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Harsh times: Do stressors lead to labor market losses?

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Tiivistelmä

Tutkimuksesssa tarkastellaan stressiä aiheuttavien elämänmuutosten vaikutuksia työmarkkinamenestykseen Suomessa. Tutkimus perustuu suomalaiseen kaksoisaineistoon, joka on yhdistetty kattavaan palkkatuloja ja työllisyyttä kuvaavaan rekisteriin. Työmarkkinamenestystä mitataan 20 vuoden seurantajakson aikana. Kaksoisaineiston avulla huomioidaan yhteiset perhetekijät sekä genetiikan vaikutus tulemiin. Tutkimus paljastaa kolme tulosta. Ensinnäkin stressiä aiheuttavat elämänmuutokset heikentävät merkittävästi työmarkkinamenestystä. Toiseksi miesten menestykseen työmarkkinoilla vaikuttavat enemmän taloudelliseen tilanteeseen ja työhön liittyvät stressitekijät, kuten ristiriitojen lisääntyminen töissä. Naiset reagoivat sitä vastoin vahvemmin perhepiirissä tapahtuviin muutoksiin, kuten perheenjäsenen kuolemaan tai sairastumiseen. Kolmanneksi stessiä aiheuttavien elämänmuutosten vaikutukset liukenevat ajan myötä.

Abstract

This paper examines the effects of past stressful life events on subsequent labor market success using data on twins matched to comprehensive register-based, individual-level information on income and employment status. The long-term labor market outcomes are measured during 20-year follow-up. We use the within-twin method to account for unobservable family and genetic confounders. The twin design reveals three important findings. First, stressors lead to worse labor market outcomes. Second, men are more affected by financial and job-related stressors, while women are more affected by family stressors. Third, the negative effects that stressors have on labor market outcomes diminish as time passes.

Conflict of interest: No

Keywords: Stressors; Stressful life events; Employment; Earnings; Co-twin control; Twins

JEL codes: I31; J24; J31

I. Introduction

Shocks are a fact of life. Adverse life events, such as losing one's job, profoundly affect health behaviors such as alcohol consumption and smoking (McKee *et al*., 2003, Dawson *et al*., 2005), subjective wellbeing at the individual level (Misheva, 2015) and labor market outcomes (Jacobson *et al.*, 1993). Shocks cause stress because they are often beyond an individual's control. Therefore, negative life events lead to potentially large welfare losses that must be accompanied by the appropriate public policy responses.

Shocks come in many forms. Researchers have distinguished independent and dependent life events (Bemmels *et al*., 2008). Some shocks, such as the death of a spouse or other close relative are independent and outside of any one person's control. However, other shocks that individuals encounter in their lives, such as marital and financial problems, are at least partially dependent on a person's own behavior and autonomous choices.

The true effects of adverse shocks are challenging to identify for at least two reasons. First, exposure to stressful life events may be influenced by shared environmental and genetic confounders, and these factors may also be significantly correlated with labor market success later in life. For example, early life conditions may exposure to shocks and have an influence on earnings and employment outcomes. There is also evidence that exposure to dependent life events is substantially influenced by genetic factors (Bemmels *et al*., 2008).

Second, individuals react in different ways to negative life events. Social support is particularly important in the recovery process (Wethington and Kessler, 1986), and the availability of such support varies significantly between individuals. Outside of social support, there are many important psychological traits that help individuals to mitigate and

overcome the stress caused by adverse life events. These sources of resiliency include self-confidence and autonomy, for example. Genetic factors play a significant role in explaining human resilience to stress and adversity (Boardman, Blalock and Button, 2008; Waaktaar and Torgensen, 2012).

This paper examines the effects of adverse life events on register-based *long-run* labor market outcomes using twin design. There is an extensive stream in the economics literature on the dynamic effects of various specific shocks on labor market outcomes, including employment interruptions, such as mass lay-offs (e.g., Jacobson, LaLonde and Sullivan, 1993; Arulampalam, Gregg and Gregory, 2001; Korkeamäki and Kyyrä, 2014), the onset of disability and health shocks (e.g., Currie and Madrian, 1999; Mok *et al*., 2008; García-Gómez, 2011) and different types of household disruptions, such as divorce, widowhood or sickness in the family (e.g., Haurin, 1989; Siegel, 2006). Most recently, Van den Berg, Lundborg and Vikström (2017) examine the effect of an (exogenous) death of a child on parents' future labor market outcomes, marital status and health.

The intersection between psychology and other social sciences is increasingly fruitful ground for new economic insights into policy-relevant issues. We use the Stressful Life Events (SLE) index that systematically accounts for a broad set of adverse shocks. The shocks described by the SLE index have been a locus of empirical research in the psychiatric epidemiology literature. Adverse life events are stressors that have been shown to lead to negative outcomes, such as the onset of a major depression in life (Kendler *et al*., 1999; Tennant, 2002 for a literature review). Our novel contribution is that we introduce the SLE concept to economic research and examine the effects of stressful life events on long-term labor market attachment and earnings using a twin design.

A burgeoning literature shows that some primary shocks, such as lay-offs, may predispose an individual to a series of secondary shocks, such as marital problems and

risky health behavior (Doiron and Mendolia, 2012; Black, Devereux and Salvanes, 2015), and that individuals with poor health are more likely to become unemployed (Böckerman and Ilmakunnas, 2009; Schmitz, 2011). The cumulative exposure to different shocks may have substantial effects on labor market outcomes in the long run. Under this scenario, it is difficult to disentangle the separate effects of a specific shock to subsequent labor market losses when the total effects are partly influenced by other factors. A remedy to surmount such worries is to use the SLE index because it captures the total burden of different types of shocks in the long run. In a regression setting, it is in principle possible to simultaneously control for a variety of different shocks and estimate the statistical significance of the individual effects. However, the interpretation of the estimated effects may become cumbersome if the regression is overloaded with many variables that have significant interaction effects. Thus, the use of the SLE index mitigates residual confounding caused by other shocks. The SLE index compactly summarizes information about several negative aspects, which implies that we can combine different shocks into one index (or three different indexes as we do in our paper) to create a single variable that provides an overall account of the underlying structure of shocks.

We estimate the impact of the SLE index on long-term labor market outcomes using a large and representative data on Finnish twins. Although the effects of various specific shocks on labor market outcomes have been documented in the literature, the evidence on these relationships using a twin design is relatively sparse. The previous literature has mainly focused on the effects of birth weight on labor market outcomes (Black *et al.*, 2007; Johnson and Schoeni, 2011) and the impact of children on female labor supply and earnings (Silles, 2016). However, there is little evidence on the relationship between negative life events and subsequent labor market outcomes using a twin design. The only

exception is Lundborg, Nilsson and Rooth (2014), who examine the effects of early life health on long-run outcomes.

Using data on non-identical (dizygotic, DZ) twins allows us to account for two types of shared family factors. First, there are adversities that two siblings within a family share, such as the death of a parent or a grandparent. Second, it is important to address the role of social support from the family or other shared social groups (such as a church) that help in the recovery process. Using data on identical (monozygotic, MZ) twins allows us to further control for inherited traits and preferences that are potential determinants of dependent shocks that people face in their lives. Accordingly, by using MZ twins, we can control for the individual differences in the resilience of adversities. The use of a single index for negative shocks is particularly useful in a twin design because the sample sizes are relatively small, especially for MZ twins.

To obtain a more nuanced picture, we distinguish independent and dependent life events, as well as work and financial events and familial events. Twin data are linked to the administrative information on long-term income and labor market attachment. Because we analyze the effects in the context of a Nordic welfare state (Finland), we also examine the effects of stressful life events on receiving social income transfers. To paint a dynamic picture, we analyze the adaptation to stressful life events. This analysis is possible because our data contain systematic information on the timing of various adverse shocks. Gaining deeper knowledge regarding the adaptation to shocks is particularly useful for public policy purposes. There is an apparent need for policy intervention if the effects of a shock on subsequent labor market attachment and earnings are permanent.

The remainder of this paper is organized as follows. The next section describes the Finnish twin cohort study that has been matched to register-based data on labor market outcomes. This section also presents descriptive evidence on the heritability of adverse

shocks. The third section briefly discusses our empirical approach, and the fourth section presents the baseline results of our analysis and various extensions. The final section concludes the paper by putting our findings into the larger context of the literature.

II. Data

Twin survey and register data on labor market outcomes

Our analysis makes extensive use of the Finnish twin survey matched to the Finnish Longitudinal Employer-Employee Data (FLEED). The linked data have been created for research purposes by Statistics Finland. The data cover the period from 1975 to 2009. Our twin survey sample is based on the Older Finnish Twin Cohort Study by the Department of Public Health in the University of Helsinki, which was compiled from the Central Population Registry of Finland (Kaprio *et al*., 1979; Kaprio and Koskenvuo, 2012). Initial candidates for the survey were all Finnish twins born before 1958, identified using information on birth date, the place of birth, sex, and surname at birth. The twin data contain only same-sex twin pairs. A questionnaire was mailed to these candidates in 1975 to collect baseline data and to determine their zygosity. Two follow-up surveys were conducted in 1981 and 1990.

The number of twin pairs in the data is 12,502, which corresponds to 25,004 individuals (Kaprio *et al*., 1979). The twin study contains information on smoking, alcohol use, symptoms of illnesses and reported diseases, medication use, physical characteristics, psychosocial factors and multi-faceted information on experiences at work and in one's personal life. Based on previous explorations, our twin data are a representative sample of the general population in Finland (Kaprio *et al*., 1979; Maczulskij, 2013a; Hyytinen *et al*.,

2013). The linked data remain representative also for the smaller sample of MZ twins (Maczulskij, 2013b, p. 124-125).

The twin study is linked to the FLEED using personal identifiers (Hyytinen *et al*., 2013). The FLEED consists of annual panel data over the 1990-2009 period. Using linked data, we are able to comprehensively track the labor market behavior of those twins who participated in the original twin surveys. FLEED is based on various administrative registers on individuals and firms that are collected and/or maintained by Statistics Finland. The data include information on an individual's exact labor market status and income taken directly from tax and other administrative registers. Thus, the income and employment information do not suffer from the characteristic shortcomings of survey data (e.g., underreporting, recall errors or top-coding).

We focus on the non-retired primary working-age persons, who were at least 33 years old in 1990. The twin survey in 1990 was mailed only to twin pairs born 1930–1957 (n = 12,450 individuals) with the response rate of 77%. Our analysis focuses on twin pairs for whom we have data on experiencing stressful life events, relevant covariates, and labor market outcomes. After excluding missing information further decreases the sample size to 6,247 twin pairs. Those observations that do not have information on one's sibling are also excluded from the estimation sample, resulting 3,216 twin pairs (i.e., 6,432 individuals). Of these individuals, ~58% are females and ~37% are MZ twins.

Outcome measures

As the outcome variables from FLEED, we use employment, earnings and social income transfers. Our measure for employment months is calculated as the average number of employment months per year over the 1990-2009 sample period. We also use two income

measures. First, we approximate the lifetime earnings by the logarithm of the average of annual wage and salary earnings and self-employment income over the 1990-2009 period. Second, we use social income transfers. Specifically, the data contain information on total annual taxable income obtained from the Finnish tax authorities. Total income is a broader concept than earnings because total income also includes income transfers and social security benefits, such as parental leave and unemployment benefits. Annual social income transfers are calculated by subtracting annual wage and salary earnings and self-employment income from total annual taxable income. Lifetime income transfers are measured by the logarithm of the average social security benefits and income transfers over the 1990-2009 period. Both income measures and social income transfers are deflated to 2009 euros using the consumer price index of Statistics Finland.

The sufficient condition for a twin pair to be included in the analyses is that we observe the labor market outcomes for the twin pair at least once (one year) during the observation window of 1990-2009. Thus, we do not make the assumption that everyone in the sample should be working and have positive earnings for the entire 20-year time period. Accordingly, when an individual becomes retired, his/her subsequent person-year observations are excluded from the calculation of labor market outcomes.

Assessment of stressful life events

The SLE index is measured by the weighted sum of experiencing negative life events using self-reported data from the 1990 survey. The twin data contain a 17-item Holmes and Rahe life event inventory. The twins were requested to indicate which SLEs they had experienced and to specify the timing of the events as follows:

1 – ‘Never’

2 – ‘During the last six months’

3 – ‘During the last five years (excluding the events during the first 6 months)’

4 – ‘Happened to me earlier’

A thorough description of the construction of the SLE index is provided in earlier publications (Lillberg *et al*., 2003; Riese *et al*., 2013) that used the twin data from the 1981 survey. Of the 17 items, 11 were initially rated as negative (Riese *et al*., 2013). There was some disagreement on two items as being negative (‘Marked increase in work load’ and ‘Marked change in the health of a family member’). However, Riese *et al*. (2013) found that the results were not sensitive to the manner in which they calculated the SLE index, whether they used 9 or 11 items of negative SLEs. This finding is important because we use data from the 1990 survey for SLEs that do not include the question that reveals whether an individual has experienced a ‘Marked increase in work load’. According to Riese *et al*. (2013), using 10 items instead of 11 to calculate the SLE index should not have an impact on our main results.

The SLE index was calculated as the weighted sum of these 10 items. Prior findings suggest that the impact of life events at a low frequency is larger compared with those at a high frequency (Masuda and Holmes, 1978). The weights for the SLEs were calculated as the inverse of the lifetime prevalence (1 minus prevalence) of each negative SLE within our sample.[1] The prevalence was defined as ever having experienced the specific SLE. Those subjects who had more than two items missing were excluded. Analogously to Riese

[1] This method closely tracks the use of ‘Life Change Unit’ (LCU) weights that originate from the Social Readjustment Rating Scale (SRRS) (Holmes and Rahe, 1967). These weights are measured on the basis of the extent to which particular SLEs are assumed to require adaptive behavior. For example, widowhood has the highest weight (100). We use this weighting method in the robustness tests.

et al. (2013), if subjects had less than three missing SLE items, then they were coded as 'never experiencing'. The SLE index was standardized to have a mean of zero and a standard deviation of one to obtain easily comparable regression coefficients. The prevalence of each SLE and their weights are documented in Table 1. The non-normalized frequency histogram of the SLE index is presented in Figure 1.

[Table 1 and Figure 1 in here]

Two relevant empirical facts have been established in the literature. First, previous studies have shown that environmental and genetic factors contribute differently to the variance of dependent and independent life events. In particular, dependent life events are explained by genetic factors for the most part, whereas shared and unshared environmental factors are a larger contributor to the variance in independent life events (Bemmels *et al*., 2008). Second, men and women are distressed by distinctly different types of adverse events. Men are primarily more influenced by work and financial events, whereas women are more likely than men to be distressed by various (social) network events and shocks within the family (Kessler and McLeod, 1984; Conger *et al*., 1993; Kendler *et al*., 2001). This finding is consistent with the "cost-of-caring" hypothesis according to which the greater vulnerability of women is explained by a higher emotional engagement in others' lives. Using these stylized empirical facts from previous studies, stressful life events were further categorized into three non-overlapping classes.

Specifically, events were measured by the weighted sum of exposure to negative life events as follows:

1 – *Dependent work and financial events*: Loss of a job, difficulties with a boss or colleagues at work and financial difficulties

2 – *Dependent familial events*: Divorce or separation, difficulties with a spouse, sexual difficulties, and disease or injury leading to more than three weeks of disability from work

3 – *Independent familial events*: Death of a spouse, death of a close relative or friend, and change in the health of a family member

There may be disagreement about 'Disease or injury causing over three weeks of disability from work' being included in the class of dependent familial events. For example, being involved in an accident may be outside the control of an individual person. However, our results are robust to the use of differently categorized classes of events, in which we removed the 'Disease or injury causing…' event from the category of dependent familial events and included it to the class of independent familial events.

Controls

We control for socio-economic characteristics, the number of diseases and previous wage level in all specifications. The socioeconomic confounders include age and age squared, education (measured in years, based on the highest completed education level) and marital status (1 if ever married, as reported in the 1975, 1981 and 1990 twin surveys). The number of chronic diseases (1981) is used to account for the pre-existing health

endowment. The chronic diseases include, among others, emphysema, chronic obstructive pulmonary disease, high blood pressure, angina pectoris, peptic ulcer, diabetes, and gout.

We account for the possibility that the relationship between stressful life events and subsequent labor market outcomes is driven by reverse causality. Early income is strongly correlated with subsequent labor market success. Thus, if early labor market success or failure has affected the experience of negative shocks, then our estimates might reflect reverse or two-way causality, at least in part. Our measure for early labor market success is the individual's annual taxable income in 1980.[2] This information originates from the comprehensive Longitudinal Population Census by Statistics Finland to which the twin data have been linked with personal IDs.

There are several potential mechanisms between experiencing stressful life events and subsequent labor market success. We explore these mechanisms by adding measures for the crucial aspects of health behavior, as well as the measures for mental stability in the additional models as covariates. For example, adverse life events have been found to affect risky health behavior, such as excessive alcohol consumption and smoking (McKee *et al*., 2003, Dawson *et al*., 2005), which lead to substantial losses in the labor market (Böckerman *et al*., 2015a; Böckerman *et al*., 2015b). The health-related controls include smoking and alcohol use. Smoking is measured using pack-years in 1990, which describes lifetime consumption of cigarettes (Böckerman *et al.,* 2015b). Our measure of alcohol use is the extreme case of binge drinking, which is based on the question regarding the pass out frequency during the past 12 months in the 1990 twin survey.

[2] Some of the events may have happened before the initial health endowment and wage level are measured. However, the SLE index is measured in 1990, and most of the events have happened during the last five years, according to the data. The events must have happened over ten years ago for the controls not being pre-determined.

Mental stability is measured using the indicators of neuroticism and extraversion that originate from the 1981 survey. We add neuroticism as an additional control because there is a previously established link between experiencing adverse shocks and neuroticism on the one hand (Kendler *et al*., 2012; Riese *et al*., 2013) and between neuroticism and labor market success on the other hand (Nandi and Nicoletti, 2014). In turn, extraversion may predispose individuals to experience negative life events more positively (Lucas *et al*., 2000). Neuroticism (extraversion) was assessed by 10 (9) items in the short form of the Eysenck Personality Inventory. We also add the use of tranquilizers from the 1990 survey as a covariate, which captures an aspect of mental health. Tranquilizer use has the value of one if the twin reports using a positive quantity of tranquilizers in 1990.

Heritability of stressful life events

Table 2 reports the intra-class correlations of the SLE index and its three classes between DZ and MZ twins. The within-pair correlation of the SLE index is 0.13 for DZ twins and 0.24 for MZ twins. Therefore, MZ twins are much more similar with respect to each other than DZ twins are in their reporting of adverse life events. This pattern is more striking when the dependent and independent life events are analyzed separately. We find that there is no significant discrepancy between the intra-class correlations of independent familial events between DZ and MZ twins (0.08 vs. 0.09). This observation most likely reflects the fact that random shocks are beyond one's own control.

[Table 2 in here]

The results suggest that exposure to negative life events is partly explained by genetic factors. The contribution of heritability is more profound for dependent adverse events. We evaluate this pattern further using the DF-model (DeFries and Fulker, 1985), which yields estimates for the shared environment and heritability of SLE using the following equation estimated by using OLS (Ordinary Least Squares):

$$SLE_{1j} = \alpha_0 + \beta_1 SLE_{2j} + \beta_2 R_j + \beta_3 R_j SLE_{2j} + \varepsilon_{1j}\,, \qquad (1)$$

where SLE_{1j} is the SLE index for twin 1 in family *j*, SLE_{2j} is the SLE index for twin 2 in family *j*, and R is the genetic relatedness (0.5 for DZ twins and 1 for MZ twins). Thus, the variation in experiencing stressful life events is decomposed into components that are attributed to a shared environment (coefficient β_1) and genetic effects (coefficient β_3). The intra-correlation of the outcome variable within MZ twins is, in certain cases, more than twice of that for the DZ twins, i.e., $r_{MZ} > 2r_{DZ}$. This pattern suggests that additive genetic effects may be present, and the model can yield estimates that fall within the categories $\beta_3 > 1$ and/or $\beta_1 < 0$ (Waller 1994). In this setting, the basic DF-model can be re-formulated as:

$$SLE_{1j} = \alpha_0 + \beta_2 R_j + \beta_3 R_j SLE_{2j} + \beta_4 D_j SLE_{2j} + \varepsilon_{1j}, \qquad (2)$$

where D is 0.25 for DZ twins and 1 for MZ twins. Broad-sense heritability is the sum of the parameter estimates $\beta_3 + \beta_4$ and corresponds to the heritability estimate (genetic effect) β_3 in equation (1). Thus, this specification omits the term of shared environment, i.e., we set $\beta_1 = 0$. In both specifications, the double-entry method is used (Cherny *et al*., 1992), which means that each twin is entered twice in the model: once as proband and once

as co-twin. In accordance with Kohler and Rodgers (2001), we calculate the asymptotic standard errors for double-entry twin data.

The estimates for the shared environment and genetic heritability are reported in Table 2 (Columns 3 and 4). The estimated contribution of heritability in the SLE index is 0.23. The estimate for the shared environment is notably lower at 0.005 and statistically insignificant. Under the standard assumptions of the DF-model,[3] the results show that the variation in exposure to adverse shocks is heritable at a rate of 23%. In the case of dependent work and financial events, the estimate for the shared environment is negative, which indicates the presence of additive genetic effect. The intra-class correlations reveal the same pattern. The correlation within MZ twins (0.34) is more than twice the correlation for DZ twins (0.08). The result of our preferred model (equation 2) shows that the heritability is 26%. Interestingly, neither the genetic effects nor the shared environment appear to explain the variation in dependent familial events. The variation in independent familial events (such as the death of a close relative) is statistically significantly explained by the shared environment and the effects of heritability are statistically zero. These results support the external validity for our estimates because Bemmels *et al*. (2008) found similarly that the variance in dependent life events is significantly explained by genetic factors, whereas the shared environmental effects are the largest contributor to the variance in independent familial events.

[3] The DF-model is based on four key assumptions: 1) genes and the environment have additive effects, 2) additive environmental influence is similar for DZ and MZ twins, 3) there is no assortative mating, and 4) there is no correlation or interaction between shared environment and genetic factors (e.g. Behrman and Taubman, 1976). A discussion of the DF-model and criticisms of it are presented in Maczulskij (2013a).

III. Statistical method

Our main econometric analysis is based on the following model:

$$Y_{ij} = \alpha + \beta' SLE_{ij} + f_j + g_{ij} + \varepsilon_{ij} \quad (3)$$

where Y_{ij} is the long-term labor market outcome of twin *i* in twin-pair *j*. SLE_{ij} is the index for past adverse shocks in life, f_j is the unobserved family endowment common to both twins of pair *j*, g_{ij} is the unobserved genetic endowment specific to twin *i* of pair *j*, and ε_{ij} is a random shock to twin *i* of pair *j*.

The equation is first estimated by OLS using cross-sectional variation between individuals. This model provides an estimate for SLE that is denoted by β_{OLS}. Because the SLE index is standardized, β_{OLS} measures in percent terms how much one standard deviation increase in the SLE index is associated with an increase/decrease in a specific long-term labor market outcome Y_{ij}. For β_{OLS} to be a consistent estimator of the coefficient of β, the moment condition $E[f_j + g_{ij} + \varepsilon_{ij} | SLE_{ij}] = 0$ should hold. This condition does not hold if f_j or g_{ij} are correlated with the SLE index. Because f_j and g_{ij} are generally not accounted for in observational data, the omission of these terms yields biased estimates for the association between SLE and subsequent labor market success. For example, a positive correlation between risk-loving behavior and dependent SLEs, such as having a divorce or being involved in an accident that causes injuries, will lead β_{OLS} to overestimate the true value of β.

We use within-twins variation among the DZ twins to difference out the family effects, f_j. In the twin-differenced DZ sample, the estimator is consistent if $E[(g_{2j} - g_{1j}) + (\varepsilon_{2j} - \varepsilon_{1j}) | (SLE_{2j} - SLE_{1j})] = 0$, where the terms inside the brackets refer to the

within-sibling differences of the variables. The condition does not hold if $(g_{2j} - g_{1j})$ is correlated with $(SLE_{2j} - SLE_{1j})$. Furthermore, if the twins are identical, $(g_{2j} - g_{1j}) = 0$. Thus, the genetic effects can also be differenced out. Thus, using within-twins variation among the MZ twins yields an estimator that is denoted by β_{MZ}. If shocks in life are random conditional on genetic endowment, then β_{MZ} is a consistent estimate of β.

There are four possible problems with the twin-based design. First, there is a potential endogeneity problem caused by omitted variables if there are unaccounted variables that affect both adverse life events and subsequent labor market outcomes. Because independent life events are considered to be truly exogenous, this omitted variable bias should be relevant solely in the case of dependent life events. For example, MZ twins can differ in their initial endowments, such as birth weight (Bound and Solon, 1999). Low birth weight has been linked to various adult outcomes, such as lower cognitive ability, lower mental stability (i.e., neuroticism), deficits in social skills (introversion), lower autonomy, lower probability of mating, and poorer labor market outcomes (e.g., Behrman and Rosenzweig, 2004; Black, Devereux and Salvanes, 2007; Kajantie *et al*., 2008; Eryigit-Madzwamude *et al*., 2015). If low birth weight is positively related to experiencing dependent (adverse) life events, then our within MZ twin-pair results would be upward biased because we have no information on birth weight. However, lower mental stability (such as neuroticism) may capture, at least partly, the potential negative effects of low birth weight on both experiencing dependent (adverse) life events and labor market success.

The second problem is that twin-differencing may exacerbate the measurement error problem compared to a conventional cross-sectional analysis (Griliches, 1979; Bound and Solon, 1999). If life event measures were subject to classical measurement error, then our results would be downward biased and lead to conservative estimates for adverse life events. The third potential problem is that SLEs can also happen during the 1990-2009

window. These post 1990 SLEs that are omitted in the linked data thereby potentially confound estimates. It is not unreasonable to think that someone who is 33 in 1990 would have such an event (divorce, death of a parent, spouse or child) over the next 20 years and that that event would affect his or her labor market experience. However, it is typical to exclude the additional shocks later in life also in the earlier literature that has examined the effects of specific shocks on labor market outcomes, and some of these later shocks may also be endogenous with respect to the labor market status. The fourth potential problem is that the SLE index accounts only for negative shocks by construction. It is possible that there are also positive shocks that counter negative ones, buffering the effects on labor market outcomes over the 1990-2009 period. This would imply that we obtain conservative estimates for the effects of negative shocks.

IV. Results

Descriptive evidence

Table 3 documents the mean values of the variables by gender. We also report F-test statistics for the null hypothesis of equal group means in column 3. The means of the variables are consistent with well-known empirical facts. Women have higher scores in the SLE index. Interestingly, this pattern is driven by women experiencing more adversities within the family. Women have weaker labor market success in terms of long-term earnings and employment compared with men; however, they receive less social income transfers over time. Although women drink and smoke less, they have more chronic diseases, and they also use more tranquilizers. Women have higher scores in neuroticism (e.g., Flecher, 2013), whereas men have higher scores in extraversion.

The means of the absolute values of the twin differences in the MZ sample are reported in columns 4 and 5. These statistics show that there is a sufficient amount of within-twin pair variation in the data even among MZ twins, which is a necessary condition for model identification. Therefore, our results do not rely on an idiosyncratic subset of the sample of twins with unusual differences.

type of stressful life event index and individual's basic individual characteristics by gender. The individual characteristics are measured in 1980/1981. Therefore, they are arguably pre-determined for our stress measures to a large extent. The correlations are reported in Table A1 in the Appendix. The results show that the within-MZ differences in initial labor market status (unemployment) and skill-level (wages in 1980 and education level) do not explain the differences in experiencing stressful life events for men. For women we find that previous wage level is positively related to experiencing independent familial events. Personality characteristics are also important in explaining differences in experiencing dependent stressful life events for both genders. The number of chronic diseases and excess alcohol use in 1981 are positively related to experiencing dependent work and financial events for men. For women we find a strong relationship between risky health behaviors and all types of negative events, also regarding independent familial events, such as death of a spouse and illness in the family. This pattern may be explained by non-random mating and convergence (Ask *et al*., 2012).

[Table 3 in here]

Main results

The effects of stressful life events on long-term earnings, employment months and social income transfers are reported in Table 4 for men and in Table 5 for women. The specifications marked with 'A' report the estimates for the SLE index, whereas the specifications marked with 'B' report the estimates for three non-overlapping classes of SLEs: dependent work and financial, dependent familial, and independent familial events. The controls include marital status, education years, the initial number of chronic diseases (1981) and the previous earnings level (1980). The OLS specification (column 1) also controls for age to be comparable with the specifications (columns 2-4) that are estimated using the within-twin pair regressions that automatically account for such an invariant within-twin variable.

We first discuss the results for men. The baseline estimates that use the standard OLS specification reveal that stressful life events are negatively correlated with both long-term earnings and labor market attachment. Negative life shocks are also positively linked to receiving social income transfers over the estimation window. The estimates are economically significant. The estimates show that a one-standard deviation increase in the SLE index is associated with a reduction in average employment months of ~0.5. This decrease corresponds to 10 months over our 20-year observation period. A similar increase in the SLE index is associated with a decrease in average earnings of 9% and an increase in social income transfers of 42%.

The point estimates tend to decrease when we focus on the twin-differenced DZ-MZ model (column 2) and the DZ model (column 3), which both control for shared environment. The overall pattern of the estimation results nevertheless remains the same. The results for the MZ sample (column 4) confirm our earlier findings for earnings and

employment when both shared environmental and genetic factors are controlled for. These preferred estimates reveal that a one-standard deviation increase in the SLE index is associated with a decrease in average employment months of ~0.3 and average earnings of ~5%. To further illustrate the quantitative magnitude of the estimated effects, one-standard deviation increase in the SLE index is roughly equivalent to two additional events of average prevalence or one additional event of low prevalence.

Table 5 reports the estimates for women. The baseline OLS estimates (column 1) are comparable with those for men in Table 4. The results remain unchanged when we focus on the twin-differenced models (columns 2 and 3) that account for shared environmental factors. Using earnings as the outcome variable, our preferred twin-differenced MZ model (column 4) estimate shows that experiencing stressful life events is no longer associated with lower earnings for women when both shared environment and genetic factors are fully controlled for. The estimate for social income transfers in the MZ sample, however, remains statistically significant at 0.34. This point estimate implies that a one-standard deviation increase in the SLE index is associated with an increase of receiving social income transfers by 40%. A similar increase in the SLE index is associated with a decrease in average employment months by ~0.3.

The separate estimates for the three classes of the SLE index are reported in the specifications marked with 'B' in Tables 4-5. Our preferred results for the MZ sample that use earnings as the outcome variable show that men are adversely influenced by work and financial events, whereas women are not distressed by work-related shocks. Using employment as the outcome variable the quantitative magnitude of work-related shocks is also significantly larger for men compared with that for women. Interestingly, experiencing adverse independent familial events, such as the death of a spouse or sickness in the family, is associated with receiving less social income transfers for men and more

for women. A possible explanation for this observation is that work-oriented men may seek support from social networks from their workplaces, which induces them to work more and implies a lesser need for social income transfers. It is also possible that exogenous family shocks lead to a notable increase in social income transfers for women to compensate for lost income because men are usually the primary family breadwinners (cf. Bargain *et al.*, 2012). Thus, men and women respond differently to negative shocks. Our findings are in accordance with the results in Kendler *et al*. (2001) who showed that men are more sensitive to work-related problems, whereas women are more sensitive to various network events, including the death of a spouse.

When we use income transfers as our outcome variable, the estimate of SLE index is highly positive in the DZ sample but not in the MZ sample for men. This suggests that some of the genetic factors are positively correlated with experiencing adverse shock, and especially dependent familial shocks, which could lead to an upward bias in the OLS and within-DZ estimates. One explanation is risk preferences, because risk-loving behavior is positively related to having a divorce (and other problems with a spouse) and disability (e.g.,Light and Ahn, 2010). However, the reverse is true for women: the estimate for experiencing adverse (independent familial) events is higher in the MZ sample than in the DZ sample when we use income transfers as the outcome variable. Because independent familial events are exogenous, and thus independent on genetics, the difference in the DZ and MZ estimates could be explained by differences in the resilience of shocks.

We also took into account that individuals in our sample can only experience the death of a spouse, divorce and marital discord if they are married. To this end, we restricted our sample to married individuals only. There may also be a correlation between age and the type of shock, e.g., losing a spouse after the age of 45 when there are meaningful differences in the marriage market. Both of these additional tests provided

highly comparable results for women. For men, we observed that the estimates were, for the most part, quantitatively similar, but not always statistically significant due to smaller sample sizes (results not reported).

[Tables 4-5 in here]

Robustness checks

To explore the sensitivity of the main results, we have estimated additional specifications. We briefly discuss each of these results.

The main estimation results are based on the standard formulation of the SLE index. However, we have considered the robustness of our estimation results regarding the exact weighting method for the SLE index (results are not reported). First, we set the threshold to zero for missing items. The number of observations decreased from 6,432 to 5,460. The estimates were quantitatively similar, but sometimes only marginally significant. Importantly, the statistical insignificances were not driven by the smaller (absolute) point estimates but a smaller sample size. Second, the results were robust to the use of equal weighting method. Third, we used the weights for an individual SLE from the Holmes and Rahe (1976) scale, i.e., the LCU weights (see the weights in Riese *et al*., 2013, Table 1). These results were highly comparable with the main results, except that the estimates also showed larger effects of familial events on long-run earnings for women.

We have excluded the key control variables from the models (marital status, education, initial health endowment and the previous wage level). The results are stable and the earlier conclusions remain intact. The only exception is that when the previous wage level is excluded from the set of controls, there is a stronger relationship between familial events and labor market outcomes for women. For example, dependent familial

shocks (such as divorce) contribute positively on females' earnings. This result is likely to be driven by reverse causality between females' earnings level and subsequent familial events, such as marital difficulties. This is in line with the results by Johnson and Skinner (1986), who show that women increase their labor supply several years prior to separation.

Additional aspects

We have also examined the role of risky health behavior (alcohol consumption and smoking) and mental stability (neuroticism, extroversion and the use of tranquilizers) as potential mediators in the relationship between stressful life events and subsequent labor market outcomes. This examination is an important extension of the earlier literature because stress may trigger changes in substantial health behavior, such as excessive alcohol consumption (McKee *et al*., 2003; Dawson *et al*., 2005), which leads to serious difficulties in the labor market (Böckerman *et al*., 2015a). We use the within-twin pair variation for these variables to explore the robustness of our within twin results for three classes of the SLE index. The earlier results for the SLE indexes remain intact, showing that the negative effects of adverse shocks on labor market outcomes are not primarily caused by health behaviors.[4]

Finally, we used an alternative measure for (weak) labor market attachment, namely the average number of unemployment months. Our preferred within-MZ results show that stressors are positively related to unemployment months in the long run and that this

[4] We do not include the measures for risky health behavior as controls in the baseline models because smoking and drinking are measured in 1990 based on recall (with likely measurement error) and are also likely to change over the 20-year time span used for labor market outcomes. Moreover, changes in health behavior between 1990-2009 could be endogenously related to unobserved SLEs during this time period.

relationship is entirely explained by experiencing adverse work and financial events. The estimate is approximately 0.29 for both genders, indicating that a one-standard deviation increase in the stressors related to work and financial events is associated with an increase in average unemployment months by ~0.3 (not reported in tables).

Timing of stressful life events and labor market outcomes

Hedonic adaptation refers to the psychological process in which individuals return to their earlier baseline level of happiness following a change in external life circumstances. Misheva (2015) found that more recent traumatic events, such as an assault or rape, have a much greater impact on various aspects of emotional well-being. Another interesting study is by Clark *et al*. (2008) who provided evidence on the adaptation hypothesis for experiencing several life events, such as divorce, widowhood and layoff. Using German panel data that allows Clark *et al.* (2008) to follow individuals over time, they have also reported that there is an incomplete adaption to unemployment for men.

We analyze the adaptation to stressful life events using labor market success as the outcome variable. This analysis is possible because our twin data contain systematic information on the timing of various adverse shocks. We used this information to distinguish between recent (the last six months), later (during the last 5 years excluding the latest six months) and distant (occurred over five years ago) SLEs as measured by the weighted sum of the events.

The estimates from our preferred within MZ twin-pair specification are reported in Table 6. These results confirm the overall validity of the adaptation hypothesis. It appears that more recent adverse events matter more for men. Women are also affected by the

events that occurred to them during the last five years. For both men and women, none of the distant events matter for subsequent labor market success.

We have estimated models that examine the adaptation to shocks also using the three non-overlapping indexes because individuals may adapt to different shocks in different amounts of time. The results using the long-term labor market outcomes with the separate classes of adverse shocks are broadly consistent with the patterns using the overall SLE index (not reported). The only exception is that more distant independent familial events are associated with receiving less social income transfers for men.

[Table 6 in here]

5. Conclusions

Life is full of stressors. Negative shocks include events such as job loss, divorce and the onset of major illness. Adverse life events may have long-lasting effects on an individual's ability to earn and be employed. This paper explores the relationship between past stressful life events and long-term labor market success using a twin design. The earlier literature in economic research has examined the effects of specific shocks, such as mass lay-offs or the onset of divorce, on subsequent labor market outcomes. Our contribution is that we used comprehensive measures for stressful life events that capture the full spectrum of negative shocks that individuals are forced to cope with in their lives. Focusing on single separate shocks does not account for this.

We use data on Finnish twins linked to comprehensive register-based, individual-level information on earnings and employment status. The long-term labor market outcomes are measured in adulthood. To identify the effects, we use twin data because the literature has shown that family environment and genetics have a profound role in

predisposing individuals to experience stressful life events in certain ways. Thus, we exploit the within-twin dimension of the linked data to fully account for both unobservable family and genetic confounders.

Our main finding is that stressful life events are an important, but neglected, determinant of long-term labor market outcomes. Using within-twin pair estimations for monozygotic twins, we find that those who have previously experienced stressful life events have significantly weaker long-term labor market attachment. Adverse shocks are also negatively linked to earnings for men and positively linked to receipt of social income transfers for women. These findings are robust to using comprehensive health-related controls.

We also establish two other important empirical patterns. First, there is a notable difference between men and women regarding the importance of different types of shocks. Men are influenced by work and financial events, whereas women are more likely than men to be distressed by events within the family. Second, people adapt to shocks. We find support for the adaptation hypothesis that states that recent adverse life events matter more for subsequent labor market outcomes. The results show that men adapt faster than women to negative life effects using labor market success as a metric.

The fact that stressful life events profoundly matter for long-term labor market outcomes provides support for the role of social insurance and other policies that accommodate these shocks. The results are obtained within a Finnish setting. Finland is a much smaller, more culturally homogenous country with a more robust welfare state than some other EU countries or the US. We clearly need more evidence on the impact of stressful life events in other cultural and institutional settings.

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Tables and Figures

Figure 1. Histogram of the SLE index

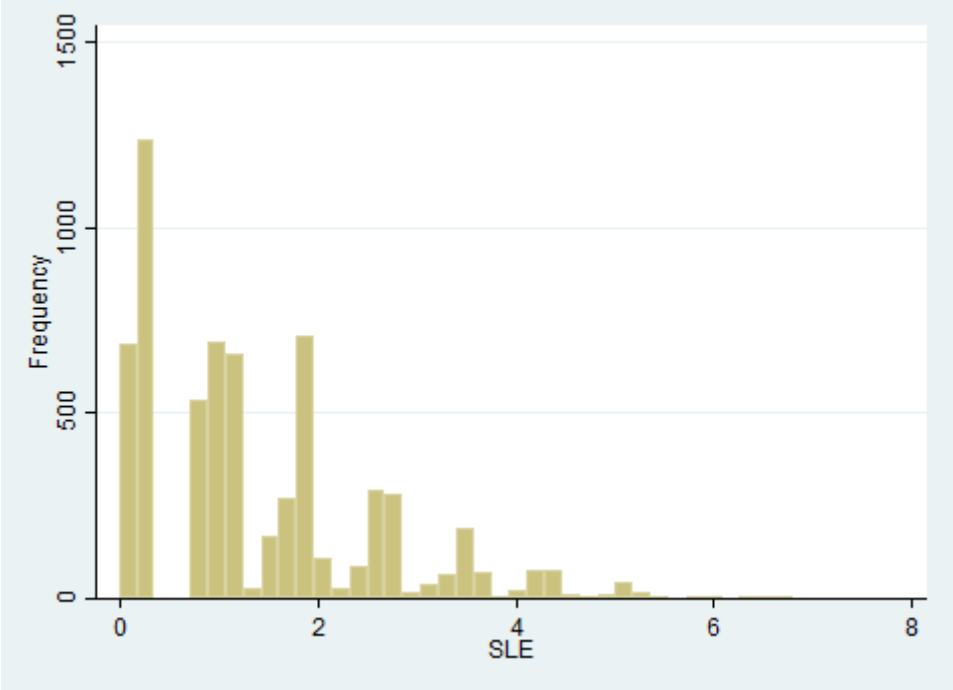

Table 1. Prevalence of each stressful life events and SLE weights.

	Prevalence SLEs, %	SLE weight
Death of a spouse	2.7	0.973
Loss of a job	10.5	0.895
Divorce or separation	11.6	0.884
Marked increase in difficulties with spouse	15.1	0.849
Marked difficulties with boss or colleagues at work	19.2	0.808
Marked worsening in financial situation	20.2	0.798
Difficulties in sexual nature	21.9	0.781
Disease or injury causing over 3 weeks work disability	25.1	0.749
Marked change in the health of a family member	27.5	0.725
Death of a close relative or good friend	70.7	0.293

Table 2. Intra-class correlations and OLS estimates of DF-model.

	Intra-class correlations		OLS estimates of DF-model	
	DZ-twins	MZ-twins	Genetic	Shared environment
SLE	0.13 ***	0.24 ***	0.234 (0.077) ***	0.005 (0.055)
SLE dependent financial	0.08 ***	0.34 ***	0.258 (0.033) ***	..
SLE dependent familial	0.10 ***	0.13 ***	0.120 (0.078)	0.038 (0.056)
SLE independent familial	0.08 ***	0.09 ***	0.009 (0.077)	0.112 (0.055) **

Notes: *** ($p < 0.010$), ** ($p < 0.050$)

Table 3. Summary statistics by gender

	Men	Women	F-test	Within MZ differences, men	Within MZ differences, women
SLE					
SLE index	-0.051	0.038	12.37 ***	0.86	0.98
SLE, dep. work & financial	0.020	-0.015	1.85	0.79	0.75
SLE, dep. Familial	-0.046	0.034	10.37 ***	0.87	0.93
SLE, indep. Familial	-0.101	0.074	50.55 ***	0.86	0.92
Outcomes					
Earnings, euros	23,969	17,145	553.57 ***	8,721	6,639
Social income transfers, euros	2,461	2,041	17.42 ***	2,622	2,221
Employment, months	10.01	9.53	37.65 ***	1.99	2.56
Basic controls					
Age	43.2	42.1	35.13 ***	0	0
Education, years	12.0	11.8	8.00 ***	1.17	1.03
Married, dummy	0.80	0.80	0.19	0.19	0.24
No. of diseases in 1981	0.62	0.75	32.66 ***	0.71	0.72
Earnings in 1980, euros	20,230	11,991	886.48 ***	7,971	6,059
Mediators					
Smoking, pack-years in 1990	10.13	4.00	446.79 ***	6.89	3.22
Passing out in 1990, dummy	0.20	0.07	219.65 ***	0.24	0.10
Tranquilizer use, dummy	0.09	0.13	33.51 ***	0.14	0.20
Extraversion	0.055	-0.041	14.56 ***	0.79	0.75
Neuroticism	-0.101	0.074	48.29 ***	0.90	0.77
Number of obs.	2,732	3,700		483	700

Notes: Heteroscedasticity-robust F-test statistics for the null hypothesis of equal group means. *** ($p < 0.010$). Within-MZ twin differences: the means of the absolute values of the twin differences in the MZ sample.

Table 4. Regressions of long-term earnings, income transfers and employment for men.

	All twins (1)	DZ – MZ sample (2)	DZ sample (3)	MZ sample (4)
	OLS regressions	Twin-differences	Twin-differences	Twin-differences
Log(earnings)				
A. SLE index	-0.090 (0.017) ***	-0.075 (0.022) ***	-0.088 (0.029) ***	-0.048 (0.028) *
B. SLE 3 classes:				
SLE dep. work & financial	-0.130 (0.016) ***	-0.087 (0.020) ***	-0.100 (0.026) ***	-0.068 (0.026) ***
SLE dep. familial	-0.004 (0.016)	-0.022 (0.021)	-0.041 (0.030)	0.016 (0.023)
SLE ind. familial	0.036 (0.015) **	0.025 (0.018)	0.058 (0.024) **	-0.025 (0.025)
Log(income transfers)				
A. SLE index	0.354 (0.048) ***	0.238 (0.070) ***	0.280 (0.082) ***	0.128 (0.130)
B. SLE 3 classes:				
SLE dep. work & financial	0.379 (0.047) ***	0.240 (0.069) ***	0.236 (0.082) ***	0.206 (0.130)
SLE dep. familial	0.138 (0.054) **	0.165 (0.076) **	0.206 (0.096) **	0.104 (0.129)
SLE ind. familial	-0.119 (0.057) **	-0.182 (0.076) **	-0.165 (0.098) *	-0.227 (0.125) *
Employment months				
A. SLE index	-0.474 (0.065) ***	-0.331 (0.090) ***	-0.337 (0.110) ***	-0.307 (0.153) **
B. SLE 3 classes:				
SLE dep. work & financial	-0.636 (0.065) ***	-0.476 (0.087) ***	-0.489 (0.114) ***	-0.460 (0.125) ***
SLE dep. familial	-0.059 (0.066)	-0.022 (0.090)	0.001 (0.116)	-0.053 (0.139)
SLE ind. familial	0.171 (0.060) ***	0.139 (0.078) *	0.137 (0.100)	0.151 (0.120)
Number of obs.	2,732	1,366	883	483

Notes: Standard errors are robust to within-twin variation. *** ($p < 0.010$), ** ($p < 0.050$), * ($p < 0.100$). Additional controls include number of chronic diseases, marital status, education years and previous earnings level. OLS specification in Colum1 also controls for age and age squared.

Table 5. Regressions of long-term earnings, income transfers and employment for women.

	All twins (1)	DZ – MZ sample (2)	DZ sample (3)	MZ sample (4)
	OLS regressions	Twin-differences	Twin-differences	Twin-differences
Log(earnings)				
A. SLE index	-0.037 (0.014) ***	-0.040 (0.018) **	-0.064 (0.024) ***	-0.001 (0.024)
B. SLE 3 classes:				
SLE dep. work & financial	-0.070 (0.014) ***	-0.061 (0.018) ***	-0.074 (0.023) ***	-0.035 (0.025)
SLE dep. familial	0.027 (0.013) **	0.014 (0.017)	0.009 (0.022)	0.039 (0.025)
SLE ind. familial	-0.021 (0.013)	-0.019 (0.018)	-0.025 (0.024)	-0.016 (0.026)
Log(income transfers)				
A. SLE index	0.298 (0.041) ***	0.271 (0.064) ***	0.230 (0.086) ***	0.335 (0.091) ***
B. SLE 3 classes:				
SLE dep. work & financial	0.178 (0.044) ***	0.186 (0.066) ***	0.183 (0.089) **	0.188 (0.095) **
SLE dep. familial	0.122 (0.041) ***	0.054 (0.058)	0.049 (0.075)	0.050 (0.094)
SLE ind. familial	0.144 (0.041) ***	0.185 (0.059) ***	0.120 (0.076)	0.289 (0.095) ***
Empoyment months				
A. SLE index	-0.253 (0.059) ***	-0.280 (0.078) ***	-0.309 (0.104) ***	-0.234 (0.116) **
B. SLE 3 classes:				
SLE dep. work & financial	-0.344 (0.062) ***	-0.333 (0.077) ***	-0.384 (0.099) ***	-0.244 (0.120) **
SLE dep. familial	-0.045 (0.059)	-0.047 (0.076)	-0.054 (0.099)	-0.024 (0.116)
SLE ind. familial	0.043 (0.055)	-0.022 (0.076)	0.014 (0.101)	-0.094 (0.114)
Number of obs.	3,700	1,850	1,150	700

Notes: Standard errors are robust to within-twin variation. *** ($p < 0.010$), ** ($p < 0.050$), * ($p < 0.100$). Additional controls include number of chronic diseases, marital status, education years and previous earnings level. OLS specification in Colum1 also controls for age and age squared.

Table 6. Within MZ twin-pair regressions of long-term earnings, social security benefits, employment and self-employment: timing of SLE

	(1)	(2)	(3)
Men	*Log(earnings)*	*Log(income transfers)*	*Employment*
SLE, in the past 6 months	-0.072 (0.026) ***	0.268 (0.123) **	-0.239 (0.126) *
SLE, in the past 5 years	-0.035 (0.023)	0.145 (0.132)	-0.222 (0.122) *
SLE, over 5 years ago	0.011 (0.025)	-0.137 (0.123)	-0.088 (0.152)
Other controls	Yes	Yes	Yes
Women	*Log(earnings)*	*Log(income transfers)*	*Employment*
SLE, in the past 6 months	-0.004 (0.025)	0.242 (0.076) ***	-0.093 (0.116)
SLE, in the past 5 years	0.013 (0.027)	0.294 (0.091) ***	-0.219 (0.132) *
SLE, over 5 years ago	-0.011 (0.024)	0.065 (0.090)	-0.092 (0.102)
Other controls	Yes	Yes	Yes

Notes: Standard errors are robust to within-twin variation. *** ($p < 0.010$), ** ($p < 0.050$), * ($p < 0.100$). Number of observations: 483 for men and 700 for women. Other controls include number of chronic diseases, marital status, education years, and previous earnings level.

Appendix

Table A1. Within-MZ correlations between stressful life events and individual characteristics

Men	SLE index	SLE, dep. work & financial	SLE, indep. Familial	SLE, dep. Familial
No. of diseases, 1981	0.07	0.08 *	-0.03	0.07
Smoking, pack-years in 1981	0.07	0.05	0.03	0.05
Alcohol use, 1981	0.11 **	0.08 *	0.06	0.06
Extraversion, 1981	-0.003	0.002	0.06	-0.04
Neuroticism, 1981	0.23 ***	0.16 ***	-0.01	0.22 ***
Wages in euros, 1980	0.05	0.01	-0.001	0.07
Unemployment, 1981	-0.004	0.02	-0.03	-0.001
Education years, 1981	0.01	-0.04	0.02	0.04
Women	**SLE index**	**SLE, dep. work & financial**	**SLE, dep. Familial**	**SLE, indep. Familial**
No. of diseases, 1981	0.13 ***	0.12 ***	0.09 **	0.08 **
Smoking, pack-years in 1981	0.14 ***	0.06	0.08 **	0.14 ***
Alcohol use, 1981	0.08 **	-0.03	0.12 ***	0.08 **
Extraversion, 1981	-0.10 **	-0.10 ***	-0.03	-0.07 *
Neuroticism, 1981	0.10 **	0.07 *	0.05	0.08 **
Wages in euros, 1980	0.09 **	0.01	0.02	0.13 ***
Unemployment, 1981	0.02	0.05	0.02	-0.01
Education years, 1981	-0.01	-0.03	-0.01	0.01