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by

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Do agricultural debt moratoriums help or hurt? The heterogenous impacts on rural households in Thailand

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Abstract

Majority of Thai agricultural households have been at risk of trapping in persistent debt problems, which could in turn impede their development prospects. Over the past decade, debt moratoriums have been one of the most extensive policies aiming to help Thai agricultural households – resulting in 41.4% of households being in debt moratoriums for more than 4 years. This paper estimates the impacts of agricultural debt moratoriums on households' debt, saving and agricultural investment dynamics using a unique panel data of 1 million representative households nationwide. We found that while the debt moratoriums could decrease delinquency propensity for the other loans that do not enroll, they significantly resulted in higher debt accumulation, especially among those with medium debt and those with higher participation intensity. The moratoriums had no significant impact on saving, while could increase agricultural investment for certain groups of borrowers. The findings imply that design of Thailand's popular debt moratoriums should be revisited, especially they should be more targeted and limited to short-term relief.

JEL Codes: G28, G51, Q12, Q14, O16
Keywords: Farmer debt; debt moratorium; debt relief; debt accumulation; agriculture; Thailand

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1 Introduction

Agriculture is a large sector in Thailand comprising of over 4.6 million households in 2021. The fundamental problems of agriculture households are that their incomes are insufficient and instable, and they face illiquidity problem during some months of the year (Chantarat, Ratanavararak, and Chawanote, 2022; Morduch, 2021). Credit is a main tool that farmers use to manage their financials, resulting in 90% of surveyed farmer households reported being indebted to various lenders ranging from government banks, non-bank financial institutions, to community financial institutions, and money lenders. Having access to credit from several sources amidst the asymmetric information problem in the Thai rural credit markets could lead to farmers overborrowing beyond their capacity to repay. The problem is aggravated by the fact that each farmer situation is different and complex, making it unlikely that a universal and standard debt contract could match their varying cash flow, possibly further reducing the farmer's ability and willingness to repay. The weak contract enforcement and low cost of default in some financial institutions could also contribute to farmers accumulating more debt without the strong need to repay. As a consequence, the Thai farmer households might become caught up in debt traps with continuously rising debts over the last decade.

Agriculture in Thailand is also a heavily subsidized and supported sector. Government-endorsed programs cover from agriculture production cost, occupational training, crop insurance subsidy, disaster relief, to debt bailouts. One of the largest debt relief programs in terms of farmer participation and a long history of over two decades is the Debt Moratorium (DM) scheme. The main goal of the DM scheme is to temporarily alleviate the debt repayment burden of small-scale farmers during difficult times, but without debt forgiveness. The pervasiveness of the program allows the farmer borrowers to participate in more than one DM program at the same time and continuously stay in the DM program for many years. Combining with the fact that the program only defers the debt repayment to a later date without principal haircut, it is still debatable whether the program helps or hurts the Thai farmer households.

Despite the importance of the issue and the extensive debate, the empirical evidence of the impact of a large-scale debt relief scheme is limited, and even almost non-existent when comes to the impact of DM program in Thailand. As far as we know, there is only one empirical paper by Tambunlertchai (2004) that evaluates the effect of the first DM scheme in Thailand during 2001–2004 on Thai agriculture households using Townsend Thai survey data. The author finds no significantly positive impact on participants' consumption, asset accumulation, and savings. Other studies in Thailand mostly rely on evidence from small-area survey, focus group discussion, or case

studies, which raise questions on whether the findings are applicable nationwide.[2] In a broader context of debt relief program in agricultural and rural sectors in other countries, the literature typically explores one specific debt relief policy using survey or administrative data. The literature mostly find that debt relief programs could lead to greater defaults, moral hazard, and adverse incentive impact, with no offsetting significant positive effect on savings, consumption, investment, and productivity.[3]

Thus, this paper aims to investigate the impacts of DM policies on farmers' debt accumulation dynamics, repayment behavior, savings, and agriculture activities, and how the impacts vary across heterogenous farmer borrowers. To the best of our knowledge, this paper is the first study of DM impact in Thailand using administrative microdata over a long period of time. We employ large loan-level panel data of one million randomly selected rice farmer borrowers from the largest farmers' financial institution merged with household-level farmer registry data over 8 years. The DM program in Thailand as a debt relief is unique in its kind as it only suspends the debt repayment for a certain period, unlike the debt waiver program and farm foreclosure moratorium in other countries. The intensities of DM participation are also explored, both in the aspects of participating in more than one DM program and participating over a long period of time. This study extensively explores various types of heterogeneities across agricultural households[4], and seeks to find the mechanisms that might explain the finding.

It is found that DM could potentially hurt the farmers by contributing to higher debt accumulation and distressed repayment behavior, with small help on reducing the delinquency likelihood of other loans not enrolled in DM and slightly increasing likelihood of progressive farming. No significant benefit on savings is found. Main mechanism for the higher debt growth is possibly through the principal outstanding of DM loans relatively decreasing less than the loans not enrolled in DM due to the suspended repayment, and the DM participating borrowers seeking more credit by opening new loan account. This increasing loan growth impact is found to increase with the longer duration participating in DM and the more DM programs participated. The finding also suggests that the negative impacts of participating in DM seem to diminish after the borrowers exit the DM scheme for a few years, but some borrowers might keep re-entering another DM programs before that could happen.

[2] See Chawanote and Achavanuntakul (2019) for example.

[3] See Giné and Kanz (2017), Kanz (2016), Mukherjee et al. (2018), and Raj and Prabu (2018) for example.

[4] Impact heterogeneity is generally not explored in the literature, e.g., in Tambunlertchai (2004), Giné and Kanz (2017), and Kanz (2016). Mukherjee at al. (2018), among the few, examine only one dimension of heterogeneity between distressed versus non-distressed borrowers.

The distributional impacts of DM are found across different groups of farmers. The finding suggests that DM could partially help the borrowers who are in adverse circumstances; those having high level of debt, having no owned land, and cultivating in a high disaster risk area. On the other hand, DM tends to be associated with higher debt accumulation among borrowers who might have higher capacity to borrow more. Investigating top-participating DM programs individually, it is found that the more targeted DM programs for the borrowers in distressed condition seem to help more than large-scaled ones.

This paper contributes to the strand of literature investigating the financial and real impacts of debt relief program in agricultural and rural sectors. Giné and Kanz (2017), Kanz (2016), Mukherjee, Subramanian, and Tantri (2018), De and Tantri (2017), and Mishra, Tantri, and Thota (2017) study one of the largest farmer bailouts in India—the Agricultural Debt Waiver and Debt Relief Scheme (ADWDRS) in 2008—and similarly find no significant benefits of the bailout. Giné and Kanz (2017) examine the program using district-level data and show that the program did not lead to higher household consumption and productivity but resulted in greater moral hazard and strategic default that is responsive to the electoral cycle. Kanz (2016) employs the household survey data and finds that the debt waiver program had no positive impact on savings and consumption. Instead, it lowered agricultural investment and productivity and increased reliance on the informal credit, potentially due to reduced formal credit financing after the debt waiver. The author also suggests that the scheme brought about moral hazard and incentive distortion as the borrowers became less concerned about the consequences of delinquency. De and Tantri (2017) show that the debt waiver did not result in lower delinquency rates among the beneficiaries but led to credit rationing in the market after the bailout. Mishra et al. (2017) find that the debt relief could help increase certain types of consumption and spending, but the impact was short-lived. Mukherjee et al. (2018) show that the program only helped the disaster-distressed beneficiaries in the form of lower delinquency but worsened the loan performance of the non-distressed borrowers, suggesting that borrower heterogeneity could influence the effect of a debt relief program.

Other debt relief programs in India are also explored. Raj and Prabu (2018) examine Tamil Nadu's agricultural loan waiver scheme of 2016 and find that the beneficiary farmers became less likely to obtain new credit than the non-beneficiary farmers. Chakraborty and Gupta (2017) study another debt relief program (UP Rin Maafi Yojna) in 2014 and show that the program increased unproductive expenditures such as social spending in expectation of the loan waiver, with no positive effect on productivity enhancement. Studies in other countries include Alston (1984) and Rucker and Alston (1987), who study farm foreclosure moratoria in the United States in the 1930's

and find that the program effectively alleviated farm foreclosure, but at the cost of moral hazard and credit rationing in the credit market for farm mortgage.

This study is also closely related to the literature that explores large-scale debt relief of non-agricultural loans, such as the U.S. mortgage modification programs as a policy response to the financial crisis. See, for example, Agarwal, Amromin, Ben-David, Chomsisengphet, Piskorski, and Seru (2017), and Mayer, Morrison, Piskorski, and Gupta (2014).

The remainder of the paper is organized as follows. Section 2 first provides background on farmer debt and debt moratorium in Thailand. Section 3 outlines the main data set used in this paper. Section 4 presents stylized facts on farmer debt dynamics, debt-related government support, and debt moratorium program in various dimensions. Identification strategy is then discussed in Section 5. Results are presented in Section 6 along with discussion on the findings, and Section 7 concludes.

2 Background

Farmers' Debt. Over the past decade, we have seen rising debt accumulation among Thai farmers. As farmers use credit as a main tool to manage their financials, 90% of surveyed farmer households are indebted with average level of total debt outstanding around 450,000 Baht[5] (around 11,900 US dollar) (Chantarat et al., 2022; Chantarat et al., 2023). They borrow from multiple lenders for all-around purposes not only for the farming, but also for more general purposes like household expenses, housing, vehicles, education, and even for paying other debts. Their lenders range from state-owned Specialized Financial Institutions (SFIs), commercial banks, non-bank financial institutions (non-banks), village funds, saving groups, cooperatives, to agricultural input shops and informal lenders. Farmers' largest creditor in terms of the number of farmer borrowers and loan size is Bank for Agriculture and Agricultural Cooperatives (BAAC), which is an SFI established specifically for farmers.

Focusing on formal loans[6], Figure 1 shows that out of 6.3 million farmers in Thailand in 2021, 63% borrow from formal financial institutions, with average total debt rising from 353,000 in 2016 to 441,000 in 2021. Having access to credit from several sources on the one hand is a good thing.

[5] This data is from a national representative survey of randomly selected 720 rice farmer households in Thailand during 2019–2020. See Chantarat et al. (2023) for more details of the survey.

[6] The data on non-formal debt are scarce and must largely rely on the survey which can be carried out on only a small number of farmer households, making it difficult to study farmer debt dynamics over time trying to include the non-formal loans. Thus, this paper mainly studies the formal loan from the largest debtor, of which richer administrative data is available.

But on the other hand, with the asymmetric information problem in the Thai rural financial markets, this might lead to farmers overborrowing beyond their capacity to repay. From the data, 14% of farmer borrowers cannot pay back their formal loans[7] and this is likely underestimated. From the field study, farmers are found to engage in debt rotation, for example, they take out loans from lender A to repay lender B at the due date, and then take out loan from lender B to repay lender A at a later due date (Chantarat et al., 2022; Chantarat et al., 2023). These, coupled with the fact that the farmers' ability to repay can be considerably affected by widespread disaster shocks and agricultural price volatilities, make the debt problem of Thai farmers structurally concerning.

[Figure 1 here]

Debt Moratorium. As one solution to the farmer debt problem in Thailand, Debt Moratorium (DM) scheme has been one of the most extensive debt relief programs endorsed by the government. The main objective is to temporarily alleviate the debt repayment burden of small-scale farmers during difficult times. The program mainly suspends the repayment of the loan principal for a certain period and the repayment resumes after the program ends without debt forgiveness or principal haircut. A large-scale DM program was first introduced in 2001 for the debt suspension period of three years. The main goal of the program was to "urgently solve debt problems of the farmers along with providing occupation rehabilitation program to aid farmers' production" (BAAC, 2004). DM program was brought back again in 2011 and has been used widely since 2018 (Chawanote, 2021).

DM programs has many variations. Some DM programs serve purposely as a disaster or shock relief to help farmers experiencing income losses from disasters or a special case of COVID-19 pandemic. Some are only for farmers planting certain types of crops or planting in certain areas, and some are nationwide and for more general purpose.

Variation of DM features also include suspending only the principal repayment or both the principal and the interest; whether the interest rate is partially subsidized by the government resulting in the farmers paying lower rate of interest; the restriction on whether the borrowers can take out new loans during the DM period; types of loans that are applicable, and eligibility criteria and selection process into the programs. Common eligibility criteria are being a customer of the BAAC through which DM programs are mainly implemented[8], types of loans, the size of total debt outstanding of the borrowers, not participating in other restricted government support

[7] This is the share of delinquent farmer borrowers to all farmer borrowers in the National Credit Bureau database.

[8] DM programs can also be implemented with loans from the Village Fund, which is one type of community financial institutions, but this is much less common than DM programs implemented via the BAAC.

programs, and not under litigation (BAAC, 2011; Bureau of Rice Policy and Strategy, 2018). For DM programs in the early years, eligible farmers were self-selected into the program, but recent DM programs tend towards automatic enrollment. Under this, the eligible loans that pass the program criteria are automatically given the DM participation status and the repayment of principal and/or interest are automatically suspended. The farmers can choose to opt out by repaying back the loan even when the loan is not due, and they do not need to repay. The farmers who do not repay accordingly to the debt suspension, either intentionally or unintentionally, are deemed as DM participants.[9]

Apart from the direct and immediate benefit of DM programs on mitigating debt burden, its longer-term benefits are still debatable. With temporary higher disposable income from less burden on loan repayment, DM program could lead to higher consumption, higher savings, or higher investment in improving farming capacity and efficiency that could potentially improve agricultural productivity and farmers' ability to repay in the longer run (BAAC, 2016, 2018; Sonakul, 2001, as cited in Tambunlertchai, 2004). Early generations of DM programs were implemented along with occupation development and support program to improve farmers' productivity and income so that the farmers can pay back their debts after the program ended (BAAC, 2004, 2011). But this farming support program tends to fade away for DM programs in recent years. The assessment of the first DM program in 2001 based on farmers' self-report found that the farmers were satisfied with the program and some farmers reported having increased income and savings (BAAC, 2004). However, these benefits have not been found empirically and it is uncertain if the participating borrowers use the debt holiday period productively (Tambunlertchai, 2004).[10]

By construction, DM could reduce delinquency from much lower debt repayment burden during the debt suspension period. But once the farmers exit the DM programs, whether the farmers can repay the same principal amount as when they enter the program, plus interest if any, is left to be further explored. Some of the DM programs could serve as a safety net helping shock affected households or households struggled with high debt to move on economically, ideally leading to more ability to repay loan in the future. But with many DM programs repeatedly offered across the board for over a decade and widespread farmer participation, the DM scheme could distort the borrowers' incentive and result in increased moral hazard and deteriorated credit

[9] The information in this section is taken from BAAC annual reports, Bureau of Rice Policy and Strategy (2018), and discussion with the BAAC officers and the Bank of Thailand staff.

[10] Specifically studying DM in Thailand, Tambunlertchai (2004) empirically find no significant positive impact on participants' consumption, asset accumulation, and savings. Examining the debt relief program in India, Giné and Kanz (2017) and Kanz (2016) also find no positive effect on household consumption, savings, investment, and agricultural productivity.

disciplines of the farmer borrowers.[11] The frequentness of the scheme might also hinder or even undermine the development of rural credit system.

Some important aspects of DM programs that need emphasizing are that (1) DM participation is at the loan level, not the borrower level. This means the borrowers can enroll in more than one DM programs at the same time if they have multiple loan accounts. (2) DM participation is not restricted to non-overdue loans. Under some DM programs, the defaulted loan can be eligible to participate[12]. (3) Loans that are currently under the DM status can still go into default if the interest repayment is not suspended in that program and farmers miss paying back the full interest at the repayment due date. (4) Loans already enrolling in DM scheme are not eligible for other kinds of debt support by the bank such as debt rescheduling and troubled debt restructuring.[13] This mean if the borrowers have troubled debt already enrolling in DM program, they might not choose to do debt rescheduling or debt restructuring to clear up their overdue status, because otherwise they would need to exit the DM program and give up the debt suspension opportunity. Given the complexity of the DM scheme, it is still unclear how the DM programs affect farmers' indebtedness, debt accumulation, and repayment behavior beyond the temporary debt relief.[14]

3 Data

Our study employs a unique dataset, combining administrative microdata from three sources: (1) account-level loan data and borrowers' characteristics from Bank for Agriculture and Agricultural Cooperatives (BAAC); (2) household-level farmers' and farming characteristic and data on disaster relief transfer from Department of Agriculture Extension (DOAE); and (3) farmer-level crop insurance data from Thai General Insurance Association (TGIA). The data are provided under the Memorandum of Understanding (MOU) on Developing Sustainable Crop Insurance using Technology and Behavioral Economics for Thai Farmers among six organizations: DOAE, Digital

[11] Incentive distortion, increased moral hazard, deteriorated credit discipline, strategic behavior, and credit rationing resulting from debt relief are documented, for example, by Giné and Kanz (2017), Kanz (2016), De and Tantri (2017), Raj and Prabu (2018), and Alston (1984) in the context of agricultural and rural debt bailouts, and by Mayer et al. (2014) in the context of mortgage modification program in the U.S.

[12] See, for example, DM for Rice Farmers program as outlined in Bureau of Rice Policy and Strategy (2018).

[13] Debt rescheduling is generally the postponement of the principal repayment to later times so that loan delinquency can be avoided, while debt restructuring involves some formal changes to the debt contract such as loan term, interest rate, and installment amount. The latter one is thus generally reserved for the troubled debt.

[14] Kanz (2016) find that India's ADWDRS could help reducing overall indebtedness of participants. However, that program is in stark contrast with Thailand's DM scheme. In the ADWDRS, the rural households' debts were forgiven in a one-time unanticipated program; the loan accounts were closed, and the pledged collaterals were cleared. In Thailand's DM scheme, debts are not forgiven, principals are not reduced, collaterals are still pledged with the bank, and several DM programs have been continuously implemented in the last decade. The frequentness of DM programs is depicted in Section 4.3.

Economy Promotion Agency (DEPA), Geo-Informatics and Space Technology Development Agency (GISTDA), BAAC, TGIA, and Puey Ungphakorn Institute for Economic Research.

Loan and Borrower Characteristics. One million borrowers are randomly sampled from the pool of 2018 BAAC borrowers who are rice farmers registered with DOAE. Since the data used in this study are provided under the MOU on Thai crop insurance scheme which focuses primarily on the Thai rice farmers, the data is broadly restricted to rice farmer households. Figure 2 plots the ratio of our sampled rice farmer borrowers to total farmers planting any kind of crops at the Tambon level[15] and shows that our sample covers all regions although with some concentration in the northeast region where the rice farming is more prevalent, and quite sparse in the south region where rice is not their main crops.

[Figure 2 here]

Our main data set is 8-year panel data of these one-million borrowers, covering the period of March 2014 to March 2021.[16] For each borrower, we have information on age, the Tambon where they reside, account-level loan characteristics (principal amount, debt outstanding, detailed types of loans, interest rate, the begin and end date, and whether the loan is under debt restructuring), collateralization, delinquency, deposit amounts and types, and participation in government debt-related policies. All data are yearly as of March, the 31st except delinquency which is quarterly to capture the delinquency peak in the second and third quarters.[17] Yearly delinquency is constructed from the worst loan classification in that year. The loan outstanding in this paper excludes those from farmer credit card due to missing data in the first year and discrepancy between the earlier data (2015-2018) and later data (2019-2021). Only about one-fourth of the borrowers have farmer cards though, and the loan amounts are relatively small (averaging around 25,000 Baht). Moreover, the farmer card loans are not eligible to enroll in DM scheme. Thus, this exclusion should not have significant impact on our findings. It should also be noted that, unfortunately, information on accrued interest is not available in our data set. The debt outstanding is only the balance of

[15] Tambon is a sub-district administrative unit in Thailand, smaller than district (Amphoe) and provinces. There are over 7,000 Tambons in Thailand.

[16] The BAAC calendar runs from April to March each year. Instead of December, the end of March marks the end of the year for BAAC's operation. Yearly-payment loans are generally due in March. Thus, our main BAAC data is yearly snapshot as of March, the 31st each year.

[17] Because a large share of BAAC loans have yearly repayment due date at the end of March, if the borrower misses repayment in March, this loan will need to be more than 90 days past due to be classified as delinquent and likely go into default status in the second quarter. By March next year, delinquency status might already be resolved, and the loan could go back to normal status (less than 30 days past due). Hence, the quarterly loan classification is used.

unpaid principal amount exclusive of unpaid interest balance. This means the debt accumulation seen in this paper could be underestimated.

The reasons that studying only loans from the BAAC could deem sufficient are threefold. First, the BAAC is the largest debtor of Thai farmers. Second, loan data from the BAAC is administrative data that covers a long period of time sufficient to study debt dynamics. Third, the DM scheme, which is the focus of this study, is implemented almost exclusively through the BAAC.

Farming Characteristics and Disaster Relief Transfer. Farmer and farming characteristics are taken mainly from Farmer Registration database collected by the DOAE. The information we use in our study are age of all household members, education level of household members, types of crops planted, the size of planting area, water sources (irrigation, own water sources), whether the farmers own the agricultural land, the size of land owned, machine use, whether the farmers have off-farm income, and participation in government agricultural policies. The DOAE also provided us with information on disaster relief transfer, which is a government transfer in the events of disasters that cause crop and income losses to the farmers.

Crop Insurance. Farmers can receive subsidized crop insurance from the government or buy the insurance themselves. The insurance pays out when the farmers incur total crop loss due to pre-specified disasters and the loss has been verified by the government officers. During our sample period, the crop insurance in place only covers rice farming. It is included in our analysis as another important safety net for Thai rice farmers.

Merged Full Data Set. The data from three data sources are merged at the national ID level. Together, our full data set covers one million borrowers in an unbalanced panel during 2014–2021. Summary statistics for key variables from these three data sources are reported in Table 1. The average age of our sampled borrowers is 56 years. On average, the farmers have around 3 loan accounts with the BAAC and total debt outstanding amounts to 255,564 Baht. Considering the whole period, delinquency rate is at 12%.[18] Most of the farmers own land at one point in time and generally receive crop insurances, with average planting area size of 19.3 rai (about 3.1 hectares). Before we turn to discuss our regression analysis and the variables employed in Section 5, the next section first shows the motivating evidence on farmers' debt and debt moratorium using loan data from the BAAC.

[Table 1 here]

[18] This is the total delinquency rate over 2014–2021. If a borrower defaults in any year, this is counted towards the 12%.

4 Farmer Debt Dynamics and Debt Moratorium

4.1 Farmer Debt Dynamics

Considering farmer debt over a longer horizon, Figure 3 presents striking insight that Thai farmers might be caught up in debt at the steady state level of debt to deposit ratio around 100 to 350, and the farmer debt dynamics vary by the intensities of DM participation. The steady state found suggests that farmer borrowers with lower debt outstanding might accumulate debt over time moving upwards along the line and eventually catch up with medium-debt borrowers, whereas farmer borrowers with higher debt might be provided help and support to lower their debt level downwards to the steady state. Separating the farmers into three groups by whether they participate in DM and the intensity of participation, Figure 3 shows that the steady-state debt to deposit ratio of borrowers who do not participate in DM program is much lower (green line), whereas the steady state debt ratio of the borrowers who stay longer in DM scheme is the highest (red line). However, this could be because farmers with lower debt tend to not participate in DM in the first place (selection problem), or participating in DM results in higher debt accumulation, or both.

[Figure 3 here]

Over the past 8 years, farmers' debts have been steadily increasing with the average growth rate of 17.6% per year. Figure 4 depicts debt growth over time for five groups of farmers divided into quintiles based on the size of total debt outstanding in 2014. High debt growth is observed among households in lower debt quintiles, with the bottom quintile having the highest debt growth of 28.2% per year.

[Figure 4 here]

In 2021, the average size of farmers' total debt outstanding with the BAAC is 345,758 Baht and the median is at 237,638 Baht. The debt distribution of farmers segregating into debt size percentiles and their portfolio share by loan types are shown in Figure 5. Borrowers in the 95th percentile have debt outstanding that almost reaches one million Baht. The shares of portfolio by types of loan look similar across the borrowers with all levels of debt, with agriculture loans making up the largest portion of the portfolio, averaging around 66.3% in size. The rest are broadly for personal, investment, commercial and housing purposes.

[Figure 5 here]

4.2 Government Support and Farmer Debt Solution

Thai farmers receive extensive debt-related government supports, both in terms of the number of programs offered and the number of farmers participated. Almost 500 sub-programs are administered during 2014 to 2021 based on our sample data. As of 2021 alone, there were 121 sub-programs reported under the public service accounts in the BAAC annual report (BAAC, 2021). Farmer participation wise, 95% of borrowers in our sample received at least one debt-related government support program, which can be categorized into two main types. (1) Government-endorsed loans lent to farmers by the BAAC to support farmers in various specific areas such as pledging scheme loans, loans for postponement of crop harvesting and sale, soft loan for disaster relief, and loan for general efficiency improvement; and (2) government-endorsed DM programs for the purpose of short-term debt relief as already discussed in Section 2.

Another debt solution given to farmers that can be observed from the data is debt restructuring (DR). This is largely carried out by the bank itself and can be both on non-performing loans (NPL), which is called troubled debt restructuring (TDR), and non-NPL loans. There might be other debt solutions offered to the farmers such as extending the loan maturity on a case-by-case analysis, but this is not clearly recorded and cannot be observed in the data. Table 2 provides more description for each type of debt-related supports and debt solution, the number of sub-programs offered, and the ratio of farmers receiving the support.

[Table 2 here]

Among the three types of debt measures, DM scheme has the highest coverage of 85.7% of the borrowers and covers the highest share of debt outstanding at 46.3% from 14 programs implemented during 2015–2021.[19] Support loans have the highest number of sub-programs (484 sub-programs), but they have lower farmer participants (65.9%) and are small in debt size (9.7% of total outstanding). DR/TDR is the least used measure, covering less than 10% of farmers. DM being the largest type of debt programs is also constantly observed over time, as shown in Figure 6.

[Figure 6 here]

[19] Borrowers participating in DM are identified as the borrowers who are eligible for DM programs and whose debt outstanding does not decrease more than 10,000 Baht from the previous year. This is because DM eligibility can be observed in the data, but information on actual DM participation is not available. Decreased principal outstanding from the previous year might suggest that the borrowers pay back the loan even though they are eligible for debt holiday. As a result, these borrowers who do not exploit the DM given should not be included. Only the borrowers who do not repay the principal at all or repay only a very small amount should be counted as DM participants. The threshold of 10,000 Baht is chosen based on judgement and consultation with the BAAC officers and regulators. Consequently, we only have 7-year data on DM participation, dropping the first year for comparison.

4.3 Debt Moratorium (DM) Program

DM programs have been common since 2014, with more than one ongoing DM program every year. The timeline of 14 DM programs observed in our dataset and the share of borrowers participating in each program are summarized in Figure 7. DM programs are broadly categorized into two types; shock-related DM programs and non-shock-related DM programs (represented in Figure 7 by red tone and blue tone respectively). Shock-related DM programs are mostly for disaster relief, except for a special case of COVID-19 shock in 2020. More than half of the DM programs are non-shock related, which can be further classified by whether the program is targeted or near universal. DM can be targeted to farmers planting certain types of crops or farmers in distress such as NPL borrowers and low-income farmers. DM under Pracharat scheme[20], which is considered as a landslide DM, is the largest in terms of the number of participants (69% of the borrowers).

[Figure 7 here]

Having overlapping DM programs back-to-back every year allows the hopping of the borrowers from one DM program to the next and enables the borrower to continuously stay in DM for many years. This also allows the borrowers to participate in more than one DM program at the same time by having multiple loan accounts that each enrolls in different programs. Figure 8 shows the share of borrowers by DM programs or combinations of DM programs participated over our sample period.

[Figure 8 here]

As a result of pervasiveness of DM programs, participation is widespread among Thai farmers. On average, 43.6% of the BAAC borrowers each year participate in DM, and the share amounts to 77.1% in 2021. The majority of borrowers (72.8%) participate in both types of DM programs over the sample period, making it difficult to disentangle the impacts of shock- versus non-shock-related types of DM. The DM participation statistics are reported in Table 3.

[Table 3 here]

DM Intensity. The intensity of participating in DM can be considered in two dimensions. First is by the number of DM programs the borrowers have participated over the last 7 years (program intensity). Table 3 shows that 77.3% of the borrowers participated in more than one DM program,

[20] Pracharat is a government scheme that aims to support agricultural sector reform. Sub-programs under the Pracharat umbrella include alleviating debt burden, increasing competitiveness competency, supporting the use of technology and innovation in the agricultural sector, and empowering agricultural cooperatives and small and medium entrepreneurs (BAAC, 2019).

and 18.5% have received more than 4 DM programs. Second is by the number of years the borrowers stay in DM programs (time intensity). It is found that 41.4% of the borrowers have participated in DM for more than four years out of seven years that we can observe.[21]

DM Participation Pattern. DM participation of the farmer borrowers over the years has complex pattern unlike typical government policies which have clear starting point, either one time or staggered treatment timing, and tend to stay on. Table 3 Panel D shows that 39% of the farmer borrowers enter one DM program, exit the program, and re-enter another new DM program at a later time (on and off participation), while 35% of the borrowers continuously participate in DM programs – one right after another, and never exit the DM schemes once participated (always in DM and enter DM and never exit). These farmers might be considered as caught up in DM schemes. In contrast, the smaller group of borrowers (11.7%) participate in DM once, exit, and never re-enter DM again during our sample period. This latter group might be the borrowers who only need some help during difficult time but after that, they can continue on their own without having to constantly rely on the government's debt relief.

Characteristics of DM Participants. Overall mean test using 2015 data shows clear selection into the DM programs (Table 4). DM borrowers tend to have larger debt and smaller deposits and tend to be more collateralized and less delinquent. This suggests that there exists a selection problem that must be dealt with and will be discussed in the next section. This also largely confirms the initial finding in Figure 3 that DM borrowers differ from non-DM borrowers.

[Table 4 here]

Variation Across Areas. Lastly, Figure 9 shows that there is variation in debt size and DM participation across different areas in Thailand. Borrowers in the central region tend to have relatively large debt and higher DM intensity, as proxied by the average number of years in DM, whereas borrowers in the northeast region tend to have lower debt and less years in DM. High shares of borrowers participating in DM are observed across the country.

[Figure 9 here]

[21] Because identifying whether the borrowers participate in DM requires comparison of debt outstanding with the previous year, only 7 years of DM participation data is available (2015–2021).

5 Identification Strategies

Given the complexity of the DM scheme itself and the DM participation among farmer borrowers, the two-way fixed effect panel regression is employed to control for unobserved individual characteristics that might affect DM participation. The baseline specification is as follow:

$$Y_{i,t+\tau} = \beta DM_{i,t} + \delta_i + \theta_t + \alpha X_{i,t} + \varepsilon_{i,t}$$

where key outcome variables $Y_{i,t+\tau}$ are debt growth and delinquency. In the baseline regression, debt growth is the year-on-year growth of total principal outstanding of the borrowers (τ =1). Variations include debt growth over the 3-year and 4-year horizon (τ =3, 4). Delinquency takes the value of 1 if any of the borrowers' loan is delinquent[22], and 0 otherwise. The variable δ_i is the borrower fixed effect to control for unobserved individual factors, and θ_t is the time effect. Regional-year fixed effect is also included to take into account the variation across regions.

The main explanatory variables of interest $DM_{i,t}$ are (1) participation in DM, whether the borrower ever participate, currently participating, or used to participate but already exit; (2) DM program intensity, which is proxied by the number of DM programs the borrowers enroll during the period considered; and (3) DM time intensity, which is proxied by the total number of years in DM. These three are all dummy variables and equal to 0 if the borrower does not participate in any DM program. This comparison group includes both the borrowers who never enroll in DM during the whole sample period (never-treated) and the borrowers who not yet enroll in DM at the time considered (not-yet-treated). The two DM intensity variables, even though they are integers, enter the model as dummies so that non-linearity impact can be explored.

The borrower-specific time-varying controls $X_{i,t}$ are to control for time-varying factors that might affect trend of individual outcomes. These include loan size, deposit size, number of loan accounts, number of new loan accounts, having DR/TDR accounts (0/1), receiving disaster relief loans (0/1), having personal loan (0/1), having only working capital (WC) loans (0/1), having collaterals pledged (0/1), farming area (rai), being a landowner (0/1), irrigated farming area (0/1), receiving disaster relief transfer (0/1; proxy for shocks), having crop insurance (0/1), borrower age, and age-squared. Various robustness checks are carried out throughout the analysis and discussed in the notes of the tables or in the footnotes without the sub-section of its own.

[22] Delinquent loans are identified as the loans with classification of Sub Standard (SS) or lower. These encompasses loans that are over 90 days past due.

Our main data set covers 977,977 borrowers and 6.1 million borrower-year observations in an unbalanced panel during 2015–2021. Summary statistics of the main variables used in regression analysis is reported in Table 5.

[Table 5 here]

Indirect Impact on Savings and Productivity. The spillover effects from temporary lower debt burden on savings and agricultural productivity are also examined. The outcome variables that are available in the data are the growth of deposit amounts, growth of planting area, and whether the farmers invest in progressive farming (proxy of farming investment). Unfortunately, the information on consumption and the value of agricultural investment is not available in our dataset.

Analysis by Varying Debt Sizes. To mitigate potential concerns on selection bias that borrowers with higher debt might tend to participate in DM more, the regression analysis is carried out by segmenting the borrowers into 3 debt size quantiles of low, medium, and high debt. This is to examine whether there exists distributional impact of DM on borrowers with different debt levels.

Impact Heterogeneity. The heterogeneity of the DM impacts on debt growth is explored across different groups of farmers based on farmer household and farming characteristics. The differing characteristics examined are Tambon-level disaster risk, regions, household age profile, highest education of household members, land ownership, farming diversification, and progressive farming. The results from impact heterogeneity analysis are hoped to point out which type of farmer borrowers the DM scheme help or hurt.

Impact by DM Program. Lastly, the impact of six individual DM programs is examined using simple difference-in-difference specification to see if the DM impact varies by specific DM programs.

6 Result and Discussion

6.1 Direct Impact on Loan Growth

Baseline Results. Participating in DM is associated with 7 percentage points (p.p.) higher annual debt growth as compared to the borrowers who do not or do not yet participate in DM (the never-treated and not-yet-treated borrowers respectively), as reported in Table 6, column 2–4. This

impact of increased loan growth seems to stay on for one year after the borrowers exit the DM scheme, as the borrowers who just exit the DM program are associated with about 0.7 p.p. higher debt growth (column 3–4). However, the impact subsides as the borrowers stay out of the DM programs longer and do not re-enter. Analyzing a smaller sub-sample comparing only the borrowers who enter DM and never exit (treatment group) with the borrowers who never participate in DM (comparison group), the result in Table 6 column 5 shows a larger impact of 10 p.p. higher debt growth associated with DM participation. The positive and statistically significant impact of DM on loan growth will need to be further explored to find which mechanism that might drive this result. Other variables significantly contribute to higher debt growth are the number of new loan accounts opened during the year and borrowers' age.

[Table 6 here]

Impact Mechanism. DM participation could lead to higher overall borrowers' debt growth through four channels, which are empirically investigated and reported in Table 7, column 1–4. First is the impact on the DM-participating loan accounts themselves. The result in Table 7 column 1 shows that the loan accounts currently enrolling in DM has 8.4 p.p. higher relative loan growth than the loan accounts not enrolling in DM. Because the loans under DM scheme do not require principal repayment; consequently, the principal outstanding decreases relatively less than the loans not under DM scheme, resulting in higher relative loan growth.[23]

[Table 7 here]

Second, the borrowers can accumulate more debt during DM period when their existing debt is frozen by obtaining new credit since recent DM programs generally do not forbid the creation of new loan. Table 7 column 2 shows that the borrowers who participate in DM and open new loan account are associated with about 16 p.p. higher loan growth than the borrowers who participate in DM but do not open new loan account, and around 6 p.p. higher loan growth than the borrowers are not in DM and open new loan account. It should be noted that opening new loan accounts could be from at least three possibilities; (1) actual obtaining new loans from existing excess capacity (2) opening new loan account for the purpose of repaying existing loans that are due, both within the bank or loans with other creditors; and (3) opening new loan accounts as a part of DR or TDR that might materialize the unpaid accrued interest that could not be seen in

[23] The loan growth at the account-level is non-positive since the data in our sample only covers the principal outstanding and not the accrued interest. Due to the nature of the loans, the principal outstanding of each loan account can only decrease through debt repayment, and obtaining more loan is carried out by opening new loan account.

our data prior to the debt restructuring.[24] From the data, 77% of the borrowers who participate in DM scheme open new loan accounts during the period of DM enrollment.

Third, DM enrollment in one loan account could have spillover impact to other non-DM loans since the borrowers might have larger net cashflow to pay back other loans when they do not need to repay the principal of the loans participating in DM. The result in column 3, Table 7 confirms that DM participation in one loan could have positive impact on other non-DM loan of the same borrower in the form of lower relative debt growth, but this positive impact is small (about 1 p.p. lower loan growth).

Fourth, the borrowers participating in DM programs might accumulate more accrued interest, resulting in larger overall debt outstanding. This is possible both in the DM programs that also suspend the interest repayment, but the interest still accrues during the DM period and requires repayment after the DM program ends; and in the DM programs that only suspend the principal repayment and still require the interest repayment, but the borrowers do not or forget to repay or even misunderstand that they do not need to repay the interest. However, this accrued interest channel cannot be observed using our main dataset. As a result, we turn to use an alternative dataset but with a shorter period (2018–2021) instead. The results reported in column 4, Table 7 do not show that the borrowers participating in DM accumulate more accrued interest both during the DM period and after exiting the program.

Medium-Term Horizon. Extending the outcome time horizon to over 3 and 4 years yield consistent results. Participating in DM corresponds to about 8–9 p.p. and 5–6 p.p. increase in 3-year and 4-year debt growth respectively (Table 8, columns 4–9).[25] The impacts also descend the longer the borrowers stay out of DM programs. This likely suggests that the increasing growth effect of DM program could be short-lived if the borrowers do not re-enter DM again after a few years.

[Table 8 here]

[24] For second and third types of opening new loan accounts, in general we should see some existing loan accounts closed and some new loan accounts opened with larger principal or credit limit to cover both the principal outstanding and accrued interest of the former loans.

[25] This section reports the results on the impact of participating in DM program in which both the outcome and explanatory variables are considered over the 3- and 4-year period. The coefficients are not perfectly comparable to the results of 1-year period reported in Table 6 and Table 8, column 1-3, due to (1) the growth outcome sizes differ, as shown in the middle panel of Table 8; and (2) the samples of the borrowers differ because the borrowers who are present in the data in shorter duration than 3- and 4-year are dropped in the longer-term impact analysis; hence, a smaller sample.

Impact of DM Program Intensity. The negative impact of DM participation on debt growth increases with the number of DM programs the borrowers enroll as presented in Table 9 using the 3-year horizon model. The intensity impact on the borrowers who already exit DM programs are slightly smaller, but the pattern of increasing coefficients with the number of DM programs participated is still observed (the lower panel in column 2). The number of total loan accounts and the number of new accounts opening during the period are already controlled for. Our conjecture based on the detailed investigation of some cases from our data is that, as a higher share of debt portfolio is frozen in many DM programs, the borrower might still need to seek more credit to fund the farming operation or household needs on a yearly basis. The existing loan enrolls in one DM program, then the borrower needs to take out a new loan, then this new loan enrolls in another DM program in a few years' time, then the borrower takes out another new loan, and this pattern could go on.

[Table 9 here]

Impact of DM Time Intensity. The impact of DM on debt growth also tends to increase with time intensity of DM participation. The longer the borrower participates in DM, the higher debt accumulation as shown in Table 10. Similar to the result on program intensity, the impact on the borrowers who already exited DM programs are smaller. Staying participated in DM for 5 years could result in about 10 p.p. higher debt growth over the medium term of 3 years.

[Table 10 here]

6.2 Impact on Delinquency and Borrowers' Behavior

Baseline Results. Participating in DM is associated with higher likelihood of being in delinquency status as reported in Table 11. This somewhat seems contradict to the conjecture that DM could significantly lower the debt repayment burden for farmers and should likely be associated with lower delinquency probability. Similar to the results on loan growth, this impact tends to die out after the borrowers exit the DM scheme.

[Table 11 here]

DM versus Non-DM Delinquency. Separating the overall impact of DM participation into DM loan delinquency and non-DM loan delinquency in Table 12, it is found that enrolling in DM indeed likely help the borrowers to be able to repay other non-DM outstanding loans, as can be

seen from the negative coefficient in column 2, although this positive effect is reversed when the borrower exit from DM as they resume paying back the principal. However, on the DM loan itself, debt suspension does not seem to help lower the delinquency rate. Possible explanations are that (1) the borrowers can enter the DM scheme with delinquent status and the status is kept as such because there is no repayment to release the borrowers back to non-delinquent status and loans cannot be provided other forms of support if they are already enrolled in DM scheme. Comparing to other non-DM borrowers who might start with delinquent status, but they could repay some amount or engage in other debt restructuring program that could help them change to non-delinquent status. As a result, the DM borrowers are relatively worse. (2) It could also be that the borrowers do not repay the interest during the DM period, either because they do not have the ability to repay or because they are simply not aware that they need to repay the interest during DM, resulting in the delinquent status.

[Table 12 here]

Medium-Term Horizon. Investigating the change of delinquency status over a period of three years in Table 13, the results are similar. Currently participation in DM and one year after exiting the DM program are associated with more likelihood of adverse change in delinquency status, but the impact is small in size. This impact peaks when the borrowers participate in DM for around 3-4 years out of 5 years.

[Table 13 here]

Other Measures of Borrowers' Behavior. Apart from delinquency, two other measures of borrower's credit behavior are explored. The first one is the behavior change of whether the borrowers repay the principal outstanding comparing time t with 3 years after.[26] The second one is whether the DM borrowers who already exit tend to re-enter the DM programs again or not. The results are reported in Table 14. It is found that DM participation is correlated with higher likelihood of adverse behavior change in repaying the principal (Table 14 column 1-4), but this could be reversed if the borrowers exit the DM programs and stay out for many years. On the other hand, the borrowers who exit the DM program for a few years have higher likelihood of re-entering the DM scheme again (Table 14 column 7). These are in line with the stylized fact that 39% of the farmer borrowers enroll in DM scheme in an on and off pattern. It might imply that some borrowers could keep re-entering another DM program, repaying less principal,

26 Typically, some borrowers only repay the interest in each year when the loan repayment is due and are not able or choose not to repay large enough to cover the principal outstanding. Thus, principal repayment, and not only the interest repayment, represents good repayment behavior.

accumulating more debt, and could not enjoy the benefit that possibly exists a few years after the borrowers truly exit the DM scheme.

[Table 14 here]

6.3 Spillover Impact on Savings and Productivity

Apart from the direct impact on debt accumulation and loan repayment behavior, DM might have spillover impacts on consumption, savings, investment, and productivity as discussed in Section 2. The results presented in Table 15 suggest that overall, DM participation does not crowd in either savings or higher farming activities (column 1–2). Participating in DM could lead to increase in probability of doing progressive farming, which is one proxy of agricultural productivity and investment (column 3). Nevertheless, the impact is small. It could be that temporary higher disposable income from lower debt burden is used on consumption rather than savings, farming, or investment; or the disposable income is negative from the beginning regardless of enrollment in the DM program, and lower debt repayment burden at one bank simply means less borrowing from other lenders.

The finding that DM program has no significantly positive benefits on savings growth is in line with Tambunlertchai (2004) who studies the first large-scale DM program in Thailand. Giné and Kanz (2017) and Kanz (2016) also find no positive impact of India's debt bailout program on agricultural productivity, savings, and investment.[27] However, the savings data in this study is only from the deposit accounts with the BAAC, but in fact, Thai farmers save at other financial institutions such as other SFIs, village funds, saving cooperatives, and local saving groups, and some might save in the forms of valuable assets such as gold and livestock instead of bank deposits. The finding on savings growth in this paper thus might be limited as we likely see only some portions of the farmers' total savings.

[Table 15 here]

6.4 Impact Heterogeneity Across Different Groups of Borrowers

This section explores whether the effect of DM on loan growth, saving, and agriculture activities varies across different farmer households to see whether DM helps or hurts which group of farmers. Three dimensions of farmer borrowers are considered; debt size, farmer household

[27] Mishra et al. (2017) found that India's ADWDRS led to increased household spending in jewelry, which the authors argued to be one form of precautionary savings.

characteristic, and farming profile. Figure 10 shows the 3-year loan growth impact of DM participation intensity, as proxied by the number of years the borrowers participate in DM program, for the borrowers who already exit the DM scheme to see the debt dynamics afterwards. Figure 11 depicts the spillover impact on saving and investment during the DM enrollment in the 3-year horizon specification.

[Figure 10 here]

[Figure 11 here]

By Debt Size Quantiles. Participating in DM has distributional impacts across borrowers with different levels of debt (Figure 10a and Figure 11a). Borrowers with high debt (3rd quantile) seem to be least negatively affected and benefit from positive impact on progressive farming. Although DM contributes to slightly higher debt growth in the short run, this impact diminishes as the high-debt borrower stay in DM programs longer (Figure 10a). For the DM participants with low and medium debt (1st and 2nd quantiles), DM is associated with higher debt growth and this effect evidently increases with DM time intensity, suggesting that they could accumulate more debt as they stay longer in DM programs.[28] Moreover, no offsetting benefit on saving and agriculture investment is found among low and median debt borrowers.

By Household Characteristics. No outstanding difference is observed among borrowers across different regions, household age profile, and household education level (Figure 10b – Figure 10d and Figure 11b – Figure 11d). Rice farmers in the south region tend to have lower debt growth associated with DM participation, but the result is not significantly robust due to small number of rice farmers in the south region. Participation in DM has positive spillover effect on larger planting area for farmers in the north and higher likelihood of progressive farming for the farmers in the northeast, but the effect is small.

By Farming Characteristics. Similar DM impacts on debt growth are found between households who are and are not susceptible to disaster shocks (Figure 10e), but the borrowers in risk-prone areas could benefit from DM in terms of slightly higher likelihood of progressive farming (Figure 11e). It can be that there are indeed no significant differences between borrowers in risky versus non-risky areas, or because using disaster relief transfer from the government as a proxy might not

[28] Caveat to note is that the debt growth is in percentage unit, whereas the low/medium/high debt level is in monetary value. This means low (high) debt growth in percentage for the borrowers with high (low) debt size might translate into large (small) amount of debt increased in monetary value.

truly capture the actual disaster risk.[29] The finding in this part thus needs further research if the quality data is available. For farmers with varying income diversification and farming progressiveness, no significant difference of DM impacts is found (Figre10g and Figure11g).

The apparent difference Is for the landless borrowers, whose participation in DM seems to be unrelated with higher debt accumulation (Figure 10f), while DM might help them be able to invest more both in terms of larger planting area and the likelihood of investing in progressive farming (Figure 11f). On the opposite, the farmers with larger land owned tend to accumulate more debt as they stay longer under the DM scheme, while no significant benefit on agriculture investment is found. Possible explanation could be that farmers with no owned land might have limited access to new credit, contributing to insignificant DM's impact on debt growth, while the release of cashflow from debt repayment suspension could in turn be used on farming investment instead. For farmers with larger owned land, they might be able to easily access more credit using lands as collaterals during the DM period, resulting in higher debt growth.

Overall, it seems that DM does not hurt or partially helps the borrowers who are in adverse circumstances and might be naturally restrained from borrowing more – the borrowers having no owned land, the borrowers already having high level of debt, and the farmers in high disaster risk area. In contrast, DM tends to be associated with higher debt accumulation among borrowers who likely have higher capacity to borrow more and possibly might not need debt relief in the first place, that is, borrowers having higher asset and borrowers with low to medium debt.

6.5 Impact by Individual DM Programs

In this last sub-section, six DM programs with high borrower participation ratios are separately examined using simple difference-in-difference specification. Five of them are still active as of March 2022, which is the end of our sample period. These are Pracharat DM, COVID-19 DM, DM for low-income farmers, DM for 2019 drought affected borrowers, and DM for 2019 flood affected borrowers. The other DM program investigated is DM for rice farmers that ended in 2018. See Figure 7 for the timeline and the ratio of participants for each DM program.

[Table 16 here]

[29] Mukherjee et al. (2018) find contrasting impacts of India's 2008 ADWDRS on disaster-distressed versus non-disaster-distressed borrowers. Distressed (non-distressed) farmers who are debt relief beneficiaries default less (more) on the loan than their non-beneficiary counterparts. The distressed borrowers are proxied from farmers who made a claim for crop insurance. Different findings between that paper and this study could be due to the different characteristics of India's ADWDRS and Thailand's DM scheme. The latter is more complex in nature with various DM programs running concurrently since 2014.

Varying DM impacts across different programs are found. Table 16 reports these results. Pracharat DM scheme (Panel A), which is the largest in terms of the participants (69% of the borrowers) is associated with 11.4 p.p. higher debt growth and 86.4 p.p. higher delinquency likelihood, with small or no offsetting benefit on saving and agriculture productivity. The second largest, DM for COVID-19 (Panel B), is also associated with higher debt growth and higher probability of being in the delinquent status, but this program seems to indirectly help the borrowers' farming activities. DM programs for disaster relief seem to be associated with higher debt growth as well, but they could potentially help lower the delinquency and contribute to higher agricultural investment during the DM periods (Panel D and E). The program that seems to benefit the participants the most is the DM program for low-income farmers, in which the DM participation is associated with moderate debt accumulation, lower likelihood of being delinquent, and positive spillover effect on saving and investment to a certain extent (Panel C).

The finding seems to suggest that large-scaled DM programs might hurt the borrower participants rather than help and the more targeted DM programs for the borrowers in distressed condition seem to be more beneficial, as the large-scaled programs might be provided to the borrowers who are not in need of debt relief, possibly resulting in moral hazard. This finding is broadly in line with the literatures, which find that debt relief could benefit under some economic conditions and those targeted at disaster-affected farmers could improve loan performance, whereas universal debt relief or debt relief not conditional on adverse shocks could be counterproductive and have negative unintended consequences on the credit markets (Bolton and Rosenthal, 2002; De and Tantri, 2017; Mukherjee et al., 2018).

However, these results must be interpreted with caution because the estimated coefficients might be subjected to a selection bias problem and it is not straightforward to categorize the DM programs due to their complex characteristics. What seem to be targeted programs like DM for rice farmers and 2015 drought DM could be deem large-scale with high farmer participation. It can then be argued that DM for rice farmers is rather a universal DM program than a targeted one since rice farmers constitute a majority of farmers in Thailand covering all regions. DM program for low-income farmers might sound targeted but as most farmers have low income, the share of eligible farmers could be large. Disaster-contingent DM programs can as well have different aspects and conditions in detail.[30] DM program for 2015 drought in general has about half of the

[30] We have tried to focus the analysis only on the disaster-related DM programs since it might be the only type that can be clearly distinguished. However, due to the complicated nature of DM participation and limited data, no clear identification strategy can be carried out. The supposed prerequisite to participate in risk-contingent DM program is that the farmers experience loss from natural disasters, but the data on actual areas or farmers affected by disasters are not of good quality. We have tried to use a

farmer borrowers participated (47% of borrowers), and the program only suspends the principal amount without interest rate reduction, whereas DM program for 2015 drought in 22 provinces are evidently targeted with the criteria that eligible farmers must be in specified 22 provinces, resulting in only 8% of the borrowers participated. This latter program also involves a reduction of interest rate subsidized by the government.[31]

7 Conclusion

Using a unique micro-level dataset, we have found that DM could potentially hurt the farmers by contributing to higher debt accumulation and distressed repayment behavior, with small help on reducing the delinquency likelihood of other loans not enrolled in DM and slightly increasing likelihood of progressive farming. No significant benefit on savings is found. Main mechanism for the higher debt growth is possibly through the principal outstanding of DM loans relatively decreasing less than the loans not under DM scheme because the repayment is suspended by design; and the DM participating borrowers seeking more credit by opening new loan account while their existing debt is frozen in DM. This increasing loan growth impact is found to increase with the longer duration participating in DM and the more DM programs participated. The finding also suggests that the negative impacts of participating in DM seem to diminish after the borrowers exit the DM scheme for a few years, but some borrowers might keep re-entering another DM programs before that could happen.

The distributional impacts of DM are found across different groups of farmers and different DM programs. DM could partially help the borrowers who are in adverse circumstances and might be naturally restrained from borrowing more – the borrowers already having high level of debt, the borrowers having no owned land, and the farmers in high disaster risk area. In contrast, DM tends to be associated with higher debt accumulation among borrowers having larger owned land and borrowers with medium debt. These borrowers who *seem* to have higher capacity to borrow more might be able to continuously obtain new credit while compiling the suspended existing loans in the DM programs, possibly leading to debt accumulation over time. Investigating large

proxy from areas in which farmers receive disaster relief transfer from the government, although it is subjected to loss verification by the government officers and might not represent the actual disaster risk. Even so, the borrowers who receive relief transfer (i.e., disaster-prone) and do not receive disaster relief DM program are not many, and some of them are engaged with another non-disaster-related DM programs. Therefore, they might not be a good control group for comparing the borrowers in risky areas who do not receive DM versus the borrowers in risky areas who receive DM. In addition, the risk-prone borrowers who receive shock-related DM should not be compared with the borrowers in general because they are likely worse off than the borrowers who are not susceptible to disaster risk.

[31] The information on 2015 drought DM program comes from the BAAC annual report for the year 2017 and the discussion with the BAAC loan officers and the Bank of Thailand staff.

DM programs individually, it is found that large-scaled DM programs might hurt the borrower participants and the more targeted DM programs for the borrowers in distressed condition seem to be more of help.

The limitations of the study, however, are that the main debt outstanding analyzed only includes the principal outstanding with little information on accrued interest outstanding. We also have no good-quality data on income, consumption, and savings with other financial institution, which weaken our finding on the indirect impact of DM participation on other aspects of the farmer households. Lastly, the results primarily point out the correlation between participation in DM and economic outcomes of the farmer household which could be from various underlying factors, but the causation of DM participation on households are not extensively explored.

The findings offer important policy implications. First, the DM scheme should be used only when necessary and with the borrowers with necessities to prevent debt accumulation without real capacity to pay. The program enrollment could be changed from opt out to opt in to exclude borrowers unintentionally participate in DM and include only those borrowers sufficiently in need to apply for the program. Some restriction on participation in DM could be put in place. For example, participating in more than one DM program at a time might not be allowed or the number of years the borrowers can consecutively participate in DM should be limited. A proper incentive could be offered to the borrowers to exit the program before the program ends, such as credit rating upgrade like the first DM program in 2001 or partial haircut of the accrued interest. Additionally, a non-incentive-distorted measure could be put in place to prevent the DM-exited borrowers from unnecessary re-entering into the DM scheme again.

Second, allowing new debt creation while participating in DM should be reconsidered. On the one hand, continuously giving new loans to the borrowers under DM scheme leads to debt accumulation, but on the other hand, if the bank does not lend the needed money, the farmers might need to seek capital and liquidity from informal loans, which could be worse than being indebted with formal financial institution. The financial institution for farmers needs to balance between these two ends. The solution might involve giving out new loans to only DM participating borrowers with proven high agricultural capacity and high capability to repay. The actual farming activity could also be checked with the DOAE's Farmer Registration so that the bank can accurately provide appropriate amounts of lending that matches with the farmer's production.

Third, the DM scheme that could potentially contribute to unproductive debt accumulation with small offsetting benefits might be replaced with measures that deem more effective to curb farmer debt. Shifting away from near-universal programs to more targeted and even tailor-made

measures could be one thing. Targeted DM programs with clear eligibility rules that requires efforts to entry to prevent incentive distortion and moral hazard might be more preferred. Even more preferred could be a case-by-case customized debt restructuring that matches with individual farmer's circumstance and ability to repay. The proper debt restructuring must involve more than just extending the principal repayment. The loan contracts must be modified to suit each farmer to ensure that the farmers can follow the new repayment plan accordingly. However, this requires the understanding of different situations each borrower is in and the borrowers' actual capacity to repay to be able to come up with the restructuring program that suits each borrower. These involves extensive resources from the lender side. Another possibility is to move away from ex-post measures like the DM programs to more ex-ante measure such as insurance-linked loans that provides a safety net in the adverse state such as disaster shock that is not in the control of the borrowers.

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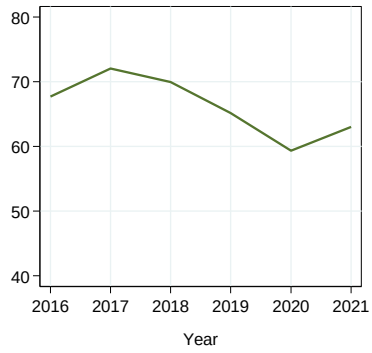
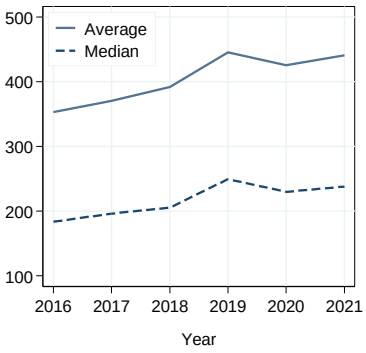
Figure 1: Overview of Farmers' Debt 2016–2021

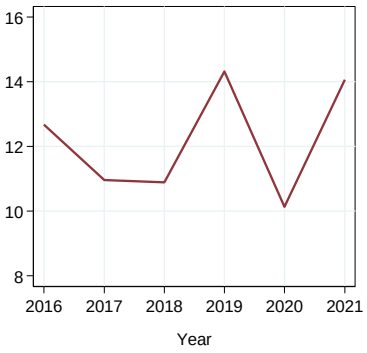
(a) Share of farmer borrowers to farmer households (%)



(b) Average and median debt per borrower (thousand Baht)

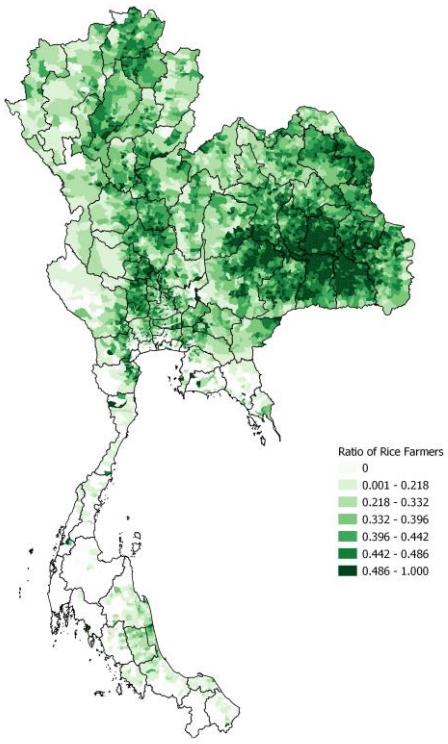


(c) Share of delinquent borrowers to total borrowers (%)



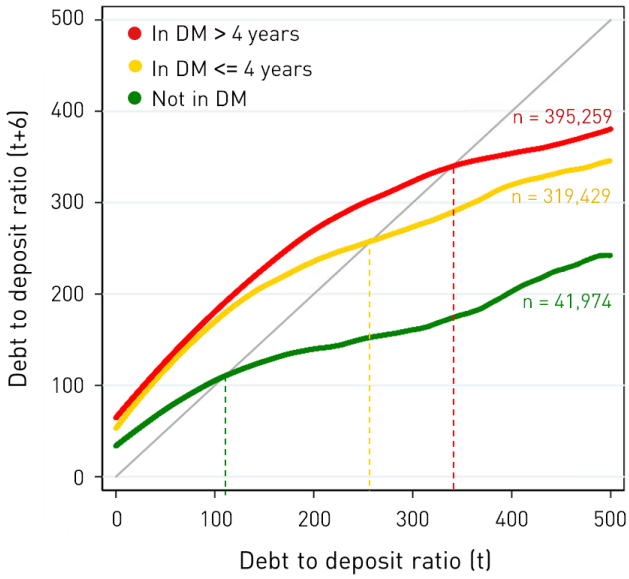
These figures plot the farmers' loan from National Credit Bureau database, which includes all type of loans from commercial banks, non-banks, and SFIs. These figures exclude loans from informal and semi-formal lenders such as loan from village funds and cooperatives. Delinquency refers to more than 90 days past due. The number of farmer households is from DOAE.

Figure 2: Sampled Rice Farmer Borrowers to All Farmers by Tambon



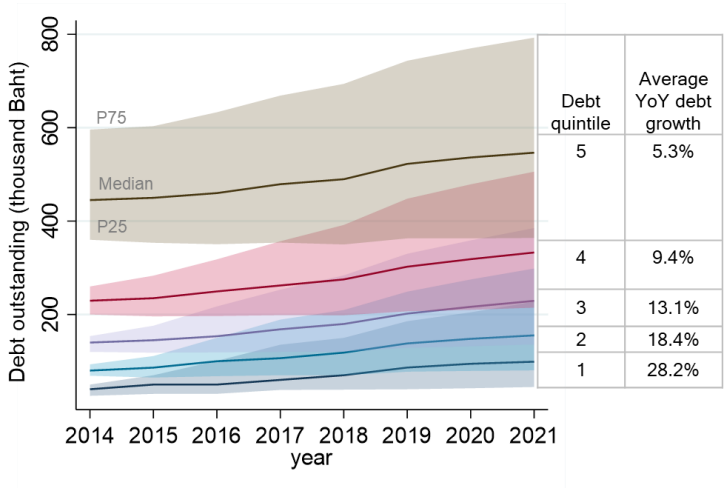
This figure plots the ratio of one-million sampled rice farmer borrowers to total farmers at the Tambon level. Only Tambon with more than five rice farmer borrowers are plotted.

Figure 3: Nonparametric Estimation of 6-year Debt Dynamics



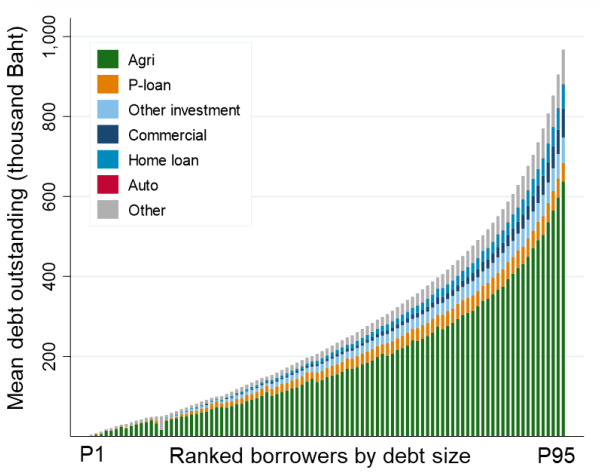
These figures plot the non-parametric Kernel estimation of the debt to deposit ratio in period t versus in period t+6 years for three groups of borrowers; the borrowers who never participate in DM (green), the borrowers who participate in DM up to four years (yellow), and the borrowers who participate in DM more than four years (red). Debt to deposit ratio is computed from the total loan outstanding to total deposits. The borrowers who have debt to deposit ratio below the 1st percentile or above the 95th percentile are excluded. The colored numbers after n represent the number of borrowers in each group, but only randomized 20,000 data pairs from each group of borrowers are used in the estimation for the illustration purpose. Using the 3- and 7-year interval and changing from debt to deposit ratio to debt to collateral ratio yield similar curves with clear steady state level of debt ratios and distinction among varying intensities of DM participation. Debt dynamics patterns do not clearly differ across varying education levels, different types of diversification (on-farm/off-farm income, mono/multi crop), whether being in DR/TDR or not, and different levels of disaster risk.

Figure 4: Debt Outstanding and Debt Growth Over Time by Debt Quintiles



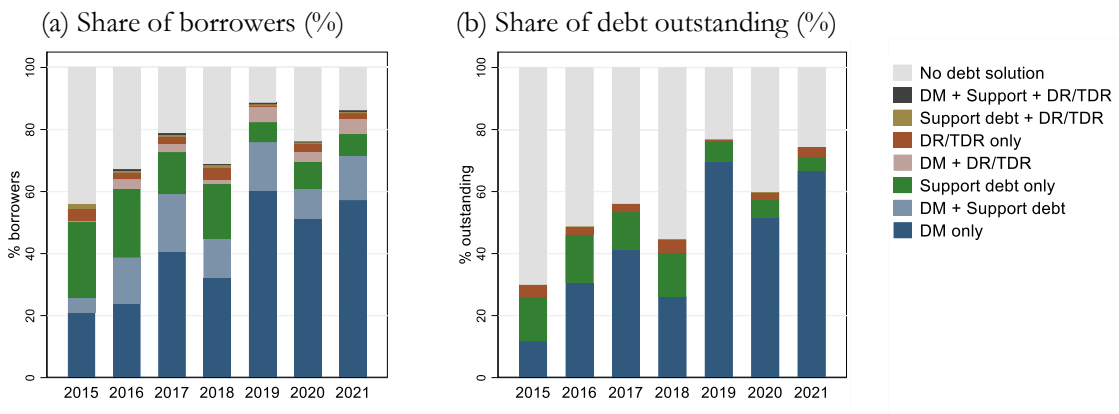
This figure plots debt outstanding per borrower by debt quintiles over the period of 2014 to 2021. The lines represent median debt outstanding, and the shaded areas represent debt outstanding at the 25th and 75th percentiles for each group.

Figure 5: Distribution of Mean Debt Outstanding by Loan Type



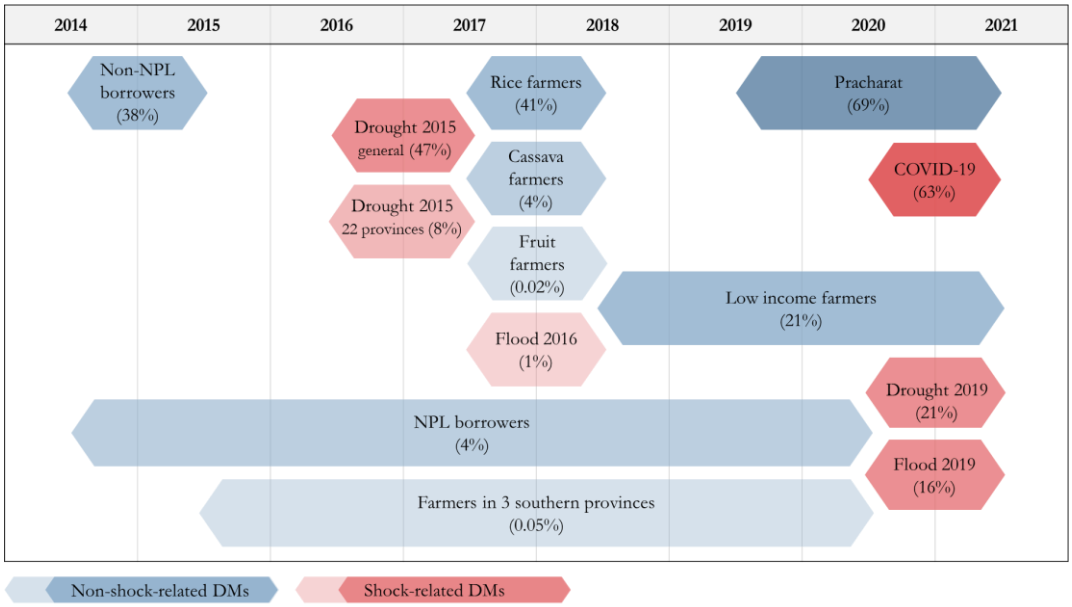
This figure plots mean debt outstanding per borrower by debt size percentiles as of March 2021. The borrowers are ranked by their debt size from the 1st percentile to the 95th percentile in the x axis. Grouping of loan types is categorized by the authors based on detailed codebook. Agriculture loans include loans for agriculture inputs, loans for investment in the agriculture sector, and loans for agriculture land. Other investment is investment for non-agricultural purposes.

Figure 6: Share of Borrowers and Debt Outstanding by Debt Solution Mix



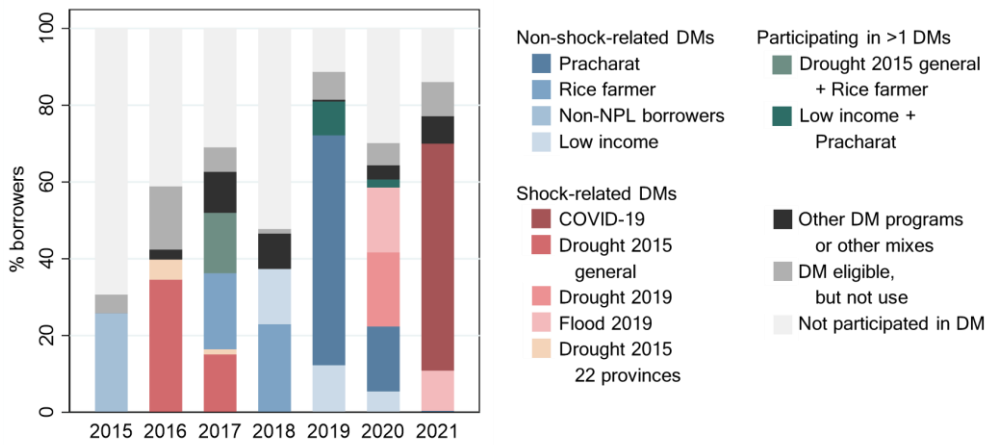
These figures plot the share of borrowers and share of debt outstanding by debt solution mix over time. Participation in DM are identified as borrowers who are eligible for DM programs and whose debt outstanding does not decrease more than 10,000 Baht from the previous year because this might suggest that the borrowers pay back the loan even though they are eligible for debt holiday. For Figure 6a, each borrower can receive more than one type of government support/debt solution at the same time, represented by the plus sign (+), by having multiple loan accounts. But each loan account generally engages with only one program at each point in time; thus, there is no combination of debt measures in Figure 6b.

Figure 7: Timeline of DM Programs and Share of Participating Borrowers 2014–2021



This figure shows the timeline of all 14 DM programs found in the sample and share of participating borrowers to total borrowers for each DM program. The timeline is based on what is seen in the data as of 31 March each year. For example, we see borrowers participating in Flood 2016 DM program in March 2017 and 2018, and 1% of farmer borrowers participated in this program. The years in disaster-related program names likely come from the year of the disaster or the crop year that experiences loss. There could be lagged time in implementing the DM program as well as in the data as we only see yearly snapshots as of 31 March each year. It could be that Flood 2016 program started since the end of 2016 or it might just start in the beginning of 2017. Not all programs are reported in detail in BAAC annual reports, so we choose to present the timeline only according to what we see from the data. Blue-toned boxes are non-shock-related DMs. Red-toned boxes are shock-related DMs. Darker colors refer to higher DM participation.

Figure 8: Share of Borrowers by DM Program Participation



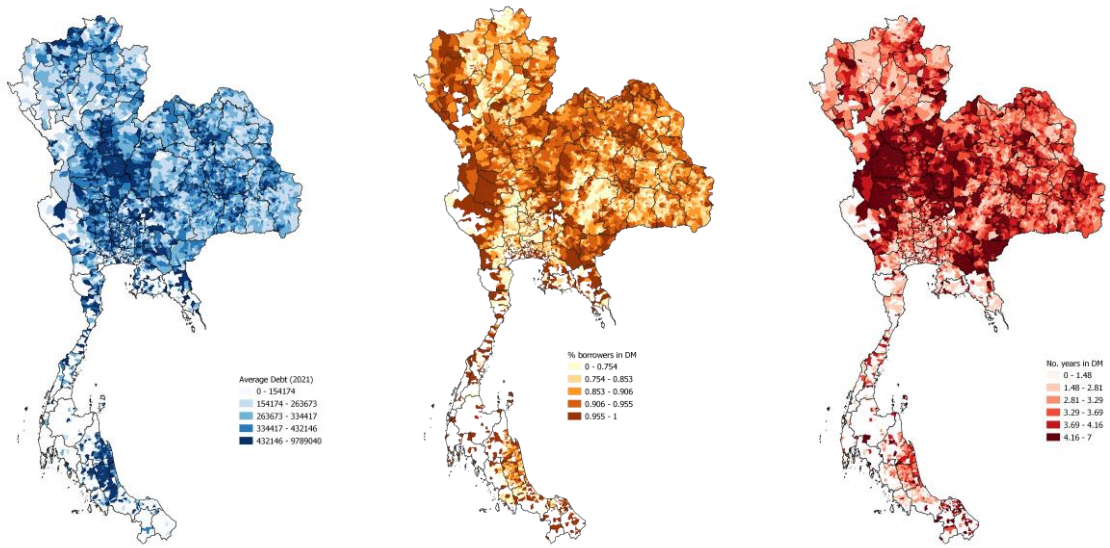
This figure shows the share of borrowers by DM program participation from 2015 to 2021. Other DM programs are flood 2016, NPL borrowers, fruit farmers, cassava farmers, and farmers in 3 southern provinces. Blue-toned bars are non-shock-related DMs. Red-toned bars are shock-related DMs. Green-toned bars are combinations of DM programs. Pracharat is a government scheme that aims to support agricultural sector reform. Alleviating debt burden through debt deferral is one of its sub-programs.

Figure 9: Variation Across Geography

(a) Average debt outstanding 2021 (Baht)

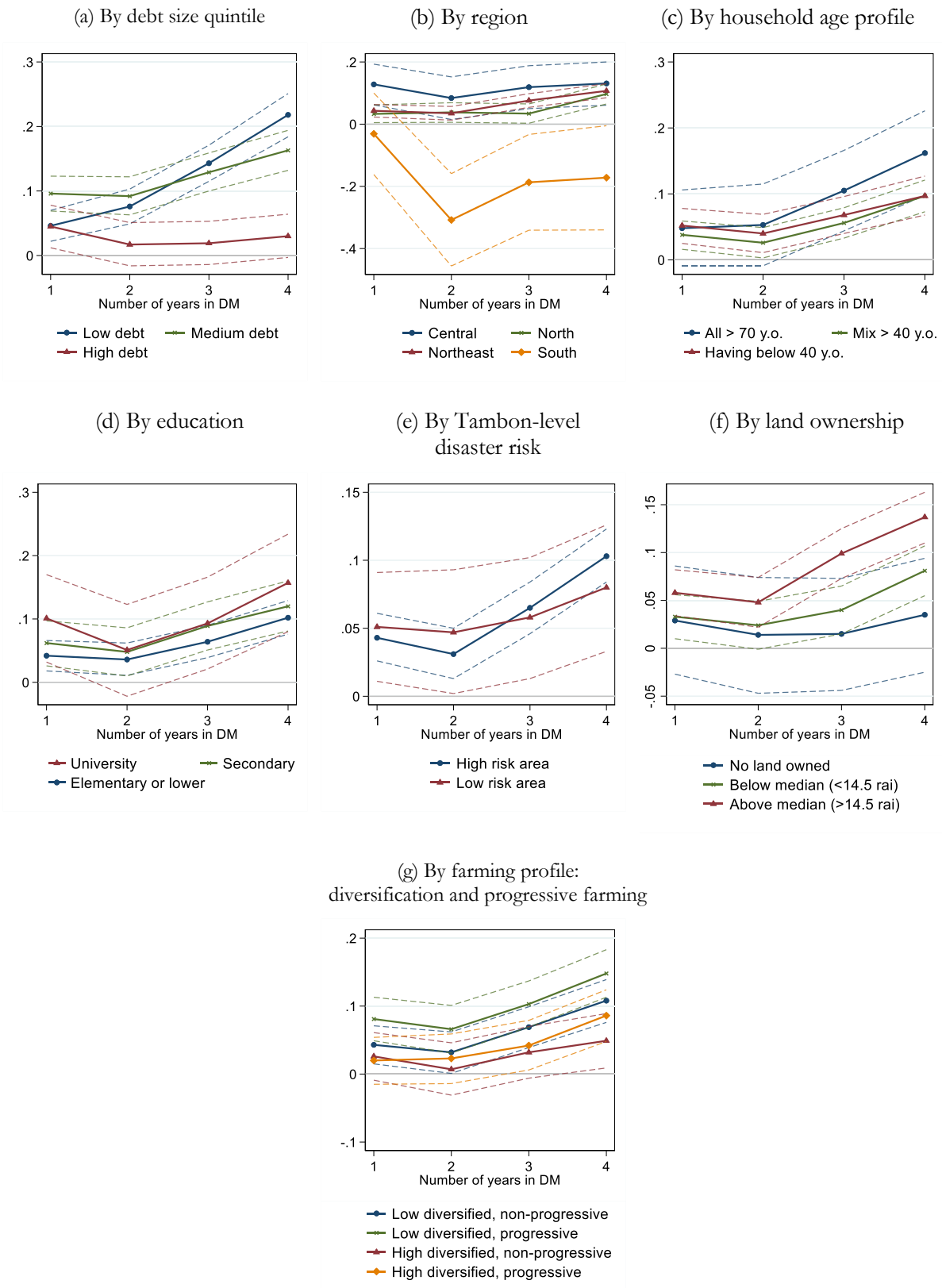
(b) Share of borrowers participating in DM 2015–2021 (%)

(c) Average years in DM



This figure plots at the Tambon level. Only Tambon with more than five rice farmer borrowers are included.

Figure 10: Heterogenous Impact of DM Intensity on Debt Growth for Exited Borrowers

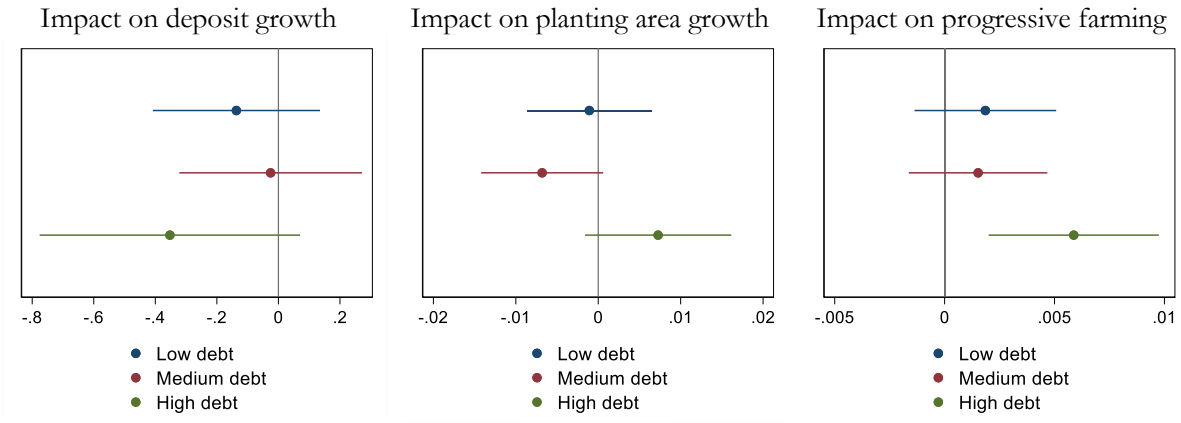


These figures plot the estimated coefficients (solid line) and the associated 95% confidence intervals (dashed line) of the number of years in DM. Each solid line represents one regression. The specification is the same as in Table 10, column 2, but the regressions are estimated separately for each group of borrowers and only the coefficients of the borrowers who already exited from DM at period t+3 are plotted (the lower panel in Table 10). The regressions are fixed-effect panel regressions at the borrower-year level. The dependent variable is 3-year growth of principal outstanding from time t to t+3. The number of years in DM enters the model as dummy variables. All specification includes borrower FE, year dummies, interactions between year dummies and region dummies, and borrower controls. Borrower controls include lagged dependent variables, loan size at time t, average deposit size, number of total loan accounts during the period, number of new loans during the period, having DR/TDR accounts (0/1), receiving disaster relief loans (0/1), having P-loan (0/1), having only WC loans (0/1), collaterals pledged (0/1), farming area, landowner (0/1), irrigated farming area (0/1), receiving disaster relief transfer (0/1), receiving crop insurance (0/1), age, and age-squared. All regressors are lagged except age.

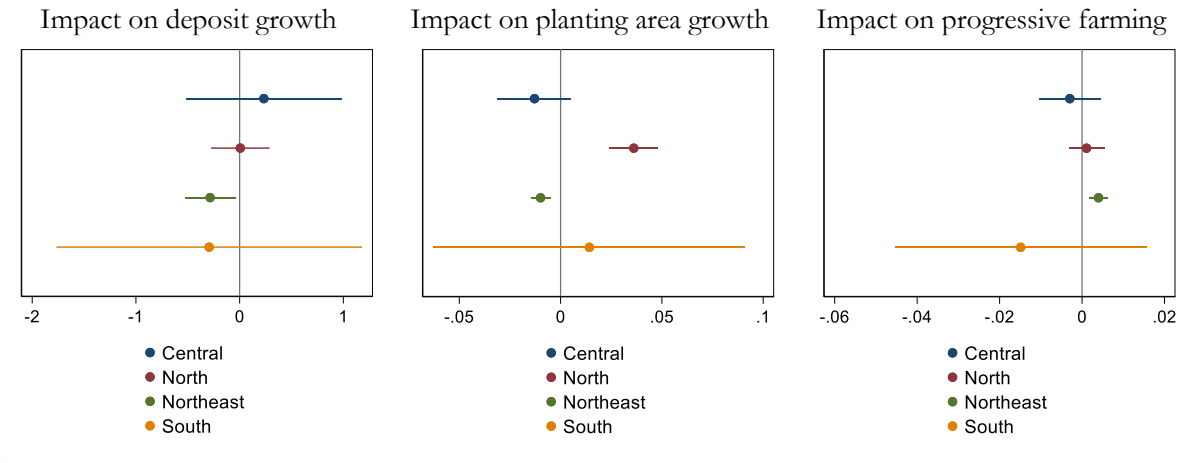
Low debt = borrowers in the first quantile with principal outstanding below 119,889 Baht; medium debt = borrowers in the second quantile with principal outstanding between 119,890 to 286,935 Baht; high debt = borrowers in the third quantile with principal outstanding above 286,935 Baht. Household age profile considers the age of all household members, whereas age as a control variable is the age of the borrower. Age profile is divided into three groups (1) All above 70 y.o. = all household members are above 70 years old; (2) Mix above 40 y.o. = all household members are above 40 years old with at least one member younger than 70 years old; (3) Having below 40 y.o. = households with at least one member younger than 40 years old. Education in is the highest education of all household members and excludes borrowers with missing education data. Tambon-level disaster risk is proxied by whether farmers in that Tambon received disaster relief subsidy in that year or not. Any farmer receiving the subsidy suggests that the Tambon was affected by the disaster. Robustness check using individual-level disaster risk instead of Tambon-level yields similar results and is not reported. Land ownership (Figure 10f), farming diversification (Figure 10g), and progressive farming (Figure 10g) are considered over the entire sample period. If the borrowers own any land, plant multi crop/have off-farm income, or do progressive farming in any given year, the borrowers are classified in those groups accordingly. Land ownership dimension is divided into 3 groups of borrowers; no land owned, having owned land with the size below the median, and having owned land with the size above the median. Farming diversification considers two aspects; whether the farmers only plant rice or plant other crops as well (multi crop), and whether the farmers have off-farm income. Since the borrowers in our sample are rice farmers, rice is the base crop. High diversification refers to planting multi crops and having off-farm income. Other combinations are considered as low diversification. Progressive farming refers to either one of the followings; planting sustainably, planting premium rice, having modern machine, or investing in own water source.

Figure 11: Heterogenous Impact of DM Participation on Savings and Agricultural Investment

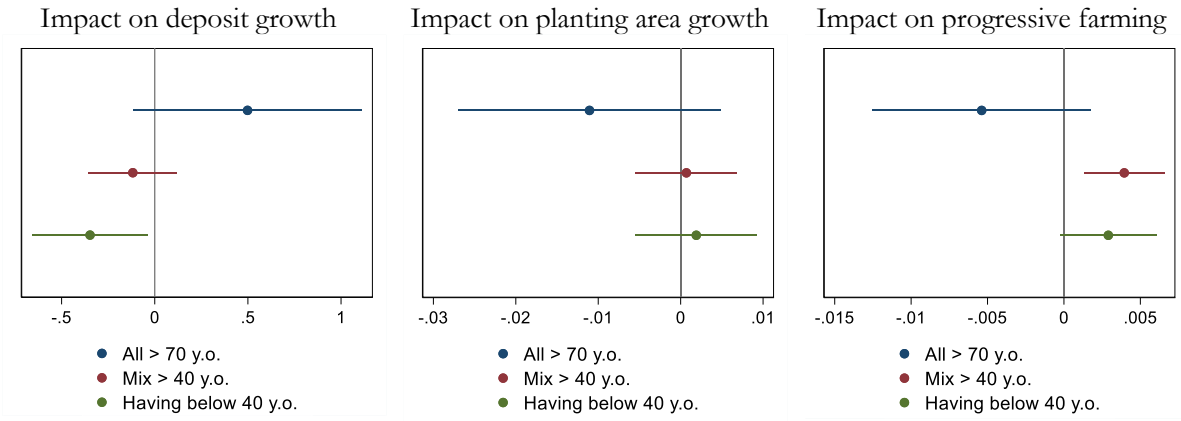
(a) By deb size quintiles



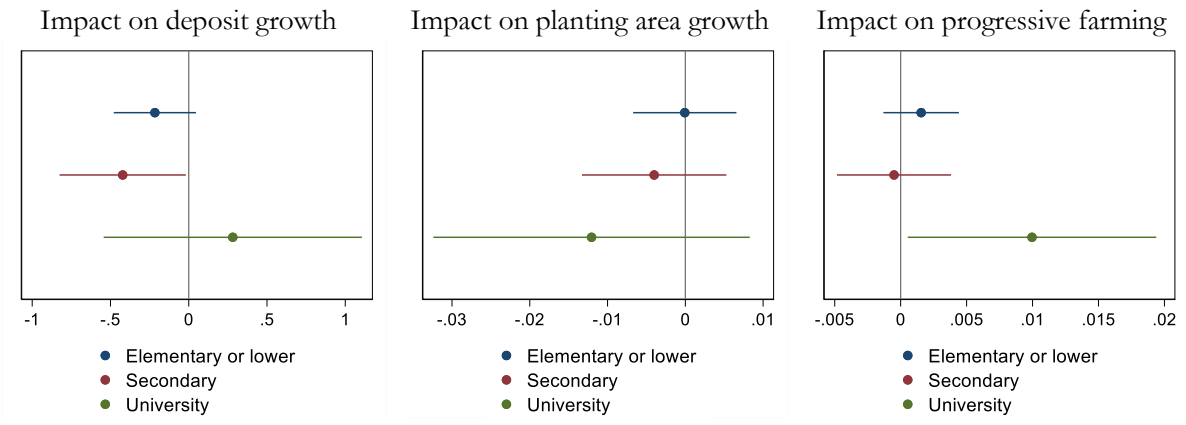
(b) By region



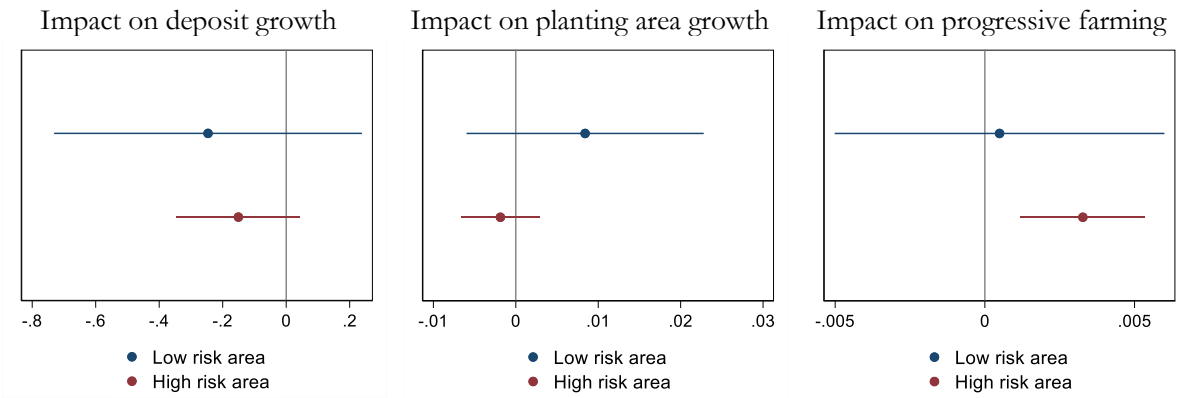
(c) By household age profile



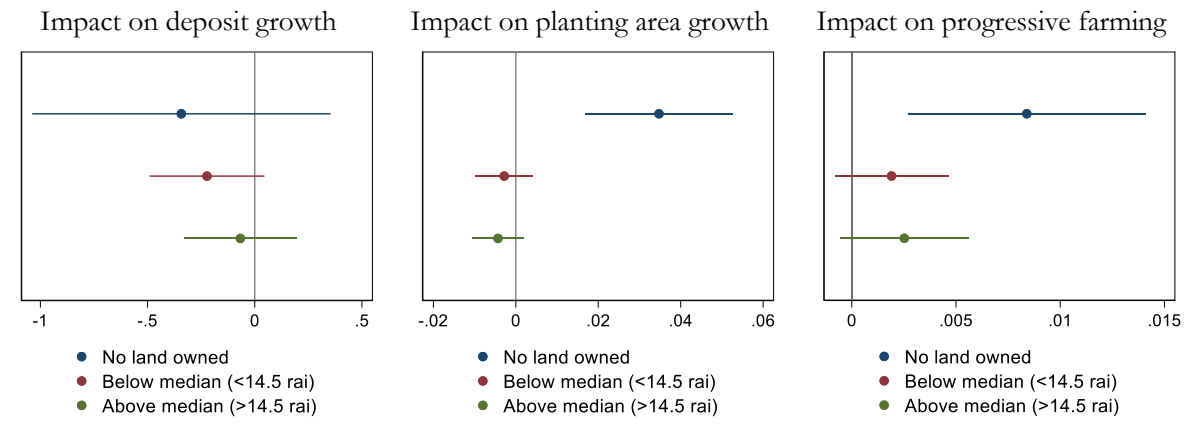
(d) By education



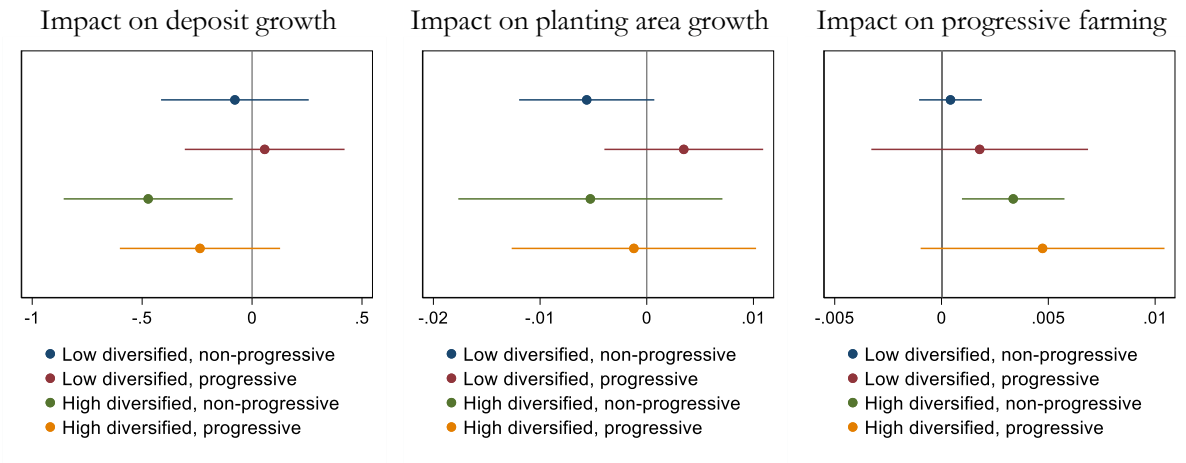
(e) By Tambon-level disaster risk



(f) By land ownership



(g) By farming profile: diversification and progressive farming



These figures plot the estimated coefficients in solid circles and the associated 95% confidence intervals in solid lines. Each circles represents one regression. The specification is the same as in Table 15, column 1–3, but the regressions are estimated separately for each group of borrowers. The coefficients represent the overall impact of DM participation for all DM participants. The regressions are linear fixed-effect panel regressions at the borrower-year level. The deposit growth and planting area growth are growths over the period from time t to t+3, but the progressive farming (0/1) in column 3 is the following year progressive farming (considered from time t+3 to t+4). Deposit amount in column 1 includes current account, saving account, fixed saving accounts, and lottery-style saving accounts. Progressive farming refers to either one of the followings; planting sustainably, planting premium rice, or investing in own water source. All specification includes borrower FE, year dummies, interactions between year dummies and region dummies, and borrower controls. Borrower controls include lagged dependent variables, average loan size, average deposit size, number of total loan accounts during the period, number of new loans during the period, having DR/TDR accounts (0/1), receiving disaster relief loans (0/1), having P-loan (0/1), having only WC loans (0/1), collaterals pledged (0/1), farming area, landowner (0/1), irrigated farming area (0/1), receiving disaster relief transfer (0/1), receiving crop insurance (0/1), age, and age-squared. All regressors are lagged except age.

Low debt = borrowers in the first quantile with principal outstanding below 119,889 Baht; medium debt = borrowers in the second quantile with principal outstanding between 119,890 to 286,935 Baht; high debt = borrowers in the third quantile with principal outstanding above 286,935 Baht. Household age profile considers the age of all household members, whereas age as a control variable is the age of the borrower. Age profile is divided into three groups (1) All above 70 y.o. = all household members are above 70 years old; (2) Mix above 40 y.o. = all household members are above 40 years old with at least one member younger than 70 years old; (3) Having below 40 y.o. = households with at least one member younger than 40 years old. Education in is the highest education of all household members and excludes borrowers with missing education data. Tambon-level disaster risk is proxied by whether farmers in that Tambon received disaster relief subsidy in that year or not. Any farmer receiving the subsidy suggests that the Tambon was affected by the disaster. Robustness check using individual-level disaster risk instead of Tambon-level yields similar results and is not reported. Land ownership (Figure 11f), farming diversification (Figure 11g), and progressive farming (Figure 11g) are considered over the entire sample period. If the borrowers own any land, plant multi crop/have off-farm income, or do progressive farming in any given year, the borrowers are classified in those groups accordingly. Land ownership dimension is divided into 3 groups of borrowers; no land owned, having owned land with the size below the median, and having owned land with the size above the median. Farming diversification considers two aspects; whether the farmers only plant rice or plant other crops as well (multi crop), and whether the farmers have off-farm income. Since the borrowers in our sample are rice farmers, rice is the base crop. High diversification refers to planting multi crops and having off-farm income. Other combinations are considered as low diversification. Progressive farming refers to either one of the followings; planting sustainably, planting premium rice, having modern machine, or investing in own water source.

Table 1: Descriptive Statistics of Farmer Borrowers by Data Source 2014–2021

	N	Mean	SD	Median
	(1)	(2)	(3)	(4)
A. Borrower characteristics from BAAC				
Age (year)	989,047	56.01	10.36	56
Debt outstanding (Baht, yearly average)	968,157	255,564	300,390	179,601
Deposit (Baht, yearly average)	999,631	31,165	121,892	9,892
Number of loan accounts (yearly average)	983,793	2.84	1.77	2.38
Delinquency (0/1)	983,793	0.12	0.32	0
Collateralization (0/1)	983,793	0.73	0.44	1
B. Farming characteristics from DOAE				
Planting area (rai, yearly average)	999,989	19.30	14.02	15.75
Landowner (0/1)	999,999	0.94	0.24	1
Participating in agricultural growth policy (0/1)	998,542	0.13	0.34	0
Receiving relief transfer (0/1)	1,000,000	0.30	0.46	0
C. Insurance information from TGIA				
Having crop insurance (0/1)	1,000,000	0.97	0.17	1

The table presents summary statistics at the borrower level for the main variables from three data sources. N is the number of borrowers. Age and participating in agricultural growth policy are 2018 data. Dummy variables are considered during the whole period of 2014–2021 and equal to 1 if the borrower falls into the criteria at least once in any year. One rai equals 0.16 hectare. Agricultural growth policies are large farming program and after-rice planting program. The borrowers who are not found in the list of the farmers receiving relief transfer or having crop insurance are considered as not receiving relief transfer and not having crop insurance respectively; hence, the observation is one million borrowers.

Table 2: Debt-Related Government Support and Available Debt Solutions for Farmers 2015–2021

Type of debt solution	Description	No. of sub-programs in data	Share of borrowers receiving debt solution	Share of debt outstanding
Debt moratorium (DM)	Government-endorsed scheme that mainly suspends the repayment of the principal during the program period. Interest rate might be lowered, or interest repayment might also be suspended, depending on the specific programs. The duration of the program is typically 2–3 years but can also be extended up to 7 years. The main goal of the program is to alleviate debt burden of small-scale farmers during difficult times.	14	85.7%	46.3%
Support loans for specific support (Support loans)	Loans that are endorsed by the government to be lent to farmers by the BAAC for the purpose of supporting farmers in various specific areas. Examples include, but not exclusive to, loans under pledging scheme, loans to help the postponement of crop harvesting, loans to help the postponement of crop sale, loans for crop collection, soft loan for disaster relief, loans to solve agricultural problems such as pest, loan for general efficiency improvement, loans to resolve external debt, and value chain financing (BAAC, 2021)	484	65.9%	9.7%
Debt restructuring/ Troubled debt restructuring (DR/TDR)	The debt restructuring can be carried out by various alterations to the loan contract such as extending the loan maturity, lowering the interest rate, and combining many loan accounts into one account. However, the BAAC is believed to generally do not give a principal haircut in restructured loans. Early debt restructuring was applied mainly to defaulted loans, but debt restructuring in recent few years could also be applied to non-NPL loans as a pre-emptive measure.	-	9.1%	5.3%

Number of sub-programs counts all specific programs seen in the data, e.g., support loan for good farmers in 3 southern provinces 2014 program, support loan program for troubled farmers in 3 southern provinces 2014 program, and support loan for good farmers in 3 southern provinces 2015 program are counted as 3 sub-programs. We do not try to match these data with the programs reported in BAAC annual reports. Chawanote (2021) summarizes some of the key debt-related government programs as reported in BAAC annual reports, and their timelines. See her paper for more details. Share of borrowers receiving debt solutions is considered over the entire period. The share of debt outstanding is computed from the borrower-year level. Participation in DM are identified as borrowers who are eligible for DM programs and whose debt outstanding does not decrease more than 10,000 Baht from the previous year because this might suggest that the borrowers pay back the loan even though they are eligible for debt holiday; hence, they should be classified as borrowers who did not exploit the DM given. DR/TDR is collectively counted as one debt program; thus, the number of sub-programs is not shown. Non-NPL DR accounts cannot be exclusively distinguished from TDR accounts from the data. Details of how each loan account is restructured is also not available in the data.

Table 3: Share of Borrowers by Types of DM, DM Intensity, and DM Participation Pattern 2015–2021

	Share of borrowers
	(1)
Not participating in DM	14.3%
Panel A: By DM program type	
Participating in shock-related DM only	5.2%
Participating in non-shock-related DM only	7.7%
Participating in both types of DM	72.8%
Panel B: By number of DM programs	
1 program	8.4%
2 programs	16.2%
3 programs	22.3%
4 programs	20.4%
5 programs	12.6%
6 programs	4.8%
> 6 programs	1.0%
Panel C: By number of years in DM	
1 year in DM	6.5%
2 years in DM	9.2%
3 years in DM	14.6%
4 years in DM	14.0%
5 years in DM	20.5%
6 years in DM	16.1%
7 years in DM	4.8%
Panel D: By pattern of DM participation	
Always in DM	4.8%
Enter DM and never exit	30.2%
On and off participation with 1-year exit duration	19.3%
On and off participation with > 1 year exit duration	19.8%
Enter DM once, exit, and never enter again	11.7%

There are 14 DM programs during 2015–2021. The first year in the sample (2014) must be dropped because identifying DM participation needs to compare current debt outstanding with the previous year debt outstanding. Panel A groups the DM programs into two types of shock-related and non-shock-related DM programs. Panel B and C present the intensities of DM participation by number of programs and number of years participating in DM respectively. Panel D groups the borrowers by the pattern of DM participation over the years. On and off participation means we see the borrowers participate in one DM program, then exit, and then enter another DM program at later time.

Table 4: Summary Statistics for DM and Non-DM Borrowers

	DM borrowers		Non-DM borrowers		Difference		
	Mean	SD	Mean	SD	Mean	SE	t-stat
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Farmer/farm characteristics							
Age (year)	52.95	11.36	54.26	13.53	-1.31	0.05	-24.779***
Central region (0/1)	0.08	0.26	0.11	0.31	-0.03	0.00	-25.889***
Northeast region (0/1)	0.68	0.47	0.63	0.48	0.05	0.00	23.739***
Education: elementary or lower (0/1)	0.46	0.50	0.45	0.50	0.00	0.00	1.964**
Planting area (rai)	20.52	16.90	21.20	16.22	-0.68	0.07	-10.259***
Landowner (0/1)	0.81	0.39	0.82	0.38	-0.01	0.00	-6.852***
Irrigation (0/1)	0.13	0.34	0.19	0.39	-0.06	0.00	-36.335***
High diversification (0/1)	0.39	0.49	0.34	0.47	0.05	0.00	27.637***
Participating in agricultural growth policy (0/1)	0.13	0.34	0.14	0.35	-0.01	0.00	-6.343***
Receiving relief transfer (0/1)	0.06	0.24	0.05	0.21	0.01	0.00	13.669***
B. Borrower characteristics							
Debt outstanding (Baht)	227,388	267,936	145,427	248,543	81,961	1,156	70.930***
Deposit (Baht)	23,040	98,245	43,640	199,702	-20,600	763	-26.999***
Number of loan accounts	2.79	1.69	1.34	0.77	1.46	0.00	420***
Delinquency (0/1)	0.10	0.30	0.19	0.39	-0.09	0.00	-60.752***
DR/TDR (0/1)	0.05	0.23	0.08	0.27	-0.02	0.00	-23.539***
Collateralization (0/1)	0.61	0.49	0.46	0.50	0.15	0.00	75.556***
Having p-loan (0/1)	0.38	0.48	0.10	0.30	0.28	0.00	220***

Statistics are from 2015 data to examine the borrowers at the beginning of the sample period. High diversification refers to planting multi crops and having off-farm income. One rai equals 0.16 hectare. Agricultural growth policies are large farming program and after-rice planting program. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Descriptive Statistics of Main Variables in Regression Analysis

	Unit	N	Mean	SD	Median
	(1)	(2)	(3)	(4)	(5)
A. Outcome variables					
One-year debt growth	%	5,623,615	0.14	0.58	0
Delinquency	0/1	5,235,090	0.08	0.27	0
B. Explanatory variables of interest					
Participation in DM	0/1	6,071,226	0.58	0.49	1
Number of years in DM	integer	6,071,226	1.94	1.82	2
C. Control variables					
Loan size	ln	5,902,033	12.00	1.08	12.13
Deposit size	ln	6,009,402	8.43	2.33	8.65
Number of loan accounts	integer	6,071,226	3.09	2.18	2
Number of new loan accounts	integer	6,071,226	0.79	1.03	0
Having DR/TDR accounts	0/1	6,071,226	0.06	0.25	0
Receiving disaster relief loans	0/1	6,071,226	0.02	0.16	0
Having p-loan	0/1	6,071,211	0.39	0.49	0
Having only WC loans	0/1	6,071,211	0.29	0.45	0
Collaterals pledged	0/1	6,071,226	0.63	0.48	1
Farming area	rai	5,873,038	18.59	13.56	15
Landowner	0/1	5,235,090	0.84	0.37	1
Irrigated farming area	0/1	5,235,090	0.13	0.34	0
Receiving disaster relief transfer	0/1	5,235,090	0.09	0.28	0
Receiving crop insurance	0/1	5,235,090	0.72	0.45	1
Age	integer	6,071,226	55.29	11.54	55

The table presents summary statistics for the variables used in the regression analysis at the borrower-year level. The sample period is 2015–2021 and includes 977,977 borrowers. N is the number of borrowers x years. One rai equals to 0.16 hectare.

Table 6: Impact of DM Participation on Debt Growth – Baseline

	Dependent variable: 1-year loan growth				
	Full sample				Sub-sample
	(1)	(2)	(3)	(4)	(5)
Ever participate in DM (0/1)	0.055***				0.101***
	(0.001)				(0.002)
Currently participating in DM (0/1)		0.070***	0.068***	0.067***	
		(0.001)	(0.001)	(0.001)	
Exited from DM (0/1)		-0.005***			
		(0.001)			
Exited from DM < 1 year (0/1)			0.007***	0.006***	
			(0.002)	(0.002)	
Exited from DM >= 1 year (0/1)			-0.060***		
			(0.002)		
Exited from DM 1-2 years (0/1)				-0.043***	
				(0.002)	
Exited from DM >= 2 years (0/1)				-0.109***	
				(0.003)	
Lagged dependent variable	-0.037***	-0.037***	-0.037***	-0.036***	-0.040***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Loan size (ln)	-0.734***	-0.735***	-0.735***	-0.736***	-0.788***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Deposit size (ln)	-0.006***	-0.006***	-0.006***	-0.006***	-0.006***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of loan accounts	0.019***	0.020***	0.018***	0.018***	0.035***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Number of new loans	0.166***	0.169***	0.169***	0.169***	0.175***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Having DR/TDR accounts (0/1)	0.004*	0.006**	0.005**	0.004*	0.026***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)
Receiving disaster relief loans (0/1)	-0.018***	-0.021***	-0.020***	-0.019***	-0.035***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Having p-loan (0/1)	0.012***	0.011***	0.011***	0.012***	0.018***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Having only WC loans (0/1)	0.035***	0.035***	0.036***	0.036***	0.046***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)
Collaterals pledged (0/1)	-0.096***	-0.098***	-0.097***	-0.097***	-0.116***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Farming area	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Landowner (0/1)	0.013***	0.013***	0.013***	0.013***	0.011***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Irrigated farming area (0/1)	0.009***	0.008***	0.008***	0.008***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Receiving disaster relief transfer (0/1)	-0.004***	-0.008***	-0.007***	-0.008***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Receiving crop insurance (0/1)	0.006***	0.005***	0.004***	0.005***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Age	0.099***	0.100***	0.101***	0.101***	0.095***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Age-squared	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	5.263***	5.240***	5.158***	5.172***	5.821***
	(0.048)	(0.048)	(0.048)	(0.048)	(0.086)
Borrower FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Year*region FE	Y	Y	Y	Y	Y
Number of borrowers	915,887	915,887	915,887	915,887	381,822
Number of observations	4,466,492	4,466,492	4,466,492	4,466,492	1,745,339
R-squared	0.330	0.332	0.332	0.332	0.354
F-statistic	15230	14924	14621	14258	6444
p-value	0.000	0.000	0.000	0.000	0.000

The data are at the borrower-year level. Each column represents a regression. All specifications are fixed-effect panel regressions. The dependent variable is the 1-year growth of principal outstanding. All regressors are lagged except age. Ever participate in DM is a dummy variable that equals to 1 in every year since the borrower participates in DM for the first time as far as we can see in the dataset. This variable still equals to 1 even after the borrower exits the DM program. For the full sample specification, all borrowers are included. For the sub-sample in column 5, only the treatment borrowers who participated in DM and never exited during our sample period and the never-treated non-DM borrowers are included. This latter specification resembles the standard difference-in-difference analysis more. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 7: Impact of DM Participation on Debt Growth – Mechanism and Channels

	Main dataset						Alternative dataset	
	Dependent variable: Account-level relative loan growth		Dependent variable: Borrower-level loan growth		Dependent variable: Account-level relative loan growth		Dependent variable: Account-level accrued interest growth	
	(1)		(2)		(3)		(4)	
			*Interaction: borrowers' DM status * opening new loan account during the last year*		*Interaction: accounts' DM status * borrowers' DM status*			
	Account currently participating in DM (0/1)	0.084*** (0.000)	Non-DM borrower, open new account	0.211*** (0.002)	Non-DM account, but borrower in DM that year	-0.010*** (0.000)	Account currently participating in DM (0/1)	-13.301*** (0.177)
	Account exited from DM (0/1)	-0.001*** (0.000)	Borrower in DM, no new account	0.109*** (0.002)			Account exited from DM (0/1)	-6.718*** (0.205)
			Borrower in DM, open new account	0.270*** (0.002)	Account in DM, borrower in DM	0.078*** (0.000)		
			Borrower exited from DM, no new account	0.013*** (0.002)	Account exited from DM, borrower not in DM that year	0.000 (0.000)		
			Borrower exited from DM, open new account	0.201*** (0.002)	Account exited from DM, borrower in DM that year	-0.013*** (0.000)		
Dependent variable average		-0.043		0.145		-0.043		7.142
Borrower FE		Y		Y		Y		Y
Year FE		Y		Y		Y		Y
Year*region FE		Y		Y		Y		Y
Borrower controls		Y		Y		Y		Y
Number of accounts/borrowers		2,468,875		915,887		2,468,875		1,547,156
Number of observations		7,399,524		4,466,492		7,399,524		2,640,686
+R-squared		0.220		0.339		0.221		0.170

The data are at the account-year level except column 2, which is at the borrower-year level. Each column represents a regression. All specifications are fixed-effect panel regressions. The dependent variables are all 1-year growth. Borrower controls include lagged dependent variables, loan size, deposit size, number of loan accounts, number of new loans in previous year, having DR/TDR accounts (0/1), receiving disaster relief loans (0/1), having P-loan (0/1), having only WC loans (0/1), collaterals pledged (0/1), farming area, landowner (0/1), irrigated farming area (0/1), receiving disaster relief transfer (0/1), receiving crop insurance (0/1), age, and age-squared. All regressors are lagged except age. The main dataset in this study covers the period 2015–2021 and only the data on principal outstanding is available. Alternative dataset refers to a shorter-time updated dataset from 2018 to 2021 that has the information on accrued interest in additional of the loan principal outstanding. The account-level relative loan growth, which is the dependent variable in column 1 and 3, has non-positive values due to the nature of the loans, in which the principal outstanding of each loan account only decrease, and obtaining new credit is carried out by opening new loan account. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 8: Longer-term Impact of DM Participation on Debt Growth

	Dependent variable: 1-year loan growth			Dependent variable: 3-year loan growth			Dependent variable: 4-year loan growth		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Ever participate in DM (0/1)	0.055***								
	(0.001)								
Participate in DM during the period (0/1)				0.076***			0.046***		
				(0.007)			(0.012)		
Currently participating in DM (0/1)		0.070***	0.068***		0.084***	0.091***		0.056***	0.064***
		(0.001)	(0.001)		(0.007)	(0.007)		(0.012)	(0.012)
Exited from DM (0/1)		-0.005***			0.059***			0.018	
		(0.001)			(0.007)			(0.012)	
Exited from DM < 1 year (0/1)			0.007***			0.072***			0.033***
			(0.002)			(0.007)			(0.012)
Exited from DM >= 1 year (0/1)			-0.060***			0.040***			-0.030**
			(0.002)			(0.008)			(0.013)
Dependent variable average	0.145			0.488			0.680		
Borrower FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year*region FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Borrower controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Number of borrowers	915,887	915,887	915,887	818,138	818,138	818,138	745,759	745,759	745,759
Number of observations	4,466,492	4,466,492	4,466,492	2,190,287	2,190,287	2,190,287	1,402,721	1,402,721	1,402,721
R-squared	0.330	0.332	0.332	0.539	0.539	0.539	0.542	0.542	0.542

The data are at the borrower-year level. Each column represents a regression. All specifications are fixed-effect panel regressions. Regressions in column 1–3 are the same as regressions in Table 6 column 1–3. Both the dependent variables and the explanatory variables are considered during the 3-year and 4-year periods. To illustrate, the 3-year loan growth is comparing the principal outstanding in year t+3 with that in year t. Ever participate in DM is a dummy variable that equals to 1 in every year since the borrower participates in DM for the first time as far as we can see in the dataset. This variable still equals to 1 even after the borrower exits the DM program. Participate in DM during the period is a dummy variable that equals to 1 if the borrowers participate in DM in any year from t to t+3 or t+4. Exited from DM for the 3-year (4-year) specification means the borrowers participated in DM in any year during the period, but already exited from DM in year t+3 (t+4). Borrower controls include lagged dependent variables, loan size at time t, average deposit size, number of total loan accounts during the period, number of new loans during the period, having DR/TDR accounts (0/1), receiving disaster relief loans (0/1), having P-loan (0/1), having only WC loans (0/1), collaterals pledged (0/1), farming area, landowner (0/1), irrigated farming area (0/1), receiving disaster relief transfer (0/1), receiving crop insurance (0/1), age, and age-squared. All regressors are lagged except age. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Impact of DM Participation on Debt Growth – By Program Intensities

	Dependent variable: 3-year loan growth	
	(1)	(2)
Number of participating DM programs		
1 program	0.078***	
	(0.007)	
2 programs	0.083***	
	(0.008)	
3 programs	0.109***	
	(0.008)	
>3 programs	0.136***	
	(0.008)	
*Interaction: number of participating DM programs * whether currently in DM*		
1 program, currently in DM		0.095***
		(0.007)
2 programs, currently in DM		0.081***
		(0.008)
3 programs, currently in DM		0.104***
		(0.008)
>3 programs, currently in DM		0.130***
		(0.008)
1 program, exited from DM		0.044***
		(0.008)
2 programs, exited from DM		0.076***
		(0.008)
3 programs, exited from DM		0.100***
		(0.008)
>3 programs, exited from DM		0.123***
		(0.009)
Borrower FE	Y	Y
Year FE	Y	Y
Year*region FE	Y	Y
Borrower controls	Y	Y
Number of borrowers	818,138	818,138
Number of observations	2,190,287	2,190,287
R-squared	0.539	0.539

The data are at the borrower-year level. Each column represents a regression. All specifications are fixed-effect panel regressions. Both the dependent variables and the explanatory variables are considered during the period from time t to t+3. DM participation is observed at 4 points in time from t to t+3. The number of participating DM programs enter the model as dummy variables. Currently in DM is a dummy variable that equals to 1 if the borrowers participate in DM at time t+3. Exited from DM is a dummy variable that equals to 1 if the borrowers participated in DM in any year during the period, but already exited from DM in year t+3. Borrower controls include lagged dependent variables, loan size at time t, average deposit size, number of total loan accounts during the period, number of new loans during the period, having DR/TDR accounts (0/1), receiving disaster relief loans (0/1), having P-loan (0/1), having only WC loans (0/1), collaterals pledged (0/1), farming area, landowner (0/1), irrigated farming area (0/1), receiving disaster relief transfer (0/1), receiving crop insurance (0/1), age, and age-squared. All regressors are lagged except age. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Impact of DM Participation on Debt Growth – By Time Intensities

	Dependent variable: 3-year loan growth	
	(1)	(2)
Number of years in DM		
1 year in DM	0.073***	
	(0.008)	
2 years in DM	0.064***	
	(0.009)	
3 years in DM	0.072***	
	(0.009)	
4 years in DM	0.097***	
	(0.009)	
5 years in DM	0.123***	
	(0.010)	
*Interaction: number of years in DM * whether currently in DM*		
1 year in DM, currently in DM		0.093***
		(0.008)
2 years in DM, currently in DM		0.062***
		(0.009)
3 years in DM, currently in DM		0.065***
		(0.009)
4 years in DM, currently in DM		0.083***
		(0.009)
5 years in DM, currently in DM		0.108***
		(0.010)
1 year in DM, exited from DM		0.026***
		(0.009)
2 years in DM, exited from DM		0.023**
		(0.010)
3 years in DM, exited from DM		0.052***
		(0.010)
4 years in DM, exited from DM		0.089***
		(0.010)
Borrower FE	Y	Y
Year FE	Y	Y
Year*region FE	Y	Y
Borrower controls	Y	Y
Number of borrowers	818,138	818,138
Number of observations	2,190,287	2,190,287
R-squared	0.539	0.539

The data are at the borrower-year level. Each column represents a regression. All specifications are fixed-effect panel regressions. Both the dependent variables and the explanatory variables are considered during the period from time t to t+3 except the number of years in DM, which includes 1-year lag. The number of years in DM is thus considered at 5 points in time from t-1 to t+3 in order to observe higher time intensities beyond 4 years in DM. The number of years in DM enter the model as dummy variables. Currently in DM is a dummy variable that equals to 1 if the borrowers participate in DM at time t+3. Exited from DM is a dummy variable that equals to 1 if the borrowers participated in DM in any year during the period, but already exited from DM in year t+3. Borrower controls include lagged dependent variables, loan size at time t, average deposit size, number of total loan accounts during the period, number of new loans during the period, having DR/TDR accounts (0/1), receiving disaster relief loans (0/1), having P-loan (0/1), having only WC loans (0/1), collaterals pledged (0/1), farming area, landowner (0/1), irrigated farming area (0/1), receiving disaster relief transfer (0/1), receiving crop insurance (0/1), age, and age-squared. All regressors are lagged except age. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 11: Impact of DM Participation on Delinquency – Baseline

	Dependent variable: 1-year delinquency status (0/1)							
	FE OLS				FE Logit			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ever participate in DM (0/1)	0.007***				0.271***			
	(0.000)				(0.016)			
Currently participating in DM (0/1)		0.006***	0.005***	0.005***		0.239***	0.223***	0.224***
		(0.000)	(0.000)	(0.000)		(0.016)	(0.016)	(0.016)
Exited from DM (0/1)		0.012***				0.455***		
		(0.000)				(0.020)		
Exited from DM < 1 year (0/1)			0.014***	0.014***			0.521***	0.522***
			(0.000)	(0.000)			(0.020)	(0.020)
Exited from DM >= 1 year (0/1)			-0.001				-0.283***	
			(0.001)				(0.036)	
Exited from DM 1-2 years (0/1)				-0.005***				-0.314***
				(0.001)				(0.038)
Exited from DM >= 2 years (0/1)				0.008***				-0.147**
				(0.001)				(0.063)
Lagged dependent variable	0.054***	0.054***	0.054***	0.054***	0.275***	0.265***	0.259***	0.260***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.008)	(0.008)	(0.008)	(0.008)
Loan size (ln)	-0.007***	-0.008***	-0.008***	-0.008***	-0.035*	-0.037**	-0.041**	-0.040**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.018)	(0.018)	(0.018)	(0.018)
Deposit size (ln)	-0.002***	-0.002***	-0.002***	-0.002***	-0.045***	-0.045***	-0.045***	-0.045***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)	(0.002)
Number of loan accounts	0.017***	0.018***	0.018***	0.018***	0.392***	0.407***	0.407***	0.407***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)	(0.005)	(0.005)	(0.005)
Number of new loans	-0.008***	-0.008***	-0.008***	-0.008***	-0.185***	-0.197***	-0.198***	-0.199***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.004)	(0.004)	(0.004)
Having DR/TDR accounts (0/1)	0.019***	0.019***	0.018***	0.018***	0.696***	0.679***	0.672***	0.673***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.021)	(0.021)	(0.021)	(0.021)
Receiving disaster relief loans (0/1)	-0.012***	-0.012***	-0.013***	-0.012***	-0.213***	-0.221***	-0.232***	-0.232***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.026)	(0.026)	(0.027)	(0.027)
Having p-loan (0/1)	0.019***	0.020***	0.020***	0.020***	0.988***	0.989***	0.996***	0.996***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.020)	(0.020)	(0.020)	(0.020)
Having only WC loans (0/1)	0.008***	0.008***	0.008***	0.008***	-0.655***	-0.662***	-0.655***	-0.655***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.026)	(0.026)	(0.026)	(0.026)
Collaterals pledged (0/1)	0.006***	0.006***	0.006***	0.006***	0.304***	0.301***	0.303***	0.302***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.020)	(0.020)	(0.020)	(0.020)
Farming area	-0.000	-0.000	-0.000	-0.000	-0.001	-0.001	-0.001*	-0.001*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Landowner (0/1)	0.000	0.000	0.000	0.000	-0.039*	-0.039*	-0.038	-0.038
	(0.001)	(0.001)	(0.001)	(0.001)	(0.023)	(0.023)	(0.023)	(0.023)
Irrigated farming area (0/1)	-0.001	-0.000	-0.000	-0.000	0.001	0.006	0.006	0.006
	(0.001)	(0.001)	(0.001)	(0.001)	(0.023)	(0.023)	(0.023)	(0.023)
Receiving disaster relief transfer (0/1)	-0.001***	-0.001***	-0.001***	-0.001***	0.002	0.010	0.011	0.011
	(0.000)	(0.000)	(0.000)	(0.000)	(0.015)	(0.015)	(0.015)	(0.015)
Receiving crop insurance (0/1)	0.002***	0.002***	0.001***	0.001***	0.073***	0.070***	0.066***	0.065***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.013)	(0.013)	(0.013)	(0.013)
Borrower FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Year*region FE	Y	Y	Y	Y	Y	Y	Y	Y
Number of borrowers	873,845	873,845	873,845	873,845	85,125	85,125	85,125	85,125
Number of observations	3,721,132	3,721,132	3,721,132	3,721,132	393,703	393,703	393,703	393,703
R-squared / Pseudo R-Square	0.020	0.020	0.020	0.020	0.132	0.133	0.136	0.136
F-statistic / Chi-squared	939.6	917.8	904.8	880.4	39030	39271	39954	39961
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

The data are at the borrower-year level. Each column represents a regression. Specifications in column 1–3 are linear fixed-effect model. Specifications in column 4–6 are fixed-effect logit model. The dependent variable is the 1-year delinquency status, which takes the values of 1 if the borrower has the delinquency status in any loan at any time during the year. All regressors are lagged. Ever participate in DM is a dummy variable that equals to 1 in every year since the borrower participates in DM for the first time as far as we can see in the dataset. This variable still equals to 1 even after the borrower exits the DM program. Age variables are excluded to achieve convergence in the logit estimation. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 12: Impact of DM Participation on Delinquency – DM versus Non-DM

	Dependent variable: 1-year delinquency of DM loan (0/1)	Dependent variable: 1-year delinquency of non-DM loan (0/1)
	(1)	(2)
Borrower currently participating in DM (0/1)	0.031***	-0.010***
	(0.000)	(0.000)
Borrower exited from DM (0/1)	0.002***	0.018***
	(0.000)	(0.000)
Borrower FE	Y	Y
Year FE	Y	Y
Year*region FE	Y	Y
Borrower controls	Y	Y
Number of borrowers	873,845	873,845
Number of observations	3,721,132	3,721,132
R-squared	0.030	0.016

The data are at the borrower-year level. Each column represents a regression. The specification reported uses the linear fixed-effect panel model because the convergence is not achieved in logit regression estimation of column 1 specification. The FE logit estimation of column 2 yields similar result to the linear model. The dependent variable is the 1-year delinquency status of only the loan in DM in column 1 and only the loan not in DM in column 2 of each borrower. All regressors are lagged. Borrower controls include lagged dependent variables, loan size, deposit size, number of loan accounts, number of new loans in previous year, having DR/TDR accounts (0/1), receiving disaster relief loans (0/1), having P-loan (0/1), having only WC loans (0/1), collaterals pledged (0/1), farming area, landowner (0/1), irrigated farming area (0/1), receiving disaster relief transfer (0/1), and receiving crop insurance (0/1). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 13: Longer-term Impact of DM Participation on Delinquency

	Dependent variable: change of delinquency status (-1/0/1)			
	(1)	(2)	(3)	(4)
Participate in DM during the period (0/1)	0.013***			
	(0.001)			
Currently participating in DM (0/1)		0.016***	0.017***	
		(0.001)	(0.001)	
Exited from DM (0/1)		0.007***		
		(0.001)		
Exited from DM < 1 year (0/1)			0.011***	
			(0.001)	
Exited from DM >= 1 year (0/1)			-0.004***	
			(0.001)	
Number of years in DM				
1 year in DM				0.013***
				(0.001)
2 years in DM				0.019***
				(0.001)
3 years in DM				0.027***
				(0.001)
4 years in DM				0.026***
				(0.001)
5 years in DM				0.018***
				(0.001)
Borrower FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Year*region FE	Y	Y	Y	Y
Borrower controls	Y	Y	Y	Y
Number of borrowers	786,366	786,366	786,366	786,366
Number of observations	2,116,628	2,116,628	2,116,628	2,116,628
R-squared	0.699	0.699	0.699	0.699

The data are at the borrower-year level. Each column represents a regression. All specifications reported are linear fixed-effect panel regressions because the convergence is not achieved in some specifications of logit regression estimation. Both the dependent variables and the explanatory variables are considered during the period from time t to t+3 except the number of years in DM, which includes 1-year lag. The dependent variable is the change of delinquency status (0/1) from time t to t+3, resulting in 3 possibles values (-1/0/1). The positive (negative) value means adverse (better) change and zero means no change. Participate in DM during the period is a dummy variable that equals to 1 if the borrowers participate in DM in any year from t to t+3. Currently in DM is a dummy variable that equals to 1 if the borrowers participate in DM at time t+3. Exited from DM is a dummy variable that equals to 1 if the borrowers participated in DM in any year during the period, but already exited from DM in year t+3. The number of years in DM is considered at 5 points in time from t-1 to t+3 in order to observe higher time intensities beyond 4 years in DM. The number of years in DM enter the model as dummy variables. Borrower controls include lagged dependent variables, average loan size, average deposit size, number of total loan accounts during the period, number of new loans during the period, having DR/TDR accounts (0/1), receiving disaster relief loans (0/1), having P-loan (0/1), having only WC loans (0/1), collaterals pledged (0/1), farming area, landowner (0/1), irrigated farming area (0/1), receiving disaster relief transfer (0/1), and receiving crop insurance. All regressors are lagged. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 14: Impact of DM Participation on Other Measures of Borrowers' Behaviors

	Dependent variable: Change of principal repayment behavior (-1/0/1)				Dependent variable: Participating in DM again (0/1)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Participate in DM during the period (0/1)	-0.061***				-0.160***			
	(0.002)				(0.001)			
Currently participating in DM (0/1)		-0.103***	-0.109***			-0.240***	-0.244***	
		(0.002)	(0.002)			(0.001)	(0.001)	
Exited from DM (0/1)		0.005***				-0.012***		
		(0.002)				(0.002)		
Exited from DM < 1 year (0/1)			-0.018***				-0.025***	
			(0.002)				(0.002)	
Exited from DM >= 1 year (0/1)			0.053***				0.026***	
			(0.002)				(0.002)	
Number of years in DM								
1 year in DM				-0.076***				-0.316***
				(0.002)				(0.002)
2 years in DM				-0.141***				-0.589***
				(0.002)				(0.002)
3 years in DM				-0.197***				-0.850***
				(0.002)				(0.003)
4 years in DM				-0.251***				-1.089***
				(0.003)				(0.003)
5 years in DM				-0.297***				-1.356***
				(0.003)				(0.004)
Borrower FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Year*region FE	Y	Y	Y	Y	Y	Y	Y	Y
Borrower controls	Y	Y	Y	Y	Y	Y	Y	Y
Number of borrowers	850,059	850,059	850,059	850,059	769,772	769,772	769,772	769,772
Number of observations	2,929,751	2,929,751	2,929,751	2,929,751	2,129,086	2,129,086	2,129,086	2,129,086
R-squared	0.550	0.554	0.554	0.552	0.125	0.176	0.177	0.199

The data are at the borrower-year level. Each column represents a regression. All specifications reported are linear fixed-effect panel regressions because the convergence is not achieved in some specifications of logit regression estimation. Both the dependent variables and the explanatory variables are considered during the period from time t to t+3 except the number of years in DM, which includes 1-year lag. The dependent variable in column 1–4 is the change of whether the borrower can repay the principal (0/1) from time t to t+3, resulting in 3 possibles values (-1/0/1). The positive (negative) value of change in principal repayment means better (adverse) change of behavior and zero means no change. Typically, some borrowers only repay the interest in each year when the loan repayment is due and are not able or choose not to repay large enough to cover the principal outstanding. Thus, principal repayment, and not only the interest repayment, represents good repayment behavior. The dependent variable in column 5–8 is whether the borrowers participate in DM again in the following year (considered from time t+3 to t+4). Participate in DM during the period is a dummy variable that equals to 1 if the borrowers participate in DM in any year from t to t+3. Currently in DM is a dummy variable that equals to 1 if the borrowers participate in DM at time t+3. Exited from DM is a dummy variable that equals to 1 if the borrowers participated in DM in any year during the period, but already exited from DM in year t+3. The number of years in DM is considered at 5 points in time from t-1 to t+3 in order to observe higher time intensities beyond 4 years in DM. The number of years in DM enter the model as dummy variables. Borrower controls include lagged dependent variables, average loan size, average deposit size, number of total loan accounts during the period, number of new loans during the period, having DR/TDR accounts (0/1), receiving disaster relief loans (0/1), having P-loan (0/1), having only WC loans (0/1), collaterals pledged (0/1), farming area, landowner (0/1), irrigated farming area (0/1), receiving disaster relief transfer (0/1), and receiving crop insurance. All regressors are lagged. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 15: Impact of DM Participation on Savings and Agricultural Investment

	Dependent variable: 3- year growth of deposit amount	Dependent variable: 3- year growth of planting area	Dependent variable: Progressive farming (0/1)
	(1)	(2)	(3)
Participate in DM during the period (0/1)	-0.157*	0.000	0.003***
	(0.092)	(0.002)	(0.001)
Borrower FE	Y	Y	Y
Year FE	Y	Y	Y
Year*region FE	Y	Y	Y
Borrower controls	Y	Y	Y
Number of borrowers	818,320	805,632	818,707
Number of observations	2,168,293	2,041,063	2,178,134
R-squared	0.054	0.066	0.021

The data are at the borrower-year level. Each column in each panel represents a regression. All specifications use linear fixed-effect panel regressions. The convergence is not achieved in logit regression estimation of column 3. The dependent variables in column 1 and 2 are growth over the period from time t to t+3, but the dependent variable in column 3 is the following year progressive farming (considered from time t+3 to t+4). Deposit amount in column 1 includes current account, saving account, fixed saving accounts, and lottery-style saving accounts. Progressive farming refers to either one of the followings; planting sustainably, planting premium rice, or investing in own water source. Borrower controls include lagged dependent variables, average loan size, average deposit size, number of total loan accounts during the period, number of new loans during the period, having DR/TDR accounts (0/1), receiving disaster relief loans (0/1), having P-loan (0/1), having only WC loans (0/1), collaterals pledged (0/1), farming area, landowner (0/1), irrigated farming area (0/1), receiving disaster relief transfer (0/1), receiving crop insurance (0/1), age, and age-squared. All regressors are lagged except age. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 16: Impact of DM Participation on Debt Growth – Difference-in-Difference Estimation by DM Programs

	Dependent variable				
	Loan growth	Delinquency (0/1)	Deposit growth	Growth of planting area	Progressive farming (0/1)
	(1)	(2)	(3)	(4)	(5)
Panel A: Pracharat DM (2019-2021)					
69% participation; average debt 304,878 Baht					
Participation in DM (DiD coefficient)	0.114***	0.864***	-0.395***	-0.003***	0.032***
	(0.001)	(0.019)	(0.019)	(0.001)	(0.010)
R-squared	0.333	0.139	0.187	0.281	0.091
Panel B: COVID-19 DM (2020-2021)					
63% participation; average debt 300,106 Baht					
Participation in DM (DiD coefficient)	0.154***	0.474***	-0.132***	0.014***	0.141***
	(0.001)	(0.025)	(0.019)	(0.001)	(0.010)
R-squared	0.334	0.133	0.187	0.281	0.091
Panel C: DM for low-income farmers (2018-2021)					
21% participation; average debt 268,136 Baht					
Participation in DM (DiD coefficient)	0.060***	-0.239***	0.102***	0.017***	-0.032**
	(0.001)	(0.016)	(0.021)	(0.001)	(0.012)
R-squared	0.332	0.133	0.187	0.282	0.091
Panel D: DM for 2019 drought affected borrowers (2020-2021)					
21% participation; average debt 291,726 Baht					
Participation in DM (DiD coefficient)	0.093***	-0.136***	0.052**	0.035***	0.306***
	(0.001)	(0.025)	(0.021)	(0.001)	(0.011)
R-squared	0.332	0.132	0.187	0.282	0.092
Panel E: DM for 2019 flood affected borrowers (2020-2021)					
16% participation; average debt 275,335 Baht					
Participation in DM (DiD coefficient)	0.069***	-0.307***	-0.409***	-0.006***	-0.247***
	(0.001)	(0.028)	(0.024)	(0.001)	(0.014)
R-squared	0.331	0.132	0.187	0.282	0.092
Panel F: DM for rice farmers (2017-2018)					
41% participation; average debt 310,549 Baht					
Participation in DM (DiD coefficient)	0.075***	-0.299***	-0.088***	0.029***	0.000
	(0.002)	(0.019)	(0.024)	(0.001)	(0.000)
After exiting from DM	0.088***	-0.538***	0.176***	-0.016***	-0.391***
	(0.002)	(0.020)	(0.025)	(0.001)	(0.009)
R-squared	0.332	0.134	0.187	0.282	0.093
Borrower FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Year*region FE	Y	Y	Y	Y	Y
Borrower controls	Y	Y	Y	Y	Y
Number of borrowers	915,887	85,125	921,677	919,004	201,614
Number of observations	4,466,492	393,703	4,480,391	4,324,237	934,470

The data are at the borrower-year level. Specifications in column 1, 3, and 4 are linear fixed-effect panel model. Specifications in column 2 and 5 are logit fixed-effect panel model. Each column in each panel represents a regression. Each panel examines specific DM program. Six DM programs with high borrower participation ratios are studied. Five of them are still active as of March 2022, which is the end of our sample period. These are Pracharat DM, COVID-19 DM, DM for low-income farmers, DM for 2019 drought affected borrowers, and DM for 2019 flood affected borrowers. The years in parentheses are the years each program is in place as can be seen from our dataset. The DiD coefficient equals to 1 when each DM program is active. The other DM program studied is DM for rice farmers that ended in 2018. The dependent variables are all 1-year variables. Borrower controls include lagged

dependent variables, loan size, deposit size, number of loan accounts, number of new loans in previous year, having DR/TDR accounts (0/1), receiving disaster relief loans (0/1), having P-loan (0/1), having only WC loans (0/1), collaterals pledged (0/1), farming area, landowner (0/1), irrigated farming area (0/1), receiving disaster relief transfer (0/1), receiving crop insurance (0/1), age, and age-squared. All regressors are lagged except age. Robust standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.