UNITED NATIONS UNIVERSITY
UNU-WIDER

WIDER Working Paper 2018/76

Tenurial security and agricultural investment

Evidence from Vietnam

Marc F. Bellemare,[1] Kenn Chua,[2] Julieth Santamaria,[2] and Khoa Vu[2]

July 2018

United Nations University World Institute for Development Economics Research
wider.unu.edu

Abstract: In Vietnam, all lands belong to the state, who assigns usufruct rights to those lands to individuals and households. In 1993, the state gave 20-year usufruct rights to growers of annual crops, and 50-year usufruct rights to growers of perennial crops. In 2013, as the usufruct rights of growers of annual crops were set to expire, the Vietnamese government passed a law—the Land Law of 2013—that extended the usufruct rights of all landowners by 50 years. We exploit this largely unanticipated shock to study the effect of the Land Law of 2013 on the investment behaviour of growers of annual crops. Using a difference-in-differences design, we find that the Land Law of 2013 is associated with a higher likelihood of investment in irrigation technology or soil and water conservation, but not other types of investment. Our results are robust to controlling for endogenous switching from annual to perennial crops, and our data support the parallel trends assumption. Our results also suggest that the long-term effects of the Land Law of 2013 are larger than its short-term effects.

Keywords: investment, land, land rights, Vietnam
JEL classification: K11, O12, O13, Q15

Acknowledgements: We thank UNU-WIDER for supporting this research project and for giving us access to the VARHS data. We also thank conference participants at the 2018 Waves of VARHS Data project workshop for useful comments and suggestions. All remaining errors are ours.

All tables and figures are at the end of the paper.

[1] Associate Professor, Department of Applied Economics, University of Minnesota, Minneapolis, USA, corresponding author: mbellema@umn.edu; [2] PhD Student, Department of Applied Economics, University of Minnesota, Minneapolis, USA.

This study has been prepared within the UNU-WIDER project on 'Structural transformation and inclusive growth in Vietnam'.

Information and requests: publications@wider.unu.edu

ISSN 1798-7237 ISBN 978-92-9256-518-3 https://doi.org/10.35188/UNU-WIDER/2018/518-3

Typescript prepared by Ans Vehmaanperä.

The United Nations University World Institute for Development Economics Research provides economic analysis and policy advice with the aim of promoting sustainable and equitable development. The Institute began operations in 1985 in Helsinki, Finland, as the first research and training centre of the United Nations University. Today it is a unique blend of think tank, research institute, and UN agency—providing a range of services from policy advice to governments as well as freely available original research.

The Institute is funded through income from an endowment fund with additional contributions to its work programme from Finland, Sweden, and the United Kingdom as well as earmarked contributions for specific projects from a variety of donors.

Katajanokanlaituri 6 B, 00160 Helsinki, Finland

1 Introduction

In Vietnam, all plots of land belong to the state, and the state assigns individuals and households usufruct rights on those plots for a pre-defined period.[1] For instance, the 1993 Vietnamese Land Law gave 20-year usufruct rights to those growing annual crops on their plots,[2] but 50-year usufruct rights to agricultural households growing perennial crops on theirs. Two decades later, when the usufruct rights of those households growing annual crops were set to expire, the government of Vietnam passed the 2013 Land Law, which extended the usufruct rights of both the growers of annual crops and of the growers of perennial crops on their plots. This unexpected change in the law was a boon to all landowners, but particularly to growers of annual crops.

Economic theory suggests that on the eve of the Land Law of 2013, the incentives of annual crop growers to invest in their plots were considerably weaker than the incentives of perennial crop growers to invest in theirs given the relationship specificity of investments in land (Joskow 1987). Put simply, before the passage of the 2013 Land Law, a grower of annual crops and a grower of perennial crops making the exact same investment in their respective plots were going to face drastically different returns on their investments ceteris paribus, with the annual crop grower capturing effectively none of those returns and the perennial crop grower capturing most, if not all, of them over the remaining 30 years of her usufruct period.

In this paper, we look at whether this is the case, and whether we see differential investment behaviors of annual versus perennial crop growers as a consequence of the Land Law of 2013 in Vietnam. To do so, we use a newly available longitudinal data set on Vietnamese households, and we examine the impacts of the 2013 Land Law on landowner decisions to invest in maintaining and improving their plots of land. We exploit the facts that (i) the Land Law's passage was largely unanticipated, and (ii) the Land Law affected land tenure security differentially for growers of annual versus perennial crops in a difference-in-differences setup.

There is a substantial literature looking at the relationship between property rights and investment when it comes to land in rural areas of developing countries. On the one hand, Besley (1995), Bandiera (2007), Goldstein and Udry (2008), Holden, Deininger, and Ghebru (2009), and Goldstein, Houngbedji, Kondylis, O'Sullivan, and Selod (2018) find that better-defined property rights translate into more investment in land. On the other hand, Brasselle, Gaspart, and Platteau (2002) find no such relationship.[3] More generally, a systematic review of the literature on the effects of land rights in developing countries by (Lawry et al. 2017) concludes that greater tenurial security translates much more clearly into more investment in Asia and in Latin American than it does in Africa.

The contribution of this paper is twofold. First, we look at whether an extension of the usufruct rights of some Vietnamese landowners relative to others led to more investment in land by those same landowners, finding that it did. Second, to our knowledge, ours is the first study to apply a difference-in-differences (DID) strategy to generate evidence on the causal impacts of land rights on agricultural investment, which brings internal validity to the literature. Combined with the nationally representative nature of

[1] Merriam-Webster defines usufruct as "the legal right of using and enjoying the fruits or profits of something belonging to another" (Merriam-Webster, 2018). In the Vietnamese context, usufruct is more concretely defined as having the right to cultivate, sell, lease, and rent a plot, or use it as collateral.

[2] In the interest of brevity, and in a slight abuse of language, we refer for the remainder of this paper to plots on which agricultural households have usufruct rights as "their" plots, and to operators of plots under usufruct as "landowners."

[3] Likewise, Bellemare (2013) finds no statistically significant relationship between the presence of a land title on a plot and the same plot's rice productivity in Madagascar.

our data, this means that our results have more internal validity and more external validity than some earlier findings in the literature.

The remainder of this paper is organized as follows. In section 2, we provide some background on the Vietnamese Land Law of 2013. Section 3 discusses the data and presents some descriptive statistics. In section 4, we discuss the empirical framework we use to study the effect of the Land Law of 2013 on agricultural investment, discussing in turn our estimation and identification strategies. Section 5 presents and discusses our estimation results. We conclude in section 6 by discussing the research and policy implications of our findings.

2 Background

Landownership and land use have always been heavily regulated in Vietnam, especially for agricultural lands. All lands are legally owned by the state, who assigns them to individuals and households, along with usufruct rights, for a predefined period. Beyond this period, lands are subject to be reallocated by the state. This institutional characteristic is arguably influenced by the land collectivization process that took place during the Vietnam War, and which brought farmlands into cooperatives so that multiple households could work on them together.

Since the end of the Vietnam War in 1975, the country has moved gradually toward land liberalization and privatization (Deininger and Jin 2008; Do and Iyer 2008; Markussen, Tarp, and Van den Broeck 2011). The 1988 Land Law marked the first major milestone in this process as the law transferred land control and usufruct rights from farming cooperatives to households. The same law also established the duration of land use rights varying from 10 to 15 years (Do and Iyer 2008).

The 1993 Land Law strengthened land rights substantially by allowing for the legal trading (i.e., selling, leasing, and renting) of plots and by issuing land titles, known as Land Use Certificates (LUCs) or Red Books, which allowed landowners to pledge their lands as collateral for loans. More importantly for our purposes, the Land Law of 1993 also set the duration of usufruct rights for annual crop plots at 20 years and for perennial crop plots at 50 years. After 1993, there were further modifications to simplify the process of obtaining a LUC in 2003. In late 2013, the government passed the 2013 Land Law, which extended the duration of usufruct for all agricultural lands—annual *and* perennial crop plots—by 50 years. This law went into effect in July 2014.

Under these laws, the duration of usufruct rights on a plot of land is defined as the period during which the usufruct of individuals and households with respect to that land is legally recognized. The 1993 Land Law established that for any plot assigned before or on October 15, 1993, that date would be the starting date for their land use duration. For any plot assigned after this date, the usufruct duration would start on the date at which the government assigned that land to its "owner." In other words, the start date does not change when the land is sold from one "owner" to another. Because the length of usufruct duration varies by land use (i.e., annual or perennial crop cultivation), landowners have to register with the government how they plan to use the plot (i.e., to grow annual crops, to grow perennial crops, to construct residential buildings, and so on). In most cases when landowners want to switch use, they can request that the government update the duration of their usufruct rights, but the starting date would not change. As mentioned before, the 1993 Land Law set usufruct duration at 20 years for landowners growing annual crops and at 50 years for landowners growing perennial crops.

What was supposed to happen when the usufruct period ended? The 1993 Land Law stated that the government would then reassign the lands to the same owners provided they had not used the lands in any illegal way. The 2003 Land Law, however, added that (i) landowners would be responsible to return

the plot if the government wanted to take it back or the usufruct duration ended, and (ii) the government would recover a plot in case the duration of usufruct ended without any extension. This means that without the 2013 Land Law that extended the duration of usufruct rights, landowners whose usufruct period was ending faced uncertainty over what would happen to their plots regardless of whether they held a LUC for those plots or not.

Based on these laws, we argue that usufruct duration effectively characterizes land tenure security because land rights are protected by the law against wrongful land-grabbing only within the usufruct period.[4] Beyond that period, one's status on one's plot becomes legally murky as that plot could legally be recovered by the government.[5] That is, landowners with a shorter usufruct duration will feel less secure than landowners with a relatively longer duration.

Hence it becomes clear that the 2013 Land Law substantially improves the tenurial security of landowners who grow annual crops, since their original usufruct period was only 20 years. This is especially true for those whose lands were assigned to them before or during 1993 as their usufruct period was ending in 2013. In contrast, because the original usufruct period of landowners who grow perennial crop was 50 years, these households still had at least 30 more years before their usufruct period ended. Therefore, we argue that the effect of the 2013 Land Law on tenurial security among these landowners should be relatively much smaller than for landowners growing annual crops. That difference in the tenurial security effects of the Land Law of 2013 allows using a difference-in-differences approach as our empirical strategy.

3 Data and Summary Statistics

To examine the effects of the 2013 Land Law on agricultural investment, we use the Vietnam Access to Resources Household Survey (VARHS), a biennial panel of rural households from across 12 provinces in Vietnam. The data set follows over 2,000 households between the years 2008-2016 and contains information on the agricultural activities of each household, including plot-specific investments and production decisions. As the questions are asked retrospectively for the previous two years, we observe household information during 2014 and 2015, the first two years after the 2013 Land Law came into effect.

The longitudinal sample of VARHS consists of 2,343 households for the period 2008-2016. The panel constructed from this sample is unbalanced, with 2,131 households appearing in all five waves. The type of crop being grown (i.e. annual or perennial) as well as land-related investment decision are both observed at the plot level.

In terms of investment outcomes, we rely on a series of indicator variables measuring whether the household has made specific investments in given plot over the last two years. We distinguish among four specific types of investments:

1. Investment in irrigation technology or soil and water conservation improvements,
2. Investments in permanent or semi-permanent infrastructure (e.g., a fence, an animal shed),
3. Investment in trees or bushes, and

[4] This protection does not guarantee that a landowner's plot will not be taken away wrongfully, but it provides the landowner with a legal basis to reclaim her plot.

[5] In the data, 1 to 2 percent of plots were expropriated by the state in any given year.

4. Investments in aquaculture (i.e., ponds).

Considering those four different types of investment as our outcome variables does two things. First, we allow for investments that are crop type-specific. For instance, households growing annual crops are likely to invest in irrigation technology or soil and water conservation improvement. Second, our inclusion of investments in aquaculture allows conducting a placebo test, since we would expect investments in aquaculture on a given plot not to be affected by the Land Law of 2013.

In Table 1, we present the plot-level descriptive statistics for perennial and annual crop plots, both before and after the Land Law of 2013 went into effect in late 2014. The number of plots dedicated to growing perennial crops is relatively small compared to the number of plots dedicated to growing annual crops. For the purposes of identification, it is important to note that households can switch between perennial and annual crops. Hence, we document crop-switching plots, i.e., plots whose owners switch between the two types of crop at some point during 2008-2016. Crop-switching is relatively more prevalent among perennial crop plots than among annual crop plots: 31 to 36 percent of perennial crop plots have been used to grow annual crop at some point during 2008-2016 while only 3 to 4 percent of annual crop plots have been used to grow perennial crop at some point during the same period. Crop-switching behavior presents a potential threat to our identification strategy because landowners can switch crops when anticipating that their usufruct rights will expire. This issue is explored in more detail in the next section.

It is also important to note that some plots face a government restrictions on crop choice, which means farmers can only grow a specific crop on these plots. In our sample, roughly 30 percent of perennial crop plots and 3 percent of annual crop plots face such restrictions. Markussen et al. (2011) specifically studied these plots using the VARHS data and found that farmers facing this restriction tend to receive favors from the government in terms of higher quality inputs such as hybrid seeds. Markussen et al. also found that such farmers tend to work harder. Because of these differences, we suspect that landowners of plots with crop restriction may behave differently in response to the 2013 Land Law than landowners of plots without such restrictions do, and we account for these restrictions in our analysis.

Another important observation is that while most plots are owned, roughly 10 percent of plots are either borrowed or rented out. For owner-operated plots, landowners are directly subject to the usufruct duration and are thus affected by the Land Law. For plots that are borrowed or rented out, it is unclear whether farmers who borrow or rent out face similar tenurial security as owner-operators.

Given the foregoing, we apply two restrictions to the VARHS sample to obtain our estimation sample. First, we only consider agricultural plots, namely plots that are used to grow annual or perennial crops. Our empirical strategy relies on the fact that the Land Law of 2013 affects tenurial security for these plots differently, which in turn affects their landowners' investment decisions. Landowners of plots with non-agricultural purposes (e.g., gardening or fish-farming) may behave differently from those of agricultural plots or face different usufruct duration constraints, and we thus exclude them from our analysis. Second, we only consider owner-operated plots. Combining these restrictions, we first define our households of interest as those who own at least one agricultural plot in any year the data were collected. We use plot-specific information for these households to construct our estimation sample, and the unit of analysis is a given plot in a given year. Table 2 provides a comparison in sample size between the VARHS sample and our estimation sample by year at both household and plot levels.

In Table 3, we calculate and compare the differences in investment decisions for annual and perennial crop plots for the pre- and post-2014 periods. We first observe that landowners are likely to invest in irrigation for both plot types in any given period; that is, irrigation investment is not specific to the type of crop being grown on a given plot. Landowners growing annual crops, however, are more likely to invest in irrigation relative to those growing perennial crop in both periods. In contrast, we observe

that tree-planting investment are more prevalent on plots that are dedicated to growing perennial crops; specifically, investment in trees takes place on 47 to 51 percent of perennial crop plots compared to only 1 to 2 percent of annual crop plots. Lastly, we note that infrastructure and aquaculture investments are rare for both crop types.

These exploratory observations suggest that we are more likely to observe the effect of the Land Law of 2013 on investment in irrigation investment relative to the other three types because the Land Law only increases tenurial security for annual crop plots. We show this by taking the difference in the two "difference" columns and presenting the result in the last column. This simple calculation suggests that the effect of the Land Law of 2013 on investment in irrigation is larger than the effect on the other three types of investment. In the next section, we explain our identification strategy we rely on to formally quantify the effects of the Land Law of 2013 on investment.

4 Empirical Framework

As explained in Section 2, we expect the 2013 Land Law to affect tenurial security differently on annual crop plots versus perennial crop plots. Specifically, given that the usufruct duration for landowners growing annual crops is considerably shorter, we argue that the Land Law increases tenurial security more for those who own annual crop plots than for those who own perennial crop plots, because the latter did not face the immediate threat of asset loss. Therefore, we compare the difference in investment outcomes between the two types of plots before and after the passage of the Land Law of 2013. To account for unobserved heterogeneity across plots, we control for plot fixed effects, and we also control for province-year fixed effects to account for unobserved macroeconomic shocks which could have affected investment decisions.

We estimate the following difference-in-differences specification:

$$y_{ijpt} = \beta_0 + \beta_1 a_{ijpt} + \beta_2 (a_{ijpt} \times T_t) + \beta_3 h_{ijpt} + \gamma_{pt} + \sigma_i + _{ijpt} \quad (1)$$

where a_{ijpt} is a variable equal to one if plot i owned and operated by household j in province p in year t is used to grow annual crops and equal to zero otherwise, T is a variable equal to one after the passage of the Land Law of 2013 and equal to zero otherwise, h denotes the size of the plot, γ is a province-year fixed effect, σ is a plot fixed effect, and is an error term whose mean is zero.

We estimate equation 1 by ordinary least squares. Given that we are adopting a difference-in-differences design, our coefficient of interest is β_2, which captures the effect of investment of the passage of the Land Law of 2013 (i.e., its adoption in late 2014) for annual crop plots. Following Bertrand, Duflo, and Mullainathan (2004), standard errors are clustered throughout at the household level.

We consider several threats to our identifications. First, we note that households can switch from growing annual to perennial crops, and vice versa. If this switching decision is endogenous, a_{ijpt} is endogenous. Fortunately, the number of plots for which the landowner switched crops is small, possibly because switching crop requires that notifying local authorities, and so there might be significant transaction costs to switching. We thus suspect that the potential endogeneity problem posed by crop switching is minimal. Still, to address this issue, we re-estimate equation 1 using the sub-sample of non-switching plots.

We rely on a difference-in-differences design, and so a the most important assumption of our identifications strategy is that the investments of households growing annual crops would have followed the same trend as the investments of households growing perennial crops in the absence of the tenurial insecurity brought on by the different usufruct durations before the passage of the Land Law of 2013.

To ensure that this is the case, we plot in Figure 1 the probability of investment for each type of investment for the period 2008-2016. Figure 1 suggests that these investments follow similar trends before the passage of the Land Law of 2013. To test the parallel trends assumption holds, we estimate our model using pre-treatment data only, using 2010 as the treatment period, that is, with $T_t = I(t \geq 2010)$. This allows looking at whether there is any differential effect in the investment variables between households growing annual and perennial crops during the pre-treatment period. If the parallel trends assumption holds, we expect β_3 to be statistically insignificant in this specification.

We present the results of this parallel trends test in Table 4. The results suggest that there is no significant difference in all four investment types between annual and perennial crop plots during the pre-treatment period when controlling for province-year and plot fixed effects. Specifically, the coefficient of interest is statistically insignificant for investments in irrigation or soil and water conservation and investments in infrastructure; this result is robust to controlling for year fixed effects and plot fixed effects. For investment in trees, the coefficient of interest first appears statistically significant when we omit fixed effects, but the inclusion of those fixed effects makes that apparent statistical significance go away. We thus rule ouf the possibility that the parallel trends assumption is violated.

5 Results and Discussion

Table 5 presents estimation results when we estimate the effects of the 2013 Land Law on investment decisions at the plot level using various specifications. Each cell shows the estimation coefficient of interest in a regression in which the dependent variable corresponds to the investment type in the column on the far left, while each of the subsequent columns represent a different specification. Specifically, in column 1, we estimate a standard difference-in-differences specification with a dummy variable for plots growing an annual crop, a dummy variable for the post-treatment period, an interaction term for the two variables, and plot size. In column 2, we include year fixed effects instead of only the post-treatment dummy. In column 3, we also control for plot fixed effects—the inclusion of which is made possible by the fact that some landowners switch from annual to perennial crops or vice versa—in addition to year fixed effects. In column 4, instead of controlling for year fixed effects, we control for province-year fixed effects by including dummy variables for each province-year pair.

Our results suggest that the Land Law of 2013 has had a positive, statistically significant impact on investment in irrigation technology or soil and water conservation improvements, an effect that is robust across all specifications. Specifically, our results indicate that owner-operators of annual crops plots are 16 to 30 percentage points more likely to invest in irrigation technology of soil and water conservation improvements as a consequence of the Land Law of 2013. In contrast, we find no statistically significant impact of the Land Law of 2013 on investments in infrastructure, trees, or aquaculture. Given that there is no reason for aquaculture to be affected by what happens to annual crop plots, the fact that we find no statistically significant effect for investment in aquaculture serves as a useful placebo test.

To address the issue of endogenous crop switching, we re-estimate our model using the subset of plots on which landowners not switch crop during the period we study and present the result in Table 6. The results in Table 6 are qualitatively similar to those in Table 5. Focusing on the statistically significant coefficients, this exercise suggests that endogenous crop switching is a minor issue, given that the estimated coefficients in Table 5 are only slightly smaller in magnitude than those in Table 6.

Lastly, we estimate the long-term effects of the Land Law of 2013 by only considering the first and last years (i.e., 2008 and 2016) of the study period. These results are presented in Table 7. Similar to the main findings, we find a positive, statistically significant impact of the Law on investment in irrigation technology or soil and water conservation. In the last column of Table 7, which presents the

specification that controls for plot and province-year fixed effects, the effect of the Law is estimated to be 0.49, compared to 0.16 and 0.27 in Tables 5 and 6, respectively. This suggests that the long-term effects of the Land Law of 2013 on investment in irrigation technology or soil and water conservation are even larger than the short-term effects.

6 Summary and Concluding Remarks

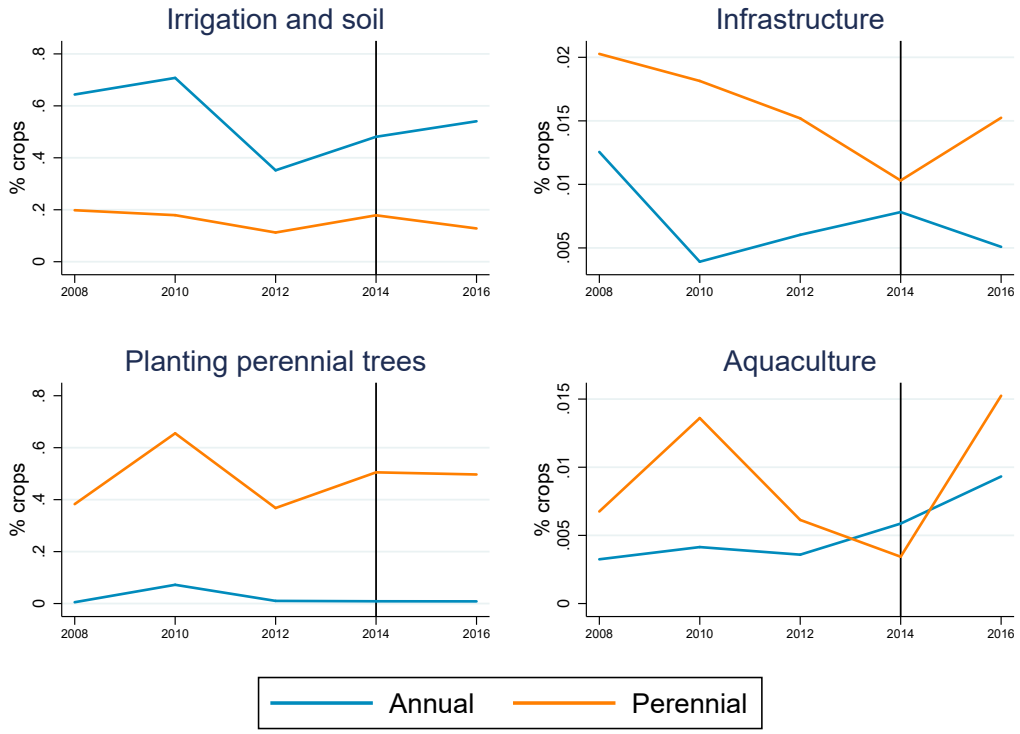
The 2013 Vietnamese Land Law renewed the usufruct rights of individuals and households growing annual crops on the plots they use to do so, thereby giving those individuals and households greater security of tenure. Given what economic theory posits about the effects of greater tenurial security on investment, we look at whether the 2013 Land Law had any effect on the investment behaviors of rural households in Vietnam. Using data from the Vietnam Access to Resources Household Survey for the period 2008-2016, we use a difference-in-differences design to disentangle the potential causal impact of the Land Law of 2013 on investment from the correlation between the two.

Our results indicate that the Land Law of 2013 has had a positive, statistically significant effect on investments in irrigation technology or soil and water conservation, and our most conservative estimate of that effect suggest that the renewal of usufruct rights increased that the likelihood of that type of investment by 16 percentage points on the average annual crop plot. Looking at long-term effects, we find that they are larger than our estimates of the short-term effects of the Land Law of 2013. Our results are robust to controlling for endogenous crop switching, and our data support the parallel trends assumption necessary for our difference-in-differences design to generate a causal estimate.

In order to draw policy recommendations from our empirical findings, one would have to be willing to assume that they have more external validity than they do. Specifically, to draw policy recommendations for other countries, one would have to be willing to assume that the Vietnamese experience translates to other countries. Likewise, to draw policy recommendations for other types of crop or other years in Vietnam, one would have to be willing that our findings apply to those other crops and years. If one is willing to make such assumptions, one should thus conclude that in situations where landowners cultivate plots under usufruct rights given by the state, investment could be stimulated by an extension of the duration of those usufruct rights.

Figures

Figure 1: Investment trends by type of crop



Source: Authors' compilations based on the VARHS data for 2008-2016.

Tables

Table 1: Plot-level descriptive statistics of the VAHRS sample

	Before		After	
	Perennial (N = 2606)	Annual (N = 32993)	Perennial (N = 817)	Annual (N = 7110)
Area plot (m2)	6695.50	1268.69	6647.97	1382.06
	(8917.82)	(3567.36)	(11551.15)	(3642.09)
Plot value (1000 VND/m2)	37.96	42.27	39.38	75.35
	(352.99)	(195.52)	(90.97)	(240.03)
Distance from home to plot (m)	3491.32	1087.90	2881.82	1036.93
	(27436.00)	(5915.61)	(14667.72)	(1431.17)
Can construct permanent structures (1/0)	0.52	0.09	0.26	0.06
	(0.50)	(0.29)	(0.44)	(0.24)
Plot has crop restriction (1/0)	0.08	0.53	0.04	0.40
	(0.27)	(0.50)	(0.21)	(0.49)
Crop switching (1/0)	0.31	0.04	0.36	0.03
	(0.46)	(0.19)	(0.48)	(0.17)
Investment type (1/0)				
Irrigation	0.17	0.59	0.13	0.54
	(0.38)	(0.49)	(0.33)	(0.50)
Infrastructure	0.02	0.01	0.02	0.01
	(0.13)	(0.09)	(0.12)	(0.07)
Tree planting	0.46	0.01	0.50	0.01
	(0.50)	(0.10)	(0.50)	(0.09)
Aquaculture	0.01	0.00	0.02	0.01
	(0.09)	(0.06)	(0.12)	(0.10)
Type of ownership (1/0)				
Owned	0.91	0.82	0.94	0.76
	(0.28)	(0.39)	(0.24)	(0.43)
Borrowed	0.06	0.08	0.04	0.07
	(0.23)	(0.27)	(0.19)	(0.26)
Rented out	0.03	0.11	0.02	0.17
	(0.17)	(0.31)	(0.15)	(0.38)
Plot has red book (1/0)	0.67	0.75	0.71	0.72
	(0.47)	(0.43)	(0.45)	(0.45)

Source: Authors' compilations based on the VARHS data for 2008-2016.

Table 2: VARHS and Analytical sample size comparison

Unit	Sample	2008	2010	2012	2014	2016
Household	VARHS	2278	2244	2758	2721	2669
	Analytical	1860	1775	2034	1963	1869
Plot	VARHS	9321	8679	9339	8260	7927
	Analytical	7853	7168	7624	6650	6161

Source: Authors' compilations based on the VARHS data for 2008-2016.

Table 3: Differences in investment decisions for annual and perennial crop plots for pre- and post-2014

	Before			After			Difference
	Perennial	Annual	Difference	Perennial	Annual	Difference	in differences
Irrigation	0.17	0.51	-0.34	0.10	0.60	-0.50	0.15
	(0.37)	(0.50)	(0.01)	(0.30)	(0.49)	(0.03)	(0.04)
Infrastructure	0.02	0.01	0.01	0.01	0.00	0.01	-0.00
	(0.13)	(0.10)	(0.00)	(0.12)	(0.05)	(0.01)	(0.01)
Tree planting	0.47	0.02	0.45	0.51	0.01	0.50	-0.04
	(0.50)	(0.13)	(0.01)	(0.50)	(0.11)	(0.02)	(0.02)
Aquaculture	0.01	0.01	0.00	0.01	0.01	0.00	0.00
	(0.09)	(0.07)	(0.00)	(0.10)	(0.09)	(0.01)	(0.01)
Observations	2204	13025		740	3355		

Source: Authors' compilations based on the VARHS data for 2008-2016.

Table 4: Placebo test using the pre-treatment period - Non-restricted, owned plots

Outcomes	Model 1	Model 2	Model 3	Model 4
Irrigation	0.00	-0.03	0.01	0.08
	(0.04)	(0.04)	(0.05)	(0.05)
	[7295]	[7295]	[7295]	[7295]
Infrastructure	0.00	0.00	-0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.02)
	[7295]	[7295]	[7295]	[7295]
Tree-planting	-0.10**	-0.07	-0.03	-0.09
	(0.04)	(0.04)	(0.05)	(0.06)
	[5144]	[5144]	[5144]	[5144]
Aquaculture	0.00	0.00	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
	[7284]	[7284]	[7284]	[7284]
Year FE	No	Yes	Yes	No
Plot FE	No	No	Yes	Yes
Province-year FE	No	No	No	Yes

Note: Clustered standard errors in parenthesis. Number of observations in bracket. Each cell corresponds to an individual OLS regression in which the outcome variable is specified in every row. Four specifications are analyzed. Model (1) regress the corresponding outcome to a dummy of whether the plot is annual or perennial, a time dummy that takes the value of 1 in year 2016, and the interaction of the latter two dummies. Model (2) includes year fixed effects. Model (3) adds plot fixed effects. Model (4) add province-year fixed effects. All four specifications control for plot area. *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' compilations based on the VARHS data for 2008-2016.

Table 5: Effects of the Land Law on investment for owned, non-restricted plots

Outcomes	Model 1	Model 2	Model 3	Model 4
Irrigation	0.16***	0.18***	0.30***	0.16*
	(0.04)	(0.04)	(0.06)	(0.08)
	[8273]	[8273]	[8273]	[8273]
Infrastructure	0.00	0.00	0.00	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
	[8273]	[8273]	[8273]	[8273]
Tree-planting	-0.04	-0.07	-0.04	-0.11
	(0.04)	(0.04)	(0.07)	(0.08)
	[6122]	[6122]	[6122]	[6122]
Aquaculture	0.00	0.00	0.00	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
	[8262]	[8262]	[8262]	[8262]
Year FE	No	Yes	Yes	No
Plot FE	No	No	Yes	Yes
Province-year FE	No	No	No	Yes

Note: Clustered standard errors in parenthesis. Number of observations in bracket. Each cell corresponds to an individual OLS regression in which the outcome variable is specified in every row. Four specifications are analyzed. Model (1) regress the corresponding outcome to a dummy of whether the plot is annual or perennial, a time dummy that takes the value of 1 in year 2016, and the interaction of the latter two dummies. Model (2) includes year fixed effects. Model (3) adds plot fixed effects. Model (4) add province-year fixed effects. All four specifications control for plot area. *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' compilations based on the VARHS data for 2008-2016.

Table 6: Effects of the Land Law on investment for owned, non-restricted, non-switching plots

Outcomes	Model 1	Model 2	Model 3	Model 4
Irrigation	0.16***	0.19***	0.32***	0.27*
	(0.05)	(0.04)	(0.06)	(0.11)
	[7400]	[7400]	[7400]	[7400]
Infrastructure	0.00	0.00	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.00)
	[7400]	[7400]	[7400]	[7400]
Tree-planting	0.00	-0.03	0.01	-0.10
	(0.05)	(0.05)	(0.08)	(0.09)
	[5389]	[5389]	[5389]	[5389]
Aquaculture	0.00	0.00	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
	[7390]	[7390]	[7390]	[7390]
Year FE	No	Yes	Yes	No
Plot FE	No	No	Yes	Yes
Province-year FE	No	No	No	Yes

Note: Clustered standard errors in parenthesis. Number of observations in bracket. Each cell corresponds to an individual OLS regression in which the outcome variable is specified in every row. Four specifications are analyzed. Model (1) regress the corresponding outcome to a dummy of whether the plot is annual or perennial, a time dummy that takes the value of 1 in year 2016, and the interaction of the latter two dummies. Model (2) includes year fixed effects. Model (3) adds plot fixed effects. Model (4) add province-year fixed effects. All four specifications control for plot area. *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' compilations based on the VARHS data for 2008-2016.

Table 7: Long term effects of the Land Law on investment for owned, non-restricted plots

Outcomes	Model 1	Model 2	Model 3	Model 4
Irrigation	0.15**	0.15**	0.49***	0.49**
	(0.05)	(0.05)	(0.11)	(0.17)
	[3590]	[3590]	[3590]	[3590]
Infrastructure	-0.01	-0.01	-0.02*	0.00
	(0.01)	(0.01)	(0.01)	(0.00)
	[3590]	[3590]	[3590]	[3590]
Tree-planting	-0.11*	-0.11*	0.03	-0.07
	(0.05)	(0.05)	(0.11)	(0.14)
	[3590]	[3590]	[3590]	[3590]
Aquaculture	0.00	0.00	-0.02	-0.06
	(0.01)	(0.01)	(0.02)	(0.05)
	[3590]	[3590]	[3590]	[3590]
Year FE	No	Yes	Yes	No
Plot FE	No	No	Yes	Yes
Province-year FE	No	No	No	Yes

Note: Clustered standard errors in parenthesis. Number of observations in bracket. Each cell corresponds to an individual OLS regression in which the outcome variable is specified in every row. Four specifications are analyzed. Model (1) regress the corresponding outcome to a dummy of whether the plot is annual or perennial, a time dummy that takes the value of 1 in year 2016, and the interaction of the latter two dummies. Model (2) includes year fixed effects. Model (3) adds plot fixed effects. Model (4) add province-year fixed effects. All four specifications control for plot area. *** p<0.01, ** p<0.05, * p<0.1
Source: Authors' compilations based on the VARHS data for 2008-2016.

References

Bandiera, O. (2007). 'Land tenure, investment incentives, and the choice of techniques: Evidence from nicaragua'. *The world bank economic review*, *21*(3): 487–508.

Bellemare, M. F. (2013). 'The productivity impacts of formal and informal land rights: Evidence from madagascar'. *Land Economics*, *89*(2): 272–290.

Bertrand, M., Duflo, E., and Mullainathan, S. (2004). 'How much should we trust differences-in-differences estimates?' *The Quarterly journal of economics*, *119*(1): 249–275.

Besley, T. (1995). 'Property rights and investment incentives: Theory and evidence from ghana'. *Journal of Political Economy*, *103*(5): 903–937.

Brasselle, A.-S., Gaspart, F., and Platteau, J.-P. (2002). 'Land tenure security and investment incentives: puzzling evidence from burkina faso'. *Journal of Development Economics*, *67*(2): 373–418.

Deininger, K., and Jin, S. (2008). 'Land sales and rental markets in transition: Evidence from rural vietnam'. *Oxford bulletin of Economics and Statistics*, *70*(1): 67–101.

Do, Q.-T., and Iyer, L. (2008). 'Land titling and rural transition in vietnam'. *Economic Development and Cultural Change*, *56*(3): 531–579.

Goldstein, M., Houngbedji, K., Kondylis, F., O'Sullivan, M., and Selod, H. (2018). 'Formalization without certification? experimental evidence on property rights and investment'. *Journal of Development Economics*, *132*(): 57–74.

Goldstein, M., and Udry, C. (2008). 'The profits of power: Land rights and agricultural investment in ghana'. *Journal of political Economy*, *116*(6): 981–1022.

Holden, S. T., Deininger, K., and Ghebru, H. (2009). 'Impacts of low-cost land certification on investment and productivity'. *American Journal of Agricultural Economics*, *91*(2): 359–373.

Joskow, P. L. (1987). 'Contract duration and relationship-specific investments: Empirical evidence from coal markets'. *The American Economic Review*,(): 168–185.

Lawry, S., Samii, C., Hall, R., Leopold, A., Hornby, D., and Mtero, F. (2017). 'The impact of land property rights interventions on investment and agricultural productivity in developing countries: a systematic review'. *Journal of Development Effectiveness*, *9*(1): 61–81.

Markussen, T., Tarp, F., and Van den Broeck, K. (2011). 'The forgotten property rights: Evidence on land use rights in vietnam'. *World Development*, *39*(5): 839–850.