

What Can Tobit-Piecewise Regression Tell Us about the Determinants of Household Educational Debt?

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Abstract

Educational debt as part of household debt remains a problem for Thailand. The significant factors of household characteristics with regard to educational debt are shown by constructing a Tobit-piecewise regression for three different clusters, namely poor, middle and affluent households in Thailand. It was found that household debt is likely to be significant for educational debt in all clusters, with much greater effect in poor households. Household income directly influences the educational debt in households with only moderate economic status. Nevertheless, the result of this study indicates that an effect of the administrative area on educational debt was not found.

Keywords: Thailand, educational debt, Tobit-Piecewise regression

1. Introduction

Families who want their family members to move successfully from compulsory education to bachelor degree or beyond are required to spend large amounts of money for higher education and, as a consequence, poor families have always been unable to make ends meet. Consequently, educational debt is necessary. Education with debt becomes more serious when many households/families face difficulties in repayment not only for educational debt, but also for other household debt.

In the National Education Act 2010, the direction of the potential development of education is outlined. Basic or compulsory education is focused and communities are consulted to provide and an equitable education system in Thailand. Compulsory education, which is subsidized by government, has not been much of a burden for households supporting their children; while education at the upper level of basic education is more of a burden for a poor household, especially those who live in rural areas.

Thailand's education policy supports the local communities which can participate in the education system to provide more equality for households. The policy of compulsory education has been focused on basic education for life and preparing students for future work. For a long time, households in poor economic status could support their children in the education system only at the compulsory level whereas households with better economic status could support their family members at secondary school and at bachelor level as well as at higher levels. Thus inequality between households in poor status when compared to wealthy families is always evident.

Table 1. The number of graduates classified by highest educational level for the years 2006 to 2008

Highest Educational Level	2006	2007	2008	2006	2007	2008
Basic Education		Number			Percentage	
Primary	952 627	981 096	976 915	34%	36%	36%
Lower-Secondary	865 806	760 331	725 803	31%	28%	27%
Upper-Secondary	476 527	469 973	476 097	17%	17%	18%
Higher Education						
Lower-Bachelor	152 534	153 739	143 041	6%	6%	5%
Bachelor	262 703	304 035	311 377	10%	11%	11%
Upper-Bachelor	58 112	67 947	78 452	2%	2%	3%
Total	2 768 309	2 737 121	2 711 685	100%	100%	100%

Source of data: Office of the National Economic and Social Development Board.

From the Population and Housing Census, reported by the National Statistical Office over three decades, it was found that the mean education level in Thailand for the school age population was 5.7, 7.2, and 8.0 in 1990, 2000 and 2010, respectively. Nevertheless, it is lower than the USA, Japan and Korea by about 5 years and also lower than Singapore and Malaysia by approximately 2.7 and 1.7 years, respectively (Cohen & Soto, 2001). Moreover, from the report of Office of the National Economic and Social Development Board as shown in Table 1, it was found that from 2006 to 2008, the highest proportion of people who graduated was from the primary level at 34-36 percent followed by the lower-secondary level at 27-31 percent and the upper-secondary level at 17-18 percent whereas the proportion of people who finished bachelor or higher than bachelor level was 11-14 percent. Nevertheless by considering the trend of this proportion, it was found that it has decreased for all education levels except bachelor and higher than bachelor levels, which have both increased. It is well known that an increase in the level of education in order to have better human capital arises from increased investment by the household.

Moreover, there is the one important role that is the disaggregated analysis for the households nationwide as shown the evident in some researches. The ability of look beyond the mean of the data is critical to the design of education policy. Recent studies by Chapman et al. (2010) on student loan repayment burdens and Lounkaew (2013) on the determinants of academic achievement of students in urban and rural areas are examples of studies of this nature. Both studies found that disaggregated analysis provides valuable insights into the issues being examined. For example, in Chapman et al. (2010), the repayment burdens of university graduates with low income are three to five times higher than the average; Lounkaew (2013) found that, compared to an average student, low-performing students benefit more from improvement in family as well as school endowments. This paper contributes to the debate in education literature and education policy by demonstrating empirically the usefulness of disaggregated analysis using an innovative statistical technique called the Tobit-piecewise regression developed by Mekbunditkul (2010) (Note). The exercise will be carried out in the context of determinants of educational debt. To provide a research context within which this approach will be carried out, the rest of this section is dedicated to providing essential information about the current Thai education situation.

As previously mentioned, educational debt is a focus of the study in the sense of household characteristic factors that are related to the educational debt of households in Thailand. Furthermore, the effects of this relationship are investigated by the Tobit-piecewise regression.

2. Previous Research

In this study, literature which is related to factors affecting educational debt has been addressed and is divided into three parts: the effect of household characteristics on family members' education, the investment of households in education, and educational loans or education debt.

2.1 The Effect of Household Characteristics on Family Members' Education

The education of family members in households requires the support from parents. Thus equity in education is affected by the financial differences of each household. The research of Glick and Sahn (2000) focused on poor urban environments in West Africa. Probit regression was employed to illustrate the relationship between household financial characteristics and the educational investment for schooling. The results demonstrated that

increasing household income impacted to the household investment for girls' schooling but did not impinge on the investment for the schooling of boys. The coefficient of the father's education level was found to have a significant positive effect on the opportunity of both girl's and boy's education while the level of the mother's education was significantly related to only the likelihood of girl's education. Moreover, it was found that the number of young siblings in a household considerably reduced the probability of girl's education in households.

Maldonado and González-Vega (2008) estimated the effect of explanatory variables on the schooling gap (expected schooling–actual schooling) in rural households in Bolivia. Households in this study are those which had joined the microfinance program of microfinance institutions (MFIs). The innovations in lending technologies of this program were used to offer credit and sometimes provide facilities to segments of the rural population otherwise without access to formal finance (de Aghion & Morduch, 2005; González-Vega, 2003). For these innovations, households were permitted to ensure their participation or the present value of their association with the MFI without collateral. Their human capital and their ability for income generation through the sustainability of the MFI were taken into account to evaluate household potential—as an incentive to repay loans. Negative binomial regression has been applied to investigate the effects. The results indicate the sign and the significance of the effect without considering the magnitude of the effects. It was found that the length of membership, the child's age, the child's gender, the human capital of the household head, the poverty index, the land holdings and female empowerment have impacted the schooling gap.

The effects of household characteristics on household schooling decisions in Burkina Faso were displayed by the logit model (Kazianga, 2012) and it was found that the regression coefficients of income risk and the child's gender were significant to the household schooling decisions in that income risk noticeably affected the enrollment status. Furthermore, the separate regressions for boys and girls indicated that income risk had a negative effect on boy's enrollment but did not impact girls' enrollment. Whenever income risk increased by 1 CFA (Communaute Financiere Africaine), enrollment for boys and girls decreased by about 0.033 percent.

In addition, the research of Sabates, Hossain, and Lewin (2013) pointed out that age, gender, together with financial constraints, such as lack of income and school expenditure were significant variables which has impacted the school drop-out status. This research used the multivariate logit model to predict the percentage of school drop-outs in Bangladesh.

2.2 Investment of Households in Education

Some papers have studied the investment of households in family members' education, for example, the impact of poverty, household structure, and economic well-being, and more typically, to invest in the education of their children as mentioned in Shapiro and Tambashe's research (2001). It was found that increasing economic well-being moderately drives greater investment in children's education. The family structure, namely the number of children in the household in different age groups, and a child's relationship to the household head, was found to be statistically significant to the children's education. Logistic regression has been employed to investigate what factors have impacted the children's education in Kinshasa, Congo. In 2006, Tansel and Bircan investigated the relationship of household factors to the demand for education measured by private tutoring expenditure in Turkey. The advantage of Tobit regression is the ability to construct the association of independent variables and the dependent variable. The tutoring expenditure of households varies greatly, especially in East Asia. Bray and Kwok (2003) and Bray (1999) reviewed examples of private tutoring from a wide range of countries from Egypt to Taiwan. Universities with very high reputations in some countries, such as South Korea, Greece, Japan and Turkey have a highly competitive entrance examination. The existence of competitive entrance examinations to the universities has impelled the demand of tutoring as most students believe that tutoring could probably increase their chance of admission success in universities. In this research, the result indicated that the regression coefficient of each factor, namely household expenditure, household head's age, square of household head's age, years of study for father and mother, mother's marital status, area and the number of family members in the household were statistically and linearly significant to the private tutoring expenditures of their households.

In addition, Stair, Rephan, and Heberling (2006) discussed the importance of considering household income, household income squared, the current connection status to the local public school, the perception of primary income earner, the status of children's attention in the appropriate age and area driving change on the probability that a respondent submits a positive bid for an increase in public school quality.

2.3 Educational Loan

Studies contributing to what factors impact educational loans are referred in this section. Schwartz and Finnie (2002) investigated student loans in Canada to project an economic analysis of the borrowing and repayment

patterns of Canadian bachelor's student. Both the probit and Tobit models were employed. Probit regression is modeled to investigate the relationship between the dependent variable, student loan borrowing status, and independent variables, namely age, field of study and province/region. The result of this study indicated that only the age of respondents did not significantly influence the student loan borrowing status for both of males and females. This study also applied Tobit regression to predict the proportion repaid by the same set of independent variables as mentioned before. The result illustrated the same result as the probit regression that the coefficient of age did not significantly differ from zero. Baum and Malley (2003) pointed out that the borrowers who come from low-income families were more likely than others to struggle to repay their education debt. Laura and Seaks (1992) analyzed the factors associated with the probability of default on federally guaranteed student loans by employing probit regression and found that the individual characteristics, namely parent's income, presence of two parents at home, student's graduation, and student's race, significantly impacted default rates. In addition, the institutional characteristics such as four year or two year college, private or public, school size, and individual school dummies have exiguous influence. A part of Eckel and et al. (2007) research, the impact of each independent variable on the dependent variable, which is an indicator variable equal to 1 if the subject chooses at least one type of the education subsidy, was investigated by the probit regression. Independent variables in this study are demographic variables (household income, age, employment status, immigrant status and gender), preference measures (risk aversion and patience), ability (math literacy), attitudes toward education, educational attainment and debt measures (debt aversion, debt use). Many of these factors are divided into categories and are indicated by dummy variables. It was found that all independent factors affected the dependent variable. Furthermore, it was concluded that there is a strong relationship between the willingness to invest for postsecondary education by the household head and the independent factors.

Although the papers referred to above would give proper and detailed information on various household education factors, relatively few investigations have been carried out to identify factors associated with the educational debt of households. On the other hand, the main objective of this study is to determine the major household characteristics that impact household educational debt in Thailand by firstly utilizing of the Tobit-piecewise regression. The related data and variables are presented in the following section. The results of the regression are synthesized. Finally, the implications are deduced in the conclusions.

3. Data and Variables

The data set in this study comprises 10 261 households with family members attending school in 2010. The data were collected by the National Economic and Social Development Board as reported in the Socio-Economic Survey (SES) Thailand. The 506 households had educational debt among all of these households while the remainder had no educational debt.

Eleven independent variables in this study, linearly related with household education debt, are taken into account as follows: 1) the logarithm of household-expenditure where household-expenditure is the average monthly total expenditure per household; 2) the education of household head, which is the number of years of school until graduation; 3) the logarithm of household-income, where household income is calculated from the sum of all monthly income and income in-kind; 4) the household head's age at the day of observation, 5) the logarithm of value of household assets is namely the value of the house, land and buildings, the value of vehicles owned by households and the value of other financial assets; 6) the scholarships provided by the private sector and/or government during the past 12 months, 7) the logarithm of educational expenditure, which is calculated by the average monthly total educational expenditure in each household, 8) the administrative area is related to the household location, namely the municipal area or non-municipal area, 9) the household size is the number of household members excluding servants, 10) the logarithm of the amount of household debt (at the end of last month) and 11) the number of family members in the household who have recently attended school. The multicollinearity problem is checked which the value of VIF not being greater than 2.3, which means that such a problem was not found.

The independent variables are selected based on two reasons. First, some specific factors indicated in previous papers are taken into account. Second, although relatively few studies have investigated the significant parameters on the educational loan or educational debt, their conclusions may not be completely suitable to a developing country such as Thailand. So, it is determined that the selected variables would be appropriate in the sense that they need to linearly relate to at least the dependent variable.

The dependent variable is the logarithm of the educational debt of the household, which is the loan for supporting the education of a family member in the household.

4. Model Specifications

Mekbunditkul (2010)'s earlier research constructed the Tobit-piecewise (abbreviated by TP) regression model which is developed with two ideas. Firstly, the Tobit regression is a tool used to investigate the linear relationship when the dependent variable in a regression model is limited. Second, piecewise regression is a regression analysis properly applied when structural change in regression occurs. Hence the TP regression is superior to either the Tobit or piecewise regression in cases where the educational debt is limited at zero value and the heterogeneous group in households has fallen.

The lower-limit TP regression (as a special case of TP in the research of Mekbunditkul, 2010) is appropriately defined in two parts, namely piecewise and Tobit regressions as follows,

$$f(\underline{x}) = \begin{cases} \underline{x}_1\beta_1 & \text{if } \underline{x}_1 \in X_1, \\ \vdots & \\ \underline{x}_s\beta_s & \text{if } \underline{x}_s \in X_s, \end{cases}$$

and the dependent variable is in the form of

$$Y_p = \begin{cases} 0 & ; Y_p^* \leq 0, \\ Y_p^* = f(\underline{x}) + \varepsilon & ; Y_p^* > 0. \end{cases} \quad (1)$$

Where the parameters vector is as $\beta_p \in \mathbb{R}^{k+1}$, $p=1, \dots, s$ define the submodels in the partitions X_p , $p=1, \dots, s$ and k is the number on independent variables. The parameters estimate can be solved by using maximum likelihood (ML) estimation. Moreover, the effect of a change in each independent variable on dependent variable is

$$\frac{\partial E(Y)}{\partial x_p} = \beta_p \Phi \left(\frac{x_p \beta_p}{\sigma} \right) \quad (2)$$

It is called the unconditional marginal effects provide economic meaning for the impact of changes in the independent variables on the dependent variable. Specifically, it measures the percentage change in a dependent variable caused by a one percentage change in an independent variable while holding other independent variables constant.

The dependent variable in this study, the educational debt, is the limited variable. Therefore, the least square (LS) regression is not preferable in the sense that its property is as an asymptotic bias estimator (Greene, 1981).

5. Results

In this section, the demographic characteristics of household heads that have family members attending the education system are studied and are presented in Tables 2-3. This data set was collected by the Office of the National Economic and Social Development Board. The relationship of household characteristics to educational debt is investigated by OLS, Tobit and TP regression as shown in Table 4.

5.1 Background of Household Characteristics

From Table 2, the 10 261 households who have family members attending any education level, 71 percent come from non-municipal areas and the remaining households live in municipal areas. More than half of the households (70.9 percent) have a male household head and 29.1 percent are female. The percentage of households is 30.1 for the age range of 41 to 50 years old and the average age is 51.7 years. Moreover, it was found that a household size of 3-4 persons had a percentage of 50.8 and the number of dependents is on average approximately 1.4 persons. Considering the average household finance, household monthly income is 25 364 baht and household monthly consumption expenditure is 19 734 baht. Household assets are 1 369 937 baht.

Furthermore, it was found that average household educational expenditure was 9483 baht. For the distribution of household educational debt, the highest proportion is households which had debt not greater than 50 000 baht over the previous year. The average is 5000 baht. In addition, average debt repayment per month was approximately 3300 baht.

The households have monthly income, monthly consumption expenditure and debt repayments per month of 25 364, 19 734 and 3300 baht, respectively; thus, the remainder is 2230 baht per month without considering other expenditure and savings. In other words, it can be said that households have remaining money of about 28 000 baht per year. This amount can be invested to educate 1-2 family members at levels below bachelor degree.

Therefore, the question “why do households need educational debt?” needs to be addressed.

Table 2. The demographic characteristics of household heads who have family members in education and have debt

Characteristics	Percentage	Characteristics	Percentage
Gender		Education-Debt (Baht in last year) Distribution	
Male	70.9	≤ 50 000	97.7
Female	29.1	50 001-100 000	0.9
Administrative Area		100 001-150 000	0.4
Municipal	29.0	150 001-200 000	0.5
Non-municipal	71.0	≥200 001	0.5
Age		Average (in Baht): 5000	
≤ 30	3.8	Debt repayment average per month	
31-40	16.3	Average (in Baht): 3300	
41-50	30.1	Income (Baht per month) Distribution	
51-60	26.4	≤20 000	58.6
≥ 61	23.4	20 001-40 000	26.5
Average (in years): 51.65		40 001-80 000	11.4
Highest Education Level		80 001-120 000	2.1
Primary	69.5	≥120 001	1.4
Secondary	18.8	Average (in Baht): 25 364	
Bachelor	10.4	Consumption Expenditure (Baht per month) Distribution	
Upper Bachelor	1.3	≤ 20 000	67.1
Average (in years attainment): 6.9		20 001-40 000	24.2
Household Size		40 001-80 000	7.5
1-2	21.9	80 001-120 000	0.8
3-4	50.8	≥ 120 001	0.3
≥ 5	27.4	Average (in Baht): 19 734	
Average 3.73		Assets (Baht) Distribution	
Number of Educational Attainments		≤ 30 000	
1-2	88.5	30 001-50 000	
3-4	10.8	50 001-100 000	8.0
≥ 5	0.7	100 001-500 000	25.1
Average: 1.38		500 001-1 000 000	26.6
Educational expenditure (Baht in last		1 000 001-5 000 000	36.4

year) Distribution		≥ 5 000 001	3.9
≤ 10 000	77.3	Average (in Baht): 1 369 937	
10 000-30 000	16.2		
30 001-60 000	4.4		
60 001-100 000	1.5		
≥ 100 001	0.7		
Average (in Baht): 9483			

Source of Data: Office of the National Economic and Social Development Board.

5.2 Tobit-Piecewise Regression Results

After TP regression is employed, it was found that households with family members attending school are divided into three clusters which have different household characteristics as presented in Table 3.

Table 3. Characteristics of household classified by cluster

Characteristics	Cluster		
	1 (3879 households)	2 (4040 households)	3 (2341 households)
Income	12 621	22 927	60 058
Expenditure	12 008	19 170	40 716
Assets	410 080	1 337 777	3 296 067
Educational Expenditure	7 079	8 145	13 948
Debt	32 960	148 160	1 060 293
Size	3	4	4
Age of household head	50	52	50
Educational debt	2937	5653	17 448

Source of data: Socio-Economic Survey in Thailand (SES), Nation of Statistical Office (NSO), year 2011.

From the important household characteristics as shown in Table 3, the name of each cluster is appropriately identified by “poor”, “middle” and “affluent” households. The “poor” households have the lowest of the financial household characteristics, namely income, expenditure, assets, educational expenditure, debt, and educational debt, among all clusters followed by the “middle” and the “affluent” households respectively. The household-income is lowest for “poor” at 12 621 baht, followed by “middle” at 22 927 baht and “affluent” at 60 058 baht. The educational expenditure is similarly the highest in “affluent” households at about 13 948 baht per year a followed by “middle” (8145) and “poor” (7079). This has caused the “affluent” to have more educational

debt at about 17 448 baht per year among all clusters; nevertheless this number is not much of a burden for this cluster, in the sense of educational debt to income ratio.

The researcher has estimated the effect of 11 dependent variables on the *logarithm of educational debt* of households by Tobit-piecewise (TP) regression compared with ordinary least square (OLS) regression as well as Tobit regression. The study of the effects of household characteristics on educational debt without the consideration of either the heterogeneous problem or the limited dependent variable is not appropriate so the result of only of OLS or Tobit regression might not reflect the truth well, and the reduction of educational debt of household in Thailand might not be solved.

From the marginal effects of the Tobit regression, it was found that household characteristics which affect the *log of educational debt* are the *logarithm of value of household assets*, the *logarithm of educational expenditure* and the *logarithm of household debt*. Furthermore, the factors which impact the *log of educational debt* almost all exclude the *education of household head* and *administration area* in the case of OLS regression as shown in Table 4.

Table 4. The marginal effects of Tobit, Ordinary least square (OLS) and Tobit-piecewise (TP) regression

Predictor variables	OLS	Tobit	Tobit-piecewise		
			Poor	Middle	Affluent
	$\hat{\beta}_{OLS}$	$\hat{\beta}_{Tobit}\Phi(z)$	$\hat{\beta}_{TP1}\Phi(z)$	$\hat{\beta}_{TP2}\Phi(z)$	$\hat{\beta}_{TP3}\Phi(z)$
Intercept	0.419	1.441***	1.0716***	0.7118***	1.5085***
Logarithm of household-expenditure	0.243***	0.00088	0.0062	-0.0016	0.0142
Education of household head	-0.001	-0.00088	-0.0001	-0.0004	0.0006
Logarithm of household-income	-0.071**	-0.0035	0.0013	-0.0083*	-0.0124
Age of household head	-0.008***	-0.000	-0.0001	-0.0001	0.0011**
Logarithm of value of household assets	-0.299***	-0.0053***	0.0019	-0.0020	0.0071
Logarithm of scholarship	0.000***	0.000	0.0000	0.0000	0.0000
Logarithm of educational expenditure	0.075***	0.0035**	0.0044**	0.0019	-0.0022
Administrative area	-0.055	-0.00088	0.0017	-0.0003	-0.0060
Household size	-0.110***	-0.00088	-0.0049*	0.0005	-0.0139***
Logarithm of household debt	0.225***	0.064***	0.0825***	0.0417***	0.0402***
The number of family members attending	0.086**	0.0044	0.0015	0.0005*	0.0038

The TP regression was first conducted to identify the characteristics of households that are likely affect the household's educational debt classified by subgroup. The results are shown in Table 4 (the full version is shown in Appendix). From the analysis of cluster 1 or "poor" households, it can be seen that there is at least one of all 11 predictors that affect the *logarithm of educational debt*. It means that there is an overall fit of the model. The number of marginal effects for the TP estimated for "poor" households has a negligible effect (very close to zero) on the *logarithm of educational debt*. The variable the *logarithm of household debt* is found to have the greatest positive effect on the *logarithm of educational debt* in the TP regressions. The marginal effect on the *logarithm*

of educational debt can be explained in the sense that with an increase of 1 percent in the *logarithm of household debt*, the *logarithm of educational debt* also increases by 0.0825 percent.

In terms of magnitude, the *household size* has the greatest effect, albeit a negative effect for the TP regression. For every 1 percent increase in the *household size*, there is a decline by 0.0049 percent in the *logarithm of educational debt*.

Results of the “middle” households as shown in Table 4 are described as follows. The marginal effects of the TP regression, namely the *logarithm of household-income*, the *logarithm of household debt* and the *number of family members attending* are significant at 0.10, 0.01 and 0.05, respectively. Moreover, it was found that the *logarithm of household-income* has the most negative effect on the *logarithm of educational debt* with a corresponding marginal effect of -0.0083, while the *logarithm of household debt* has the most positive effect and is followed by the *number of family members attending* with magnitudes of 0.0417 and 0.0005, respectively.

From the “affluent” households, the marginal effect of the *logarithm of household debt* of 0.0402 is high. As it increases by 1 percent, the *logarithm of educational debt* also increases by approximately 0.04 percent. The *household size* and the *age of household head* are both statistically significant with negative and positive signs, respectively. This implies that the *logarithm of educational debt* decreases in both magnitude and probability with the *household size* and the *age of household head* at a decreasing rate.

From the previous results, it is evident that if the heterogeneous nature problem and the limited dependent variable are not taken into account as illustrated in the OLS result, then the factors which affect the educational debt are not the same as in the Tobit or TP regression, especially for the household asset and household-income factors. From the OLS or Tobit results, it can be said that the factors which can reduce the educational debt for households in Thailand are their assets and income. However, if we address the previous issues as shown in the result in the TP regression, we can see that the household asset factor has not impinged on the educational debt and the household-income impacts this factor only in the “middle” households. This means that households with more assets might not reduce their educational debt. In addition, household income might reduce the educational debt only in the “middle” household. However, the “poor” households were found to have no impact of income on educational debt because there was not much income in this group, and they may be denied credit. It can be said that if the researcher does not consider the issue of heterogeneous nature or the issue of limited dependent variables, the solution is not evident and the educational debt of households in Thailand cannot be reduced.

6. Summaries and Conclusions

Past studies on the information content of educational debt produced varied results. A possible reason for this was that households have been treated as a homogeneous group, and that there was little variation in the educational debt value used. The aim of this study is to investigate the effect of different values for educational debt constructed for different clusters of household characteristics. Moreover, the relationship between household characteristics and educational debt has been explicated by comparisons between OLS, Tobit and TP regression. Since, in cases where the dependent variable in this study is limited, least square estimation in this case leads to biased and inconsistent estimates of the coefficients (Greene, 1981). The Tobit model is specifically derived to handle the problem of a limited dependent variable. Moreover, in the case where there exists the heterogeneous in nature problem the piecewise regression is preferable than OLS. Therefore, the statistical analysis in this study utilized by the TP model seems to be preferable to OLS and Tobit regression.

TP regression is taken into consideration because the education debt is limited at the zero value, and as expected, that households are not a homogeneous group. For the empirical analysis, the data set of Socio-Economic Survey in Thailand (SES) collected by National Statistical Office (NSO) 2011 was used.

The empirical results of this study indicate that different clusters of households do indeed have different values of household characteristics. In the case of the “poor” households, the TP regression effects of household education expenditure and household debt have highly significant impacts on the educational debt with positive signs. It means that educational debt increases when the household education expenditure or household debt increases. Straight forward, when the educational expenditure increases, the educational debt would also increase. For household debt, it is well-known that educational debt is a part of household debt; thus, they are the strongly linear relation. Furthermore, household size is significantly related to educational debt. This finding corresponds with the research results of Bray (1999), Ogawa and Wan (2007) and Bray and Kwok (2003), who discovered that some household characteristics, such as age of household head, household member and working status, have a linear influence on either household or educational expenditure.

For the group of “middle” households, there are significant positive effects of household debt and the number of

family members attending school whereas the household-income are significant negative effects on the educational debt. In common with much previous research, such as Glick and Sahn (2000), Maldonado and González-Vega (2008), Kazianga (2012), Sabates, Hossain, and Lewin (2013), Stair, Rephan, and Heberling (2006), Baum and Malley (2003), Laura and Seaks (2013) as well as Eckel et al. (2007) (household) income has impacted dependent variables which include educational opportunities of dependents, educational investment along with the educational debt whereas for the “affluent” cluster, factors which have important effects on educational debt are household debt and followed by household size and household head’s age.

From what has been mentioned above, it can be seen that the important factor that has driven households to have more educational debt is household debt; the educational debt increases when the household debt increases, moreover it also probably leads to more educational debt too (determined by the marginal effect). Surprisingly, the income variable played an important role in educational debt only for middle income households.

It is necessary to establish whether households in Thailand have liability due to the educational investment. This indicates that households recognize the importance of the education level so enough capital is required. Moreover, educational investment yields a return after the family member has graduated which is much more than the rate of return based on their savings. The relationship between household characteristics and educational debt might create some policy conclusions to reduce educational debt. First, the study of household characteristics that affect educational debt by considering households nationwide without regard to the heterogeneous nature problem might lead to inaccurate conclusions and the solutions might not be appropriate because factors that affect educational debt differed for each group. Second, in the cluster of “poor” households, the factors which impact educational debt are household debt, educational expenditure, and for the “middle” households it was found that educational debt was significantly affected by household debt or the number of family members in education. Therefore, more provision of government subsidies and scholarships to “poor” and “middle” households might reduce their burden as well as their household education expenditure through educational debt. In addition, an increase in income could reduce the ratio of educational debt to income of the households in these groups.

Further studies are recommended as follows: in this study, the educational debt included student loans, so in subsequent studies, the student loan should be removed from educational debt and studied separately by employing the TP regression statistical tool to determine which factors affect this loan. In addition, a comparison of education debt from 2003 to 2013 should be taken into account. Moreover, the household debt after the political crisis in Thailand and after the reduction of the student loan fund might also be interesting.

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Note

The Tobit-piecewise regression is an extension of standard Tobit regression (Tobin, 1958) commonly used to deal with censored data. One important inherent assumption that many researchers have overlooked when using Tobit model is that there might be a structural change in the data. When such a break is present, a piecewise estimate is called for. By not acknowledging the structural change and proceeding with a single regression line reduces the legitimacy of the results in two critical ways. The first is higher numbers of errors; the second is that the estimated regression does not properly represent the overall patterns of the data. A traditional piecewise regression without acknowledging the censored nature of the data thus does not provide an adequate remedy to this problem.

Appendix

Table A1. TP Regression Coefficients and the associated unconditional marginal effects of the logarithm of educational debt and PWS coefficients for the “poor” households

Predictor variables	TP coefficients		PWS coefficients
	$\hat{\beta}_{TP}$	$\hat{\beta}_{TP}\Phi(z)$	$\hat{\beta}_{WLS}$
Intercept	1.2191***	1.0716***	-0.7647
Logarithm of household-expenditure	0.0070	0.0062	0.1027
Education of household head	-0.0001	-0.0001	-0.0116
Logarithm of household-income	0.0015	0.0013	-0.0258
Age of household head	-0.0001	-0.0001	-0.0235***
Logarithm of value of household assets	0.0022	0.0019	-0.2288***
Logarithm of scholarship	0.0000	0.0000	0.0002***
Logarithm of educational expenditure	0.0050**	0.0044**	0.1032***
Administrative area	0.0019	0.0017	-0.0183
Household size	-0.0056*	-0.0049*	-0.2200***
Logarithm of household debt	0.0939***	0.0825***	0.4175***
The number of family members attending	0.0017	0.0015	0.2763***

*Significant at 0.10, **Significant at 0.05, ***Significant at 0.01.

Table A2. TP Regression Coefficients and the associated unconditional marginal effects of the *logarithm of educational debt* and PWS coefficients for the “middle” households

Predictor variables	TP coefficients		PWS coefficients
	$\hat{\beta}_{TP}$	$\hat{\beta}_{TP}\Phi(z)$	$\hat{\beta}_{WLS}$
Intercept	1.3902***	0.7118***	-0.0397
Logarithm of household-expenditure	-0.0032	-0.0016	0.2751**
Education of household head	-0.0008	-0.0004	0.0098
Logarithm of household-income	-0.0162*	-0.0083*	-0.0799
Age of household head	-0.0002	-0.0001	-0.0016
Logarithm of value of household assets	-0.0040	-0.0020	-0.2584***
Logarithm of scholarship	0.0000	0.0000	0.0001***
Logarithm of educational expenditure	0.0038	0.0019	0.1133***
Administrative area	-0.0005	-0.0003	-0.0646
Household size	0.0009	0.0005	-0.0269
Logarithm of household debt	0.0814***	0.0417***	0.1326***
The number of family members attending	0.0106*	0.0005*	-0.0428

*Significant at 0.10, **Significant at 0.05, ***Significant at 0.01.

Table A3. TP Regression Coefficients and the associated unconditional marginal effects of the *logarithm of educational debt* and PWS coefficients for the “affluent” households

Predictor variables	TP coefficients		PWS coefficients
	$\hat{\beta}_{TP}$	$\hat{\beta}_{TP}\Phi(z)$	$\hat{\beta}_{WLS}$
Intercept	1.7541***	1.5085***	-0.9958
Logarithm of household-expenditure	0.0165	0.0142	0.5144***
Education of household head	0.0007	0.0006	0.0072
Logarithm of household-income	-0.0144	-0.0124	-0.0738
Age of household head	0.0013**	0.0011**	0.0137***
Logarithm of value of household assets	0.0083	0.0071	-0.4407***
Logarithm of scholarship	0.0000	0.0000	0.0000
Logarithm of educational expenditure	-0.0026	-0.0022	0.0079
Administrative area	-0.0070	-0.0060	-0.0099
Household size	-0.0162***	-0.0139***	-0.1241**
Logarithm of household debt	0.0467***	0.0402***	0.2333***
The number of family members attending	0.0044	0.0038	0.0277

*Significant at 0.10, **Significant at 0.05, ***Significant at 0.01.

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