Title: Investing in Human Capital through Student Loan Reform: the case of Vietnam

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Investing in Human Capital through Student Loan Reform: the case of Vietnam

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I. Introduction

East Asian developing countries have been a major engine of global economic growth in the last four decades, with GDP per capita growing at double digits in China and in the healthy range of 4-7 percent per year in many others. Their spectacular growth has generally been propelled by an abundant pool of young workers and a labor-intensive export-oriented manufacturing sector. Yet as both mortality and fertility rates decrease, population aging has threatened, or will soon threaten, the sustainability of this model in many countries, notably China, Mongolia, Sri Lanka, Thailand, and Vietnam (ADB 2011, United Nations 2015). Also, as such countries transition into more knowledge-based and capital-intensive economies in their efforts to reach high-income status, expanding the supply of skilled labor is essential for their long-term prosperity.

Vietnam is an example of this problem. Its stellar economic growth since the early 1990s – averaged 7.3 percent per year – has been fueled by a young labor force with strong literacy and numeracy skills, with net enrollment rate at lower secondary increasing from 70.1 percent in 2000 to near universal (99.1 percent) in 2018 and about 900,000 additional workers joining the work force per year during 1990-2018. Total exports rose from 34 to 95 percent of GDP between 1994 and 2018, yet medium- and high-tech exports consistently accounted for less than 30 percent of manufactured exports until 2010.

The growth model that relies on cheap labor, however, will no longer sustain the country's growth miracle. With the demographic dividend reaching its peak around 2015 and the share of the population older than 65 projected to more than double from 6.7 percent in 2015 to 14.4 percent in 2035 (World Bank 2016, p. 12), a growing concern is that Vietnam will get old before getting rich. As labor supply growth slows down significantly (from 2.2 percent during 1990-2010 to only 1.3 percent during the 2010s), human capital deepening becomes even more vital for the country to boost productivity and escape the middle-income trap.

Yet the higher education system has been falling short in meeting the country's evolving demand for skilled labor. Compared to upper-middle income neighbors, gross tertiary education enrollment in Vietnam is relatively low at 28.3 percent; in Malaysia and Thailand, the figure is 44.1 percent and 49.3 percent, respectively. Occupational skill shortage is often cited as a major constrain for businesses (World Bank 2014; Montague 2013). While skill shortage is an indicator of a dynamic economy that generates new and more skill-intensive jobs, obtaining a domestic degree does not necessarily equip Vietnamese graduates with the skills demanded by the labor market (Tran 2013, Tran and Swierczek 2009).

In addition, the domestic higher education system has been losing an increasing number of students in the last two decades. Between 2000 and 2017, as income level rose the number of Vietnamese students seeking a degree overseas (mostly in the US, Australia, and Europe) hiked from 9,131 to 94,662[1], making the country one of the most dynamic outbound student markets worldwide, trailing China and India only in sheer size. This "student drain" could arguable be attributed to not only better job and migration opportunities after graduation but also better education quality overseas.

[1] Source: UNESCO Institute for Statistics

Expanding access and boosting higher education quality thus have been a central part of Vietnam's development plan, yet the system faces a fundamental huddle: the lack of public funding. Public expenditure on higher education has traditionally been dwarfed by that on pre-schooling and basic education. In 2015, about 10 percent of government spending on education and training was allocated to higher education. However, more than half of that figure was tuition fees collected from students and redistributed to higher education institutions by the state. Excluding tuition fees, higher education received only 5 percent, or 0.8 percent of total government spending and 0.25 percent of GDP (World Bank 2018). This is much lower than the GDP share of higher education spending in the East and Southeast Asian neighbors, such as Singapore (1.0 percent), South Korea (0.94 percent), Malaysia (1.3 percent) and Thailand (0.64 percent)[2].

Private funding has been a prominent source of finance for Vietnam's higher education and will likely be even more so. Approximately half of the total cost of US$ 20 billion to implement the government's Higher Education Reform Agenda 2006-2020, for instance, has been expected from private sources, including tuition fees (World Bank 2015). Notably, in 2015 the government issued Decree No. 86/2015/ND-CP, a move that effectively further shifts the cost of higher education towards students. The decree allows public higher education institutions greater financial autonomy and substantially higher tuition fee limits in exchange for a reduction in public funding.

Currently being piloted and going to be fully implemented in 2021, the decree raises grave concerns about access and equity. The tuition fee increase is likely to deepen the already unequal access to higher education of students from lower-income background. Increasing financial barriers might also lead to a reduction in demand for higher education in the long term as the population ages and students from disadvantaged background cannot afford to pursue a degree.

Within this context of rising tuition charges, Vietnamese students have few options for financial assistance. The public student loan scheme is nearly non-existent, poorly designed and narrowly means-tested. Merely 70,000 out of 2.1 million enrolled students received government-provided loans in 2017. Commercial student loans, besides requiring strict collaterals, are also negligible in scale and often available to students from one particular university. Public grants and scholarships are similarly limited.

Without an overhaul of this financial assistance system, Vietnam is unlikely to meet the demand for skilled labor to sustain its economic growth. Most importantly, the focus of such reform should be on the provision and design of the public student loan scheme. Government intervention in providing student loans is needed because of the profound market failures of commercial loans. Given the information asymmetry between creditors and potential borrowers, as well as students' lack of collateral, commercial creditors are unlikely to lend to prospective students from disadvantaged background, who, without rich guarantors and collateral assets, are deemed risky (Chapman 2014, Chapman 2016, Chapman, Dearden and

[2] Source: UNESCO Institute for Statistics. The figure is as of 2013 for Thailand and as of 2016 for Malaysia, Singapore, and South Korea.

Doan 2019). Moreover, unlike grants and scholarship, student loans can be collected and thus create less pressure on the government's budget.

The next policy questions then are should the current system be simply expanded to better support credit-constrained students or should it be replaced with a new one? If the latter, what should the new loan scheme look like?

In the last 30 years, there has been a quiet but solid international revolution in higher education financing away from the traditional mortgage-style student loans towards income contingent loans (ICLs). The traditional so-called time-based repayment loans (TBRLs), like a mortgage, require fixed repayments over a set period of time. Vietnam's current loan system falls into this category. In contrast, ICLs require repayment if and only when a debtor's income exceeds a certain threshold and repayment amount is usually capped at a small percentage of debtor's earnings. Starting in Australia in 1989, ICL has now operated in full or in part five other countries, namely New Zealand, England and Wales, Hungary, South Korea, and Japan, and has been under legislative discussion in various others (Chapman *et al*. 2019).

A burgeoning literature, both theoretical and empirical, on higher education financing has shown that ICL has important advantages over TBRL, including protecting borrowers against adverse employment outcomes, providing better consumption smoothing, and being more cost efficient (Ngo 2019, Chapman 2014, Britton and Gruber 2019). If designed well, an ICL might also generate higher revenue for the government. On the other hand, TBRLs have been found to have detrimental effects on various aspects of borrowers' post-college wellbeing, such as occupational choices, wealth accumulation, and family formation decisions (see, for example, Rothstein and Rouse 2011, Gervais and Ziebarth 2019, Elliot *et al.* 2013, Cooper and Wang 2014, Walsemann *et al*. 2015, and Bozick and Estacion 2014).

Should it be inferred from this literature that Vietnam should reform its student scheme into an ICL? As far as this author is aware, research on student loan reform in Vietnam has been scarce. The probably only study that examines Vietnam's student loan system is Chapman and Liu (2013), which estimates the financial burden Vietnamese graduates would face under a hypothetical time-based repayment loan scheme.

Bridging this gap, this paper is the first to examine Vietnam's current student loan system and propose alternative ICL schemes for the country. The paper shows that the current scheme is not only inadequate to support credit-constrained students amidst rising tuition fees but also creates excessive repayment burden to debtors. The paper then proposes three potential ICL schemes and analyses how they might perform in Vietnam in terms of government subsidies and recovery rate as well as debtor's repayment experience. Using data from the Vietnam Household Living Standard Survey 2012-2016 and the Labor Force Survey 2016, and a recent econometric innovation that involves Copula functions to project graduate lifetime earnings and loan repayments, the paper demonstrates that it is feasible to design an ICL system that is both gentle on the fiscal budget and generous on borrowers in terms of both borrowing limit and repayment obligations.

The remaining of this paper proceeds as follows. Section 2 describes the current context and issues of higher education financing in Vietnam, followed by the documentation of the data

and empirical methodology used to project graduate income and loan performance. The analysis of alternative loan designs and a discussion of important policy implications appear in Section 4. Concluding remarks and suggestions for future research are reserved for Section 5.

II. Higher education financing in Vietnam

2.1. Public spending and tuition fees

Since 2000, together with robust economic growth and increasing demand for higher education, Vietnam's higher education system has expanded significantly. The numbers of universities and 2-years colleges rose from 178 to 445 whilst the number of enrolled students more than doubled from nearly 900,000 to above 2.1 million within 15 years between 2000 and 2015[3]. Gross tertiary enrollment rate, although still low, tripled from 9.4 percent to 28.8 percent[4] during the same period.

This expansion in size, however, has not been accompanied by equivalent improvement in education quality. Vietnamese higher education institutions (HEIs) remain mediocre by international standards – the QS World University Rankings 2019 for the first time lists two Vietnamese universities in the top 1000, none made it to its top-1000 list before. The teacher-to-student ratio has been persistently low at around 3-4 percent in the last two decades[5], salaries of faculty members are not sufficiently attractive to elicit a dedicated professional commitment, lecturers often lack sufficient academic credentials and training and most are not involved in research (Martin and Lam 2015, World Bank 2015). As well, curricula are outdated, teaching equipment is inadequate and there is a lack of a quality assurance system to provide feedback to HEIs (World Bank 2015, p. 4).

Many of these issues are associated with the system's highly centralized public funding structure. As of 2015, 80 percent of HEIs are state-owned, accounting for 87 percent of enrolled students. It is worth noting that although the number of private HEIs has increased moderately faster than that of public HEIs – by 2.9 times as compared to 2.4 times during 2000-2015, most private HEIs are small and the dominance of the public sector has remained virtually unchanged with the proportion of enrolled students in public institutions hovering between 85 and 90 percent.

Traditionally, public HEIs are fully state-funded and generally lack the authority to control their own resources and make strategic investments (World Bank 2015). While tuition charges exist, fee levels are capped and highly regulated. Most importantly, all tuitions collected by public HEIs, except those from unsubsidized programs, must be sent to the central bank for redistribution by the government. Public HEIs can access only the tuition fees from unsubsidized programs, which are the minority. Even then, the collected fees must be deposited at commercial banks and any interest earned from such deposits can only be used to provide financial aids to students.

[3] Source: Vietnam General Statistics Office
[4] Source: World Development Indicators database
[5] Source: Vietnam General Statistics Office

Decree No. 86/2015/ND-CP, issued by the government in 2015, disrupts this structure. The decree allows public HEIs greater financial and management autonomy in exchange for reduction in public funding. In particular, public HEIs that are granted financial autonomy under the decree will no longer receive state funding for their recurrent and capital spending, instead they are allowed to charge substantially higher fees and use the collected fees at will[6]. By 2018, 23 public HEIs have been granted full financial autonomy status, some are still eligible to receive part of their recurrent funding from public finance until 2020, with all public HEIs scheduled to follow suit after 2021.

While providing public HEIs with the much needed freedom to manage their financial resources, this decree raises the financial barriers to higher education. The tuition caps for year 2020/2021 for a full-time bachelor's degree at autonomous public universities, for instance, is 2.1 to 3.5 times higher than those in non-autonomous universities (the largest increase is in Medicine). While it is still unclear whether this will push tuition charges up in the private sector, such significant fee increase in the dominant public sector raises concerns about restricting access among credit-constraint students, widening access inequality and undermining the government's efforts to further expand the higher education system.

Vietnam's higher education system already has a high fee-for-service ratio. Tuition fees are estimated to make up 46 percent of the direct cost[7] per enrolled students in the public sector and about 69 percent in the private sector in 2016 (World Bank 2018). Participation in higher education is, unsurprisingly, highly unequal; the gross enrollment rate by household income quintile in 2016 was 52 percent among the top quintile yet only 19 percent among the bottom one. Without a sustainable and effective financial assistance system, the issues of access and equity will likely worsen when Decree 86 is fully implemented in 2021.

2.2. Student loan

Amidst heavy fee-for-service ratio and rising tuition charges, Vietnamese tertiary students have few options with respect to financial aid. Government-provided scholarships and grants are small and extremely narrowly targeted based on disciplines, poverty status, and ethnicity. The current student loan scheme, introduced in 2005, is a time-based repayment loan and has limited coverage, low borrowing limit, and various design issues.

Designed more like a social protection policy, the loan is available only to tertiary and vocational students from households with income per capita up to 150 percent of the national poverty line – that is, about 16.4 percent of the population, orphans, enrolled students whose households face health or natural disaster shocks during study period, displaced farmers, veterans and rural working-age students in certain vocational fields. In 2017, only 70,000 students (including both tertiary and vocational education) received funding through the scheme, a negligible number compared to 2.1 million enrolled tertiary students. Ironically,

[6] Interests earned from the fees deposited at commercial banks must still be used to provide financial assistance to students.

[7] Per student education cost refers to direct education cost related to students' learning, which comprises of tuition fees and other contributions, including contributions to school construction, parents' fund, uniforms, textbooks, learning materials, extracurricular classes, health insurance, travel costs and fees. Indirect costs for living such as meal, accommodation, clothing and other basic needs are not included.

while targeting students from disadvantaged background, the loan requires student's parents or guardians, who by eligibility criteria have low income, to be the official borrowers and responsible for repayment instead of the students themselves.

The current loan size is capped at VND 1.5 million/month (or VND 15 million/year) and can be spent on both tuition fees and living costs. However, given that the (unweighted) average tuition fee at non-autonomous public HEIs is VND 1.1 million per month in 2019/20 and rising, this borrowing limit is insufficient to cover both tuition fees and living costs, especially for students from rural areas who need to rent an accommodation. The loan cap is in fact already below the current average tuition fees at autonomous HEIs of VND 2.9 million/month. By the same token, the loan can cover only 84 percent of educational cost in public institutions and 52 percent in private institutions as the annual per student cost in public and private tertiary institutions in 2016 were VND 17.8 million and VND 28.8 million, respectively (World Bank 2018).

Besides its limited coverage and low borrowing cap, the scheme also features short repayment duration and a high interest rate. Borrowers are required to start repaying 12 months after finishing their study, with repayment frequency of at least one every 6 months. For tertiary programs, the repayment period equals the duration that the borrower received funding, with a maximum extension of half of the original maturity. Undergraduates pursuing a four-year degree thus would have at most six years to pay off their debt, much shorter than what their counterparts are entitled to in many countries, such as Brazil (12 years), China (23 years), Japan (18 years), Malaysia (20 years), and South Korea (20 years).

Nominal interest is set at 6.8 percent per annum and starts incurring from the date the loan is disbursed. Given the average inflation rate of 2.6 percent per annum during 2014-2018, this is equivalent to a hefty positive real interest rate of about 4.2 percent. Without paying interest during study period, an undergraduate would have an outstanding debt of VND 71 million at the end of her/his four-year degree, which is equivalent to 1.4 times the average starting annual salary of bachelor's degree holders. Overdue payment incurs an interest penalty of 130 percent the original interest rate.

All these make the policy case for a student loan reform in Vietnam. The current loan scheme not only fails to sufficiently cover students in need of funding to finance their degree but also creates heavy repayment burdens to borrowers, as will be shown in Section 4.1 below. A better scheme would have broader coverage, higher loan cap, softer repayment terms, and be financially sustainable.

III. Data and Methodology

The analysis of loan performance and its long-run budget implications requires that earnings and loan repayment obligations are projected over a debtor's lifetime. In other words, one needs to know the value of repayment obligations that each debtor faces each year and the annual income of each debtor over their repayment period. While the former is relatively straightforward to calculate from loan design parameters, the latter is more challenging.

Graduates with lower income are likely to face heavier repayment difficulty, less likely to pay off their debts, and if they do, take longer to do so. Approximating lifetime income of an

average graduate is therefore of little policy interest to gauge how difficult it is for graduates to repay their student debts and how much they are likely repay; instead, understanding the repayment performances of graduates with different income profile is critical. A key challenge is that graduates are unlikely to stay at the same position on the income distribution throughout their lives, making it necessary to estimate the age-specific distribution of graduate income and the graduates' mobility along this distribution. The following sections describe the data and estimation method used to conduct this empirical task.

3.1. Data

To estimate the dynamic lifetime income of Vietnamese graduates, this paper employs two data sources, the Vietnam Household Living Standard Survey (VHLSS) 2010-2016 and the Labor Force Survey (LFS) 2016. The VHLSS is a nationally representative rotating panel survey conducted every two years. Its panel feature allows us to capture how graduates transition along the graduate income distribution overtime, yet its small sample size undermines the reliability of its age-specific graduate income distribution. The LFS, on the other hand, offers a much larger sample of graduates and thus can compensate for the VHLSS sample size shortcoming.

This empirical exercise only includes bachelor's degree holders aged between 23 and 60 years old. Vietnam's official retirement age is 55 for females and 60 for males, thus graduates aged 61 and above are ignored in this analysis. The five rounds of VHLSS 2012-2016 contains 2,882 graduates (1,437 males and 1,445 females), with each graduate appearing in at least two consecutive rounds of the survey. From the LFS, a sample of 48,629 graduates is constructed. Summary statistics for the VHLSS and LFS samples are presented in Tables 1 and 2, respectively.

Table 1: Summary statistics of VHLSS panel

		All graduates	Male graduates	Female graduate
Total income in 2010 (VND '000)	Mean	65,540.00	76,400.31	53,719.95
	(SD)	(61436.74)	(76203.35)	(36191.76)
Total income in 2012 (VND '000)	Mean	72,367.25	82,225.40	62,084.83
	(SD)	(57792.91)	(70014.30)	(38878.03)
Total income in 2014 (VND '000)	Mean	80,023.84	90,261.63	70,300.00
	(SD)	(64080.15)	(71505.95)	(54441.2)
Total income in 2016 (VND '000)	Mean	84,231.90	95,189.00	73,892.56
	(SD)	(63507.18)	(73024.62)	(50974.15)
Age in 2010 (in years)	Mean	37.8	39.0	36.6
	(SD)	(10.4)	(10.5)	(10.1)
Proportion of graduates with zero income	2010	10.7%	12.8%	8.4%
	2012	10.7%	12.1%	9.1%
	2014	11.6%	12.3%	11.0%
	2016	9.9%	11.0%	8.9%
Proportion of graduates not	2010	14.9%	15.8%	14.0%

working	2012	14.4%	14.3%	14.4%
	2014	15.3%	15.4%	15.3%
	2016	14.8%	15.7%	13.9%
N (23-60 year old graduates)	2010	449	234	215
	2012	807	412	395
	2014	971	473	498
	2016	655	318	337
	All	2,882	1,437	1,445

Note: Income refers to total pre-tax labor income. All incomes were inflated to 2016 price level using the official annual CPI.

Table 2: Summary statistics of LFS

Total income in 2016 (VND '000)	Mean	78,955.26	89,498.15	68,175.15
	(SD)	(69193.01)	(81221.26)	(52039.1)
Age in 2016 (in years)	Mean	37.3	38.8	35.7
	(SD)	(9.9)	(10.2)	(9.2)
Proportion of graduates with zero income		10.3%	8.3%	12.4%
Proportion of graduates not working		18.8%	17.3%	20.4%
N (23-60 year old graduates)		48,629	24,585	24,044

Note: Income refers to total pre-tax labor income. All incomes were inflated to 2016 price level using the official annual CPI.

3.2. Methodology

3.2.1. Copula approach

This paper adopts the dynamic estimation approach proposed by Dearden (2019) with some adjustments to generate lifetime income projections for graduates. The key difference between this paper and Dearden (2019) is that the later uses only one panel dataset whereas this paper relies on two data sources due to the small size of the panel sample from the VHLSS. We use the VHLSS panel data to predict how graduates transition from one income percentile to another along the age-specific income distribution over their life course, then link each graduate's predicted income percentile at each age with a corresponding income level extracted from the LFS age-specific income distribution. This results in a panel of graduate income spanning over their working life; all monies are inflated to 2016 price level using the official annual CPI.

This approach involves three main steps as follows.

i. Estimate static age-income profiles by smoothing raw income percentiles over a polynomial function of age.

Raw income percentiles by age are calculated from the LFS cross-sectional sample – for males and females separately – and regressed against a polynomial function of age. Based on the Bayesian Information Criterion, the quintic function is found to best capture the fluctuation of graduate income over age, especially for those below 30 years old, who tend to

have lower income and are more prone to student loan repayment difficulty. Appendix A displays the raw and smoothed age-income profiles for both genders.

ii. Use Copula function to model the joint distribution of the adjoining continuous marginal cumulative distribution functions (CDF)[8] of income at each age in the VHLSS data.

Following Dearden (2019), this exercise aims to find the bivariate Copula function that best captures the joint distribution of the adjacent income percentiles for each age transition from 23 to 60. The VHLSS's panel sample, however, is too small to provide a reliable model of the transitions between consecutive ages. To boost sample size, this paper pools data from the five waves 2012-2016 of the VHLSS to form a two-period panel, then model the transitions between two adjacent age ranges, with each range spanning 3 years, that is, from ages [*t, t+1, t+2*] to ages [*t+1, t+2, t+3*].

The Akaike Information Criterion (AIC) was used to pick the best Copula amongst all the bivariate Copula families available in the BiCopSelect function of R's "VineCopula" package. As was the case for the US (Dearden, 2019) and Brazil (Dearden and Nascimento 2019), the t-Copula is found to provide the best fit for most age ranges for both males and females.

Once the appropriate Copula function – the *t*-Copula in this case – to formalise the dependence structures of the graduates' income distribution has been determined, R's "Copula" package is used to estimate the relevant parameters of t-Copulas, the correlation parameter rho (ρ) and the degree of freedom (ν), at each age. These parameters are then smoothed over age to be used in the simulation step below. See Appendix C for the estimated ρ and ν, their 95% confidence interval, and their age-smoothed values.

iii. Simulate two hypothetical samples of 10,000 observations each for males and females separately to project graduate future income over their lifetime.

Debt repayment performance based on debtor's income should be analysed for males and females separately because of the gender wage gap. To accommodate this, the paper simulates two samples of the same size (10,000 observations): one sample for female graduates and one for male graduates. The simulation for gender involves the followings.

- Step 1: Drawing a sample of 10,000 graduates aged 23 with replacement from the VHLSS panel sample.
- Step 2: Estimating the conditional distribution function of u_{24} given u_{23} which is given by:

$$C_{u_{23}}(u_{24}) = \frac{\partial}{\partial u_{23}} C_{23}(u_{23}, u_{24})$$

where C_{23} is the estimated t-Copula with parameters ν and ρ from our age-smoothed estimates at age 23, and u_t is the income CDF at age *t (t=23, .. 58)*

[8] The marginal CDFs are uniformly distributed between 0 and 1 and hence can be easily mapped onto the percentile estimates of the marginal distributions at each age once the simulations have been completed.

- Step 3: For each sample, generating a random standard uniform variable r with the same dimension as u_{23}, i.e. 10,000 observations.
- Step 4: Generate $u_{24} = C_{u_{23}}^{-1}(r)$ to get the uniformly distributed predicted income rank at age 24 which has a stochastic element due to the rank prediction being determined by the draw from the random uniform function.
- Step 5: Repeat steps 2 to 4 above for each sequential age.

Once the relative income ranks of these graduates have been simulated, they are linked to the corresponding age-smoothed income percentiles by age and gender derived from the LFS 2016 and projected to grow in real terms as a result of productivity growth over time. Real income growth is assumed to be 3.8 percent per annum over the lifetime of graduates, based on the average aggregate labor productivity growth rate in during 2000-2013 (World Bank, 2016, p. 134). The hypothetical samples are also re-weighted by gender to reflect the sex ratio among Vietnamese graduates in 2016.

3.2.2 Estimated t-Copulas and simulated graduate income

How do our simulations perform in terms of generating a realistic projection of graduate lifetime earnings? The first criterion is the prediction accuracy of the estimated t-Copula function when projecting graduate future income one year ahead on the VHLSS panel sample. As can be seen in Figure 1, the distribution of predicted income follows the actual distribution quite closely, especially for female graduates. The estimation only slightly overestimates income changes between adjacent ages (Figure 2).

Figure 1: Distribution of actual and predicted graduate income from the VHLSS

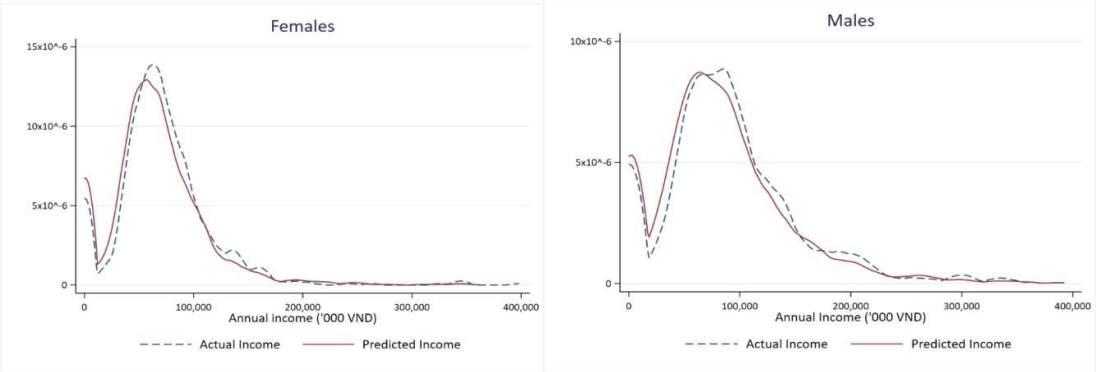
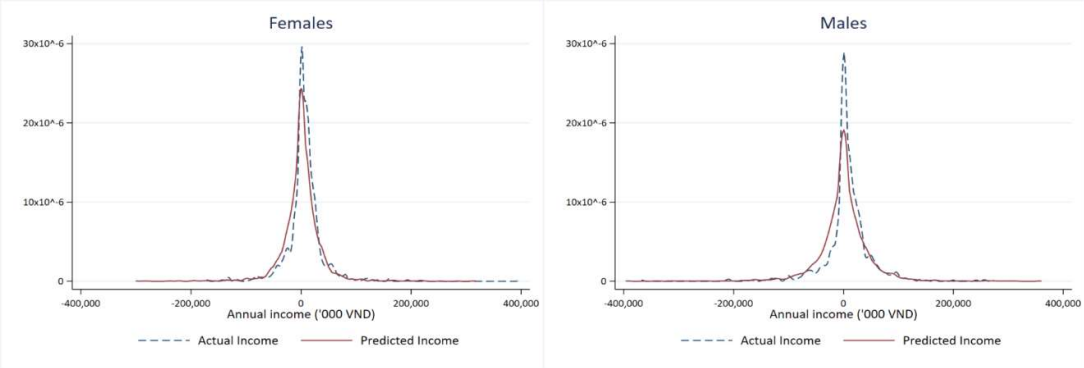
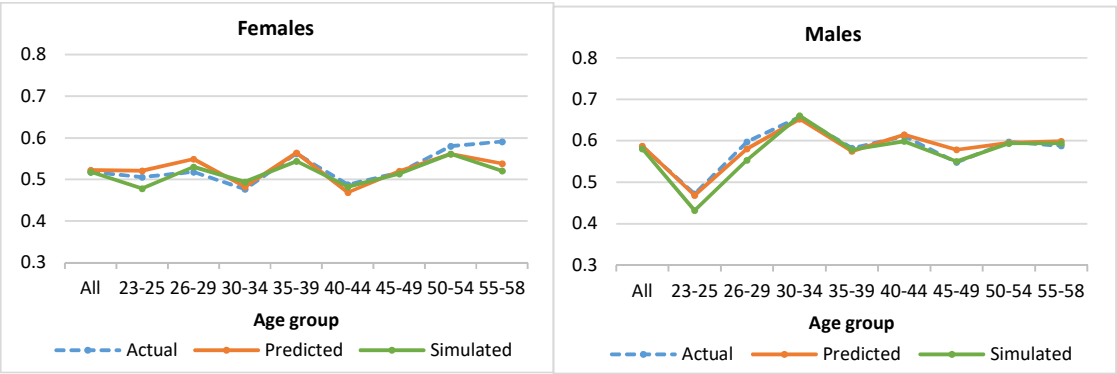


Figure 2: Distribution of actual and predicted income changes



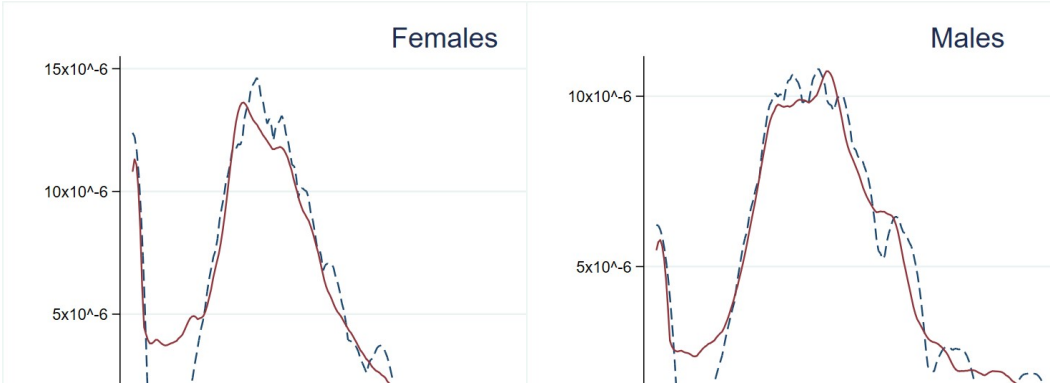
Another criterion is the Kendall's tau, which measures the rank correlation or the degree of concordance of the graduate earnings CDF's at adjacent ages. (See Dearden (2019, Appendix B) for further details about the calculation of Kendall's tau). As shown in Figure 3, the actual Kendall's tau from the VHLSS panel, the Kendall's tau predicted by the t-Copula on the VHLSS sample, and the Kendall's tau from the simulated samples are highly similar across most age groups for both males and females. This indicates the selected t-Copula does a good job in predict income dynamics and that the income dependence between consecutive ages in the simulated samples closely mimic that in the actual data.

Figure 3: Kendall's tau from the actual, predicted and simulated income



Given that the estimated t-Copula predicts income dynamics well in the VHLSS and simulates dynamic patterns that are closely similar to actual ones, how does it fair when we combine the VHLSS dynamics and the LFS distribution of income level? The simulated income distribution is found to be reasonably close to the actual distribution from the LFS (see Figure 4 below), except at the lower tail of the distribution. The repayment burdens of Vietnam's current time-based student loan and the repayment profile under proposed income-contingent loan schemes are estimated based on lifetime income of these simulated samples.

Figure 4: Distribution of actual and simulate graduate income from the LFS



IV. Results

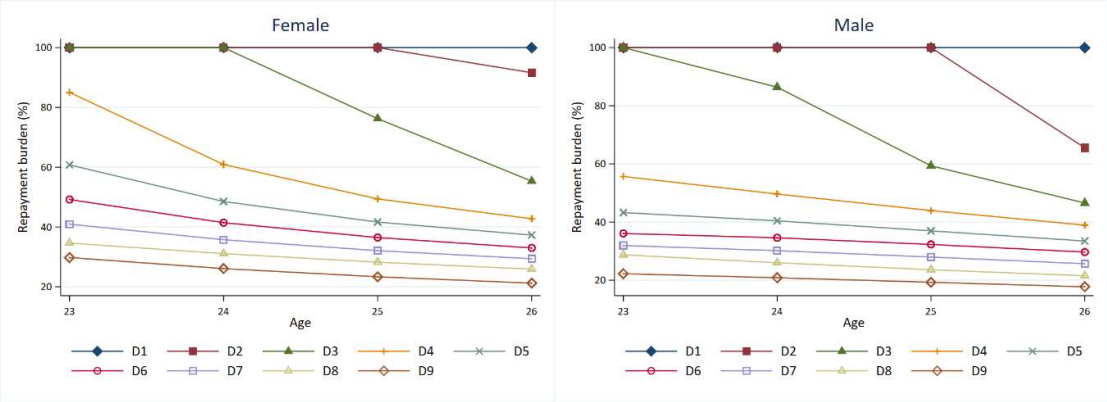
Before contemplating an income-contingent loan for Vietnam, an intuitive question is, Should the current time-based repayment loan scheme be expanded and/or revised to better cover credit-constraint students? This question can be addressed by an examination of its repayment burden on borrowers in Section 4.1. The following sections then proceed to describe three potential ICL designs and how they might perform in Vietnam in terms of government subsidies and recovery rate as well as debtor's repayment experience.

4.1. Repayment burdens associated with the existing time-based repayment loan

Figure 5 displays the estimated repayment burden (RB) associated with Vietnam's current loan scheme for bachelor's degree holders who borrowed to finance their four-year degrees and, thus, have four years after graduation to pay off their debts. The RB is measured by the repayment-to-income ratio – the proportion of annual income that a graduate need to fulfill his/her annual repayment obligation[9] – for each graduate income decile over a four-year repayment period. In other words, the estimates in Figure 5 represent the financial difficulty associated with repaying the loan that graduates at each decile of the age-specific graduate income income distribution would face given their earnings and no financial supports from any private or public source.

[9] For a detailed discussion on the pros and cons of the repayment-to-income ratio as a measure of student loan repayment burden, see Doan (2019) and Chapman and Doan (2019).

Figure 5: Repayment burdens associated with the current loan scheme by gender



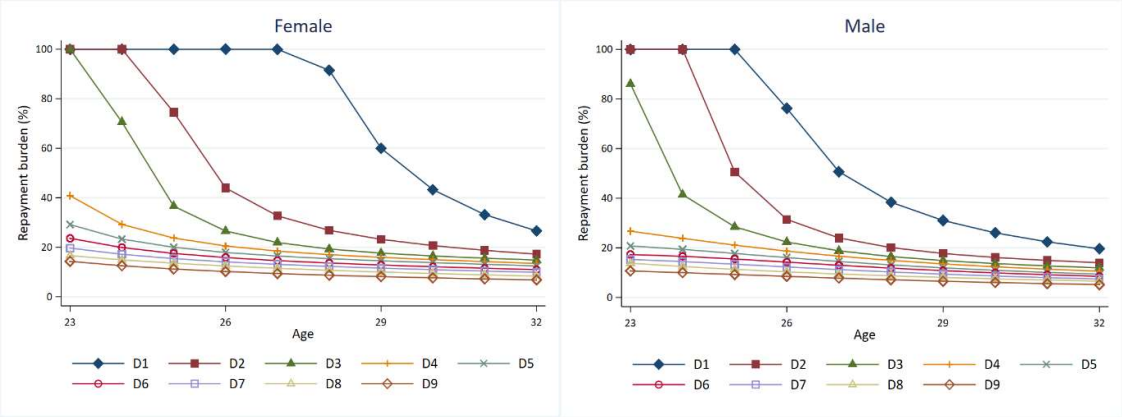
Note: Given the current loan's low borrowing limit, graduates are assumed to borrow the maximum amount allowed, i.e. VND 15 million/year, for four years to finance their degree. (All bachelor's degrees in Vietnam take four years to complete). This entails an outstanding debt of VND 71 million at graduation. Graduates are also assumed to pay no interest during their study time, finish their study at age 22 and start repaying at age 23, 12 months after their graduation as allowed by the scheme. For presentation purpose, repayment-to-income ratio that exceeds 100% is displayed as 100% in the figure.

The repayment burden appears excessive for a considerable portion of graduates when they start repaying and remains so for the whole repayment duration for those at the bottom of the earnings distribution, especially females. It is plainly impossible for the poorest 20 percent of graduates to meet their debt obligations with their earnings in the first 3 years for females and first 2 years for males since repayment amount either equals to or exceeds their earnings. The repayment-to-income ratio stays above 40 percent for about half of graduates in their first two years of repayment, and for about 30 percent of graduates for the whole debt maturity.

Linking the estimates in this study to the literature on repayment-to-income benchmarks for manageable student debt levels provides a sense of how heavy the burdens are for Vietnamese graduates. Various benchmarks have been proposed, ranging from 5.4 percent (Horch, 1978, p.5) to 18 percent (Salmi 2003, p.15), yet even the most generous one – 18 percent – is far below the estimates documented in this study. Even the 90th percentile of graduates (both females and males) are estimated to have RBs above this threshold during their first three years of repayment.

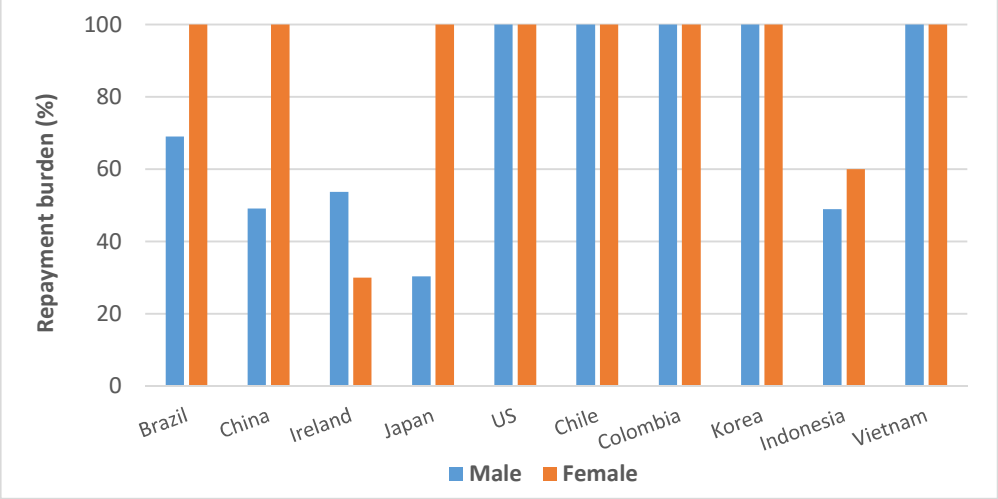
Will the debt burn subside if the current scheme is modified to provide a substantially longer repayment duration of 10 years? Unfortunately, the answer is No. This more generous TBRL would still create RBs above the 18 percent threshold for about half of debtors in their first four years of repayment (Figure 6). This means that even if these debtors get the maximum two-year extension on their repayment time, they would still face excessive loan stress and default risk if not receiving financial supports from other sources.

Figure 6: Repayment burdens associated with a more generous TBRL by gender



These findings echo results from previous studies for a wide range of countries. To put them in comparative context, Figure 7 displays the estimated RB for Vietnam alongside those reported in similar exercises for Brazil (Dearden and Nascimento, 2019), China (Cai *et al*. 2019), Chile (Chapman and Dearden, 2018), Colombia (Penrose, 2017), Indonesia (Chapman and Suryadarma, 2013), Ireland (Chapman and Doris, 2019), Japan (Armstrong *et al*. 2019), South Korea and the US (Doan, 2019) and shows how consistently high RB associated with TBRLs can be. In almost all cases, the ratio is highest in the first year after graduation, when graduate earnings are at the lowest, with the exception being Japanese females, whose ratio becomes substantial from age 29 onwards and exceeds 100 percent at age 31 when a large proportion of graduate women leave full-time employment after marriage and/or first child birth (see Armstrong *et al.* 2019).

Figure 7: Maximum repayment-to-income ratio for bottom 20% of graduates aged 23-31*



* For presentation purpose, repayment-to-income ratio that exceeds 100% is displayed as 100%. The ratio is calculated with respect to pre-tax labor earnings in the cases of Brazil, Chile, Colombia, Indonesia, Japan, the US, and Vietnam, pre-tax total individual income in the case of China, and post-tax earnings in the cases of Ireland and South Korea.
Source: Author's calculation and reproduced from Chapman and Doan (2019).

Such excessive RBs under the current TBRL scheme can have detrimental impacts on various aspects of debtors' wellbeing. Heavy repayment burdens drive debtors into consumption hardship and, in severe cases, default and consequential loss of credit reputation and future access to other loans. Even in the absence of default, liquidity constraint due to student debt obligations have been found to adversely affect occupational choice and lifetime income (Rothstein and Rouse 2011; Gervais and Ziebarth 2019), house ownership and wealth accumulation (Elliot *et al.* 2013; Cooper and Wang 2014), economic mobility (Elliot and Rauscher, 2018), mental health (Walsemann *et al*. 2015), and marriage and fertility decisions (Bozick and Estacion, 2014; Gicheva, 2016; Nau *et al.* 2015).

Amidst the need to increase both borrowing limit and loan coverage to better promote higher education access and equity, TBRL apparently is not the optimal choice for Vietnam; nor is it not for any country (Barr *et al*. 2019). The most critical problem with TBRL is the lack of a built-in mechanism to protect debtors against income shock and adverse labor market outcome. Fixed repayment obligations under TBRL, no matter how small, ignores debtor's capability to pay and thus will always cause difficulty to those who earn no income. A well-designed ICL can provide better consumption smoothing and insurance against adverse labor market outcomes to debtors and potentially generate higher revenue for the government (Barr *et al*. 2019, Chapman 2014).

4.2. Possible income-contingent loans for Vietnam

This paper tests three potential ICL schemes, two of which follow the loan designs in Australia and New Zealand, where ICLs have been well-established and fueled a cost-effective expansion of the higher education system[10]. The last one is designed in an attempt to balance the basic trade-off between protecting borrowers against repayment hardship and the costs to the public purse. The schemes' parameters and underlying assumptions are displayed in Table 3, with key features as follows.

Table 3: Potential ICL designs

	Scheme A ("Australian" design)	Scheme B ("New Zealand" design)	Scheme C
Loan size per year (000' VND)	20,000	20,000	40,000
Loan surcharge	15%	0%	5%
Real interest rate	0%	-3.4%	1.4%
Government cost of borrowing	1.4%	1.4%	1.4%
Forgiveness	None	None	None

[10] Readers interested in the performance of the ICLs in Australia and New Zealand could refer to Norton (2016), Norton & Cherastidtham (2018), and New Zealand Student Loan Scheme Annual Reports prepared by New Zealand Inland Revenue, Ministry of Education, and Ministry of Social Development (https://www.educationcounts.govt.nz/publications/tertiary_education/annual)

Type of repayment rate	Gross rate		Marginal rate		Marginal rate	
Repayment arrangement	Income threshold (VND '000/month)	Repayment rate	Income threshold (VND '000/month)	Repayment rate	Income threshold (VND '000/month)	Repayment rate
	<4,500	0%	< 2,250	0%	< 4,200	0%
	4,500-5,196	1%	≥ 2,250	12%	4,200-4,999	2%
	5,197-5,508	2%			5,000-5,999	2.5%
	5,509-5,840	2.5%			6,000-6,999	3%
	5,841-6,191	3%			7,000-7,999	4%
	6,192-6,563	3.5%			8,000-8,999	5%
	6,564-6,958	4%			9,000-9,999	6%
	6,959-7,377	4.5%			>10,000	7%
	7,378-7,820	5%				
	7,821-8,291	5.5%				
	8,292-8,789	6%				
	8,790-9,317	6.5%				
	9,318-9,877	7%				
	9,878-10,471	7.5%				
	10,471-11,100	8%				
	11,101-11,767	8.5%				
	11,768-12,474	9%				
	12,475-13,223	9.5%				
	>13,223	10%				

i. Given the need to increase borrowing limit to help students cope with rising tuition fees, loan size is set at VND 20 million /year for Schemes A and B (33 percent higher than the current limit and most likely sufficient to cover tuition fee and living costs at non-autonomous public HEIs) and VND 40 million/year for Scheme C, which is roughly sufficient to cover the costs at autonomous public HEIs.

ii. All three schemes require no repayment when a debtor's income is below their respective first repayment threshold. The first threshold is set at the average annual income of 23-years old fresh graduate for Scheme A, [xxx] percent of the minimum wage for Scheme B[11], and at the urban minimum wage for Scheme C.

iii. The government's cost of borrowing is assumed to equal the government's current five-year bond yield.

iv. Scheme A, following the Australian design, has a zero real interest rate. In contrast, the New Zealand design features a zero nominal interest rate, which translates to -3.4 percent when applying to Vietnam's context given the average inflation rate during 2013-2018. Scheme C sets the interest rate equal the government cost of borrowing, i.e. there is no interest subsidy.

v. None of these schemes provides loan forgiveness. Debtors repay until they pay off in full or until they permanently stop earning above the first repayment threshold.

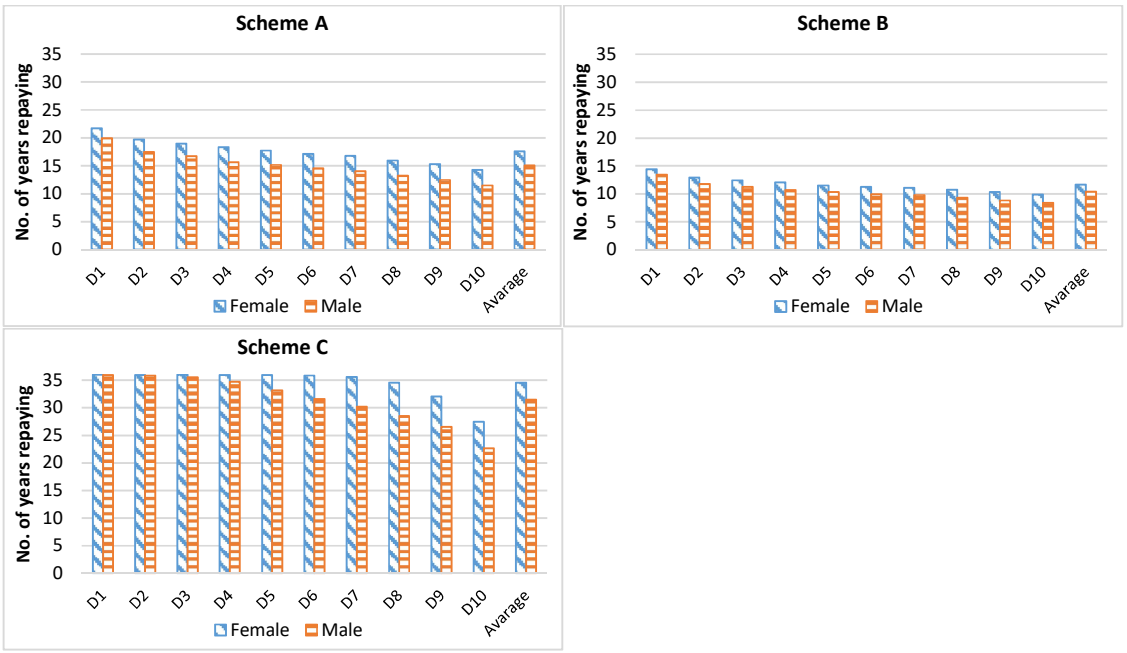
Since Scheme C does not follow any existing design, sensitivity to some of its parameters will be tested in Section 4.2.4.

[11] This is the ratio between the repayment threshold and annual minimum wage for graduates in New Zealand.

4.2.1 Repayment experience

While TBRL requires fixed repayment amount over a set period of time, under ICL scheme repayment is only required if and when a debtor's income exceeds the first repayment threshold, and the repayment amount is capped by law. Repayment time, as a result, varies across debtors while the repayment burden is either equal to the repayment rate(s) for ICLs that feature gross repayment rates – such as Scheme A – or below the repayment rate(s) for ICLs that feature marginal repayment rates – such as Scheme B and C in this paper. What is more relevant to understand loan impacts on debtors under ICL systems is the duration of repayment, which depends on the loan size, the interest rate, and the surcharge.

Figure 8: Repayment duration



Note: Debtors are assumed to retire and, thus, stop repaying at age 60.

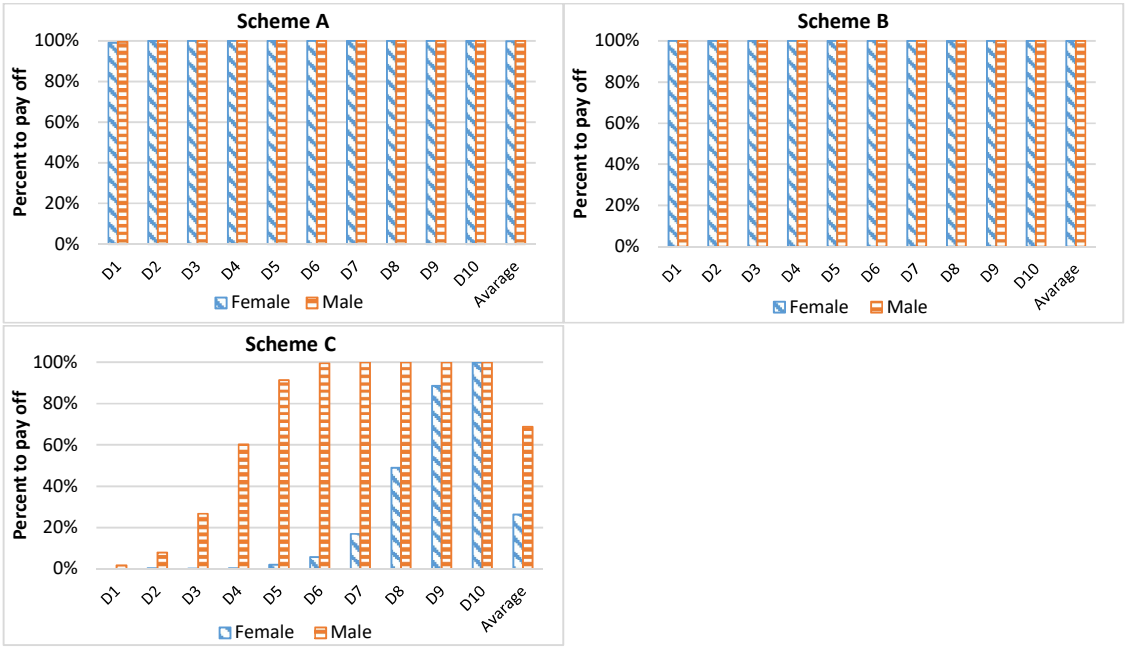
Figure 8 presents the average number of years that graduates among each lifetime income decile would spend repaying their student debt under each scheme. On average, it takes 15.1 years for males and 17.6 years for females to fully repay their debts under Scheme A. Scheme B, which features no surcharge and a considerable negative real interest rate, unsurprisingly takes the least time to be paid off, only 10.4 years for males and 11.7 years for females. In contrast, Scheme C, although having a lower surcharge and a relatively softer repayment arrangement than Scheme A, takes the longest, 34.5 and 31.5 years for females and males, respectively, due to both the larger loan size and the positive interest rate.

While a direct comparison is not feasible due to differences in loan size and graduate income distribution, it is worth noting that the repayment duration under Scheme A and B appear compatible with their original models in Australia and New Zealand. As of 2017/18, an average Australian debtor needs 9.1 years to repay their debt while a median New Zealand graduate needs 6.8 years. These figures are only moderately smaller than our estimates. The difference is mostly because (i) unlike Scheme A, the Australian system does not include a surcharge, and (ii) the New Zealand system requires 12 percent marginal rate on a borrower's

main earnings but 12 percent gross repayment rate on all secondary earnings, which help speed up repayment as compared to the arrangement in Scheme B.

Repayment duration is generally longer among those who earn less over their working life. The gap is largest under Scheme C; male and female graduates at the bottom lifetime income decile would spend approximately 13.3 and 8.6 more years than those at the top decile, respectively, to pay off their debts. The figures are 8.5 and 7.4 years under Scheme A and 5 and 4.5 years under Scheme B. This is mostly because the progressive repayment rates, coupled with small incremental income brackets, in Scheme A make low-earners pay back faster as their income increases.

Figure 9: Proportion of debtors repaying in full



Another aspect of repayment performance is the proportion of graduates who would pay back in full. All debtors are projected to fully repay their debts under Scheme A and B, yet only 26 percent of females and 69 percent of males would under Scheme C (Figure 9). Most notably, almost no female at the bottom half of the lifetime income distribution can pay off their debts by the time they retire, neither do 98 percent of males among the poorest decile.

This, however, does not necessarily mean that these debtors repay less than their borrowed amount. The combination of a surcharge and an interest rate equal the government's cost of borrowing in Scheme C makes those who pay off, or even though nearly pay off their debt effectively return more than what they received and thus cross-subsidize those who do not. In contrast, the negative interest rate and zero surcharge in Scheme B means that even fully paid off debts fall short of their original amounts in present value terms.

4.2.2 Government subsidies

From a public financing perspective, two important questions related to student loan performance are how much government needs to subsidize for non-repayment and the difference between the

loan's interest rate and the government's cost of borrowing[12], and how the subsidy is distributed among different groups of debtors. To address these questions in our exercise, Figure 10 illustrates the government subsidy rates based on lifetime repayments of a cohort of borrowers and highlights the differences across the three schemes. Two key things stand out from this figure.

One, Scheme C turns out to be most progressive in terms of cross-subsidy between high-income and low-income borrowers. In particular, the top 60 percent of males and top 30 percent of females repay more than what they borrowed – hence their negative subsidy rates – and effectively compensate for the shortfalls in repayment from those at the lower end of the income distribution. While the government generally subsidizes low-earners more, the contrast is much more modest in Scheme A and B. The differences in subsidy rates between male and female borrowers are also most striking under Scheme A.

Two, despite providing a two-times larger loan size which increases the probability of non-repayment, Scheme C is only the second most expensive. Taking into account the sex ratio among graduates, the overall subsidy rates are estimated to be 5.5 percent, 37.5 percent, and 12.5 percent for Scheme A, B and C, respectively. Scheme B unsurprisingly is the costliest due to its negative interest rate and the absence of a surcharge.

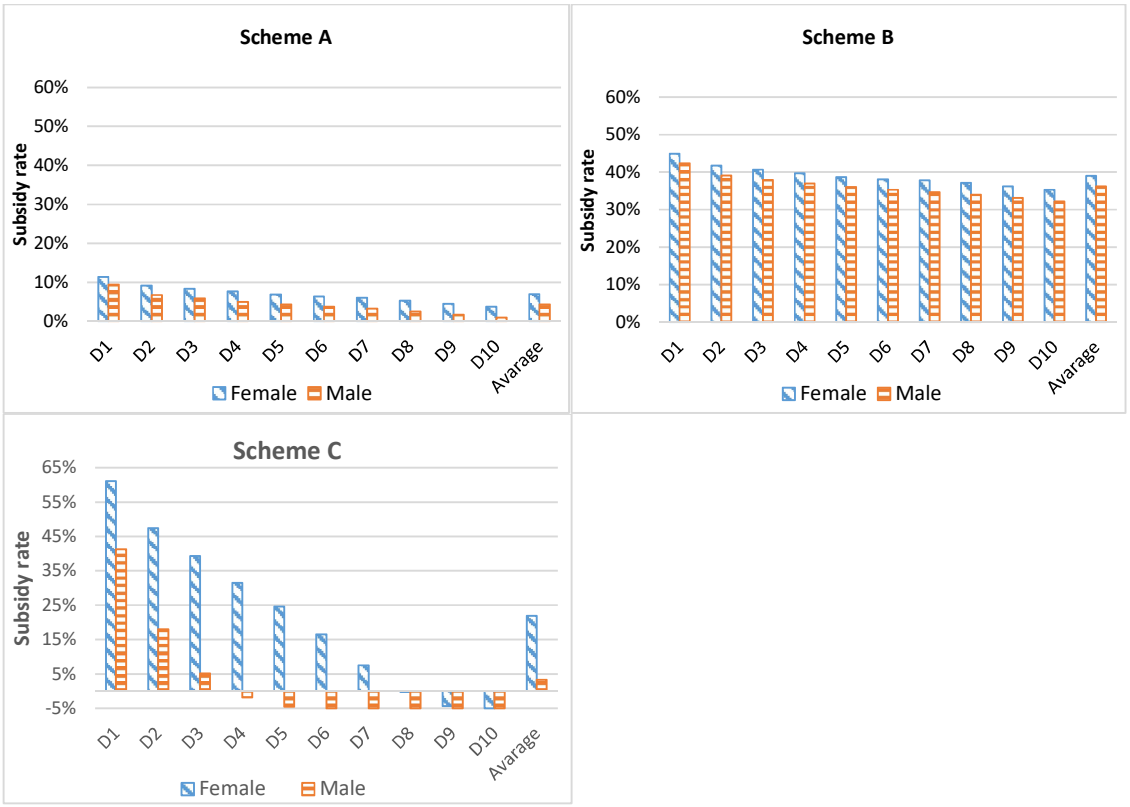
How do these figures compare with subsidy rates of existing ICL schemes? The most relevant reference points for our exercise would be the Australian and New Zealand systems. The subsidy of Scheme B is on par with that of the New Zealand system, which ranged between 40-45 percent during 2014-2018 and notably included non-repayment from overseas debtors, a factor not accounted for in our analysis. In contrast, about 20 percent of Australian student loans are expected to not be repaid (Norton 2016, p. 1), much higher than the subsidy rate in Scheme A.

[12] Following Chapman and Doan (2019), government's loan subsidy is calculated by $\frac{PvDebt - PvPay}{PVDebt}$.

The formula for the present value of repayments of an ICL is $PvPay = \sum_t \frac{Pay_t}{(1+d)^{t-a}}$ where Pay_t is the repayment amount at age t in real prices, d is the discount rate and a is the age at which the debtor started university. The number of repayments depends on the loan size upon graduation, income thresholds, repayment rates, interest rates, and whether the loan is written off.

The present value of the debt upon graduation is calculated as $PvDebt = \frac{\sum_u Loan_u (1+s)(1+r)^{U-u+1}}{(1+d)^U}$ where $Loan_u$ is the loan amount taken out by the student in year u of university (u=1,2,..U). The total number of years of attending university is given by U and the first repayment is made at age $t=a+U+1$. r represents the real interest rate on the loan during the study period, and s is the loan surcharge.

Figure 10: Government subsidy rate

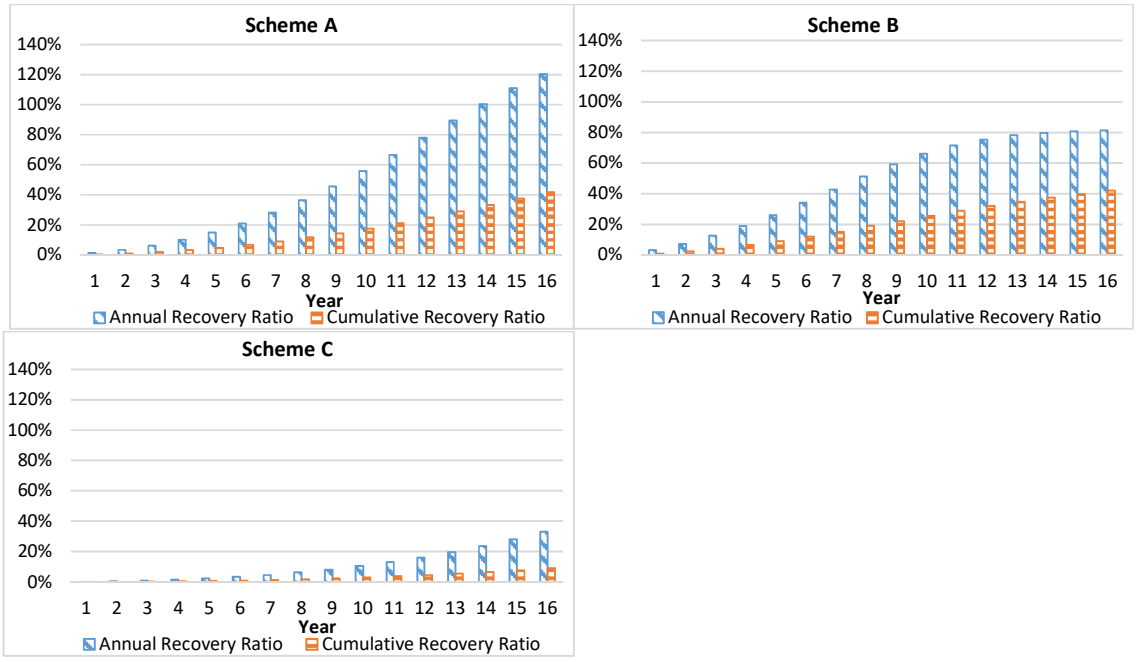


While actual subsidies depend on loan parameters and economic assumptions as well as the number of loan take-ups, this exercise demonstrates that it is feasible to design an ICL scheme for Vietnam that is both soft on the fiscal budget and generous for borrowers. Scheme C in particular allows debtors to fully finance the cost of their degrees in the context of higher tuition charges under Decree 86 yet requires relatively gentle repayment obligations and a modest subsidy from the government. The scheme's repayment rates are in fact lower than those in New Zealand (12 percent), the UK (9 percent) as well as Australia (maximum 10 percent gross). Another advantage of the scheme is its progressive distribution of government subsidy that let low-earning borrowers, especially females, benefit from the cross-subsidization from their high-earning counterparts.

4.2.3 Government recovery rates

Besides the subsidy for a certain cohort of borrowers, another issue of policy interest is how much money government can recover over time as multiple cohorts of borrowers enter the system. We examine this through the ratio of annual collected debts to annual disbursed loan amount and the ratio of cumulative collected debts to cumulative disbursed loans. These two ratios, which we term "annual recovery rate" and "cumulative recovery rate", respectively, can shed light on the cash flows that government need to consider as a student loan scheme matures.

Figure 11: Government recovery ratios



Note: The number of borrowers is assumed to increase by 1% per year while all loan and economic parameters are assumed to remain unchanged over time.

Figure 11 illustrates the annual and cumulative recovery rates for each scheme over 16 years, with year 1 being the year that the first cohort of borrowers graduate and start their repayment. With respect to annual recovery rate, Scheme A thanks to its gross repayment rates collects money quickly and thus has a sharply increasing recovery rate. From year 13 onwards, the amount of debts collected annually will be more than sufficient to cover the amount of new loans given out; that is, the system becomes self-sustainable. On the other hand, Scheme B's annual recovery rate seems to flat out at about 80 percent around year 12. This is because borrowers under this scheme only need 10-11 years on average to pay back their debts (see Figure 8); from year 12 onwards as borrowers from the first cohort starts to exit the system, the number of cohorts remaining in repayment stabilizes and the increase in the number of debtors in repayment is mainly driven by the system's expansion rate, which is set at only 1 percent per year in this exercise. The scheme's negative interest rate is also a factor contributing to its recovery rate not reaching 100 percent as a fully repaid debt is smaller than its principle in present value terms. Scheme C, due to its gentle marginal repayment rates, recover outflow money the slowest as debtors take the longest to pay back.

Compared to the annual recovery rate, the cumulative rate is much smaller and increases at a slower pace under all three schemes. By year 16, the government can recover approximately 42 percent what they have lent in Scheme A and B, whereas Scheme C reaches only 9 percent. As a reference point, in Australia the gap between the annual collected amount and outlay widens rapidly over time since both the number of borrowers and loan size have increased significantly (Norton 2016, p.10; Norton & Cherastidtham 2018, p. 53). The expansion of the system and the speed of fund recovery are ultimately a fiscal issue that the government should consider with respect to their current and expected budget.

It is important to note that 16 years is a relatively short period to fully assess the fiscal implications of a student loan system. Figure 11 provides only a brief illustration of how the alternative schemes are likely to evolve in fiscal terms. A much longer timeframe and a more flexible set of loan and economic assumptions are needed to estimate whether and when the government might break even. The growth rate of number of borrowers, changes in loan size and other loan parameters, as well as economic conditions that influence graduate labor market outcomes can all influence how a loan system might perform.

4.2.4 Sensitivity analysis

For robustness, this exercise investigates how Scheme C performs in terms of government subsidy, number of years for borrowers to pay off and the proportion of borrowers paying off their debts when loan size is reduced by half to VND 20 million/year and surcharge rate varies from 0 percent, 5 percent, 10 percent to 15 percent (Table 4). On the one hand, given the same repayment arrangement and interest rates, downsizing the loan limit significantly reduces government subsidy; the government can even make a profit when putting a surcharge of 5 percent or more on the loan. The smaller loan also means that the vast majority of borrowers would pay off their debts before retirement. On the other hand, increasing/decreasing the surcharge while keeping loan size at VND 40 million/year can decrease/increase government subsidy and the proportion of debtors repaying in full considerably. The average repayment duration, however, only change slightly by about one year for each 5 percentage points change in the surcharge.

Table 4: How does Scheme C perform with different loan sizes and surcharges?

Loan size (VND '000/year)	Surcharge	Government subsidy rate			No. years to pay back			Proportion of debtors repaying in full		
		female	male	average	female	male	average	female	male	average
40,000	15%	19.54%	-3.18%	8.05%	34.94	32.37	33.64	19.96%	60.89%	40.65%
	10%	20.61%	-0.03%	10.17%	34.76	31.94	33.33	22.83%	64.86%	44.08%
	5%	21.83%	3.30%	12.46%	34.54	31.48	31.48	26.29%	68.73%	47.75%
	0%	23.24%	6.83%	14.94%	34.26	30.98	32.60	30.32%	72.51%	51.65%
20,000	15%	-9.15%	-13.69%	-11.45%	29.25	25.01	27.11	77.81%	95.00%	86.50%
	10%	-5.20%	-8.93%	-7.09%	28.76	24.55	26.63	80.24%	95.72%	88.07%
	5%	-1.12%	-4.12%	-2.64%	28.24	24.09	26.14	82.94%	96.47%	89.78%
	0%	3.10%	0.71%	1.89%	27.68	23.60	25.62	85.60%	96.95%	91.34%

This exercise, together with the findings in Section 4.2.1-4.2.3 above, demonstrates that it is feasible to design an ICL scheme for Vietnam that is both revenue-neutral for the government and generous for borrowers. The various parameters of an ICL, namely interest rate, repayment rate, repayment thresholds, surcharge, loan size, and loan forgiveness, make it sufficiently flexible to simultaneously accommodate multiple goals of a student loan system with respect to budget constrain, assistance to borrowers, and progressiveness of government subsidy. Yet as illustrated by the performance of Scheme A and B in comparison with Scheme C, there is no one-size-fits-all design. A scheme that works well in one country might not in another. For an in-depth discussion on desirable characteristics and design parameters of ICL, see Barr *et al*. (2019). The most suitable loan design for Vietnam in particular and any country in general depends on the government's objectives, budget

constrain, as well as the country's specific demographic and labor market characteristics (Chapman and Doan 2019).

V. Conclusion

Facing a rapidly aging population and slowed growth momentum, Vietnam is arguably on the edge of entering or, as warned by some, has already entered the middle-income trap. In order to transform into a high-income economy, it is important for the country to graduate from the growth model that capitalizes on comparatively cheap labor and relies on export-led manufacturing. Investment in human capital deepening is critical for the country to boost productivity and transition to a knowledge-based capital-intensive economy.

Yet Vietnam's higher education enrollment is still low by regional standard and the higher education system has been slow and inefficient in responding to evolving demands for new occupational skills. Most of this problem is associated with the country's highly centralized funding approach. In an attempt to address this problem, the government issued Decree 86 to allow public higher education institutions greater financial autonomy and substantially higher tuition fee limits in exchange for reduction in public funding. A direct consequence of this decree is a hike in public tuition fees, raising concerns about high education access and equity.

The need to expand and improve the higher education system requires, among other things, an increase in funding and a sustainable financial assistance system for disadvantaged students. The solution, this paper argues, is a well-designed student loan system that can simultaneously pump additional funding into the system and help credit-constrained students pursue a degree.

This paper, for the first time, reports that Vietnam's current loan system not only inadequately covers credit-constrained students in the context of rising tuition fees but more importantly creates excessive financial difficulty to debtors. The paper then demonstrates that it is feasible to design an ICL system that is both gentle on the fiscal budget and generous on borrowers; the scheme provides sufficient resources for students to finance their degrees yet does not penalize low-earning debtors.

Although further research is needed to fine-tune this proposed ICL, taking into account actual enrollment number and other costs associated with implementing and administering a new loan scheme, this study demonstrated that a well-designed ICL could help Vietnam expand higher education access and improve access equity in a cost-effective manner. As Vietnam's experience speaks to a wide range of middle-income countries that have been struggled to reach high-income status, this research contributes to a growing literature that analyzes and designs student loan reform as a key tool to boost human capital accumulation and help developing countries transition to knowledge-based economies.

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Appendix A: Raw and age-smoothed age-income profiles

Figure A1: Raw and age-smoothed age-income profiles of female graduates

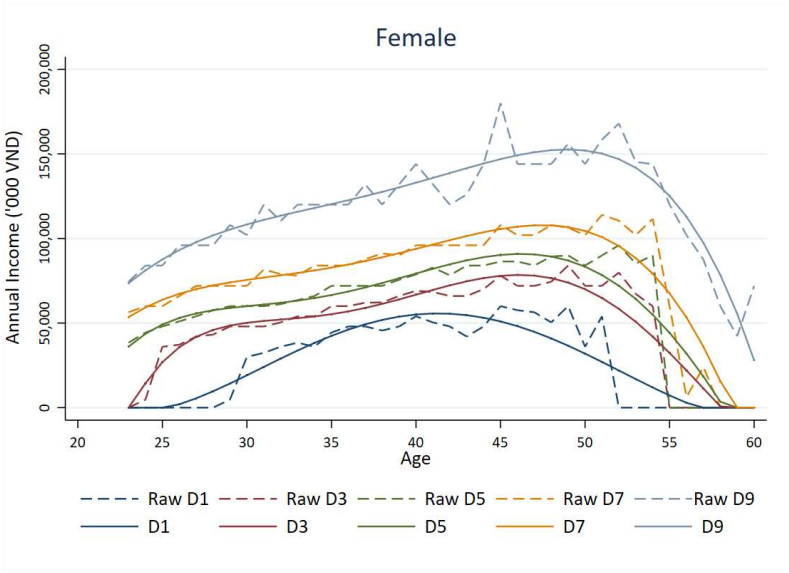
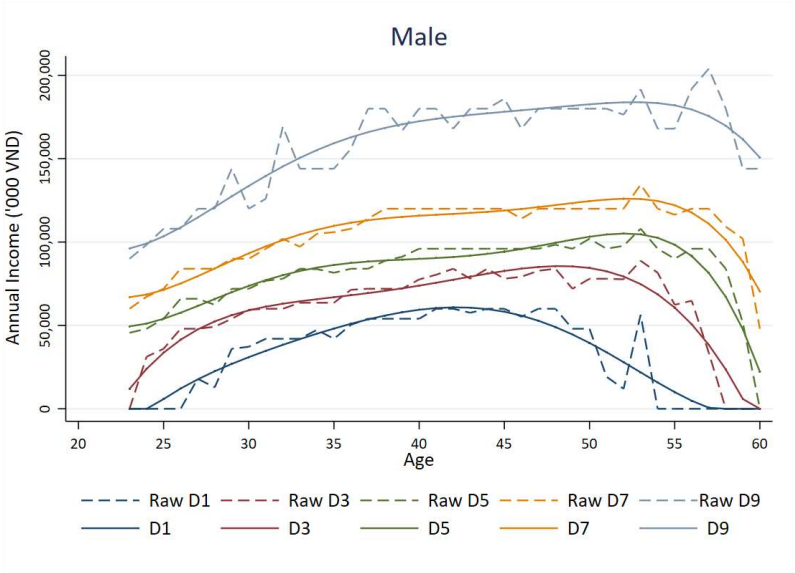


Figure A2: Raw and age-smoothed age-income profiles of male graduates



Appendix B: Transition matrix of graduate income quintiles

Panel A. Female						Panel B. Male					
Quintile	Q1	Q2	Q3	Q4	Q5	**Quintile**	Q1	Q2	Q3	Q4	Q5
Q1	**56.35**	22.15	11.24	5.86	4.40	Q1	**63.17**	20.84	9.21	3.88	2.91
Q2	25.09	**33.10**	27.05	11.21	3.56	Q2	25.63	**40.32**	20.79	10.75	2.51
Q3	9.35	22.52	**35.69**	24.62	7.82	Q3	7.87	23.03	**38.39**	23.99	6.72
Q4	9.02	13.08	21.18	**37.38**	19.34	Q4	3.17	8.19	28.31	**40.60**	19.74
Q5	4.47	4.28	9.50	24.58	**57.17**	Q5	3.33	3.33	9.30	27.19	**56.84**

Appendix C: Estimated and age-smoothed rho and degree of freedom of t-Copula

Figures display the estimated rho (ρ) and degree of freedom (ν) and their age-smoothed estimates for each of the income variables at each age.