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A fresh look at self-employment, stress and health: Accounting for self-selection, time, and gender

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Abstract

Purpose: Past research on self-employment and health yielded conflicting findings. Integrating predictions from the Stressor-Strain Outcome model, research on challenge stressors and allostatic load, we predict that physical and mental health are affected by self-employment in distinct ways which play out over different time horizons. We also test whether the health impacts of self-employment are due to enhanced stress (work-related strain) and differ for men and women.

Methodology: We apply non-parametric propensity score matching in combination with a difference-in-difference approach and longitudinal cohort data to examine self-selection and the causal relationship between self-employment and health. We focus on those that transit into self-employment from paid employment (opportunity self-employment) and analyse strain and health over four years relative to individuals in paid employment.

Findings: Those with poorer mental health are more likely to self-select into self-employment. After entering self-employment, individuals experience a short-term uplift in mental health due to lower work-related strain, especially for self-employed men. In the longer-term (4 years) the mental health of the self-employed drops back to pre-self-employment levels. We find no effect of self-employment on physical health.

Originality/value: This article advances research on self-employment and health. Grounded in stress theories it offers new insights relating to self-selection, the temporality of effects, the mediating role of work-related strain, and gender that collectively help to explain why past research yielded conflicting findings.

Practical implications: Our research helps to understand the nonpecuniary benefits of self-employment and suggests that we should not advocate self-employment as a 'healthy' career.

Key words: self-employment, work-related stress, mental health, physical health, propensity score matching, time, Understanding Society

Introduction

Today, more people than ever before are choosing self-employment. The self-employed are those who work for their own account and risk (cf. Hebert and Link, 1982), for example, through running their own limited company or as a sole trader. In the UK, the growth of self-

employment in the last decade is seen as supporting the country's recent economic recovery (Wales and Amankwah, 2016). Paradoxically, the risk-taking self-employed are often rewarded by a sustained loss of income after moving from employment into self-employment (Carter, 2011; Patel and Ganzach, 2018). This led to suggestions that the self-employed are compensated for by nonpecuniary benefits (Xu and Ruef, 2004) such as autonomy or procedural utility (Benz and Frey, 2008) and consequently have higher mental and physical health and wellbeing than the wage employed (Stephan, 2018; Nikolova, 2019).

Yet, research comparing the mental and physical health of self-employed individuals with those of employees is marked by mixed and inconclusive findings. Some studies document health benefits of being self-employed (Nikolova, 2019; Stephan and Roesler, 2010), other studies find lower health among the self-employed (e.g., Benavides, Benach, Diez-Roux and Roman, 2000; Cardon and Patel, 2015; Patel, Wolfe and Williams, 2019) and still other studies find no differences (e.g., Dolinksy and Caputo, 2003; Perry and Rosen, 2001) between the self-employed and employees. This study builds on the Stressor-Strain-Outcome model (Koeske and Koeske, 1993) to unpack the mixed findings of past research. Firstly, it assesses work-related strain as a key stress process through which self-employment may affect health. Secondly, it draws attention to the timing of effects as work stress does not impair health immediately. Thirdly, it accounts for the possibility that more stress-resistant individuals or those with prior health problems selectively self-select into self-employment. Finally, this study also examines whether health benefits possibly accrue for some self-employed but not others and in doing so draws attention to the gendered nature of self-employment (e.g., Minniti, 2009).

There is broad agreement in the literature that the work characteristics of the self-employed differ from those in employment (Stephan, 2018 for a review). Working for oneself entails high amounts of autonomy (Benz and Frey, 2008) as well as high levels of stressors such as uncertainty, high workload, long hours and complex tasks (e.g., Rauch, Fink and Hatak, 2018). Yet research rarely investigates the experience of strain (i.e. 'stress')[1] resulting from the combination of autonomy and stressors which is the key mechanism in the development of poor health outcomes (see Stressor-Strain-Outcome model, Koeske and Koeseke, 1993). Indeed, research findings on whether the self-employed experience more or less 'stress' than employees are also mixed (e.g. Hessels, Rietveld and Van der Zwan, 2017 find less stress, Cardon and Patel, 2015 find more stress among the self-employed), and they are rarely measured and related to health outcomes in the same study[2]. Moreover, the timing of stress and

health effects of self-employment remains poorly understood. For instance, even studies drawing on longitudinal or cohort data typically aggregate these data rather than investigate the development of strain or health over time (e.g. Nikolova, 2019)[3].

Stress processes do not affect health overnight but unfold over time. In the short-term, exposure to stressors results in the mobilization of extra energy (Selye, 1976) and can improve performance and possibly mental health. For instance, research on employees has documented positive effects of so-called challenge stressors which overlap with the key stressors commonly argued to be characteristics for the work of the self-employed such as high workload and demands, complexity, and high levels of responsibility (e.g., Cavanaugh, Boswell, Roehling, & Boudreau, 2000). Yet continued long-term exposure to high levels of stressors results in the build-up of the physiological stress response (allostatic load) that is a precursor to the development of mental and physical illness (McEwen, 1998, 2004).

Finally, there is an increasing recognition that answering whether the self-employed experience better or worse health than employees requires accounting for selection bias. This is because particular types of individuals may be more likely than others to pursue self-employment. While there is some agreement that self-selection is likely important (Stephan, 2018), authors differ in their views of the type of self-selection taking place. Some suggest that particular stress-resistant individuals become self-employed (Baron, Franklin and Hmieleski, 2016) whereas others suggest that those with existing physical or mental health issues may be more likely to opt for self-employment (Rietveld, van Kippersluis and Thurik, 2015; Wiklund, Hatak, Patzelt and Shepherd, 2018).

The purpose of this research is to address the above concerns within one study based on a conceptual model that integrates insights from the Stressor-Strain-Outcome model with research on challenge stress and allostatic load to understand how self-employment may affect mental and physical health in unique ways over time (specifically, a period of four years) and to examine the mediating role of strain. In an extension of extant research, our study first empirically establishes whether self-selection into self-employment takes place and then accounts for its effects when relating self-employment to mental and physical health over time. We use a cohort sample from *Understanding Society* a large longitudinal household study in the UK and focus on individuals who enter self-employment from employment (at t_0) and compare these to those who stay in employment over the same time period (at t_0, t_1 and t_2, i.e.

2 and 4 years). Thus, our approach limits known heterogeneity in self-employment by focussing on so-called opportunity self-employment in contrast to self-employment out of unemployment, i.e. necessity entrepreneurship (Binder and Coad, 2016; Nikolova, 2019). We further examine possible gender differences in strain and health outcomes.

We make several contributions to the literature. First, by combining the matching methodology with the difference-in-difference approach and longitudinal data, we can empirically estimate and then control for self-selection effects as well as generate causal insights into the link of self-employment and health. In terms of the nature of self-selection effects, we find that those with *lower* mental health are more likely to self-select into self-employment in line with the view that self-employment offers flexibility to tailor work arounds one's individual needs (Wiklund et al., 2018). Put differently, individuals with lower health capital proactively seek out the nonpecuniary benefits of self-employment. Thus our findings offer novel evidence to the debate on whether those with better or lower health self-select into self-employment (Rietveld et al; 2015; Wiklund et al., 2018). Methodologically, our study advances quantitative theory-testing entrepreneurship and health research by obtaining estimates of the causal impact of self-employment on mental and physical health in a way that aligns with calls for studies to use standard matching estimators in combination with difference-in-differences methodology to improve the quality of nonexperimental data (Blundell and Costa Dias, 2000, also Anderson, Wennberg and McMullen, 2019). The difference-in-differences matching estimator has the additional advantage of eliminating unobserved time-invariant differences in health between self-employed individuals and wage employees that standard matching estimators fail to eliminate (Smith and Todd, 2005). Our research design and analytical approach thus facilitate improved causal inference that helps to make more accurate predictions about entrepreneurship and health phenomena.

Second, building on recent calls that entrepreneurship research needs to pay more attention to time and temporal processes (Levesque and Stephan, 2020), we reveal a new temporal effect of self-employment on work stress and mental health. This effect is consistent with a honeymoon effect of those who newly engage in self-employment and with shorter-term positive effects of challenge stressors (which are prevalent in the work of the self-employed), but which wear off over time. Moreover, we identify empirically a key theoretical mechanism informed by the Stressor-Strain-Outcome model: the temporary uplift in mental health is due to (mediated by) the self-employed experiencing lower work-related strain (less job-related

depressive affect and anxiety). Our findings, tracing a population-representative sample of newly self-employed and of wage employees over four years, suggest that the health benefits of self-employment may have been exaggerated in past research. Although entering self-employment provides a temporary emotional uplift and higher mental well-being, in the longer-term (four years) these effects appear to wear off. Moreover, we could not identify any impact on physical health. In sum, considering the timing of effects helps to understand why past research reports conflicting finding for mental health and stress, both are only temporarily enhanced.

Finally, our findings extend research on the gendered nature of self-employment to stress and health. We find that the uplift in mental health driven by lower work-related strain is only experienced by self-employed men, not by self-employed women. These findings help to identify the boundaries of the mechanism through which self-employment affects health and add to the body of research on heterogeneity in entrepreneurship. To date this research has focussed on contrasting opportunity and necessity entrepreneurs (broadly understood, see Stephan, 2018 for a review). Our study instead showcases important gender-based heterogeneity in a sample of opportunity entrepreneurs and raises concerns on how self-employed women can experience the well-being benefits of self-employment.

The remainder of the paper is structured as follows. In Section 2 we review the literature on self-employment and health followed by elaborating our hypotheses. Section 3 explains data and methodology. Section 4 describes the empirical results and Section 4 discusses the results.

Literature review

Thriving organisations depend on having a healthy and productive workforce. Likewise, high performing new firms depend on having healthy and productive entrepreneurs. Nonetheless, many societies now face a mounting challenge of stress and health in the workplace. The World Health Organization (WHO) defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.[4] An independent review of mental health and employers in the UK reveals that around 15% of people at work have symptoms of an existing mental health condition and that the annual cost of poor mental health to employers is between £33 billion and £42 billion (Stevenson and Farmer, 2017). Self-employed people work in environments considerably different from their organisationally-employed counterparts. They are frequently burdened by uncertainty, market fluctuations, and

threat of loss of assets, which incurs considerable stress and impairs health (Rauch et al., 2018; Tetrick, Slack, Da Silva & Sinclair, 2000). However, whether they experience better or worse health at work than employees is still a matter of conceptual and empirical inquiry. Results comparing the mental and physical health of the self-employed and employees have been mixed and inconclusive. Appendix 1 provides details of individual studies. In the following, we give an overview.

First, there are studies that found a positive relationship between self-employment and mental or physical health. For example, Stephan and Roesler (2010) compared entrepreneurs' and employees' health in a national representative sample from the German National Health Survey 1998 where mental and physical health were diagnosed by physicians and supplemented with physiological measure. Employing a case-control design, they found that entrepreneurs showed significantly better overall mental and physical health as well as lower blood pressure, lower prevalence rates of hypertension, and somatoform disorders. Yoon and Bernell (2013) investigated the effect of self-employment on health, access to health care, and health behaviors. They analyzed 13,435 self-employed and salaried workers in the US. They found that self-employment is positively associated with perceived physical health, and is negatively associated with having diabetes, high blood pressure, high cholesterol and arthritis. Mental health outcomes were not significantly associated with self-employment. Rietveld, Bailey, Hessels and van der Zwan (2016) examined the relationship between health and entrepreneurship on a sample of 4555 business owners and wage-workers in four Caribbean Basin countries. Health status was measured by an index comprising five dimensions (mobility, self-care, ability to perform usual activities, pain/discomfort, anxiety/depression). They found that business owners were healthier than wage-workers. Goncalves and Martins (2018) examined the impact of self-employment on health as measured by hospital admissions based on a representative sample of 100,000 individuals for the period from 2005 to 2011 in Portugal. They found that the likelihood of hospital admission of self-employed individuals is about half that of wage workers. Nikolova (2019) studied the physical and mental health consequences of self-employment, utilizing German longitudinal data for the period 2002–2014. She found that necessity entrepreneurs experience improvements in their mental but not physical health, while opportunity entrepreneurship leads to both physical and mental health gains. Tetrick et al. (2000) compared business owners with wage workers and examined stressors and occupational health in a sample of 160 self-employed individuals and wage workers from Michigan, USA. They found that business owners experienced less emotional exhaustion.

Second, other studies find a negative relationship between self-employment and health. For example, Jamal (1997) examined the relationship between work experience and well-being in a sample of 235 self-employed and employed individuals in Canada. He found that the self-employed experienced more psychosomatic health problems, although there were no differences in mental health. Benavides, Benach, Diez-Roux & Roman (2000) compared associations between types of employment and health indicators in a sample of 15146 self-employed and employed individuals in 15 EU countries from the Second European Survey on Working Conditions in 1995. Health was measured by three health indicators (overall fatigue, backache, and muscle pain). They found that the self-employed were more likely to report fatigue and backache. Benach, Gimeno, Benavides, Martinez & del Mar Torné (2004) conducted a follow-up study using survey data from the Second (1995) and Third (2000) European Survey on Working Conditions. They came to the similar conclusion. Andersson (2008) investigated happiness and health between the self-employed and wage earners, using data from the Swedish Level-of-Living Survey from 1991 and 2000. Health was measured by two indicators, namely mental health problems and poor general health. She found that becoming self-employed enhanced the probability of having mental health problems, although there were no differences in general health between wage-earners and the self-employed.

Lee and Kim (2017) examined the effect of transition into self-employment on physical health, using longitudinal panel data from five Waves of the Korea Retirement and Income Study. They found that those who became self-employed experienced significantly greater odds of reporting subjective poor physical health. Patel, Wolfe and Williams (2019) used three different studies to examine the relationship between self-employment and allostatic load, i.e. a compound index made up of several physiological indicator (e.g. neuroendocrine, cardiovascular, immune) and representing a physiologically accumulated stress response (McEwen, 1998). They found that self-employment is marginally positively related to allostatic load and that allostatic load marginally mediates the relationship between self-employment and physical, but not mental, health. They also found that those who are self-employed for longer periods have a higher allostatic load, suggesting overall poor physical health.

Thirdly, there are studies that have found no differences in overall health conditions between the self-employed and organizationally-employed workers. For example, Dolinsky and Caputo (2003) investigated health and female self-employment, using data from the Mature Women's

Cohort of the National Longitudinal Survey of Labor Market Experience (NLSLME) in the United States. They found that self-employment had no significant effect on health status. Similarly, Parslow, Jorm, Christensen, Rodgers, Strazdins & D'souza (2004) examined the associations between work stressors and mental health in organizationally employed and self-employed workers, and with the numbers of general practitioner (GP) services used by these two employment groups. Using data from the PATH Through Life Project in Australia, they found that self-employment offered men no health benefit. However, women who were self-employed reported worse physical health than their organizationally employed counterparts. Toivanen, Griep, Mellner, Vinberg & Eloranta (2016) analysed mortality differences between the self-employed and paid employees, using the Total Population Register data in Sweden. They found mixed results. Mortality is lower among those self-employed who run a limited liability company, but mortality is higher among those self-employed operating as sole proprietors in the trade and transportation sector.

These mixed findings in the existing literature render it difficult to draw general conclusions about the relationship between self-employment and health. Such contrasting evidence and gaps in our understanding encourage a closer examination of the precise nature and causes of the nonpecuniary benefits with regard to health that may be derived from self-employment. While the reason for the inconsistent findings of past research are likely numerous[5], we believe among the most relevant and interesting for enhancing our understanding of self-employment and health are the following concerns: a lack of accounting for self-selection and for the timing of effects, as well as a weak understanding of the mediating stress processes and the gendered nature of entrepreneurship and self-employment. We discuss them in turn.

Self-selection

There is some recognition in the entrepreneurship literature that self-selection into entrepreneurship may take place, yet past research on entrepreneurship and health rarely accounts for self-selection (see Appendix 1, column ‘endogenous selection control’). An example of a study that accounts for self-selection and where doing so alters the effect of self-employment on health is Rietveld, van Kippersluis and Thurik (2015). They examined self-employment and health in a sample of 13449 self-employed and employed individuals from the United States (1992-2010) Health and Retirement Study. Health was measure by three indicators: number of health conditions, self-reported health and mental health. The self-employed were generally healthier than wage workers, both in terms of subjective health

outcomes as well as in more objective outcomes such as the absence of chronic conditions. However, their results suggest that the health differences can be attributed to a selection effect, namely healthier individuals self-select into self-employment. Two other studies employ propensity score matching or case-control designs to account for systematic differences in demographic profiles and occupational contexts between self-employed and organisationally employed (Cardon and Patel, 2015; Stephan and Roesler, 2010). However, they do not compare result with and without matching thus it is unclear to what extent the relationship between self-employment and health may be altered. One further notable approach was Nikolova (2019) who combined entropy balancing with difference-indifference (DID) to account for self-selection problems.

The theoretical discussion regarding self-selection is also little developed. Some authors suggest that particular stress-resistant individuals become self-employed, and this is linked to specific personality traits such as hope, optimism, resilience and self-efficacy (Baron, Franklin and Hmieleski, 2016). However, these specific traits are also closely related with mental health, for instance, they correlate negatively with anxiety or depression (Arvey et al., 2011). This speaks for a self-selection effect similar to that identified by Rietveld et al. (2015), namely that healthier individuals self-select into self-employment. Considering that the self-employed work long and intense hours and must deal with many stressors, it seems plausible that it would attract healthier individuals. At the same time, however, others have suggested that self-selection into self-employment takes place based on poor health, whereby those with existing physical or mental health issues may be more likely to opt for self-employment (Wiklund et al., 2018). This is because self-employment offers significant flexibility to design one's own work in line with one's needs and thus can help to accommodate for physical or mental health issues.

Since empirical evidence and theoretical arguments on self-selection are still nascent and different authors predict contrasting effects, we formulate a research question instead of a directional hypothesis:

> *Research question 1: Is there a self-selection effect such that either more or less healthy individuals are more likely to enter self-employment compared to wage employment?*

The Timing of Health Impacts

The timing of stress and health effects of self-employment remains poorly understood. The reason is that most research is conducted cross-sectionally (Stephan, 2018) and thus cannot

speak to the timing of effects. Yet even studies drawing on longitudinal or cohort data typically aggregate these data rather than investigate the development of strain or health over time (e.g. Nikolova, 2019). An exception is the work by Binder and Coad (2016) who investigate life satisfaction but not mental or physical health over the first three years of self-employment. However, considering the time might help to understand the mixed findings of past research, because it may take time before self-employment affects stress or health. Put differently, it is unlikely that a person's health is immediately affected after that person becomes self-employed. Our longitudinal data allow us to trace individuals over 4 years after they first entered self-employment from employment. This is a time frame in which we may even observe different effects for mental and physical health. The reason is that *relative* to physical health, mental wellbeing and mental health are likely more immediately affected as they are more strongly rooted in (emotional) experiences, whereas physical health is relatively more affected by physiological changes resulting from long-term exposure to stress. In the short-term, exposure to stressors results in the mobilization of extra energy and can improve performance (Selye, 1976). In response to stressors the body mobilizes extra energy to deal with the demands that are placed upon it. However, faced with persistent stress over time this response becomes eventually exhausted (Selye, 1976, also McEwen, 1998).

Work on stress in employees has documented positive effects of so-called challenge stressors which describe work stressors that entail opportunities to learn, achieve goals and to grow (Lepine, Podsakoff, & Lepine, 2005, p.765). These stressors trigger positive emotions and prompt an increase in effort and in turn enhance performance and work-related wellbeing (Lepine, et al., 2005; Podsakoff, LePine, & LePine, 2007). The self-employed face many typical challenge stressors (Stephan, 2018) such as high workload, intense job demands, job complexity, and high responsibility (Wach et al., 2020; Lepine et al., 2005). In other words, the self-employed work intensely and for long hours, while also bearing full responsibility (personally and legally) for their work. Yet their hard work also means they earn more income and learn new things especially when they first become self-employed and later on when engaging in new contracts. Thus their intense work has an upside that allows them to grow as a person as well as potentially to grow their business; after all they are working for their own account and whilst stressful there is also a sense of mastering challenges and thriving.

In sum, research on stress and challenge stressors in particular suggests that in the short-term certain stressors that are common for the self-employed can have positive effects on well-being

and mental health. Yet in the longer term the continued exposure to high levels of stressors results in the build-up of the physiological stress response (allostatic load) that is a precursor to the development of both mental and physical illness (McEwen, 1998, 2004). This suggests that immediately after becoming self-employed we may see an upswing in mental health that is likely to wear off over time. There is unlikely to be an upswing in physical health however as the intense work in self-employment still puts strain on the body, that the body can compensate for in the short- but not in the longer-term. Unfortunately, there is little existing research to go by regarding the precise timing of effects and definition of short- and long-term. For the purposes of our study we use a two-year time window as an indicator of the shorter term and four years after becoming self-employed as a proxy for the longer-term. This fits with the differentiation of new entrepreneurs and established entrepreneurs in worldwide research on entrepreneurship by the Global Entrepreneurship Monitor (Reynolds et al., 2005). Taken together, we posit that

> *H1a: Self-employed individuals experience better mental health than individuals in wage work after entering self-employment, i.e. in the shorter term (two years after entering self-employment).*
>
> *H1b: The mental health benefits of self-employment are not sustained over the longer term (four years after entering self-employment).*
>
> *H2: Self-employed individuals experience poorer physical health than individuals in wage work in the longer term (four years after entering self-employment).*

The Stress Process: Work-related Strain as a Mediator

We also propose that it is important to understand and test why and how self-employment affects health. According to the Stressor-Strain-Outcome model (Koeske and Koeseke, 1993) environmental demands (stressors) lead to strain which in turn impairs health. Research on self-employment and health is often implicitly or explicitly guided by the Stressor-Strain-Outcome model, yet researchers assume rather than empirically test and establish that strain is indeed a key mechanism through which self-employment affects health. Strain results from the exposure to a stressor, which are work demands that "require sustained physical and/or psychological effort and are therefore associated with certain physiological and/or psychological costs" (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001, p.501). Strain is typically captured through negative affective experience, e.g. 'feeling stressed' (e.g., Hessels, Rietveld and Van der Zwan, 2017). Key measures of work related strain are those of activated

negative affect (job anxiety) and low-activation negative affect (job depression, e.g., Warr et al. 2014).

Just as with research on self-employment and health, research on whether the self-employed experience more or less 'stress' than employees is also mixed (e.g. less stress in Hessels, Rietveld and Van der Zwan (2017) and more stress in Cardon and Patel (2015) among the self-employed). Moreover, strain is rarely measured and related to health outcomes in the same study. Above, we suggested that (challenge) stressors are plentiful in self-employment and that they can in the short-term lead to positive emotion, enhanced motivated and performance, thus positively impact mental health. We may observe a similar pattern for strain, which may be lifted by the positive emotional effects of challenge stress. However, considering just how demanding and intense the work of the self-employed can be, it is unlikely that this positive response can be sustained over time. Thus,

> *H3a: Self-employed individuals experience* less *work-related strain than individuals in wage employment in the shorter-term.*
> *H3b. Self-employed individuals experience* more *work-related strain than individuals in wage employment in the longer-term.*

Guided by the Stressor-Strain-Outcome model, we further propose that strain mediates the effect of self-employment on health and thus helps explain how self-employment impacts health.

> *H4: The effects of self-employment on mental health (H4a) and physical health (H4b) are mediated by work-related strain.*

The Moderating Effect of Gender

Heterogeneity in self-employment has attracted much research attention and may also help to understand some of the mixed findings in past research. Several studies suggest that individuals who pursue self-employment as a choice (opportunity entrepreneurs) rather than for lack of employment options (necessity entrepreneurs) derive greater well-being or health benefits (Stephan, 2018 for an overview). The measures of opportunity and necessity entrepreneurs vary, yet one of the most robust operationalizations is whether the business was started by someone who was previously employed (opportunity entrepreneurship) or unemployed (necessity entrepreneurship). Since these effects are fairly well understood and opportunity

entrepreneurs are more numerous in our context (the UK), we restrict our sample to opportunity entrepreneurs and draw attention to gender as an often overlooked source of heterogeneity that determines whether individuals can derive health benefits from self-employment.

Self-employment and entrepreneurship are stereotypically male careers (Gupta, Turban, Wasti, and Sikdar, 2009; Lewis, 2006) which helps to explain why women are less likely to become self-employed compared to men. Indeed, women are in part disadvantaged in self-employment because they are expected to underperform, a belief that stems from the misfit with the gender stereotype and persists despite evidence to the contrary (Marlow and McAdam, 2013 for a review). For instance, women find it more difficult to access finance (Marlow and Patton, 2005; Minniti, 2009). Thus, being self-employed is more demanding for women as they have to overcome a lack of legitimacy inherent in the stereotypical view of self-employed as a male carer and which is likely shared by funders, customers and suppliers. At the same time, women also face additional constraints from home (Carter, 2011). Women are still primarily responsible for household duties and caring for children and the elderly around the world (Altintas & Sullivan, 2016; Arráiz, 2018). Self-employed women appear to be no exception, indeed evidence from Sweden suggests that self-employed women experience more time-related strain in their life than either their counterparts in organizational employment or self-employed men (Hagqvist, Toivanen, and Vinberg, 2015).

In sum, considering the already high demands of self-employed work, the additional demands upon self-employed women stemming from the household and the additional difficulties in operating due to a perceived lack of legitimacy are likely to make self-employment more stressful for women compared to men. Empirical research is scarce, although the findings of one study drawing on large-scale Australian data align with this rationale. It found that self-employment offered men no health benefits, but self-employed women had worse physical health than their organizationally employed counterparts (Parslow et al., 2004). Hence, we propose that

> *H5: Self-employed women compared to self-employed men experience more strain (H5a) as well as lower mental (H5b) and physical (H5c) health.*

Figure 1 summarizes our general research framework. Figure 2 depicts the time-related effects that we hypothesize.

--- Figure 1 and 2 here ---

Data and Methods

Sample

The data used for this research are from *Understanding Society*, the largest UK Household Longitudinal Study (UKHLS). It is a nationally representative longitudinal survey of approximately 100,000 individuals in 40,000 households in the United Kingdom. The survey focused on collecting high quality longitudinal data about subjects such as health, work, education, income, family, and social life to help understand the long term effects of social and economic change. Households recruited at the first round of data collection in 2009 are visited each year to collect information on changes to their household and individual circumstances. So far, *Understanding Society* has released data from nine waves of survey. The data used for this research are from Wave 2, Wave 4 and Wave 6. *Understanding Society* first included work-related strain measures in Wave 2 (2010-2012) and repeated them in Wave 4 (2012-2014) and Wave 6 (2014-2016). It contains data about many work and wellbeing-related characteristics and has been used in research on self-employment (e.g. Henley, 2017; Reuschke, 2016) and health (e.g. Bryan, 2012; Chandola & Zhang, 2018; Davillas and Pudney, 2017; Patel et al., 2019).

We started our initial sampling frame with Wave 2, which is marked as t_0, and then incorporated data from Wave 4 (t_1) and Wave 6 (t_2). In each wave, respondents were asked if they considered themselves (a) self-employed or (b) an employee. As we focused on transition from employment into self-employment, we identified the cohort of self-employment as one who was an employee at t_0 (Wave 2) and transited into self-employment at t_1 (Wave 4, 2012-2014) and stayed in self-employment at t_2 (Wave 6, 2014-2016). A comparative cohort is one who was an employee at all three waves (t_0, t_1, t_2). After data cleansing, our final sample consisted of a cohort of 174 self-employed people and 9696 salaried employees followed over the three waves.

Measures

Health. We measured an individual's health in two dimensions, mental health and physical health. Our measures of mental health and physical health are the scale score calculated from *Understanding Society*'s self-completion SF-12 module which includes 12 questions from the SF-36 Health Survey (Version 1). These include: 2 questions concerning physical functioning,

2 questions on role limitations because of physical health problems, 1 question on bodily pain, 1 question on general health perceptions, 1 question on vitality (energy/fatigue), 1 question on social functioning, 2 questions on role limitations because of emotional problems, and 2 questions on general mental health (psychological distress and psychological well-being). The measure of mental health is the SF-12 Mental Component Summary (MCS) score, and the measure of physical health is the SF-12 Physical Component Summary (MCS) score. Both measures convert valid answers to the survey questions into a single mental and physical functioning score respectively, resulting in a continuous scale, ranging from 0 (low functioning) to 100 (high functioning). The reliability and validity of SF12 has been tested and confirmed for measuring self-reported health status in the general population world-wide (Ware, Kosinski, Dewey & Gandek, 2001; Gandek, Ware, Aaronson, Apolone, Bjorner, Brazier et al., 1998; Lundberg, Johannesson, Isacson & Borgquist, 1999).

Work-related strain. We used anxiety and depression as two indicators of work-related strain. *Understanding Society*'s work conditions module includes two measures of 'affective well-being' (job-related anxiety and depression). The two measures use the job-related wellbeing items originally developed by Warr (1990). Job Anxiety items come from Warr's three-item "Anxiety-Contentment" scale, and job depression items come from Warr's three-item "Depression-Enthusiasm" scale. Both scales use a Likert-type response format. *Understanding Society* dataset automatically calculates two indexes of job anxiety and job depression as measures of psychological distress. A higher score in both indexes indicates higher levels of work-related strain. The measures have demonstrated high reliability and validity and have been used to test job stress (e.g. Kerr, McHugh, and McCrory 2009; Rothmann 2008).

Self-employment. Our main independent variable is self-employment. Individuals who are in paid job in all three Waves are identified as employees and coded as 0, and individuals who transited from employment into self-employment at t_1 and remained in self-employment at t_2 are identified as self-employed and coded as 1. Our measure of self-employment is consistent with past research which has labeled it opportunity entrepreneurship (Binder & Coad, 2016; Nikolova, 2019), in contrast to necessity entrepreneurship, i.e. self-employment out of unemployment (Binder & Coad, 2016; Nikolova 2019). We do not consider individuals who move from unemployment into self-employment as their number is very low in advanced economies (Binder and Coad, 2016) such as the UK.

Control variables. Consistent with earlier studies (e.g. Cardon and Patel, 2015; Hessels et al., 2017), we controlled for age (years), gender (1 = male), education (1: no degree to 6: degree level), marital status (1 = married), job-related income (monthly gross income in GBP), and regions. Regions were ranked by population density and were coded using 11 dummy variables – London, Northwest, Southeast, West Midlands, Yorkshire and the Humber, East of England, Northeast, East Midlands, Southwest, Wales, Scotland, Northern Ireland. Finally, three Wave dummy variables were included in our analysis to capture the time structure of the data.

Methods

Matching approach

As discussed in the literature review, previous research has raised concerns about the validity of comparing health and wellbeing between entrepreneurs and non-entrepreneurs in light of the possibility of healthy individuals self-selecting into self-employment (Baron, Franklin and Hmieleski 2016; Rietveld et al., 2015). In order to address the concern of selection bias and to answer our first research question, we used Propensity Score Matching (PSM) to create comparable groups of the self-employed and employees. In essence, matching models simulate the conditions of an experiment in which individuals in treatment group (the self-employed) and control group (employees) are randomly assigned, allowing for the identification of a causal link between the career choice and outcome variables (Rosenbaum and Rubin, 1985).

To match the 174 self-employed individuals with a comparable group of employees, we first estimated a logit model to calculate the propensity score or the conditional probability of a person switching from employment to self-employment, using ten matching covariates – age, gender, education, marital status, income, region, mental and physical health (t_0), and anxiety and depression work stress (t_0). We then used the propensity scores to generate a sample consisting of the self-employed and their matched paid employees. We used three different matching algorithms to identify a matching set of employees: (1) Nearest neighbour, (2) Genetic matching, and (3) Subclassification matching. The nearest neighbour method is the most commonly used approach. It consists of matching each treated individual with the control individual that has the closest propensity score. We used nearest neighbor matching with the ratio 1:1. Genetic matching is a method of multivariate matching that uses an evolutionary search algorithm to determine the weight each covariate is given (Diamond and Sekhon 2013). It matches covariates to identify employees who are most similar to the self-employed people in our sample. The goal of subclassification is to form subclasses, such that in each the

distribution (rather than the exact values) of covariates for the treated and control groups are as similar as possible (Stuart, King, Imai & Ho, 2011).

After matching, we conducted propensity score balance test to ensure the equality of means of observed characteristics in the treatment and control groups. We followed the following common balance test procedure: (1) a two-sample *t*-test: after matching, there should be no significant differences. (2) comparison of the pseudo R^2 and *p*-values of the likelihood ratio test of the joint insignificance of all the regressors obtained from the logit analysis before and after matching the samples: The pseudo-R^2 should be lower and the joint significance of covariates should be rejected (or the p-values of the likelihood ratio should be insignificant) (Sianesi, 2004). (3) checking mean absolute standardized bias (MASB) between the self-employed and employees as suggested by Rosenbaum and Rubin (1985), in which they recommend that a standardized difference of greater than 20% should be considered too large, indicating that the matching process has failed.

After propensity score balance test, we used average treatment effect (ATT) and difference in difference (DiD) to test our first two hypotheses: Self-employed individuals experience better (or worse) health (mental and physical) than individuals in wage work (H1a, H1b, H2). We compared the differences of health status between the self-employed and employees at different time points. We also used the genetic and subgroup methods to validate our results.

Mediation analysis

Our third and fourth hypotheses (H3, H4) focus on the mediating role of work-related strain (job anxiety and job depression) in the relationship between self-employment and health. Traditionally, such mediation models are tested using Baron and Kenny's (1986) classic four-step approach. According to this approach, a mediation effect exists if (1) self-employment is a significant predictor of health (*c* path; i.e., overall relationship), (2) self-employment is a significant predictor of the mediator (job anxiety or job depression)(*a* path), (3) the mediator is a significant predictor of health when controlling for self-employment (*b* path), and (4) the effect of self-employment on health becomes significantly smaller or non-significant when controlling for the mediator (*c′* path, or "direct effect"). However, there are shortcomings inherent in the Baron and Kenny method (see Holmbeck, 2002). Preacher and Hayes (2004) thus suggested that tests of mediation should be based on a significance test of the indirect

effect *ab*, that is, the product of the *a* and *b* paths. The indirect effect is the proportion of the relationship between self-employment and health that is mediated by work-related strain.

To test our mediation model, we applied Sobel's (1982) often-used method to assess the significance of the indirect effect that runs through the mediator variables (Hessels et al., 2017). We estimated the indirect effects by assessing the reduction of the coefficient of self-employment as mentioned in step 4 above. If the addition of mediator renders the coefficient of self-employment insignificant, full mediation takes place; if the coefficient of self-employment is reduced but is still significantly different from zero, partial mediation is present (MacKinnon, Lockwood, Hoffman, West & Sheets, 2002).

Moderation analysis

Our fifth hypothesis (H5) focuses on the moderating effect of gender on the relationship between self-employment and work-related strain and between self-employment and health. Since gender is a time invariant variable, we used pooled OLS regressions to estimate the role of gender in moderating the relationship between self-employment and work-related strain and between self-employment and health.

Results

Demographic characteristics

Descriptive statistics before matching-means, standard deviations and *t*-test are presented in Table 1 for individuals in wage work (N=9696) and in self-employment (N=174). As can be observed in Table 1, the self-employed (43.49) are on average older than employees (41.78) ($p<0.05$). Moreover, the self-employed (63%) are more likely to be male than employees (45%)($p<0.001$). They are more likely to be in densely-populated regions ($p<0.05$), and earn less than their wage-paid counterparts after entering into self-employment ($p<0.05$).

Table 1 inserted about here

Propensity score matching and balance test

In the first step of the PSM, the logit model was estimated in order to analyze the factors that affect occupational change, and to calculate the propensity to transit into self-employment for each individual. The results in Table 2 show that those with lower mental health are more likely to become self-employed (-0.02, $p<0.04$). Older people are more likely to transit into self-

employed compared to staying in paid employment (0.02, p<0.001). Men have a higher likelihood of moving into self-employment (0.87, p<0.001). People from London have much higher chance to transition into self-employed than those from the Northwest (-0.27, p<0.05), West Midlands (-0.68, p<0.01), Northeast (-0.47, p<0.1), Scotland (-0.82, p<0.01) and Northern Ireland (-0.29, p<0.1).

Table 2 inserted about here

Results of balance test are presented in Appendix 2 and Appendix 3. First, after matching the bias between the treatment group and control group is largely reduced. That is, the *t*-test significance of group differences for any of the covariates disappears while the *p*-value increased (Appendix 2). Second, the pseudo R^2 of the estimated logit model is high before matching, and low afterwards (Appendix 3). Similarly, the *p*-values of the likelihood ratio test are all insignificant after matching, indicating that no systematic differences remain in the distribution of covariates between the two groups. The joint significant effect of the covariates on occupational change, as expressed by the significant Chi^2, cannot be rejected before matching but is rejected after matching in all three matching algorithms. Third, the mean and median bias are all below 20% as required, and are all even below 10%, indicating a very good match (see last two columns Appendix 3). Note that the subclass method conducts matching via producing weights. Hence the observant stays the same as original dataset, which explains the mean and median bias is the same before and after matching (Appendix 3). In this case, we abandon the subclass matching algorithms in the average treatment effect (ATT) on the treated test. Results of balance test can also be assessed by checking the overlap in the range of propensity scores across treatment and comparison groups (called “common support”)(Garrido et al., 2014). Common support is subjectively assessed by examining a graph of propensity scores across self-employment and employment groups (Appendix 4). We found the extent of overlap to be satisfactory.

Hypotheses

In Hypotheses H1a and H1b, we posit that self-employed individuals experience better mental health than individuals in wage work in the shorter term (i.e. two-years) after entering self-employment and that the mental health benefits of self-employment are not sustained over the longer term (four years after entering self-employment). In Table 3, the results show that individuals transiting from employment into self-employment experience better mental health

in the next 2 years (at t_1). Results from both nearest neighbor and Genetic matching algorithms also corroborate this upswing in mental health at t_1 (NNM: ATT: 2.11, p<0.02; GEN: ATT: 2.87, p<0.01). However, after two further years, the positive effect of self-employment on mental health at t_2 disappears. The group difference on mental health is insignificant at t_2 (NNM: ATT: 0.75, p>0.10; GEN: ATT: 1.54, p>0.10). The results support Hypotheses H1a and H1b. In Hypothesis H2, we posit that self-employed individuals experience poorer physical health than individuals in wage work in the longer term. Results in Table 3 indicate that the group differences in physical health at t_1 and t_2 are insignificant (p>0.10), suggesting that those entering self-employment neither experience poorer physical health in the shorter term (two-years after occupational change) nor in the longer term (four years after becoming self-employed) than individuals in paid employment. Thus, Hypothesis H2 is rejected.

In Hypothesis 3, we postulate that self-employed individuals experience less work-related strain than individuals in wage employment in the shorter term (H3a) and that self-employed individuals experience more work-related strain than individuals in wage employment in the longer term (H3b). For the two indicators we used to measure work-related strain, results in Table 3 show that self-employed individuals experience less job anxiety (NNM: ATT: -0.59, p<0.001; GEN: ATT: -0.59, p<0.01) and job depression (NNM: ATT: -0.84, p<0.001; GEN: ATT: -0.78, p<0.001) than individuals in wage employment at t_1, thereby confirming Hypothesis H3a. Contrary to our expectations, results in Table 3 show that self-employed individuals continue to experience significantly less job depression (NNM: ATT: -0.55, p<0.001; GEN: ATT: -0.68, p<0.001) than individuals in wage employment at t_2. They also experience relatively less job anxiety t_2 but the average treatment effect on job anxiety at t_2 is not significant (NNM: ATT: -0.21, p>0.10; GEN: ATT: -0.40, p>0.10). Taken the results together, Hypothesis H3b is not supported. The temporal changes of health and work-related strain are also depicted in Figure 3.

Table 3 and Figure 3 inserted about here

In Hypothesis 4, we propose that the effects of self-employment on mental health (H4a) and physical health (H4b) are mediated by work-related strain. Before testing Hypothesis 4, we checked multicollinearity. Table 4 presents the correlation matrix of variables. Job anxiety and job depression are shown to be highly correlated (0.65, p<0.001). We then conducted a diagnostic test of multicollinearity by analyzing the variance inflation factors (VIFs) of all

variables. The test results show that all VIFs are lower than 10. Although there is no general cut-off point for VIFs, most researchers believe that the issue of multicollinearity is not a concern if VIF is lower than 10 (Hair, Anderson, Tatham, & Black, 1995; Kennedy, 1992). Hence, our diagnosis test suggests that the issue of multicollinearity should be of no concern in our regressions.

Table 4 inserted abut here

We also conducted a Hausman test to choose between a fixed effects model and a random effects model. The null hypothesis is that the preferred model is random effects. Consistent with Hausman (1978), we rejected the null hypothesis and applied fixed effects regressions since the *p*-value of our Hausman test is small (<0.05).

To test the mediating effect of work-related strain on the relationship between self-employment and mental health, we added the mediator (job anxiety and job depression) into regressions in column 2 and column 3 of Table 5. This renders the coefficient for self-employment insignificant, suggesting that the relationship between self-employment and mental health is fully mediated by job anxiety and job depression. We then applied Sobel's (1982) method to assess the significance of the indirect effect that runs through the mediator variables. Table 5 (see bottom part of Table 5) presents the indirect effect, and the proportion of the relationship between self-employment and health mediated by job anxiety and job depression. The indirect effects in columns 2-3 indicate that job anxiety and job depression fully mediate the relationship between self-employment and mental health. The percentage mediated by job anxiety is 32.9% ($p<0.1$) and the percentage mediated by job depression is 84.9% ($p<0.001$). The indirect effects in columns 2–3 suggest that job depression plays a larger mediating role. When job anxiety and job depression are added simultaneously in column 4, the coefficient for self-employment also becomes insignificant, confirming that the relationship between self-employment and mental health is fully mediated by job anxiety and job depression. This supports Hypothesis H4a.

To test the mediating effect of work-related strain on the relationship between self-employment and physical health, we carried out the same procedure. The effect of self-employment on physical health in columns 5 of Table 5 is insignificant, implying that the pre-condition of mediating effect on physical health is not satisfied. In this case, there is no mediating

relationship of work-related strain between self-employment and physical health. Thus, Hypothesis H4b is rejected.

Table 5 inserted about here

In Hypothesis 5, we posit that self-employed women compared to self-employed men experience more work-related strain (H5a) as well as lower mental health (H5b) and physical health (H5c) after entering self-employment. To test the hypotheses regarding the moderating effect of gender, we conducted pooled OLS regressions for work-related strain and health. The results in Table 6 confirm gender's role in moderating the relationship between self-employment and job anxiety (-.020, $p<0.01$) and between self-employment and job depression (-.046, $p<0.01$), suggesting that self-employed women compared to self-employed men experience more work-related strain after entering self-employment. Hence, H5a is supported. The results in Table 6 also confirm that self-employed women compared to self-employed men experience lower mental health after entering self-employment (-2.16, $p<0.001$). Thus, H5b is supported. However, results in Table 6 do not suggest that self-employed women compared to self-employed men experience lower physical health after entering self-employment (0.13, $p>0.05$). Thus, H5c is not supported. We plot the interaction of self-employment and gender on work-related strain in Figure 4 and the interaction of self-employment and gender on health in Figure 5.

Table 6, Figures 4 & 5 inserted about here

Robustness checks

To check the robustness of findings for Hypothesis 1 for mental health, we carried out two additional analyses. First, we followed Becker and Ichino (2002) and conducted Rosenbaum bounds sensitivity analysis to test if the PSM results are sensitive to hidden bias (unobserved selection). This is because the PSM method is unable to capture selection bias based on unobserved covariates (Rubin, 1977). The results of sensitivity analysis are reported in Appendix 5. The bounds under the assumption that the true treatment effect is underestimated (sig-) reveal that the results are largely insensitive to unobserved covariates. The odds of differential assignment of treatment due to unobserved factors (gamma) would have to increase by a factor of 1.3 and 1.4 respectively to change the inference on the effect of self-employment on mental health both at t_1 and t_2.

Second, we the used difference in difference approach to check results from ATT. As shown in Appendix 6, from t_0 to t_1, we find the DiD (difference in difference) on mental health is significant (3.13, $p<0.05$), while from t_0 to t_2, we find the DiD is insignificant (0.85, $p>0.05$). Concerning physical health, no DiD is significant. The results are consistent with what we conclude from ATT analysis.

We also conducted a pooled OLS regression to check the robustness of findings for Hypothesis 3. The pooled regressions exploit all available variation in the data (both across and within individuals), whereas the fixed-effects regressions have the advantage of focusing on the variation within individuals (over time) and standard errors are clustered on the individual level (Hessels et al., 2017). Results in Appendix 7 verify the mediating effect of job anxiety and job depression between self-employment and mental health (Job anxiety: percentage mediated is 46.1%, $p<0.001$; Job depression: percentage mediated is 86.68%, $p<0.001$). In addition, no mediation relationship has found in terms of physical health.

Discussion

This study advances new insights on the health consequences of changing from employment to self-employment. We integrate the Stressor-Strain-Outcome model with research on challenge stress and allostatic load to offer new explanations for the causal mechanisms through which self-employment affects mental and physical health. Through employing a sophisticated matching methodology in combination with difference-in-difference analyses of longitudinal data in the UK, we identify the unique temporal patterns of the impact of self-employment on health. We also clarify who self-selects into self-employment. In light of heterogeneity in entrepreneurship, we introduce gender as an important source of heterogeneity to understand the conditions under which self-employment affects health. Our research thus contributes new insights to the thriving literature of entrepreneurship and health.

New insights into self-selection and health

Despite a growing awareness that self-selection into self-employment might bias estimates of the health benefits of self-employment (Baron et al., 2016), few studies have empirically accounted for such bias in research on self-employment and health and the nature and direction of self-selection is either debated or not commented on. Utilizing a sophisticated matching

methodology and difference-in-difference analyses, we consider counterfactual cases and offer insight into the nature of self-selection for the debate on whether healthier individuals (Baron et al 2016; Rietveld et al., 2015) or those with health issues (Wiklund et al., 2018, 2020) are more likely to become self-employed.

We find that those with poorer mental health (although not physical health) are more likely to change from employment into self-employment. This novel evidence on self-selection based on a population representative sample of opportunity (not necessity) self-employed is important as previous research is scarce and rarely based on population-representative samples (see Wiklund et al., 2018 for an overview). We note that our findings are opposite to those by Rietveld et al. (2015) who find that healthier individuals self-select into self-employment. The key difference between theirs and the present study is the sample. Rietveld et al. (2015) use the U.S Health and Retirement Study which includes individuals over 50 years of age only; whereas our study is based on a representative sample of the UK working-age population. Intuitively it makes sense that in later life only those that feel energetic and healthy enough engage in self-employment as in Rietveld et al. (2015). Yet our study allows us to identify a more general trend across the entire working-age population. Notably, our findings are aligned with research that, although not explicitly testing for self-selection, suggests that those with disability (Pagan, 2009) and certain mental health disorders (Verheul et al., 2016; Wiklund, Yu, Tucker and Marino, 2017; Wolfe and Patel, 2017) may be more likely to engage in self-employment and entrepreneurship.

Our study points to the need for more research on the nature and direction of self-selection in entrepreneurship. For example, finding a self-selection effect for necessity entrepreneurs could paint a bleak picture where discrimination in the labor market forces those with mental health issues to find alternative options for employment and to become reluctant entrepreneurs. However, finding, as we did, that those with lower mental health self-select out of wage employment into self-employment suggests that it is the flexibility that self-employment offers to tailor work arounds one's individual needs and to craft one's own job that creates a positive pull into self-employment (Wiklund et al., 2018). Put differently, individuals with lower mental health capital proactively seek out the nonpecuniary benefits of self-employment. In sum, our findings advance the debate on the role of health-based self-selection into self-employment (Rietveld et al; 2015; Wiklund et al., 2018).

Advancing the understanding of timing and temporality of health outcomes

In response to recent calls to take time and temporal processes seriously in entrepreneurship research (Levesque and Stephan, 2020) and research on entrepreneurs' well-being and health (Stephan, 2018), we consider time in our framework integrating the Stressor-Strain-Outcome model, challenge stress and allostatic load. This allows us to develop theoretical explanations of 'when' self-employment will impact mental as opposed to physical health and *how* (through work-related strain).

Our specific findings reveal an uplift in mental health due to lower work-related strain in the short term after individuals enter self-employment. This effect is consistent with a honeymoon effect and consistent with challenge stressors such as those that are inherent in self-employment creating positive emotions, motivational and performance enhancements in the shorter term but which wear off over time (in our study they wear off after four years). Notably our findings do not suggest that there is no stress in self-employment, but rather they are consistent with a pattern of 'positive' or challenge stress that lifts negative affective reactions (i.e. lowering job-related depressive affect and anxiety). Thus, we confirm strain as the mechanism that mediates the impact of self-employment on mental health in line with the Stressor-Strain-Outcome model (Koeske and Koeske, 1993), while the direction of effects is consistent with research on challenge stress (e.g., Cavanaugh et al., 2000). The newly self-employed will have a sense of thriving, due to ongoing learning and grappling with the complexities of being responsible for everything in their work. Yet this uplift in emotions and performance can only be maintain for a shorter time period, which is why we see at the end of our study period after four years that stress levels rise again (relative to the two-year measurement point) and the mental health uplift subsides back to pre-self-employment levels.

Considering the temporality of effects also offers an explanation (in addition to self-selection) as to why past research on strain finds mixed evidence on whether the self-employed experience more or less strain than their organizationally employed counterparts (Cardon and Patel, 2015; Hessels et al., 2017). Unfortunately, past research typically pools longitudinal data over time[6] and not all studies account for self-selection (Hessels et al., 2017). Based on our theoretical framework and empirical findings we suggest that future research should ask *when* (and not whether) the self-employed experience better mental and physical health and that such research should pay attention to temporality to differentiate short-term challenge stress from longer-term aggregated strain.

We find that self-employment has no short-term or long-term effect on physical health. This finding is consistent with some past studies (e.g., Perry and Rosen, 2001) but not others including studies that like ours account for self-selection (e.g., Nikolova, 2019; Stephan & Roesler, 2010; Rietveld et al., 2015). We suggest that a possible answer lies in considering temporality and especially long-term effects. Some research indicates that the effect of work-related stressors on the physiological stress processes (allostatic load) that underpin poor physical health can take considerable time to unfold (for instance, five years, Hammar, Alfredsson and Theorell, 1994; Stephan and Roesler, 2010). Yet for the most part the temporality of such effects is not considered. Our findings show that both considering time and treating mental and physical health as distinct outcomes is essential in disentangling the effect of self-employment on health. This calls for future research on self-employment, stress and health to take temporality seriously and to extend, if possible, the investigation over time horizons beyond four years. Such research will allow to ascertain the longer-term effect of self-employment on mental health and physical health. Certainly, we are aware that substantial resources are needed to address drop-outs (see limitations below). Furthermore, our findings call for dedicated theorizing on mental and physical health as related but also distinct outcomes.

New insights into heterogeneity of self-employment and health: Gendered stress and health

Our theoretical framework and findings extend research on the gendered nature of self-employment which typically investigates entry (e.g. Minniti, 2009), firm performance and access to finance (Marlow and McAdam, 2013; Marlow and Patton, 2005) to the rapidly growing research on self-employment, stress and health (Stephan, 2018; Wiklund et al., 2019). We find that the uplift in mental health driven by lower work-related strain is only experienced by self-employed men, not by self-employed women. This complements research by Parslow et al. (2004) who found self-employed women suffered worse physical health compared to self-employed men (We discussed above temporality as a reason for our lack of findings with regard to physical health). Our theory on the gender-based sources of strain in self-employment also complements existing work which has identified work-life balance and interference as one source of stress for self-employed women (see Stephan, 2018, p.304 for an overview) by highlighting gendered stress and health effects in a study on a population representative sample and a research and analytical design that allows to draw causal conclusions. Moreover, we also suggest that in addition to stresses arising from work-life interference, the gendered nature of household and care work, further stresses arise from the stereotypical view of self-employment

as a male career that likely disadvantages self-employed women more indirectly yet still profoundly (e.g., when suppliers or customers prefer to contract with self-employed men rather than women).

Considering that our sample were opportunity self-employed, our findings also add to the body of research on heterogeneity in the health and well-being benefits of self-employment and call for gender to be included as a key aspect of heterogeneity that is often overlooked. To date extant research has focussed on contrasting opportunity and necessity entrepreneurs (also Stephan, 2018 for a review), while our study showcases important gender-based heterogeneity among opportunity self-employed. Our findings are made starker by the fact that our setting is the UK i.e. a developed economy that embraces gender equality. If we identify gendered stress and health effects to the disadvantage of women in this setting, it is likely that such effects are even more dramatic in countries with less commitment to gender equality and patriarchal societies and where women find it often more difficult to enter self-employment in the first place (Bhuiyan and Ivlevs, 2019; Estrin and Mickiewicz, 2011). Future research is needed to understand how self-employed women can experience the health and well-being benefits of self-employment and the contexts that enabling these outcomes to happen.

Conclusion

In this paper, we apply a non-parametric propensity score matching approach to examining the relationship between self-employment and health. Our research design allows us to account for selection bias and establish a causal effect of self-employment on health. We offer novel evidence to the emerging research on health-based self-selection into self-employment. We find those with lower mental health are more likely to self-select into self-employment. Furthermore, our research draws new attention to the timing of health and well-being benefits in self-employment and offers insights on causal processes related to work-related strain that past research often mentions but rarely investigates. Compared to those who stay in paid employment, after becoming self-employed, the self-employed experience a short-term uplift in mental health which is explained by lower job-related strain. This uplift is however not sustained over the longer-term (four years in our study) and chiefly occurs for self-employed men rather than women. There is also no relationship of self-employment with physical health.

Practical implications

Our findings, accounting for self-selection and tracing a population-representative sample of

newly self-employed and of wage employees over four years, suggest that the health benefits of self-employment may have been exaggerated in past research. This is important knowledge for educators and policy makers who wish to encourage self-employment. They should not present self-employment as the 'healthy occupation' even though some self-employed (men) will experience an uplift in mental health initially. It is also important knowledge for those supporting the self-employed such as mentors, coaches and business advisors who should prepare the self-employed for the long-term by helping them to manage their strain levels. Equally investors and lenders should have an interest to council the self-employed about the potential long-term strain and health risks as a way of protecting their investments.

Our findings on the gendered nature of stress and health in self-employment to the disadvantage of self-employed women suggest on the one hand that self-employed women might benefit from dedicated support and training in coping strategies to maintain their well-being. Yet we believe these findings call for broader interventions such as promoting greater acceptance of self-employed women and women entrepreneurs through positive role models, in education and media campaigns to help overturn the stereotype that self-employment and entrepreneurship are a 'men's game'. Moreover, it is likely that the widespread provision of longer hours of child care and promoting gender equality in care work would go a long way of alleviating the gendered nature of stress and health in self-employment.

Limitations and future research

This study has a number of limitations. First, our research identifies variation in stress and mental health levels over time. Yet, we are not able to investigate longer-term trends beyond four years. It may be that the often cited stressful nature of work only reflects in the physical health of the self-employed after four years. Moreover, it may only be at later time points that the physiological stress response builds up (as set out in research on allostatic load, e.g., Patel et al., 2018). The Understanding Society survey in the UK is ongoing and will enable analysis of longer time periods as new waves of data are made available. At the same time, the already small sample of self-employed can be expected to shrink further as some previous respondents drop out of the survey, which is a common problem in longitudinal research. In order to have a more nuanced understanding of the temporal effect of self-employment on health, future research needs to explore other data sources at the population level (see Toivanen et al., 2015 and Goncalves and Martins, 2018) for examples.

Second, addressing self-selection into self-employment is empirically challenging (Goncalves, & Martins, 2018; Nikolova, 2019). The measurement error in choice into self-employment is much higher than choice into employment. This measurement error is further exacerbated when health is a selection factor into a highly heterogeneous and episodic outcome – self-employment. Many factors can create identification challenges. The PSM approach we used in this paper can help address some concerns about self-selection bias but not without caveats. In her recent paper, Nikolova (2019) used entropy balancing with difference in difference (DID) to tackle self-selection and time-invariant unobserved heterogeneity. While entropy balancing has a number of advantages over matching and propensity score methods, Hainmueller (2012) has pointed out that entropy balancing provides no safeguard against bias from unmeasured confounds that are often a vexing problem in observational studies. Thus, other problems that are commonly associated with preprocessing methods still apply. Future research will need to continue to find innovative methodology to tackle empirical challenges to the identification of the effect of self-employment on health.

Third, similar to Goncalves, & Martins (2018), Nikolova (2019), and Stephan & Roesler (2010), in this research, we have not measured job characteristics directly. Therefore, our interpretations rest on an assumption that the self-employed work in a job situation characterized by autonomy but also considerable stressors (in line with arguments and research by Cardon and Patel, 2015; Rauch et al., 2018; and others). Future research should measure stressors as well as job resources in studies on self-employment and health.

Fourth, in acknowledgement of considerable differences between different types of self-employment, research indeed needs to disentangle the idiosyncrasies of self-employment (Burke, 2015; Dvouletý, 2018). Unfortunately, since we used a longitudinal cohort sample to investigate the temporal nature of the impact of self-employment on health, we were constrained by the sample size to account for the idiosyncratic nature of self-employment. We acknowledge this as a limitation and important area for future research. Nonetheless, past research has used prior employment status (employed vs. unemployed) of the self-employed to capture opportunity vs. necessity entrepreneurship (Nikolova 2019; Binder & Coad, 2016). Note however that there are typically very few individuals moving from unemployment into both employment and self-employment (also Binder & Coad, 2016). Hence our focus is on those self-employed that have been employed before. In this sense we are already investigating a particular type of the self-employment i.e. opportunity entrepreneurs. As is common in

advanced economies such as the UK, opportunity self-employment is the dominant form of self-employment.

[1] Strain results from exposure to stressor (or work demands) and is the resulting negative experience, which is colloquially expressed as 'feeling stressed'.

[2] Cardon and Patel (2015) is an exception and measures both stress and health. Their study focusses on health behaviors (e.g. drinking, smoking, weight gain) instead of illness itself.

[3] Binder and Coad (2016) investigate life satisfaction but not mental or physical health over the first three years of self-employment.

[4] Preamble to the Constitution of WHO as adopted by the International Health Conference, New York, 19 June - 22 July 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of WHO, no. 2, p. 100) and entered into force on 7 April 1948.

[5] For instance, the inconsistent findings may also be related to the differences in the measures used. However, even studies using similar objective and physiological measures still yield different results (e.g., Stephan and Roesler, 2010 better objective health of self-employed vs. Patel et al., 2019 worse objective health).

[6] Some studies consider job tenure, which can help proxy time-effects. Yet tenure is typically a control for the overall sample, rather than examined in interaction with self-employment. The overall effect of tenure is typically positive suggesting rising stress levels with longer (self-)employment (e.g., Hessels et al., 2017).

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Table 1 Variables description

	Employees N=9696		Self-employed N=174			
	Mean	SD	Mean	SD	Differences	Pr(>|z|)
Mental health t_0	50.46	8.25	49.64	9.91	0.82	0.26
Mental health t_1	49.88	8.78	52.63	7.76	-2.75	0.001
Mental health t_2	50.17	8.71	51.51	8.73	-1.34	0.13
Physical health t_0	53.66	7.3	54.6	6.76	-0.94	0.47
Physical health t_1	53.31	7.76	54.01	6.12	-0.7	0.17
Physical health t_2	52.91	8.16	53.59	7.54	-0.68	0.51
Job Anxiety t_0	4.13	2.51	4.16	2.62	-0.03	0.91
Job Anxiety t_1	4.07	2.59	3.33	2.04	0.74	0.001
Job Anxiety t_2	4.03	2.61	3.71	2.54	0.32	0.09
Job Depression t_0	2.66	2.34	1.61	2.57	0.09	0.62
Job Depression t_1	2.66	2.4	1.76	1.56	0.90	0.001
Job Depression t_2	2.64	2.41	2.01	2.04	0.63	0.001
Age	41.78	10.58	43.49	11.24	-1.71	0.05
Gender	0.45	0.5	0.63	0.49	-0.18	0.001
Marital status	0.26	0.44	0.23	0.42	0.03	0.41
Education	4.34	1.46	4.41	1.45	-0.07	0.21
Regions	6.18	3.5	5.98	3.41	0.2	0.03
Income t_0	2091.4	1470.76	2454	2588	-362.96	0.69
Income t_1	2218.44	1553.16	1991	2496	227.87	0.03
Income t_2	2400.85	1736.59	2391	2909	9.67	0.55

Table 2 Estimation of the logit model on the propensity to transit into self-employment

		Estimate	Std. Error	Pr(>|z|)	
Mental Health t_0		-0.02	0.01	0.04	*
Physical Health t_0		-0.02	0.01	0.15	
job anxiety t_0		0.03	0.04	0.07	^
job depression t_0		0.05	0.04	0.84	
Age		0.02	0.01	0.001	***
Gender		0.87	0.16	0.001	***
Marital status		-0.04	0.17	0.95	
Education	No qualification				
	Other qualification	0.07	0.46	0.83	
	GCSE	0.01	0.42	0.94	
	A-level	0.36	0.42	0.64	
	Other higher degree	0.01	0.43	0.48	
	Degree	0.42	0.42	0.77	
Regions	London				
	North west	-0.27	0.32	0.03	*
	South east	-0.22	0.27	0.24	
	West Midlands	-0.68	0.41	0.01	**
	Yorkshire and the Humber	-0.54	0.31	0.37	
	East of England	-0.54	0.29	0.56	
	North East	-0.47	0.49	0.08	^
	East Midlands	0.16	0.28	0.90	
	South West	-0.03	0.29	0.59	
	Wales	-0.54	0.35	0.12	
	Scotland	-0.82	0.34	0.01	*
	Northern Ireland	-0.65	0.39	0.10	^
Income t_0		-0.29	0.00	0.67	
Number of observations 9870					
LR $Chi^2(26)$	64.124				
Prob > Chi^2	0.00				
Pseudo R^2	0.04				
Log likelihood	857.31				

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, ^ $p < 0.1$

Table 3 Mean differences and ATT before and after matching

Outcome Variable	Matching Algorithm	Self-employed Mean	Employees Mean	ATT	SE	*t*-test
Mental health at t_1						
	Before Matching	52.63	49.88			0.01
	NNM	52.63	50.98	2.11	0.58	0.02
	GEN	52.63	50.30	2.87	0.59	0.01
Mental health at t_2						
	Before Matching	51.51	50.17			0.04
	NNM	51.51	51.24	0.75	0.59	0.77
	GEN	51.51	50.39	1.54	0.62	0.24
Physical health at t_1						
	Before Matching	54.01	53.31			0.13
	NNM	54.01	54.15	-0.12	0.45	0.84
	GEN	54.01	53.57	0.01	0.42	0.54
Physical health at t_2						
	Before Matching	53.59	52.91			0.24
	NNM	53.59	52.90	0.67	0.54	0.41
	GEN	53.59	53.51	-0.35	0.49	0.92
Job anxiety at t_1						
	Before Matching	3.33	4.07			0.001
	NNM	3.33	3.97	-0.59	0.08	0.001
	GEN	3.33	3.94	-0.59	0.17	0.01
Job anxiety at t_2						
	Before Matching	3.71	4.03			0.09
	NNM	3.71	3.94	-0.21	0.09	0.25
	GEN	3.71	4.13	-0.40	0.20	0.13
Job depression at t_1						
	Before Matching	1.76	2.66			0.001
	NNM	1.76	2.61	-0.84	0.07	0.001
	GEN	1.76	2.54	-0.78	0.14	0.001
Job depression at t_2						
	Before Matching	2.01	2.64			0.001
	NNM	2.01	2.56	-0.55	0.07	0.001
	GEN	2.01	2.69	-0.68	0.16	0.001

Table 4 Correlation matrix

		1	2	3	4	5	6	7	8	9	10	11
1	Self-employment	1.00										
2	Mental Health	0.07*	1.00									
3	Physical Health	-0.02	-0.26***	1.00								
4	Job Anxiety	-0.09**	-0.47***	-0.11***	1.00							
5	Job Depression	-0.13***	-0.51***	-0.10***	0.65***	1.00						
6	Age	0.08**	0.15***	-0.15***	-0.07*	-0.09**	1.00					
7	Gender	0.29***	0.04	-0.09**	-0.03	-0.04	0.08**	1.00				
8	Marital status	-0.02	-0.06	0	0.06*	0.05	-0.13***	0.02	1.00			
9	Education	-0.02	-0.06	0.11***	0.13***	0.04	0.03	0.02	0.09**	1.00		
10	Regions	-0.01	-0.02	0.01	-0.05	-0.01	0.07*	-0.01	-0.12***	-0.15***	1.00	
11	Income	-0.26***	0.02	0.09**	0.11***	0.05	0.04	-0.14***	0.02	0.25***	-0.05	1.00

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, ^ $p < 0.1$

Table 5 Linear fixed-effects regression results with health as dependent variable

	Mental Health				Physical Health			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Added Mediators		+Job Anxiety	+Job depression	+Job Anxiety &Job Depression		+Job Anxiety	+Job depression	+Job Anxiety &Job Depression
Self-employment (Base: wage workers)	1.76^ (0.94)	1.18 (0.79)	0.22 (0.81)	0.53 (0.78)	0.19 (0.75)	0.27 (0.75)	0.40 (0.76)	0.36 (0.76)
Mediators								
Job Anxiety		-1.93*** (0.17)		-1.22*** (0.22)		0.26^ (0.16)		0.17 (0.22)
Job Depression			-2.10*** (0.19)	-1.17*** (0.25)			0.29^ (0.18)	0.16 (0.24)
Control Variables								
Age	0.09* (0.04)	0.08* (0.04)	0.06^ (0.04)	0.07* (0.03)	-0.09** (0.03)	-0.09** (0.03)	-0.09** (0.03)	-0.09** (0.03)
Gender	0.08 (0.97)	0.81 (0.82)	-0.15 (0.83)	0.42 (0.80)	-1.54* (0.77)	-1.64* (0.77)	-1.51^ (0.77)	-1.58^ (0.05)
Marital status	-1.70 (1.11)	-1.40 (0.93)	-1.42 (0.94)	-1.35 (0.91)	0.33 (0.88)	0.29 (0.87)	0.29 (0.87)	0.28 (0.87)
Income	0.07 (0.30)	0.34 (0.25)	0.05 (0.25)	0.23 (0.24)	0.42^ (0.24)	0.39^ (0.24)	0.43^ (0.23)	0.40^ (0.24)
Other qualification	-1.89 (4.05)	-1.09 (3.41)	-1.71 (3.45)	-1.28 (3.31)	3.83 (3.25)	3.72 (3.24)	3.81 (3.24)	3.75 (3.24)
GCSE etc	-2.36 (3.83)	-1.20 (3.23)	-2.64 (3.27)	-1.78 (3.13)	2.26 (3.07)	2.10 (3.06)	2.30 (3.06)	2.18 (3.06)
A-level etc	-3.83 (3.80)	-2.28 (3.21)	-3.69 (3.24)	-2.77 (3.11)	3.89 (3.04)	3.68 (3.04)	3.87 (3.03)	3.74 (3.03)
Other higher degree	-3.48 (3.87)	-1.22 (3.27)	-3.23 (3.30)	-1.92 (3.17)	2.80 (3.10)	2.49 (3.10)	2.76 (3.09)	2.58 (3.09)
Degree	-3.22 (3.76)	-1.05 (3.18)	-2.83 (3.21)	-1.63 (3.08)	4.40 (3.02)	4.10 (3.02)	4.34 (3.01)	4.18 (3.01)
North west	1.40 (2.02)	0.66 (1.70)	-0.73 (1.73)	-0.26 (1.66)	-1.92 (1.62)	-1.82 (1.62)	-1.63 (1.62)	-1.69 (1.62)
South east	0.95 (1.78)	0.30 (1.50)	-1.15 (1.53)	-0.64 (1.47)	-1.20 (1.42)	-1.11 (1.42)	-0.91 (1.43)	-0.98 (1.43)
West Midlands	2.33 (2.20)	2.28 (1.85)	1.35 (1.88)	1.75 (1.80)	-1.61 (1.77)	-1.60 (1.76)	-1.48 (1.76)	-1.53 (1.76)
Yorkshire and the Humber	2.61 (2.11)	0.35 (1.79)	0.44 (1.81)	-0.03 (1.74)	0.44 (1.70)	0.75 (1.70)	0.74 (1.70)	0.81 (1.70)
East of England	-1.73 (1.88)	-0.64 (1.59)	-2.51 (1.61)	-1.48 (1.54)	1.23 (1.50)	1.08 (1.50)	1.33 (1.50)	1.19 (1.50)
North East	-0.87 (2.80)	-2.48 (2.37)	-2.17 (2.40)	-2.61 (2.30)	2.27 (2.26)	2.49 (2.26)	2.45 (2.25)	2.51 (1.25)
East Midlands	-0.78 (1.93)	-1.20 (1.63)	-1.78 (1.65)	-1.60 (1.58)	-1.31 (1.54)	-1.25 (1.54)	-1.17 (1.54)	-1.19 (1.54)
South West	1.54 (1.90)	0.77 (1.60)	0.60 (1.63)	-0.14 (1.57)	0.20 (1.53)	0.30 (1.52)	0.49 (1.53)	0.43 (1.53)
Wales	-1.46 (2.33)	-1.41 (1.97)	-1.14 (1.99)	-1.07 (1.91)	-0.28 (1.87)	-0.32 (1.87)	-0.32 (1.87)	-0.33 (1.87)
Scotland	-1.51 (2.09)	0.25 (1.76)	-1.70 (1.78)	-1.55 (1.71)	1.54 (1.68)	1.53 (1.68)	1.57 (1.67)	1.55 (1.68)
Northern Ireland	2.51 (2.31)	0.43 (1.96)	0.17 (1.98)	-0.22 (1.90)	0.04 (1.87)	0.35 (1.86)	0.36 (1.86)	0.42 (1.86)
Indirect effects								
via job anxiety		0.59^ (32.9%)		0.32^ (22%)		-0.08 (-0.29%)		-0.06 (0.32%)
via job depression			1.56*** (84.9%)	0..84*** (55.1%)			-0.22 (-9.22%)	-0.14 (1.68%)
F	1.28	7.76	7.78	9.45	1.80	1.86	1.85	1.79
R^2	0.08	0.34	0.32	0.38	0.10	0.11	0.11	0.11
p-value	0.018	0.001	0.001	0.001	0.001	0.001	0.001	0.001

*** $p< 0.001$, ** $p < 0.01$, * $p < 0.05$, ^ $p < 0.1$ (two-sided). Regression coefficients are displayed with standard errors between parentheses. Standard errors are clustered on the individual level. Proportion of total relationship mediated by job anxiety or job depression is shown in brackets.

Table 6 Pooled OLS regressions on work-related strain and health with moderating test of gender

	Job anxiety		Job depression		Mental health		Physical health	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Added Moderator		+SE* Gender		+SE* Gender		+SE* Gender		+SE* Gender
Self-employment (Base: wage workers)	-0.13** (0.12)	-0.09** (0.25)	-0.43*** (0.11)	-0.09 (0.22)	1.57*** (0.42)	2.03*** (0.41)	0.36 (0.33)	-0.53 (0.33)
Control Variables								
Age	-0.02*** (0.001)	-0.02*** (0.001)	-0.02*** (0.001)	-0.02*** (0.001)	0.08*** (0.01)	0.09*** (0.01)	-0.10*** (0.01)	-0.10*** (0.01)
Marital status	-0.10 (0.10)	-0.10 (0.10)	0.10 (0.09)	0.10 (0.09)	-1.64*** (0.37)	-1..34*** (0.37)	0.19 (0.29)	0.15 (0.29)
Income	0.26*** (0.05)	0.26*** (0.05)	0.05 (0.05)	0.03 (0.05)	0.32^ (0.18)	0.02 (0.18)	0.58*** (0.14)	0.60*** (0.14)
Other qualification	-0.03 (0.15)	-0.04 (0.15)	0.15 (0.13)	0.13 (0.13)	0.15 (0.53)	0.33 (0.53)	-1.65*** (0.41)	-1.77*** (0.42)
GCSE etc	-0.30* (0.13)	-0.30* (0.13)	0.06 (0.12)	0.06 (0.12)	0.33 (0.46)	0.33 (0.47)	-1.30*** (0.36)	-1.43*** (0.37)
A-level etc	-0.34* (0.13)	-0.34* (0.13)	0.17 (0.12)	0.16 (0.12)	0.69 (0.47)	0.71 (0.48)	-1.63*** (0.37)	-1.82*** (0.38)
Other higher degree	0.04 (0.17)	0.04 (0.17)	0.13 (0.15)	0.13 (0.15)	0.24 (0.60)	0.40 (0.62)	-0.74 (0.47)	-1.00* (0.49)
Degree	0.38* (0.16)	0.38* (0.16)	0.05 (0.14)	0.04 (0.14)	-0.48 (0.56)	-0.31 (0.65)	0.16 (0.44)	0.40 (0.51)
North West	0.49* (0.23)	0.49* (0.23)	0.08 (0.20)	0.08 (0.20)	0.40 (0.81)	0.29 (0.81)	-0.57 (0.64)	-0.54 (0.64)
South East	0.02 (0.23)	0.03 (0.23)	-0.09 (0.20)	-0.08 (0.20)	0.35 (0.81)	0.42 (0.81)	-0.22 (0.64)	-0.24 (0.64)
West Midlands	0.23 (0.24)	0.24 (0.24)	0.23 (0.22)	0.24 (0.22)	-0.06 (0.87)	-0.07 (0.87)	-1.03 (0.68)	-1.01 (0.68)
Yorkshire and the Humber	0.41^ (0.25)	0.41^ (0.25)	0.33 (0.22)	0.32 (0.22)	0.59 (0.88)	0.56 (0.87)	-0.91 (0.69)	-0.90 (0.69)
East of England	0.13 (0.23)	0.13 (0.23)	-0.14 (0.20)	-0.13 (0.20)	0.58 (0.81)	0.68 (0.81)	-0.35 (0.63)	-0.33 (0.63)
North East	0.42^ (0.24)	0.42^ (0.24)	0.08 (0.22)	0.09 (0.22)	0.56 (0.86)	0.58 (0.86)	0.08 (0.67)	0.16 (0.67)
East Midlands	0.27 (0.22)	0.27 (0.22)	-0.13 (0.20)	-0.13 (0.20)	0.36 (0.79)	0.42 (0.78)	-0.36 (0.62)	-0.29 (0.62)
South West	-0.06 (0.23)	-0.06 (0.23)	-0.13 (0.20)	-0.12 (0.20)	0.64 (0.80)	0.55 (0.80)	0.64 (0.63)	0.68 (0.63)
Wales	-0.20 (0.26)	-0.20 (0.26)	-0.19 (0.23)	-0.19 (0.23)	0.27 (0.92)	0.20 (0.91)	-0.11 (0.72)	-0.08 (0.72)
Scotland	0.14 (0.24)	0.14 (0.24)	-0.02 (0.22)	-0.02 (0.22)	-0.38 (0.87)	-0.37 (0.86)	0.50 (0.68)	0.53 (0.68)
Northern Ireland	-0.04 (0.25)	-0.04 (0.25)	-0.08 (0.23)	-0.08 (0.23)	0.72 (0.90)	0.81 (0.90)	-2.40*** (0.71)	-2.40*** (0.71)
Moderators								
Gender	0.13* (0.08)	0.17* (0.08)	0.01 (0.07)	0.08 (0.08)	0.12 (0.28)	2.62*** (0.49)	-0.13 (0.22)	-0.03 (0.39)
Interaction effects								
Self-employment* Gender		-0.20** (0.20)		-0.46** (0.18)		-2.16*** (0.34)		0.13 (0.27)
F	5.88	5.66	2.96	3.14	3.86	4.95	9.52	9.26
R^2	0.04	0.04	0.02	0.02	0.02	0.03	0.06	0.06
p-value	0.001	0.001	0.001	0.001	0.02	0.03	0.001	0.001

*** p< 0.001, ** p < 0.01, * p < 0.05, ^ p < 0.1 (two-sided). Regression coefficients are displayed with standard errors between parentheses.

Figure 1. Hypothesized relationships among self-employment, work-related strain, gender, and health

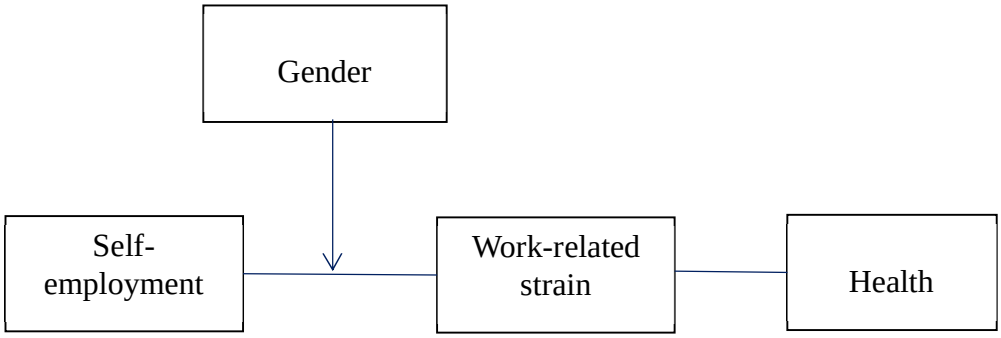


Figure 2. Hypothesized time-related effects of self-employment on health

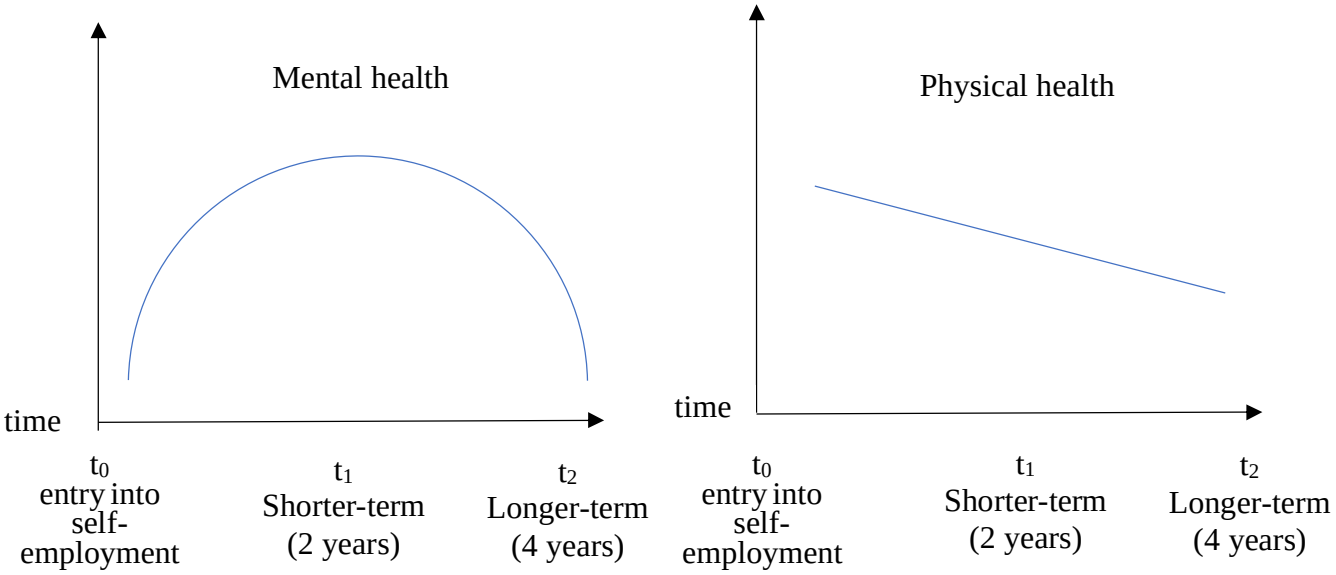
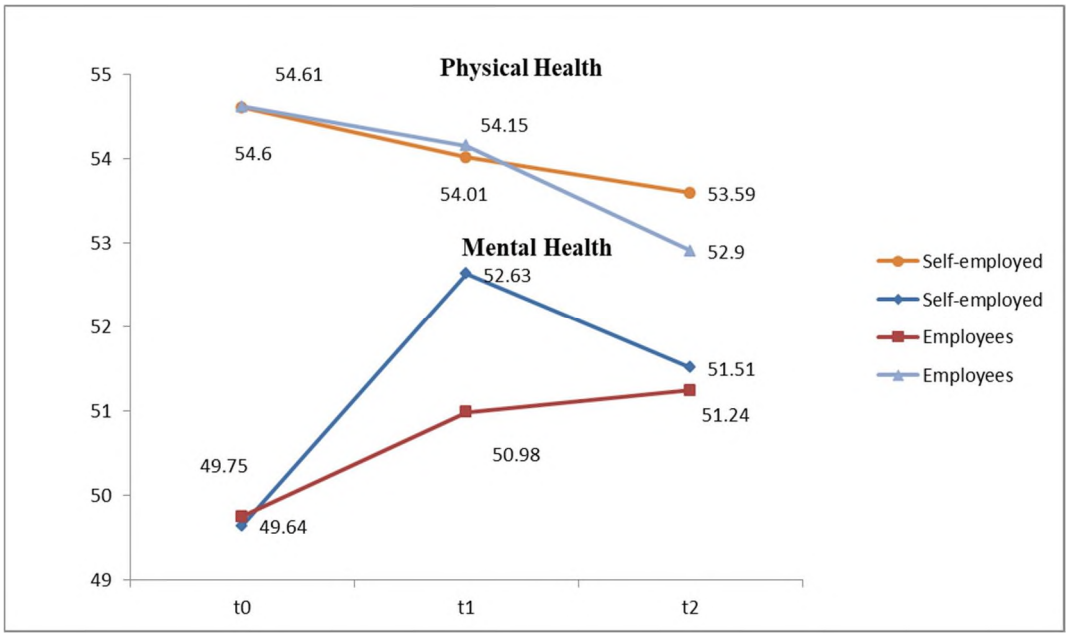


Figure 3 Temporal features of health and work-related strain



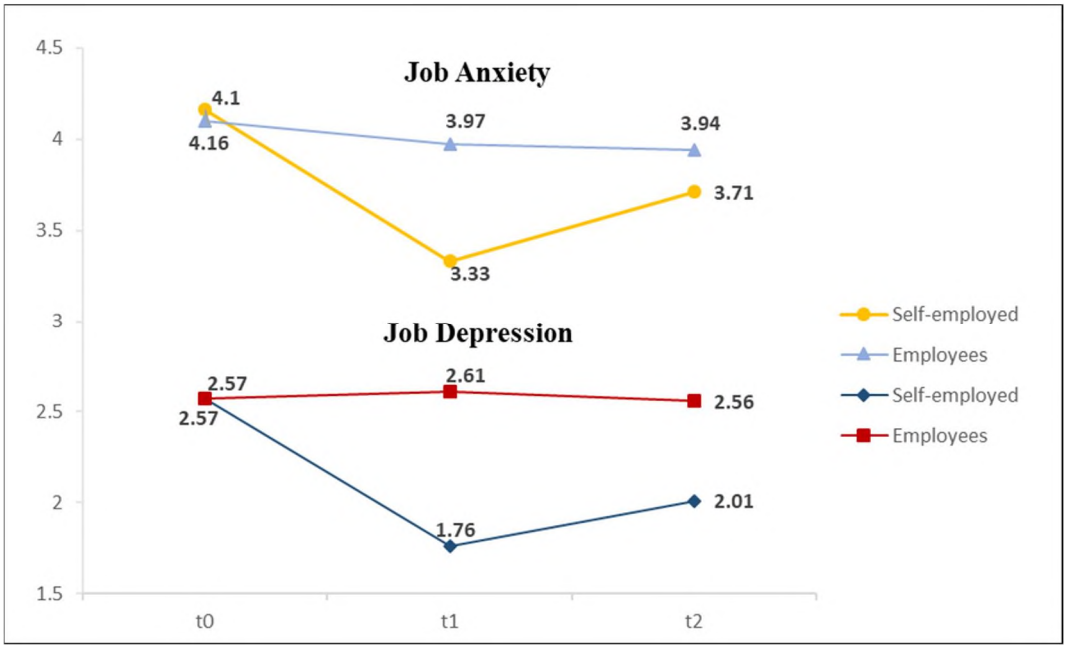


Figure 4 Interaction of self-employment and gender on work-related strain

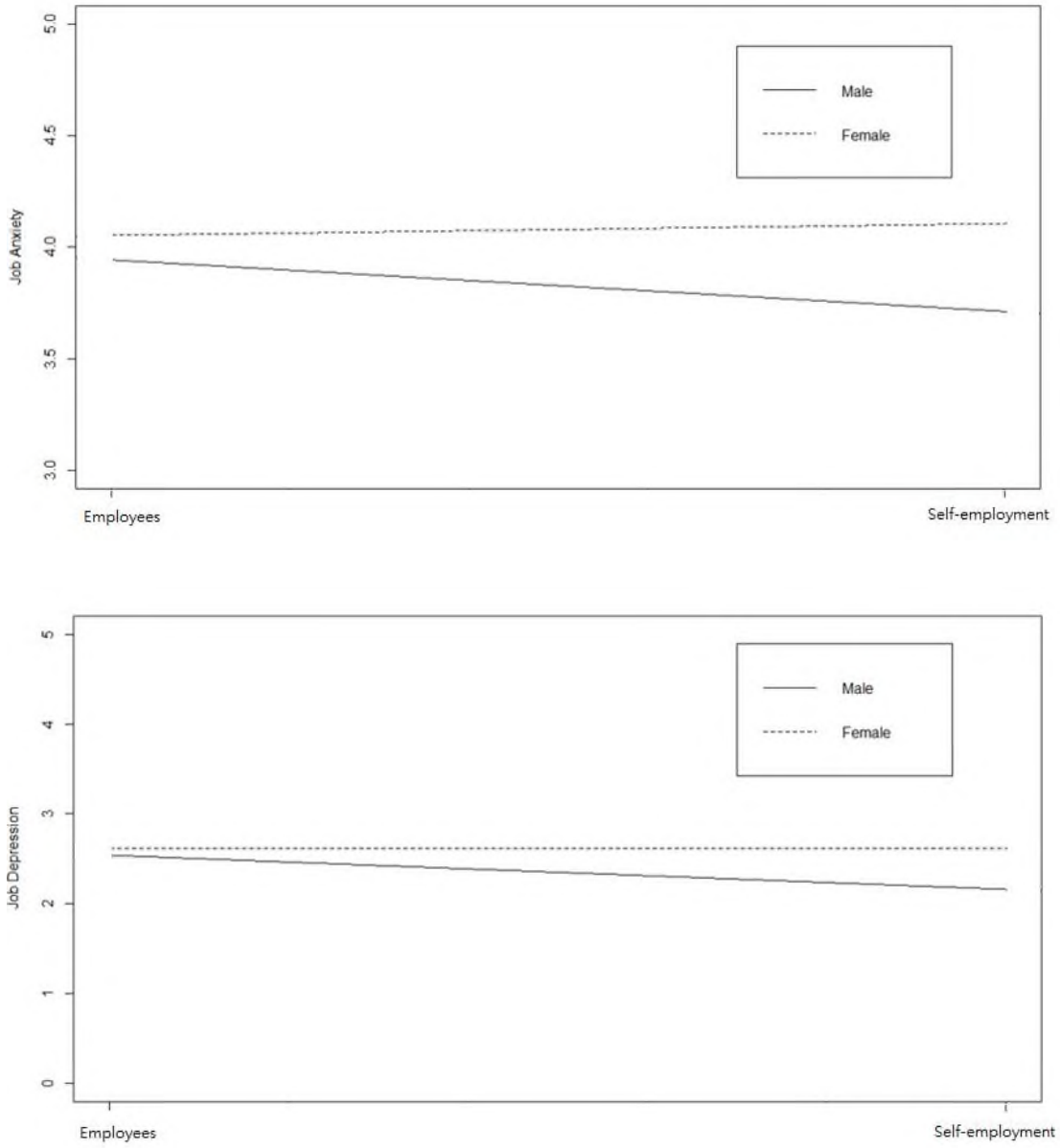
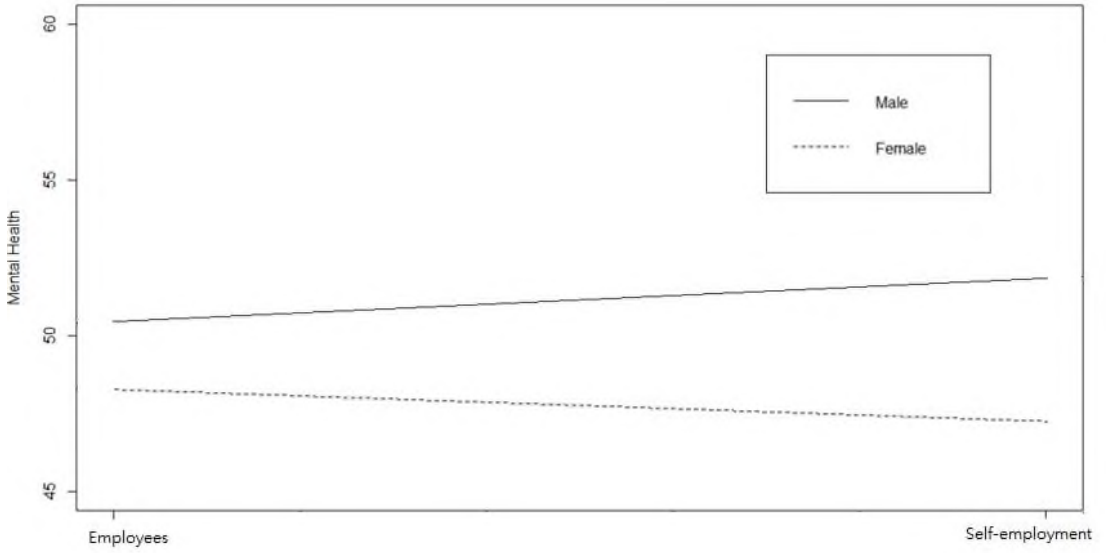
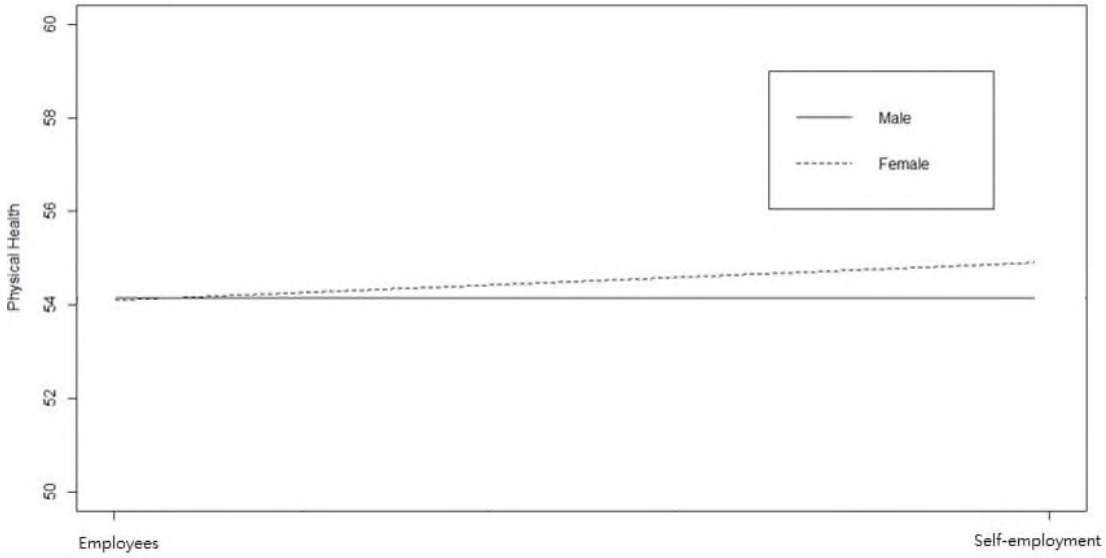


Figure 5 Interaction of self-employment and gender on health





Appendix 1 Overview of research on self-employment and health

Study	Sample	Health measure(s)	Method(s)		Significant relation: Self-employment and health	
			Procedures	Endogenous selection control	Mental health	Physical health
Eden (1975)	183 self-employed individuals and 1092 salary workers in the USA in 1969	An index containing 21 items measured undesirable symptoms: somatic complaints, depression, and performance debilitation. One-item measure of positive mental health	Means comparison	No	No	N/A
Lewin-Epstein & Yuchtmann-Yaar (1991)	131 self-employed individuals and 434 salaried workers from two cities of Holon and Bat-Yam, Israel	9-item measure of health (diastolic BP, Serum cholesterol, Triglycerides, HDL (%), HDL (mg), Perceived health, Somatic complaints, Physician visits, and Disability days)	Multivariate analysis	No	N/A	(-) (greater risk of cardiovascular disease)
Jamal (1997)	70 self-employed individuals and 165 wage workers from a city of Canada	Measures of psychosomatic health problems from Michigan studies of workers' health, and 22-item mental health scale	One-way ANOVA	No	N/A	(-) (in psychosomatic health problems)
Benavides et al. (2000)	1836 sole traders and 13310 people in other types of employment from 2nd European Survey on Working Conditions Surveys in 15 EU countries (1995)	Three self-reported health indicators - overall fatigue, backache, and muscular pain	Logistic regressions	No	(-)	(-)
Tetrick et al. (2000)	75 self-employed individuals and 82 wage workers from Michigan, USA	9-item emotional exhaustion scale	MANOVA	No	(+)	N/A
Perry and Rosen (2001)	1086 self-employed individuals and 7898 wage-workers from the United State (1996 Medical Expenditure Panel Survey, MEPS)	Subjective measure of general physical and mental health status; objective measure of physical limitations and a variety of medical conditions (e.g. cancer, cardiac problem)	Means comparison	Partially by employing two different dataset to examine transitions from wage-earning to self-employment	No	No
Dolinsky & Caputo (2003)	1412 self-employed, wage-earning, and non-employed women from the United State (1976-1995 Mature Women's Cohort of the National Longitudinal Survey of Labor Market Experience (NLSLME))	One-item measure of self-reported health status	Multivariate regressions	No	No	N/A
Benach et al. (2004)	4289 sole traders and 30262 people in other types of employment from 2nd and 3rd European Survey on Working Conditions Surveys in 15 EU countries (1995 and 2000)	Two self-reported health indicators: fatigue and backache	Logistic regressions	No	(-)	(-)
Parslow et al. (2004)	324 self-employed individuals and 1951 wage workers from Australia (PATH Through Life Project)	12-item physical health scale, scores on Goldberg's depression and anxiety scales	Hierarchical regressions	No	No	(-) for self-employed women
Andersson (2008)	149 self-employed individuals and 1849 wage workers from Sweden (1991 and 2000 Swedish Level-of Living Survey)	Mental health dummy	Multivariate regression (fixed-effects)	No	(-)	N/A

Stephan & Roesler (2010)	149 self-employed individuals and 149 wage workers from the German National Health Survey 1998	Blood pressure, somatic diseases, mental disorders, and behavioural health indicators	Multivariate regressions	Yes, case control design	(+)	(+)
Yoon and Bernell (2013)	1481 self-employed individuals and 11954 wage workers from the household component of the 2007 Medical Expenditure Panel Survey (MEPS), USA	Perceived physical and mental health status; Physical Health Composite Scores derived from the Short-Form 12 Version 2 (SF-12v2); Mental Health Composite Scores calculated from the SF-12v2 and the Kessler Index of non-specific psychological distress); and a set of medical conditions (stroke, diabetes, asthma, high blood pressure, high cholesterol, emphysema, joint pain, and arthritis).	Multivariate regressions	Yes, instrumental variables	No	(+)
Cardon and Patel (2015)	688 self-employed, 688 employed from NHANES I Epidemiologic Follow-up Study (NHEFS I), USA, 1982-84, outcomes measured in 1987	Stress (three measures of blood pressure and three items of general self-reported life stress) Health measure combines alcohol use, smoking, physical activity, weight gain, and subjective health	Path analysis	Yes, propensity score matching and instrumental variables	N/A	(-) indirect via stress
Rietveld, Bailey, Hessels and van der Zwan (2016)	1276 business owners and 3279 wage-workers from 2013 Global Entrepreneurship Monitor (GEM) Survey with the EQ-5D-5L Self-Reported Health Instrument in four Caribbean Basin countries	EuroQol EQ-5D-5L Self Reported Health instrument	Binary logit regressions	No	(+)	(+)
Rietveld, Kippersluis, H., & Thurik (2016)	3050 self-employed individuals and 10399 wage workers from the United States (1992-2010 Health and Retirement Study)	Three health indicators (number of health conditions, self-reported health and mental health)	Pooled regressions and longitudinal regressions	Yes. Uses the selection on observable variables as an indication for the potential selection on unobservable variables	(-)	(-)
Toivanen et al. (2016)	A cohort of the total working population (4 776 135 individuals; 7.2% self-employed; 18–100 years of age at baseline 2003) in Sweden	mortality (all-cause, CVD, neoplasms and suicide)	Cox proportional hazards models	No	N/A	(+/-) mortality is lower among those self- employed who run a limited liability Company, but mortality is higher those self-employed operating as sole proprietors, mortality is higher in trade and transportation
Lee & Kim (2017)	2501 self-employed individuals and 3289 people in other types of employment from 2005-2013 Korean Retirement and Income Study	Subjective physical health measured by a single survey question: “In general, how would you estimate that your physical health is?” on a 5-point scale	Pooled cross-sectional model and fixed effect models	No	N/A	(-)
Goncalves & Martins (2018)	132,000 self-employed individuals and wage workers over a period of up to 84 months between January 2005 and December 2011 from administrative social security records representative of the active population in Portugal	Hospital admissions	Pooled OLS models and fixed-effects panel data models	Yes, control for individual time-invariant heterogeneity through individual fixed effects	N/A	(+)

Nikolova (2019)	German longitudinal data for the period 2002–2014	the Short Form (SF)-12 questionnaire (physical health in four domains - bodily pain, general health, role physical, and physical functioning; the mental health in four domains - vitality, role emotional, mental health, and social functioning)	Binary logit regressions	Yes, difference-in-differences (DID) applied after entropy balancing	necessity entrepreneurs (+); opportunity entrepreneurs (+)	opportunity entrepreneurs (+)
Patel et al. (2019)	194 self-employed and 1511 employed individuals	Allostatic load	generalized structural equation model	No	No	(-)

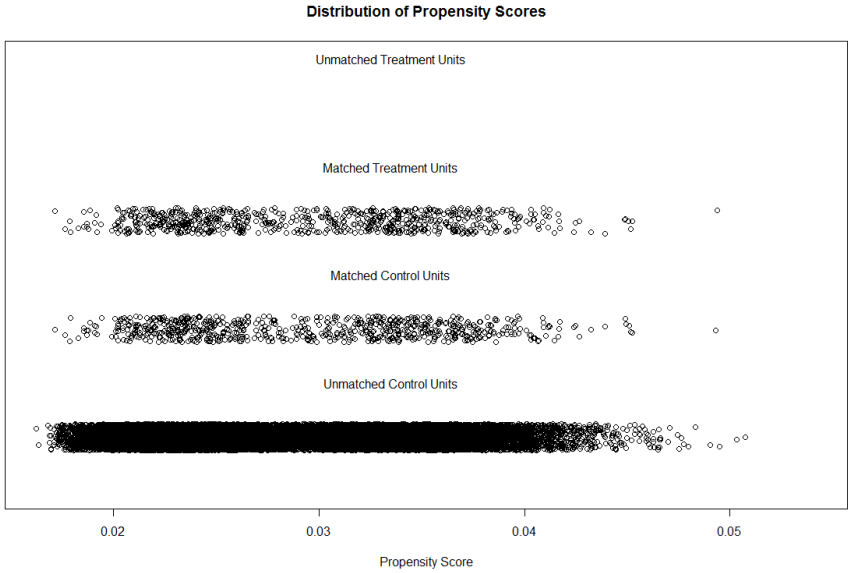
Appendix 2 Tests for selection bias after matching

	Matched Sample		Bias		*t*-test
	Treated	Control			
	N=174	N=174	Bias	Bias reduction	*p*-value
Physical health at t_0	54.60	54.61	0.001	0.13	0.99
Mental health at t_0	49.64	49.75	0.01	0.08	0.91
Job anxiety at t_0	4.16	4.10	0.08	0.05	0.58
Job depression at t_0	2.57	2.56	0.03	0.01	0.52
Age	43.49	42.95	0.02	0.11	0.65
Gender	0.63	0.61	0.04	0.33	0.83
Marital status	0.23	0.24	0.00	0.03	0.80
Education	4.41	4.55	0.06	0.04	0.36
Regions	5.98	6.02	0.01	0.05	0.91
Income t_0	2454.36	2597.20	0.09	0.11	0.59

Appendix 3 Statistical tests to evaluate the matching

Matching Method	Pseudo R^2	Likelihood Ratio Chi^2	$p > Chi^2$	Mean bias	Median bias
Before Matching	0.29	1031.56	0.00	0.11	0.06
NNM	0.02	241.22	0.79	0.05	0.04
Genetic	0.00	241.30	1.00	0.01	0.01
SUBCLASS	0.00	872.93	0.94	0.11	0.06

Appendix 4 Distribution of Propensity Scores



Appendix 5 Sensitivity Analysis at t_1 and t_2

	Mental health at t_1		Physical health at t_1		Mental health at t_2		Physical health at t_2	
Gamma	sig-	sig+	sig-	sig+	sig-	sig+	sig-	sig+
1	0.0241	0.0241	0.2761	0.2761	0.3646	0.3646	0.3762	0.3762
1.1	0.0059	0.0756	0.1294	0.4758	0.1879	0.5763	0.1959	0.589
1.2	0.0013	0.1722	0.0526	0.665	0.0838	0.7532	0.0882	0.7638
1.3	0.0002	0.3099	0.019	0.8092	0.0331	0.8725	0.0351	0.8798
1.4	0	0.4678	0.0063	0.9018	0.0118	0.9407	0.0126	0.9449
1.5	0	0.62	0.0019	0.9536	0.0039	0.9747	0.0042	0.9769
1.6	0	0.7477	0.0005	0.9797	0.0012	0.99	0.0013	0.991
1.7	0	0.8432	0.0001	0.9916	0.0003	0.9963	0.0004	0.9967
1.8	0	0.9082	0	0.9967	0.0001	0.9987	0.0001	0.9989
1.9	0	0.949	0	0.9988	0	0.9996	0	0.9996
2	0	0.973	0	0.9996	0	0.9999	0	0.9999
2.1	0	0.9862	0	0.9999	0	1	0	1
2.2	0	0.9932	0	1	0	1	0	1
2.3	0	0.9968	0	1	0	1	0	1
2.4	0	0.9985	0	1	0	1	0	1
2.5	0	0.9993	0	1	0	1	0	1
2.6	0	0.9997	0	1	0	1	0	1
2.7	0	0.9999	0	1	0	1	0	1
2.8	0	0.9999	0	1	0	1	0	1
2.9	0	1	0	1	0	1	0	1
3	0	1	0	1	0	1	0	1

Gamma – Log odds of differential assignment due to unobserved factors
sig- - Lower bound significant level (underestimation of treatment effect)
sig+ - Upper bound significant level (overestimation of treatment level)

Appendix 6 Difference in Difference Analysis

	Self-employment			Employees			DiD no controls	DiD with controls
	1	2	3 (=2-1)	4	5	6 (=5-4)	7 (=3-6)	8
Mental Health (t_0, t_1)	49.64	52.63	2.99	49.75	50.98	1.23	1.76	3.13*
Mental Health (t_0, t_2)	49.64	51.51	1.87	49.75	51.24	1.49	0.38	0.85
Physical Health (t_0, t_1)	54.60	54.01	-0.59	54.61	54.15	-0.46	-0.13	0.01
Physical Health (t_0, t_2)	54.60	53.59	-1.01	54.61	52.90	-1.71	0.70	0.33
Job Anxiety (t_0, t_1)	4.16	3.33	-0.83	4.10	3.97	-0.13	-0.70	-0.43*
Job Anxiety (t_0, t_2)	4.16	3.71	-0.45	4.10	3.94	-0.16	-0.29	-0.09
Job Depression (t_0, t_1)	2.57	1.76	-0.81	2.56	2.61	0.05	-0.86	-0.83**
Job Depression (t_0, t_2)	2.57	2.01	-0.56	2.56	2.56	0	-0.56	-0.27*

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, ^ $p < 0.1$ (two-sided)

Appendix 7 Pooled OLS regression results with health as dependent variable

	Mental Health				Physical Health			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Added Mediators		+Job Anxiety	+Job depression	+Job Anxiety &Job Depression		+Job Anxiety	+Job depression	+Job Anxiety &Job Depression
Self-employment (Base: wage workers)	1.57*** (0.42)	1.35*** (0.37)	0.69* (0.36)	0.85* (0.35)	0.36 (0.33)	0.37 (0.33)	0.40 (0.76)	0.36 (0.76)
Mediators								
Job Anxiety		-1.71*** (0.06)		-1.89*** (0.07)		0.08 (0.05)		0.17 (0.22)
Job Depression			-2.05*** (0.06)	-1.42*** (0.08)			0.29^ (0.18)	0.16 (0.24)
Control Variables								
Age	0.08*** (0.01)	0.05*** (0.01)	0.05*** (0.01)	0.04** (0.01)	-0.10*** (0.01)	-0.10*** (0.01)	-0.10*** (0.01)	-0.10*** (0.01)
Gender	0.12 (0.28)	0.35 (0.24)	0.13 (0.24)	0.25 (0.23)	-0.13 (0.22)	-0.14 (0.22)	-0.13 (0.22)	-0.14 (0.22)
Marital status	-1.64*** (0.37)	-1.80*** (0.32)	-1.43*** (0.31)	-1.58*** (0.31)	0.19 (0.29)	0.20 (0.29)	0.18 (0.29)	0.19 (0.29)
Income	0.32^ (0.18)	0.77*** (0.16)	0.41** (0.15)	0.62*** (0.15)	0.58*** (0.14)	0.56*** (0.14)	0.57*** (0.14)	0.56*** (0.14)
Other qualification	0.15 (0.53)	0.10 (0.46)	0.45 (0.45)	0.33 (0.44)	-1.65*** (0.41)	-1.65*** (0.41)	-1.67*** (0.41)	-1.66*** (0.41)
GCSE etc	0.33 (0.46)	0.18 (0.41)	0.46 (0.40)	0.15 (0.39)	-1.30*** (0.36)	-1.28*** (0.36)	-1.31*** (0.36)	-1.29*** (0.36)
A-level etc	0.69 (0.47)	0.12 (0.42)	1.04* (0.41)	0.64 (0.40)	-1.63*** (0.37)	-1.61*** (0.37)	-1.65*** (0.37)	-1.63*** (0.37)
Other higher degree	0.24 (0.60)	0.30 (0.53)	0.50 (0.52)	0.46 (0.50)	-0.74 (0.47)	-0.74 (0.47)	-0.75 (0.47)	-0.75 (0.47)
Degree	-0.48 (0.56)	-0.17 (0.49)	-0.38 (0.48)	-0.17 (0.47)	0.16 (0.44)	0.13 (0.44)	0.15 (0.44)	0.14 (0.44)
North West	0.40 (0.81)	1.23^ (0.71)	0.56 (0.69)	0.94 (0.68)	-0.57 (0.64)	-0.60 (0.64)	-0.57 (0.64)	-0.59 (0.64)
South East	0.35 (0.81)	0.39 (0.71)	0.17 (0.69)	0.25 (0.68)	-0.22 (0.64)	-0.22 (0.64)	-0.21 (0.64)	-0.22 (0.64)
West Midlands	-0.06 (0.87)	0.33 (0.76)	0.41 (0.74)	0.47 (0.72)	-1.03 (0.68)	-1.05 (0.68)	-1.05 (0.68)	-1.06 (0.68)
Yorkshire and the Humber	0.59 (0.88)	1.29^ (0.77)	1.26^ (0.75)	1.42^ (0.73)	-0.91 (0.69)	-0.95 (0.69)	-0.95 (0.69)	-0.95 (0.69)
East of England	0.58 (0.81)	0.79 (0.71)	0.30 (0.69)	0.50 (0.67)	-0.35 (0.63)	-0.36 (0.63)	-0.34 (0.63)	-0.35 (0.63)
North East	0.56 (0.86)	1.28^ (0.75)	0.72 (0.73)	1.04 (0.72)	0.08 (0.67)	0.05 (0.67)	0.08 (0.67)	0.06 (0.67)
East Midlands	0.36 (0.79)	0.82 (0.69)	0.10 (0.67)	0.42 (0.66)	-0.36 (0.62)	-0.39 (0.62)	-0.35 (0.62)	-0.36 (0.62)
South West	0.64 (0.80)	0.53 (0.70)	0.38 (0.69)	0.40 (0.67)	0.64 (0.63)	0.64 (0.63)	0.65 (0.63)	0.65 (0.63)
Wales	0.27 (0.92)	-0.07 (0.80)	-0.11 (0.78)	-0.17 (0.76)	-0.11 (0.72)	-0.10 (0.72)	-0.10 (0.72)	-0.09 (0.72)
Scotland	-0.38 (0.87)	-0.15 (0.76)	-0.42 (0.74)	-0.28 (0.72)	0.50 (0.68)	0.49 (0.68)	0.51 (0.68)	0.50 (0.68)
Northern Ireland	0.72 (0.90)	0.65 (0.79)	0.55 (0.77)	0.57 (0.75)	-2.40*** (0.71)	-2.40*** (0.71)	-2.40*** (0.71)	-2.40*** (0.71)
Indirect effects								
via job anxiety		-2.31*** (94.67%)		-0.76*** (85.33%)		-0.02 (1.85%)		-0.04 (3.74%)
via job depression			-1.41*** (76.68%)	-1.21*** (73.73%)			-0.12 (10.26%)	-0.08 (6.78%)
F	3.86	48.55	58.97	66.73	9.52	9.20	9.247	8.85
R^2	0.02	0.25	0.29	0.32	0.06	0.06	0.06	0.06
p-value	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

*** p< 0.001, ** p < 0.01, * p < 0.05, ^ p < 0.1 (two-sided). Regression coefficients are displayed with standard errors between parentheses. Standard errors are clustered on the individual level. Proportion of total relationship mediated by job anxiety, job depression or job demand is shown between brackets.