magnitudes.

8.3. Sensitivity Analysis

8.3.1. Preferences and Technologies

Using the baseline LAVT tax reform of Figure 12 as our point of departure, we have studied the dependence of our results on three key preference parameters. It turns out that two of them, the land elasticity in the production function ξ, and the intertemporal elasticity of substitution, which depends on σ, have only very small effects on the results, while a third, the labor supply elasticity in preferences θ, has very large effects.

We do not show the results for ξ and σ to conserve space. The baseline value of ξ is 0.8, and we have explored the alternatives of 0.5 and 1.0. While different values of ξ imply a slightly different behavior of the land price, the effect on real variables is negligible. The baseline value of the intertemporal elasticity in consumption $\tilde{\sigma}$ is 0.5, and we have explored the alternatives of 0.25 and 1.0. The main difference to the baseline results is not the final steady state, which is almost identical, but the time it takes for the economy to reach that steady state, which is appreciably longer under a low intertemporal elasticity and appreciably shorter under a high intertemporal elasticity. For example, after 30 years GDP increases by 7.4% under $\tilde{\sigma} = 0.25$, by 9.9% under $\tilde{\sigma} = 0.5$, and by 12.1% under $\tilde{\sigma} = 1.0$.

Figure 14 shows the results for different labor supply elasticities θ. The baseline value of θ is 0.75, and we have explored the alternatives of 0.5 and 1.0, an empirically reasonable range as argued above. In this case, while the long-term welfare and output gains under the baseline calibration equal 3.4% and 14.8%, under the alternative of $\theta = 0.5$ they equal 2.4% and 9.9%, and under the alternative of $\theta = 1.0$ they equal 4.5% and 20.8%. The reason is that with a higher elasticity labor supply responds much more strongly to the improved incentives to work under the tax reform.

8.3.2. Household Heterogeneity

Figure 15 again studies the baseline LAVT tax reform, but in this case for an economy with separate groups of workers, capitalists and landlords. The long-run output gains, at 14.8%, are identical to those of the representative household economy in Figure 12. However, there are significant differences across the three household groups. While our GHH preference specification implies identical percentage increases in labor supplies across the three groups (these are not shown to conserve space), their consumption responses are very different. Landlords experience a drop in post-tax rental income, so that after 20 years their consumption has dropped by almost 15%. However, the longer-run drop in their consumption is far smaller, at less than 4%. This is because, as the economy becomes more productive, their pre-tax rental income, and also their labor income, increase very significantly. On the other hand, consumption of capitalists and workers, who together account for 92.5% of the population, increases substantially, by 23% and 25%, respectively, as they benefit from the very large reduction of tax disincentives to work and to accumulate capital. Therefore, if compensation of the losers of this tax reform were to be considered, it must first be subject to the strict caveats discussed in Section 2.1, but it would then not be difficult to finance, particularly because a large share of landlords are simultaneously capitalists and workers and may therefore not suffer any net losses at all.

This latter trade-off can be quantified using the model. A capitalist-landlord hybrid agent, who simultaneously invests in land and capital (including structures on the land), experiences after-tax income losses on his land holdings but significantly larger after-tax income gains on his capital holdings. We find that, for such an agent to suffer overall income losses, 86% or more of his investments would have to be in land. This recalls our discussion in Section 5.3 that, based on what we know about landholdings in US data, the group that suffers net losses from a shifting of taxes onto land is likely to be very small.

As for welfare, we recall that for the representative household economy the gains amounted to 4.3%. With three separate groups of households, we obtain gains of 8.1% for workers and 6.8% for capitalists, losses of 12.8% for landlords, and population-weighted overall gains of 6.4%. The reason is that the tax reform distributes the gains to those households with by far the largest marginal utilities of consumption (and of wealth), namely workers, by far the greatest potential to grow the economy through capital accumulation, namely capitalists, and by far the greatest population share, namely 92.5% of the overall population.

8.4. Alternative Benchmarks: Wealth Taxes and Optimal Taxes

8.4.1. LAVT versus Wealth Taxes

As discussed in our review of the literature, some economies are considering one-off or recurring wealth taxes as a response to the fiscal strains triggered by the lockdowns and accompanying income support measures. Figure 16 therefore studies a tax reform whereby the tax rates on the values of land and capital are raised by 2.5 percentage points each, rather than the 5 percentage points increase in the tax rate on the value of land alone in our baseline tax reform. Accompanying tax cuts are again mainly on the incomes of capital and land, with smaller labor tax cuts. Figure 16 shows the results of such a reform as the red dashed lines, while the black solid lines represent our baseline tax reform of Figure 12.

The figure shows that taxing all wealth is clearly inferior to taxing only land. While the drop in labor income taxes leads to a broadly comparable increase in labor supply, the net effect of higher taxes on capital values and lower taxes on capital incomes is broadly neutral for investment and the capital stock, which remains almost unchanged. As a result, gains in welfare (+1.9%) and output (+6.9%) are approximately half of those of the baseline tax reform.

But beyond this, there is a question of how practically feasible it is to tax wealth. We recall the argument of Foldvary (2005) that land, unlike virtually all other forms of wealth, cannot flow abroad, and is therefore not only a non-distortionary but also a reliable tax base. The fact that enormous quantities of wealth flow to tax havens has been documented by, among others, Alstadsaeter et al. (2018), and this phenomenon would surely increase following the imposition of wealth taxes. And it would just as surely decrease, or cease, if only land and other forms of nonproduced wealth were taxed.

8.4.2. LAVT versus Optimal Taxes

Figure 17 concludes our analysis by studying optimal taxation. We recall from Figure 13 that the Laffer curve for the LAVT becomes very flat at high tax rates, where further increases in tax rates raise very little additional revenue, and therefore permit only minimal reductions in distortionary taxes elsewhere. It is therefore not possible to realize the ideal of raising all tax revenue through LAVT, while extremely high LAVT may be politically too difficult to implement. We therefore, for the purpose of studying optimal taxes, assume that the LAVT rate has to be capped at a maximum 20% of the value of land. We then set the tax rate on the income of land to zero to maximize the tax base of the LAVT, and then optimize welfare subject to the further constraint that the tax rate on the income of capital equals zero, because a welfare criterion cannot separately determine the optimal tax rates on both the value and income of capital. We optimize over the remaining tax rates $\tau^a_{p,t}$, $\tau^k_{p,t}$, $\tau_{\ell,t}$ and $\tau_{c,t}$, subject to the condition that tax rates cannot become negative. We find that maximization of household welfare requires that the LAVT should be set to its maximum permitted value, $\tau^a_{p,t} = 0.2$, and the tax rate on the value of capital to its minimum permitted value, $\tau^k_{p,t} = 0$. Among the remaining taxes, the consumption tax is less distortionary than the labor income tax rate, so that at the optimum $\tau_{\ell,t} = 0$ and the consumption tax rate raises all revenue not raised by the LAVT. In the long run this requires a consumption tax rate of 12.2%. The land price drops by almost 75% for this reform, so that a 20% LAVT corresponds, in cash flow terms, to a 5% tax on the pre-reform value of land. The tax revenue raised by the LAVT accounts for 55% of overall tax revenue, with the remaining 45% raised by the consumption tax. The welfare gains (+5.2%) and especially the output gains (+26.0%) for this reform are extremely large, approximately 50% larger than for the baseline tax reform for welfare and almost 100% larger for output. This represents the outer limit of what could be achieved by a tax reform.

9. Conclusion

The motivation for writing this paper is the need, at the current economic juncture, for fiscal policies that can stimulate real economic activity in the aftermath of the 2020-21 lockdowns, while continuing to finance existing levels of debt and expenditures. Our proposed tax reform, which shifts taxes away from mainly the incomes of capital and labor and towards the value of land, satisfies the second requirement throughout, by assuming that the government must maintain a balanced budget. The final simulation of our study has shown just how far the stimulus effects could be taken if a radical reform is not ruled out. It shows that optimal taxation can raise more than half of all tax revenue using a tax on the current asset value of land even if the tax rate is capped at 20%, and would raise the remainder by a consumption tax of around 12%, with all taxes on incomes abolished. This would increase welfare and output by 5.2% and 26.0%. But even our more modest baseline reform, which features a land asset value tax of 5.5%, balanced by tax cuts on capital incomes, and to a lesser extent on labor incomes, offers gains in welfare and output that are extremely large by the standards of the literature, at 3.4% and 14.8%. We can do no better than repeating the conclusion of the Mirrlees Review (Institute for Fiscal Studies and Mirrlees (2011)), the most comprehensive and rigorous review of UK taxation undertaken for many decades: "This is such a powerful idea, and one that has been so comprehensively ignored by governments, that the case for a thorough official effort to design a workable system seems to us to be overwhelming." This was ten years ago. It is surely more overwhelming now.

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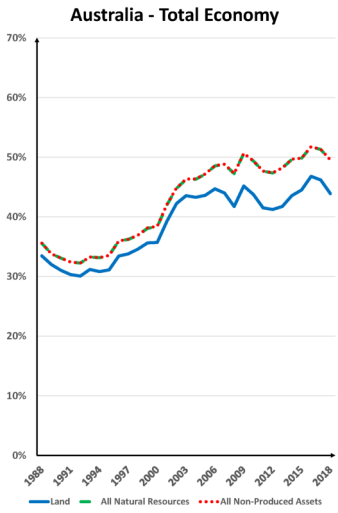
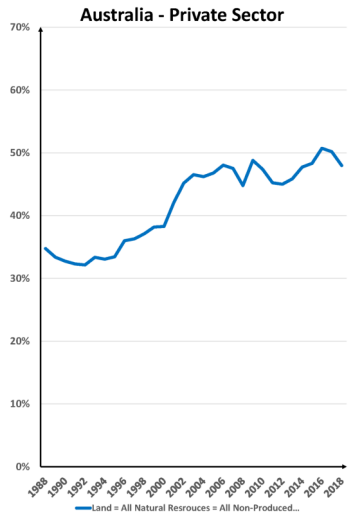
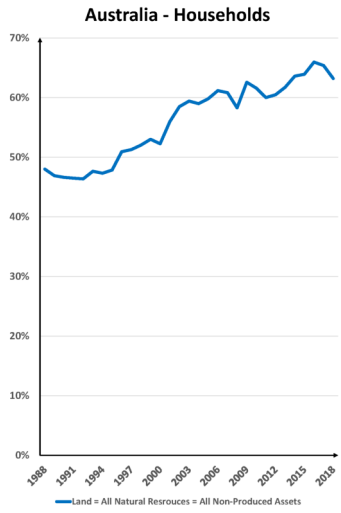
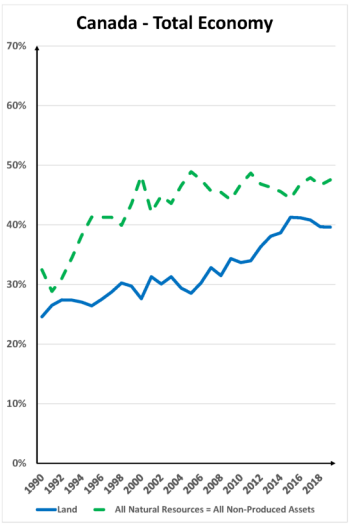
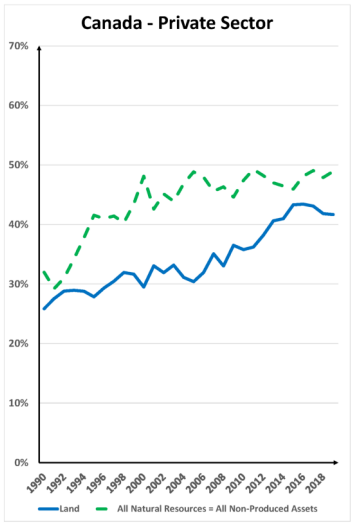
Figure 1. OECD: Anglo-Saxon Economies - Shares of Nonproduced Assets in Total Assets

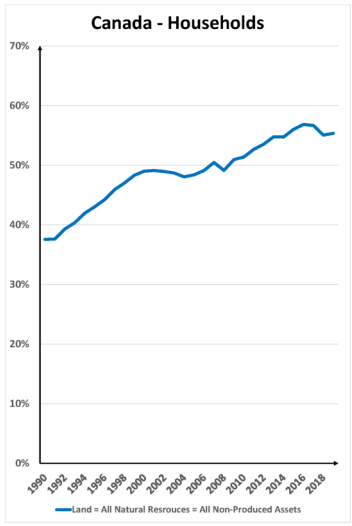


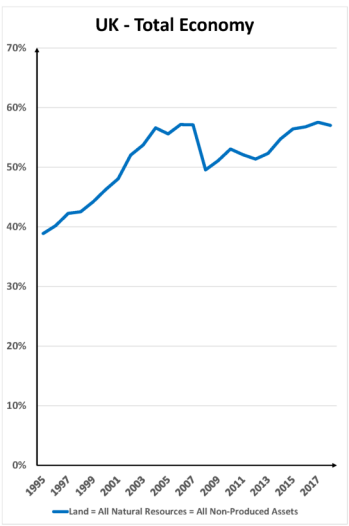


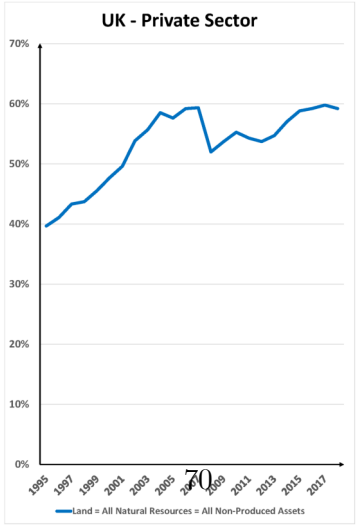












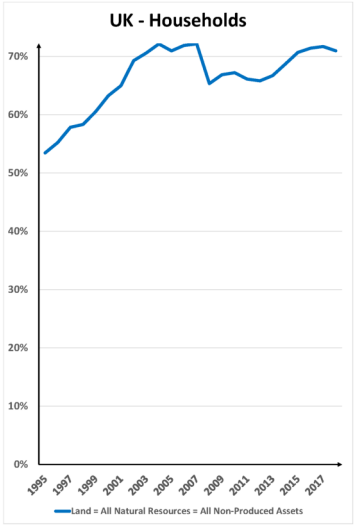


Figure 2. OECD: Asian Economies - Shares of Nonproduced Assets in Total Assets

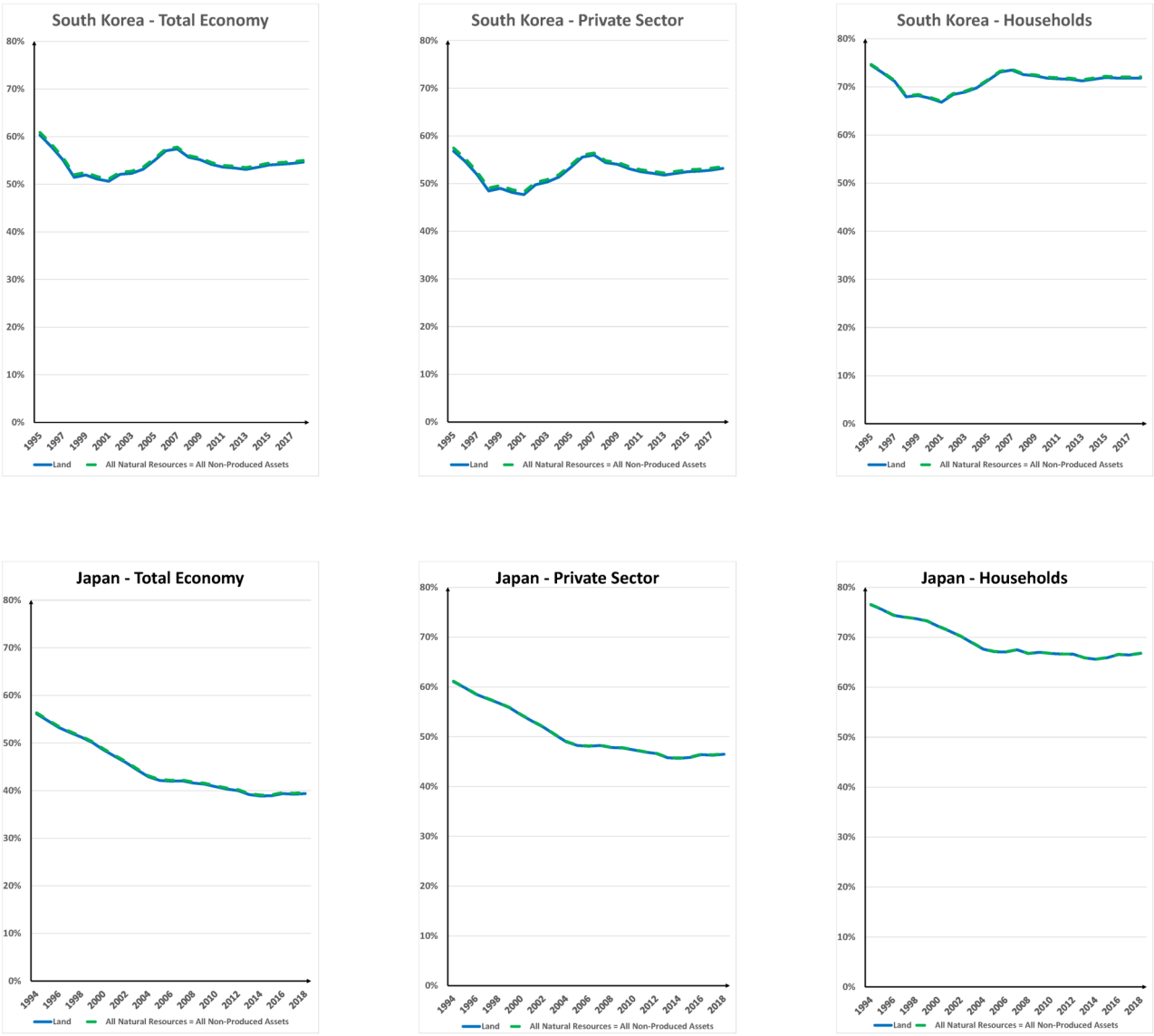


Figure 3. OECD: Large European Economies - Shares of Nonproduced Assets in Total Assets

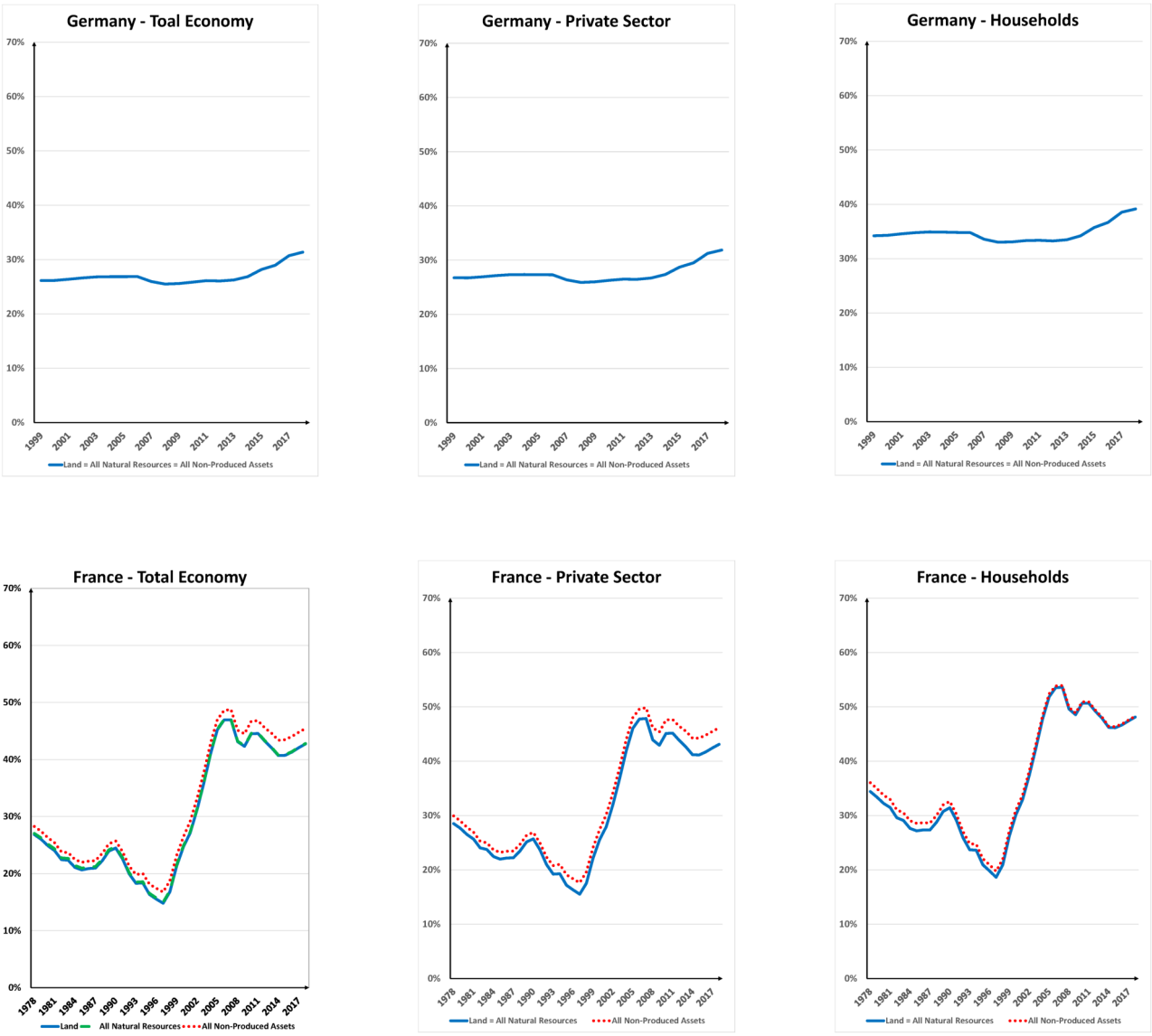
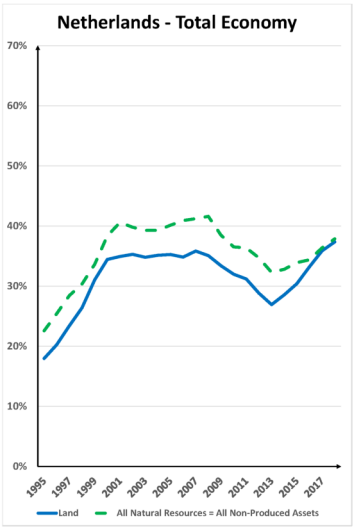
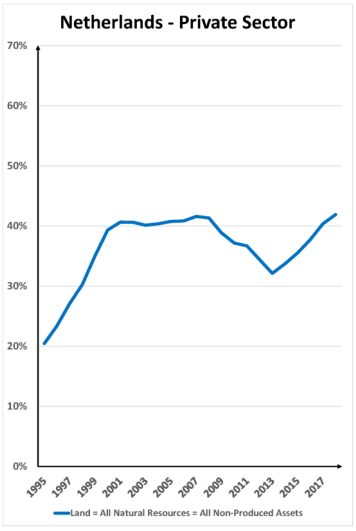
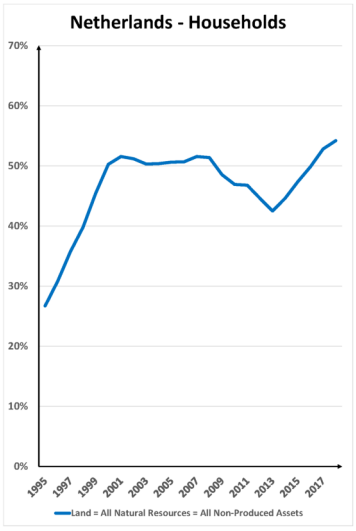
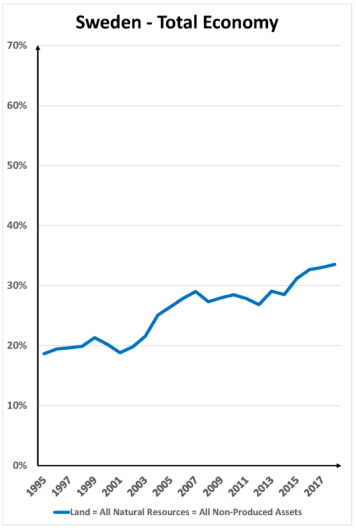


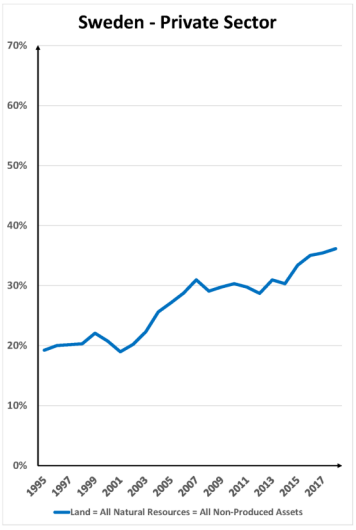
Figure 4. OECD: Smaller European Economies - Shares of Nonproduced Assets in Total Assets

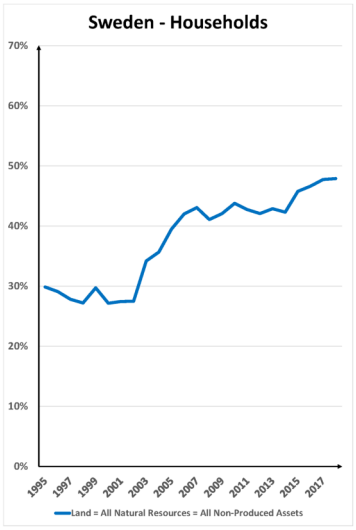


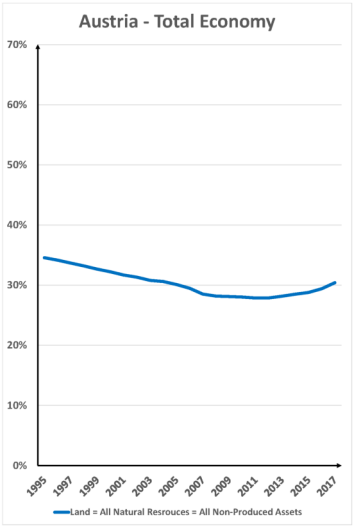


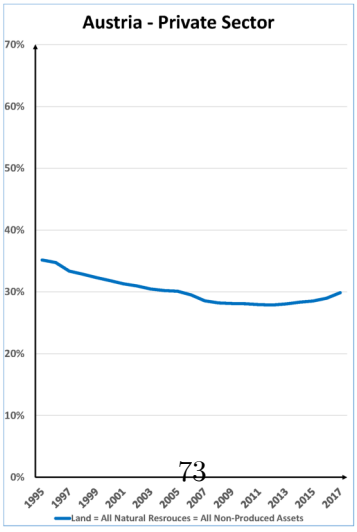












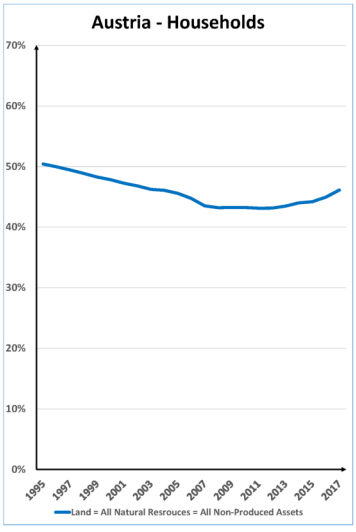


Figure 5. OECD: Six Economies - Households - Shares of Nonproduced Assets in Total Assets

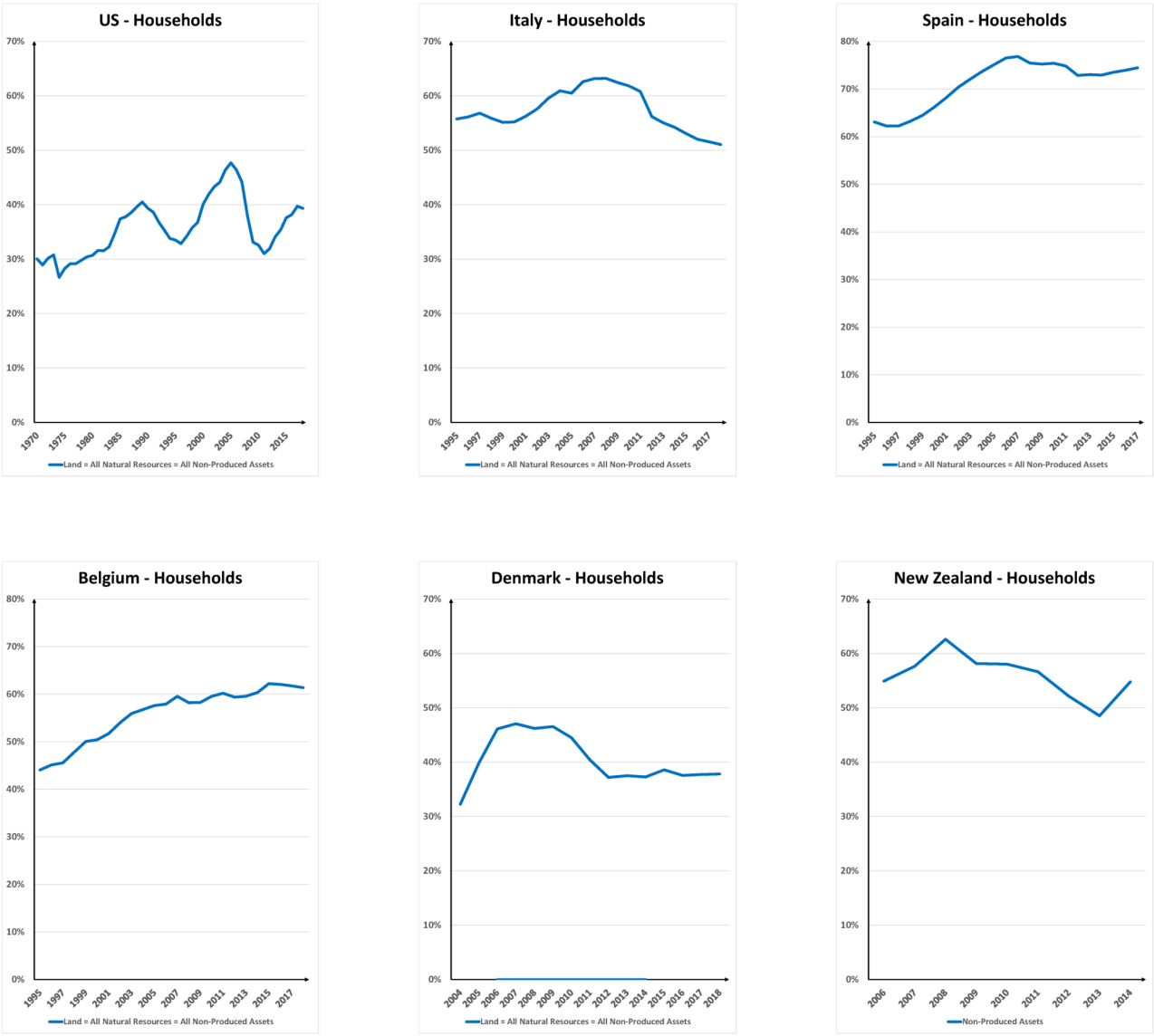


Figure 6. FRED/BEA: US - Share of Nonproduced Assets in Total Assets

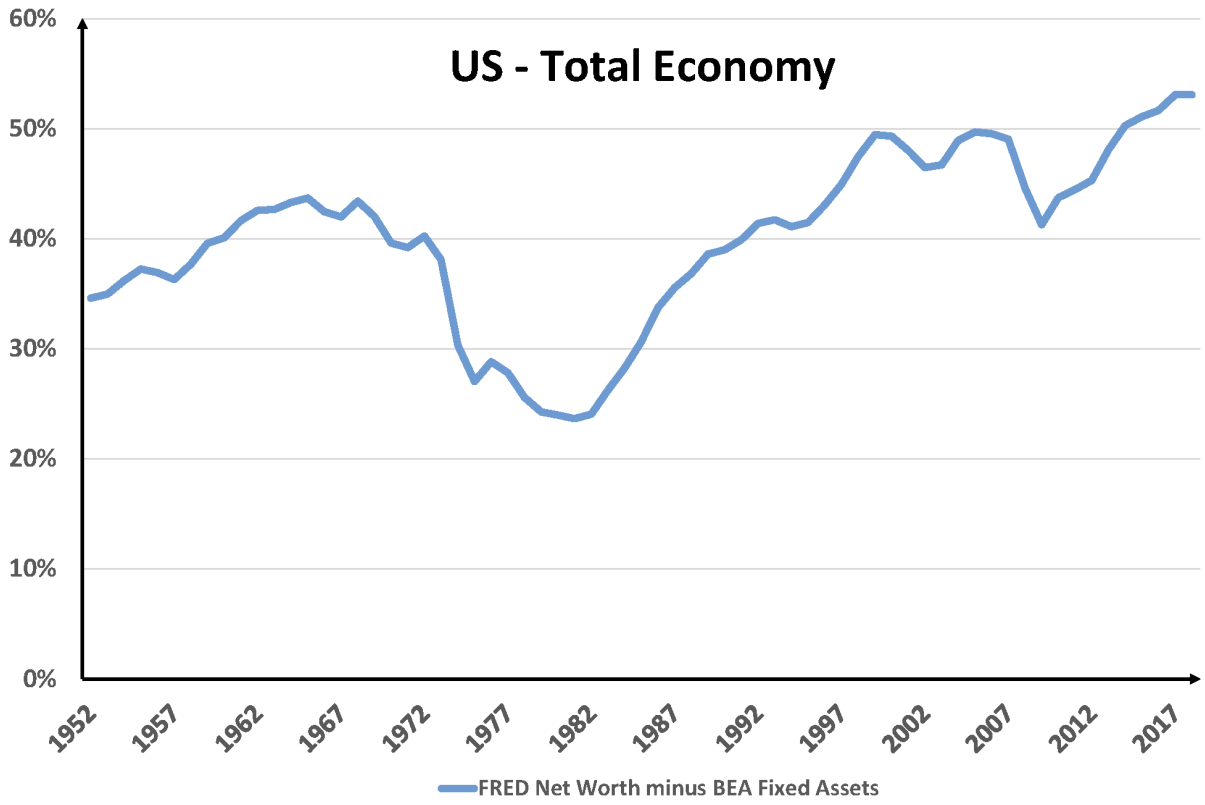
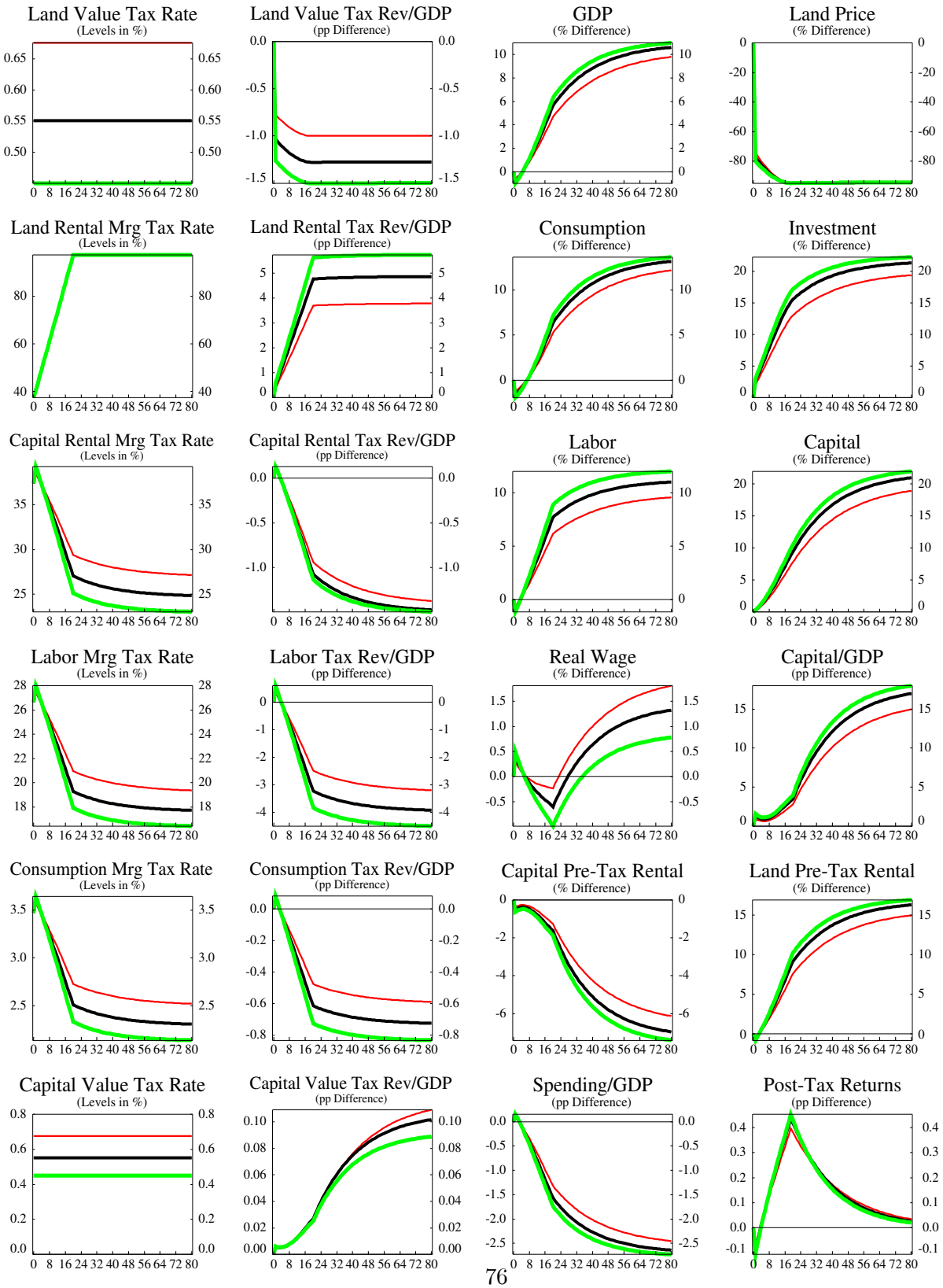
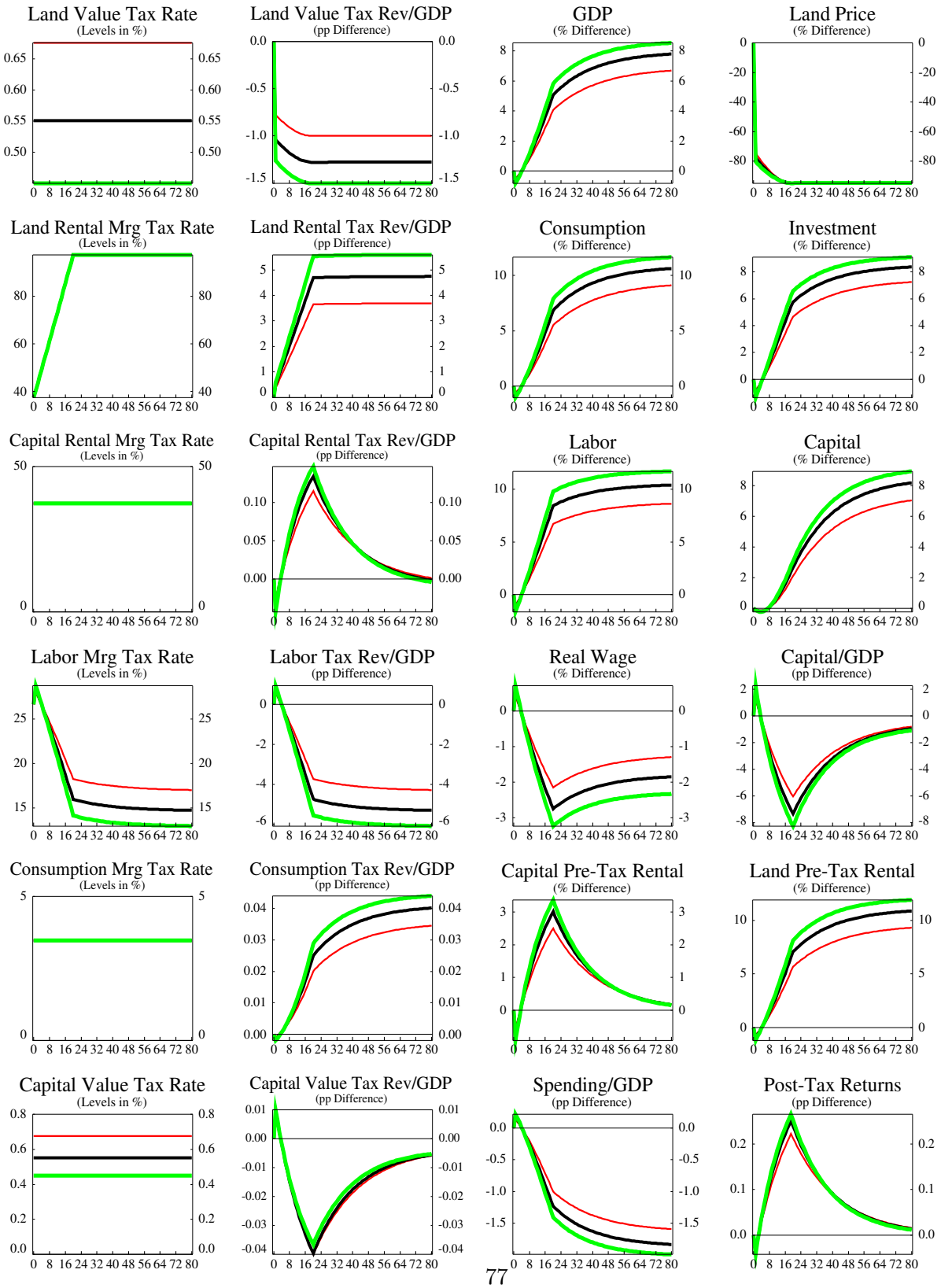


Figure 7. LRVT Increase of 60 Percentage Points and Lower Taxes on K, L and C



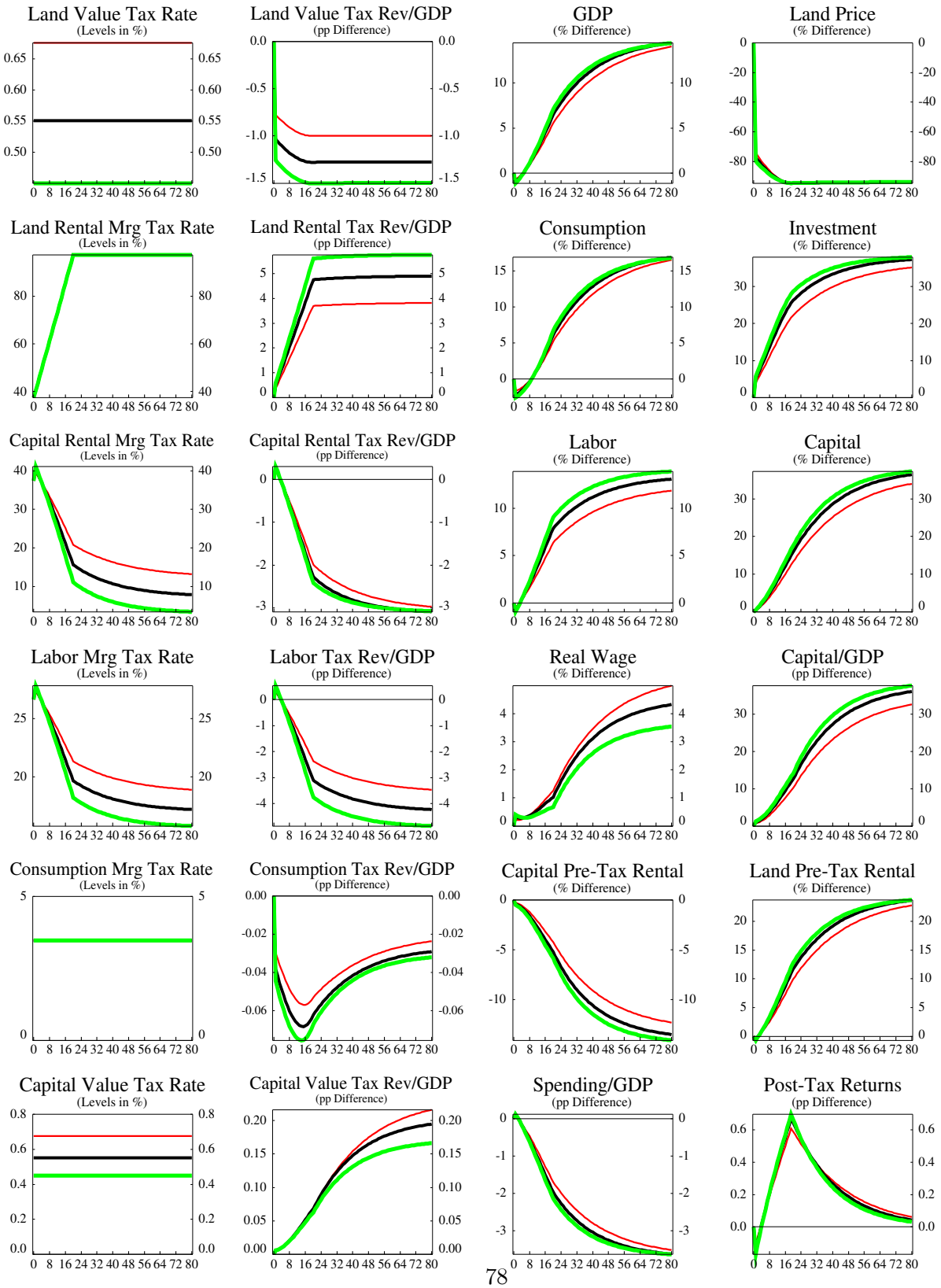
(Land Shares: thin red lines = 40% / medium black lines = 51.1% / thick green lines = 60%)

Figure 8. LRVT Increase of 60 Percentage Points and Lower Taxes Exclusively on L



(Land Shares: thin red lines = 40% / medium black lines = 51.1% / thick green lines = 60%)

Figure 9. LRVT Increase of 60 Percentage Points and Lower Taxes Mainly on K



(Land Shares: thin red lines = 40% / medium black lines = 51.1% / thick green lines = 60%)

Figure 10. LAVT Increase of 5 Percentage Points and Lower Taxes on K, L and C

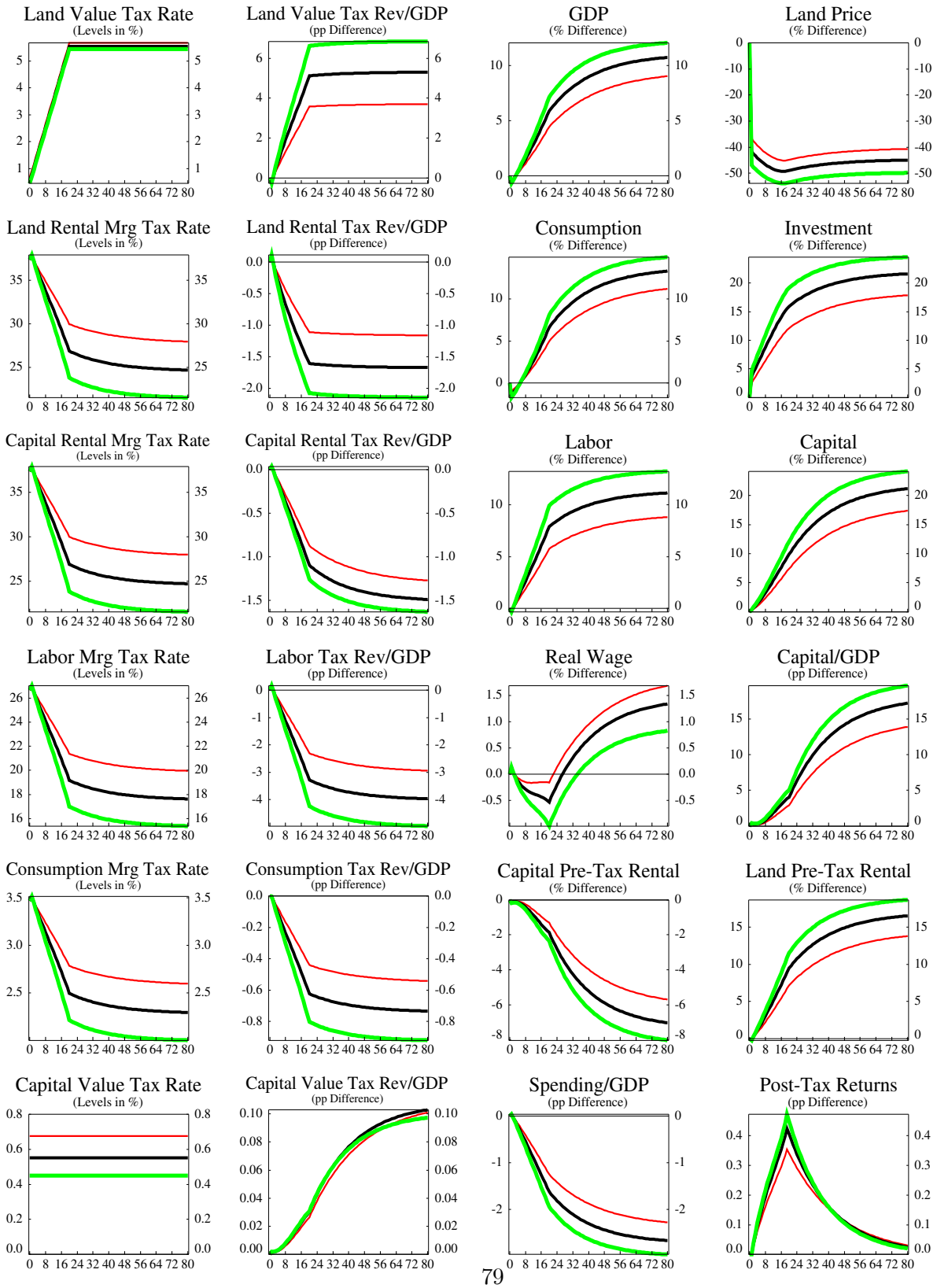


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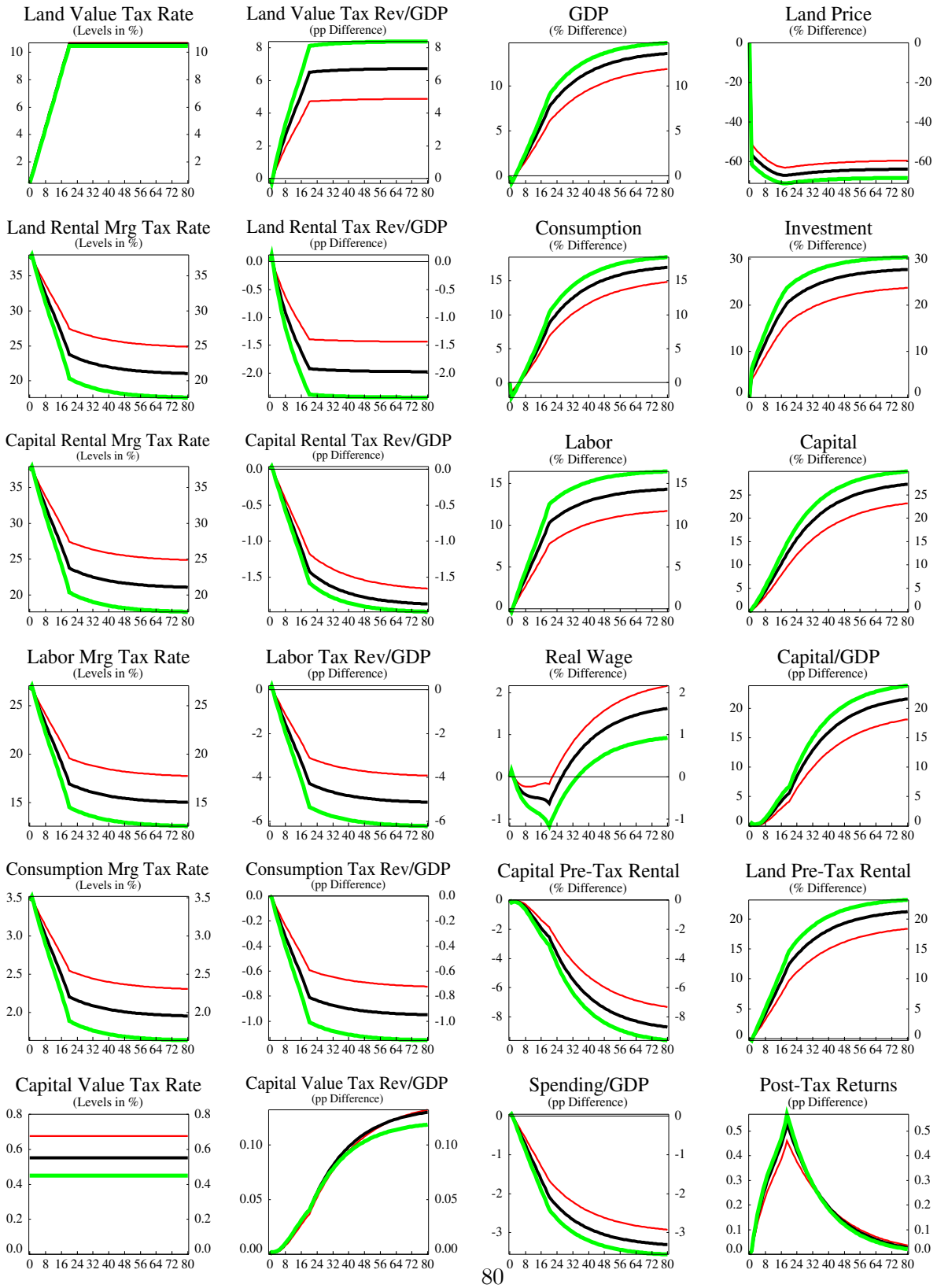
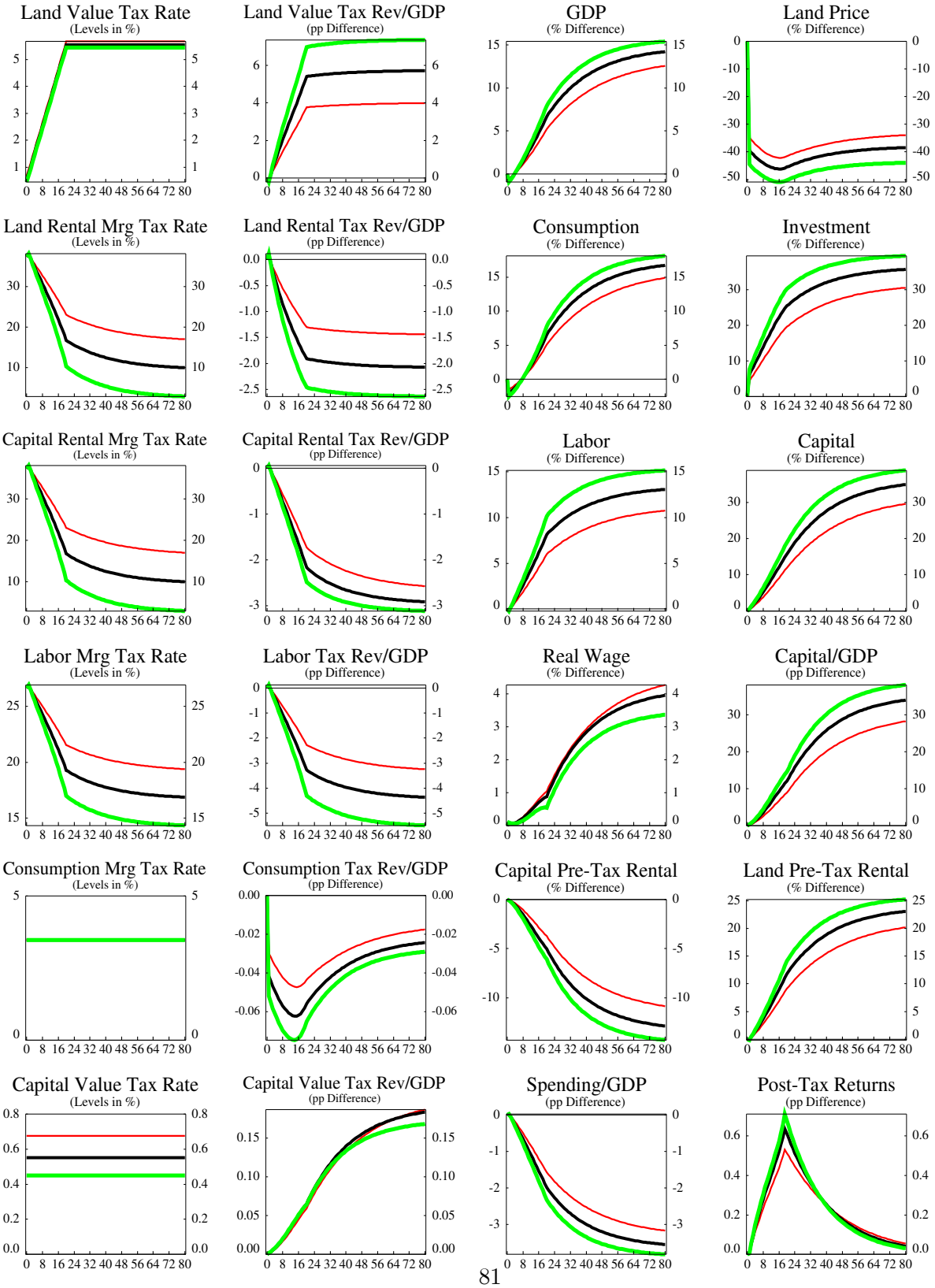
Figure 11. LAVT Increase of 10 Percentage Points and Lower Taxes on K, L and C



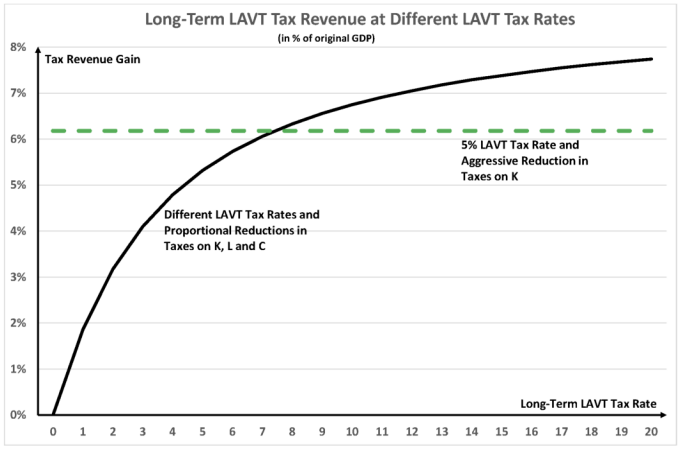
(Land Shares: thin red lines = 40% / medium black lines = 51.1% / thick green lines = 60%)

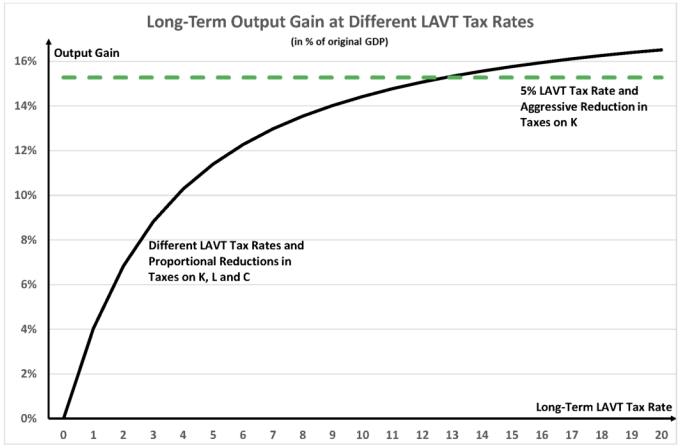
Figure 12. LAVT Increase of 5 Percentage Points and Lower Taxes Mainly on K



(Land Shares: thin red lines = 40% / medium black lines = 51.1% / thick green lines = 60%)

Figure 13. LAVT Laffer Curve and Implied GDP and Land Price





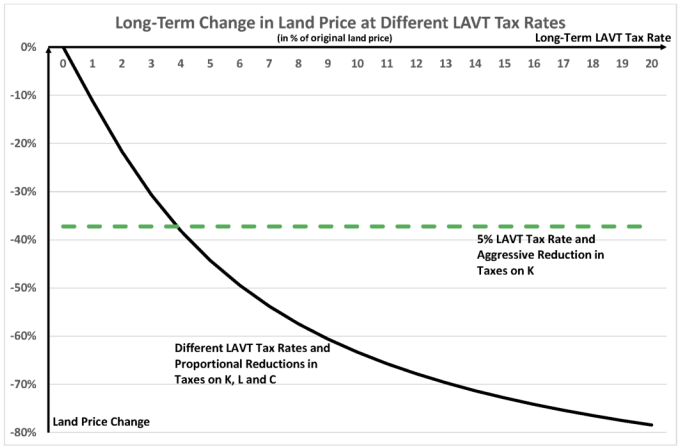
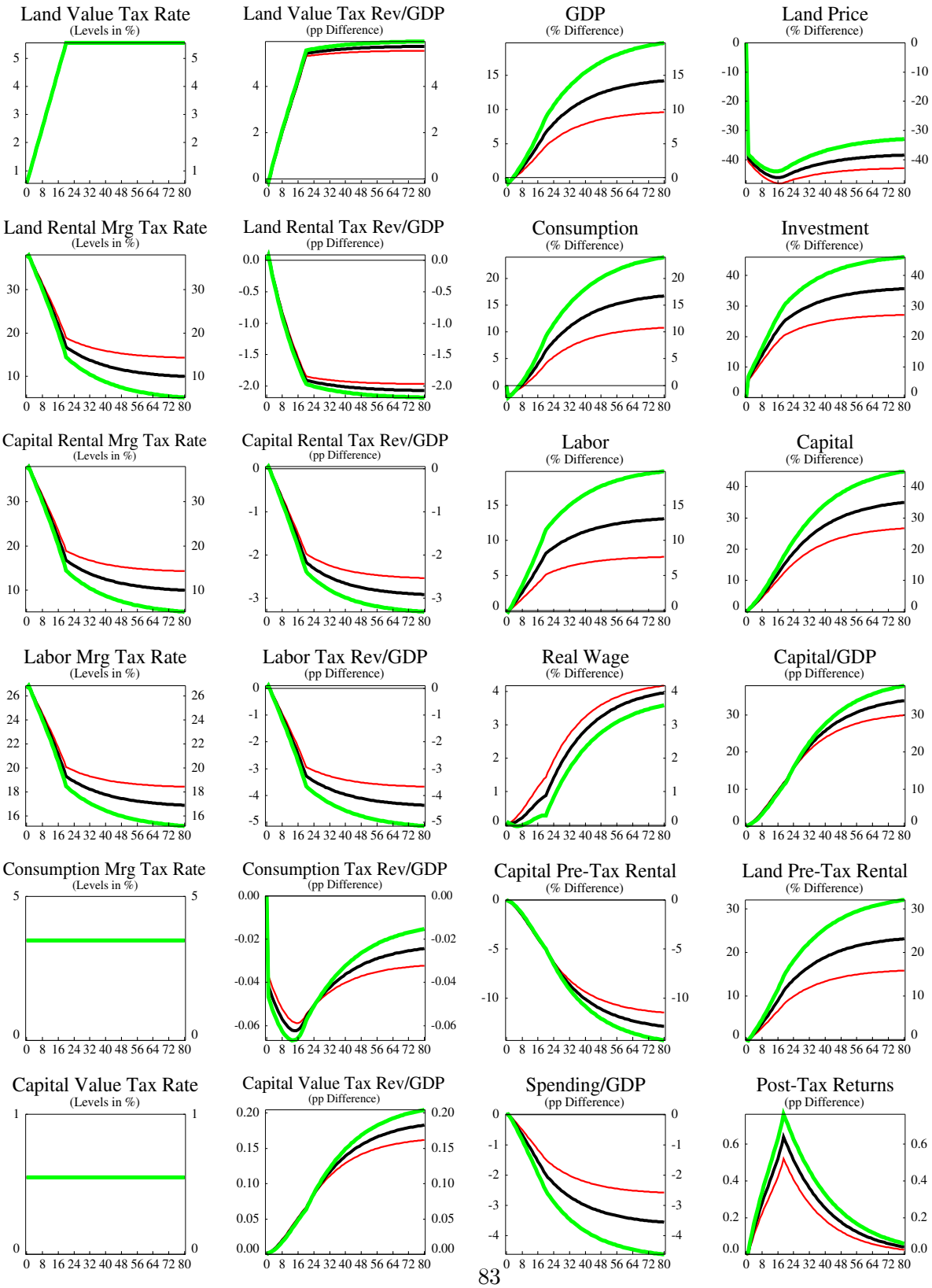
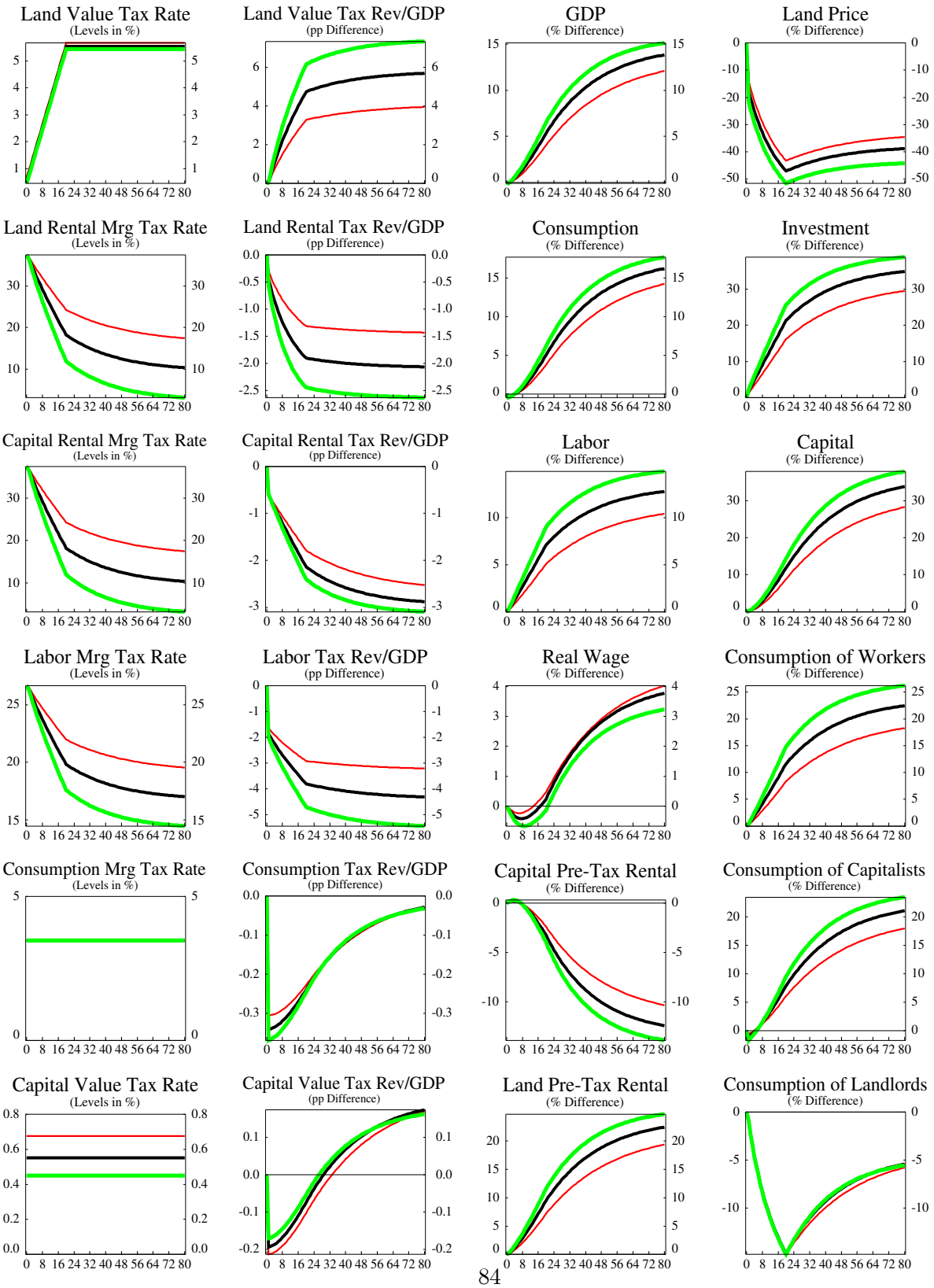


Figure 14. LAVT Increase of 5 Percentage Points under Different Labor Supply Elasticities



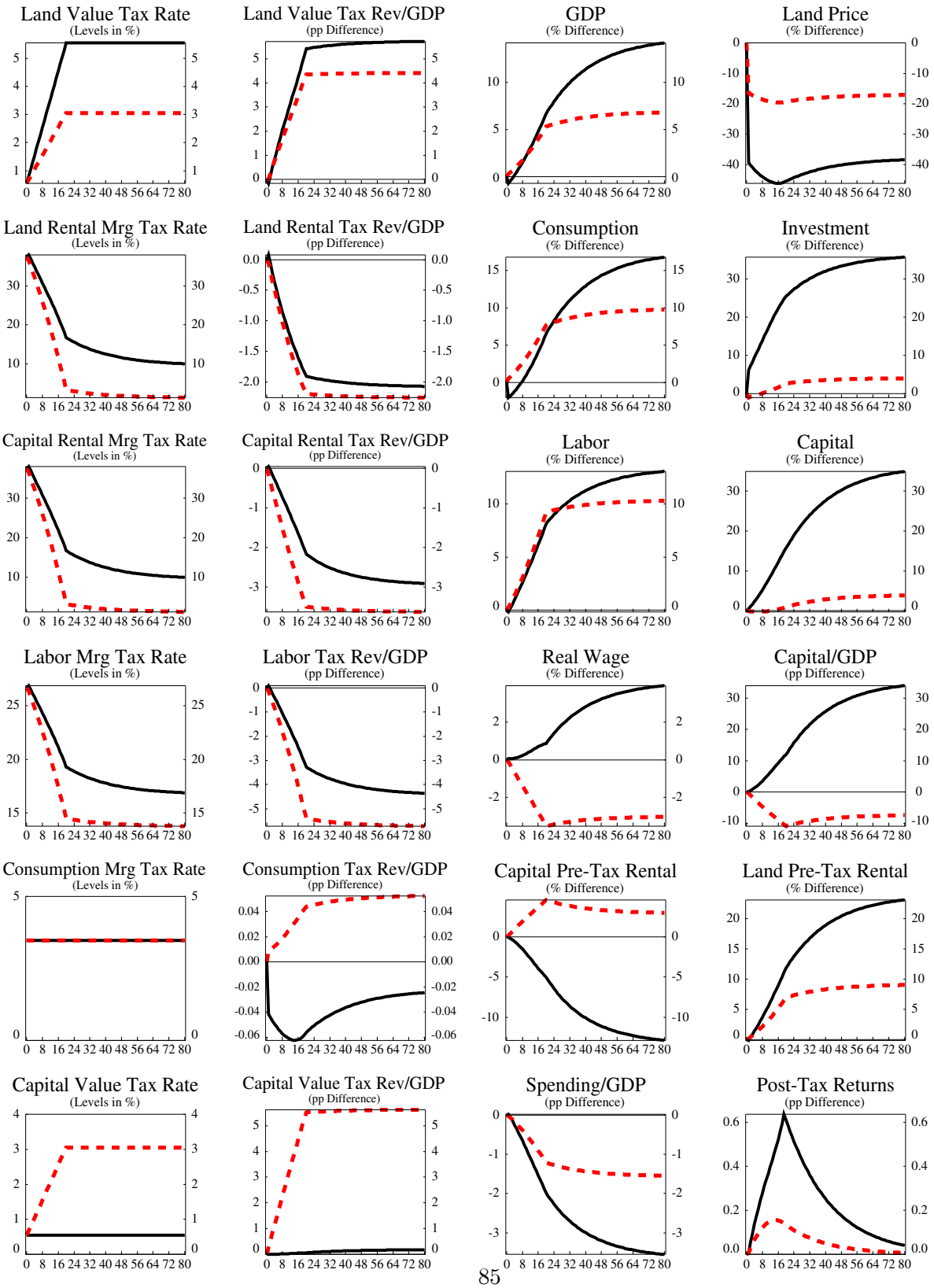
(thin red lines: $\theta = 0.50$ / medium black lines: $\theta = 0.75$ / thick green lines: $\theta = 1.00$)

Figure 15. LAVT Increase of 5 Percentage Points with Workers, Capitalists and Landlords



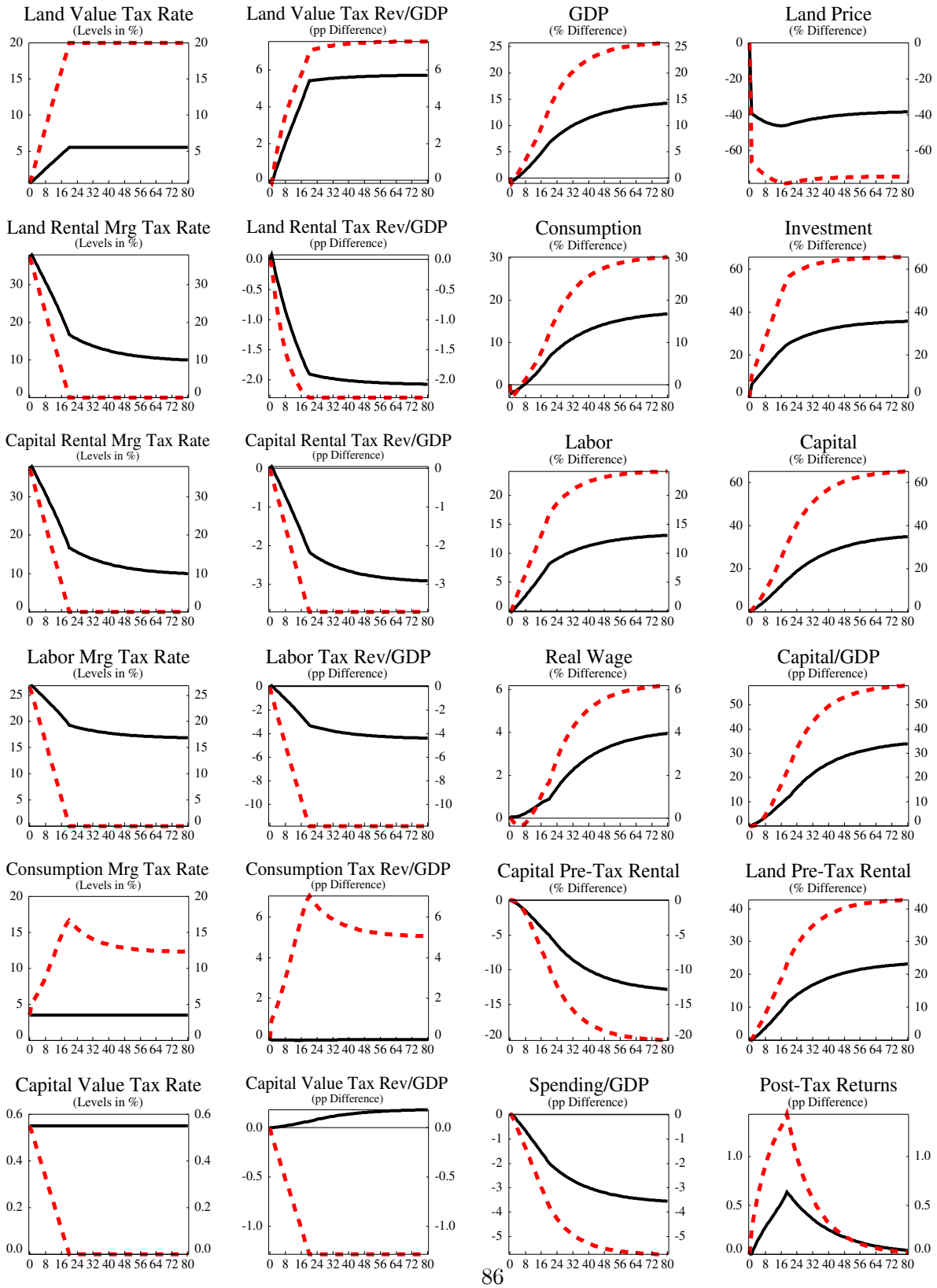
(Land Shares: thin red lines = 40% / medium black lines = 51.1% / thick green lines = 60%)

Figure 16. LAVT Baseline versus Wealth Tax



(Solid black lines = LAVT Baseline / Dashed red lines = Wealth Tax)

Figure 17. LAVT Baseline versus Optimal Tax with a 20 Percent LAVT Cap



(Solid black lines = LAVT Baseline / Dashed red lines = Optimal Tax with 20% LAVT Cap)