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Land Tax Changes and Full Capitalisation*

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Abstract

We use a unique data set to examine the extent to which changes in the Danish land tax are capitalised into house prices. The Danish local government reform in 2007, which caused tax increases in some municipalities and tax decreases in others, provides plenty of exogenous variation, thus eliminating endogeneity problems. The results imply full capitalisation of the present value of future taxes under reasonable assumptions about discount rates. Consequently, the paper gives an empirical confirmation of two striking consequences of a land tax. First, it does not distort economic decisions because it does not distort the user cost of land. Second, the full incidence of a permanent land tax change lies on the owner at the time of the (announcement of the) tax change; future owners, even though they officially pay the recurrent taxes, are not affected as they are fully compensated via a corresponding change in the acquisition price of the asset.

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Policy points

- In principle, a land tax does not affect economic activity.
- Our empirical study supports full capitalisation of changes in land tax rates into housing prices.
- Land taxes are interesting in a globalised world due to the inherently non-mobile tax base.
- Few countries have a land tax even though it is less distortive than most other taxes.

I. Introduction

According to economic theory, land taxation has several striking features. From a public finance perspective, it is one of the very few existing taxes which can be considered non-distortionary, as opposed to other taxes which distort decisions of labour supply, savings, investment, consumer choice, etc. Second, and related to this, the incidence effects of land taxation are striking. According to simple supply theory, a supposedly permanent change in the taxation of land (or any other asset with a fixed supply) will be capitalised fully in the market price of land.[1] This implies that the owner of the land plot at the time of the (reliable) announcement of the tax change will bear the full burden of tax increases and receive the full gain of tax decreases through the corresponding change in the land price. A person who buys a plot of land on which there is a land tax will formally pay these taxes in future, but will be effectively compensated by a corresponding fall in the acquisition price of the asset.

This simple reasoning may be questioned for several reasons, however. It relies on the assumption that the relevant land area is fixed so that the tax changes do not alter land supply. Also, it presupposes a very long-run horizon among the agents on the land market. Myopic agents would not take the costs of future land taxes sufficiently into account, causing the capitalisation to be less than complete.

More formally, the user cost of a unit of land P_t^{UC}, whether used for residential or other purposes, can be written as

$$(1) \qquad P_t^{UC} = (r_t + T_t)\, P_{t-1}^{L} - \left(P_t^{L} - P_{t-1}^{L}\right),$$

where r_t is the interest rate of a relevant alternative investment, T_t is the land tax rate and P_t^L is the market price of a unit of land at the end of period t. The equation states that the relevant total cost of owning a unit of land consists of the opportunity cost (the forgone interest of an alternative investment) plus the

[1] Oates, 1969.

tax paid minus the capital gain obtained if the price of the land plot rises. Full capitalisation implies that the land price, P_t^L, adjusts sufficiently in the case of a tax change to leave the future total user cost unchanged (except for the period in which the price adjustment itself takes place, which affects the last term on the right-hand side of equation 1). Hence, in the case of full capitalisation, the future relative price between land and building investments (or land and other permanent goods) is not distorted at all. Less than 100 per cent capitalisation, however, would in turn have serious consequences for the efficiency effect of the land tax. If the tax is not capitalised into prices, changing the land tax will alter the user cost of land. This may change the relative price between land and building investments and consequently distort the input mix in the production of new dwellings.[2]

The present paper performs an econometric analysis to examine capitalisation effects of land tax changes. It utilises a unique opportunity in the form of a local government reform in Denmark in 2007. Denmark has a long tradition (since 1926) of mandatory, but locally decided, taxes on the value of all land areas. In 2007, several municipalities were merged into larger units, implying a standardisation of the typically diverse rates of the different constituent parts of the new administrative units. Consequently, some landowners experienced a rise and others a fall in their future taxation. Employing prices for home sales before and after the reform was announced and carried out and controlling for a number of other potentially important factors, we examine the effect of the tax changes upon home sales prices. The conclusion is very clear, indicating a statistically significant change in sales prices compatible with 100 per cent capitalisation of the future land tax changes using a reasonable discount rate.

There exist few other studies of land taxation. However, capitalisation of property taxes (typically levied on the total value of building and land plot) has been studied in a number of cases. The method used in the present study is inspired by Borge and Rattsø (2014), who study capitalisation of Norwegian property taxes during 1995–97. They also find evidence of complete capitalisation. As the authors note themselves, however, examining the relationship between tax rate and house price changes may generally result in endogeneity problems, which they try to avoid using various instrumental variables. The present study is immune to this problem because the Danish local government reform of 2007 exogenously imposes the tax rate changes.

Oates (1969), in a seminal paper, tested the empirical validity of the hypothesis of full capitalisation. He concluded that in the case of an isolated tax increase, 'the bulk of the rise' would be capitalised in house prices. Oates's study has inspired a large flow of literature, confirming a negative effect on property values from future tax liabilities, but failing to reach a consensus on

[2]Sørensen and Vastrup, 2015.

the extent of the capitalisation. Capozza, Green and Hendershott (1996) and Palmon and Smith (1998) also find support for full house price capitalisation of changes in property taxes. Hilber (2015) surveys a number of earlier studies of house price capitalisation of local taxes as well as provision of public goods. He examines studies indicating full capitalisation as well as studies implying partial capitalisation, depending among other things on the supposed supply elasticity of housing. Hilber notes that the extent of capitalisation of property taxes should depend crucially on the long-run supply elasticity of housing: the more inelastic is supply, the larger is the capitalisation effect. This makes an analysis of land taxes as opposed to more general property taxes (taxing the total value of land including structures situated upon the land) interesting, land being completely inelastic as opposed to buildings etc., which may change over time due to depreciation as well as new investment.

It can be difficult to carry out an in-depth empirical analysis of capitalisation of land tax because detailed information on sales prices is needed. However, Denmark has nationwide registers with detailed information for a long time span about all sales prices, size, location, public assessment of the value etc. on all owner-occupied dwellings. The data cover all local governments, with large variations in housing markets. The information in the registers is considered to be of high quality because it is mandatory to report information to the authorities. We have information on the effective land tax for all owner-occupied houses. It is thus possible to investigate whether changes in land taxes are capitalised in the property value using Danish data.

The results of the paper are relevant not least because of the increasing pressure upon the tax system in many countries. Globalisation means that capital and labour are becoming more internationally mobile, and therefore the tax bases are becoming more vulnerable to international tax competition. A higher reliance on land taxation might alleviate this pressure. So far, however, only a few countries, including Australia, Brazil, China, Denmark, France and New Zealand, have a land tax.[3] In addition, several Eastern European countries instituted a land tax during the 1990s when the tax system was redesigned after the collapse of the communist regimes. Other countries might see an advantage in following in their footsteps.

The paper is organised as follows. In Section II, the institutional background for the analysis is described, i.e. the properties of the Danish land tax system and local government organisation and the reform of 2007. In Section III, the methodological approach for the analysis is set out. Section IV presents and explains the econometric model used and Section V demonstrates the results. Section VI concludes and discusses policy implications of the results.

[3] Almy, 2014.

II. Institutional background

In Denmark, land tax rates are locally set by the municipal boards and levied on the land value of the plot on which a property lies. The land value is officially assessed every two years together with the total property value (and implicitly consequently the value of the buildings and structures upon the land plot, constituting the difference between the value of the land plot and the total property value). The assessment procedure is the responsibility of the central government and common for all municipalities, using statistical valuation methods based upon property sales prices and individual housing characteristics, supplemented by discretionary judgements by individual property valuers.[4] The municipal board can set a land tax rate between 16 and 34 per mille of the assessed land value. Land tax rates differ substantially across the country and even between neighbouring municipalities.

In 2007, a local government reform reduced the number of municipalities from 270 to 98, requiring an alignment of the locally determined land tax rates within these new municipalities. Thirty-three municipalities were not affected by the reform. The remaining 237 municipalities were divided into 250 different areas, which were then merged into 65 new municipalities. Of the 237 old municipalities, 225 were merged without further changes, but 11 of the old municipalities were divided between two new municipalities and one was divided between three new municipalities. Because some old municipalities were split, it is necessary to distinguish between areas instead of old municipalities. As shown in Table 1, the local government reform resulted in an increase in land tax rates in 139 areas. In these areas, land taxes rose on average by 3.4 per mille points. The tax rate decreased in 105 areas, by an average of 2.6 per mille points. We base our identification of the capitalisation effects on these changes in land tax rates, which we regard as exogenous.

TABLE 1

Average[a] change in land tax rates in areas

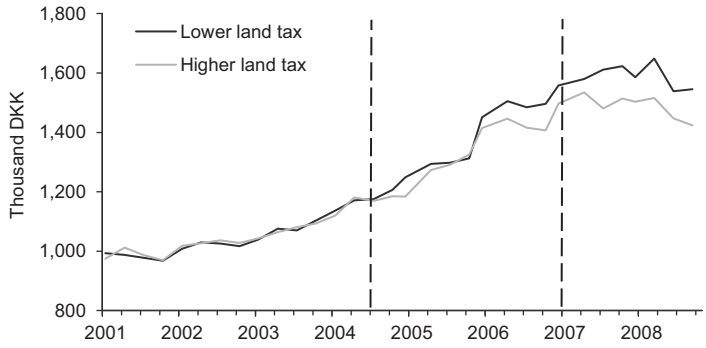
Land tax rate . . .	*Number of areas*	*Tax rate before (‰)*	*Tax rate after (‰)*	*Change in tax rate (per mille points)*
. . . increased	139	20.6	24.0	3.4
. . . unchanged	6	28.0	28.0	0.0
. . . decreased	105	26.1	23.5	–2.6
Total	250	23.1	23.9	0.8

[a]Unweighted average over areas.

[4]Besides pure land taxes, the property assessment values are used for separate taxation of the value of owner-occupied real property and of commercial buildings.

FIGURE 1

Development in prices for single-family homes experiencing respectively a decrease and an increase in land tax rates



The local government reform was brought into effect on 1 January 2007, but had already been announced in June 2004. It was decided in 2005 which municipalities should be merged, and the new land tax rates were determined in autumn of 2006.[5] It is therefore likely that real-estate prices were affected by the expectation of changes even before the mergers took place. We thus expect that the local government reform had a gradual effect on prices through the formation of expectations about future changes in tax rates.

This is supported by Figure 1, which depicts average prices for single-family homes in areas where taxes increased and decreased, respectively. Up until the announcement in 2004, indicated by the left-hand dashed line, the development of prices of single-family homes was roughly similar in the two groups. From the announcement and until the implementation in 2007, indicated by the right-hand dashed line in the figure, prices increased less in areas where the land tax was increased than in areas where it was decreased. After the implementation of the local government reform, the difference in prices stabilised through 2007 and 2008. The average prices of single-family homes are consistently higher in areas where the land tax rates decreased.

Table 2 compares the prices for single-family homes before and after the reform. In 2003, before the announcement of the reform, prices were on average 2,000 DKK lower in the areas that would later experience an increase in land value taxes than in the areas where taxes later decreased. In 2007, after the announcement and implementation of the reform, the same difference had grown to 78,000 DKK. Prices for single-family homes had, on average,

[5]The central government stipulated an upper bound for the new land tax rates for 2007 as a weighted average of the land tax rates of the old municipalities. The vast majority of the new municipalities chose to set land tax rates equal to the upper bound set by the government. Only a single municipality, Holbæk, chose a land tax rate that was more than half a per mille below the upper bound.

TABLE 2

Average[a] prices for single-family homes before and after the reform

	2003 (thousand DKK)	*2007 (thousand DKK)*	*Difference (thousand DKK)*
Areas with land tax increase	1,076	1,557	481
Areas with land tax decrease	1,078	1,635	557
Difference	–2	–78	–76

[a]Unweighted average over areas.

increased by 76,000 DKK less in the areas that experienced an increase in taxes, amounting to 7 percentage points lower price growth in those areas. Thus, there was substantially lower price growth in areas where taxes rose.

Figure 1 and Table 2 indicate that the land tax changes had a clear capitalisation effect on prices for single-family homes. However, it cannot a priori be ruled out that other factors might differ systematically between the two groups of single-family homes and explain the different developments in prices. To further test and quantify the capitalisation effect, a formal econometric analysis is conducted below.

III. Methodological approach

The mechanism behind capitalisation can be understood in a framework of household mobility and the housing market.[6] This framework is presented in this section in a way similar to the approach of Borge and Rattsø (2014). Households are assumed to have identical preferences but different incomes. The stock of housing is taken as given, and housing value is entirely demand determined. Mobility contributes to equalise the after-tax unit price of housing. If two municipalities differ only with respect to land tax rates, then the municipality with higher land tax rates should have correspondingly lower housing prices. Taxes are fully capitalised in prices if the difference in housing prices is equal to the present value of all future differences in tax payments.

Let households derive utility from housing services, H, municipal services, Q, amenities, A, and a private numeraire good, X. This implies a utility function of the form $U = U(H, Q, A, X)$. In equilibrium, the household must obtain the highest possible utility level corresponding to its income level. This yields the equilibrium condition

[6]Brueckner, 1982.

$$U^*(Y) = U(H, Q, A, X), \tag{2}$$

where the consumption of the numeraire good can be written as income, Y, less expenditure on housing, R, and housing taxes, T: $X = Y - R - T$. Thus, the equilibrium condition defines the household's bid rent for housing R as a function of housing services, municipal services, amenities and income. The after-tax value derived from living in a property for one period of time is thus

$$V_t = R(H, Q, A, Y) - T. \tag{3}$$

In the case of land value taxes, $T = LTR \times L$, where LTR denotes land tax rates and L the land value. The value of a property, V, is then the present value of all future V_t. Assuming a constant discount rate, r, and a very long time horizon gives the following expression for the value of a property:

$$V = \frac{R(H, Q, A, Y) - LTR \times L}{r}. \tag{4}$$

Since the land tax is only levied on the land value and not the value of the property, the *ceteris paribus* effect of changes in the land tax rate on the value of the property is given by

$$\Delta \mathrm{V} = -\frac{\Delta LTR \times L}{r}. \tag{5}$$

In equation 5, it is assumed that the land value is unaffected by the changes in tax rates. It is plausible that lower property prices following an increase in taxes lead to lower land value assessments. This can create a downward bias in the coefficient on land taxes in a regression and thus understate the degree of capitalisation. As the bias points to less than full capitalisation, it does not pose a problem against the conclusion of full capitalisation in Section V. Equation 5 is equivalent to the definition of full capitalisation introduced above. If the land tax rate increases, the value of the property must fall equally to the present value of all future additional land tax payments.

If both sides of equation 5 are divided by the value of the property V, it is seen that the relative effect on the value of a property caused by a change in the land tax rate depends only on the ratio of the land value to the value of the property:

$$\frac{\Delta V}{V} = -\frac{\Delta LTR}{r}\frac{L}{V}. \tag{6}$$

Define the effective land tax rate as

$$ELTR = LTR\frac{L}{V}. \tag{7}$$

Equation 7 states that the effective land tax rate is the fraction of the total property value paid in land tax. Taken together, equations 6 and 7 define a linear causal relation between changes in effective land tax rates and changes in property prices:

$$\frac{\Delta V}{V} = -\frac{1}{r}\,\Delta ELTR. \tag{8}$$

Equation 8 is crucial to the analysis. It implies that the relative effect of changes in effective land tax rates on property prices is constant. The local government reform provides a multitude of exogenous changes in tax rates and, combined with the linear restriction implied by equation 8, the effect of changes in effective land tax rates on property prices can be estimated.

If land taxes are fully capitalised, there is a negative relation between property prices and effective land tax rates of a magnitude in accordance with equation 8. That is, the coefficient on $\Delta ELTR$ in the analysis below should be inversely proportional to the discount rate of households. As the discount rate indicates how households value future cash flows, it should be in accordance with the long-term financial instruments available to the households. No single interest rate can be said to reflect the actual discount rate of households. However, comparing interest rates on primary sources of lending and savings for households indicates boundaries on the discount rate. A major source of lending for households is Danish mortgage bonds with fixed interest rates and 30-year maturity, the average real interest rate on which was 3.5 per cent in the period 2001–08.[7] This can be seen as an indication of an upper bound on the level of the discount rate of households. Danish treasury bonds with 10-year maturity are generally considered to be a safe long-term investment in Denmark and can be used to indicate a lower bound on the discount rate of households. From 2001 to 2008, the average real interest rate on treasury bonds was 2.2 per cent. It was possible for households to lend and save at both lower and higher interest rates, but this would generally imply a shorter maturity or a higher risk. Thus, the presented interest rates indicate that households faced real interest rates of around 2–3 per cent.

A real interest rate and thus an expected discount rate of 2–3 per cent is consistent with the literature. Borge and Rattsø (2014), who use an approach similar to ours, find implied discount rates in the interval 2.3–2.9 per cent. They compare their estimates with real interest rates on bank deposits and loans and

[7]The interest rate is deflated by the consumer price index.

find these discount rates consistent with full capitalisation. Giglio, Maggiori and Stroebel (2015) compare differences in prices between freeholds and leaseholds on the UK and Singaporean housing markets. Their results imply a discount rate for 100-year claims of 2.6 per cent. Do and Sirmans (1994) exploit evidence from a tax expected to be fully capitalised into property values in the south-western part of San Diego County, California. They find that households discount future tax payments with a nominal interest rate of 4 per cent. Depending on the inflationary expectations of San Diego households, their approach similarly implies a real interest rate and therefore a discount rate of around 2–3 per cent.

Based on the prevailing interest rates and the evidence from the literature, we find it reasonable to expect a discount rate of 2–3 per cent. Thus, the coefficients on the change in effective land tax rates estimated below should imply a discount rate of around 2–3 per cent, if we are to conclude full capitalisation of changes in land taxes into housing prices.

IV. Data and econometric model

The approach adopted in this paper is a before-, during- and after-treatment set-up due to the likely gradual formation of expectations of future tax rates described in Section II. This requires data on property prices for single-family homes prior to the implementation of the reform as well as prior to the announcement of the reform. Single-family homes sold from 2001 and up to the announcement in the second quarter of 2004 are used as a pre-treatment group. Single-family homes sold between the third quarter of 2004 and the implementation of the reform on 1 January 2007 constitute a during-treatment group. The mergers and new tax rates were decided and announced during this period. Lastly, the after-treatment group consists of houses sold during 2007 and 2008.

As implied by equation 8, the changes in effective land tax rates following the local government reform are used to identify the degree of capitalisation of land value taxes. The analysis is therefore based on single-family homes in municipalities affected by the local government reform sold between 2001 and 2008. The price for single-family homes is for the property, i.e. building and land. Data on house sales and prices come from the Danish Land Registration Court. The court handles the registration of all titles to land and properties in Denmark and ownership is only recognised if registered at the Land Registration Court. Data on property taxes come from the Danish Customs and Tax Administration and other data on houses come from the Building and Dwelling Register maintained by the Danish municipalities. The analysis is therefore based on a rich administrative data set of a high quality.

The main econometric model is presented in equation 9. It resembles that of a standard difference-in-differences approach, where the development of

the prices for single-family homes is compared before and after the local government reform. However, in our approach, the binary treatment indicator is replaced by a continuous treatment, and the parameter δ_t describes the effect at time t of changes in effective land tax rates $\Delta ELTR_h$ in 2007. $\Delta ELTR_h$ is calculated using equation 7. δ_t is estimated from the third quarter of 2004 to capture the gradual effect on prices:

$$\log P_{h,t} = \lambda_t + \alpha_j + \sum_{t=2004}^{2008} \delta_t \, \Delta ELTR_h + \sum_{t=2004}^{2008} \gamma_t \, \Delta TAX_j + \beta \, asmt01_h + \varepsilon_{h,j,t}. \quad (9)$$

Index h denotes house, j area and t time. The dependent variable, $\log P_{h,t}$, is the logarithm of deflated house prices. Prices are deflated with Statistics Denmark's regional price index (11 regions) for property sales of single-family homes.[8] $asmt01_h$ is the logarithm of the public property assessment in 2001. Yearly dummies, λ_t, and area dummies, α_j, are included as controls and $\varepsilon_{h,j,t}$ is an error term.

Because we have chosen to specify our model in logarithms, we assume that the percentage changes in prices for single-family homes that experienced respectively a decrease and an increase in land tax would be the same in the case with no property tax reform. This assumption is violated if there are general equilibrium effects on the market for single-family homes as a result of the change in land taxes, which could be the case if there is a negative cross-price-elasticity effect. For example, it is possible that a demand shift occurred towards single-family homes in areas where the land taxes decreased. It is not possible to test the assumption directly. However, it seems that the prices for the two groups in Figure 1 evolve relatively parallel after 2008.

The merger led to uniform land tax rates as well as uniform service provision in the new municipalities. If a municipality with relatively high tax rates and service levels is merged with a municipality having lower tax rates and service levels, it would presumably experience a decrease in tax rates as well as in services after the merger. As both tax rates and service provision will affect housing prices, ideally municipal services should be included as well as taxes in the estimation equation.

However, we do not have a consistent measure of overall service provided by the municipalities before and after the reform. The reason is that the reform not only altered the size of the municipalities, but also abolished the former Danish counties. Some of the services provided by the counties were transferred

[8]The model has also been estimated with nominal prices instead of real prices, with no qualitative and limited quantitative consequences for the results.

to the new municipalities.[9] Instead, changes in municipal income tax rates following the reform, ΔTAX_j, are included as a proxy for changes in municipal services.[10] This is based on an assumption that changes in local income tax rates are closely correlated to changes in the locally provided service. Since municipalities in Denmark are required to run a balanced budget, this seems a plausible assumption. ΔTAX_j is interacted with yearly dummies starting from the third quarter of 2004 to capture any potential expectations of changes in future municipal services following the reform.

Important aspects when it comes to determining the price of a single-family home are housing characteristics and proximity to public amenities, shops and infrastructure. We use the official property assessments as a proxy for these factors, instead of geospatial data and lots of data on characteristics for the individual buildings. The public property assessments are based on geospatial data and on data about housing characteristics, such as size, year of construction and facilities, from the Building and Dwelling Register and other sources. The Danish public assessment system on immovable property has been considered in an international context to be quite advanced and accurate.[11] To avoid having the reform interfering with the assessments, the property assessments from 2001 are used. This amounts to assuming that amenities, infrastructure etc. have been roughly constant during the period of estimation.

Descriptive statistics on variables used in equation 9 are presented in Table 3. It should be noticed that the average change in effective land tax rates is close to zero. This implies that the reform was not used to systematically raise or lower land tax revenues. Our data set contains 211,209 observations covering 250 areas. All houses within the same area experienced the same changes in actual land tax rates following the reform. This implies that adding a new area should yield more information than adding more houses to existing areas. To control for these potential correlations within areas, clustered standard errors are used, where the clusters are the areas. The consistency of the estimator of clustered standard errors depends not only on the number of observations but also on the number of clusters.[12] The numbers of observations and areas reported in Table 3 imply that there are, on average, 845 houses in each cluster. The number of clusters and the number of observations in each cluster should be sufficient to ensure consistency.

[9]Until 2007, Denmark was divided into 15 counties and 270 municipalities, each administrative level having its own responsibilities. The reform abolished the counties and introduced five major regions. The counties' tasks were divided between the new municipalities, the new regions and the central government.

[10]Changes in land taxes could also affect municipal service, but are not included as a proxy for municipal service. However, land taxes account for only 13 per cent of total municipal revenue, so the potential bias of this is considered to be very limited.

[11]Almy, 2014; OECD, 2016.

[12]Angrist and Pischke, 2009.

TABLE 3

Descriptive statistics

	Mean	*Standard deviation*
Real house price in 2006 (DKK)[a]	1,552,322	983,950
Public property assessment in 2001 (DKK)[b]	1,370,254	665,530
Change in effective land tax rate (per mille points)[c]	0.05	0.64
Change in local income tax (percentage points)[c]	−0.14	0.76
Number of observations	211,209	
Number of areas	250	

[a]House prices are deflated by Statistics Denmark's regional house price index.
[b]Displayed average and standard deviation are deflated by the regional house price index.
[c]Average based on houses sold after the announcement of the reform.

V. Results

In this section, the results are presented and their robustness is tested. The results are summarised in Table 4. The results from the main model indicate full capitalisation of changes in land taxes. Excluding all controls shows that they only contribute to the efficiency of the estimates.

1. Main model

Model 1 in Table 4 presents the estimated coefficients from the main model. The coefficients on effective land tax rates fall from –0.0225 in 2004 to –0.0426 in 2007, implying a gradually larger impact of the changes in tax rates on prices. This is in accordance with the expected gradual formation of expectations following the announcement of the reform. The magnitude of the coefficients is also consistent with full capitalisation of changes in land taxes. Equation 8 implies that the inverse of the coefficient should equal the long-term interest rate. For 2007, this implies a discount rate of 2.3 per cent:

$$(10) \qquad r = -\frac{0.001}{\delta_{2007}} = \frac{0.001}{0.0426} = 0.023.$$

All implied discount rates are reported in Table 4. Given the reported standard error, the estimated coefficient for 2007 is reconcilable with a discount rate in the interval 2–3 per cent. The main model thus indicates full capitalisation of land value taxes into real-estate prices.

The implied discount rate of 4.1 per cent in 2008 is not directly reconcilable with full capitalisation. However, the year 2008 was in many ways special. In that year, the Customs and Tax Administration introduced new assessments

TABLE 4

Regression results

	Model 1		Model 2	
	Estimate	*Discount rate*	*Estimate*	*Discount rate*
2004: Δ*ELTR*	–0.0225**	4.4%	–0.0252*	4.0%
	(0.01069)		(0.01467)	
2005: Δ*ELTR*	–0.0346***	2.9%	–0.0441***	2.3%
	(0.01152)		(0.01475)	
2006: Δ*ELTR*	–0.0364***	2.7%	–0.0403***	2.5%
	(0.01066)		(0.01344)	
2007: Δ*ELTR*	–0.0426***	2.3%	–0.0474***	2.1%
	(0.01152)		(0.01414)	
2008: Δ*ELTR*	–0.0246***	4.1%	–0.0289***	3.5%
	(0.00830)		(0.01014)	
2004: Δ*TAX*	0.0069*			
	(0.00363)			
2005: Δ*TAX*	0.0052			
	(0.00408)			
2006: Δ*TAX*	0.0122**			
	(0.00547)			
2007: Δ*TAX*	0.0148***			
	(0.00528)			
2008: Δ*TAX*	0.0055			
	(0.00469)			
Assessment	0.6615***			
	(0.01175)			
Observations	211,209		211,209	
R^2	0.768		0.572	

Note: Clustered standard errors are given in parentheses. ***p<0.01, **p<0.05, *p<0.1.

such that the average assessed land value in the population of single-family homes used in the analysis increased by 50 per cent between 2007 and 2008, but with a considerable dispersion. Changes in assessments affect land taxes. The change in assessments coincided with the financial crisis, which affected house prices differently in various areas. These circumstances call into question what really determines the coefficient in 2008. We therefore refrain from giving the coefficients and implied discount rates in 2008 a causal interpretation.

2. Without controls

A way to examine whether the changes in land tax rates were truly exogenous is to remove all controls. The main assumption behind the conclusion of full capitalisation is that the observed changes in prices are only due to the changes

in land tax rates. If it is so, all other controls only serve to explain the overall level of prices and leaving them out should only affect efficiency.

The estimated coefficients from the model estimated without controls are presented as model 2 in Table 4. They are only marginally larger in magnitude than before. The standard errors, however, have all grown by roughly a third, implying that the controls only contribute to efficiency.

Overall, after we have addressed all major objections against the econometric analysis, the conclusion of full capitalisation of changes in land taxes still holds.

VI. Conclusion

Using a unique administrative Danish data set for sales prices and house characteristics for single-family homes, effects upon sales prices of changes in land tax rates have been analysed in this paper. The analysis utilises the Danish local government reform in 2007 when numerous smaller municipalities were merged into larger ones, resulting in changes in land tax rates for several local areas. Altogether, 237 out of 270 original municipalities containing about 75 per cent of all Danish one-family homes were merged during the process, the vast majority experiencing a resulting change in land tax rates. The reform thus provides plenty of exogenous variation, eliminating potential endogeneity problems. The results demonstrate a clear effect on sales prices of the observed changes in land tax rates. Furthermore, the magnitude of the changes implies full capitalisation of the present value of the change in future tax payments for a discount rate of 2.3 per cent, which is within the range of reasonable discount rates for households during the period in question. The analysis consequently supports the hypothesis that perceived permanent land tax changes are capitalised fully into the price of land and property.

The result supports the view that a tax on the value of all land, such as the existing Danish land tax, does not distort economic decisions as it does not affect the user cost of land and consequently the relevant relative prices. An implication is that introducing or increasing the relative weight of land taxation in the tax system would conceivably reduce overall distortions and create a system that is more robust to the pressure of globalisation upon other sources of revenue. At the same time, however, full capitalisation of land taxes implies that the owner of a land plot at the time of the announcement of a permanent land tax change bears the whole burden of the tax change in present-value terms. Hence, land tax changes may have large redistributive implications, implying a requirement to impose such changes, when desired, rather incrementally.

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