'Generation Debt' Turns 40: Modeling Millennial Debt Trajectories in a Multilevel Framework

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Introduction

▶ Widespread public concern over finances of young American adults ("Millennials")

  ▶ Especially regarding debt - labeled "Generation Debt" (Kamenetz 2006)

▶ Research in sociology has confirmed high debt levels and financial distress for Millennials (Houle 2014)

▶ Other researchers have explored implications of high debt levels, for example associations between debt and fertility (Nau, Dwyer, & Hodson 2015), physical health (Lippert, Houle, & Walsemann 2022), home buying (Houle and Berger 2015), and cohabitation (Addo 2014)

▶ *Much of the sociological research studied Millennials in their twenties, what has changed now that Millennials are in their thirties?*

Research Questions

1. How much of the variance in debt is attributable to between-individual and within-individual differences?
2. What is the association between debt and time?
3. What is the association between parental net worth and initial debt levels and debt trajectories?

Data

- ▶ National Longitudinal Survey of Youth 1997 (NLSY97)
  - ▶ Nationally representative panel study of Americans between the ages of 12 and 16 in 1997
    - ▶ Respondents are between ages of 39 and 43 today
  - ▶ Currently in its 20th round
  - ▶ Administered by the Bureau of Labor Statistics
- ▶ Respondents are asked about debt every five years in Youth Asset (YAST) modules
  - ▶ Currently six YAST modules - YAST20 through YAST40
- ▶ Sample restricted to respondents reporting debt at least once
  - ▶ Number of individuals (N) = 7523
  - ▶ Number of measurements (n) = 29397

Variables

▶ Dependent Variable = Debt
  ▶ Includes automobile debt, student debt, debt owed to family/friends, credit card debt, store debt, healthcare debt, and other forms of debt
  ▶ Does not include housing debt

▶ Independent Variables
  ▶ Time = measurement occasion
  ▶ Parental Net Worth = household assets minus household debt of respondents' parents measured in Round 1 of survey (when respondent was between 12-16)

▶ Control Variables
  ▶ Level-1 = age, education, income, assets, marital status, number of children
  ▶ Level-2 = sex, race, parent income, parent education

▶ All financial measures adjusted for inflation and missing values imputed using bagging decision tree (machine learning algorithm)

Methods

▶ Implement a multilevel model with individuals as the level-2 units and measurement occasions as the level-1 units

▶ RQ #1: How much of the variance in debt is attributable to between-individual and within-individual differences?

    ▶ Run a null model and calculate residual intraclass correlation coefficient

▶ RQ #2: What is the association between debt and time?

    ▶ Test the fixed and random effect of time

▶ RQ #3: What is the association between parental net worth and initial debt levels and debt trajectories?

    ▶ Test the fixed effect of parental net worth (impact on initial debt) and interaction between time and parental net worth (impact on debt trajectories)

Total Debt Inferences

Table 1: Total Debt Inferences Across Age, N=(7523)

Age	Mean Debt	Mean Debt SE	Debt SD	Debt SD SE
20	7,045.960	178.210	13,742.370	3,676.970
25	22,180.640	580.040	35,056.440	11,505.220
30	32,916.560	840.200	52,840.610	14,573.350
35	34,727.430	927.140	55,636.320	15,016.360
40	34,776.810	1,249.310	55,647.820	16,264.550

Source: NLSY97. Among respondents reporting debt at least
once. Adjusted for survey design and inflation.

Null Model

Table 2: Null Model for Total Debt

	Dependent variable:
	Total Debt (Logged)
Constant	6.66
	(0.03)
Level-Two Variation	
τ_0 Intercept SD	1.9
Level-One Variation	
σ Residual SD	4.16
Number of Groups (Individuals)	7523
Number of Observations (Measurements)	29397
Deviance	171642.67
Note:	Source: NLSY97

Research Question #1

▶ RQ #1: How much of the variance in debt is attributable to between-individual and within-individual differences?

▶ The intraclass correlation coefficient (ICC) for the null model is 0.17

▶ 17% of the variation in total debt is attributable to *between*-individual differences

Model Formulation

Level 1:

$$Debt_{ij} = \beta_{0j} + \beta_{1j}Time_{ij} + \beta_2 Time_{ij}^2 + \beta_3 Age_{ij} + \beta_4 Education_{ij} + \beta_5 Income_{ij} + \beta_6 Assets_{ij} + \beta_7 Married_{ij} + \beta_8 NumChildren_{ij} + \beta_9 HasDebt_{ij} + r_{ij}$$

Level 2:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}ParentNetWorth_j + \gamma_{02}ParentEducation_j + \gamma_{03}ParentIncome_j + \gamma_{04}Sex_j + \gamma_{05-07}Race_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}ParentNetWorth_j$$

Where

$$r_{ij} \sim \mathsf{N}(0,\sigma^2) \text{ and } \begin{pmatrix} u_{0j} \\ u_{1j} \end{pmatrix} \sim \mathsf{MVN}\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \tau_0^2 & \tau_{01} \\ \tau_{10} & \tau_1^2 \end{pmatrix} \right)$$

Table 3: Descriptive Statistics, N=(7523)

Variable	Mean	StdDev	Min.	Max.
Debt 20 ($)	6781.54	14002.61	0	348000
Debt 25 ($)	20790.9	33268.37	0	562400
Debt 30 ($)	30661.7	50337.31	0	525400
Debt 35 ($)	32762.7	52892.59	0	488400
Debt 40 ($)	34523.43	55955.56	0	436600
Parent Net Worth ($1000s)	178.56	244.72	-1814.39	1164
Parent Income ($1000s)	88.58	72.86	0	478.16
Parent Education	13.15	2.98	1	20
Sex (1 = Female)	0.51		0	1
Non-Black / Non-Hispanic	0.54		0	1
Black	0.24		0	1
Hispanic	0.22		0	1
Multiracial (Non-Hispanic)	0.01		0	1
Age 20	20.12	0.63	19	24
Age 25	25.12	0.59	19	29
Age 30	30.52	0.73	30	34
Age 35	35.58	0.79	35	39
Age 40	40.47	0.5	40	41
Education 20	12.34	1.53	0	17
Education 25	13.39	2.52	1	20
Education 30	13.82	2.89	0	20
Education 35	14.07	3.01	0	20
Education 40	14.11	3.01	0	20
Income ($1000s) 20	93.48	97.63	0	703.68
Income ($1000s) 25	88.51	81.06	0	557.23
Income ($1000s) 30	94.33	77.9	0	596.36
Income ($1000s) 35	113.8	101.18	0	707.68
Income ($1000s) 40	129.44	128.26	0	707.68
Assets ($1000s) 20	31.16	60.68	0	1451.12
Assets ($1000s) 25	51.69	82.68	0	1109.6
Assets ($1000s) 30	77.32	115.12	0	1260
Assets ($1000s) 35	121.82	171.01	0	1188
Assets ($1000s) 40	176.68	214.08	0	1062
Married 20	0.08		0	1
Married 25	0.27		0	1
Married 30	0.43		0	1
Married 35	0.48		0	1
Married 40	0.51		0	1
# Children 20	0.24	0.56	0	5
# Children 25	0.69	1	0	8
# Children 30	1.24	1.29	0	9
# Children 35	1.61	1.39	0	12
# Children 40	1.38	1.23	0	7
Has Debt 20	0.52		0	1
Has Debt 25	0.78		0	1
Has Debt 30	0.76		0	1
Has Debt 35	0.74		0	1
Has Debt 40	0.69		0	1

Source: NLSY97. Among respondents reporting debt at least
once. Adjusted for inflation.

Table 3: Longitudinal Random Slope Model for Total Debt (Logged)

	Dependent variable:
	Total Debt (Logged)
$\gamma_{10} Time$	0.31
	(0.05)
$\beta_2 Time^2$	−0.06
	(0.005)
$\gamma_{01} ParentNetWorth (1000s)$	−0.0002
	(0.0001)
$\gamma_{02} ParentEducation$	−0.003
	(0.004)
$\gamma_{03} ParentIncome (\$1000s)$	0.0003
	(0.0002)
$\gamma_{04} Sex (Female = 1)$	0.02
	(0.02)
$\gamma_{05} Black$	−0.08
	(0.02)
$\gamma_{06} Hispanic$	−0.09
	(0.02)
$\gamma_{07} Multiracial (Non-Hispanic)$	0.06
	(0.09)
$\beta_3 Age$	0.01
	(0.01)
$\beta_4 Education$	0.13
	(0.004)
$\beta_5 Income (\$1000s)$	0.0004
	(0.0001)
$\beta_6 Assets (\$1000s)$	0.001
	(0.0001)
$\beta_7 Married$	0.31
	(0.02)
$\beta_8 Children$	−0.03
	(0.01)
$\beta_9 HasDebt$	9.06
	(0.02)
$\gamma_{11} Time : ParentNetWorth$	−0.0001
	(0.0000)
Constant	−2.14
	(0.20)

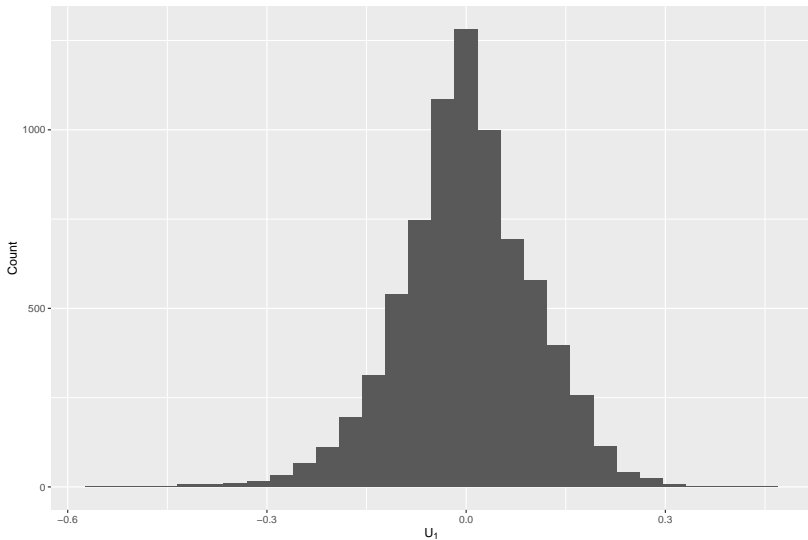| *Level-Two Variation*	
τ_0 Intercept SD	0.4
τ_1 Slope SD	0.19
τ_{01} Intercept Slope Correlation	0
Level-One Variation	
σ Residual SD	1.06
Number of Groups (Individuals)	7523
Number of Observations (Measurements)	29397
Deviance	92600.4

Note:	Source: NLSY97

Model Assumptions

Figure 1. Distribution of U_0
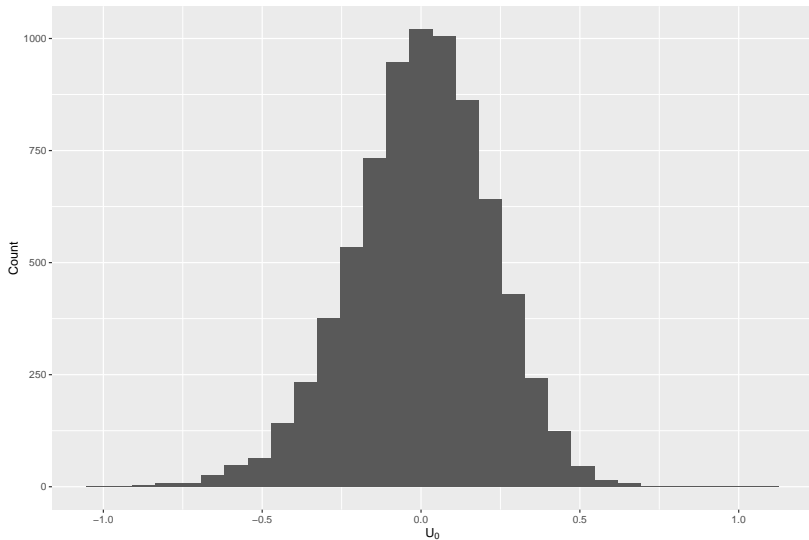
Model Assumptions

Figure 2. Distribution of U_1

Research Question #2

▶ RQ #2: What is the association between debt and time?
▶ $\gamma_{10} = 0.31288$ (p < 0.001)
  ▶ Time is significantly associated with total debt
  ▶ The average growth rate of total debt across each measurement occasion (5 years) is 31%
▶ $\beta_2 = -0.0623$ (p < 0.001)
  ▶ Time^2 is significantly associated with total debt
  ▶ On average, the growth rate of total debt is *decelerating*

Research Question #2

- Likelihood Ratio Test, AIC, and BIC all prefer the model with random slope for time
  - There is significant variation in the growth rate of debt
- $\tau_1 = 0.19$
  - For 95% of individuals, the growth rate of debt varies by $\tau_1 * 4 = 76\%$
- $\tau_{01} = 0.00375$
  - There is no correlation between initial debt levels and the rate of growth

Research Question #3

▶ RQ #3: What is the association between parental net worth and initial debt levels and debt trajectories?

▶ $\gamma_{01} = -1.6 \times 10^{-4}$ (p < 0.01)
  ▶ An increase of $1,000 in parental net worth decreases initial debt levels by 0.016%
    OR
  ▶ An increase of $100,000 in parental net worth decreases initial debt levels by 1.63%

▶ $\gamma_{11} = -7.8 \times 10^{-5}$ (p < 0.001)
  ▶ An increase in parental net worth decreases the growth rate of total debt

▶ While statistically significant, these associations are not *practically* significant

Limitations

▶ A mixture model (e.g., zero-inflated model) would better handle respondents with $0 debt

▶ Multilevel packages in R like `lme4` don't include options for specifying survey design and the `survey` package doesn't include options for multilevel modeling

▶ NLSY97 poorly measures sex/gender and race

Conclusion

- Among Millennials...
  - Most of the variation in debt comes from within individuals rather than between individuals
  - Debt significantly increases over time, although the increase diminishes
  - Individuals experience varied trajectories of debt growth
  - Parental net worth does not meaningfully impact debt

References

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Thank You!

https://github.com/ethanphilipweiland/millennial-debt