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RESEARCH ARTICLE

## Role of Marital Dissolution in Mental Depression of Younger Adults: Evidence from the United States

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### ABSTRACT

**Objective:** The study uses data from the National Longitudinal Survey of Youth, 1997 to test the hypothesis that mental depression of younger adults during a given time is significantly related to whether they are the victims of marital dissolution. Although the literature examining the relationship between mental health and marital dissolution is quite vast, there are only a few studies that examine this relationship among younger adults. By following an appropriate two-stage procedure, this study for the first-time tests the hypothesis that both depression and divorce may influence each other simultaneously.

**Method:** Using two samples from the National Longitudinal Survey of Youth 1997 of the United States, the study first estimates depression equation by ordered probit. Recognizing the importance of both social causation and social selection theories, the study further estimates both depression and marital dissolution equations simultaneously.

**Results:** Both approaches just mentioned indicate a strong correlation between these two variables. Further estimation of the depression equation by an instrumental variable approach indicates that this relationship may result from a causal connection.

**Conclusion:** The study concludes that depression and divorce among younger adults are highly correlated and affect each other simultaneously during the same time. Evidence of the presence of a strong correlation and the possibility of a causal connection between divorce and depression clearly have important policy implications. Any policy to improve one is likely to have a favorable effect on the other and thus it deserves further attention of researchers and policy makers.

## 1. Introduction

In the presence of widespread mental depression among younger and older people in almost all countries of the world today, it has become a challenge for researchers in medical science as well as social science to find out the causes of such a devastating problem.<sup>5,6,14,25,27</sup> Mental depression has become one of the primary causes of excessive drug abuse, leading to untimely and unnatural death. To find a solution to this worldwide epidemic, researchers and policy makers of all lands currently are in active search of not only the causes, but also the cure for this problem. In fact, the World Health Organization (WHO) has already initiated a “*Comprehensive Mental Health Action Plan 2013-2020*” which was adopted by the 66<sup>th</sup> World Health Assembly (2013) at Geneva to promote mental health and prevent onslaught of mental health related problems.<sup>29</sup> The four major objectives of this action plan are to “(1) strengthen effective leadership and governance for mental health, (2) provide comprehensive, integrated and responsive mental health and social care services in community-based setting, (3) implement strategies for promotion and prevention in mental health and (4) strengthen information systems, evidence and research for mental health.” (See *Comprehensive Mental Health Action Plan 2013-2020*, Resolution WHA66/8 by the World Health Organization for more information on this plan). The current study attempts to identify one of the determinants of mental depression among younger adults in the United States. Following the literature on marital dissolution and its consequences, this study claims that own marital dissolution, among other factors, may contribute significantly to the presence of severe mental depression among younger adults, and consequently a policy designed to alleviate this problem may be more effective if it improves the stability of their marriage and family. Note that marital dissolution of parents is known in the literature to cause anxiety and unhappiness among children and thus it lowers their schooling and hence future earnings as adults.<sup>22</sup> It is natural therefore to assume that their own marital dissolution is likely to cause anxiety, leading to depression.

The role of marital dissolution as a determinant of mental depression is not new in the literature. In fact, the literature that studies this relationship is quite vast.<sup>3,10,11,12,13,14,15,16,19,24,26,28</sup> Most of these studies are based on two major theories that relate marital status to mental health, and they are “social causation theory” and “social selection theory.” Social causation theory suggests that marriage has a positive effect on mental health,<sup>14,15,26</sup> and consequently marital dissolution is likely to result in mental stress. This line of thought thus considers

marital dissolution as a determinant of mental depression. Social selection theory, on the other hand, claims that it is the mental health, which determines the probability of entry into marriage and marital stability.<sup>11,12,16,25</sup> These studies maintain the view that depressed individuals by expressing negative feelings are less likely to succeed in their marriage.<sup>4,8,9</sup> The protagonists of this theory thus claim that it is mental depression, which results in marital dissolution. Under social selection theory, the causality runs in the opposite direction.

Recently, several studies have claimed that the relationship between marital dissolution and mental depression follows from causality running in both directions.<sup>16,25</sup> These studies claim that one of these two events in an earlier period results in subsequent occurrence of the other in a later period. None of these studies, however, have examined whether they affect each other simultaneously during the same period. The current study does that. By following an appropriate two-stage procedure, this study for the first-time estimates both mental depression and marital dissolution equations in a simultaneous equations framework, and thus makes a contribution to the literature.

Although the literature examining the relationship between mental health and marital dissolution as discussed in above paragraphs is quite vast, there are only a few studies that examine this relationship among younger adults.<sup>10,11,12</sup> It is important to note that for most of the younger adults, their current marriage may be their first marriage. After completing their education and settling in their jobs, these younger adults may have entered married life for the first time with the dream of starting their cherished family. The impact of divorce on this group of individuals with a shorter marital life and lesser experience in dealing with marital problems may be quite different from that on mature adults with longer marital experience. Note that it may be more painful for younger adults because they may be experiencing it for the first time or may be less painful because their chances of entering into another marriage are higher than those of mature adults. In both cases, however, it clearly is different from that of mature adults. They may therefore be treated as a special group of individuals that deserves an independent study in contrast with the middle-aged or mature adults who may have already experienced prior divorces. By restricting the analysis to younger adults only, the current study thus extends the literature in an area that deserves further attention.

To verify the relationship between the two variables just mentioned among younger adults, the study uses

data from the National Longitudinal Survey of Youth, 1997 (NLSY97). The NLSY97 is a longitudinal data set from the United States that started in 1997 with 8,984 youths aged between 12 and 18. This ongoing cohort has been surveyed 19 times to this date and is now interviewed biennially. We chose this longitudinal data set because it contains information on mental depression of younger adults in most of the recent surveys. In fact, the study uses data from its 2010 and 2015 surveys when respondents were aged respectively between 25 and 31, and between 30 and 36. We first estimate all relevant equations separately by ordered probit following the traditional single-equation estimation procedure. Then recognizing the importance of both social causation and social selection theories in the determination of a relation between these two variables, we further estimate both mental depression and marital dissolution equations in a simultaneous equations framework. Finally, an instrumental variable procedure is used to examine if there exists a causal relationship between these two variables. The next section presents the estimating equations and outlines different estimation procedures to test our proposed hypothesis. This section also introduces the data and variables. Section III reports the results, and Section IV presents discussion of results. The final section summarizes our findings.

## 2. Methods

### A. ESTIMATING EQUATIONS AND TEST PROCEDURE

To test the hypothesis that an individual's mental depression ( $D$ ) may be related to his/her marital dissolution ( $MD$ ), we outline in this section different strategies to estimate the depression equation with marital dissolution as an explanatory variable. Note that the variable depression for the  $i^{\text{th}}$  individual  $D_i$  ( $i = 1, 2, \dots, n$ ) in most data sets are reported in Likert scale as an ordered categorical variable. For example,  $D_i$  in our data assumes the following values:

(1)  $D_i = 3$ , if the  $i^{\text{th}}$  respondent was depressed all the time during the last month,  
 $= 2$ , if the  $i^{\text{th}}$  respondent was depressed most of the time during the last month,  
 $= 1$ , if the  $i^{\text{th}}$  respondent was depressed some of the time during the last month,  
 $= 0$ , if the  $i^{\text{th}}$  respondent was depressed none of the time during the last month.

This variable assumes the above values when the latent continuous depression variable  $D_i^*$  that generates  $D_i$  assumes following values:

(2)  $D_i = 0$ , if  $D_i^* \leq 0$ ,  
 $D_i = 1$ , if  $0 < D_i^* \leq \mu_1$ ,

$D_i = 2$ , if  $\mu_1 < D_i^* \leq \mu_2$ ,

$D_i = 3$ , if  $\mu_2 < D_i^*$ ,

where  $\mu_1$  and  $\mu_2$  are the cut-off points for different categories of the latent variable  $D_i^*$ , and

(3)  $D_i^* = \mathbf{X}_i\boldsymbol{\beta} + \delta MD_i + \epsilon_i$ .

$\mathbf{X}_i$  is the row vector of different covariates in the depression equation for the  $i^{\text{th}}$  individual and  $\boldsymbol{\beta}$  is a column vector of parameters of appropriate dimension. Under the assumption that the error term is standard normal, equation (3) along with equation (2) can be estimated by ordered probit from a cross-sectional sample. A statistically significant positive  $\delta$  in this case would validate our claim that mental depression is positively correlated with marital dissolution.

As mentioned earlier in the last section, marital dissolution and mental depression may be simultaneously related and should therefore be estimated in a simultaneous-equations framework. Since the variable depression ( $D$ ) is available as an ordered categorical variable and the variable marital dissolution ( $MD$ ) as a binary variable in our data set, we convert  $D$  into a binary variable to estimate both equations simultaneously following Maddala's two-stage procedure.<sup>17</sup> (See Model 6 of Maddala (p. 246-247) for detailed discussion of this two-stage procedure and the derivation of asymptotic variance-covariance matrices of these two-stage estimators).

Define the binary depression variable  $D_i$  and binary marital dissolution variable  $MD_i$  as,

(4)  $D_i = 1$ , if  $D_i^* > 0$ ;  $= 0$ , otherwise,

(5)  $MD_i = 1$ , if  $MD_i^* > 0$ ;  $= 0$ , otherwise,

where  $D_i^*$  and  $MD_i^*$  are the latent continuous variables that generate  $D_i$  and  $MD_i$ , respectively. Note that the binary variable  $D$  assumes the value 1, if the categorical depression variable assumes values 1 or 2 or 3. In other words, if the respondent is depressed at least some of the time during the previous month, the binary variable  $D$  assumes the value 1, and is 0, otherwise. The structural relationship between these two latent variables can then be written as follows:

(6)  $D_i^* = \mathbf{X}_{1i}\boldsymbol{\beta}_1 + \delta_1 MD_i^* + \epsilon_{1i}$ ,

(7)  $MD_i^* = \mathbf{X}_{2i}\boldsymbol{\beta}_2 + \delta_2 D_i^* + \epsilon_{2i}$ .

First, we obtain the following reduced form equations:

(8)  $D_i^* = \mathbf{X}_i\boldsymbol{\pi}_1 + v_{1i}$

(9)  $MD_i^* = \mathbf{X}_i\boldsymbol{\pi}_2 + v_{2i}$ ,

where  $\mathbf{X}_i$  includes all variables included in  $\mathbf{X}_{1i}$  and  $\mathbf{X}_{2i}$ . Under the assumption of standard normality of the reduced form error terms, equations (8) and (9) along respectively with equations (4) and (5) are estimated in stage 1 by probit which generates the predicted variables  $\tilde{D}_i^* = \mathbf{X}_i\tilde{\boldsymbol{\pi}}_1$  and  $\tilde{MD}_i^* =$

$X_i\tilde{\pi}_2$ . These predicted variables replace the actual latent variables in structural equations (6) and (7), which are then estimated in stage 2 by a second stage probit. Corrected standard errors of estimated coefficients are obtained in Maddala (p. 247) to test their statistical significance.<sup>17</sup> Note that The Econometric software LIMDEP routinely estimates this model and automatically generates the corrected standard errors and t-statistics necessary for hypothesis testing.<sup>7</sup> The presence of a simultaneous relationship between mental depression and marital dissolution can then be tested by examining whether  $\delta_1$  and  $\delta_2$  are positive and statistically significant.

Both estimation procedures described above help us determine the presence of a correlation between depression and marital dissolution. They do not, however, indicate whether there exists any causal connection between these two variables. To test the presence of such a causal connection, we further estimate the depression equation by an instrumental variable (IV) procedure. Under the assumption that marital dissolution is strongly related to the respondent's family size (*FS*), we use *FS* as an instrument for marital dissolution. Married couples living in large families are likely to get mental support and free counselling from the family members, which may act as a shield against marital dissolution, in the event of a conflict between spouses. This variable may therefore act as a possible instrument for marital dissolution. Note that an ideal instrumental variable must satisfy the following two conditions: (i) it is strongly correlated with the endogenous explanatory variable (test of relevance), and (ii) it is uncorrelated with the regression error term and hence has no direct effect on the dependent variable (test of exclusion).<sup>2</sup> We assume that both these conditions are satisfied by family size, and hence it is used as an IV to estimate the depression equation for examining the existence of a causal relation between both variables. Note that satisfaction of these conditions is an empirical issue, which can be verified by appropriate empirical tests. It is important to note that the first condition is easily verifiable, but the second condition is difficult to verify unless we have additional instruments.<sup>2</sup>

Under the IV approach, we estimate in the first stage the marital dissolution (*MD*) equation with family size (*FS*) as an explanatory variable by linear probability method and obtain the predicted *MD* variable. This is used as an explanatory variable in the Depression equation, which then is estimated by a second stage linear probability. Statistical significance of the coefficient of predicted *MD* would indicate whether there exists a

causal relation between depression and marital dissolution.

## B. DATA AND VARIABLES

To test the hypothesis that depression is positively related to marital dissolution of younger adults, we drew two samples from the National Longitudinal Survey of Youth, 1997 (NLSY97). NLSY97 is a nationally representative longitudinal data set from the United States that started in 1997 with 8984 youths who were then aged between 12 and 18 and is continued annually until 2011 and biennially thereafter. The two samples used in this study are from 2010 and 2015 surveys. As pointed out earlier, the respondents in 2010 were aged between 25 and 31, and in 2015, they were 30 to 36 years old. These two samples were chosen because (1) the respondents in surveys before 2010 are too young for marriage and thus marital dissolution is not relevant to those individuals, and (2) the respondents after 2015 may be too old to be considered as younger adults. Note that the most recent survey of NLSY97 that contains the information on mental depression is in the year 2017, which is very close to 2015, and consequently we do not expect significant changes in results between 2015 and 2017.

Since our goal is to examine the relationship between marital dissolution and mental depression, we restricted our samples to married or divorced individuals only. After eliminating observations with no valid information on several variables discussed in the next paragraph, we obtained a sample of 2975 observations from the 2010 survey and a sample of 3722 observations from the 2015 survey. It may appear unreasonable to have a smaller sample in 2010 than in 2015 because later surveys of the NLSY97 usually are marked by larger non-response rates. This, however, is not surprising in our study, which focuses on married or divorced individuals only, because compared to those in the 2015 survey, a larger percentage of individuals in the 2010 survey, who were aged between 25 and 31, were not married and therefore were excluded from the sample. The variable "church attendance during youth" which is obtained from an earlier period is used in this study because this variable is not available in the current period.

The dependent variable in the mental depression equation is the ordered categorical variable *D* defined in Equation (1). The set of explanatory variables for this equation includes among others the variable of interest for this study, the marital dissolution (*Divorce*). This variable assumes the value 1, if the respondent at the time of interview was either divorced or separated and was living

separately. Some family related variables that may affect an individual's mental depression are parental education (Mother High school, Mother college, Father High school, Father college), parental divorce (Parental divorce),<sup>22</sup> family income (Family income) and household size (Family size). Regular church attendance (Church attendance) during youth may have a negative impact on depression,<sup>20,21</sup> whereas drug addiction (Drug addiction), drunk driving (Drunk driving) and delinquency (Delinquency) in the current period may escalate this problem. Years of schooling, school

enrollment (Enrolled), intelligence measured by PIAT math score (PIAT score), age (Age), current health condition (Good health), physical health limitations or disabilities (Health limitation), employment status (Employed), gender (Male), race (Black, Hispanic) and location of residence (Urban) are known to have some effects on mental condition, and therefore are included in the regression as explanatory variables. All these variables are defined in Table 1, which also reports their means and standard deviations.

**Table 1:** Names, Definition, Means and Standard Deviations of Variables

Variables	Definition	Means <sup>a</sup>	
		2010	2015
Depression	= 3, if depressed all the time (last month) = 2, if depressed most of the time (last month) = 1, if depressed some of the time (last month) = 0, if depressed none of the time (last month)	0.2726 (0.533)	0.2458 (0.515)
Depress	= 1, if depressed at least some time (last month)	0.2114 (0.408)	0.2355 (0.424)
Divorce	= 1, if divorced or separated without cohabitation	0.1103 (0.313)	0.1201 (0.325)
Parental Divorce	= 1, if parents were divorced	0.1244 (0.330)	0.1263 (0.332)
Male	= 1, if the respondent is a male	0.4538 (0.498)	0.4578 (0.498)
Church attendance	= 1, if the respondent attended church when young	0.4229 (0.494)	0.4275 (0.495)
Mother High School	= 1, if mother has a high school diploma	0.2982 (0.458)	0.3055 (0.461)
Mother College	= 1, if mother has a college degree	0.1549 (0.362)	0.1625 (0.369)
Father High School	= 1, if father has a high school diploma	0.2306 (0.421)	0.2343 (0.424)
Father College	= 1, if father has a college degree	0.1647 (0.371)	0.1738 (0.379)
PIAT Score	= Respondent's revised Math Peabody Individual Achievement Test (PIAT) Score in 1998	44.650 (37.57)	47.127 (37.26)
Black	= 1, if the respondent is Black	0.1539 (0.361)	0.1698 (0.376)
Hispanic	= 1, if the respondent is Hispanic	0.2326 (0.423)	0.2157 (0.411)
Delinquency	= Delinquency score in 1997 ranging from 0 to 10, higher score indicating more incidents of delinquency	1.2992 (1.806)	1.2821 (1.772)
Age	= Age of the respondent in years	28.152 (1.402)	33.057 (1.424)
Enrolled	= 1, if the respondent is enrolled in school/college	0.1318 (0.338)	0.0811 (0.273)
Years of schooling	= Completed years of schooling	13.606 (2.829)	14.186 (3.011)
Family income	= Gross family income (in thousands of \$)	62.779 (54.03)	80.366 (69.31)
Family Size	= Number of people in the household	3.5714 (1.609)	3.7979 (1.593)
Urban	= 1, if the respondent lives in an urban area	0.7311 (0.443)	0.7915 (0.406)

Drug addict	= 1, if the respondent is addicted to non-prescription drugs, such as cocaine, crack, heroin, crystal meth etc.	0.0188 (0.136)	0.0191 (0.137)
Good health	= 1, if the respondent maintains a good health	0.9116 (0.284)	0.8933 (0.309)
Drunk driving	= 1, if the respondent has problem of driving drunk	0.0666 (0.249)	0.0634 (0.244)
Health limitation	= 1, if the respondent has health problems or Disabilities that limit his/her amount of work	0.0464 (0.210)	0.0567 (0.231)
Employed	= 1, if the worker is employed either fulltime or part-time	0.6282 (0.483)	0.6284 (0.483)
Sample size		2975	3722

<sup>a</sup> Quantities in parentheses are standard deviations.

### 3. Results

#### A. ORDERED PROBIT ESTIMATES

To test the hypothesis that mental depression is positively related to marital dissolution, we estimated the depression equation by ordered probit with Divorce as one of the explanatory variables. We obtained these estimates separately from both 2010 and 2015 samples, and the results are reported in Table 2. It is interesting to note that some variable coefficients in Table 2 assume very similar signs and significance levels in both 2010

and 2015 samples. Males suffer less depression than females and individuals with more schooling are less likely to suffer from depression than those with less schooling in both 2010 and 2015 samples. As expected, individuals with higher family income and good health, and those who are employed are less likely to suffer from depression than their otherwise identical counterparts. Individuals with health limitations and drug addiction, on the other hand, are more likely to suffer from depression than those without these problems, regardless of whether the sample is drawn from 2010 or 2015 survey.

**Table 2:** Ordered Probit Estimates of Depression Equations

Variables	2010		2015	
	Coefficient	t	Coefficient	t
Constant	1.096	1.59	0.842	1.18
<b>Divorce</b>	<b>0.243**</b>	<b>3.05</b>	<b>0.215**</b>	<b>2.92</b>
Parental Divorce	0.011	0.14	-0.033	0.48
Male	-0.213**	3.94	-0.136**	2.76
Church attendance	-0.059	1.12	0.020	0.42
Mother High School	0.047	0.68	0.118*	1.92
Mother College	0.017	0.18	0.085	1.03
Father High School	-0.165**	2.27	-0.143**	2.18
Father College	-0.034	0.39	-0.075	0.95
PIATscore	-0.001	1.24	-0.001	1.15
Black	0.102	1.39	0.094	1.46
Hispanic	0.029	0.43	0.009	0.15
Delinquency	0.003	0.22	0.021	1.60
Age	-0.006	0.27	-0.018	0.87
Enrolled	0.004	0.05	0.087	1.03
Years of schooling	-0.060**	5.43	-0.037**	4.04
Family income	0.002**	2.76	-0.002**	3.74
Family size	0.0004	0.03	-0.016	1.05
Urban	0.007	0.12	0.082	1.38
Drug addict	0.446**	2.73	0.664**	4.77
Good health	-0.636**	7.92	-0.472**	6.56
Drunk driving	0.175*	1.70	0.087	0.91
Health limitation	0.349**	3.23	0.508**	5.52
Employed	-0.160**	2.80	-0.108**	1.99
$\mu_1$	1.295**	26.41	1.204**	27.73
$\mu_2$	1.985**	22.40	1.930**	23.04

Log likelihood	-1792.1	-2120.9
$\chi^2_{23}$	295.60	331.33
Sample size	2975	3722

\*(\*\*) Significant at 5 (10) percent level.

Mental depression is negatively related to father's high school education in all samples. Although father's college education lowers the respondent's likelihood of depression in both 2010 and 2015 samples, it is not statistically significant. These results indicate that, holding other variables constant, higher education of the father acts as a moderating factor for mental depression of younger adults aged between 25 and 35. Note that intergenerational transfer of genetic endowments may result in more educated children growing up in families with parents who are more educated. Father's education may thus act as a proxy for the respondent's own education. Since we have already shown that individuals with more schooling are less likely to be depressed than those with less schooling, it is not surprising to find a negative relation between father's higher education and depression. Mother's education does not, however, seem to have a significant correlation with depression of these younger adults. Although blacks are more likely to be depressed than whites, this variable is not statistically significant in any sample. However, with a t-ratio around 1.5, the importance of this variable in both samples cannot be ignored completely. Note that depression is related to drunk driving positively in both samples but is statistically significant in the 2010 sample only. The variable of importance for the test of our proposed hypothesis is "Divorce." This variable in both 2010 and 2015 samples assumes

statistically significant positive coefficients. This clearly indicates that marital dissolution enhances the likelihood of suffering from mental depression among younger adults, regardless of their age.

#### B. TWO-STAGE PROBIT ESTIMATES

So far, we have examined the relationship between depression and marital dissolution in a framework in which depression is treated as the dependent variable and marital dissolution as an independent variable. As we have discussed in the introductory section, depression and marital dissolution may affect each other simultaneously and should therefore be estimated in a simultaneous-equations framework. In this section, we estimate these two equations simultaneously following model 6 of Maddala's two-stage procedure.<sup>17</sup>

As pointed out earlier, Maddala's two-stage procedure assumes both dependent variables to be binary. Since the mental depression variable in our data set is ordered categorical as shown in equation (1), we first converted it into a binary variable. To check the reliability of this binary depression variable as the dependent variable, we first estimated depression equations by binary probit from both 2010 and 2015 samples and compare them with the ordered probit estimates reported in Table 2. These results are reported in Table 3.

**Table 3: Binary Probit Estimates of Depression Equations**

Variables	2010		2015	
	Coefficient	t	Coefficient	t
Constant	1.085	1.52	1.092	1.47
<b>Divorce</b>	<b>0.280**</b>	<b>3.32</b>	<b>0.232**</b>	<b>2.96</b>
Parental Divorce	-0.017	0.21	-0.021	0.29
Male	-0.197**	3.52	-0.160**	3.13
Church attendance	-0.056	1.02	0.002	0.03
Mother High School	0.054	0.76	0.135**	2.12
Mother College	0.008	0.09	0.110	1.28
Father High School	-0.157**	2.09	-0.137**	2.02
Father College	-0.010	0.11	-0.098	1.19
PIAT Score	-0.001	0.98	-0.001	1.23
Black	0.065	0.85	0.093	1.38
Hispanic	0.008	0.11	0.016	0.24
Delinquency	0.001	0.05	0.021	1.50
Age	-0.008	0.32	-0.026	1.20
Enrolled	0.003	0.04	0.099	1.14

Years of schooling	-0.059**	5.10	-0.036**	3.73
Family income	-0.001**	2.58	-0.001**	3.30
Family size	-0.003	0.15	-0.015	0.96
Urban	0.038	0.61	0.056	0.92
Drug addict	0.558**	3.08	0.798**	5.14
Good health	-0.651**	7.43	-0.475**	6.19
Drunk driving	0.165	1.55	0.099	1.00
Health limitation	0.361**	3.03	0.571**	5.66
Employed	-0.137**	2.29	-0.119**	2.13
Log likelihood	-1495.9		-1761.2	
$\chi^2_{23}$	261.57		317.75	
Sample size	2975		3722	

\*(\*\*) Significant at 5 (10) percent level.

It is interesting to note that in terms of signs and significance levels, all coefficients of marital dissolution equations in Table 3 under binary probit estimation are very similar to those in Table 2 estimated by ordered probit. The only difference is that the binary probit estimates of the coefficients of Divorce in both samples are slightly larger in absolute value than those obtained by ordered probit. This is not surprising because the binary dependent variable used in binary probit assumes the value 1 when the categorical dependent variable of ordered probit assumes the values 1 or 2 or 3, and consequently the marginal effect of marital dissolution on depression assuming the value 1 is likely to be larger under binary probit than on ordered probit. The signs and significance levels of all other explanatory variables in Table 2 and Table 3 are also very similar. The findings in Table 3 thus suggest that the binary depression variable as the dependent variable in depression regression is as reliable as the ordered categorical dependent variable and therefore is suitable for Maddala's two-stage estimation of both depression and marital dissolution equations.

Following the two-stage procedure outlined in Section 2, we estimated depression and marital dissolution equations simultaneously. To ensure identification and avoid convergence and singular covariance matrix problems (which are quite standard in two-stage estimation), we excluded a few variables from the depression equation and a few others from the marital dissolution equation. The variables excluded from the mental depression

equation are delinquency, drug addiction and drunk driving. Although these variables may result from depression, they are less likely to cause it, and therefore are excluded from depression equation. On the other hand, these variables are likely to damage personal relationship with spouse leading to divorce, and therefore are included in the divorce equation. We also excluded the variable "parental divorce in an earlier period" from the depression equation because it is more relevant to the respondent's marital dissolution than mental depression in the current period. Clearly, parental divorce in the current period is likely to cause unhappiness and depression of an individual in the same period.<sup>22</sup> However, parental divorce that happened in distant past is much less likely to cause depression of the younger adult in the current period. From marital dissolution equation, we excluded parental education, household size and family income.

Although these exclusion restrictions appear to be arbitrary, they are imposed because (i) they prevent non-convergence of likelihood functions resulting from singular covariance matrices and (ii) the coefficients of these excluded variables are statistically insignificant when they are used in some equations. The specifications reported in this study did not encounter any convergence problem in any equation and therefore are preferred to others with different specifications. With these variable restrictions, both equations of our simultaneous equations model are identified.



**Table 4:** Two-Stage Estimates of the Coefficients of Marital Dissolution and Mental Depression variables in Depression and Marital Dissolution Equations

Equation→	Mental Depression Equation		Marital Dissolution Equation	
	Coefficient	t	Coefficient	t
<b>A. 2010</b>				
Divorce	1.2297***	3.32	—	—
Depression	—	—	0.649***	3.52
Other Variables	YES		YES	
<b>B. 2015</b>				
Divorce	1.9513***	3.91	—	—
Depression	—	—	1.3072***	4.29
Other Variables	YES		YES	

\*\*\* Significant at 1 percent level.

Table 4 reports the two-stage estimates of both depression and divorce equation coefficients obtained from both 2010 and 2015 samples. To focus exclusively on the presence of a simultaneous relationship between marital dissolution and mental depression, we report in Table 4 the coefficients of the predicted right-hand-side endogenous variables only and the corrected t-values associated with these coefficients. Note that these are the only coefficients necessary for verifying the presence of simultaneous relationship between the two variables just mentioned. Full set of coefficients from all equations can, however, be obtained from

the author on request. These coefficients are positive and statistically significant which confirm that mental depression not only influences marital dissolution, but also is influenced by marital dissolution.

As an extension of our study, we estimated both depression and marital dissolution equations simultaneously separately from male and female samples. Results reported in Table 5 indicates that the simultaneous relationship between these two variables remains valid for both males and females.

**Table 5:** Two-Stage Estimates of the Coefficients of Depression Equations for Males and Females

Variables	Males		Females	
	Coefficient	t	Coefficient	t
<b>A. 2010 Sample</b>				
Divorce	0.789**	2.07	0.492*	1.93
Other Variables		YES		YES
Log likelihood		-674.6		-868.4
Sample size		1350		1625
<b>B. 2015 Sample</b>				
Divorce	1.165**	2.90	1.239**	2.64
Other Variables		YES		YES
Log likelihood		-796.4		-1022.5
Sample size		1704		2018

\*(\*\*) Significant at 5 (10) percent level.

**Table 6:** First Stage Linear Probability Estimates of the Marital Dissolution Equation

Variables	2010		2015	
	Coefficient	t	Coefficient	t
Constant	0.552**	3.79	0.589**	4.10
Parental Divorce	-0.006	-0.35	-0.017	1.21
Male	-0.045**	4.00	-0.072**	7.60
Church attendance	0.002	0.21	-0.012	1.26
Mother High School	-0.007	0.46	0.010	0.78
Mother College	-0.013	0.69	-0.008	0.47
Father High School	0.009	0.63	0.003	0.26
Father College	0.010	0.55	-0.004	0.24
PIAT Score	-0.0001	0.63	-0.0004**	2.28
Black	0.030*	1.89	0.036**	2.64
Hispanic	0.002	0.13	0.023*	1.78
Delinquency	0.003	0.88	0.001	0.53
Age	-0.001	0.13	0.001	0.14
Enrolled	0.012	0.75	0.038**	2.22
Years of schooling	-0.007**	2.94	-0.005**	2.90
Family income	-0.0004**	3.97	-0.0002**	2.28
Urban	-0.007	0.55	0.001	0.10
Drug addict	0.024	0.59	0.072**	2.10
Good health	-0.034*	1.71	-0.018	1.06
Drunk driving	0.058**	2.67	0.045**	2.33
Health limitation	0.031	1.16	0.038*	1.76
Employed	-0.204**	17.46	-0.255**	25.01
<b>Family Size</b>	<b>-0.037**</b>	<b>10.58</b>	<b>-0.050**</b>	<b>16.74</b>
Sample size	2975		3722	
<b>F-Statistics</b>	<b>24.88</b>		<b>55.08</b>	

\*(\*\*) Significant at 5 (10) percent level.

### C. INSTRUMENTAL VARIABLE (IV) ESTIMATES

As mentioned earlier, the above two approaches confirm the presence of a correlation between depression and marital dissolution. To examine the presence of a causal connection, however, we estimate depression equations from both 2010 and 2015 samples using "Family Size" as an instrumental variable for "Divorce." The first stage linear probability estimates of divorce equation reported in Table 6 indicate that family size is significantly related to divorce in both 2010 and 2015 samples.

F-statistics associated with these estimates respectively are 24.88 and 55.08. With F-statistic more than 10, Family Size satisfies the first condition (relevance) of a good instrument. Note that in the absence of additional instruments, it is not possible to test the exclusion condition formally. Lack of statistical significance of Family Size in Table 2, however, provides a possible indication of no

correlation between this variable and mental depression and hence between Family Size and the error term in structural depression equation. In the absence of a formal test, therefore we intuitively assume this evidence as a possible indication of the satisfaction of the exclusion condition. With a strong relevance test result, Family Size may thus be treated as a good instrument of divorce in the depression equation. At the least, such an instrument is likely to shed further light on the strength of correlation between divorce and depression and thereby may indicate the possibility of a causal connection between these two variables.

The first stage estimates are used to compute the predicted Divorce variable, which is used as an explanatory variable in the depression equation estimated in stage 2 by linear probability. These instrumental variable estimates of depression equation coefficients obtained from both 2010 and 2015 samples are reported in Table 7.

**Table 7:** Instrumental Variable Estimates of Depression Equations

Variables	2010		2015	
	Coefficient	t	Coefficient	t
Constant	0.774**	3.76	0.717**	3.60
<b>Divorce</b>	<b>0.127</b>	<b>0.96</b>	<b>0.162**</b>	<b>1.97</b>
Parental Divorce	-0.003	0.15	-0.007	0.35
Male	-0.056**	3.45	-0.040**	2.80
Church attendance	-0.014	0.94	0.001	0.09
Mother High School	0.014	0.69	0.034	2.00
Mother College	0.002	0.09	0.029	1.27
Father High School	-0.042**	2.04	-0.037**	2.07
Father College	-0.003	0.11	-0.024	1.13
PIAT Score	-0.0002	0.96	-0.0002	1.06
Black	0.016	0.72	0.023	1.17
Hispanic	0.001	0.04	0.0002	0.01
Delinquency	-0.0004	0.10	0.005	1.39
Age	-0.002	0.25	-0.007	1.26
Enrolled	-0.0003	0.01	0.020	0.84
Years of schooling	-0.016**	5.24	-0.009**	3.67
Family income	-0.0003**	2.12	-0.0003**	2.82
Urban	0.010	0.58	0.013	0.82
Drug addict	0.202**	3.61	0.271**	5.65
Good health	-0.232**	8.32	-0.157**	6.90
Drunk driving	0.041	1.30	0.022	0.80
Health limitation	0.126**	3.38	0.203**	6.69
Employed	-0.034	1.09	-0.013	0.52
Sample size	2975		3722	
F <sub>22, 2952</sub>	13.7		16.8	

\*(\*\*) Significant at 5 (10) percent level.

It is interesting to note that results in Table 7 are very much similar to the ordered probit estimates reported in Table 2 and binary probit estimates in Table 3. Since the dependent variable in both binary probit and IV estimations are the same, the former results are more comparable to IV results than those under ordered probit. In fact, the signs and significance levels of almost all coefficients estimated under binary probit and IV are found to be the same, which shows the reliability of our IV estimates. The variable of interest in this table is predicted Divorce. Although this variable has a positive sign in both samples, it assumes statistical significance at a desired level in the 2015 sample only. This indicates that the possibility of a causal connection between divorce and depression, if there is any, is stronger in the older group.

#### 4. Discussion

In this section, we summarize the key results reported in the last section. We also discuss their policy implications and highlight a few notes of caution while interpreting our results. Our ordered probit estimates in Table 2 clearly confirms that

marital dissolution adversely affects the likelihood of mental depression among younger adults, regardless of their age. Our unreported results further indicate that the marginal effect of marital dissolution on the probability of depression is statistically significant at all conventional levels. (These results can be obtained from the author on request). The results in Table 2 thus support the earlier finding that mental depression is positively related to marital dissolution during a given time period.

One of the primary objectives of this study is to examine whether divorce and depression influence each other simultaneously during the same time period. The two-stage estimates reported in Table 4 confirm that mental depression not only influences marital dissolution, but also is influenced by marital dissolution. Results in Table 5 further confirms that this finding is true for both males and females. Thus, as predicted, both social causation and social selection forces work contemporaneously to determine the relationship between marital dissolution and mental depression. Unlike earlier studies which predict occurrence of one of these two

events in a later period following the prior occurrence of the other event, the current study further demonstrates that both events may occur simultaneously and influence each other in the same period, which in turn justifies the use of Maddala's two-stage procedure in estimating both equations.

It is important to note that our two-stage estimation result does not by any means contradict the earlier finding of a one-way sequential relation between mental depression and marital dissolution. It simply reveals another dimension of their contemporaneous relationship that remained hidden under traditional estimation. By estimating both equations using an appropriate two-stage procedure, the current study clearly resolves the problem of simultaneous equations bias that may have affected the earlier estimates and thus contributes to the literature.

Our instrumental variable estimation results deserve further discussion. In addition to providing strong support to the earlier finding of the presence of a correlation between divorce and depression, these IV results further suggest that there is a possibility of a causal connection between these two variables, especially in the older group. Although these estimates are limited by our inability to test the exclusion condition formally, we used some intuitive criteria to test this condition, and hence our conjecture of the presence of a causal connection between these two variables in case of older young adults should not be ignored without further investigation. At the least, our IV analysis confirms the presence of a strong correlation between marital dissolution and depression.

The results in this study clearly suggest that any policy that improves marital relationship among younger adults is likely to be effective in combating their mental depression. This finding clearly has important policy implications and thus deserves further attention by researchers and policy makers. In today's world infected by rapid growth of mental depression among individuals of all ages, any solution to this devastating epidemic is worth considering. The solution recommended by the current study is clearly in line with the vision of the *Comprehensive Mental Health Action Plan 2013-2020* of the World Health Organization. It is important to note that improvement of marital relationship by itself resolves numerous problems associated with broken families. Thus, a policy to restore healthy marital relationship is likely to not only resolve undesirable marital problems, but also promote mental health. Since improvement in mental health, as indicated by our simultaneous equations results, is likely to lower the probability of marital

dissolution, any policy to deal with one of these two problems is also likely to resolve the other either directly or indirectly. The overall contribution and the policy implications of this study should not therefore be underestimated without further investigation.

We conclude with a few precautionary notes. First, our findings are based on data obtained from younger adults in the United States. Data from other countries or other cultures and from other age groups may yield different results. Although we do not expect much variation in our findings, such a possibility cannot be ruled out without further research in this direction. Our results should not therefore be generalized to individuals of all age groups and cultures.

Second, the identification restrictions used in our simultaneous equations model may seem to be somewhat arbitrary. We tried alternative specifications to make sure that we do not encounter singular covariance matrix and convergence problems, and yet our results remained robust to all these specification changes. Although we are comfortable with the variable restrictions used in this study, other identifying restrictions and use of other explanatory variables may improve the estimates. Our findings based on two-stage estimates should therefore be interpreted with caution.

Finally, the study confirms the presence of a positive correlation between mental depression and marital dissolution. Although our IV analysis attempts to explore the possibility of a causal connection, it is limited by our failure to test the exclusion condition. Clearly, it is not easy to establish a causal connection without additional information.<sup>23</sup> This should not, however, reduce the importance of our findings. Angrist and Pischke quite aptly remark, *"Like most researchers, we have an interest in mechanisms and as well as causal effects. But inconclusive and incomplete evidence on mechanisms does not void empirical evidence of predictive value."*<sup>1</sup> The results presented in this study clearly have enough predictive value that deserves further attention. Future research in this direction therefore is highly recommended.

## 5. Conclusion

Using two samples from the National Longitudinal Survey of Youth 1997 (NLSY97), a longitudinal data set from the United States, the current study tests the hypothesis that probability of mental depression of younger adults is related to their marital dissolution positively. Following the traditional approach, the study first estimates the

depression equation by ordered probit. Then we estimate this equation in a simultaneous-equations framework following an appropriate two-stage procedure to examine whether or not depression and divorce affect each other simultaneously. All these estimates provide strong support to our hypothesis that mental depression is related to marital dissolution not only positively, but also simultaneously. To further examine the possibility of a causal connection between these two variables, we estimate depression equation by instrumental variable method which suggests that the possibility of a causal connection between these two variables cannot be ignored completely. These findings have important policy implications. They indicate that any policy to resolve the problem of marital dissolution among younger adults is likely to lower not only their mental depression directly, but also their marital problems indirectly through better mental health. This calls for further attention by researchers and policy makers.

**Conflict of Interest:**

The author has no competing interests to declare that are relevant to the content of this article.

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## Reference

1. Angrist JD, Pischke J. The Credibility Revolution in Empirical Economics: How Better Research Design is taking the Con out of Econometrics. *Journal of Economic Perspectives*, 2010;24(2):3-30.
2. Bollen KA. Instrumental Variables in Sociology and the Social Sciences. *Annual Review of Sociology*, 2012;38(1):37-72.
3. Booth A, Amato P. Divorce and Psychological Stress. *Journal of Health and Social Behavior*, 1991;32(December):396-407.
4. Coyne JC, Kessler RC, Tal M, Turnbull J, Wortman CB, Greden JF. Living with a Depressed Person. *Journal of Consulting and Clinical Psychology*, 1987;55(3):347-352.
5. Elkin I, Shea T, Watkins JT, Imber SD, Sotsky SM, Collins JF, Glass DR, Pilkonis PA, Leber WR, Docherty JP, Fiester SJ, Parloff MB. National Institute of Mental Health Treatment of Depression Collaborative Research Program: General effectiveness of treatments. *Archives of General Psychiatry*, 1989;46 (November):971-983.
6. Elkin I, Gibbons RD, Shea T, Sotsky SM, Watkins JT, Pilkonis PA, Hedeker D. Initial Severity and Differential Treatment Outcome in the National Institute of Mental Health Treatment of Depression Collaborative Research Program. *Journal of Consulting and Clinical Psychology*, 1995;63 (5):841-847.
7. Greene W. *LIMDEP 11.0*, Econometric Software, Inc, Plainview, New York. 2016.
8. Hinchliffe MD, Hooper F, Roberts J, Vaughan PW. A Study of the Interaction between Depressed Patients and their Spouses. *British Journal of Psychiatry*, 1975;126 (2): 164-172.
9. Hinchliffe MD, Vaughan PW, Hooper D, Roberts FJ. The Melancholy Marriage: An Inquiry into the Interaction of Depression. II. Expressiveness. *British Journal of Medical Psychology*, 1977;50 (2):125-142.
10. Horwitz AV, White HR. Becoming Married, Depression, and Alcohol Problems among Young Adults. *Journal of Health and Social Behavior*, 1991;32 (3):221-237.
11. Horwitz AV, White HR, Howell-White S. Becoming Married and Mental Health: A Longitudinal Study of a Cohort of Young Adults. *Journal of Marriage and Family*, 1996;58 (4):895-907.
12. Horwitz AV, McLaughlin J, White H. How the Negative and Positive Aspects of Partner Relationships Affect the Mental Health of Young Married People. *Journal of Health and Social Behavior*, 1998;39(2):124-136.
13. Kessler R, Walters E, Forthofer M. The Social Consequences of Psychiatric Disorders, III: Probability of Marital Stability. *American Journal of Psychiatry*, 1998;155(8):1092-1096.
14. Kim H, McKenry P. The Relationship between Marriage and Psychological Well-Being: A Longitudinal Analysis. *Journal of Family Issues*, 2002;23(8):885-911.
15. Lamb KA, Lee GR, Demaris A. Union Formation and Depression: Selection and Relationship Effects. *Journal of Marriage and Family*, 2003;65(4):953-962.
16. Lee C, Kim HS. The Relationship between Mental Health and Marital Dissolution: The Prior Depression and the Following Divorce. Presented at the Session 77 of the Annual Meeting of Population Association of America, 2009:1-37.
17. Maddala GS. *Limited Dependent and Qualitative Variables in Econometrics*. Cambridge University Press, New York. 1983.
18. Makki N, Mohanty MS. Mental Health and Happiness: Evidence from the US Data. *The American Economist*, 2019;64 (2):197-215.
19. Mastekaasa A. Psychological Well-Being and Marital Dissolution: Selection Effects? *Journal of Family Issues*, 1994;15(2):208-228.
20. Mohanty MS. What Determines Attitude Improvements? Does Religiosity Help? *International Journal of Business and Social Science*, 2013;4(9):37-64.
21. Mohanty MS. Effect of church attendance during youth on future psychological capital endowments: the US evidence. *Education Economics*, 2022;30(2):129-154.
22. Mohanty MS, Ullah A. Why Does Growing Up in an Intact Family during Childhood Lead to Higher Earnings during Adulthood? *American Journal of Economics and Sociology*, 2012;71(3):662-95.
23. Painter G, Levine D. Family Structure and Youths' Outcomes: Which Correlations are Causal? *Journal of Human Resources*, 2000;35(3):524-50.
24. Rotermann M. Marital Breakdown and Subsequent Depression. *Statistics Canada Health Reports*, 2007;18(2):33-44.
25. Sbarra D, Emery R, Beam C, Ocker B. Marital Dissolution and Major Depression in Midlife: A Propensity Score Analysis. *Clinical Psychological Science*, 2014;2(3):249-257.
26. Simon RW. Revisiting the Relationships among Gender, Marital Status, and Mental Health. *American Journal of Sociology*, 2002;107(4):1065-1096.
27. Shea MT, Elkin I, Imber SD, Sotsky SM, Watkins JT, Collins JF, Pilkonis PA, Beckham E, Glass DR, Dolan RT, Parloff MB. Course of Depressive Symptoms Over Follow-up: Findings From the

- National Institute of Mental Health Treatment of Depression Collaborative Research Program. *Archives of General Psychiatry*, 1992;49(10):782-787.
28. Wade TJ, Pevalin DJ. Marital Transitions and Mental Health. *Journal of Health and Social Behavior*. 2004;45(2):155-170.
29. World Health Organization. *Comprehensive Mental Health Action Plan 2013-2020*, 66<sup>th</sup> World Health Assembly, Geneva, Switzerland. 2013.