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Mental Health Across the Life Course and Across Cohorts in Taiwan: The Impacts of Education, Adult Children's Education, and Economic Hardship

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ABSTRACT

Whether mental health diverges or converges across levels of education with age and whether this relationship exist in non-Western societies are much less known. This study consequently elaborates the temporal education-depression patterns on the Taiwanese middle-aged and elderly population and examines the effects of adult children's education and of economic hardship on these patterns. Using the latent growth curve model with aging vectors techniques of the longitudinal data from the 1989-2003 Survey of Health and Living Status of the Elderly in Taiwan, the preliminary findings suggest: First, the effects of education on depression in Taiwan strengthen across age, with the adjustment of physical health. Second, the highly educated middle-age cohorts have lower depression than their older cohorts counterparts. Third, economic hardship mediates the effects of education on the initial level of depression. Fourth, the strength of educational impacts is stronger among people with higher levels of economic hardship.

Keywords: Education; Depression; Aging; Cohort; Economic Hardship; Taiwan

INTRODUCTION

A tremendous body of literatures has demonstrated that the relationships between education and physical health and mortality vary across the life course or across birth cohorts in Western societies. Nevertheless, whether these temporal patterns extended to mental health (Miech and Shanahan 2000) and exist in non-Western societies (Beckett et al. 2002) are much less known. This study consequently elaborates the temporal education-depression patterns on the population of the middle-aged and elderly Taiwanese to complement the existing studies based on Western countries and to enrich the literatures of how social factors influence individual well-being.

As a setting of such a study, the middle-aged and elderly Taiwanese population provides a variety of intriguing and worthy assessing properties. To begin with, Taiwan is a society that has undergone dramatic social change over the last century, including rapid education transformation. The elderly that have been born before middle 1930s are either the so-called Taiwanese ethnic groups that would have been school-aged during Japan Colonial Period (1895-1945), when there were easily accessible elementary education but limited upper-level schooling, or the so-called Mainlanders ethnic group that received Chinese education and who migrated to Taiwan after Chinese Civil War in 1949, who were mainly well-educated civil officers or low-educated soldiers of the National Party Government. On the other hand, the middle-aged Taiwanese who have been born after the middle 1930s generally have higher levels of education due to the increasing number of education institutions after World War Two (Hsieh et al. 1999; Tsurumi 1977). As a result, whether years of education is an essential social status that differentiates inequality

in mental health in Taiwan and whether educational effects on depression vary across cohorts are unexplored questions that needed be unveiled.

Subsequently, Taiwan is a society characteristic of higher levels of family cohesion and intergenerational transfers. It is common that adult children substantially involve in the lives of their elderly parents. As a result, whether adult children's education is associated with health of the elderly becomes a key issue in the collectivist Taiwan. Two studies have empirically accessed this statement and demonstrated that adult children's education predict the severity of limitations and have stronger effects on mortality for those older adults with a serious disease (Zimmer, Hermalin, and Lin 2002; Zimmer et al. 2007). However, whether adult children's education influence their parent's mental health have not been investigated.

Third, since Taiwan is a society that has experienced rapid economic growth, as indicated by that per capita gross national product (GNP) has increased from 145 USD in 1951 to 16,098 USD in 2006 (Executive Yuan 2000, 2007), whether economic factors attenuate the effects of education on mental health becomes an essential question. This study hence investigates whether the education-depression patterns are explained by economic hardship, asserts the well educated have better emotional well-being because they are less likely to exposure to stressors associated with economic hardship (Ross and Van Willigen 1997; Schieman, van Gundy, and Taylor 2001), and whether the strength of this association depends economic hardship, with the examination of two theories, including *the resource substitution hypothesis* that proposes education's influence on depression is greater for individuals with limited alternative resources in economic resources than it is for their counterparts with more resources, and *the resource*

multiplication hypothesis that asserts the effect of education on depression is greater for the more advantaged (Mirowsky and Ross 2003a; Ross and Mirowsky 2006).

This study utilizes the latent growth curve model (LGM) with aging vectors techniques (Mirowsky and Kim 2007; Mirowsky and Ross 2007) on data drawn from the longitudinal *1989, 1993, 1996, 1999, and 2003 Survey of Health and Living Status of the Middle-Aged and Elderly in Taiwan* to delineate both aging and cohort effects on the relationship between education and depression. In particular, aging vector model is an innovative method that enables this study to investigate whether the origins and slopes of change of depression stratified by levels of education during the follow-up period as functions of age at the time and to capture and reveal inter-cohort trends. This analytical approach facilitates the distinction between aging and cohort effects in the temporal education-depression pattern. Moreover, it enables to visualize whether the temporal pattern eliminates or augments with the adjustment of other factors and whether the strength of the pattern is contingent on these factors.

THEORETICAL BACKGROUND

Education and Health in Taiwan

The association between education and health in Taiwan has progressively merited more attention in sociological and demographic studies. Previous research has pointed out that education advantages several health domains of Taiwanese elders, including the initial level of morbidity, disability, functional limitation, self-reported health, and the avoidance of adverse health transition over time (Beckett et al. 2002; Tung and Mutran 2005; Zimmer, Hermalin, and Lin 2002; Zimmer et al. 1998; Zimmer, Martin, and Chang

2002). Additionally, education is associated with lower relatively risks of dying (Liu, Hermalin, and Chuang 1998; Zimmer, Martin, and Lin 2005) and with higher levels of "allostatic load"—an index of cumulative risk that measures chronic fluctuation on physiological system (Weinstein et al. 2003). The impacts of education on mental health in Taiwan are less discussed yet still manifested (Wang 2005; Yeager et al. 2006) although most depression studies center on the impacts of social relationships (Cornman et al. 2003; Cornman et al. 2004; Weinstein et al. 2004).

Although empirical research has demonstrated that declining mortality leads to compression of disability in Taiwan (Tu and Chen 1994), whether this temporal health pattern differs across levels of education is still blurred. This study proposes that educational impacts on mental health vary across the life course and across cohorts in Taiwan. In the life course perspective, education has been deeply accredited as the most equitable and efficient way to improve upward social mobility and to acquire highly ranked occupations or elevated social prestige (Hsieh et al. 1999; Tsurumi 1977). It would be no surprise that the impacts of education on social hierarchy eventually accumulate health-fostering resources, producing a diverging educational-based inequality in health across age. Instead, whether the magnitude of educational impacts on health in Taiwan is as substantial as those found in U.S. is a mystery. Educational impacts in Taiwan may not be as dominant as those in U.S. The disadvantage that poor-educated Taiwanese encounter may be offset by other factors related to social network characteristics in the collective Taiwan society. For instance, among Taiwanese elderly, their own educational attainment actually has smaller effects than their adult child's in

predicting severity of physical limitation over time (Zimmer, Hermalin, and Lin 2002). Family factors thus moderate the extent of educational impacts among Taiwanese elderly.

Subsequently, rapid social transformation suggests that social circumstances and life experiences differ tremendously across cohorts in Taiwan. As discussed earlier, in an educational aspect, education's distribution and content have changed dramatically over the last 60 years. For instance, the proportion of population aged 15 and over receiving at least junior college degree has expanded from 5.5% to 24.4% between 1970 and 2000 (Executive Yuan 2000). Demographically, crude birth rate (‰) has dropped from 25.93 in 1976 to 9.06 in 2005. Life expectancy for males and females has improved from 57.4 and 60.3 in 1952 to 75.6 and 80.8 in 2006, respectively. In addition, the influx of about 1.5 Mainlanders came to Taiwan from Mainland China when the Nationalist army lost the Chinese Civil War in 1949. This immigration arrival had changed the demographic structure in Taiwan, since mainlanders were overwhelmingly male and served as government officials or soldiers. Mainlanders represent as the cohort who had received Chinese education and had spent their early adult lives under war conditions, in contrast to their Taiwanese counterparts who had received Japanese education in a relatively stable Japan colonial period and had needed to adjust to the totally different political and social system after World War Two (Executive Yuan 2007; Luoh 2001). Taiwan has also been transformed from an agricultural economy to an affluent and industrial one. Per capita gross national product (GNP) has increased from 145 USD in 1951 to 16,098 USD in 2006. The percentage of the labor force in agriculture has plummeted from 55.5% in 1956 to 8.5% in 2000 (Executive Yuan 2000, 2007). The strong medical and health care system has been established, marked by the National Health Insurance (NHI) launched in

1995, a comprehensive medical service for the total Taiwanese population (Bureau of National Health Insurance 2006). As well, infectious diseases have almost been eradicated and chronic diseases such as malignant neoplasms has became the leading cause of death (Executive Yuan 2007).

Under such circumstances, it is highly plausible that educational impacts on health vary across cohorts in Taiwan. In particular, older Taiwanese cohorts may live in times with huge social change, political turmoil, material deprivation, and prevalent unpreventable causes of death. According to the epidemiologic transition theory and the fundamental cause theory discussed earlier (Omran 1971; Phelan et al. 2004), the rate of educational divergence in health tends to be smaller in the society with above characteristics. Likewise, younger Taiwanese cohorts live in an age of stable social environment, affluent economy, accessible medical technology, advanced health knowledge, and highly preventable major causes of death. The rate of educational diverge in health hence grows more quickly.

Education, Economic Hardship, and Depression

Research over the last decade has effectively explained the pattern between education and depression via the incorporation of mediators (Turner and Lloyd 1999). In other words, what the mechanisms by which education affects psychological well-being and whether education's effect extend beyond these mechanisms are well investigated (Miech and Shanahan 2000; Ross and Van Willigen 1997). Among these mechanisms, the economic mediators are major linkages that influence the effects of education on health

in the Taiwanese elderly population (Beckett et al. 2002; Liu, Hermalin, and Chuang 1998; Zimmer, Martin, and Chang 2002).

The Impacts of Economic Hardship

Education structures economic insufficiency, which in turn influences variations in exposure to stressful circumstances or chronic stressors (Miech and Shanahan 2000; Turner, Wheaton, and Lloyd 1995). In other words, the well educated tend to have better psychological well-being because they are less likely to be associated with economic hardship, unemployment, lower income, and lower occupational class (Ross and Van Willigen 1997). The lack of economic resources not only causes material deprivation but also diminishes the problem-coping resources such as the sense of control, both of which increases psychological distress (Mirowsky and Ross 2003b). Among those economic factors associated with education, economic hardship—difficulty paying bills or meeting the household needs for food, clothing, shelter, or medical care—is the prominent one affecting mental health. Economic hardship is the day-to-day struggle to meet basic human needs. It reflects whether people recurrently engage in chronic stressors that affect their mental health intensely (Aneshensel 1992). In fact, economic hardship mediates the substantial part of the effects of income or earnings on depression or physical health. Once needs are met or hardships are solved, the increments of other economic resources display diminishing effects on health (Mirowsky and Hu 1996; Ross and Huber 1985). Moreover, the effects of temporal category of economic hardship on depression have gradually been discussed. Research has indicated that persistent or new economic hardship over survey periods affect depression, but not resolved economic hardship

(Mirowsky and Ross 2001). However, whether the education-depression pattern is contingent on the temporal pattern of economic hardship remains unexamined.

Resource Substitution or Resource Multiplication

Whether the strength of the association between education and depression depends on economic hardship is a latest research interest in health studies (Kim 2006; Ross and Mirowsky 2006). This study hence explores whether the disadvantage in economic resources influences the strength of education-depression associations in Taiwan by examining two competing theories—resource substitution or resource multiplication?

In general, resource substitution refers to the phenomenon that people with more resources are less dependent on the presence of any specific resource for their psychological well-being. In other words, if a certain resource is absent, people with more resources can utilize other alternative resources to replace that lost resource. Conversely, people with the fewest resources are most dependent on any one resource they have for their psychological well-being. The absence of any resource makes their life more critical since they have no other ones to substitute (Mirowsky and Ross 2003a).

Two characteristics make education a particular resource that effectively substitutes other absent resources. First, education instills people human capital—the general ability to learn, think, and meet situations effectively. Second, a person's education is part of the person and inalienable. It is not like the external SES status such as income or a job, which can be taken away (Mirowsky and Ross 1998; Ross and Mirowsky 2006). Education's effect exists in every stage of the life course and is able to substitute other external resources. For instance, elderly people tend to suffer from the loss of economic

resources due to retirement. The presence of education probably makes the absence of these resources less deleterious (Miech and Shanahan 2000; Schieman, van Gundy, and Taylor 2001). In sum, the resource substitution theory predicts that education's effects are greater for people with disadvantage status (Ross and Mirowsky 2006).

In contrast to the resource substitution theory, the resources multiplication theory proposes that the multiple resources of the advantaged group multiply each other to perpetuate and augment their benefits. For instance, people from privileged backgrounds tend to enter the college with highly prestige, which eventually reproducing social inequality. Thus, certain resources have stronger effects on health in advantaged group (Ross and Mirowsky 2006).

Accordingly, elderly who are advantaged in economic resources have greater emotional benefits from education. These different types of resources reinforce each other. This situation implies that education's benefits for well-being are less for elderly with higher economic hardship than those for their counterparts. In sum, resource multiplication implies that people with disadvantaged status gain less psychological benefits from education.

Research Hypotheses

Taken together, this research examines the following core sets of hypotheses.

Hypothesis 1: the educational-based gap in depression increases with age within each cohort, with the adjustment of physical impairment.

Hypothesis 2: among the people with higher education, younger cohorts have lower depression than their older cohorts counterparts at any given age.

Hypothesis 3: adult children's education is inversely associated with depression.

Hypothesis 4: the disadvantage status in economic resources mediates the effects of education on the level and slope of depression.

Hypothesis 5: the effects of education are stronger among persons with higher levels of disadvantage status, consistent with the resource substitution view.

Hypothesis 6: the effects of education are stronger among persons with advantage statuses, consistent with the resource multiplication view.

MEHODS AND DATA

This research adopts LGM models with aging-vector techniques developed by Mirowsky and Kim (2007) to study depression, with the utilization of the 1989, 1993, 1996, 1999, and 2003 Survey of Health and Living Status of the Elderly in Taiwan.

Aging Vector Model

Aging vector models can be regarded as a multi-level latent growth model estimating the origins and slopes of changes during the follow-up period as function of age at the time. In other words, aging vectors illustrate the outcome's (depression in this sample) life course trajectory. The basic aging-vector structural equation model has three sets of equations: within-person vector equations, between-person structural equations, and measurement equations. Figure 1 illustrates the most complex form, which corresponds to the following sets of equations.

<Figure 1 around here>

1) Basic Model

A. Within-Person Equations

Equation (1) describes the depression outcome *D* for person *i* at time *t* is a linear function of time plus an error term e_{it} that is random with respect to time. a_{i0} and a_{i1} represent the origin level of predicted depression at the wave designated at time zero and slope of predicted depression over the follow-up period.

$$D_{it} = a_{i0} + a_{i1}t + e_{it} \quad (1)$$

The most important characteristic of Equation (1) is that it analyzes changes with respect to time rather than age. It means that the within-person equation indicates the effect of aging *t* years rather than the effect of the age differences at different times of interviews. This approach allows age at baseline or mid-follow-up to appear in the between-person model. Hence the effects of aging *t* years depend on age at the time of the study.

Equation (2) demonstrates that time (*t*) can be measured as the difference between the calendar year of the survey wave and the calendar year of the wave designated at time zero, which equals the difference between age at the time of an observation and age in the reference year.

$$t = S_t - S_0 = A_{it} - A_{i0} \quad (2)$$

Taken together, this model demonstrates two latent factors, the level and slope in depression. The level factor has a fixed 1.0 effect on the depression level reported in five waves. It means that it contributes the same level of depression in these five surveys. The slope factor has fixed effects that centers on the middle of the follow-up survey periods, which measures time as a deviation from the middle of the follow-up period. It means the

0 year of change in 1996, less 7 and 3 years in 1989 and 1993, and by 3 and 7 years in 1999 and 2003, respectively.

B. Between-Person Equations

Equation (3) predict the individual's origin of depression are functions of age at time zero (A_{io}) centered on a reference age 70 (linear, squared or cubic terms), of education centered on 6 education years (negative sign means education decreases depression), of adjusted covariates (such as female, Mainlander, and physical impairment, etc.), and of individual random deviations u_{io} from the expected value, describing cumulative effects up to that wave. Equation (4) describes subsequent change over the period depends on these effects and a residual $u_{i1,}$ with the adjustment for the accumulation of the effects.

$$a_{io} = a_{00} - a_{01}(E-6) + a_{02}(A_{i0}-70) - a_{03}\left(A_{io}-70\right)^2 + a_{0c}ControlVar + u_{io} \quad (3)$$

$$a_{i1} = a_{10} - a_{11}(E-6) + a_{12}(A_{i0}-70) + a_{13}(A_{i0}-70)^2 - a_{14}(A_{i0}-70)^3 + a_{1c}ControlVar + u_{i1} \quad (4)$$

Furthermore, Equation (5) clarifies age at time zero (A_{i0}) is the difference between the calendar year of the survey at time zero (S_0) and the individual's birth year (B_i), representing the confounding relationship between age, cohort, and period. It means that the reference age A_{i0} in equations (3) and (4) is the age in year S_0 (the reference year t = 0) of a reference cohort. In other words, age at time zero can also represent cohort. For instance, persons age 70 in the survey year 1994 are all born in 1924.

$$A_{i0} = S_0 - B_i \quad (5)$$

C. Measurement Equations

This set of equations represents the relationship between latent factors of depression and its observed indicators, describing the scores on subscales of mood and malaise as linear functions of the latent depression. Equation (6) has an intercept fixed to zero and a slope fixed to 1, setting the metric of the latent factor to that of the mood subscale. Equation (7) describes the effect on mood over malaise. The slope (the "1*" loading in the Figure 1) means that malaise will move up or down in parallel with mood but by a proportional amount that may be larger or smaller than 1.0.

$$D_{mood_{it}} = D_{it} + e_{D_{mood\_it}} \tag{6}$$

$$D_{malaise_{it}} = \lambda_0 + \lambda_1 D_{it} + e_{D_{mailaise-it}} \tag{7}$$

2) Diverge/Converge Model

In order to examine whether the impacts of education on depression increases with age, the interaction term between education and age is added into both between-person equations.

$$\begin{aligned} a_{io} = {} & a_{00} - a_{01}(E-6) + a_{02}(A_{i0}-70) - a_{03}\left(A_{io}-70\right)^2 \\ & \pm a_{04}(E-6)\times(A_{io}-70) + a_{0c}ControlVar + u_{io} \end{aligned} \tag{8}$$

$$\begin{aligned} a_{i1} = {} & a_{10} - a_{11}(E-6) + a_{12}(A_{i0}-70) + a_{13}(A_{i0}-70)^2 - a_{14}(A_{i0}-70)^3 \\ & \pm a_{15}(E-6)\times(A_{io}-70) + a_{1c}ControlVar + u_{i1} \end{aligned} \tag{9}$$

The negative sign of the interaction term indicates that the effects of education on depression level or slope increases with age, suggesting divergence in depression; the positive sign means that the effects of education on depression level or slope decreases with age, suggesting convergence in depression; the insignificant term shows the effects of education on decreasing depression level or slope are the same in all age groups.

3) Resource Substitution/Multiplication Model

The following between-person equation models add various disadvantage status (in economic resources or social relationships). The comparison between coefficients of education in the models without and with these disadvantage status demonstrates whether educational effects on either depression level or slope are mediated by these disadvantage status.

Furthermore, the interaction term between education and disadvantaged status is added into the model to examine whether the strength of education-depression association is contingent on disadvantage status. The negative sign of interaction term indicates that the effects of education on depression level or slope are greater for those with certain disadvantage status or having higher level in that certain disadvantage, supporting the resource substitution theory; the positive sign indicates that the effects of education on depression level or slope are smaller for those with certain disadvantage status or with higher level in that certain disadvantage, supporting the resource multiplication theory; and insignificant sign indicates that the effects of education are the same in all status groups.

$$a_{io} = a_{00} - a_{01}(E-6) + a_{02}(A_{i0}-70) - a_{03}\left(A_{io}-70\right)^2 + a_{04}DS \pm a_{05}(E-6)\times DS + a_{0c}ControlVar + u_{io} \quad (10)$$

$$a_{i1} = a_{10} - a_{11}(E-6) + a_{12}(A_{i0}-70) + a_{13}(A_{i0}-70)^2 - a_{14}(A_{i0}-70)^3 + a_{15}DS \pm a_{16}(E-6)\times DS + a_{1c}ControlVar + u_{i1} \quad (11)$$

Sample

The analyses are based on *The Survey of Health and Living Status of the Middle Aged and Elderly in Taiwan*, a face-to-face survey with a national representative sample of middle aged and elderly residing in non-aboriginal areas of Taiwan, including those in institutions such as nursing homes or long-term hospitals. The surveys are conducted jointly by the Bureau of Health Promotion of the Department of Health, Taiwan, and by various institutions at the University of Michigan, Georgetown University, and Princeton University. The multi-stage equal probability sampling is utilized. The primary sampling unit was townships, while blocks in the selected townships served as clusters in the second stage. Each stage was selected proportional to size. Finally, two elderly were selected randomly from each selected block.

Two samples are incorporated into this dataset. The first one includes 4,049 respondents aged over 60 in 1989 with the response rate of 91.8%. Follow-up interviews were undertaken in 1993, 1996, 1999, and 2003 with the sample sizes of 3,155, 2,669, 2,310, and 1,743, respectively. The second one includes 2,462 respondents aged 50 to 66 in 1996 with the response rate of 81.2%. Follow-up interviews were undertaken in 1999 and 2003 with the sample sizes of 2,130 and 2,035, respectively. Because age is an independent variable in all of the models, the oversample problem resulted from different age structures and sizes between these two samples does not bias results (Winship and Radbill 1994).

Furthermore, this research estimates the model using all available data and corrects for data missing because or nonresponse or attrition via Full-Information Maximum Likelihood (FIML) procedure executed in the AMOS Structure Equation Modeling program. FIML is an estimating approach that uses all available data regardless of their

status in the follow-up interviews (Wothke 2000) and correct for data "missing at ransom" (MAR), assuming that the structural relationships vary only randomly across groups defined by missing data patterns, and the absence of values depend upon a combination of random change and tendencies predictable form all observed data (Mirowsky and Ross 2007; Singer and Willett 2003). Aging-vector models estimated with FIML procedures considerably lessen attrition bias and provide more accurate estimation than common approaches such as listwise deletion, pairwise deletion, and mean-imputation (Mirowsky and Kim 2007).

Measurement

Depression is measured by two sets of indicators: depressed mood and malaise. Questions of these two indicators are drawn from the Center for Epidemiological Studies-Depression Scale (CES-D). *Depressed Mood* averages the scores of four items, "In the past year, have you experienced the following situations or feelings?" (1) "felt you were in a terrible mood," (2) "felt lonely," (3) "felt people around you were not nice to you," and (4) "felt anguished." Responses include "rarely", "sometimes", "often", and "chronically" (coded as 0 to 3). The alpha reliability of the index in four waves are .71, .80, .78, .82, and.76, respectively. *Malaise* averages the scores of four items, "In the past year, have you experienced the following situations or feelings?" (1) "not interested in eating, had a poor appetite," (2) "felt that doing anything was exhausting," (3) "sleep poorly," and (4) "unable to gather your energy to do things." Responses include "rarely", "sometimes", "often", and "chronically" (coded as 0 to 3). The alpha reliability of the index in four waves are .69, .73, 78, .78, and .73, respectively.

Education is scored in number of highest level of schooling. Respondents who attended graduate schools are counted as 19. Respondents who did not receive formal education but report "literate" are counted as 3. Education is centered at a deviation from 6 years, which is a suitable division in terms of lower average of education years among Taiwanese elderly.

Age is measured in number of years in 1995 and centered as a deviation from age 70.

Among control variables, *Female* is a dummy variable comparing females (1) with males (0). *Mainlander* is a dummy variable comparing Mainlanders (1) and other ethnic groups (0). *Baseline Physical Impairment* is measured according to responses to six questions regarding the ability to perform general physical movements that might be necessary for conducting daily tasks: taking a bath, walking, crouching, climbing stairs, reaching up over head, and grasping with fingers. Responses are "no problem", "some difficulty", "very difficult", and "cannot do it" (coded as 0 to 3). The physical impairment index is the mean response.

Economic Hardship is assessed by asking respondents, "do you (and your spouse) have enough money or any difficulty meeting monthly living expenses or other expenditures?" Responses ranged from "enough money and with some left over", "just enough money and with no difficulty", "with some difficulty", and "with much difficulty" (coded as 1 to 4).

PRELIMINARY FINDINGS

Table 1 reports the results from the selected models to sketch preliminary findings of this research. Only significant paths are included in these models. All of them fit the

observed data well with the comparative fit indexes (CFI) over .990 and the root mean square of the analysis below .018. Figure 2 to Figure 4 illustrate the vectors predicted by these models and demonstrate a clear pattern of life course growth and decline in depression.

Figure 2 illustrates the vectors predicted by model 1 in Table 1. Each arrow represents the depression trajectory predicted at wave designated as time zero and the change predicted over the fourteen-year follow-up for persons of the same age, with arrows drawn for every seventh one-year birth cohort. Two major phenomena are revealed. First, depression increases with age slightly in the middle adulthood. Then, after the early 70s, depression increases steeply with age. Second, the vertical displacement between adjoining arrows manifests a favorable trend toward lower levels of depression across cohorts in middle-aged groups but an unfavorable trend across cohorts in age groups after age 80. The seven-year vectors are derived from the original fourteen-year vectors and to display clear disjunction across cohorts. For instance, the predicted depression at age 60.5 is somewhat lower for individuals who were born in 1939 (those aged 57 in 1996) than for those who were born in 1932 (those aged 64 in 1996). However, the predicted depression at age 81.5 is somewhat higher for individuals who were born in 1918 (those aged 78 in 1996) than for those who were born in 1911 (those aged 85 in 1996).

Model 4 examines the interaction term between education and depression. The negative and significant sign of this interaction term on the slope equation suggests the effect of education on the decline of depression increases with age, consistent with the cumulative advantage hypothesis. However, the insignificant sign of this interaction term

on depression level means the effects of education on depression level in 1996 are the same in all age groups. Figure 3 illustrates these results and displays clear divergence in depression that starts developing in the middle 60s. Moreover, it reflects education influences cohort variation in depression trends. Among the well-educated people, younger cohorts commonly report lower depression than their older cohorts counterparts. Depression even decreases in the late life. In contrast, among people with lower levels of education, younger cohorts commonly have higher depression levels than their older cohort counterparts. The lower panel of Figure 3 is the simplified 7-year vectors to emphasize divergence with the life course and disjunction across cohorts.

Model 5 displays that economic hardship mediates about 37% of educational effects on depression level (from -1.365 in Model 4 to -.864 in Model 5); while suppresses the effects of education on depression slope (from -.059 in Model 4 to -.079 in Model 5). Additionally, the negative sign of economic hardship on depression slope suggests that individuals adapt to economic hardship over time.

Model 6 examines whether the strength of education-depression associations is contingent on economic hardship. The negative and significant sign of this interaction term on depression level indicates that the effects of education on depression level are greater for persons with higher levels of economic hardship; while the insignificant sign on depression slope suggests that the effects of education are all the same in all status groups. Figure 4 indicates two phenomena. First, the beneficial educational effects emerge notably after people meet problems such as economic hardship. Among people with 16 education years, the rate of diminishing depression with age within each cohort is bigger for those with much economic hardship than those without economic hardship.

Second, the poor-educated elderly who suffer from much economic hardship are the depressed. Conversely, the well-educated elderly are more likely to adapt to economic hardship over time. Third, a favorable trend toward lower depression levels for younger cohorts appears among those with higher levels of education, while an unfavorable trend is found for those with lower levels of education.

PRELIMINARY DISCUSSION

The preliminary findings suggest that education manifests prevailing beneficial impacts on the level and the change in depression in Taiwan. These effects strengthen across the life course and mostly increases across cohorts. Moreover, the effects of education on depression still exist, with the adjustment of economic hardship. It seems that economic factors do not replace the unique factor of education in Taiwan. Meanwhile, the effects of education are stronger among people with higher levels of economic hardship, supporting the resource substitution theory. However, adult children's education has not yet been examined in the current version of this study but will be investigated in the follow-up analyses.

Figure 1: Path Diagram Representing the Full Structural Equation Model.

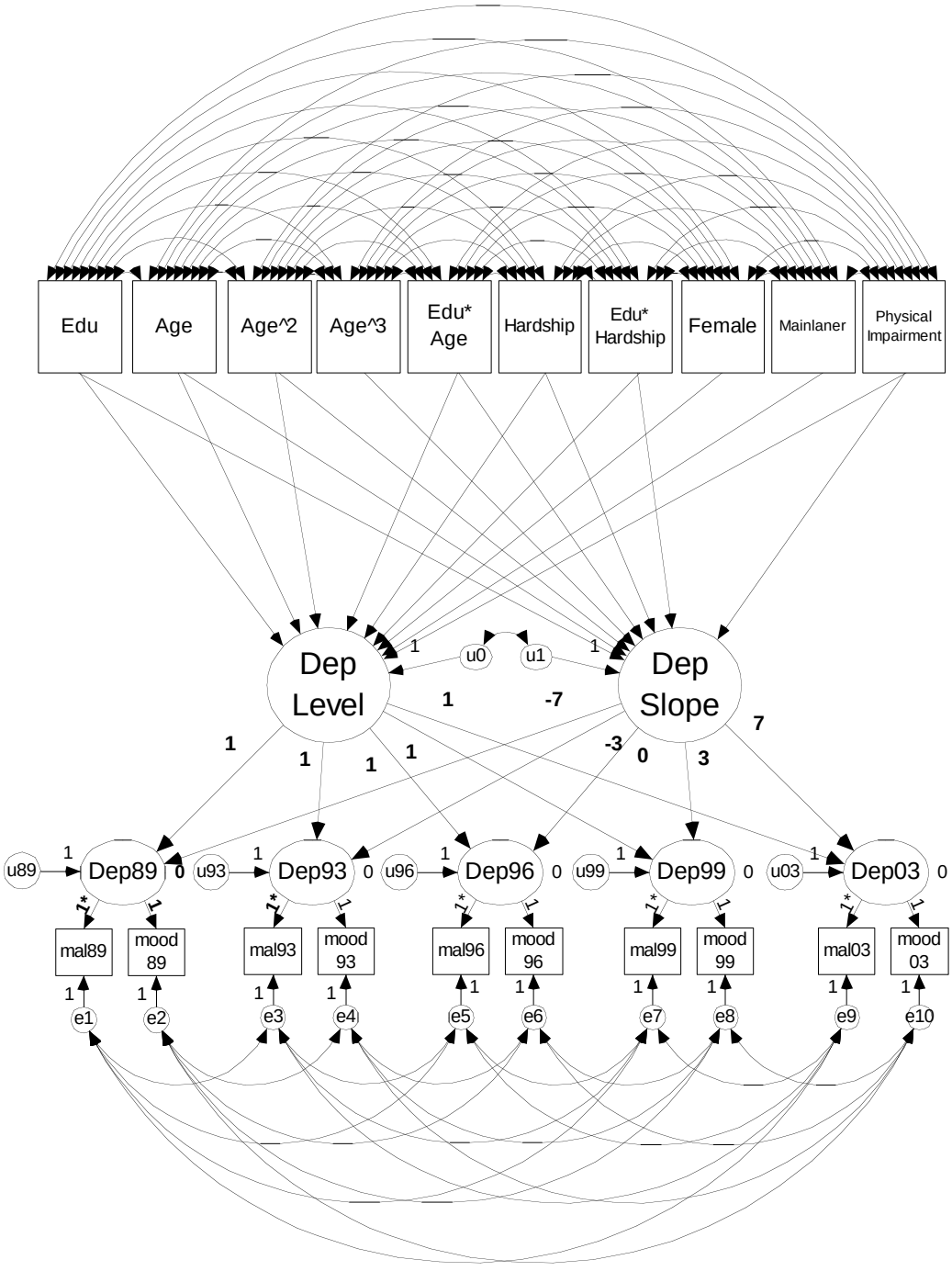


Table 1: Level and Slope in Depression Regressed on Education, Age, Economic Hardship, and Their Interaction Terms, Adjusting for Sex, Ethnicity, and Physical Impairment, based on a Multi-Indicator Structural Equation Model of Aging Vectors.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
LEVEL						
(Edu-6) x 10^{-2}		-1.448***	-1.224***	-1.365***	-.864***	
		(-11.987)	(-10.715)	(-11.945)	(-7.175)	
(Age-70) x 10^{-2}	.897***	.785***	.507***	.490***	.644***	.649***
	(17.745)	(15.843)	(10.793)	(10.473)	(13.154)	(13.344)
(Age-70) ^{2} x 10^{-2}	-.008*		-.015***	-.015***	-.013***	-.012**
	(-2.193)		(-4.167)	(-4.221)	(-3.483)	(-3.275)
Economic Hardship					.162***	.152***
					(22.619)	(20.153)
Educ. x Hardship [b]						-.784***
						(-8.349)
Female	.155***	.115***	.093***	.093***	.110***	.110***
	(15.368)	(11.325)	(9.712)	(9.749)	(11.115)	(11.253)
Mainlander	-.021+	.032*	.030*	.031*	.040**	.039**
	(-1.726)	(2.543)	(2.359)	(2.450)	(3.057)	(3.003)
Physical Impairment			.354***	.353***	.333***	.331***
			(34.217)	(34.220)	(32.862)	(32.632)
Intercept	.322***	.305***	.274***	.272***	.086***	.092***
	(37.497)	(39.055)	(32.048)	(31.866)	(7.239)	(7.724)
Residual Variance	.073***	.072***	.061***	.061***	.057***	.057***
	(21.436)	(22.362)	(24.239)	(24.278)	(22.718)	(22.622)
R^2	.166	.205	.461	.466	.554	.558
SLOPE						
(Edu-6) x 10^{-2}		-.053***	-.057***	-.059***	-.079***	-.076***
		(-3.602)	(-3.732)	(-3.808)	(-4.663)	(-4.523)
(Age-70) x 10^{-2}	.053***	.053***	.059***	.047***	.056***	.057***
	(4.402)	(4.237)	(4.603)	(3.553)	(3.930)	(4.039)
(Age-70) ^{2} x 10^{-2}	.002**	.002***	.003***	.002***	.002***	.002***
	(3.138)	(4.185)	(5.355)	(3.849)	(3.856)	(3.946)
(Age-70) ^{3} x 10^{-4}	-.008+	-.007+	-.008+	-.008+	-.011*	-.011*
	(-1.949)	(-1.694)	(-2.027)	(-1.871)	(-2.526)	(-2.508)
Education x Age [a]				-.006***	-.006***	-.006***
				(-4.088)	(-3.829)	(-3.517)
Economic Hardship					-.005***	-.005***
					(-4.827)	(-4.338)
Female	.003**					
	(2.605)					
Mainlander	-.004*					
	(-2.215)					
Physical Impairment			.008***	.007***	.008***	.008***
			(5.582)	(5.384)	(5.563)	(5.491)
Intercept	.005***	.004**	.004***	.004***	.010***	.009***
	(3.655)	(4.239)	(3.645)	(3.711)	(6.160)	(5.814)
Residual Variance	.001***	.001***	.001***	.001***	.001***	.001***
	(8.078)	(8.259)	(8.863)	(8.845)	(9.102)	(9.180)
R^2	.038	.047	.097	.105	.113	.109
FIT STATISTICS						
χ^2	134.706	159.688	199.655	205.776	303.658	328.567
df	60	71	78	87	95	105
CFI	.997	.997	.996	.996	.993	.994

NFI	.994	.994	.993	.993	.990	.992
RMSEA	.014	.014	.015	.014	.018	.018

Note: Metric coefficients with t-Values in parentheses. Full Information maximum-likelihood is used.
a. The Education-Age interaction is not significant in the level model; Education x Age is modeled as (Education-6) x (Age-70) x 10^{-2}.
b. The Education-Hardship interaction is not significant in the slope model. Education x Hardship is modeled as (Education - 6) x Hardship x 10^{-2}.
+p < .10; ** p < .05; ** p < .01; *** p <.001

Figure 2: Vector Graph of Predicted level and Slope of Depression for Every Seventh One-Year Cohort (Model 1 in Table 1). The Upper Panel is 14-Year Vector and the Lower Panel is Simplified 7-Year Vector.

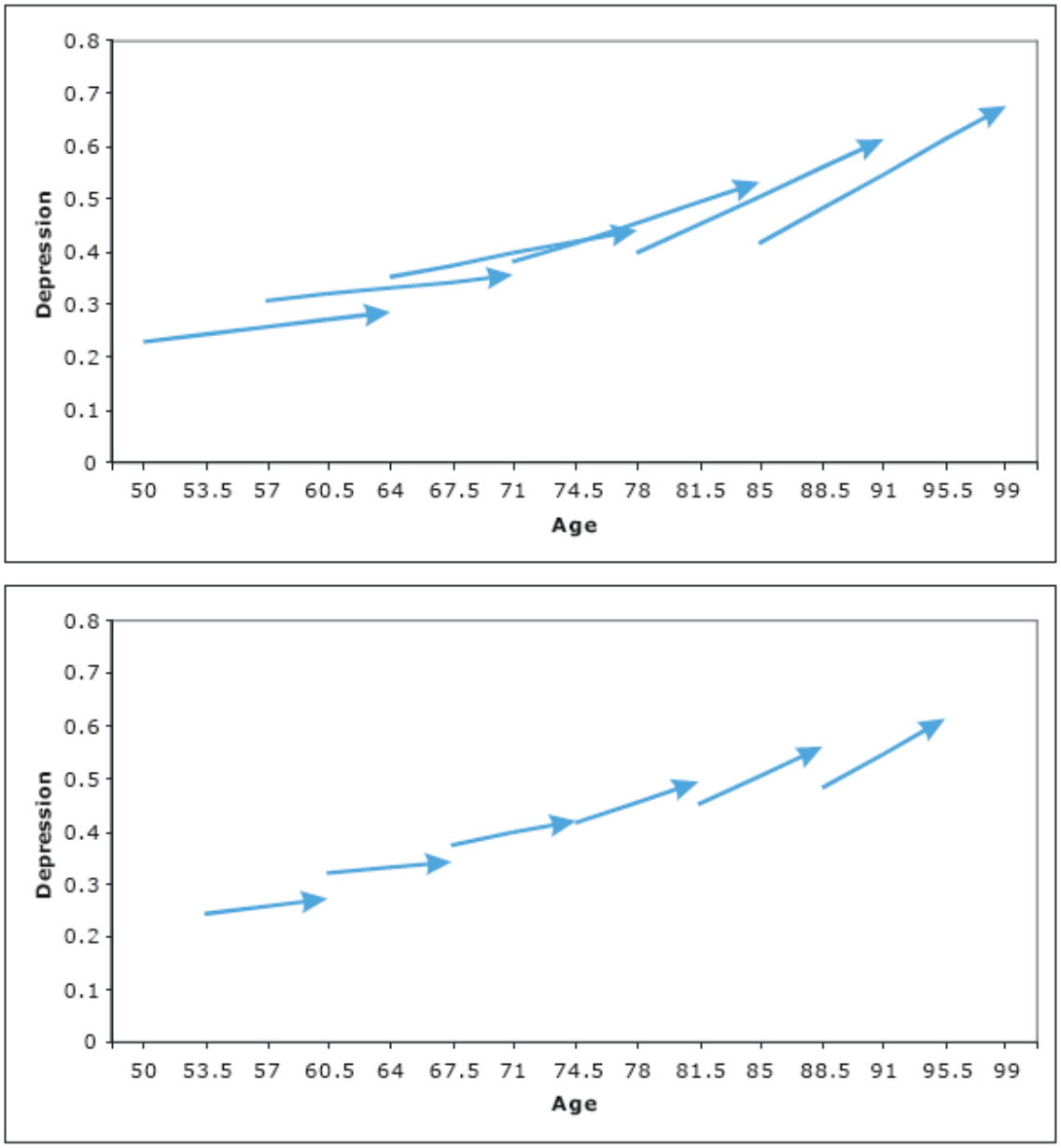


Figure 3: Vector Graph of Predicted level and Slope of Depression for Every Seventh One-Year Cohort by Levels of Education (Model 4 in Table 1). The Upper Panel is 14-Year Vector and the Lower Panel is Simplified 7-Year Vector.

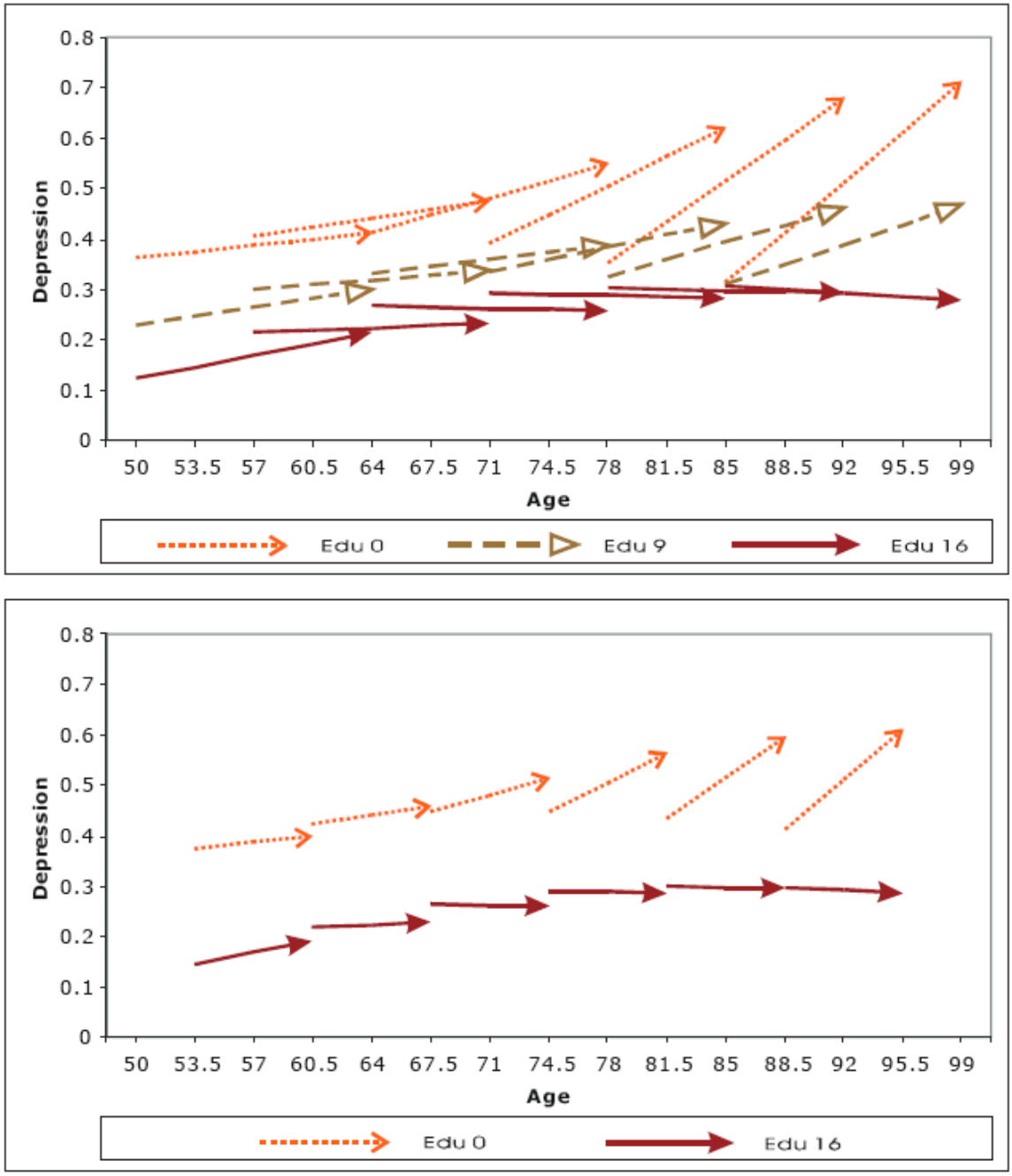
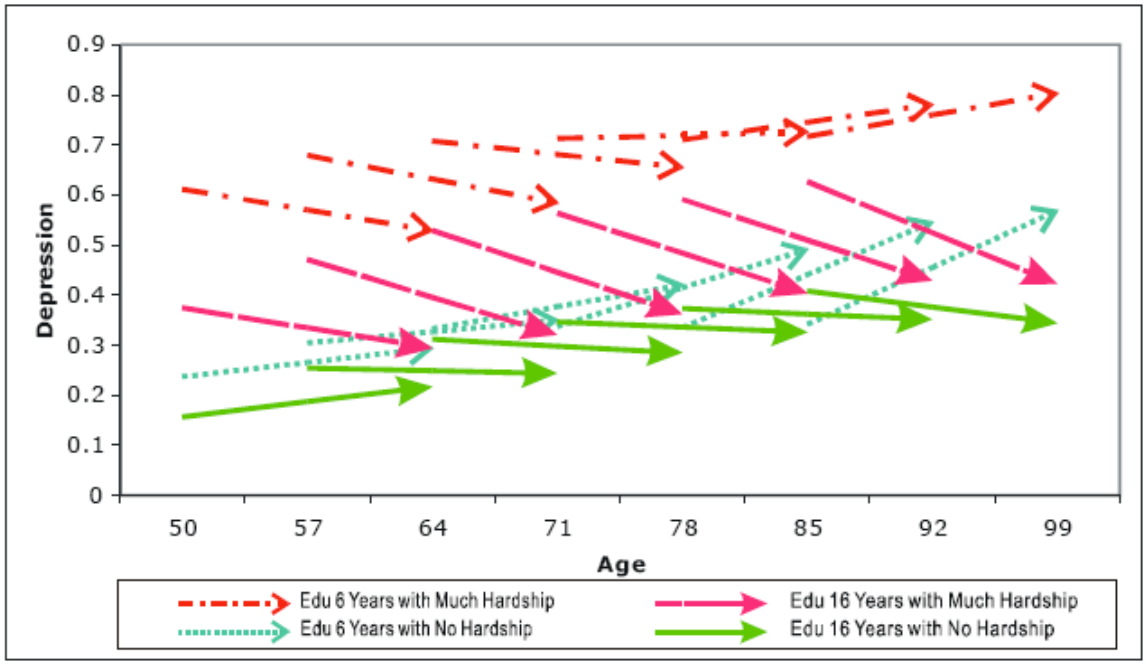


Figure 4: Vector Graph of Predicted level and Slope of Depression for Every Seventh One-Year Cohort by Two Levels of Education and Two Levels of Economic Hardship (Model 6 in Table 1).



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