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Modelling Malaysian graduates' income profiles: An attempt to understand repayment burden in PTPTN loan

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Abstract:
This paper aims to empirically examine individual borrower repayment burdens in the Malaysian PTPTN[1] system through a static income model. We first capture patterns in the cross-sectional distribution of income using Malaysia Wages and Salaries Survey data and use these patterns to develop a simple model of lifetime income profiles of hypothetical Malaysian graduates; and secondly, to use the simulated lifetime income profile to examine repayment burdens across the income distribution. We explore non-parametric and parametric approach in estimating the income profile of Malaysian bachelor's degree graduates. We found that conditional quantile regression is a straightforward application to age-specific raw income data and meaningful to capture distribution of income, hence employed to simulate graduates income. Our analysis is followed by examination of the extent of repayment burden by decile (i.e. the bottom 10th percentile up to top 10th percentile) for males and females using a set of loan. Our results show the different impact of the scheduled repayments in the current time-based PTPTN loan across borrowers with different income levels. Critically, borrowers with zero income immediately default and the lowest earners disproportionately repay more than the highest earners.

Keywords:
Repayment hardship; student loan; static income; conditional quantile regression

1. Introduction:
The case of national student loan (abbreviated as PTPTN loan) default is not new, it is a popular political debate topics and importantly, its rationale as higher education savings and source of higher education funding for students are necessary, if not necessity. The issues of non-repayment and default are critically important as default and credit risk lead to efficiency losses, distributional inequities, and financial hardship for borrowers (Chapman and Sinning, 2014). When PTPTN borrowers default, this is recorded in

[1] *Perbadanan Tabung Pendidikan Tinggi Malaysia* or National Higher Education Fund Corporation.

Central Credit Reference Information System (CCRIS) thus impacting borrower credit reputation.[2] The deferment of PTPTN repayments for those who could justify non-affordability to repay have helped the vulnerable graduates.[3] However, without addressing the real problem of non-repayments associated with borrowers facing financial hardship, the already poor PTPTN repayment performance and constraints in fiscal budgets would result in increased defaults, and thus, a significant reduction in the funding and financing available to prospective higher education students.

The PTPTN internal study in Jan (2020) found almost half of PTPTN defaulters have monthly income less than MYR 2000; while a quarter have no regular income; slightly less than a quarter have income between MYR 2001- 4000 per month; and only a small number of defaulters have high income. The recent Covid-19 pandemic has provided a warning that individual incomes for graduates are not assured and young graduates with PTPTN repayment obligations are not spared, and thus more likely to face significant repayment stresses and a higher chance of loss in credit reputation.[4] The objective of this paper is to do an empirical examination of the extent to which low-income graduates facing repayment hardship that is speculated to have led to low recovery from low-income borrowers. We examine the extent of variability in repayment burden (RB) for individual borrowers across the income distribution in PTPTN and discuss the implications to loan delinquency.

The concepts of repayment burden

The current PTPTN scheme requires pre-determined repayment based on period of repayment, loan amount and *ujrah* (or administration fee). This is a type of mortgage-type loan, or also known as time-based repayment loan (TBRL), which does not link repayments to borrower income. So effectively, graduates with low or no income at a particular point in time with fixed-monthly repayment obligations are most likely to face repayment hardship, which may lead to default. Repayment burden (RB) analysis has been used in the student loan literatures to study the extent of repayment difficulties facing borrowers/graduates, particularly RBs associated with TBRL in some countries such as: Japan (Armstrong, Dearden, Kobayashi and Nagase, 2019); China (Cai, Chapman and Wang, 2019); Brazil (Dearden and Nascimento, 2019); Ireland (Chapman and Doris, 2019); USA (Barr, Chapman, Dearden and Dynarski, 2019; and Dearden, 2019); Thailand (Chapman and Lounkaew, 2015); Malaysia (Zein, 2022 and (Hock-Eam, Ibrahim and Ismail, 2014[5]); and Germany (Chapman and Sinning, 2014). The measure of RB at an individual level is given by the ratio of repayment to income in any period *t*.[6] Since the loan repayment is fixed over the repayment period of the scheduled TBRL, the lower the

[2] Default status can be removed, and credit reputation restored if students repay the missing payments.
[3] Discount incentives announced in the national budget has been popular policies to encourage repayments but at the expense of the costs to the taxpayers/government.
[4] Malaysia recorded that 22.3% of new graduates (with at least a bachelor's degree) earned between MYR 1001 and MYR 1500 in 2020, representing a much larger proportion of new graduates in this low income range compared to 2019. Among the young population, the unemployment rate for 15–25 year-old increased by 2.5 times the national average of 4.8 per cent in 2020 (Quarter 4, Labour Force Survey Report, Department of Statistic Malaysia). The unemployability among graduates, particularly new graduates who face higher challenges due to limited skills and experience, has implications for those with debts.
[5] The study by Hock-Eam, Ibrahim, and Ismail (2014) has concluded that the current mortgage-type student loan in PTPTN is likely to cause repayment burden to graduates with relatively low income. Further inference and concern over high underemployment of graduates and high unemployment of fresh graduates are made relating to the high burden to repay. The analysis was done using unconditional quantile regression which was argued in Dearden (2019) as inappropriate method for study of RB across income distribution.
[6] Repayment burden in period t = Loan repayment in period t/Income in period t

income the higher the RB or the percentage of income to repay. The implication of high or excessive RB is that it results in low disposable income, and consequently translates into consumption hardship. The unfortunate borrowers with zero income (or 100% or greater RB) due to unemployment will be unable to repay, and those facing interruption in employment or low income would face excessive RB which likely lead them to default[7].

2. Methodology:

We use Wages and Salaries Survey (WSS) 2015 data which was inflated to 2020 prices, 2019 Malaysian Graduates Statistics, and 2019 Malaysia Labour Force Data. For the purpose of calculating repayment burdens, we assume the annual loan amount for bachelor degree students is set at MYR 6,650 per year for four years of study, thus the total principal loan borrowed is MYR 26,600, *ujrah* is 1 per cent, and repayment period is 15 years.

Income smoothing

Our analysis compares parametric estimates using conditional quantile regression (CQR) with some other parametric and non-parametric approaches including polynomial regression and loess, at different quantiles of the income distribution. The preferred approach that we apply to estimate smooth income profiles by age is CQR. CQR is appropriate here, because for repayment burden, we are interested in individual age-income profiles for individual quantiles. In our application to income, the quantile regression method allows us to identify the effects of age at different locations in the conditional distribution of bachelor degree graduate income, for males and females separately. Let x be the range of age, and y be income. The quantile regression equation can be written as follows (for detail description of quantile regression model specification, see also Koenker (2005)):

$$y_i = \beta_0^{(\tau)} + \beta_1^{(\tau)} x_i + e_i^{(\tau)} \ , 0 < \tau < 1$$
$$Q\tau\ (y_i|x_i) = \beta_0^{(\tau)} + \beta_1^{(\tau)} x_i$$

where e is the error term. $Q\tau\ (y_i|x_i)$ denotes the τth quantile of y conditional on x, determined by the quantile specific parameters, β_τ. For a vector x_i, an individual coefficient $\beta_j^{(\tau)}$ associated with the jth independent variable in the vector x_i, called x_{ij}, could be interpreted as "how y_i in its τth conditional quantile reacts to a (*ceteris peribus*) marginal change in x_{ij}". The τth regression quantile estimate, $\hat{\beta}\tau$, is the solution to the following minimization problem, solved via linear programming:[8]

$$Q(\beta_\tau) = \sum_{y_i \geq x_i'\beta} \tau|y_i - x_i'\beta_\tau| + \sum_{y_i < x_i'\beta} (1-\tau)|y_i - x_i'\beta_\tau|$$

Following the best-fit estimates of CQR model and the assumption of static income whereby individuals in a kth percentile remain in kth percentile over time,[9] graduates lifetime income is then simulated. The age-income profile estimates include income of

[7] PTPTN defaulters (i.e, having at least one repayment in arrear) would face legal actions when three letters of warning are ignored) including poor credit reports in the national CCRIS.

[8] As illustrated in Buchinsky (1995), the bootstrap method is used to obtain estimates of the standard errors for the coefficients in quantile regression. This consistent and robust estimation method is important particularly when the error term is heteroscedastic and non-normally distributed, and is thus employed in our analysis.

[9] This implies that income mobility is omitted, which means that each simulated individual's income is restricted to the same income decile for the duration of the income projection based on a pre-determined income model.

employed persons (based on smoothed incomes as illustrated above) and also zero incomes from graduates who are either unemployed or not in the labour force. We incorporate the proportion of graduates who are unemployed and out of labour force based on 2019 Graduate Statistics into our simulation of income.[10]

3. Result:

For illustration, Figure 1 and Figure 2 show the income smoothing at the 10th percentile for males and females, respectively. Overall, in all the smoothing methods considered, the same order of polynomial in age gives approximately the same shape or curve[11]. Other findings worth noting include:

- The raw data shows females in the 10th percentile, and both males and females in the 90th percentile[12] of income, appear to have higher variability in income across age.
- The results show that a quadratic polynomial provides a superior CQR fit, and quantile polynomial fit for males in the 10th percentile, while females in the same income quantile are best estimated by a quartic CQR and quadratic polynomial fit.
- Greater variability of the 90th percentile raw income data is best fitted by a cubic CQR for males and a quartic CQR for female.

One of the advantageous is of CQR ability to produce coherent fitted values over the range of quantiles. This desirable property can be lost when polynomials are fit separately to different quantiles.

The income simulation found males earn higher in present terms[13] across the income distribution, and 28 per cent higher on average compared to females. This has implications for the RB analysis. Table 1 and Table 2 show that males in the first income decile would default immediately after graduation for five consecutive years *due to zero income*, whereas females in the first income decile would have greater than 100% repayment burden for the full 15-year repayment period. Unaffordable repayments are also apparent for graduates in the second[14] and third deciles of the income distribution. The results indicate that repayment is beyond financial capacity for the lowest earners. Further, fixed repayments that are independent of income in the current time-based PTPTN loan translate into high repayment burdens for lower income graduates compared to graduates within the higher income deciles, illustrating the regressivity of the scheme. Additionally, we found female face a significantly higher repayment burden across the 15-years repayment period compared to male. From an equity perspective, the scenario of repayment burdens in our findings is regressive. Under a more equitable arrangement, borrowers in the lower income decile would not face a higher burden than those who earn higher income.

[10] We assume that labour force state for an individual graduate remains static over the projection period. For example, if a graduate is employed at the starting age, then it is assumed they stay employed. However, some adjustments to an individual's labour force state may be made in our model to also ensure that the proportions of graduates at each labour force state at each age in our projections match with the age-specific cross-sectional distribution of labour force states.

[11] Quadratic polynomial in age is used in loess. Thus, loess estimates are close to quadratic polynomial regression on the quantile data.

[12] 90th percentile results are not shown in this paper.

[13] Discounted at Consumer Price Index, 2.6 per cent.

[14] Not shown in this table.

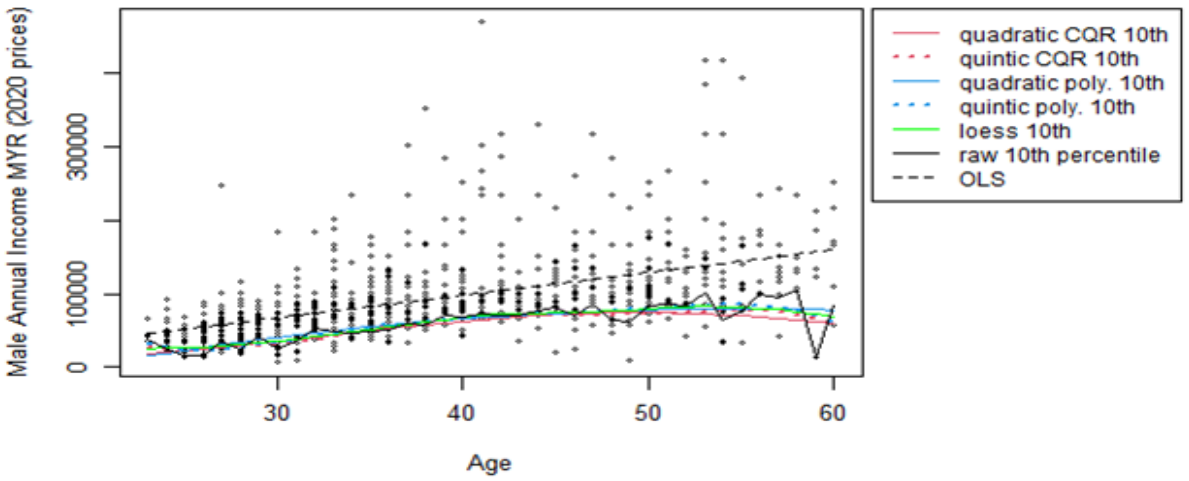

Figure 1 Comparing CQR with 10th percentile polynomial regression and loess fit for male graduates.

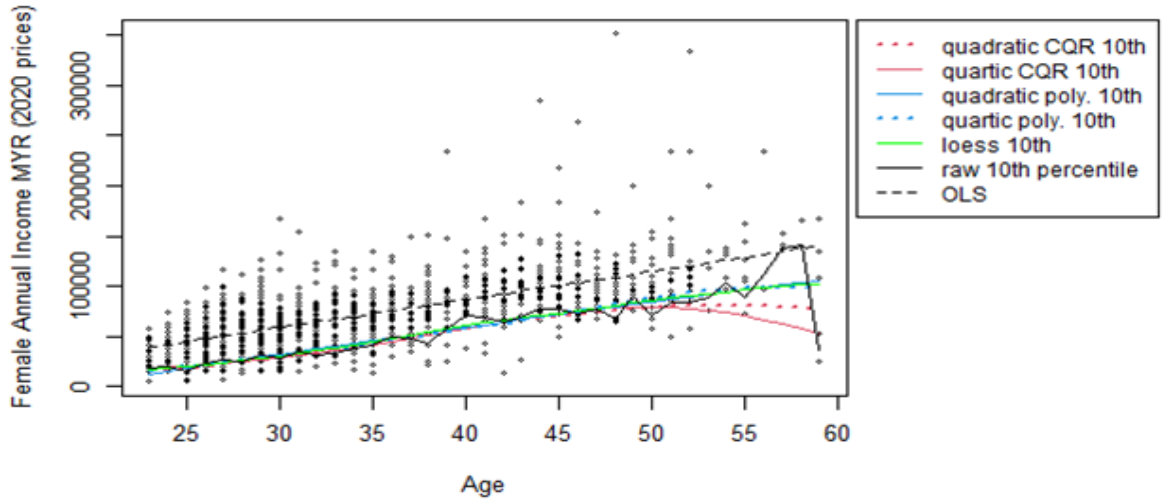

Figure 2 Comparing CQR with 10th percentile polynomial regression and loess fit for female graduates

Period	1st decile	3rd decile	5th decile	7th decile	9th decile
1	>100%	>100%	9.7%	6.2%	5.1%
2	>100%	>100%	7.6%	5.6%	4.7%
14	6.0%	3.9%	3.4%	2.8%	2.0%
15	5.3%	3.7%	3.3%	2.7%	1.9%

Table 1 Repayment burden for male bachelor degree graduates under PTPTN loan in nominal terms.

Period	1st decile	3rd decile	5th decile	7th decile	9th decile
1	>100%	>100%	15.2%	6.8%	4.8%
2	>100%	>100%	10.7%	6.1%	4.5%
14	>100%	4.7%	3.7%	3.2%	2.6%
15	>100%	4.4%	3.5%	3.1%	2.5%

Table 2 Repayment burden for female bachelor degree graduates under PTPTN loan in nominal terms.

4. Discussion and Conclusion:

Our analysis of repayment burdens reveals that the chance of default and the case of non-repayment in PTPTN are high for low-income borrowers due to lack of consideration of the borrower's capacity to repay. From an equity point of view, exist regressivity in repayment across income levels whereby higher earners repay a lower proportion of their income compared to the lower earners who has to pay a higher portion of income per period. In contrast to PTPTN, an alternative higher education student financing scheme available in Australia, England, the US, and Hungary known as an income-contingent loan set repayment as a percentage of income per period that put a cap on the repayment burden and thereby, prevent excessive or unmanageable debt, thus providing insurance against low labour outcomes affecting graduates' income. Further, repayments in ICL only start after income reaches a particular income threshold - providing insurance against default. Importantly, each borrower would have a unique repayment profile according to their income, in contrast to fixed repayments under time-based PTPTN.

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