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Differential land rent and agricultural taxation

Alexander RYMANOV

Department of Corporate Governance and Finance, Novosibirsk State University of Economics and Management, Novosibirsk, Russia

Corresponding author: rymanov@yandex.com

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Abstract: The paper addresses the influence of various types of taxes on changes in differential (Ricardian) land rent, and the economic performance of agricultural producers. Labour and capital taxes lead to higher prices for agricultural products, causing a decrease in consumer demand and lower income for agricultural producers (mostly utilizing marginal land). A polynomial single-product model has been used to demonstrate that reducing the tax burden on agricultural producers – specifically taxes on labour and capital – will result in increases in differential land rents on the average and relatively better plots, and/or the emergence of the rent on the marginal land. Thus, substituting labour and capital taxes for land/property taxes reduces the overall tax burden of agricultural producers on marginal lands.

Keywords: economic rent, farm costs, farm taxation, marginal land, real estate tax, tax on labour

The value of land rent described by the developers of classical economics (Smith 1776; Ricardo 1821) differs from that described in modern economics. In classical economics, rent was considered in terms of the low rate of the tax burden. In conditions of public expenditure growth, its level rose significantly. Thus, with taxes excluded, the relatively better and average plots could generate differential land rent, which was significantly reduced or absent given the existing tax burden. The main reason for why the reduced differential land rent is due to rising taxes, rather than returns on other production factors, is the fact that the supply of land is inelastic. Reduced wages or interest due to increased taxes will lead to an outflow of labour and capital resources; i.e., the supply of these production factors will decrease with resulting impacts on output. If the rate of differential land rent is reduced due to increased land and property taxes, the supply of land would not decrease due to its immobility. Consequently, the reduction of the differential land rent would not affect the production output.

Taxes on labour and capital, the major taxes in the agricultural sector, lead to an increase in prices of agricultural products, causing a decline in consumer demand and a decrease in farm income. For the most part, this applies to farms utilizing the worst land (the so-called marginal lands), which are not likely to generate differential land (economic) rent in the absence of taxes. Agricultural taxation does not fully take into account the effect of the objective conditions of agricultural production (location, quality of agricultural land).

Different countries have different land taxes and property taxes. In Australia, general land tax is applied as a state and territory tax on land in every state of the country (Andersen et al. 2002).

A unified agricultural tax utilizing a 2% uniform tax rate that substituting all other taxes has been introduced by Belarus (World Bank 2009).

Real estate taxes in Canada are claimed by the provinces or municipalities. Agriculture properties in the country are taxed less than other properties (Andersen et al. 2002).

China's tax-for-fee reform (TFR) is an attempt by the central government to alleviate the burden of taxes and fees imposed on villagers during the entire period of the 1990s (Kennedy 2007). The TFR aims to streamline local revenue collection and to put in place more transparent and efficient service provisions. The TFR has reduced the burdens imposed on villagers by completely eliminating local fees and by introducing a single agricultural tax. In 2002, this system was widely put in place in 20 provinces. The central government, in order to further alleviate the burdens of the villagers, proclaimed that agricultural

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tax would be completely eliminated by 2006. Veeck and Shui (2011), OECD-FAO (2013), and Wang and Shen (2014) reported that China did indeed, in 2006, totally eliminated the payment of agricultural tax. The tax burden on farmers had been increasing for years, until a decision was made, after much study, to scrap all taxes. In accordance with the provisions of the state, all firms that specialize in the production of agricultural machinery are qualified to tax breaks or temporarily given tax "holidays" for certain periods of time.

All agricultural and non-agricultural properties in Germany receive equal treatment when it comes to tax (Andersen et al. 2002).

Italy has a communal tax imposed on immovable property. Agricultural and forestry properties are taxed lower than other properties because the computation of such properties is made on the basis of the cadastral value rather than on the real value of farm (Andersen et al. 2002).

In the country of Kazakhstan, a 70% discount on taxes is extended to agricultural organizations. Also, a single land tax replaced six tax schemes in the form of land tax and property tax, together with social tax and value added tax, as well as corporate income tax and tax on vehicles for individual farms. This single land tax is set at a percentage of land cadastre value (OECD 2013; Yessengeldin et al. 2014).

In the Russian Federation, a single agricultural tax can be selected by agricultural organizations and individual farm owners. The rate of the single agricultural tax is 6%, which is computed by determining the difference between the value of gross receipts and costs. With single agricultural tax, tax payers are given exemption from paying income tax, property tax, and value added tax (OECD 2013; Rymanov 2014).

The property tax in Switzerland is a local tax. The calculations for the property tax in the agricultural land valuation are made on the basis of the use value.

The council tax for dwelling houses in the United Kingdom is considered a partial payment for different local services such as water and sewage, together with rubbish, and as a partial direct tax collected by the municipal and the district governments.

In the United States, many of the states have either real estate taxes or similar property taxes. The property tax of agricultural properties utilizes a value that is between 40 to 70% less than the market value. Some other states have their property tax rates for agricultural properties set at values lower than for other properties (Andersen et al. 2002).

MATERIALS AND METHODS

I used a polynomial single-product model to evaluate the influence of agricultural taxation on agricultural producers on land plots of differing productivities.

Taxation of a part or the entire value of the differential land rent was acknowledged by prominent economists such as Adam Smith and John Stuart Mill (Smith 1776; Mill 1848).

The land tax, being a neutral tax per se (Tideman 1982), has no negative impact on the nature of land utilization.

A tax-residence choice model developed by Tsai (1982) displays the alternative residential choices that every household makes between the price of land and the rate of land tax.

The discourse of Ghosh (1985) centred on the evolution and usefulness of land rent concepts with regard to political economy. The contention was that the differential rent theory suffices to clearly explain land rent in a completely capitalist agriculture.

Nieuwoudt (1987), Van Schalkwyk et al. (1994), Weiss (2005) and Rymanov (2014) argue that a tax on agricultural land does not lead to a distortion of resource allocation and an increase in food prices, and as such, is impossible to evade.

Production-based risk plays a significant role in taxation as far as land rent taxes are concerned. In order to reduce the production-based risk, some scholars suggest sharing land tax and indirect input tax (Hoff 1991). It is also suggested that the risk be reduced by means of the land tax rate indexation on the index of regional output (Newbery 1987; Hoff 1991).

Skinner (1991) contends that the system of levying progressive taxes on large farm holdings, leading to higher tax rates for larger farms, could result in the forceful breakup of these large farms into many smaller farms. This is despite the fact that, in general, every attempt at utilizing this channel in boosting land reform in many countries has woefully failed. He advanced two reasons for this. The first reason is that there are tax rates that have not been adequately high or progressive enough to have a significant impact on land use. The second reason is the political unpopularity of land taxation.

Nitikin et al. (2012) argue that land value taxation acts to stimulate further land use productivity.

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RESULTS

Agricultural production differential land rent model

Consider the polynomial single-product model of agricultural production on lands of differing productivities (and costs) in the conditional absence of taxes on labour and capital, as well as after the imposition of taxes.

The market of agricultural products is characterized by a large number of sellers of homogeneous goods, which makes it highly competitive. No farm is in a position to set its own prices. Rather, market forces set them at a level close to the long run average cost minimum in the industry (LAC). The curve of the LAC defines the lowest cost per output unit with a corresponding output of its production. As the market is competitive, the profit in the long-term period cannot exceed the normal rate, and the price is fixed at a level that reimburses costs only. Thus, the price is set by the farm with the minimum long-run average costs.

Suppose the average price is USD 1.25 per 1 kg. Price is determined by the minimum long-run average costs (LAC at the minimum point). Fixed and variable production factors depend on the time period under review. Short-run periods do not allow changing the number of permanent production factors employed, but leave enough time to change the variable factors. A change in the production output depends on the change in the quantity of variable inputs. In the long-run period, there are no fixed factors of production for a single farm. This is a period sufficient to change the volume of all resources. However, certain production factors are fixed at the industry level, even in the long run. Thus, the amount of land providing for profitable production (due to the differences in soil fertility, location) is limited. As a result, the supply of land for the entire industry is fixed. Land is a fixed factor of production for the industry as a whole. This production factor reduces farmer profits to normal rates. If the profit reaches the above normal rate in the long run, it is then reduced to a normal rate while the differential rent continues to grow.

For an agricultural producer, a differential land rent paid to a landowner is deemed to constitute the costs. Suppose that – for a farm utilizing a land plot of fairly good quality over a certain period of time – the land is the only fixed factor of production (all others are variables), while fixed costs are expressed as payment for the lease of the land plot only (without interest and depreciation on facilities located on the land plot). The maximum profit on a separate land plot is derived at the optimum output level of production:

$$\pi_i = TR_i - TC(q_i) = p \times q - TC(q_i)$$

where:
π_i = profit of the i-th farm in USD
TR_i = the total revenue of the i-th farm in USD
$TC(q_i)$ = the total costs of the i-th farm in USD
p = the price in USD
q_i = the output level of the i-th farm in kg

Equating the derivative to zero:

$$\frac{d\pi_i}{dq_i} = (pq_i)' - TC'(q_i) = 0$$

The first-order condition for achieving the optimum level is:

$$p - TC'(q_i) = p - MC(q_i) = 0$$

the second order condition is:

$$-MC'(q_i) \leq 0$$

where MC = the marginal costs in USD

Since the total costs (TC) include the total variable costs (TVC), as well as the total fixed costs in the form of differential land rent (DLR), the profit and the land rent can be defined as follows:

$$\pi_i = TR_i - TVC(q_i^*) - DLR$$

where q_i^* is an optimum production output in kg.

Since the total area of land which could generate normal profit is a fixed one, the land is regarded as a factor of production, which does not allow agricultural producers to obtain profit which is higher than normal. Thus, where profit is generated at a rate higher than normal, there is a decrease to its normal rate and a corresponding increase of the differential land rent over a given period of time. This can be formulated as follows:

$$TR - TVC - DLR^* = 0$$

where DLR^* is an increased rate of the differential land rent (due to profit which is higher than normal), USD.

Consequently, after deduction of the costs of all factors of production other than land (such as capital, labour) from the revenues, certain profit can still be registered. Given the competition for the best

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Table 1. The impact of labour and capital taxes on the change in the differential land rent of agricultural producers

Plots of land		Period	Optimum production output in kg	Total revenue in USD	Total variable costs in USD	Differential land rent in USD
			q_i^*	TR	TVC	DLR
1 relatively better plot	prior to	the imposition of taxes on labour and capital	82	103	64	39
	after		80	104	76	28
2 relatively average plot	prior to	the imposition of taxes on labour and capital	58	72	62	10
	after		52	68	68	0
3 relatively worse (marginal) plot	prior to	the imposition of taxes on labor and capital	44	55	55	0
	after		38	49	59	0

plots of land and the generation of industry profits that are higher than normal, the lease costs of the land plot under consideration (without interest and depreciation on the facilities located on the plot) will amount to the differential land rent. Profit from agricultural production comes down to a normal level (excess profit is equal to zero). The amount of rent is determined by alternative land utilization costs. Thus, both the original and the current (market) land lease costs are used to define excess profits. This allows determination of the market value of the differential land rent as the difference between the total revenues and the market value of other factors of production, i.e.:

$$DLR^* = TR - TVC$$

Consider polynomial single-product production functions (Figure 1) of agricultural producers using land plots of different quality levels:
(a) relatively better plot (1):

$$Q1 = x + 2x^2 - 0.125x^3$$

where Q1 is the output in kg, x is the quantity of inputs
(b) relatively average plot (2):

$$Q2 = 0.72x + 1.44x^2 - 0.09x^3$$

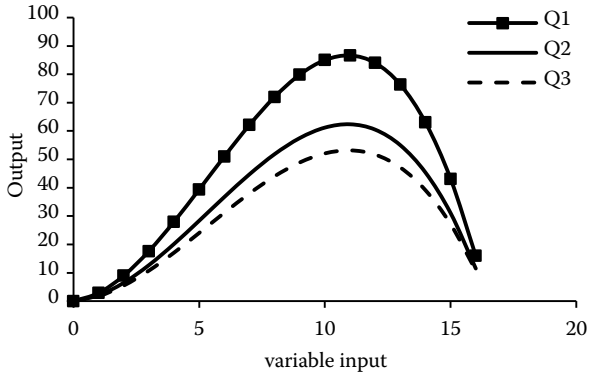

Figure 1. Production functions

(c) relatively worse (marginal) plot (3):

$$Q3 = 0.61x + 1.22x^2 - 0.076x^3$$

Based on the sale prices of the agricultural product in the amount of USD 1.25 per 1 kg and taking into account the production functions, the optimum output level corresponding to the revenues, variable costs and differential land rent are shown in Tables 1–4.

Figure 2 in Appendix shows the rate of the differential land rent on the given plots. Thus, the differential

Table 2. Differential land rent and profits prior to the imposition of taxes on labour and capital on the relatively better plot of land

Output in kg	Total revenue in USD (Q × AR)	Total costs in USD (TVC + DLR)	Total variable costs in USD (VI × AVC)	Differential land rent in USD
Q	TR_0	TC_0	TVC_0	DLR_0
0	0	39	0	39
3	4	46	7	39
9	11	53	14	39
18	22	60	21	39
28	35	66	27	39
39	49	73	34	39
51	64	80	41	39
62	78	87	48	39
72	90	94	55	39
80	100	101	62	39
82	**103**	**103**	**64**	**39**
85	106	108	69	39
87	108	114	75	39
84	105	121	82	39
76	95	128	89	39

Fixed input (land), ha – 3; Variable cost, USD per unit – 6.85; Price, USD per kg (AR) – 1.25

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Table 3. Differential land rent and profits prior to the imposition of taxes on labour and capital on the relatively average plot of land

Output in kg	Total revenue in USD (Q × AR)	Total costs in USD (TVC + DLR)	Total variable costs in USD (VI × AVC)	Differential land rent in USD
Q	TR_0	TC_0	TVC_0	DLR_0
0	0	10	0	10
2	3	17	7	10
6	8	24	14	10
13	16	31	21	10
20	25	37	27	10
28	35	44	34	10
37	46	51	41	10
45	56	58	48	10
52	65	65	55	10
58	**72**	**72**	**62**	**10**
61	77	79	69	10
62	78	85	75	10
60	76	92	82	10
55	69	99	89	10
45	57	106	96	10
31	39	113	103	10
12	14	120	110	10

Fixed input (land), ha – 3; Variable cost, USD per unit – 6.85; Price, USD per kg (AR) – 1.25

land rent (DLR) on the relatively better plot (1) with the output (Q1) equal to 82 kg is 39 USD (Figure 2a –Appendix, Table 2).

When land plots of lower quality are used in the production, the differential land rent decreases (land plot of a relatively average quality, plot 2, Figure 2b – Appendix, Table 3), or disappears completely (land plot of a relatively worse quality, (marginal) land plot 3, Figure 2c – Appendix, Table 4).

Impact of labour and capital taxes on the change in the differential land rent of agricultural producers

Due to the imposed taxes on labour and capital, as well as rates of costs, revenues for agricultural producers will change to varying degrees. Suppose that the only fixed costs for agricultural producers is the differential land rent. Imposed taxes increase the cost per unit of variable inputs from 6.85 USD

Table 4. Differential land rent and profits prior to the imposition of taxes on labour and capital on the relatively worse (marginal) plot of land

Output in kg	Total revenue in USD (Q ×AR)	Total costs in USD (TVC + DLR)	Total variable costs in USD (VI × AVC)	Differential land rent i n USD
Q	TR_0	TC_0	TVC_0	DLR_0
0	0	0	0	0
2	2	7	7	0
5	7	14	14	0
11	13	21	21	0
17	21	27	27	0
24	30	34	34	0
31	39	41	41	0
38	47	48	48	0
44	**55**	**55**	**55**	**0**
49	61	62	62	0
52	65	69	69	0
53	66	75	75	0
52	65	82	82	0

Fixed input (land), ha – 3; Variable cost, USD per unit – 6.85; Price, USD per kg (AR) – 1.25

Table 5. Differential land rent and profits after the imposition of taxes on labour and capital on the relatively better plot of land

Output in kg	Total revenue in USD (Q × AR)	Total costs in USD (TVC + DLR)	Total variable costs in USD (VI × AVC)	Differential land rent in USD
Q	TR_1	TC_1	TVC_1	DLR_1
0	0	28	0	28
3	4	36	8	28
9	12	45	17	28
18	23	53	25	28
28	36	62	34	28
39	51	70	42	28
51	66	79	51	28
62	81	87	59	28
72	94	96	68	28
80	**104**	**104**	**76**	**28**
85	111	113	85	28
87	113	121	93	28
84	109	129	101	28

Fixed input (land), ha – 3; Variable cost, USD per unit – 8.45; Price, USD per kg (AR) – 1.3

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Table 6. Differential land rent and profits after the imposition of taxes on labour and capital on the relatively average plot of land

Output in kg	Total revenue in USD (Q × AR)	Total costs in USD (TVC + DLR)	Total variable costs in USD (VI × AVC)	Differential land rent in USD
Q	TR_1	TC_1	TVC_1	DLR_1
0	0	0	0	0
2	3	8	8	0
6	8	17	17	0
13	16	25	25	0
20	26	34	34	0
28	37	42	42	0
37	48	51	51	0
45	58	59	59	0
52	**68**	**68**	**68**	**0**
58	75	76	76	0
61	80	85	85	0
62	81	93	93	0
60	79	101	101	0

Fixed input (land), ha – 3; Variable cost, USD per unit – 8.45; Price, USD per kg (AR) – 1.3

Table 7. Differential land rent and profits after the imposition of taxes on labour and capital on the relatively worse (marginal) plot of land

Output in kg	Total revenue in USD (Q × AR)	Total costs in USD (TVC + DLR)	Total variable costs in USD (VI × AVC)	Differential land rent in USD
Q	TR_1	TC_1	TVC_1	DLR_1
0	0	0	0	0
2	2	8	8	0
5	7	17	17	0
11	14	25	25	0
17	22	34	34	0
24	31	42	42	0
31	41	51	51	0
38	**49**	**59**	**59**	**0**
44	57	68	68	0
49	64	76	76	0
52	68	85	85	0
53	69	93	93	0
52	67	101	101	0

Fixed input (land), ha – 3; Variable cost, USD per unit (AVC) – 8.45; Price, USD per kg (AR) – 1.3

(Tables 2–4) to 8.45 USD (Tables 3–7) (at a rate of 20% of the share of taxes in the costs of agricultural production), which leads to an increase in total variable costs (TVC) on all three plots. However, on plots 1 and 2, the increase in variable costs as taxes is accompanied by reduced fixed costs as payment for land lease (differential land rent), while plot 3 is marked by an increase in variable costs only, since no differential land rent was originally generated on it.

Imposed taxes increase long-run average costs throughout the industry, resulting in an upwards shift of the corresponding curve (LAC).

An increase in the costs of the worse plots leads to output reduction at industry level, thus resulting in an upwards shift of the agricultural product supply curve. This leads to an increase in the average price of the agricultural products in question (estimated increase: from 1.25 USD to 1.3 USD).

However, if plots 1 and 2 generate normal profit (total revenues (TR) and total costs (TC) match, Figures 3–4 (Appendix), Tables 5–6), the production on plot 3 becomes unprofitable (total costs are greater than total revenues, the amount of the loss is 10 USD, Figure 5 (Appendix), Table 7).

DISCUSSION

Imposed taxes on labour and capital reduce the value of the differential land rent on each plot and at the industry level as a whole. The worst result from imposing taxes on labour and capital was that agricultural production on marginal plots similar to plot 3, which, in the absence of taxes on labour and capital failed to bring in the differential land rent, but generated normal profit, would become unprofitable when the taxes were imposed. Farmers are then forced to reduce wages and capital. That is, the total costs from taxes on labour and capital are higher for relatively marginal lands as compared to the average and best ones (Table 2).

Consider the impact of the tax on land (based on the differential land rent) on the economic performance of agricultural producers.

If the relative share of land tax (based on the differential land rent) in the tax structure (or upon imposed taxes) increases, no changes occur in the cost structure as compared to the pre-tax situation for all three types of agricultural producers. In this situation, all producers obtain a normal profit, while no reduction in the product supply occurs. The rate

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of the differential land rent will be equal to the pre-tax level, and it will be subject to taxation.

Similarly, it can be demonstrated that reduced taxes on labour and capital increase the revenues payable to the owner of the land, rather than to the owners of other factors of production (labour, capital) (due to the limited number of relatively better plots of land, as well as due to the competition among lessees of land).

CONCLUSION

Thus, reducing the tax burden of agricultural producers with respect to the major taxes (on labour, capital), will lead to an increase in differential land rents (on the relatively better plots) and/or to its emergence on the average plots of land. The differential land rent at the industry level increases, depending on the degree of substitution of the tax burden. The increase (or appearance) of the differential land rent is ensured by the government's efforts (by reducing the tax burden), rather than by the efforts of an agricultural producer (for example, increased intensity of production). Consequently, if the government substitutes taxes on labour and capital for land and property taxes, no deferral of tax liability from the producers to the land owners occurs. Upon substituting the overall tax burden the revenues of landowners are not reduced because the growth of differential land rent is provided for by tax reductions on labour and capital.

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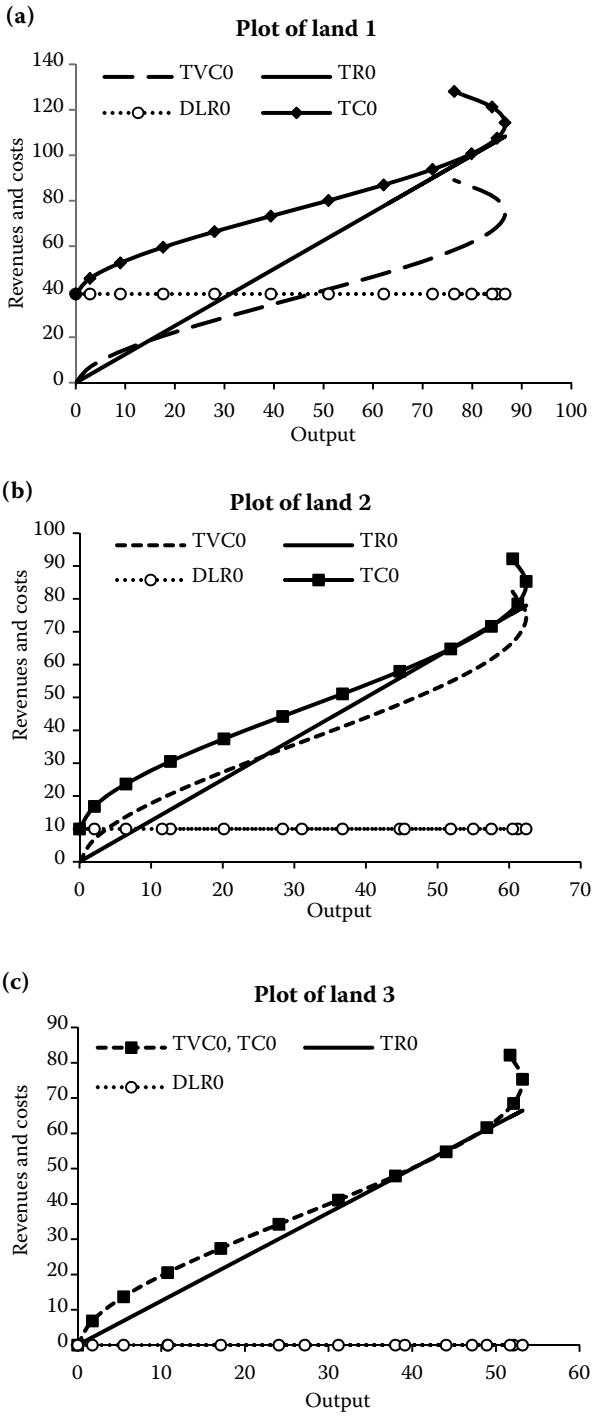
APPENDIX



TR0 – total revenue, TC0 – total costs, TVC0 – total variable costs, DLR0 – differential land rent

Figure 2. Revenues, costs and differential land rent in the absence of taxes on labour and capital on the relatively better (a), average (b) and worse (marginal) (c) plots of land

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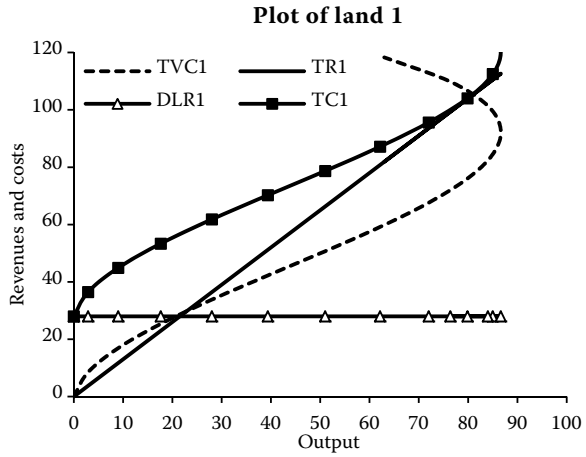
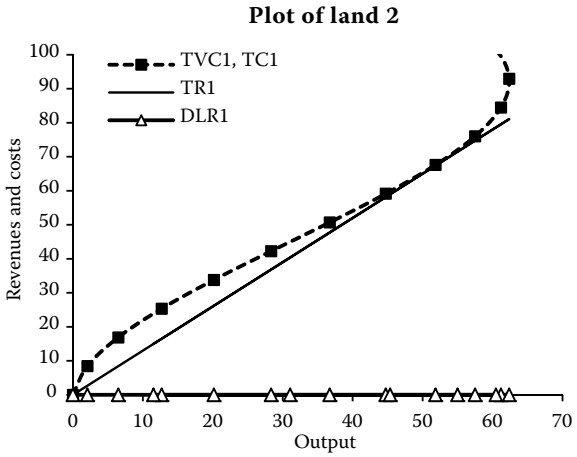
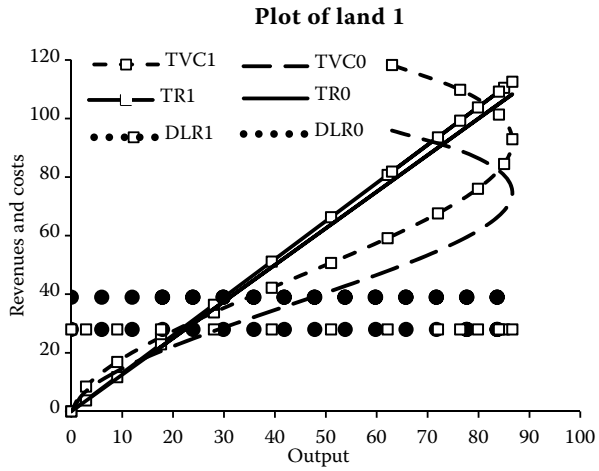
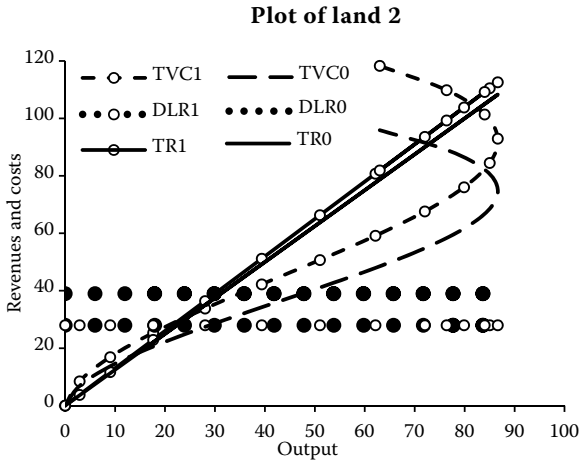






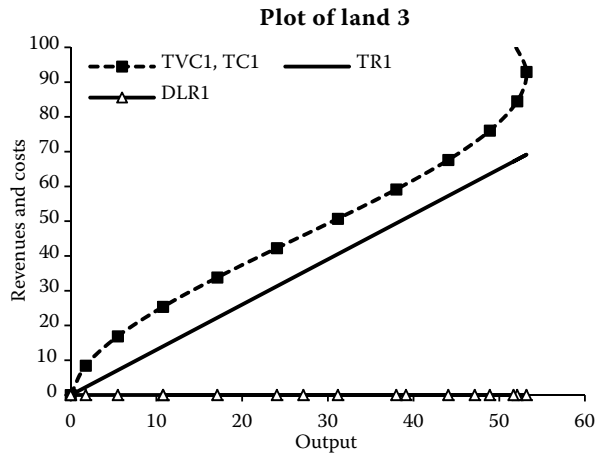
TR – total revenue, TVC – total variable costs, DLR – differential land rent.

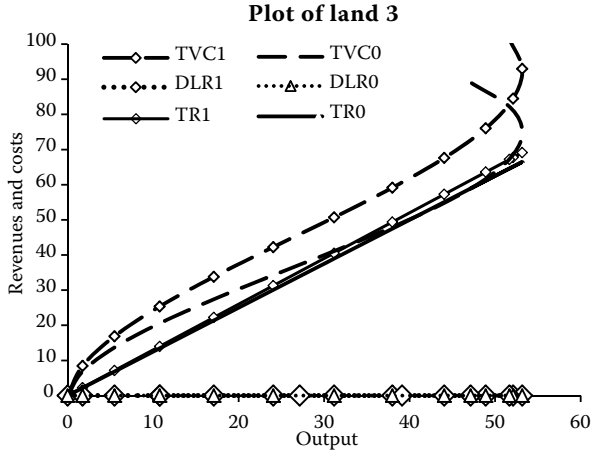
Figure 3. The ratio of revenues, costs and the differential land rent given the taxes on labor and revenues at the relatively better plots of land



TR – total revenue, TC – total costs, TVC – total variable costs, DLR – differential land rent.

Figure 4. The ratio of revenues, costs and the differential land rent given the taxes on labor and revenues at the relatively average plots of land





TR – total revenue, TVC – total variable costs, DLR – differential land rent.

Figure 5. The ratio of revenues, costs and the differential land rent given the taxes on labor and revenues at the relatively worse plots of land

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