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Announcement

The electronic International Journal of Time Use Research eIJTUR vol. 13 is the last volume under the current editorial board consisting of Prof. Dr. Joachim Merz (Managing Editor and Editor, Leuphana University Lueneburg, Germany), Prof. Jonathan Gershuny (Editor, Oxford University, UK) and Prof. Andrew S. Harvey (Editor, Saint Mary's University, Halifax, Canada) and Kimberly Fisher (Book Editor, Oxford University, UK).

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We would like to thank indeed the current assistant to the managing editor Normen Peters M.Sc., all authors, referees, co-editors and all other contributors who made eIJTUR possible. Additionally we express our thankfulness to the Forschungsinstitut Freie Berufe (FFB) and the Leuphana University Lueneburg for hosting eIJTUR.

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Measuring short and rare activities – Time diaries in criminology

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Abstract

Motivated by recent time use studies in criminology, this study examined whether time diaries are suitable for measuring short and rare activities such as offending. The study compared time diary data collected among 843 adolescents from the conurbation of The Hague (the Netherlands) with stylized questionnaire data from the same respondents, and with stylized questionnaire data from another sample that is representative for Dutch adolescents (N = 1849). Based on the reported offenses in the diaries (N = 101), findings indicate that time diaries may underestimate population offense rates and may not capture offenses committed by low-frequent offenders. On the other hand, time diaries seem able to measure changes in individuals' involvement in offending over time and to capture most of the situational conditions under which offenses occur. The study concludes with suggestions for dealing with the problems associated with measuring short and rare activities.

JEL-Codes: C00, C80, C83, K42

Keywords: Short and rare activities, crime, time diaries, validity, time use methodology

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1 Introduction

The time diary is a useful tool for collecting detailed information on activity patterns and individual lifestyles, and often the preferred method to study a variety of research questions across several disciplines (Pentland, Harvey, Lawton and McColl, 1999). However, it has been suggested that time diaries suffer from validity problems when measuring short and rare activities (Frazis and Stewart, 2012; Gershuny 2011; Gershuny, 2012; Juster, 1985; Phipps and Vernon, 2009). These problems concern the study of activities that are rare but not short (e.g., bowling or visiting the theater), as well as activities that are short but not rare (e.g., going to the restroom). Knowledge of the potential limitations of time diaries and how to deal with them might be particularly helpful for time use researchers who predominantly study phenomena that are both short and rare. Criminology is a case in point, as its main focus is on offending: An activity that is both rare and of short duration.

Time diaries have recently been introduced in criminology (Wikström and Butterworth 2006; Wikström, Ceccato, Hardie and Treiber, 2010; Wikström, Oberwittler, Treiber and Hardie, 2012a). Wikström and colleagues developed a new time use method that also captured the geographical location of respondents, and that is specifically concerned with measuring offending, victimization, and other criminologically relevant activities: the Space-Time Budget method (Wikström, et al., 2010; Wikström, et al., 2012a; Wikström, Treiber and Hardie, 2012b). The Space-Time Budget method (STB) has great potential for criminological research. For example, because it enables an accurate operationalization of 'risky' lifestyles (e.g., Osgood et al., 1996), because it enables the investigation of situations that potential offenders are exposed to, and because it directly measures the conditions under which offending and victimization occur (Averdijk and Bernasco, 2014; Bernasco, Ruiter, Bruinsma, Pauwels and Weerman, 2013). Since the method captures not only the activity, but multiple domains of respondents' time use (e.g., where it occurred, who else was present, secondary activities), the method allows for analyzing activities in a more conceptually relevant manner.

For most people, offending is a rare occasion (Van der Laan and Blom 2006). Per illustration, Wikström et al. (2012a) found that 49 percent of their sample reported less than ten acts of offending across five years. Offending is also generally assumed to be of short duration[1]. For example, Buckle and Farrington (1984) found in an observational study that shoplifters spend on average 11 minutes in the store. As offending is rare and assumed to be of short duration, it is unclear whether time diaries can be used to capture the distribution of offending across individuals or the development of involvement in offending over time. The present study examines these and related questions by comparing time diary data that was collected in the Study of Peers, Activities and Neighborhoods (SPAN), with two datasets: A stylized questionnaire

[1] This might vary for different types of offending.

administered to the same respondents (also collected in the SPAN study), and external data of the Youth Delinquency Survey (MZJ). The latter contains information on offending from a sample that is representative of adolescents in the Netherlands. Its data collection was administered by the Criminal Justice Knowledge Center of the Netherlands Ministry of Security and Justice (WODC).

The present study aims to answer three research questions. First, we investigate whether time diaries are able to generate population estimates of offending. Second, we investigate whether time diaries are able to capture the development of individuals' involvement in offending over time. Third, we examine whether time diaries adequately capture the circumstances under which offending occurs.

2 Prior literature

2.1 Time use research on rare and short activities

2.1.1 Rare activities

Whether a time use instrument is able to capture rare activities depends on the *number of individuals* who engage in these activities and on *how often* they engage in these activities (Harvey, 1999). As only a limited amount of days can be covered in time diaries, most time diaries use relatively short reference periods. Respondents are asked to record their activities for one or two days, or at most for one whole week. However, activity patterns (or the frequency with which individuals engage in certain activities) may vary per season, per week, or even per day. Using a time diary with a short reference period is therefore not necessarily representative for longer periods of time. This is especially a problem for rare activities (Frazis and Stewart, 2012). As a potential solution – for rare activities specifically, Frazis and Stewart (2012) suggest that researchers collect data over multiple days for the same respondent. This allows for studying variance within and between individuals; having information about multiple days per person enables the comparison of activity patterns from one day with activity patterns from other days (for the same person). This gives at least some indication of the extent to which the activities on this day are representative for the individuals' daily routines. Nevertheless, this approach is not sufficient if the activities occur less often than the duration of the reference period. If you would question respondents about three days, and they are engaged in the activity on a weekly basis, you may still not capture the activity. More importantly, it would seem as if a respondent is not engaged in an activity *at all*, even though he or she is engaged in the activity on a weekly basis. Extending the reference period may increase the burden on respondents, thereby causing more non-response, and may decrease recall accuracy (Gershuny, 2012; Pentland et al., 1999). Scholars have stated that this limits the usefulness of time diaries for long-term population estimates (Frazis and Stewart, 2012; Gershuny, 2011).

Strategies other than increasing the reference period are for example to increase the sample size, or to select respondents who are known to frequently engage in the activity of interest (Kalton and Anderson, 1986). Alternatively, one could combine time diary data with stylized questionnaire data (habit-type items such as "How often do you engage in … activity?") to assess the distribution of activities across individuals and populations, as proposed by Gershuny (2012). He elaborates on a statistical technique developed for nutrition research by Tooze et al. (2006) and Kipnis et al. (2009). In this analytical framework, individual long-term time use estimates are calculated by multiplying respondents' daily participation probability with the predicted time engaged in the activity. These estimates are combined to estimate the distribution across populations (Gershuny, 2011; Gershuny, 2012). Gershuny (2012) showed that his method is applicable for a variety of infrequent activities, such as going to the cinema, watching sports, eating at a restaurant, and swimming.

2.1.2 Short activities

Time diaries with fixed time intervals (e.g., ten minutes, one hour) may underestimate the frequency of activities with a short duration. The larger the time interval, the more likely that multiple activities occur during the interval and, as longer activities are more likely to be reported, this leaves the shorter activities excluded (Ås, 1978). Previous studies indeed indicated that short activities were less likely to be captured by fixed interval time diaries than by open interval time diaries (Fleming and Spellerberg, 1999).

There are several ways to address this problem. A first option is to let the length of the fixed time interval be determined by the duration of the activity one intends to measure. This would mean that researchers who are interested in short activities need to define shorter time intervals (Fleming and Spellerberg, 1999). A disadvantage of using shorter fixed time intervals is the high costs of data collection. Also, using short fixed time intervals increases the burden on respondents, as the interview length is extended, and participants are required to recall briefer activities (Gershuny, 2012; Wikström et al., 2012a). It may also generate a lot of irrelevant data, such as on the "time spent making a cup of tea" (Wikström et al., 2012a, p. 74). A second option is the use summary questions, by for example asking at the end of every interview day: "During any part of the day did this activity take place?". The end of day summary question method was initially developed to capture secondary activities (Phipps and Vernon, 2009), but is applied in the Space-Time Budget method to measure activities of short duration that are of particular interest. The questions in the STB method are referred to as 'extra incidents' (Wikström, et al., 2010; Wikström, et al., 2012a). The use of end of day summary questions is relatively easy to implement and has been found to produce more realistic estimates of secondary activities (Phipps and Vernon, 2009; Schwartz, 2001). A third solution is to use time diaries with open time intervals. When using open intervals, respondents are asked to report the starting and ending time of each activity, regardless of the length of the activity. This strategy avoids issues with choosing the appropriate length of the intervals (Fleming and Spellerberg, 1999). Time diaries with open time intervals are for example applied in the

American Time Use Study (ATUS; Bureau of Labor Statistics, 2014). The Harmonized European Time Use Survey (HETUS) guidelines acknowledge the problem of underreporting short activities when using fixed time intervals, but nevertheless recommend applying fixed time intervals of ten minutes. Open interval time diaries are said to produce larger variation in data quality and to be more difficult to process (Eurostat, 2009).

2.2 Previous studies that applied time diaries to measure short and rare activities

Time diary data have been applied in earlier studies to capture short and rare activities. Most of the previous time diary studies on *rare* activities were concerned with identifying situational characteristics of those activities. These studies typically sampled individuals who were expected to frequently engage in the activities of interest. Margraf, Taylor, Ehlers, Roth, and Agras (1987), for example, collected systematic information on a large number of panic attacks to empirically establish a valid definition for such attacks. The study specifically selected patients who met the DSM criteria for panic disorder and used time diaries to assess symptom patterns, concurrent heart rate, physical activity, and the direct context of panic attacks. Abu-Arafeh and Callaghan (2004) applied time diaries to study the duration of migraine attacks among children and adolescents. All 720 participants attended a specialist headache clinic. Of the 231 participants who had migraine, 15 were asked to fill in prospective headache diaries to accurately record the duration of headache attacks. Epstein et al. (2009) applied time diaries to examine the craving for and use of cocaine and heroin, and included a volunteer sample of 114 cocaine- and heroin-abusing patients who were being treated with methadone. What these studies have in common is that they all used *non-random sampling* methods to deal with the infrequency of the target activity. Sturgis and Jackson (2003), on the other hand, used the *random sample* from the UK 2000 Time Use Survey to examine participation in sport- and cultural activities. They were interested in the association between social and individual characteristics and clusters of cultural activities. For that purpose, the time diary data turned out to be insufficient. They decided to rely on the questionnaire data, because many target activities (e.g., picking berries, mushrooms and herbs, fishing, doing gymnastics, going to art exhibitions) were recorded in less than one percent of the population. They concluded that "despite the undoubted superior quality of the time diary data in capturing the timing and other aspects of daily activities, the reference period of activity recording is too brief to warrant the sorts of analyses we wished to conduct" (Sturgis and Jackson, 2003, p. 6).

Previous time diary studies on *short (but frequent)* activities generally used open time intervals and exclusively asked about the activities of interest. Restroom visits, cigarette smoking, and social interactions are examples of relatively short, but frequent activities. Sampselle (2003), for example, used open interval time diaries and asked patients who experienced urinary incontinence to fill in for each day when they drank, how much, and which types of fluids, when they went to the toilet, and whether accidental leakage of urine had happened. Pa-

tients also had to specify the amount of urine leakage, whether they had the urge to urinate at that moment, and during which activity the accident took place. Surawy and Cox (1986) used an open interval time diary to examine the influence of mood and situation on smoking behavior. Respondents had to report their stress levels and the strength of their desire to smoke, prior to smoking their cigarette. After each cigarette, respondents were asked to report the context in which they smoked and whether they had enjoyed it. Dodge, Heimberg, Nyman and O'Brien (1987) investigated other-sex social interactions among high socially anxious and low socially anxious students by applying open interval time diaries. Respondents were asked to keep a diary for two weeks and to report the day, time, location, and duration of the social interaction, as well as the type of interaction and the nature of the relationship with the other person (among other things). Although many social interactions are short, they can of course vary tremendously in duration. In none of these studies it was clarified why an open time interval approach was chosen.

Offending may be even more difficult to capture than the activities previously discussed, because acts of offending are both rare *and* of short duration. In the following paragraph, we will discuss particular issues related to the measurement of offending in general, and to the measurement of offending with time diaries specifically.

2.3 Self-reported offending in stylized questionnaires and time diaries

Self-reports on offending are a valuable data source in criminological research, as they are perceived to be less biased than police reports (Thornberry and Krohn, 2000). A considerable percentage of crime goes unrecorded because the victims do not report to the police. The offenses that are not recorded by the police form the so called 'dark figure' of crime. Official crime records also reflect police prioritization policies. For example, variations in recorded traffic violations may also reflect variations in traffic surveillance.

Nevertheless, self-reports on offending, generally captured in stylized questionnaires, may also suffer from measurement problems and therefore not give a representative account of the actual crime rates. Sources of error exist, for example, because frequent offending adolescents may be less willing to cooperate or participate in studies on crime (Van San, 2008), and because the common practice of retrospectively questioning about a year may evoke recall problems: Studies have indicated that recall problems may arise when respondents are asked to report retrospectively about periods longer than a few months (Bachman and O'Malley, 1980; Clark, Fiebig and Gerdtham, 2008; Hill, 1985).

Despite these sources of error in measuring offending, there is a general consensus in criminology about the use of stylized questionnaires to capture self-reported offenses. In contrast, the time diary method is relatively new. Therefore, and because of the general concerns about the suitability of time diaries to capture short and rare activities, it is important to scrutinize the applicability of time diaries for measuring offending. We will do this by examining whether and how time diary estimates of offending differ from stylized questionnaire esti-

mates of offending. Comparisons between stylized questionnaire estimates and time diary estimates of other activities generally produce small correlations and suggest that stylized questionnaires overestimate the frequency and duration of activities (Juster, Ono and Stafford, 2003, Robinson, 1985, Stafford and Duncan, 1985). For example, studies comparing stylized questionnaire estimates with time diary estimates of household activities found systematic biases in the stylized questionnaire estimates (Kan, 2008, Kan and Pudney, 2008). Additionally, studies generally found that the average time spend on household activities are overestimated by the stylized questionnaires (Marini and Shelton, 1993; Press and Townsley, 1998 Schulz and Grunow, 2012). However, in the case of lengthy recall periods (i.e., six months, one year), the stylized questionnaire method may lead to *underreporting* of activities compared to time diaries (Hill, 1985), and to less accurate estimates in the case of irregular activities (Juster et al., 2003).

For the remainder of this study, it is important to keep in mind that offending differs from other behaviors in at least one aspect: Offending is likely to be more memorable, either because it is more exciting (Gudjonsson and Sigurdsson, 2007), or because of other reasons such as careful planning beforehand. We therefore expect that measurement error due to recall inaccuracy is less relevant for this particular behavior. From previous studies, we know that respondents have less trouble recalling activities that are important to them (Engle and Lumpkin, 1992) or that are more distinctive from other activities (Niemi, 1993). Habitual activities are more likely to be forgotten after a week or a month (Juster, 1985).

We now turn our focus to a time diary method that was specifically developed for criminological research: the Space-Time Budget method.

The Space-Time Budget method in criminology

The Space-Time Budget (STB) method is the first time diary method that has been applied on a large scale in criminological research. The method was developed by Wikström and colleagues and used in The Peterborough Adolescent and Young Adult Development Study (PADS+), conducted in England (Wikström et al., 2010; Wikström et al., 2012a). The STB method is designed to test the Situational Action Theory (Wikström, 2004; Wikström, 2005; Wikström, 2014). The STB method is derived from regular time diary methods, but extended with the geographical location of the activities and with a set of end of day summary questions about offending and other delinquent activities or events (Wikström et al., 2012a). The method has a reference period of four days (one Friday, one Saturday and the two most recent weekdays prior to the interview) and a fixed time interval of one hour, thus adding up to 96 hours per interview. The time diaries were administered retrospectively in one-on-one interviews by trained researchers, which differs from other time use studies that ask respondents to keep a diary of their activities throughout the day. For each hour, respondents were asked to report about their main activity, the people who were present, and the place where the activity took place. At the end of filling out each day, respondents were specifically asked about of-

fending ("Did you steal something or damaged something that belonged to someone else or were you involved in a fight?"), victimization ("Was something you possess stolen or broken? Has somebody beaten you, attacked you or did somebody start a fight with you?"), weapon carrying ("Did you carry a weapon at some point during this day?"), alcohol consumption, and drugs use ("Have you used alcohol or drugs during this day?"). The reported incidents in these end of day summary questions were added to the time diaries at the specific hour(s) that the incidents took place. Detailed overviews of the STB method as applied in PADS+ are given by Wikström et al. (2012a, 2012b), and as applied in SPAN by Hoeben et al. (2014).

Data derived with the Space-Time Budget method have been applied for several criminological research questions. Specifically, STB data have been applied to test the Situational Action Theory. This theory explains offending as the result of an interaction between a person's *crime propensity* and *criminogenic exposure* (Wikström, 2004; Wikström, 2005; Wikström, 2014). Individuals' crime propensity depends on the individual´s morality and ability to exercise self-control. Individuals' criminogenic exposure refers to the individuals´ exposure to settings with criminogenic characteristics. The STB method is unique in criminology in its ability to capture this 'criminogenic exposure': It enables capturing individual's activity fields. When combined with data on personal characteristics, STB data allow for examining whether exposure of individuals with certain characteristics (e.g., high crime propensity) to settings with certain characteristics (e.g., highly criminogenic settings) leads to higher crime rates.

STB data as collected in the PADS+ project have been mainly used to investigate the properties of the Situational Action Theory, but have also been applied to investigate, for example, the distances adolescents travel to crime locations and to study how individual activity patterns relate to demographic background variables (Wikström et al., 2012a). Situational aspects of offending have also been scrutinized in the PADS+ study, such as the influence of peer presence, lack of adult supervision, and unstructured activities (Wikström et al., 2012a). For more detailed overviews of studies conducted with the PADS+ STB data, see Wikström et al., (2010; 2012a)

In collaboration with the PADS+ staff, the Space-Time Budget method was translated and adjusted to the Dutch situation in the Study of Peers, Activities and Neighborhoods (SPAN). Data from the SPAN project have been used to examine, for example, situational causes of crime (Bernasco et al., 2013) and victimization (Averdijk and Bernasco, 2014), conditions under which 'time spent with peers' is related to adolescent offending (Weerman, Bernasco, Bruinsma and Pauwels, 2015a), whether the locations where adolescents 'hang out' are associated with offending (Hoeben and Weerman, 2014), and to investigate the extent to which parenting is related to time spent 'hanging out' with friends (Janssen, Deković, and Bruinsma, 2014).

As described in the previous sections, there have been some concerns about the suitability of time diaries for capturing short and infrequent activities. Rare activities may not be captured if

many respondents do not engage in the activities during the reference period. Short activities may be underreported if the fixed time interval is of longer duration than the activity. We will explore these potential limitations for offending: An activity that is both rare and of short duration. We are interested in whether (or to what extent) time diaries are able to generate offending population estimates and whether they are able to capture development of individuals' involvement in offending over time. Furthermore, we are interested in whether the end of day summary questions method (Phipps and Vernon, 2009; Schwartz, 2001) is useful for capturing the circumstances of the reported offenses. As such, we contribute to the time use literature by investigating the relevance of end of day summary questions for capturing short and rare activities. The end of day summary questions method has been developed, and thus far predominantly reviewed, for capturing secondary activities. In the Space-Time Budget method, the end of day summary questions approach was applied to overcome problems with the relatively long time intervals (of one hour) and to avoid underreporting of offenses. However, this approach may no longer adequately measure the conditions under which offending occurs, because the circumstances that were reported in a given hour are not necessarily those circumstances under which the offense occurred. A few studies have explored the validity of the Space-Time Budget method for measuring offending. We will briefly discuss their findings in the remainder of this section.

With regard to the Space-Time Budget methods' ability to generate *population estimates* of offending, Wikström et al. (2012a) found that high-frequent offenders have an increased chance to report offending during the four day-reference period of the time diary compared to low-frequent offenders. They matched the reported offending in the time diaries to the reported offending in the stylized questionnaires, completed by the same respondents. The respondents who reported at least one offense during the four time diary days, reported on average 110 crimes per year in the stylized questionnaire. Whereas the respondents who reported at least one offense (over the period of a year) in the stylized questionnaires, reported on average 32.7 crimes per year. This is of course to be expected, as adolescents who offend more often, are more likely to do so in any random four days. In fact, if we would assume that respondents who report offenses in the time diaries commit a crime every four days, they would commit roughly 92 crimes in one year, which is very close to the found average of reported offences in the questionnaires of 110 crimes per year. These findings suggest that a time diary with a brief reference period (of four days, or even less) may not sufficiently take into account the varying involvement in offending across individuals. Consequently, researchers who use time diaries to analyze rare activities, even if they are not interested in population figures, are likely to conduct their analyses for a sample that is not representative for the population.

With regard to the Space-Time Budget methods' ability to capture the *frequency of individual's involvement in offending*, Wikström and Butterworth (2006) found a significant correlation of 0.35 between offenses reported in time diaries and offenses reported by the same individuals in stylized questionnaires. With a follow-up dataset, Wikström et al. (2010; 2012a) found a significant correlation of 0.57 between the frequency of reported crimes in the time

diaries and the frequency of reported crimes by the same individuals in stylized questionnaires. Furthermore, they found that adolescents who reported crimes during the four days of the time diaries were more often registered in police records, compared to adolescents who had not reported crimes in the time diaries ($r = 0.20$, $p < .010$; Wikström et al., 2012a). These findings suggest that time diaries are at least to some extent able to capture individuals' involvement in offending.

Finally, with regard to the Space-Time Budget methods' ability to capture the *circumstances of offending*, Wikström et al. (2012a) found that offenses that were reported in the time diaries and crimes as registered by the police had similar temporal and spatial distributions. Conditions other than 'time' and 'space' may be relevant as well, such as the people who were present during the activity or whether the activity took place in a public setting. Although STB data have been used to examine these conditions (e.g. Wikström et al., 2012), they have not yet been validated in a comparison with external data. The present study will compare STB diary data with external data to examine whether time diaries adequately capture the circumstances under which offending occurs.

We are not aware of previous studies that investigated the ability of the Space-Time Budget method (or any other time diary method) to capture *development over time* of involvement in offending across individuals. Neither are we aware of studies that investigated the validity of the situational conditions of the offenses reported in time diaries, other than the spatial and temporal correlates investigated by Wikström et al. (2012a). The present study intends to fill this gap in the knowledge about the validity of time diaries to capture activities that are *both* short *and* rare.

In summary, the present study will examine whether time diaries are able to capture rare and short activities by addressing three research questions. First, we compare time diaries with stylized questionnaires (administered to the same sample) to test if population estimates of time diaries are able to take into account the varying involvement in offending across individuals. Second, we compare time diaries with stylized questionnaires (administered to the same sample) to investigate the hypothesized capability of time diaries to capture the development of individuals' involvement in offending over time. Third, we will compare the time diaries with external data to examine whether time diaries adequately capture the circumstances under which offending takes place.

3 Materials and method

3.1 Design

The present study examines whether the Space-Time Budget method is able to accurately capture acts of offending. To do so, STB data from the Study of Peers, Activities and Neighbor-

hoods (SPAN) were compared with data collected with two other instruments. First, the SPAN time diary data were compared with data from a stylized questionnaire that was administered among the same sample (also collected in the SPAN project). Second, the SPAN time diary data were compared with data from a stylized questionnaire that was developed to measure self-reported offending among the Youth Delinquency Survey (MZJ stylized questionnaire), a nationally representative survey administered by the Research and Documentation Centre (WODC) of the Netherlands Ministry of Security and Justice (Van der Laan and Blom, 2011). Data from the MZJ stylized questionnaires are largely representative for the Dutch adolescent population and include information about the situations in which offending occurs, which is particularly relevant for our research purposes.

3.2 Study of peers, activities and neighborhoods (SPAN)

The Study of Peers, Activities and Neighborhoods (SPAN) is a two-wave longitudinal study of the Netherlands Institute for the Study of Crime and Law Enforcement (NSCR), conducted amongst adolescents in the city and surrounding areas of The Hague (The Netherlands). The project incorporated several data collections, among which time diary interviews and stylized questionnaire interviews.

3.2.1 Sample

The sampling base of the SPAN study concerns Dutch youth between 11 and 20 years old who were registered at one of the ten participating secondary schools in the conurbation of The Hague (the Netherlands). For the data collection, 40 schools were approached, which represent approximately one third of the secondary schools in The Hague and surrounding regions. The city councilor of The Hague supported our study with a letter to the directors of the schools. As the municipality was conducting a study on health and welfare issues among over half of the secondary schools in The Hague, these schools were not approached for our study (Weerman, Bernasco, Bruinsma and Pauwels, 2015b). Of the 40 secondary schools, ten (25 percent) agreed to participate. Reasons for refraining from participation varied. Most of these schools were already participating in other research projects, others were afraid that the study would interfere with regular teaching or exams (Bernasco et al., 2013).

In total, 942 adolescents were selected to participate in the first wave of the data collection (all first and fourth graders of the participating schools), of which 843 adolescent completed the time diaries and the stylized questionnaires. Of the non-participating 99 adolescents, 35 completed only one of these instruments, three were ill during the data collection, fifteen were withdrawn from the study by their parents, 27 could not be reached, thirteen did not show up for their interviews, and six adolescents had moved to another school. In the second wave, 615 of the 843 adolescents participated again (73 percent). The main reasons for attrition were that adolescents simply refused participation, that they could not be contacted, that their parents refused to give permission, or that the adolescents repeatedly did not show up at ap-

pointments (Bernasco et al., 2013; Weerman et al., 2015a). Two adolescents in the second wave completed the time diaries, but were ill during the entire reference period (four days). They were excluded from the analyses. Thus, the analyses of the present study were conducted for 613 participants of the second wave. There was a time-span of approximately two years between the first wave (schoolyear 2008 - 2009) and the second wave of the data collection (schoolyear 2010 - 2011).

Participants of the study were between 11 and 18 years old (M = 14.14, SD = 1.70) in the first wave and between 13 and 20 years old (M = 16.02, SD = 1.69) in the second wave of the data collection. In both waves of the SPAN study, boys and girls were evenly represented (boys: 54.9 percent in wave one, 52.5 percent in wave two; girls: 45.1 percent in wave one, 47.5 percent in wave two). While most adolescents in the SPAN sample were native Dutch (55.1 percent in wave one; 55.7 percent in wave two), a relatively large part was from an ethnic minority background. Approximately eight percent was Moroccan, approximately nine percent Turkish, approximately seven percent Surinamese, approximately three percent Antillean, and approximately 18 percent from another ethnic minority background. Of the sample, twenty percent was following practical education, approximately 55 percent was following lower vocational education and a little over twenty percent was following medium or higher secondary education. Students following medium secondary education were underrepresented, compared to the Dutch adolescent population. All respondents lived within the city of The Hague or in nearby areas. The city is the third largest city in the Netherlands and densely populated.

3.2.2 Instruments

The time diary used in the SPAN project (the Space-Time Budget method) is a time diary with fixed time intervals of an hour and a reference period of four days. The time diaries are administered in one-on-one interviews. One-on-one interviews were preferred over handwritten diaries because they are more likely to result in complete records and because it allows interviewers to help respondents to recall activities and locations (Wikström et al., 2012a). For the Friday, Saturday and the two most recent weekdays prior to the interview, adolescents were asked, retrospectively, about their hourly activities, location, and who else was present in the given situation. Additionally, respondents were asked about offending, victimization, truancy, weapon carrying, alcohol and drug use. These questions were asked as summary questions, at the end of filling out a full day in the time diary. Answers on these end of day summary questions were immediately added to the diary data at the particular hour on which the summary question was applicable. A research-assistant (12 research-assistants in wave one; 15 research-assistants in wave two) administered the one-on-one interview, which took up about 45-50 minutes. To increase the ease and speed in which respondents' answers could be processed by the research-assistant, code lists were used that included codes for possible activities, locations and present people. If none of the existing codes represented the answer of the respondent, a new code was created by the research-assistant and added to the list.

Research suggests that the presence of an interviewer or other person during the data collection may enhance social desirable answering (e.g. Tourangeau and Yan, 2007). The risk of social desirable answering depends on whether respondents fear consequences of revealing information (Aquilino, Wright, and Supple, 2000); Clear instructions on confidentiality are found to have strong effects on the self-disclosure of participants (Woods and McNamara, 1980). To better capture offending, which is a sensitive topic, the interviews were conducted in a quiet area away from other participants. Interviewers explicitly informed participants about the anonymity of their responses in the diary and interviewers were instructed to refrain from any form of judgement. Additionally, participants were allowed to shake their head or nod in response to a question, instead of saying their answer out loud. In a further attempt to minimize bias in the reports, interviewers were selected that were slightly older than the respondents (i.e., interviewers had just graduated or were still in college). Studies have shown that both too much and too little social distance between interviewer and respondent would produce biasing effects (e.g. Dohrenwend, Colombotos and Dohrenwend, 1968; Nederhof 1985). Notwithstanding these efforts to minimize social desirable answering, the possibility that the offending measures are biased has to be taken into account when interpreting our findings. For more information on the Space-Time Budget method, see Wikström and Butterworth (2006) or Wikström et al. (2012a). The publications of Hoeben et al. (2014) and Wikström et al. (2012b) specifically discuss the practical application of the method in data collections.

Apart from the time diaries, SPAN respondents were asked to fill in a self-administered stylized questionnaire. This occurred also under the supervision of a research-assistant, for four respondents at the same time, during a time-span of 45-50 minutes. The questionnaire that was used in the SPAN project was based on the PADS+ questionnaire (Wikström and Butterworth, 2006; Wikström et al., 2012a) and intended to measure self-reported offending. The questionnaire included a variety of other variables as well, such as self-control, perceived parental monitoring, perceived neighborhood control, quality of the parent-child relationship and deviancy of peers. This background information was collected to complement the time diary data. To minimize social desirable answering, participants filled in the written questionnaires in silence – they were not allowed to interact with other participants – and we made sure the interviewers could not see the responses of the participants. When participants were finished, they handed in the sheets closed without their name on it.

3.3 The WODC Youth Delinquency Survey (MZJ) – National self-reports on offending

The Youth Delinquency Survey (MZJ stylized questionnaire), conducted by the criminal justice knowledge center of the Netherlands Ministry of Security and Justice (WODC) in 2010, is a cross-sectional study among adolescents. The questionnaire was designed to construct a clear picture of involvement in offending across Dutch adolescents and to enable the investi-

gation of trends in offending. The questionnaire also contains data on situational characteristics of offending. Such data is not available in the SPAN stylized questionnaire, which is why we added data generated by the MZJ stylized questionnaire in our study. The MZJ stylized questionnaire has been an important addition to Dutch police records of criminality (Van der Laan and Blom, 2011).

3.3.1 Sample

The sampling base of the MZJ study concerns Dutch youth between 10 and 17 years old who are legally residing in the Netherlands. The study applied a stratified sampling method. First, thirty municipalities in the Netherlands were randomly selected. Within each municipality, the addresses of adolescents were then also randomly selected. Adolescents were non-randomly selected on age (10-17 years old) and on ethnicity (Dutch, Moroccan, Turkish, Surinamese, Antillean and other ethnic backgrounds) which led to the selection of 4664 adolescents (Van der Laan and Blom, 2011). Ethnic minorities were non-randomly selected to create substantial group sizes. Previous research showed that group sizes became too small to compare groups, when ethnicity was randomly selected (Van der Laan and Blom, 2011). Of the selected adolescents, 4429 could be approached and 3030 of them eventually completed the questionnaire. Turkish and Moroccan adolescents were overrepresented in the non-participant group, but differences were small.

For the present study, we increased the comparability between the MZJ sample and the SPAN sample, by excluding the MZJ participants who followed primary education or who were younger than 11 years. It is important that both datasets have similar age ranges as research found that activity patterns change significantly in the years of adolescence (Wikström et al., 2012a). One participant had an extremely high score on one of the offending items and was also excluded. After this selection, 1849 of the 3030 MZJ respondents remained (61.0 percent). The participants were between 11 and 17 years old (M = 14.62, SD = 1.65) and the sexes were exactly evenly represented (boys 50.0 percent, girls 50.0 percent). The MZJ sample incorporated primarily adolescents with a native Dutch background (56.1 percent). Other participants had a Moroccan background (7.2 percent), Turkish background (8.5 percent), Surinamese (9.0 percent), Dutch Antillean (9.7 percent) or other ethnic background (9.5 percent). With regard to educational level, 1.5 percent of the MZJ participants were following practical education, 54.6 percent were following lower vocational education, and 43.9 percent were following medium or higher secondary education.

Comparisons with the SPAN participants from the first wave of the data collection showed that more of the MZJ participants were girls (χ^2 (1) = 5.56, p = .018, φ = .05), that the MZJ participants were older (t (2690) = -6.75, p < .001, CI of mean difference = -0.60 – -0.33, d = -0.28), and higher educated (χ^2 (2) = 328.19, p < .001, φ = .36). Comparisons with the SPAN participants from the second wave of the data collection showed that the MZJ participants

were significantly younger (t (2462) = 18.25, $p < .001$, CI of mean difference = 1.26 – 1.56, d = 0.84) and higher educated (χ^2 (2) = 263.09, $p < .001$, $\varphi = .34$).

3.3.2 Instruments

The MZJ stylized questionnaire was administered in a computer assisted one-on-one interview and intended to measure the prevalence of different types of youth offenses in the past year. To account for the sensitivity of questions on offending, the Computer Assisted Self-Interviewing method was used (CASI), in which no interviewer was present. The rest of the questions were administered by the interviewer using the Computer Assisted Personal Interviewing (CAPI) method. The questionnaire contained questions like "how many times have you offended in the previous twelve months?" and included several items on burglary, vandalism, violence, weapon possession and sex offenses (Van der Laan and Blom, 2011). In the present study, the sum of all the different types of offenses is used as one offending construct.

3.4 Comparing offending measures

Although all three measures of this study used comparable items to measure offending, they were not identical. Tables A1, A2, and A3 in the Appendix present overviews of the items and corresponding frequency distributions from, respectively, the SPAN time diaries, the SPAN stylized questionnaires, and the MZJ stylized questionnaires. The instruments also differed in their response categories. In the SPAN stylized questionnaires, offending was expressed in closed categories (e.g., 6 - 10 times, more than 10 times), whereas in the MZJ stylized questionnaires and SPAN time diaries, the responses for the offending items were open ended. The categories of the SPAN stylized questionnaires were recoded as following: 0 times = 0; 1 time = 1; 2 times = 2; 3 - 5 times = 4; 6 - 10 times = 8; more than 10 times = 10. Finally, the instruments differed in how the interviews were assessed. Whereas the SPAN time diaries were conducted as one-on-one interviews, the MZJ stylized questionnaires were assessed in Computer Assisted Personal Interviews (CAPI), and the SPAN stylized questionnaires were completed in written form under supervision of a research assistant.

To provide clarity about the comparability of offense measures across the different datasets, we included Table 1. Table 1 displays the descriptive statistics of the offending measures as reported in the SPAN time diaries, SPAN stylized questionnaires, and MZJ stylized questionnaires. The total number of offenses for the SPAN and MZJ questionnaires represents sum scores of the frequencies that were reported on each offending item. As the frequency categories of the SPAN stylized questionnaires were recoded (see previous paragraph), the offending rates derived from this instrument should be interpreted as approximate averages that are based on midpoints of categories rather than precisely reported frequencies.

Table 1
Descriptive statistics of offending in the SPAN and MZJ samples

	SPAN				MZJ
	TD T1	**TD T2**	**Quest. T1**	**Quest. T2**	
N (individuals)	843	613	843	613	1849
Not Offended	792 (94.0%)	588 (95.9%)	245 (29.1%)	226 (36.9%)	1295 (70.0%)
Offended	51 (6.0 %)	25 (4.1%)	598 (70.9%)	387 (63.1%)	554 (30.0%)
Total Nr. of offenses	69	32	7614	3834	4516
Mean	0.1	0.1	6.9	10.0	3.5
SD	0.4	0.3	13.2	18.7	21.5
Theft	5 (7.3%)	1 (3.1%)	2022 (26.6%)	1028 (26.8%)	909 (20.1%)
Vandalism	26 (37.7%)	14 (43.8%)	2350 (30.9%)	1133 (29.6%)	807 (17.9%)
Violence	35 (50.7%)	16 (50.0%)	1798 (23.6%)	853 (22.2%)	2159 (47.8%)
Other	3 (4.3%)	1 (3.1%)	1444 (19.0%)	820 (21.4%)	641 (14.2%)

The frequency of offending in the SPAN stylized questionnaires was expressed in categories. These were recoded as following: 0 times = 0; 1 time = 1; 2 times = 2; 3 - 5 times = 4; 6 - 10 times = 8; more than 10 times = 10. Abbreviations: TD = SPAN time diary; Quest = SPAN stylized questionnaire; T1 and T2 = first and second wave of data collection.
Source: Study of Peers, Activities and Neighborhoods (SPAN) and Youth Delinquency Survey (MZJ), own calculations.

Table 1 should be interpreted such that, for example, for the SPAN time diaries of wave one (first column), 843 adolescents completed the interview and 51 of them reported at least one offense. The other 729 adolescents did not report offenses during the four diary days. The total amount of reported offenses was 69, which is on average 0.1 offenses per person (standard deviation of 0.4) over the total sample of 843. Because the frequencies of offending in the time diaries in both waves were small, it was decided to combine the offending items into three categories: theft, violence, and vandalism. Of the 69 offenses that were reported, 7.3 percent concerned theft, 37.7 percent concerned vandalism, 50.7 percent concerned violence, and 4.3 percent concerned other types of offenses. The specific items per category are presented in Table A1 in the Appendix.

It is clear from Table 1 that the average number of reported offenses per individual vary across instruments. This is not surprising, given that the instruments cover different reference periods, with the SPAN time diary using a substantial smaller reference period than the other instruments (four days versus one year). Also, the proportions of offenses were somewhat different across instruments. Theft was relatively rare in the SPAN time diaries, which was not the case for the other instruments.

4 Results

As a first step in exploring whether time diaries offer an adequate way to measure offending, the SPAN time diary data were compared to the SPAN stylized questionnaire data. Both instruments were assessed among the same individuals living in the conurbation of The Hague (the Netherlands). In this first step, we investigated whether time diaries are able to sufficiently measure the distribution of offenses across individuals (whether the method is able to distinguish between non-offenders, medium-frequent offenders, and high-frequent offenders), and developments over time for the same individual (decreases and increases in delinquent involvement). The findings of these analyses are discussed in paragraphs 4.1 and 4.2.

Subsequently, we investigated whether the SPAN time diaries were able to capture situational circumstances of offending. In the SPAN time diaries, the end of the day summary question method was applied to measure offending. In these analyses, we compared the SPAN time diary data to stylized questionnaire data on offending collected by the criminal justice knowledge center of the Netherlands Ministry of Security and Justice (WODC); the MZJ stylized questionnaire. As the SPAN stylized questionnaires did not include situational information about offending it was not possible to examine this question within one sample. The findings of the analyses with the MZJ stylized questionnaire are discussed in paragraph 4.3.

4.1 Population estimates of adolescent offending

To compare the offending population estimates of the two data sets (SPAN time diary data and SPAN stylized questionnaire data), we estimated the average yearly offending rate per individual because, in the stylized questionnaires, we asked about offending *in the past year*. To do so, we had to conduct a weighting procedure for the SPAN time diary data. The SPAN time diaries were administered for four days: One Friday, one Saturday and two random weekdays. Activities on Fridays and Saturdays were therefore overrepresented compared to activities on the weekdays (Monday to Thursday), whereas activities on Sundays were not recorded. Because we lack information about activities on Sundays, we could not include them in the analyses. As for the overrepresentation of Fridays and Saturdays: These days make up fifty percent of all days administered in the time diaries, whereas they only take up 33.3 percent in an actual week (when Sunday is not included; two days out of six days makes 33.3 percent). We therefore assigned a weight of 0.67 (33.3/50.0) to the offenses that occurred on Fridays and Saturdays. The other days administered in the time diaries (Monday to Thursday) also make up fifty percent of all days administered in the time diaries, whereas they take up 66.7 percent of an actual week (in which Sunday is not included; four days out of six days makes 66.7 percent). We thus assigned a weight of 1.33 (66.7/50.0) to the offenses that occurred on Mondays to Thursdays.

A total of 101 offenses were reported during the SPAN time diary days in both waves, of which 42 offenses occurred on a weekday (Monday - Thursday) and 59 offenses occurred on

a Friday or Saturday. Given these numbers and the suggested weighting procedure, we expect that 95.39 offenses ((42*1.33) + (59*0.67)) would have been reported, had we asked our sample on four *random* days about their offending behavior. Given that a year has 365 days, we expect that 8704.34 offenses ((95.39/4 days)*365 days) would have been reported, had we asked our sample on every day of the year about their offending behavior. For one individual (of our combined sample of 1456 individuals), we would have then estimated an average of 5.98 offenses per year (8704.34/1456). Additionally, we have calculated the average offenses per year for an individual with an alternative approach that was suggested by Wikström et al. (2012a, p. 325). Whereas in the first approach the Sunday is treated as an average day (over both weekdays and weekend days), in the second approach the Sunday is treated as an average *weekday*. Based on the second approach, the estimated average number of offenses per year for one individual was 5.86[2].

In the SPAN stylized questionnaire, a total of 11448 offenses were reported across both waves of the data collection. These stylized questionnaires questioned about offending in the previous year. Therefore, we estimated an average of 7.86 offenses per year per individual (11448/1456). Based on these estimations of individual yearly offending rates, we conclude that individuals in our sample reported on average 31.4 to 34.1 percent more offenses in the SPAN stylized questionnaires (7.86 offenses per person per year) than in the SPAN time diaries (5.86 to 5.98 offenses per person per year, varying with calculation method). For a specification of the reported offenses in the SPAN time diaries and SPAN stylized questionnaires, see Tables A1 and A2 in the Appendix.

As a next step, we investigated whether time diaries are able to take into account the varying involvement in offending across individuals. To do so, we focused on all individuals who reported at least one offense in the SPAN time diary and on all individuals who reported at least one offense in the SPAN stylized questionnaire, and then compared their yearly offense rates based on the SPAN stylized questionnaires. In total, 76 individuals reported at least one offense during the four days of the SPAN time diaries and 986 individuals reported at least one offense during the year that was questioned in the SPAN stylized questionnaire. Of the 76 individuals who reported offenses in the SPAN time diary, five did not report any offense in the SPAN stylized questionnaire and the remaining 71 individuals reported an average of approximately 26.3 offenses per year[3] (*SD* = 25.3) in the questionnaires. This yearly offense rate

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[2] In total, 59 crimes were reported in two weekend days. That is 59/2 = 29.5 crimes per weekend day. Next, 42 crimes were conducted across two weekdays, which is 42/2 = 21 crimes per weekday. To calculate the number of crimes per week, we have to multiply each outcome by the number of weekdays and weekend days that are present in a single week, respectively, and add them together. Thus: 29.5 crimes*2 weekend days + 21 crimes *5 weekdays = 164 crimes per week. If we multiply this by 52 (weeks per year), we find 8528 crimes per year. Divided by our sample of 1456, this leads to an estimate of 5.86 crimes per participant per year.

[3] In interpreting these averages, the reader should take into account that as the frequency categories of the SPAN stylized questionnaires were recoded, the offending rates derived from this instrument should be interpreted as approximate averages that are based on the summation of midpoints of categories rather than precisely reported frequencies.

of 26.3 offenses is higher than the average reported offense rate of the 986 adolescents who reported one or more offenses in the SPAN stylized questionnaire: They reported on average approximately 11.6 offenses per year (*SD* = 17.2). Thus, it seems that the offenses that are registered by the SPAN time diaries are more often committed by individuals who frequently engage in offending, compared to the offenses that are registered by the stylized questionnaires (See Table 1 for the yearly offending rates derived from the SPAN and MZJ questionnaires). These findings suggest that offenses committed by low-frequent offenders may not be sufficiently captured with time diaries.

4.2 Development of offending across individuals

To examine whether time diaries adequately capture decreases and increases in delinquent involvement for individuals over time, we computed 'difference scores' of offending between the two waves of the data collection. These waves had a time span of approximately two years in between. We did this for both instruments: The SPAN time diaries and the SPAN stylized questionnaires. For the SPAN time diaries, these difference scores reflected the difference in the total sum of incidents between wave one and wave two. In the SPAN stylized questionnaires, these difference scores reflected the difference in answer categories between wave one and wave two (0 = not engaged in offending in the past year; 1 = one time engaged in offending in the past year; 2 = two times; 3 = three to five times; 4 = six to ten times; 5 = more than 10 times engaged in offending in the past year). A value of zero on the difference score meant that the individual reported the same answer in both waves, a negative value indicated that the individual reported less involvement in offending in the second wave compared to the first wave, and a positive value indicated that the individual reported more involvement in offending in the second wave compared to the first wave. Descriptive statistics of the difference scores are shown in Table B in the Appendix.

Descriptive statistics of the offending measures in the SPAN stylized questionnaires and SPAN time diaries, are presented in Table 1, and Tables A1 and A2 in the Appendix. As the SPAN time diaries registered 'only' 101 offenses, we combined the reported incidents into three categories: Vandalism, theft, and violence. We made the same categories for the data from the SPAN stylized questionnaires. *Vandalism* incorporated the items on how often the adolescent had "damaged or destroyed something that not belonged to him or her". *Theft* incorporated the items on how often the adolescent had "stolen something (from a shop, a bike or scooter)". *Violence* incorporated the items on how often the adolescent had "beaten up somebody". Not many incidents of theft had been reported in the SPAN time diary. Therefore, we did not include theft in the analyses, but we included only violence and vandalism.

We then calculated Spearman correlations between the difference scores of both instruments. Spearman rank correlations are nonparametric test statistics that correct for positively skewed distributions. Significant relationships were found between the difference scores of both instruments for vandalism ($r = 0.14$, $p = .001$) and violence ($r = 0.19$, $p < .001$). This suggests

that reported violence and vandalism in both instruments (the SPAN time diary and the SPAN stylized questionnaire) showed somewhat similar developmental patterns for individuals over time. However, the correlations were small. This may indicate that one of the instruments is better in capturing developmental patterns of offending. We speculate that the longer reference period of the SPAN stylized questionnaires enables better measurement of individuals' development in engagement in offending over time, compared to the four-day reference period of the SPAN time diaries. Correlations were also examined for both waves of the data collection separately, in addition to the examination of the difference scores. The correlations for the independent waves were similar to the correlations found for the difference scores.

4.3 Capturing the circumstances of a short activity

As stated previously, the Space-Time Budget method included end of day summary questions to ask about offending (Phipps and Vernon, 2009; Schwartz, 2001). In these end of day summary questions, interviewers ask explicitly about the occurrence of (short) target activities at the end of each diary day about which participants were interviewed. They then ask during which (fixed) time intervals (e.g., in which hours), the activities occurred. In the Space-Time Budget diaries, respondents were asked at the end of each diary day whether they had been involved in offenses.

A potential disadvantage of the end of day summary question method is that it may not adequately measure the conditions under which target activities occur, because the circumstances that are reported in a given fixed time interval are not necessarily the circumstances of the activity. To study whether this method is useful for capturing the situational conditions of an offense, we compared the conditions of offenses reported in the SPAN time diaries with conditions of offenses reported in the Youth Delinquency Survey (MZJ stylized questionnaire). To do so, we isolated the offenders: The 76 adolescents who reported at least one offense in the SPAN time diary and the 554 adolescents who reported at least one offense in the MZJ stylized questionnaire. Descriptive statistics of these offenders and of the conditions under which their offenses were conducted are shown in Table C in the Appendix.

In the MZJ stylized questionnaire, individuals were asked about how often they had been involved in different types of offenses in the previous year. They were then asked about the situational characteristics of *their most recent* offense: Had it occurred in the presence of others, in a private or public location, during the week or in a weekend, at day or at night, and had they used alcohol prior to the offense? Individuals, who reported more than one *type* of offense, were asked about the situational conditions of each different type of offense. All situational conditions were recoded into dichotomous variables. The presence of others represented whether the respondent was alone during the offense (0), or whether he or she conducted the offense with others (1). The location of the offense was specified as either 'private' (0), when the participant was at home or at someone else's home, or 'public' (1), for offenses conducted elsewhere. Offenses that took place between Friday 6 P. M. and Sunday 6 P.M.

were coded as having occurred in the weekend (1), whereas offenses that took place on other moments were coded as having occurred during the week (0). Time of the offense was specified as day (0), for offenses that occurred between 6 A.M. and 6 P.M., and night (1), for offenses that occurred at other times. Alcohol use was coded as either having had alcohol (1), or not having had alcohol (0).

For the individuals who had reported more than one offense in the MZJ stylized questionnaire or SPAN time diaries, we recoded and dichotomized the situational conditions. For example, if a respondent would have reported three offenses in the SPAN time diary, of which one offense was conducted alone (score 0) and two were conducted in the presence of others (score 1), his or her mean score for 'presence of others' would be 0.67 and thus rounded to 1. This recoding allowed us to deal with dependency problems due to clustering of offenses within individuals.

We conducted several logistic regression analyses, predicting the odds that an offense had occurred under a specific condition. The results of these analyses are presented in Table 2.

Table 2
Logistic regressions predicting situational characteristics of offenses by sample (MZJ stylized questionnaire / SPAN time diary)

Variable	B	*SE*	*p*	*OR*	95 % CI
Alone/with others	1.19	0.35	<.001	3.27	[1.69, 6.32]
Private/public place	0.03	1.17	.949	1.03	[0.37, 2.88]
Week/weekend	0.28	0.27	.292	1.33	[0.78, 2.24]
Day/night	0.91	0.29	.001	2.50	[1.43, 4.35]
No alcohol/alcohol	0.55	0.45	.155	1.73	[0.81, 3.66]

Each row represents an independent logistic regression model, with the situational characteristics of offenses as the dependent variables. The coefficients in the table reflect the association between the sample variable (MZJ stylized questionnaire = 0; SPAN time diary =1) and the situational characteristic of the offense, controlled for offenders' gender, education and age. Coefficients for these control variables are not displayed. N = 76 for the SPAN time diary and N = 554 for the MZJ stylized questionnaire. The standard errors are bootstrapped on the basis of 10000 iterations. Abbreviations: *SE* = standard error; *OR* = odds ratio; CI = confidence interval.
Source: Study of Peers, Activities and Neighborhoods (SPAN) and Youth Delinquency Survey (MZJ), own calculations.

Each row of Table 2 represents a different logistic model predicting the odds that a reported offense had occurred under a specific situational condition. The main independent variable was the sample: The SPAN time diaries versus the MZJ stylized questionnaires. The models included controls for offenders' gender, education, and age. The first row in Table 2 represents a model that predicted the odds that the offense was conducted alone or with others. Results indicate that the offenses reported in the SPAN time diaries occurred more often in the presence of peers than the offenses reported in the MZJ stylized questionnaire (*OR* = 3.27,

$p < .001$). The third row in Table 2 represents a model that predicted the odds that offenses occurred during the night or during the day. Results show that the offenses reported in the SPAN time diaries occurred more often at night than the offenses reported in the MZJ stylized questionnaire ($OR = 2.50$, $p = .001$). The second, fourth and fifth row in Table 2 represent models that predict the odds that offenses occurred, respectively, in private or public places, during the week or weekend, and under the influence of alcohol. For none of these models significant differences were found between the SPAN time diaries and the MZJ stylized questionnaire.

We conclude that the situational conditions of reported offenses are for a large part similar in the two datasets (the SPAN time diary data and MZJ stylized questionnaire data). This suggests that the SPAN time diaries adequately captured most of the situational conditions under which offenses occur. It also suggests that the end of day summary question method is a valid solution to the problem of measuring short activities in time diaries, as it still enables the measurement of direct circumstances of those activities.

5 Discussion

The present study examined whether time diaries are suitable to measure short and rare activities, with a focus on one particular activity that is both short and rare; offending. We compared self-reported offending in a customized time diary to self-reported offending derived with two other instruments: Namely a stylized questionnaire that was administered among the same adolescent sample in the Dutch city of The Hague and a stylized questionnaire developed to measure self-reported offending in a nationally representative sample. The present study assessed whether time diaries were able to capture 1) long-term estimates of offending in the population, 2) changes in offending frequency over time across individuals, and 3) the circumstances under which offending occurred. To address these research questions, the study applied the Space-Time Budget method as developed by Wikström and colleagues (Wikström and Butterworth 2006; Wikström et al., 2010; Wikström et al., 2012a). Although this method was not developed to assess crime rates across time or the population, it used the end of day summary question method to capture offending (Phipps and Vernon, 2009; Wikström et al., 2012b), which makes it a unique instrument to assess validity questions regarding short and rare activities, particularly offending.

The findings indicated that time diaries may not fully capture all offenses. The population offense rate that was estimated based on the time diary data was lower than the population offense rate that was estimated based on stylized questionnaire data derived from the same sample. The offenses that were reported in the time diaries were relatively often committed by frequent offenders. These findings are consistent with previous findings from Wikström et al. (2012a). Researchers who use time diaries to analyze rare activities should be aware of the

possibility that their analyses are conducted with a sample that mainly represents people who frequently engage in the activity of interest.

The second research question of the present study concerned the development of individuals' involvement in offending over time. We found that the offenses that were reported in the time diaries showed similar patterns over time compared to the offenses that were reported in the stylized questionnaires. Although the correlations were small, this provides at least some support for the capability of time diaries to capture development over time of involvement in rare activities such as offending. Previous studies also reported small correlations between stylized questionnaires and time diaries for activities other than offending (e.g. Juster et al., 2003). Based on these results we cannot with certainty conclude which measure was most valid, as both methods apply self-reports about offending and we did not compare the diaries with administrative or observational measures. Even so, we cautiously suggest that researchers, who are solely interested in how activity patterns of rare activities change over time, may be better off using stylized questionnaire data. Stylized questionnaires generally have a longer reference period and are therefore more likely to capture the involvement in these activities by individuals who engage irregularly in these activities.

Finally, with regard to the third research question, we investigated whether the end of day summary question method is useful for capturing situational conditions of short activities such as offending. This method was initially developed to capture secondary activities (Phipps and Vernon, 2009), but was applied in the Space-Time Budget method to measure offending. We found that the end of day summary question method was indeed able to capture most of the situational conditions of the reported offenses, such as whether offenses had occurred in private or public places, during the week or in the weekend, or under the influence of alcohol.

In summary, our findings suggest that time diaries – which incorporate end of day summary questions about specific short and rare activities – might be useful for studying situational correlates of those activities (i.e. offending). Time diaries seem less useful for studying change in involvement in short and rare activities over time, or for estimating the prevalence of such activities across the general population.

The present study has some limitations that need to be addressed. First, to assess the validity of an instrument, it is best to compare it to another instrument that was administered from the same sample. This was not possible for our third research question, regarding the circumstances of offending, because the SPAN stylized questionnaire did not contain situational information about offenses. Therefore, the third research question was addressed by comparing estimates from the SPAN time diaries to estimates from the MZJ stylized questionnaires. It is possible that differences in measurement strategies and samples across both instruments confounded these comparisons. The reported situational conditions differed in two aspects: the offenses reported in the time diaries seemed to occur more often in the presence of peers (as opposed to alone) and more often at night (as opposed to during the day) than the offenses reported in the MZJ stylized questionnaires. The first difference, regarding the presence of

peers, may be explained by differing measurement strategies. The participants in the MZJ stylized questionnaire were explicitly asked about an offense and subsequently about whether peers were present. In the time diaries, the participants were first asked whether they were with peers in a specific hour, and were then asked whether an offense had occurred during that hour. The second difference, regarding daytime and nighttime offenses, may be explained by differences in the urban background of respondents. The sample from which the time diaries were administered (the SPAN sample) consisted of adolescents from a highly urban background: All participants lived within or nearby The Hague, which is the third largest city of the Netherlands. The sample from which the MZJ stylized questionnaires were administered (the MZJ sample), on the other hand, was representative for the Dutch adolescent population and therefore also included respondents from rural areas. It is possible that there is more nightly activity in urban areas compared to in rural areas, which may explain why the offenses reported in the time diaries seemed to occur more often at night. If this were the case, the findings reflect differences in measurement strategies and samples rather than validity problems of the time diary method.

A second limitation of the present study is that a small number of individuals reported an offense in the SPAN time diaries. Therefore, we could compare offending behavior of 76 offenders. With such small sample size, the risk of overlooking potential significant findings increases, as does the possibility of biased estimates. To deal at least partly with the issue of small sample sizes, we reported the bootstrapped standard errors to address the final research question regarding circumstances of offending.

A third limitation is that face-to-face interviews are potentially prone to social desirable answering, which may have affected our estimates for offending as captured with the SPAN time diaries. However, we have taken several precautions to ensure honest responses, as discussed in the method section. Also, offending incidents were still reported in these diaries, indicating that at least some offenders were willing to entrust us with such information.

A fourth limitation was that the response categories differed across the applied measurement instruments. The items in the SPAN stylized questionnaires were expressed in closed categories, whereas items in the MZJ stylized questionnaires and the SPAN time diaries were open ended. Relatedly, differences in interview style between interviewers may have resulted in differences between interviews and between measurement instruments. Both limitations, differences in response categories and interviewer effects, may have introduced measurement error.

To stimulate and inform future time use studies on offending or other short and rare activities, we have some suggestions about measuring such activities with time diaries. Our results suggest that the end of day summary question method, in which participants are asked specifically about the occurrence of a short activity, might be a valid solution for the problems concerned with measuring short activities. Other solutions – that have not been examined in the present study – for measuring short activities, are using small fixed time intervals or open

time intervals. With regard to measuring *rare* activities, we want to point again to a solution that has been widely adopted in previous time diary studies (e.g. Margraf et al., 1987; Epstein et al., 2009), namely that of including participants who are known to engage in the activity of interest. In the case of offending, candidate groups include prisoners or problem youth. This approach may not be ideal for researchers who are interested in the occurrence of a phenomenon across a general group of people, like we were interested in capturing offenses of 'normal' (not at-risk) youth. Nevertheless, this approach may become more relevant as the target activity is rarer. To illustrate this: Of the 1456 adolescents in our combined-waves sample, only 76 adolescents reported offenses in the SPAN time diary, which had a four-day reference period. Our findings indicate that the use of time diaries is especially restricted for estimating population rates of involvement in rare activities (population offense rates), and for estimating activity participation for individuals who do not often engage in the target activity (low-frequent offenders). Gershuny (2012) suggested that for relatively infrequent (much less than daily) activities researchers should combine their time diaries with habit-type items of questionnaires, such as: "How often do you engage in … activity?" (Gershuny, 2012). A final solution to better capture short and rare activities in time diaries, is to administer the interviews with smartphone time use apps. Time use smartphone apps can collect a lot of information about the activities and whereabouts of respondents, but still be less burdensome for respondents compared with time diaries that are administered in one-on-one interviews. Thus, with time use smartphone apps, one can more easily apply brief time intervals and long reference periods, which helps in capturing short and rare activities. Previous studies have already piloted smartphone time use apps (Sonck and Fernee, 2013).

Possibly many other solutions for measuring short and rare activities with time diaries are currently unexplored. Now criminology has started applying time use methods, the problems with capturing short and rare activities become increasingly relevant and are in need of a solution.

Appendix

Table A1
Frequencies of offenses in the SPAN time diaries
($N_{offenses}$ wave 1 = 69, $N_{offenses}$ wave 2 = 32)

Items	SPAN TD. T1 % (*N*)	SPAN TD. T2 % (*N*)
Theft		
Shoplift	4.3 (3)	0.0 (0)
From a person without violence	2.9 (2)	0.0 (0)
Home burglary	0.0 (0)	0.0 (0)
Burglary in a barn or garden	0.0 (0)	0.0 (0)
Burglary in a building	0.0 (0)	0.0 (0)
Breaking in a car to steal	0.0 (0)	0.0 (0)
Stealing a car	0.0 (0)	0.0 (0)
Stealing a scooter	0.0 (0)	0.0 (0)
Stealing a bike	0.0 (0)	0.0 (0)
Other theft	0.0 (0)	3.1 (1)
Vandalism		
Of a vehicle	0.0 (0)	3.1 (1)
Of a scooter	0.0 (0)	0.0 (0)
Of a bike	0.0 (0)	0.0 (0)
Of a house	0.0 (0)	3.1 (1)
Of a building	1.4 (1)	3.1 (1)
Of a lamppost or garage can	2.9 (2)	9.4 (3)
Graffiti	1.4 (1)	3.1 (1)
Other vandalism	31.9 (22)	21.9 (7)
Violence		
Hit or kicked someone	50.7 (35)	50.0 (16)
Other		
Theft from a person with violence	0.0 (0)	3.1 (1)
Traffic offenses	4.3 (3)	0.0 (0)

Abbreviations: SPAN TD. = SPAN time diary; T1 and T2 = wave 1 and wave 2. Numbers in this table represent the percentage of the total reported offenses. Numbers between brackets represent the total of reported offenses in the dataset.
Source: Study of Peers, Activities and Neighborhoods (SPAN), own calculations.

Table A2
Frequencies of offenses in the SPAN stylized questionnaires ($N_{offenses}$ wave 1 = 7614, $N_{offenses}$ wave 2 = 3834)

Items	SPAN Q. T1 % (*N*)		SPAN Q. T2 % (*N*)	
Theft				
Stolen something from a shop that was worth less than 5 euro	11.6	(885)	10.6	(406)
Stolen something from a shop that was worth more than 5 euro	2.6	(200)	5.5	(210)
Broken into a house to steal something		(85)	0.5	(21)
Broken into a car to steal something;	1.0	(76)	0.3	(13)
Broken in somewhere else to steal something	1.3	(98)	0.5	(18)
Robbed someone	1.0	(74)	1.2	(46)
Stolen anything from another person	2.2	(164)	2.9	(112)
Stolen a bike	3.5	(266)	3.3	(128)
Stolen a scooter	2.3	(174)	1.9	(74)
Vandalism				
Used graffiti or a marker on walls, doors or something else	15.2	(1157)	14.9	(570)
Damaged something not belonging to you	11.2	(853)	11.8	(454)
Set fire to something (for example in a building, a house, or a car)	4.5	(340)	2.8	(109)
Violence				
Beaten up a stranger on the streets	14.6	(1113)	14.2	(545)
Beaten up somebody which caused injuries for the person	9.0	(685)	8.0	(308)
Other				
Threatened someone to frighten the person or let the person do something for you	5.0	(380)	5.4	(208)
Sold weed or hash	4.5	(344)	5.2	(201)
Sold other drugs like XTC, cocaine, speed or something else	1.9	(143)	1.6	(64)
Bought something which you knew was stolen	5.1	(388)	6.7	(258)
Used a weapon	2.5	(189)	2.3	(89)

Abbreviations: SPAN Q. = SPAN stylized questionnaire; T1 and T2 = wave 1 and wave 2. Numbers in this table represent the percentage of the total reported offenses. Numbers between brackets represent the total of reported offenses in the dataset.
Source: Study of Peers, Activities and Neighborhoods (SPAN), own calculations.

Table A3
Frequencies of offenses in the
MZJ stylized questionnaires ($N_{offenses}$ = 4516)

Items	MZJ stylized questionnaire % (*N*)	
Theft		
Pickpocketed	1.1	(51)
Burgled	0.4	(18)
Stole something from a car	0.4	(19)
Stole a bike/scooter	3.1	(140)
Shoplifted less than 10 euro	12.4	(561)
Shoplifted more than 10 euro	2.7	(120)
Vandalism		
Damaged a vehicle	2.7	(120)
Damaged a residence	1.4	(63)
Damaged a bus, tram, metro or train	2.2	(98)
Damaged something else	11.6	(526)
Violence		
Beaten up somebody which caused injuries for the person	34.8	(1573)
Hit somebody without causing injuries	13.0	(586)
Other		
Used violence to steal something	0.1	(5)
Threatened someone with the intention to scare the other person	14.0	(630)
Threatened someone on the street to steal	0.1	(6)

Numbers in this table represent the total of reported offenses in the dataset. Absolute number of reported offenses with the percentages of the total reported offenses in brackets.
Source: Youth Delinquency Survey (MZJ), own calculations.

Table B
Descriptive statistics of the difference scores in the SPAN time diary and SPAN stylized questionnaire (*N* = 613)

	SPAN time diary					SPAN stylized questionnaire				
Variables	**Min**	**Max**	**Median**	**Mean**	**SD**	**Min**	**Max**	**Median**	**Mean**	**SD**
Vandalism	-3	2	0	0.00	0.26	-5	4	0	-0.14	0.97
Violence	-3	3	0	-0.01	0.32	-5	5	0	-0.19	1.14

N = 613, as 613 adolescents participated in both waves. Answer categories for the items from the SPAN stylized questionnaires were: zero times; 1 time; 2 times; 3-5 times; 6-10 times; more than 10 times. The numbers for the SPAN time diaries express the number of incidents in the four days of the time diaries. The difference scores express the differences in reported offending between wave one and wave two and can therefore be negative. A negative score indicates a decrease in reported offending over time and a positive score indicates an increase. Prior to calculating the difference scores, the missing values in the stylized questionnaires were imputed with the Expectation-Maximization method. For the SPAN time diaries, all abnormal days (on which the participant was ill, in the hospital, arrested, or on leave) were excluded. The remaining data was thought to better represent 'regular' days.
Abbreviations: Min. = minimum, Max. = maximum, *SD* = standard error.
Source: Study of Peers, Activities and Neighborhoods (SPAN), own calculations.

Table C
Characteristics of offenders and offenses reported in the time diary (*N* = 76 offenders) and MZJ stylized questionnaire (*N* = 554 offenders)

	SPAN time diary % (*N*)	MZJ stylized questionnaire % (*N*)
Characteristics of offenses[a]		
Present others		
Alone	15.8 (12)	40.3 (223)
With others	84.2 (64)	59.7 (331)
Place of offending		
Private	7.9 (6)	8.7 (42)
Public	92.1 (70)	91.3 (442)
Day of the week		
Weekday	51.3 (39)	62.3 (345)
Weekend	48.7 (37)	37.7 (209)
Time of offending		
Day	43.4 (33)	69.3 (384)
Night	56.6 (43)	30.7 (170)
Under influence of alcohol		
Yes	81.6 (62)	90.3 (500)
No	18.4 (14)	9.7 (54)
Characteristics of the offenders[b]		
Gender		
Boys	80.3 (61)	63.0 (349)
Girls	19.7 (15)	37.0 (205)
Educational level		
Practical education	11.0 (8)	1.7 (9)
Lower vocational education	74.0 (54)	59.1 (316)
Medium or higher secondary education	15.1 (11)	39.3 (210)

[a] Example of the 76 individuals who reported offenses in the SPAN time diaries, 12 (15.8 %) generally offended alone and 64 (84.2%) generally offended with others; [b] Offenders were between 12 and 20 years old (M = 14.92, *SD* = 1.98).

Source: Study of Peers, Activities and Neighborhoods (SPAN) and Youth Delinquency Survey (MZJ), own calculations.

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The relationship between videogames, time allocation decisions, and labour market outcomes – Evidence from the American Time Use Survey

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Abstract

Using the American Time Use Survey (ATUS), I analyze the time allocation decisions and labor market outcomes of those who play videogames. Controlling for individual and regional characteristics, I find that among students, playing videogames is negatively associated with time spent on educational activities, and I derive estimates of this association that are similar in magnitude to other recent studies. I also find that among working-age individuals, playing videogames is negatively associated with labor supply and not associated with time spent on job search. After accounting for the nonlinear effects of playing videogames, I find that more time spent playing videogames may actually attenuate or reverse the negative association found in the linear model. This paper contributes to recent research studying the impact of playing videogames on time allocation decisions in non-experimental settings and it represents a novel analysis of its effects on working-age individuals – a growing subset of people who play videogames.

JEL-Codes: I2, J22, J24

Keywords: Time allocation, labor leisure choice

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1 Introduction

This paper analyzes the time allocation decisions and labor market outcomes of students and workers who play videogames. Existing studies have found a negative relationship between the amount of time children spend playing videogames and the amount of time they spend on educational activities. Using time use data based on adolescents in a non-experimental context, Suziedelyte (2015) found that children who play videogames not only spend less time on activities related to education but also do not compensate for the increased time playing games by reducing their time spent watching TV or engaging in other leisure activities. Other studies have come to similar conclusions: Cummings and Vandewater (2007) use survey data from a nationally representative sample of children collected during the 2002-2003 school year and find a significant negative effect of videogames on time spent reading, homework, and time doing sports activities. Nakamuro et al. (2015) have also found a substitution of time out of educational activities due to videogames, though they find that the supposed negative effects of this substitution effect are moderated by time spent with parents, which has a greater influence on student success.

Due to the belief that time spent on non-educational activities must lower human capital investment and therefore earnings capacity (Becker 1965), economists have mostly argued that playing video games has negative effects on student achievement, for example through absenteeism (Ward 2013). Nevertheless, more recent research has begun to complicate the human capital-based framework. Indeed, after finding a substitution effect, Cummings and Vandewater (2007) come to no solid conclusion on the issue, noting that a negative effect of games would rely on both (1) whether time would be spent on more "useful" activities if not on videogames and (2) whether time spent on any activity is zero-sum in the sense that time spent on games gives absolutely no human capital or cognitive benefits. Even Suziedelyte (2015), who found a clear substitution effect away from educational activities, also found a positive effect of playing videogames on cognitive ability, lending support to a growing body of psychological research on the benefits of playing videogames. Nakamuro et al. (2015) also conclude that videogames may have a positive effect on child development if time spent with parents on other human capital-improving activities in the household, such as reading, is not reduced.

Concerning the broader social and economic effects of videogames, the evidence is mixed and the research is sometimes unreliable. Subrahmanyam (2000) notes that while there is a significant body of research and popular opinion that argues that videogames promote aggressive behavior and therefore violent crime, others have found the opposite (Ward 2011). At the very least, drawing such a broad conclusion from data can be difficult, as DellaVigna and Ferrara (2015) point out in their survey of the literature on the effects of media on society. One reason

for this ambiguity might be due to a psychological cathartic effect of playing videogames that has been supported by qualitative studies of people who play videogames (Bourgonjon 2015) – i.e., videogames allow a release of negative energy that lessens the probability that the negative energy translates into real violence.

Other economists and social scientists have also argued that games can make individuals happier and more productive at work (Johnson, 2005; McGonigal, 2011), though the nature of the videogame and the total time spent playing are certainly important factors to consider since experimental research has found that leisure time (proxied by internet and computer use) on the job negatively affects productivity (Corgnet et al. 2014). These studies suggest that many of the negative traits ascribed to people who play videogames may in fact be promoted by typical stereotypes of "gamers" (those who make a hobby out of playing videogames) or isolated events, when in fact there could be significant economic benefits of engaging, at least to a moderate extent, in this leisure activity.

The nature of the data used to analyze "gamers" has varied widely and has complicated the ability of researchers to draw general conclusions about the effects of videogames on labor market outcomes. There are poll data from a few media outlets that have attempted to gather basic demographic statistics on people who play videogames.[1] These polls often sample a few thousand people at most, they often do not contain many characteristics of the people they survey, and they suffer from potential selection bias since researchers would ideally want to study people who play videogames even if they do not identify as "gamers". Another source of data is experimental data used often in psychology to isolate the causal relationship of playing games by randomly assigning video game play to experimental groups (Weis and Cerankosky 2010). This research has furthered our understanding of the effects of gameplay on students' study time and test scores, though the small samples and lack of comprehensive time diary data on the subjects under study are weaknesses. There have been a limited number of studies using time use data from national surveys; examples include the use of the Panel Study of Income Dynamics – Child Development Supplement (Suziedelyte 2015) in the U.S., as well as in other countries (Nakamuro et al., 2013). Time use studies have some benefits, such as giving researchers the ability to account for time spent on other activities and additional demographic characteristics. The lack of a controlled or "natural" experiment, however, makes causal analysis difficult.

While this paper also uses time use data and cannot account for a causal effect it nevertheless makes an important contribution to the study of the impact of videogames on time allocation

[1] A recent survey in Reason magazine polled gamers on a number of political and social views, in addition to their demographic characteristics (Reason.com, 2014). LifeCourse Associates also recently published a study (with sample size of 1,227) that received attention from the online streaming site Twitch TV (LifeCourse Associates, 2014). The Electronic Software Association funds a more detailed and targeted yearly survey (http://www.theesa.com/about-esa/industry-facts/). A recent report can be found here: http://www.theesa.com/wp-content/uploads/2015/04/ESA-Essential-Facts-2015.pdf. (Accessed March 15, 2016.)

decisions. I use a measure of playing videogames that isolates the time spent *alone* in this activity, and I use a wide variety of controls afforded by the dataset, to clarify the mechanisms whereby time spent on this activity is associated with a wide range of other leisure, educational, and work activities. I use this measure for the main contribution of the paper, which is that it is the first study documenting the relationships between playing videogames and workers' labor supply and income.

For the analysis, I use the American Time Use Survey (ATUS). The ATUS was chosen because in order to study the impact of videogames on time allocation decisions and labor market characteristics one would ideally have a detailed, national survey of people who play videogames to capture as much variation as possible. Also, in addition to questions about time allocation decisions, the ATUS allows one to analyze the labor market characteristics of adults who play videogames– a not insignificant proportion of all gamers, and one that is growing. While the lack of a longitudinal dimension of this dataset or a controlled experiment do limit the questions that can be asked, it is hoped that the large and comprehensive nature of this dataset will offer a significant starting point for future research and will help address common beliefs and hypotheses in the existing research about people who play videogames.

The set of hypotheses to be explored in this paper are separated into *time allocation decisions* and *labor market outcomes*. While causal analysis cannot be undertaken due to the cross-sectional nature of the ATUS data, the rich set of controls allows one to analyze how playing videogames varies with many time allocation decisions and labor market outcomes, holding other characteristics and time allocation decisions constant.

On the question of time allocation, I am interested in the following questions:

- Is time spent playing videogames associated with more time spent on other leisure activities, such as TV or other general computer use, or does gaming simply "make up" for other leisure time normally spent doing something else?
- Among students, is there an inverse relationship between playing videogames and study time or class time?
- Does playing videogames crowd out job search for the unemployed or work time for the employed?
- How is playing games associated with labor supply (i.e. amount of hours worked)?

To address questions about the effects of videogames on human capital and labor market outcomes, I am also interested in the following questions:

- Is more time playing videogames associated with less earned income, after controlling for other individual characteristics, and after controlling for time spent on other activities?
- Is playing videogames associated with earned income in a non-linear fashion?

This paper represents a significant contribution to the effects of new media on the economy. By analyzing the time allocation decisions of gamers and non-gamers across two different sections of the population (workers and students), it is possible gain a richer understanding of the ways in which this increasingly popular activity affects time use and economic behavior at different stages of one's life. Furthermore, this is the first study to compare the labor market outcomes of those who play videogames against those who don't with a rich set of controls and time diary information.

Looking ahead to the main results, I find that students who play videogames spend 2.3 hours more time per day on leisure activities in general and 1.4 hours less time per day on educational activities. Workers who play videogames also spend more time on leisure activities in general (about 2.6 hours) and 1.5 hours less time on work-related activities. Because the ATUS samples are spread unevenly throughout the week, these results are based on weighted means. Moving to the regression analysis for the student sample, I find that an additional hour of playing videogames is associated with a 0.45-hour reduction in the time spent on educational activities, controlling for individual and state-level differences in time use. This partial effect is smaller than the one found for watching TV (where the coefficient is -0.62 instead of -0.45). For the worker sample, I find that playing videogames is negatively associated with both labor supply and labor market earnings. In the latter case, an additional hour of playing videogames is associated with a reduction in weekly earnings of about $21.50, more than the effect of time spent watching TV. Finally, after including a quadratic control for time spent playing videogames, I find that the shape is U-shaped, suggesting that the negative association between playing videogames and labor market earnings diminishes over time.

These results are generally consistent with recent research on the time allocation decisions of people who play videogames that have found that the positive benefits of playing videogames may offset, at least to a degree, the substitution out of human capital-building activities, which may explain the minor negative partial effect I find of time spent on this activity on labor earnings. My results are also a novel contribution to the research on the association between playing videogames and measures of labor supply among workers.

2 Data and summary statistics

The data come from the American Time Use Survey (ATUS), a survey conducted by the U.S. Census Bureau and sponsored by the Bureau of Labor Statistics. It is a yearly national survey of about 11,000-12,000 individuals aged 15 or older that is intended to provide detailed information about how Americans spend a typical day. The BLS takes a subset of the households that are part of the Current Population Survey (CPS) based on their demographic characteristics and follows up with them 2-5 months after the final month of their participation in the CPS to ask additional questions of one member in the household who is 15 years or older

about how they spent their previous day, through one 24-hour cycle. I use the ATUS files published by the BLS on the ATUS website and I use the full range of years for which the data were available at the time that this study was undertaken: 2003-2013.[2]

The data used in this study are published across all 5 files from the ATUS dataset. The "Activity" file contains the time diary information, which is a record of each respondent's time use over the course of an entire 24-hour day. The "Respondent" file records the respondent's labor force and family status (if married or with children), some demographic information, earnings and hours worked, as well as time spent with family and friends. The "Who" file indicates whom a respondent was with while they were engaged in a particular activity. The other two files, "CPS", and "Roster", contain information on the respondent (such as race, region, and age) as well as other members of the respondent's household.

The ATUS is based on a stratified random sample, it oversamples women, and it oversamples from weekends. For these reasons, the ATUS includes weights that can be used to generate representative estimates that are consistent across a given week. They are included in the "Respondent" file and are used to generate all the summary statistics and results in this study. In the latest methodology for generating weights – implemented starting with the 2006 dataset – the ATUS provided weights that are representative of "person-days in a quarter", rather than "person-days in a month". I have harmonized the post- and pre-2006 weights to produce consistent cross-sectional and across-time estimates that can be used to calculate the average daily time spent on an activity. Activities are coded on several levels, including information on leisure, home production, and work activities. One leisure category, coded as "playing games", allows me to identify the impact of videogames on time allocation decisions and its relationship with select labor market characteristics taken from the "Respondent" files. In the following analysis, I define a "gamer" broadly as any individual that has a positive amount of time recorded playing videogames, with the following qualification (in the next paragraph) of who is categorized as a "gamer".

Several measures of time spent playing videogames could be employed. The first uses the broad definition taken from the ATUS for "playing games" (in the ATUS activity coding lexicon, this is part of major category "12", 6-digit activity code "120307"). Because this measure could include table and card games, it is an imperfect way of tracking the amount of time people play videogames. Precisely because this includes time spent on other types of games, I do not use this broad measure in the empirical analysis below. The measure adopted in this paper is a narrower definition that uses information from the ATUS "Who" files about who was with the person while the activity took place. The "Alone" category was used to obtain a more accurate definition of gamers: those who play games without anyone else physically present with them at the time of the activity.

[2] The data are available here: http://www.bls.gov/tus/#data.

Even this narrow measure of time spent playing videogames may be complicated in at least two ways. First, this measure excludes time spent playing videogames with others who are present in the room, which may be significant. Second, this variable is still likely measured with some error because puzzle (and even card) games can be played alone. These are both examples of measurement error, most likely of the classical form because the degree of mis-measurement is likely not correlated with the actual unobserved measure (i.e., time spent playing videogames). That is because in some cases, "time spent playing games alone" will underestimate the time spent playing videogames because we fail to account for the extra time spent playing videogames with other people. In other cases, "time spent playing games alone" will overestimate the time spent playing videogames because we fail to account for the fact that those people playing games alone could be playing puzzle games (and other card games) alone. To the extent that it exists, then, the classical measurement error in the independent variable will tend to lead to coefficients that are biased towards zero because of the increased variance of the independent variable caused by the error term (Wooldridge 2015).

Table 1
ATUS Variables, definitions, and means 2003-2013

Definition	Mean	Definition	Mean	Education (Highest degree obtained) in %	
Age	44.3	Working full-time*	0.633	Not finished school	18.34
Sex (=1 if male)	0.484	Working part-time	0.144	High School	29.89
Black (=1, 0)	0.119	Unemployed	0.059	Some College	25.01
Minority (=1 if Hispanic or Black)	0.254	Student (may or may not be working)	0.044	College Degree	17.35
Married (=1, 0)	0.534	Disabled	0.046	Graduate Degree	9.41
		Stay-at-home	0.083		
		Retired	0.138		
Observations (N)	148,345				

*Labor force indicators are dummy variables, equal to 1 if the condition is true, 0 otherwise. All statistics presented in this and later tables use the harmonized ATUS weights (see Section 2).
Source: ATUS 2003-2013, own calculations.

As a check on the extent of measurement error, the analysis was also conducted using the broader definition of gaming. While the results do not differ significantly across the broad and narrow definitions, it can be argued that the narrower definition ("time spent playing games alone") most accurately captures time spent playing videogames. Videogames can be argued to promote isolation more than other types of games that people might play, such as cards, chess, or outside games. Thus, for the remainder of the paper, the statistics and econometric results presented are based on the time spent playing games alone.

Table 1 presents weighted summary statistics for the entire 2003-2013 sample. There are 148,345 observations in the entire dataset, for a yearly average of about 13,500, though earlier versions of the ATUS had more observations than the later ones. In Table 2 note that students

(sample size = 4,849) play games for over twice as long per day as the full sample, while working individuals (sample size = 92,957) spend the least amount of time playing games.

Table 2
Average time per day spent in each activity (hours), 2003-2013

Activity	Full sample	Students	Working full-time
Personal care	9.41	10.09	9.08
Household activities	2.27	0.92	1.93
Care of non-household members	0.15	0.09	0.13
Work	3.35	0.04	5.21
Education	0.44	4.39	0.26
Consumption/Eating and Drinking	1.50	1.26	1.47
Professional care services	0.08	0.04	0.07
Household and government services	0.02	0.01	0.02
Socializing, Relaxing, and Leisure (Overall)	4.63	4.43	3.69
- Playing video games	0.20	0.48	0.14
- Watching TV	2.70	2.13	2.14
Sports and Recreation	0.33	0.78	0.31
Religion	0.14	0.13	0.12
Volunteer, and Other	1.56	1.71	1.59
Observations (N)	148,345	4,849	92,957

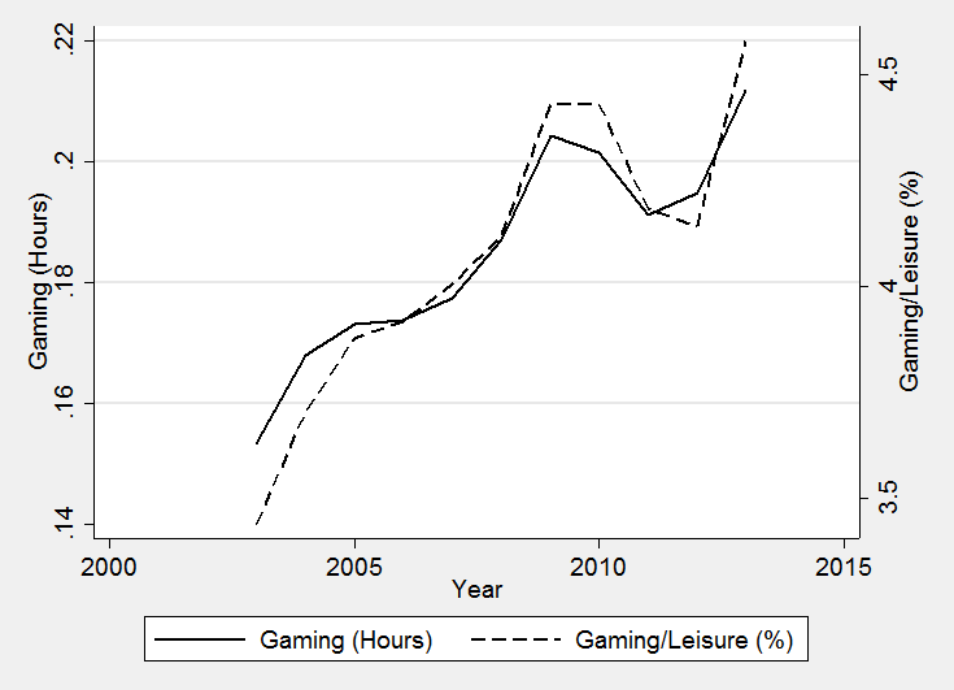
Means are weighted to produce estimates of daily time use. Personal care (ATUS major category 01 [Bureau of Labor Statistics, 2014]) includes activities such as sleeping, grooming, and personal health-related activities; Household activities (02, 03): Housework, home maintenance, food and drink preparation, care of children or other household members; Care of non-household members (04): non-market activities for non-household children or others; Work (05): working, work-related, and other income-generating activities; Education (06): Attending class, extracurricular activities, doing homework; Consumption/Eating and Drinking (07, 11); Socializing, Relaxing, and Leisure (12): Watching TV, playing games, entertaining and socializing with friends, attending social events, attending performing arts (other than sports); Professional care services (08): using banking, legal, childcare, real estate, and medical services; Household and government services (09, 10): use of lawn and garden, vehicle or home maintenance, performing civic obligations and using government services; Sports and Recreation (13); Religion (14) Volunteer or other (15, 16, 18): Performing volunteer services, telephone calls, traveling, other time use.
Source: ATUS 2003-2013, own calculations.

Students and working individuals both spend about the same time watching TV, though this is less by about half an hour than the full sample (which includes those not participating in market work or who are disabled). The notes to Table 2 also define all the time use categories used in this paper. In most cases aside from "working" and "leisure", I simply use the Major Category numerical classification from the ATUS coding lexicon (codes for major activities between 1-16 and 18).

Consistent with other findings on time use (Aguiar et al. 2013), Figure 1 (below) shows that the time spent on both leisure, and videogames as a percentage of leisure, has increased over

time, with a spike in leisure time around the Great Recession. The solid line represents the average amount of hours playing games. The values might seem low, but recall that these are averages among the entire sample in a given year. For this reason, the increase from 0.16 to 0.22 in the number of hours spent playing videogames might seem small, but it marks close to a 50% increase. The importance of gaming in leisure time is shown by the dashed line, in which the proportion of leisure time spent on playing games has also increased from about 3.5% to 4.5% and has followed an upward trend. Other findings from an analysis of the yearly patterns (not reported) show that gamers have gotten older over time. From these summary statistics, it is clear that over the last 10 years, playing games has become an increasingly important hobby.

Figure 1
Gaming and leisure time, 2003-2013



Source: ATUS 2003-2013, own illustrations.

3 Time allocation decisions among gamers and non-gamers

3.1 Comparison of means estimates

In this section, I first conduct a basic comparative analysis of people who play videogames – people referred to below as "gamers". I then compare the time allocation decisions of gamers and non-gamers. Table 3 (below) shows that the "gender gap" in gaming narrows with age,

since among students, close to 77% of people reporting that they played videogames were male, much more than the proportion of gamers among all those surveyed. Among those who are working, 61% of gamers were male. There is still a minor gender gap when the entire sample is considered – about 55% of all individuals surveyed from 2003-2013 who say they played games were male. Among individuals across the "All" and "Working" categories, gamers are younger, less likely to be a minority, and less likely to be a parent than non-gamers.

Regarding decisions on how to allocate one's time, gamers are also different from non-gamers. First, consider the "full" and "working" sample statistics in Table 3. Between gamers and non-gamers, most of the extra time spent on leisure between the two groups (5.68 hours for workers who are gamers vs. 3.55 hours for those who are not; 6.32 hours for students who are gamers vs. 4.03 hours for those who are not) appears to come from playing videogames (gamers who are workers spend on average 1.98 hours playing videogames, students, 2.51 hours), so that for gamers, there appears to be little substitution of time between various leisure activities. In the "full" and "working" samples, for example, gamers do not spend any less time watching TV than non-gamers (2.71 vs. 2.70 and 2.20 vs. 2.14 hours respectively). Gamers do spend less time on personal care activities (such as cleaning or grooming) than non-gamers across all three samples, though the difference is relatively small. Gamers spend slightly less time on household production (such as household cleaning, food and drink preparation, interior maintenance, lawn maintenance, and household management such as financial management or household personal email) than non-gamers, though again, the difference is small.

The most notable difference between gamers and non-gamers in the "full" and "working" samples is in the time spent on "socializing, relaxing, and leisure" and the time spent working: people who play games are spending about that much amount of time less at work (in the "working" sample, the difference is 5.31-3.81=1.5 hours), and they are not spending any less time socializing than people who do not play games.

Among the "student" sample specifically, a few additional patterns emerge.

Table 3
Demographic (averages) and basic time use statistics (average hours per day), 2003-2013 standard deviations in parentheses

	All who:		Working and:		Student who:	
Variable	**Do not play games**	**Play games**	**Does not play games**	**Plays games**	**Does not play games**	**Plays games**
Age	44.6	41.9	41.1	36.6	18.9	17.6
	(17.9)	(21.9)	(13.9)	(15.5)	(5.6)	(3.9)
Male	0.478	0.545	0.53	0.606	0.438	0.769
	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.4)
Minority	0.26	0.193	0.244	0.176	0.34	0.329
	(0.4)	(0.4)	(0.4)	(0.4)	(0.5)	(0.5)
Married	0.547	0.4	0.579	0.450	N/A	N/A
	(0.5)	(0.5)	(0.4)	(0.5)		
Parent	0.415	0.39	0.445	0.413	N/A	N/A
	(0.4)	(0.5)	(0.5)	(0.5)		
Weekly Earnings			$793.1	$635.6	N/A	N/A
			(616.1)	(544.5)		
Personal care	9.41	9.37	9.09	8.94	10.09	10.09
	(2.4)	(2.3)	(2.2)	(2.2)	(2.3)	(2.5)
Household activities	2.30	1.85	1.95	1.70	0.98	0.64
	(2.7)	(2.2)	(2.4)	(2.1)	(1.75)	(1.1)
Care of non-household members	0.16	0.14	0.13	0.13	0.09	0.05
	(0.8)	(0.6)	(0.7)	(0.6)	(0.6)	(0.32)
Work	3.49	1.89	5.31	3.81	-	-
	(4.3)	(3.3)	(4.3)	(3.9)		
Education	0.42	0.58	0.26	0.29	4.63	3.25
	(1.7)	(1.9)	(1.3)	(1.3)	(4.1)	(3.5)
Consumption/Eating and Drinking	1.51	1.43	1.47	1.41	1.28	1.19
	(1.2)	(1.1)	(1.2)	(1.1)	(1.1)	(1.0)
Professional care services	0.09	0.07	0.07	0.05	0.04	0.03
	(0.4)	(0.3)	(0.4)	(0.3)	(0.3)	(0.2)
Household and government services	0.02	0.02	0.02	0.02	0.01	0.002
	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.1)

Table 3 (Cont.)

	All who:		Working and:		Student who:	
Variable	**Do not play games**	**Play games**	**Does not play games**	**Plays games**	**Does not play games**	**Plays games**
"Socializing, Relaxing, and Leisure" (Overall)	4.43	6.68	3.55	5.68	4.03	6.32
	(2.3)	(2.0)	(2.0)	(1.8)	(2.4)	(1.9)
Playing video games	-	2.14	-	1.98	-	2.51
		(1.9)		(1.8)		(2.4)
Watching TV	2.70	2.71	2.14	2.20	2.10	2.28
	(2.8)	(2.5)	(2.3)	(2.2)	(2.3)	(2.3)
Sports and Recreation	0.33	0.38	0.31	0.31	0.78	0.78
	(1.0)	(1.0)	(1.0)	(0.9)	(1.5)	(1.4)
Religion	0.14	0.11	0.12	0.10	0.13	0.11
	(0.6)	(0.5)	(0.6)	(0.5)	(0.6)	(0.6)
Volunteer, and Other	1.58	1.39	1.60	1.45	1.78	1.38
	(1.8)	(1.5)	(1.7)	(1.4)	(2.0)	(1.5)
Observations (N)	136,536	11,809	87,228	5,729	3,961	888

Notes: For definitions of the time use variables, see the notes to Table 2.
Means are weighted to produce estimates of daily time use.
Source: American Time Use Survey, 2003-2013, own calculations.

Unlike in the "all" sample, gamers who are students spend less time on other leisure and socialization activities (non-TV, non-gaming) such as socializing with others, relaxing, and attending social events, though the difference is minor (4.03-2.1 = 1.93 hours for non-gamers vs. 6.32-2.51-2.28 = 1.53 hours for gamers). Similar to the "all" and "working" samples, gamers who are students do not spend any less time on personal care than non-gamers.

Where does all that extra time go, if not away from other forms of socialization – in other words, among students, what are gamers doing much less than non-gamers? Comparisons of time spent by gamers and non-gamers on educational activities, which could include class time (for degree, certification, or licensure, or for personal interest), research or homework, extracurricular club, music, or other performance activities, or registration and administrative activities, suggests an answer. To analyze this question, regression analysis will be employed in the following section.

3.2 Regression analysis

In a given 24-hour day, individuals allocate time their between various activities. To fully account for the relationship between the variation between time spent on two activities, such as educational activities and games, no other activities should be controlled for. That is because when individuals spend more time playing games, we would like to measure how much

less time this leads them to spend on educational activities without assuming that these individuals spend the same amount of time engaged in any other activity as they did before they decided to play more games (e.g., we do not want to control for time spent on other leisure activities). If we did control for time spent on other leisure activities, the partial effect of gaming on educational activities would be exaggerated because we are constraining individuals' time spent on leisure activities and not allowing them to substitute into or out of leisure activities, which they likely do, and which the comparative analysis above suggests.

To measure the association between time spent playing videogames and its association with time spent on educational activities, job search, labor supply, and weekly earnings, a regression model will be estimated. In the first model, no other time use controls are included except for gaming.

For the case of earnings, we are also interested in the *direct* impact - i.e., after controlling for time spent on all other activities excluding one activity, I estimate the association between an additional hour spent playing games and labor market earnings. I analyze the partial effect of an additional hour of playing games on earnings including all other time use variables except for one. Thus, the following two models will be estimated with the ATUS data on the "student," "unemployed," and "working" subsamples. If Y_i denotes time spent on educational, job search activities, labor supply, or labor market earnings by person *i*, model 1 is employed:

$$(1) \qquad Y_i = \alpha + Gaming_i * \beta_1 + X_i * \Gamma' + \varepsilon_i$$

Where X_i represents demographic and regional controls. Additionally, in the specific case where *Y* denotes labor market earnings, model 2 (direct effect) will also be estimated:

$$(2) \qquad Y_i = \alpha + Gaming_i * \beta_1 + Time_i * \Pi' + X_i * \Gamma' + \varepsilon_i$$

In model 2, $Time_i$ denotes a matrix of all other activities person *i* could spend their time on, except for one that is omitted and is assumed to not be related to earnings (volunteer work).

It is important to note at this point that a major limitation of this model is that it cannot be used to assess the causal effects of playing video games. Even after controlling for many observable individual characteristics that can be found in the ATUS dataset, several unobservable characteristics may also confound the relationship between time spent playing videogames and various education-, job search-, and work-related outcomes. The most obvious that has been cited in the previous literature is a higher preference for leisure that may be driving both higher time spent playing games and less work time or less earnings. Thus, instead of more time spent playing videogames causing lower earnings, it could be the case that individuals with lower earnings have a greater preference for leisure time and therefore spend more time playing videogames. A similar effect could manifest itself in the student subsample as well: a preference against studying or going to class due to low innate ability (or higher preference for leisure), which may increase time spent on video games as one of several possible outcomes of reduced time spent on educational activities.

Table 4 reports estimates of a regression in which the dependent variable is total hours spent on educational activities for students.

Table 4
Relationship between time spent on media and time spent on educational activities among students, dependent variable: Hours spent on educational activities

	(1)	(2)	(3)	(4)
Gaming	-0.453***	-0.458***		
	(0.04)	(0.04)		
Watching TV			-0.622***	-0.614***
			(0.03)	(0.03)
Intercept	4.588***	7.989***	5.717***	8.665***
	(0.08)	(1.33)	(0.11)	(1.27)
Individual-level and regional controls	No	Yes	No	Yes
R-Squared	0.024	0.050	0.120	0.139
Observations (N)	4,849	4,849	4,849	4,849

Notes: * p<0.1, ** p<0.05, *** p<0.01. Standard errors (in parentheses) corrected for heteroscedasticity. Individual-level and regional controls include age, age squared, sex, race, grade level, and state. Regressions are weighted to produce estimates of daily time use (see Section 2).
Source: American Time Use Survey, 2003-2013, own calculations.

The baseline results (Columns 1 and 3) show that playing videogames and watching TV are both negatively associated with time spent on educational activities. The association with time spent watching TV is larger than videogames by about 50%, and both are statistically significant (p<0.01). Including demographic and regional controls in the model does not alter the results significantly, though it does lead to a larger association with time spent playing videogames and a slightly smaller association with time spent watching TV. The results suggest that, holding demographic characteristics constant, an additional hour spent playing videogames is associated with a 0.46-hour (or about 28 minutes) reduction in time spent on all educational activities. An additional hour of TV watching is associated (again, holding other variables constant) with a 0.62-hour or 37.2 minutes less time spent on educational activities. This estimate is less than what is reported by Suziedelyte (2015), who finds a substitution effect out of time spent on education of about 45 minutes, though with larger standard errors than reported in this study.[3] Note that in Table 5 (in which model 1 is estimated for each day separately), the association between playing videogames and educational activities varies significantly over the course of the week, with the strongest effects during the week. Again, the

[3] The standard error of our point estimate is about 0.034 or 2 minutes, while Suziedelyte's (p. 1149) is about 0.12 or 9 minutes.

ATUS oversamples the weekends, which is why the weighted results in Table 4 present a slightly higher effect than what would be derived without weighting.

Table 5
Daily estimates of relationship between time spent on video games and educational activities among students

Day	Coefficient	Day	Coefficient
Monday	-0.668***	Friday	-0.288**
Tuesday	-0.686***	Saturday	-0.069**
Wednesday	-0.586***	Sunday	-0.152***
Thursday	-0.560***		

Notes: * p<0.1, ** p<0.05, *** p<0.01. Standard errors (not reported) corrected for heteroscedasticity. Coefficients derived from estimating an unweighted model of the educational activities-gaming relationship that includes individual-level and regional controls (similar to Column 2 of Table 4) for each interview day separately. Regressions are weighted to produce estimates of daily time use (see Section 2).
Source: American Time Use Survey, 2003-2013, own calculations.

Do these same substitution effects carry over to time spent on job search? Table 6 shows that there is a negligible association between time spent playing videogames and job search activities such as interviewing, job search, and waiting for an interview. The significance of the coefficient disappears once demographic and regional controls are included in the analysis. Further, Columns 3 and 4 show that time spent watching TV is more strongly associated with job search than playing videogames. We can conclude that after accounting for observable characteristics playing videogames is not negatively associated with time spent on job search.

In summary, the evidence does appear to support the argument that playing videogames leads to a substitution effect out of educational activities, with the regression results reported in Tables 4 and 5 confirming the comparison of means presented earlier. These results are insensitive to the inclusion of demographic controls such as age, sex, and race, and marital status, as well as regional controls. Even after controlling for individual characteristics, more time spent on playing videogames is indeed associated with significantly less time spent on educational activities.

Table 6
Relationship between time spent on media and time spent on job search among the unemployed, dependent variable: Hours spent on educational activities

	(1)	(2)	(3)	(4)
Gaming	-0.041***	-0.025		
	(0.01)	(0.02)		
Watching TV			-0.020***	-0.030***
			(0.005)	(0.03)
Intercept	0.412***	-1.339***	0.461***	-1.286***
	(0.02)	(0.227)	(0.03)	(0.23)
Individual-level and regional controls	No	Yes	No	Yes
R-Squared	0.002	0.068	0.002	0.072
Observations (N)	7,456	7,456	7,456	7,456

Notes: * p<0.1, ** p<0.05, *** p<0.01. Standard errors (in parentheses) corrected for heteroscedasticity. Individual-level and regional controls include age, age squared, sex, race, grade level, and state. Regressions are weighted to produce estimates of daily time use (see Section 2).
Source: American Time Use Survey, 2003-2013, own calculations.

As mentioned earlier, while these results suggest that playing videogames has a causal effect on the accumulation of human capital and should therefore reduce future labor market earnings, they cannot prove this claim, for two reasons. First, a causal analysis cannot be undertaken due to the cross-sectional and non-experimental nature of the ATUS data. Second, if playing videogames has a positive effect on cognitive ability, creativity, or even productivity, as some recent scholarship has shown, the negative effects may be offset. This countereffect is indeed what Suziedelyte (2015) found, and it has support from previous work in psychological research (such as the findings summarized in Subrahmanyam 2000). In the next section I turn to this question of the association between time spent playing videogames and labor supply and earnings.

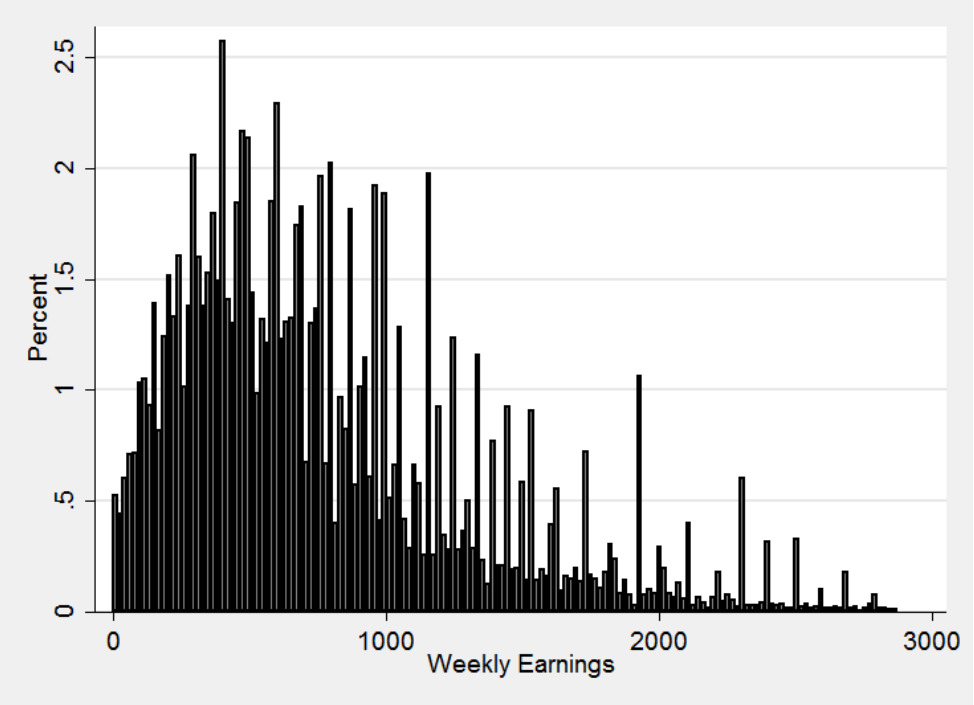
4 Labor market outcomes

In Section 3.1, a comparison of means between gamers and non-gamers in the "full" and "working" samples showed that gamers supply less hours per day on the labor market. In this section, I consider this issue using regression analysis. What is the relationship between time spent playing videogames and labor supply and earnings? Is there a corresponding negative relationship between time spent playing videogames and labor supply/earnings after controlling for other demographic, occupational, and time use statistics? Is the relationship nonlinear?

I explore these questions using additional information from the ATUS. Recall that the ATUS is based on households in the Current Population Survey who are followed up with 2-5 months later. In the "Respondent" files for these individuals, information on hours worked per week, weekly earnings (from all jobs), occupation, and industry, among other information collected for the CPS, is reported.

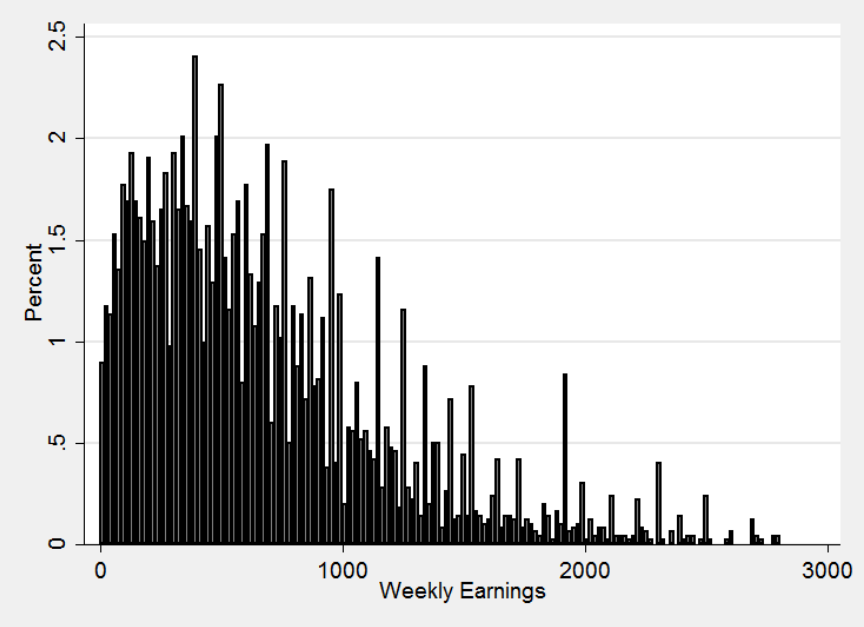
Figures 2 and 3 below report summary statistics regarding the distribution of labor market earnings among gamers and non-gamers. Between the two samples there is a difference in weekly earnings of about $140 at the mean and $130 at the median. The overall shape of the distributions between the two groups is similar. After accounting for age differences in people who play games, by focusing on the age 25-45 sample in each group, the difference in means narrows significantly – by about 50%. This suggests that further controls for education or marital status may lead to further reductions in the difference between the two groups.

Figure 2
Distribution of weekly earnings –
People who do not play video games



Notes: Mean: $742.68; Median: $611.80,
Source: ATUS 2003-2013, own illustrations.

Figure 3
Distribution of weekly earnings – People who play video games



Notes: Mean: $604.14; Median: $480.76.
Source: ATUS 2003-2013, own illustrations.

To better control for the association between playing videogames and labor market outcomes, a model is estimated via OLS in which the dependent variables (weekly earnings or daily work hours) are regressed on demographic, occupational, regional, and other time use variables. The estimates are derived using the same weights used to generate the results in earlier tables (to make the results representative for a person-day in the quarter in which the survey is taken), and the standard errors are corrected for arbitrary forms of heteroscedasticity. The results are reported in Tables 7-10.

Columns 1 and 2 of Table 7 report results from estimating model 1 – i.e., allowing for an increase in time spent playing videogames to lead to substitution of time across other activities and thus affect weekly earnings. According to these results, an hour of time spent playing videogames is associated with a $21.50 reduction in weekly earnings that is statistically significant and represents about a 3% reduction from the mean. The results for watching TV are smaller but also significant. The other coefficients in Columns 1 and 2 have the expected signs – age, sex, and marital status all contribute positively to weekly earnings while minority status contributes negatively to earnings. The age-squared coefficient has the predicted negative sign, suggesting a peak in earnings over the lifecycle. (Coefficients for education, number of children, and regional characteristics are not reported.)

Table 7
Relationship between time spent on media and labor market earnings, 2003-2013

	(1)	(2)	(3)
Gaming	-21.496***		-24.286***
	(2.39)		(2.38)
Watching TV		-13.330***	-14.894***
		(0.86)	(0.91)
Age	43.053***	43.610***	41.175***
	(0.88)	(0.88)	(0.91)
Age^2	-0.436***	-0.439***	-0.413***
	(0.01)	(0.01)	(0.01)
Minority	-78.499***	-76.708***	-83.839***
	(6.58)	(6.56)	(6.56)
Male	232.869***	236.220***	225.152***
	(5.02)	(5.02)	(5.06)
Married	55.548***	54.246***	55.422***
	(4.73)	(4.72)	(4.75)
Constant	-953.081***	-933.444***	-780.278***
	(37.51)	(37.71)	(40.40)
Controls for other time use	No	No	Yes
R^2	0.419	0.421	0.428
Observations	82,380	82,380	82,380

Notes: * p<0.1, ** p<0.05, *** p<0.01. All regressions control for occupation, industry, and state. Standard errors (in parentheses) corrected for heteroscedasticity. Regressions are weighted to produce estimates of daily time use (see Section 2).
Source: American Time Use Survey, 2003-2013, own calculations.

Column 3 of Table 7 reports results of estimating model 2, which is intended to analyze the direct relationship between time spent playing videogames and labor market earnings. The coefficient is slightly larger, suggesting that there is a direct association between playing videogames on labor market earnings that is not simply being picked up by less time spent on productive activities such as the amount of hours worked. That is to say, even after controlling for time spent on such productive activities (or any other activity), there is still a clear negative association between playing videogames and labor market earnings. The coefficient is -24.29 – representing a reduction of about 3% from average earnings.

While this result does suggest that playing videogames directly reduces productivity, seemingly at odds with the findings from Suziedelyte (2015) and Cummings and Vandewater (2007) that videogames can increase cognitive ability or productivity, a causal effect cannot be established from these findings. More importantly, as we will see now, there is strong evi-

dence to argue that a more accurate description of the relationship between videogames and earnings is nonlinear.

This evidence is reported in Table 8. Table 8 shows the estimated coefficients from adding a $Gaming^2$ variable to model 1. I use both earnings and labor supply (work hours) as dependent variables. All coefficients are reported for the baseline model (model 1) with demographic and regional controls. Controlling for the nonlinear effects of these activities while allowing for substitution between different activities is clearly very important in the earnings regressions, with coefficients for both gaming and TV being positive and significant. The results for the labor supply regressions are mixed, with coefficients for gaming and TV again positive but only the latter being significant.

Consider the weekly earnings regressions for Table 8: the association between gaming and weekly earnings rises in magnitude from -$21.50 per week to -$41.24 per week. However, the coefficient on the squared term is positive and significant (3.557), suggesting that the association between playing videogames and weekly earnings grows weaker with higher amounts of daily play. The cumulative partial effect in dollars is -41.24 + 7.114**Gaming*, so that over increasing amounts of play for person *i* the association diminishes (recall that the average gamer spends about 2.14 hours playing games, which corresponds to a partial effect of about -$26 per week). These findings suggest that while there may be some differences that can be discerned between gamers and non-gamers, these effects do not amplify with longer gameplay – indeed, after 5-6 hours per day of play, the association becomes close to zero.

Table 8
Linear and quadratic coefficients

Variable	Coefficient, Earnings Regressions	Coefficient, Labor Supply Regressions
TV	-18.841***	-0.761***
TV2	0.672***	0.038***
Gaming	-41.236***	-0.674***
Gaming2	3.557***	0.002

Notes: * p<0.1, ** p<0.05, *** p<0.01. This table adds quadratic transformations of time spent watching TV and playing games to the regressions reported in Column 5 of Tables 9 and 10 and reports the coefficients. Regressions are weighted to produce estimates of daily time use (see Section 2).
Source: American Time Use Survey, 2003-2013, own calculations.

In summary, there is no question that there are some significant differences between those who play videogames and those who do not, in terms of educational and economic outcomes. The results from the direct effects (Column 3 of Table 7) show that it is indeed the case that

holding other activities constant – including work time – more time spent playing videogames is associated with fewer earnings. But the fact that the negative association with earnings (accounting for substitution of time between activities such as work time) does not amplify with more time spent playing videogames – and, in fact, seems to diminish in magnitude – is the strongest evidence against a negative effect of videogames on economic outcomes. While not a confirmation of the argument that videogames can have a positive impact on productivity, these results support the view that videogames do not significantly affect labor market outcomes. In the final set of results, Tables 9 and 10 shed light on the labor supply decision.

Table 9
Relationship between time spent on media and labor supply, 2003-2013 (dependent variable: work hours)

	(1)	(2)
Gaming	-0.550***	
	(0.03)	
Watching TV		-0.656***
		(0.01)
Age	0.190***	0.209***
	(0.01)	(0.01)
Age^2	-0.002***	-0.002***
	(0.000)	(0.000)
Minority	0.313***	0.352***
	(0.07)	(0.06)
Male	0.836***	1.056***
	(0.04)	(0.04)
Married	-0.119***	-0.197***
	(0.04)	(0.04)
Constant	1.438***	2.674***
	(0.38)	(0.36)
R^2	0.045	0.149
Observations	82,380	82,380

Notes: * p<0.1, ** p<0.05, *** p<0.01. All regressions control for occupation, industry, and state. Standard errors (in parentheses) corrected for heteroscedasticity. Regressions are weighted to produce estimates of daily time use (see Section 2). Source: American Time Use Survey, 2003-2013, own calculations.

Refer first to Table 9. An additional hour of playing videogames is associated with a reduction in labor supply of about 0.56 hour, compared to a 0.66 hour reduction in labor supply in the case of time spent watching TV. These results are very similar to the ones for education,

suggesting that when time spent playing videogames increases, there is substitution out of productive activities. The other coefficients have the expected signs, with age showing an inverse-U relationship with labor supply over the lifecycle, a positive effect of male and minority status on labor supply, and a negative effect of marital status on labor supply.

Finally, in Table 10 (similar to Table 5), there is variation in the substitution out of labor supply activities over the course of a week, with the strongest associations between time spent playing videogames and labor supply occurring on Wednesdays and Thursdays. The week negative association of time spent playing videogames with labor supply shows that the substitution effects between playing videogames and productive labor are significant.

Table 10
Daily estimates of relationship between time spent on video games and labor supply

Day	Coefficient
Monday	-0.586***
Tuesday	-0.588***
Wednesday	-0.755***
Thursday	-0.727***
Friday	-0.384***
Saturday	-0.274***
Sunday	-0.183***

Notes: * p<0.1, ** p<0.05, *** p<0.01. [4]
Source: American Time Use Survey, 2003-2013, own calculations.

5 Discussion and conclusion

Recent studies have contributed to various parts of a research program intended to analyze the social and economic effects of time spent playing videogames. This paper represents two contributions to this program. First, I add to the existing research on new media and time allocation decisions using a nationally representative time use survey spanning 11 years (2003 to 2013) with over 140,000 observations. My findings are consistent with previous studies of children that have found that playing videogames induces a substitution out of educational time. The second contribution comes from the fact that the ATUS allows one to study work-

[4] Standard errors (not reported) corrected for heteroscedasticity. Coefficients derived from estimating an unweighted model of the labor supply-gaming relationship that includes individual-level and regional controls (similar to Column 2 of Table 4) for each interview day separately. Regressions are weighted to produce estimates of daily time use (see Section 2).

ing individuals who play videogames – a not insignificant portion of all people who play videogames today. For this sample, I find that playing games is not associated with job search, but is negatively associated with work time and labor market earnings, though the effects are small after controlling for demographic, occupational, and regional factors.

These results should be seriously considered in debates over the effects of playing videogames on economic outcomes, though there are a few caveats to keep in mind. First, I am not able to impose an exogenous variation in playing videogames, making it impossible to draw causal claims from my findings. Second and more importantly, a growing body of evidence has shown that while playing games does lead to less time spent on educational activities, this is not necessarily unproductive time, since playing videogames can improve certain cognitive abilities, unlike (for example) watching TV. This point should be considered in the context of both children and adults, who, although at a glance may be taking part in "unproductive leisure", are actively using their minds in a way that improves various human capital measures and economics performance.

This point, in the context of adults, brings a third caveat to keep in mind: the findings regarding the quadratic form of the earnings-gaming relationship in the previous section. My results offer further evidence regarding the potential benefits of playing videogames because while the coefficient on the linear term is negative, the coefficient on the squared term is positive, meaning that the negative effects of playing games on earnings disappear for longer play times – by around 6 hours per day the partial effect becomes zero. This result is encouraging since it suggests that those who are more likely to make a hobby out of playing videogames – arguably an important subsample for analyzing the effects on more permanent features like cognitive ability or productivity – have a lower partial effect of their time on earnings.

Future research in this area should clearly address the causal effects of playing videogames on both earnings and productivity. Given that some of the more recent psychological evidence on the positive effects of gaming is supported by my findings, an experimental study whereby the effects of short "breaks" of playing videogames are evaluated, or a longer-term study that captures the long-run effects of playing games into adulthood, would prove useful. More analysis of the reasons why games do not significantly reduce earnings among working-age individuals should also be explored from an economic standpoint: do games provide a more productive outlet than watching TV, making gamers mentally healthier workers and therefore more productive? Or is it a self-selection issue, whereby those individuals with higher-than-average computer skills naturally gravitate toward these games, so that the positive account is mainly due to a biased coefficient on "games played"? While panel data may help to control for these possibilities, it appears that the most fruitful work may lie in experiments that try to estimate the impacts of playing videogames on a worker's attention to a task and overall motivation and creativity. Nevertheless, it is hoped that the results in this paper are a significant first step and contribution to our understanding of the role that new media plays in our economy.

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Women's labor in South Africa – Time spent doing simultaneous paid and unpaid work

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Abstract

Empirical literature finds gender and presence of children as key determinants of unpaid work time. There is also extensive research on women's role in small-scale agriculture and women's disproportional representation in informal employment in developing countries. However, there has been no work to empirically link a woman's time spent simultaneously doing paid and unpaid work with her type of employment. The availability of rich time use data from South Africa yields an opportunity to explore this critical question with empirical rigor. Results show that small-scale agriculture and informal employment are associated with women doing more paid and unpaid work simultaneously implying a positive non-pecuniary benefit of certain types of employment related to women's need to navigate strict time constraints and limited choices.

JEL-Codes: J22, J16, J46

Keywords: Time use, female labor supply, gender, unpaid work, informal employment, small-scale agriculture

1 Introduction

For several decades, research on gender, households and economics have grappled with the challenge many women around the world face of navigating the demands of children, family, community and career, which often means balancing paid and unpaid work. Particularly for income-constrained women, the strategy of meeting both paid and unpaid work responsibilities depends on the nature of the employment. Given the diversity in types of employment in which women engage as well as variations in the levels of development across the country, South Africa is a particularly interesting context in which to investigate this challenge in the context of a developing economy. In this paper data from South Africa's 2000 Time Use Survey is used to investigate the extent to which women working in either informal employment or small-scale agriculture are more likely to combine income earning activities with unpaid household maintenance and care activities than women working in formal employment.

While arguments regarding women's unpaid work responsibilities and the nature of productive work have long existed, there is no empirical research utilizing time use data to identify the relationship between simultaneous activities and women's type of employment. Making this empirical connection enables a greater understanding of the how women's decision-making with regard to paid labor market is interconnected with decisions within the household. For example a woman selling goods informally out of her home will be able to continue doing this income-generating activity if she has a baby, while a woman working for a formal firm would have to find childcare or take time off work should she have a baby.

The results from the empirical analysis reveal that certain types of employment, namely small-scale agriculture and informal employment afford women to do more paid and unpaid work activities simultaneously. The results suggest that policy interventions that increase support for care economy would make it more feasible for women to engage in higher quality formal employment. Alternatively or in addition, inventions in the formal labor market to make the nature of work for more flexible and family friendly may also have a positive impact on women's employment in South Africa.

The findings imply that women's time allocation patterns are an important dimension of the economic policies targeting household wealth and intra-household equality. Indeed, most household policies are income-based and do not incorporate work intensity in their poverty or gender inequality reduction strategies. Yet, a poverty reduction policy may have a unintended impact on women's well-being if the policy fails to consider women's time constraints and unpaid work burdens. Monetary gains can be counterbalanced by a loss in welfare through women's health and productivity deterioration via increasing time spent simultaneously on paid and unpaid work (Jackson, 1998; Floro, 2010).

This paper highlights how the *nature* of employment can affect the economics of households and how *nature* of the household work can affect market outcomes for women. As countries set policy goals of increasing women's labor force participation and decreasing gender gaps in wages and income, policy makers must understand constraints women face both within the market and within the household.

2 Conceptual framework

Our work contributes to two strands of literature on female labor supply in developing countries. One is linked to women's participation in various types of employment; the other is related to household production and time use including overlapping activities. We use an integrated framework which merges two selection processes, labor supply by different sectors or type of employment and time allocation into singular or multiple paid and unpaid activities.

Women's time poverty. A common finding from studies using time use data is that women on average spend more time doing unpaid reproductive work than men and that women have a higher likelihood of being "time poor," or essentially tend to face more strict time constraints (Floro, 1995; Bardasi and Wodon, 2006; Goodwin, Nelson, Harris, Torras, Roach and Wittenberg, 2009; Budlender, 2010). In Budlender (2010), time use data is employed to analyze unpaid care work in seven different developing countries: Argentina, India, Japan, and Korea, Nicaragua, South Africa and Tanzania. In all countries, female gender and the presence of young children in the household were shown to be positively associated with more time spent doing unpaid care work. Work by Floro and Miles (2003) examines specifically the determinants of overlapping, or simultaneous, activities exploring time use data from Australia. They find that conditional on individual income, women spend more time doing overlapping activities than men. Floro and Miles find other factors positively associated with overlapping activities, namely having children, especially young, sick or disabled, education past high school, working at home, and having multiple jobs (Floro and Miles, 2003).

Unpaid work, informal employment and simultaneous activities as coping strategies for income poverty. Exploring the 2000 South Africa Time Use data, Burca and Emel (2009) investigate the determinants of time spent doing certain paid and unpaid work activities and find that being poor increases the amount of time women spend on unpaid work. Wittenberg (2005) using the same data specifically looks at the time allocation patterns of youth and finds that low-income children and youth, particularly females, spend significantly more time doing household chores than higher income groups. Budlender (2010) examines determinants of unpaid care work among adult South Africans and reports that gender, income, race, age, education, and having a child are significant factors.

Poverty in developing contexts concerns particularly informal and agricultural workers (Blackden and Wodon 2006, World Bank 2014). The lower tier of informal employment is often reported to be a last resort for the poorest workers (Fields, 1990; Kucera and Roncolato 2008). These workers are particularly likely to combine the coping strategies engaging into paid and unpaid work simultaneously. Increasing work intensity via overlapping time devoted to paid and unpaid work can be therefore a coping strategy to compensate low income and related low household technologies, inaccessible and/or unaffordable care facilities and poor infrastructure, i.e. limited or no access to electricity and plumbing.

Simultaneous activities as a coping strategy for time poverty. A vast body of literature has explored how unpaid work can constrain women's individual paid work participation. Kes and Swaminathan (2006), in their study of sub-Saharan Africa, find evidence of women's lost paid labor time due to time spent caring for family members with AIDS. Hallman et al. (2006) using Guatemala City data find that a reduction in the price of childcare significantly increased women's hours spent in the paid labour market. In a study of informally self-employed business owners in the townships surrounding Cape Town, Roncolato and Willoughby (2016) discuss how women working in informal employment combine paid and unpaid work. For example, a woman discussed that when her child was born, she had to shift the type of jobs she took on in her computer and design business to less labor-intensive projects. Two other women from the study discussed that they left their jobs working in formal employment due to childcare constraints and started their own home-based businesses with more flexible schedules.

This research implies that due to the nature of certain types of employment women are more easily able to combine paid and unpaid work. This intuition is initially introduced by Boserup (1970) contrasting low-tech agriculture or small own-account and home-based industrial production with large urban factories and supported by recent studies comparing more broadly informal and formal employment (Maloney, 1999, 2004; Mitra, 2005; Chen, Vanek, Lund, Jhabvala and Bonner, 2005).

Time and space flexibility by type of employment. Unlike work in formal employment, which are usually some distance from the place of residence, small-scale agriculture and informal employment activities often take place within or near the home.[1] Women can be active in these labor markets because the flexible hours and nature of the work allow them to take care of children and perform other household reproductive tasks alongside the income earning activity. Even for urban informal employment arrangements such as street vending that may take place a significant distance away from the home, a woman may have more control over work time and/or be able to bring children with her.

[1] The definition of informal employment includes work for a formal establishment without a formal contract or social protection. This is often characterized by home-based piece rate work (Chen, 2012).

Time and space inflexibility is inherent to both formal industry and formal services as the majority of formal jobs in the service sector, i.e. being an administrative assistant in an office building, also take place away from home. Yet, work in formal services is expected to have a lower lack of flexibility given the possibility of working from home in certain high and mid-skill service occupations. Given the possibility of such differences we extend the framework by contrasting not only small agriculture and formal industry, or informal employment and formal one, but also by comparing multiple sectors offering different degrees of time flexibility.

3 South African context

Time constraints created by unpaid work burdens among South Africa women have been documented in a handful of other studies also using the 2000 South Africa Time Use data (Wittenberg 2005, 2009; Antonopoulos and Memis, 2010; Kizilirmak and Memis, 2009; Budlender, 2010). Kizilirmak and Memis (2009) explore the interaction of time and income poverty among South Africa women, finding that women disproportionately bare the burden of income poverty as being poor increases the amount of time women spend on unpaid work.

Female labor supply in South Africa is still impacted by historical legacy of apartheid, when African women were not allowed to work formally and had to hold subsistent jobs (Valodia, 2001). Compared to men, South African women are more likely to engage into informal employment, most often in agriculture and household-related services (Casale and Posel, 2002; Devey et al., 2005; Banerjee et al., 2008; Rodrik, 2008; Radchenko, 2016), paying considerably lower wages compared to formal jobs.

The studies discussed show that South African women face significant time and income constraints and cope with both types of poverty outlined by the conceptual framework. Given that South Africa's informal employment is dominated by the lower tier, hosting the poorest workers with zero reservation wage (Radchenko, 2016), work intensifying is likely to be a solution for women engaged into informal employment. In this context, to compensate for their low income and given the nature of their work, informally employed women and women working in agriculture are expected to be more likely to do simultaneously paid and unpaid work than women employed formally.

Further, since South Africa deindustrialized early and now the service sector comprises the largest share of employment (Rodrik, 2011; World Bank, 2013), the South African context allows to explore intensity of engagement into simultaneous activities for women working in different segments of the formal sector, specifically industry and services.

While the studies using the South Africa Time Use data provide information on personal characteristics associated with more time spent on unpaid household work, there is no information

about how the type of employment effects time allocation. This paper fills in the gap by providing empirical evidence that certain types of employment are associated with women doing paid and unpaid work simultaneously.

4 Data

The individual time allocation data comes from Stats SA's 2000 time use survey. The survey collected data on the household and demographic information of the survey respondents, 54% of which were women, and a diary of how much time the respondent spent on different activities throughout a 24-hour period.[2] A sample portion of the diary is show in Figure 1 below. Demographic and time use data were also collected for a second person over the age of 10 in the household.

Time use data are critical for the investigation of time spent doing paid and unpaid work simultaneously for women working in different segments of labor market or holding different types of job.

4.1 Definitions of employment and work categories

We use the term "paid work" to mean work that is counted for the system of national accounts (SNA) in South Africa. Therefore in addition any income-generating activity, "paid work" also refers to work in subsistence agriculture and time spent collecting fuel and water. We identify an individual's engagement in paid/SNA work according to both the type of activity, i.e. agriculture, services or industry, as well as the type of firm, namely informal or formal.

In the analysis below informal employment is empirically defined as employment either self-employed or as an employee for an informal firm.[3] Officially, in South Africa a firm is defined to be informal if it is not paying taxes or registered with the South African government. The job-based concept recommended by the International Labour Organization (ILO) defines informal employment to also include work for a formal firm without a formal contract. Unfortunately, respondents were not asked to identify if their work fell under a formal contract and therefore this type of informal employment is not captured in our data.

We define small-scale agriculture as work in agriculture for an establishment with 20 or less employees. Note that small-scale agriculture may be formal or informal.

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[2] The day was broken down into half-hour increments from 4am on the day prior to the interview and 4am on the day of the interview (Budlender, Chobokoane and Mpetsheni, 2001).

[3] The status of the firm is determined by the respondents answer to the question "Would you call this business formal or informal?" in the survey.

Work in industry includes the following industrial classifications: mining and quarrying, manufacturing, electricity, gas and water supply, and construction. We define work in formal industry to be work in any of these classifications for a firm that the respondent classifies as formal.

Work in services includes the industrial classifications: retail and wholesale trade, transport, storage and communication services, financial intermediation, insurance, real estate and business service, and community, social and personal services. We likewise define formal services to be work in any of these classifications for a firm, which the respondent identifies as formal.

Unpaid work is defined to include the care of children, sick and elderly as well as household maintenance activities such as cleaning and cooking. Following Budlender, Chobokoane and Mpetsheni (2001), the corresponding categories of the time use survey are "Household maintenance, management, and shopping for own household" and "Care for children, the sick, elderly and disabled for own household."

4.2 Simultaneous activities

A key advantage of South Africa's time use survey is the way in which it collects information about simultaneous activities. Stats SA's survey allows respondents to list three activities per half an hour and does not ask respondents to prioritize these activities (many other time use surveys do).[4] There are several different types of simultaneous activities possible such as doing unpaid work and a leisure activity or a social activity and paid work. However, in this study, the focus is on paid (including subsistence agriculture and collecting of fuel and water) and unpaid work (care or household maintenance) done simultaneously. Moreover, the interest is not merely in paid and unpaid work done literally at the same time, but more broadly the ability to do unpaid work in close proximity (both in terms of time and space) to paid work. Thus, a variable is constructed which measures the time spent doing unpaid work in the half-hour block immediately before or after paid work in the same location. From this point forward, when the term "simultaneous activities" or "simultaneously" is used it refers both to doing paid and unpaid work at the same time and the time spent doing unpaid work immediately following paid work or paid work immediately following unpaid work in the same location, essentially paid and unpaid work sequentially.

[4] The survey also allows respondents to indicate whether activities in this 30 min time block were done at the same time or sequentially (Stats SA 2001, p. 23). Given that the construction of our main dependent variable (see section 5) is defined to include sequential activities and to avoid underreporting, we give any unpaid work reported within the same 30 min time block as paid work, an equal value of 30 minutes.

Figure 1
Diary Section from South African 2000 Time Use Survey

First person diary					
Time period	*Description of activities*	*Code*	*Same time?*	*Location 1*	*Location 2*
	1 to 3 activities per time period		*Yes No*		
09h00			1 2		
to			1 2		
09h30			1 2		
09h30			1 2		
to			1 2		
10h00			1 2		
10h00			1 2		
to			1 2		
10h30			1 2		

Source: South African 2000 Time Use Survey.

4.3 Key explanatory variables

Table 1 provides the descriptive statistics of the key explanatory variables for the sample of employed individuals age 15 to 65, divided into the sample of women and the sample of men. Of the sample women, 18% spent at least some time doing simultaneous paid and unpaid work during the day of the time use survey, whereas only 9% of the men from the sample reported doing any simultaneous paid and unpaid work. In other words, women were twice as likely as men to do simultaneous work.

Of the sample of women, 6% work in small agriculture, 6% work in large agriculture, 9% work in formal industry (manufacturing, construction, utilities or mining), 3% work in informal industry, 35% work in formal services, 15% work in informal services (other than for private households), and 26% work for private households, i.e. as a domestic worker, gardener or security guard. When comparing this to the sample of men, the biggest differences are that 25% of the sample of men work in formal industry compared to the 9% from the female sample and only 5% of the sample of men work in private households, compared to the 26% of the sample of women. For women, 43% reported working in informal employment, compared to 22% of men. Thus, in this sample, women are almost twice as likely to work in informal employment.

Some initial insights are gleaned from Table 2 which shows frequencies and sample means for time spent doing simultaneous paid and unpaid work as a share of total work time. We see that 30% of women working in small agriculture spent some time doing simultaneous activities while only 7% of women working in formal industry and 12% of women working in formal services spent any time doing simultaneous or sequential unpaid and paid work activities.

Table 1
Descriptive Statistics

		Women				Men			
Variable	**Description**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**
Simultaneous activities	Minutes spent doing simultaneous or sequential unpaid and paid work activities in the day of the time use survey	12,26	41,90	0	690	3,85	13,95	0	150
Simultaneous activities positive	SimAndSeq greater than zero	0,18	0,39	0	1	0,09	0,29	0	1
Sim. activities over total work	SimAndSeq over the total minutes spent doing unpaid and paid work in day of the time use survey	0,02	0,05	0	0	0,01	0,03	0	1
Small agriculture	Works in agriculture on a farm with 20 or less employees	0,06	0,23	0	1	0,11	0,32	0	1
Large agriculture	Works in agriculture on a farm with more than 20 employees	0,06	0,24	0	1	0,08	0,27	0	1
Industry (Formal)	Works in manufacturing, mining, construction or utilities, formal	0,09	0,28	0	1	0,25	0,43	0	1
Industry (Informal)	Works in manufacturing, mining, construction or utilities, informal	0,03	0,17	0	1	0,06	0,24	0	1
Services (Formal)	Works in services for a firm, formal	0,35	0,48	0	1	0,33	0,47	0	1
Services (Informal)	Works in services for a firm, informal	0,15	0,36	0	1	0,08	0,27	0	1
Private households	Works in a private household	0,26	0,44	0	1	0,05	0,21	0	1
Other work	Works in some other industry not categorized	0,01	0,11	0	1	0,05	0,21	0	1
Informal	Is employed or self-employed with an informal firm	0,43	0,49	0	1	0,22	0,41	0	1
Formal	Is employed or self-employed with an formal firm	0,57	0,49	0	1	0,78	0,41	0	1
Age	Age	37,38	10,71	15	65	37,29	10,89	15	65
Married	Married or cohabitating	0,52	0,50	0	1	0,63	0,48	0	1
Has at least one child	Has at least one child under the age of 18	0,71	0,45	0	1	0,66	0,47	0	1
Stove (electric or gas)	Household has an electric or a gas stove	0,59	0,49	0	1	0,55	0,50	0	1
Years of school	Highest grade/standard/class passed (education)	7,86	4,03	0	12	7,69	3,99	0	12
Studies after	Has completed studies after leaving school	0,20	0,40	0	1	0,19	0,39	0	1
Observations		2391				2787			
White	Identifies as white	0,12	0,32	0	1	0,12	0,33	0	1
African	Identifies as black	0,73	0,44	0	1	0,74	0,44	0	1
Indian	Identifies as Indian	0,02	0,15	0	1	0,03	0,17	0	1

Table 1 (cont.)

		Women				Men			
Variable	**Description**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**
Colored	Identifies as coloured	0,13	0,33	0	1	0,11	0,31	0	1
Other Race	Identifies as other race	0,00	0,02	0	1	0,00	0,05	0	1
Afrikans	Interview conducted in Afrikaans	0,13	0,34	0	1	0,14	0,35	0	1
English	Interview conducted in English	0,19	0,39	0	1	0,18	0,39	0	1
Isindebele	Interview conducted in Isindebele	0,00	0,06	0	1	0,00	0,06	0	1
Isixhosa	Interview conducted in Isixhosa	0,14	0,34	0	1	0,11	0,32	0	1
Isizulu	Interview conducted in Isizulu	0,21	0,41	0	1	0,20	0,40	0	1
Sepedi	Interview conducted in Sepedi	0,07	0,26	0	1	0,08	0,28	0	1
Sesotho	Interview conducted in Sesotho	0,12	0,33	0	1	0,13	0,33	0	1
Siswati	Interview conducted in Siswati	0,04	0,19	0	1	0,04	0,19	0	1
Setswana	Interview conducted in Setswana	0,08	0,28	0	1	0,10	0,30	0	1
Tsivenda	Interview conducted in Tsivenda	0,01	0,10	0	1	0,01	0,10	0	1
Xitsonga	Interview conducted in Xitsonga	0,01	0,08	0	1	0,01	0,09	0	1
Other language	Interview conducted in another language	0,00	0,02	0	1	0,00	0,02	0	1
Main earner in the household	Individual's income is greater than 60% of household income	0,15	0,36	0	1	0,21	0,41	0	1
Share earner in the household	Individual's income is between 30% and 60% of household income	0,28	0,45	0	1	0,25	0,43	0	1
Low personal income	Individual's income is less than 500 rand per month	0,04	0,19	0	1	0,03	0,16	0	1
Lower mid personal income	Individual's income is between 500 and 1000 rand per month	0,44	0,50	0	1	0,30	0,46	0	1
Upper mid personal income	Individual's income is between 1000 and 5000 rand per month	0,19	0,39	0	1	0,22	0,41	0	1
High personal income	Individual's income over 5000 rand per month or income is unknown	0,33	0,47	0	1	0,45	0,50	0	1
Age/10	Age/10, used to scale variable for structural model	3,74	1,07	1,5	6,5	3,73	1,09	1,5	6,5
Age Sq/100	(Age Sq)/100, used to scale variable for structural model	15,12	8,58	2,3	42,3	15,09	8,69	2,3	42,3
Observations		2391				2787			

Sample: Employed, ages 15-65.
Source: South African 2000 Time Use Survey, own calculations.

Considering informal versus formal employment, Table 2 reveals that 24% of women working in informal employment did some simultaneous paid and unpaid work in the day of time use survey, while only 14% of women working in formal employment reported positive amount of time doing such simultaneous activities. The fifth column in Table 2 shows the sample means of the key dependent variable for women in each type of work. The last column shows the means for the ratio of time on simultaneous activities to total work time for the sample of women who reported a positive about of time doing simultaneous activities.

Table 2
Frequencies and means
Simultaneous activities over total work (S)

	S > 0	S= 0	Total	Share (S>0) %	Mean (S)	Mean (S), (S >0)
Small agriculture	41	96	137	30	0,03	0,09
Large agriculture	32	110	142	23	0,01	0,06
Industry (Formal)	15	194	209	7	0,00	0,06
Industry (Informal)	20	47	67	30	0,04	0,13
Services (Formal)	101	731	832	12	0,01	0,08
Services (Informal)	113	241	354	32	0,04	0,13
Private households	109	509	618	18	0,02	0,09
Other work	7	25	32	22	0,02	0,09
Informal	249	770	1.019	24	0,03	0,11
Formal	189	1.183	1.372	14	0,01	0,08
Total	438	1.953	2.391	19	0,02	0,10

Sample: Employed women, ages 15-65.
Source: South African 2000 Time Use Survey, own calculations.

Digging further into the characteristics of women doing simultaneous paid and unpaid work, some interesting results emerge when disaggregating by race. Interestingly, white women had the highest share with positive amount of time doing simultaneous activities, 22% of white women versus 19% of African women, 11 % of colored women, and 7% of Indian women reported doing simultaneous activities.[5] Note, however, in the first row of Table 3, the frequency is still largest for African women, because of the larger representation of African women in the data (reflective of South Africa's real population). The subsequent rows of Table 3 breaks down the sample of white, African, and colored women who report doing a positive amount of time doing simultaneous paid and unpaid work into the types of employment in which they are engaged. We see that the majority (64%) of white women who report doing simultaneous activities work in

[5] The term "African" is the terminology used in the Time Use Questionnaire, other Stats SA survey's such refer to this population group as "black."

formal services, while the majority of African women doing simultaneous activities work in either informal services (29%) or private households (30%). Colored women doing simultaneous activities are concentrated in formal services (20%), informal services (15%), and private households (24%).

We also see differences according the income. The white women doing simultaneous activities are concentrated in the highest personal income category whereas the black women doing simultaneous activities are concentrated in the lower middle-income category and colored women are more evenly distributed among the income categories. Table 3 gives us a sense of doing paid and unpaid work simultaneously as a strategy in different types of situations.

Table 3
Race and simultaneous activities (in %)

	Positive simultaneous activities			**Whole sample**		
	White	**African**	**Colored**	**White**	**African**	**Colored**
Total number with S>0	64	337	33	285	1747	302
Small agriculture	13	8	18	6	5	8
Large agriculture	0	8	18	1	6	9
Industry (Formal)	3	4	0	7	8	12
Industry (Informal)	3	5	3	2	3	2
Services (Formal)	64	15	21	74	27	35
Services (Informal)	14	29	15	7	18	5
Private households	0	30	24	1	30	28
Other work	3	1	0	4	1	1
Low personal income	3	6	6	3	4	2
Lower mid personal income	5	65	42	5	53	36
Upper mid personal income	8	15	21	6	21	20
High personal income	69	13	24	75	20	37
Uspecified personal income	16	1	6	11	2	5

Source: South African 2000 Time Use Survey, own calculations.

On the one hand it appears to be a strategy for some high income-earning white women working in formal services, for example an academic or business consultant working from a home. This is juxtaposed against a more likely scenario for African women doing simultaneous activities who may be selling baked goods out of her home or working as a street vender in the township.[6] Note that when we compare the race disaggregation for the sample of women reporting simultaneous activities to the whole sample, we see higher shares in the informal employment for each race

[6] More qualitative research is necessary to investigate the means by which women working in private households do simultaneous activities. It is possible that there are women working close by their own home, but the more likely scenario that they bring their own children (babies in particular) with them when they go to the work in a house some distance from their own home.

group. We also see that the distribution is skewed toward lower income categories for each race group as well.

5 Empirical approach

Empirical analysis consists of two parts. First, we break down female employment into different groups associated with different types of paid activities, specifically small agriculture, large agriculture, formal and informal industry and services and private households, and analyze the time women spend doing simultaneously unpaid and paid work as a function of activity type. The objective of this analysis is to test whether the average time women spend doing unpaid reproductive work as a simultaneous activity with paid work varies with different type of paid work activities. The key hypothesis is that there is a higher average time spent on simultaneous activity for women working in the sectors offering higher time flexibility and/or paying low wages.

The second part of the empirical analysis is based on another breakdown of employment type focusing on different type of paid job rather than paid activity, namely formal and informal female employment (see 4.1 for job type definitions). The main hypothesis here is that women spend on average more time doing unpaid household reproductive work as a simultaneous activity if holding informal rather than formal job.

The dependent variable associated with simultaneous work is constructed as a ratio between the total amount of time spent simultaneously doing unpaid reproductive and paid work and the total number of minutes worked (both paid and unpaid). Empirical literature suggests that an appropriate approach to regression models with a fractional dependent variable is the fractional probit or logit model (Papke and Wooldridge, 1996). The advantage of the fractional model is taking into account the bounded nature of the outcome (a fraction is bounded by the unit interval) and handling the extreme values of zeros and ones without any artificial transformation of such values. In spite of the appropriate fit, a fractional model is unsuitable in the event of a marked spike at zero or one related to structural nature of the extreme values. This is the case of our framework where the dependent variable is zero for nontrivial portion of the sample (84%) but is roughly continuously distributed over the positive values. A model fitting over both zero and positive outcomes is inappropriate since the zero values represent the corner solutions and imply a decision to not perform simultaneous activities. Zero and nonzero outcomes are issued therefore from different processes corresponding to the choice to perform simultaneous activities and time allocation decision. Since both are jointly determined, a fractional model would lead to the sample selection problem (Baum, 2008).

A solution to such a problem is the tobit framework,[7] modeling both the choice to perform simultaneous activities and time allocation decisions of women. The tobit model expresses the observed response, time spent doing simultaneous work over total work, *S*, in terms of underlying latent function S_i^* defined for individual *i*:

$$(1) \qquad S_i = \begin{cases} S_i^*, \text{ if } S_i > 0 \\ 0, \text{ if } S_i \leq 0 \end{cases}$$

The latent variables are specific to different parts of the analysis.

5.1 Different types of paid activity and simultaneous work

In the first part of the analysis, the latent variable S_i^* is specified as

$$(2) \qquad S_i^* = \alpha_0 + \alpha E_i + \beta X_i + \varepsilon_i$$

where ε_i is the error term following normal distribution $N(0,\sigma^2)$. E_i is a vector of the dummies corresponding to different employment groups: small agriculture, large agriculture, formal and informal industries and services and private households.

Additionally, we control for individual and household characteristics of person *i* represented by X_i. Among them are several demographic controls, namely age, education, race, language, children and marital status. A variable that captures whether the individual is the primary earner in the household, which is calculated by considering what portion of the household's income comes from the individual's income, is also included.[8] If more than 60% of the household's income comes from the individual he or she is considered a main earner. If 30% to 60% of the household's income comes from the individual, he or she is considered a share earner. Individuals who contribute less than 30% make up the reference group in the regression. Several personal income categories are included, with high income as the reference group. A control is also included for whether or not one's household has a gas or electric stove.

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[7] Stewart (2013) argues that the tobit model is inappropriate in the framework of zero values reported in time diaries and claims that it underperforms the OLS. However, the claim applies to the context where all the agents spend some positive amount of time on a given activity each period of time but might spend zero time on this activity on a specific day of the interview. Given 84% of zeros in our sample as well as the schedule of the survey ensuring relatively even spread of the interviews over the different days of the weak and three rounds of the fieldwork run in February, June and October, it would be wrong to assume that the resulting zeros are measurement errors and all the South African women systematically do some amount of the simultaneous activities. We assume therefore that the zeros represent women's corner solutions, that is the optimal fraction of time spent. In case of "measurement errors" that may be relevant for some women due to randomness of the interviews and a short period covered by it, the corresponding zeros represent the lowest bounds of all the possible values and imply that the true values are censored by zero. This case is also covered by the tobit model which does not differentiate between the corner solutions and censored values.

[8] Given that household and personal incomes are reported in ranges, the midpoint of the range indicated for each category was used when calculating individual income as a percentage of household income.

5.2 Endogeneity

Interpretation of the parameters in (2) requires some caution. Given that we control for income, the differences in coefficients associated with the dummies relating to different women's activities (vector E_i) imply mostly responses of female time allocation to the different degrees of time flexibility offered by the disparate sectors. A threat to the validity of some of the estimators associated with these parameters is endogeneity. Informal activities are of particular concern here since as discussed above, some women choose, or are constrained to work in informal employment because of the possibility of taking care of children and household responsibilities while engaging in an income-earning activity.

The second part of the analysis addresses the issue by breaking down the female employment into formal and informal groups and using the structural approach which allows explicit modeling of the joint mechanisms underlying women's decisions relative to taking income generating informal versus formal job and time allocation between paid and unpaid work.

While the same endogeneity concerns apply to the small agriculture, a similar extension cannot be replicated to investigate further the difference in time allocation between farming women and women working in formal industry or services due to relatively small percentage of women engaged in these activities. Focusing on them and ignoring the rest of the sample would yield a severe selection bias. However, there is much less of a concern with endogeneity from reverse causality with regard to working in agriculture, because it tends to be a longer-term decision. For example, working in agriculture involves choosing the location in which one lives, with more fixed costs (such as property ownership), whereas time allocation decisions are very short-term. This is different from the choice to work in informal or formal employment, as the switch between employment types would not necessarily require moving geographically or acquiring land.

5.3 Informal vs. formal job and simultaneous work

To test empirically the difference in simultaneous working hours of formal and informal female workers, we specify the latent function as

$$S_i^* = \alpha_0 + \alpha I_i + \beta X_i + \varepsilon_i \tag{3}$$

where the key interest is in coefficient related to the dummy $I_{i,}$ which refers to the difference in intensity of simultaneous work between women in informal and formal employment groups. Based on previous research, the coefficient on informal employment is predicted to be positive: women working in informal employment are expected to do unpaid reproductive work alongside paid work and the length of time spent doing these activities simultaneously is expected to be greater among informal female workers.

A standard IV method is inappropriate in the framework of limited dependent variables (LDV) with endogenous binary regressors since it cannot respect nonlinear limited-dependent-variable

nature of the outcomes and fails to incorporate natural restrictions relating to their nonnegative (time devoted to simultaneous activities) or dummy values (selection into informal or formal employment) (Imbens, 2001; Moffitt, 2001). We therefore apply a classical structural approach to modeling endogenous variables in a simultaneous equation systems involving LDV such as tobit and probit type ones (Heckman, 1978; Moffitt, 2001). It consists of using distributional assumptions and maximum likelihood. In our framework it translates into explicit modelling of both a choice to work formally rather than informally and a decision to combine the resulting formal or informal outcome with unpaid simultaneous work. Technically, we extend the tobit model with a probit equation describing the probability of being involved in either formal or informal employment. The approach gives us an explicit way of addressing the endogeneity issue and identifying structural link between simultaneous activities and employment type rather than purely statistical association (Heckman, 1978; Moffitt, 2001). The corresponding structural system of equations is:

$$S_i = \begin{cases} S_i^*, \text{ if } S_i^* > 0 \\ 0, \text{ if } S_i^* \le 0 \end{cases} \tag{4}$$

$$I_i = \begin{cases} 1, \text{ if } I_i^* > 0 \\ 0, \text{ if } I_i^* \le 0 \end{cases} \tag{5}$$

where the latent functions S^*_i and I^*_i are defined as

$$\begin{cases} S_i^* = \alpha_0 + \alpha I_i + \beta X_i + \varepsilon_i \\ I_i^* = \gamma_0 + \gamma Z_i + u_i \end{cases} \tag{6}$$

As previously, S_i describes simultaneous work intensity; X_i and Z_i are the vectors of individual and household characteristics of women impacting intensity of their simultaneous work and allocation into formal vs. informal employment. X_i and Z_i can overlap.

The error terms (ε_i,u_i) follow joint normal distribution $N(0,\sum)$ with zero means and $\sum$ variance-covariance matrix:

$$\Sigma = \begin{pmatrix} \sigma_\varepsilon^2 & \rho\sigma_\varepsilon \\ \rho\sigma_\varepsilon & 1 \end{pmatrix}, \tag{7}$$

σ^2_ε and ρ are respectively the variance of ε_i and correlation between ε_i and u_i.

The system described by (4), (5) and (6) is estimated with the Full Information Maximum Likelihood Estimator (FIML), a standard tool to estimate a system of simultaneous equations relating to LDV. The strength of the full-information structural method is that it explicitly addresses the joint mechanisms underlying women's labor supply under focus and provides efficient estimators (Heckman, 1978). The identification relies on the functional forms of the distributions used

and exclusion variables impacting the selection into informal employment with no direct relationship to time spent on simultaneous activities.

An exclusion variable available in the data is a dummy indicating whether a person has completed any studies after leaving school (only include courses of at least six months duration). Theoretically we anticipate that pursuing some kind of study after leaving school would decrease the probability that the person works in informal employment but have no effect on simultaneous activities other than through the channel of being less likely to be in informal employment. Additional training after finishing school suggests that the person has been certified or trained to be able to some sort work most likely in a formal establishment, given that formal establishments by nature are more likely to require formal training. For example, a person may pursue a six-month course to be a beautician to work in a formal hair salon or course in CPR and first aid to work for a hospital or emergency response team as part of a formal system. Empirical evidence discussed in section 5 supports its validity.

However, the marked presence of the corner solutions, corresponding to no time spent on simultaneous activities leads to a vulnerable model identification in our framework. Given 15% of female workers allocating time simultaneously to paid and unpaid work, the model is then estimated calibrating ρ from the bivariate probit model. The bivariate probit model describes jointly women's decision to allocate time to the paid and unpaid work simultaneously and women's allocation into different types of employment.

6 Results

6.1 Simultaneous activities by different employment types

The results from the first part of analysis are shown in Table 4.[9] Consistent with the theory discussed above, the estimate associated with Small Agriculture variable is positive and highly statistically significant (at 1% level). Recall that in this regression working in formal industry is the reference group, so all other types of employment are listed except for formal industry. The two types of employments with a higher coefficient than Small Agriculture (.129) are Informal Services (.167) and Informal Industry (.157). This particular issue of simultaneous activities within informal employment is considered more rigorously below. Women working in Formal Services also do more simultaneous unpaid and paid work while the difference with Formal Industry is

[9] Given the representative data obtained using exogenous sampling and a structural approach undertaken, we report unweighted estimates (Cameron and Triverdi, 2005). Following Solon, Haider and Wooldridge (2013), we replicated the estimations using the population weights. The results proved to be robust relative to weighting: the weighted estimates including the marginal effects (available on request) are close to the estimates reported while are less efficient.

considerably lower (0.052) implying the probability of and share of time doing simultaneous activities is greater in agricultural and informal employment.

The marginal effects of the covariates estimated at their mean values on the observed outcomes, intensity of simultaneous paid and unpaid work, are shown in columns 2, 3 and 4 of Table 4. The marginal effects of working in small-scale agriculture versus formal industry for a woman is 2.36 percentage points (column 2). Comparing this result to mean for the sample (2%) shown in Table 2, we see that working in small-scale agriculture compared to formal industry doubles the share of time spent doing simultaneous activities. Among the population of women doing simultaneous work (column 3), a woman working in small agriculture, is estimated to have a 2.72 higher percentage point share of time spent doing simultaneous activities than someone in formal industry. Finally, column 4 shows that a woman working in small-scale agriculture is estimated to be 21.6% more likely to spend a positive amount of time doing simultaneous activities than someone working in formal industry. Again the two types of employment with higher probabilities of doing simultaneous activities than small-scale agriculture are informal services (27.9%) and informal industry (26.2%). In column 4 we see that while a woman working in formal services is also more likely to do simultaneous activities than a woman working in formal industry (8.7% marginal effect), the difference in the time allocated is almost two and half times lower as compared to the difference between small agriculture and formal industry.

Due to the positive correlation not taken into account when investigating simultaneous time allocation by various activities, the estimates reported risk to be biased downward, so that the structural parameters are likely to be even higher than the parameters discussed.

In terms of income, results indicate that the lower the women's personal income, the higher amount of time they spend doing simultaneously paid and unpaid labor. This is in line with the conceptual framework of doing simultaneous activities as a coping strategy for income poverty: low-income women may compensate their low budget by increasing domestic production.

Having a stove is associated with a lower amount of time spent simultaneously doing paid and unpaid labor implying that household technologies reduce the homework burden while their inaccessibility pushes women to intensify their work through overlapping paid and unpaid activities.

Table 4
Small agriculture vs. formal industry

	Tobit	Marginal effects		
	Sim. activities over total work	**Full population**	**S>0 Population**	**Probability of doing simulta-neous activities**
Small agriculture	0.129***	0.0236	0.0272	0.216
	(0.0281)			
Large agriculture	0.0903***	0.0165	0.0190	0.151
	(0.0292)			
Formal services	0.0522**	0.0096	0.0110	0.087
	(0.0237)			
Informal services	0.167***	0.0306	0.0352	0.279
	(0.0244)			
Informal industry	0.157***	0.0287	0.0331	0.262
	(0.0326)			
Private households	0.0766***	0.0140	0.0161	0.128
	(0.0241)			
Other work	0.0969**	0.0178	0.0204	0.162
	(0.0444)			
Age	-0.000344	-0.0001	-0.0001	-0.001
	(0.00314)			
Age Sq	0.0000189	0.0000	0.0000	0.000
	(0.0000392)			
Years of school	0.00107	0.0002	0.0002	0.002
	(0.00161)			
Married	0.00680	0.0012	0.0014	0.011
	(0.00997)			
Has at least one child	0.0256**	0.0047	0.0054	0.043
	(0.0120)			
Stove (gas or electric)	-0.0417***	-0.0076	-0.0088	-0.070
	(0.0115)			
Main earner in household	0.000417	0.0001	0.0001	0.001
	(0.0161)			
Low personal income	0.0566**	0.0104	0.0119	0.095
	(0.0252)			
Lower mid personal income	0.0308*	0.0056	0.0065	0.051
	(0.0157)			
Upper mid personal income	-0.0124	-0.0023	-0.0026	-0.021
	(0.0169)			

Table 4 (Cont.)

	Tobit	Marginal effects		
	Sim. activities over total work	**Full population**	**S>0 Population**	**Probability of doing simultaneous activities**
Constant	-0.220***			
	(0.0705)			
σ	0.159***			
	(0.00635)			
N	2391			

Standard errors in parantheses: * p<0.10, ** p<0.05, *** p<0.01.
Note: Reference group for type of employment is formal industry.
Control variables not shown here: Ten language dummies.
Source: South African 2000 Time Use Survey, own calculations.

6.2 Simultaneous activities by formal and informal employment

The results of the structural estimation based on 5.3 and testing whether women working in informal employment spend more time simultaneously doing paid and unpaid labor than women in formal employment are shown in Table 5. Within the sample used in the regressions (employed women ages 15-65), 43% work in informal employment and 57% work in formal employment. The key explanatory variable for this part of the investigation is a dummy variable equal to 1 if the person works in informal employment.

The coefficient on informal employment (.063) is positive and significant at the 1% level, which can be interpreted to mean that a woman working in informal employment is both more likely to spend a positive amount of time doing simultaneous activities and estimated to have a higher share of time doing unpaid and paid work simultaneously than a person working in the formal economy. Columns 2 and 3 display the marginal effects for the full population and for the population of women doing simultaneous activities. Column 4 of Table 5 shows that individuals working in the informal economy are 9.9% more likely to simultaneously do paid and unpaid labor. These results aggregate variation in time spent simultaneously doing paid and unpaid work at the extensive and intensive margins. They are therefore valid in the case of a compositional change of the population of women engaged into simultaneous work.[10]

As discussed in 5.2, interpretation of the estimates is fuzzy due to endogeneity of working in informal employment. To investigate the issue, we first run biprobit regression describing joint engagement of female workers into simultaneous work and informal type of employment. The results are shown in columns 5 and 6 of Table 5. The estimated correlation related to unobserva-

[10] Such changes could be due to wage evolution in the market, technology improvement in domestic production or improvement in early childhood mortality.

ble factors impacting both decisions is 0.226. There are indeed the common unobservable factors impacting positively both engagements.

The structural model extending the tobit framework by the selection equation describing allocation between formal and informal employment, yields 0.018 as the estimate of the marginal impact of informal employment (see column 9 of table 5). This is larger than 0.010 reported by the tobit. Results show that the tobit model slightly underestimates the degree of association between simultaneous work and informal or formal type of employment.

As it follows from the bivariate probit model and as expected, pursuing some kind of study after leaving school would decrease the probability that the person works in informal employment but have no effect on simultaneous activities other than through the channel of being less likely to be in informal employment. The variable is a determinant of the likelihood of informal employment (the estimate of -0.42 is highly statistically significant) but not a determinant of engagement into simultaneous work (the estimate of 0.029 is insignificant both in magnitude and statistically).

The structural estimate yields the difference of about 2% between informal and formal female workers in regards to the intensity of engagement into paid and unpaid work simultaneously. This implies that women engaged into informal employment supply twice as much as women working formally to the simultaneous work. As we discussed above, the engagement into simultaneous work might be related to either a budget or time constraint. Since we control for income, the higher supply to simultaneous work among informally employed workers is likely driven by time constraints. Women engaged into informal employment use the flexibility of their employment to combine unpaid household and care activities with income-earning activities.

As previously, the parameters associated with income and stove support the evidence that women also use the simultaneous activities as a coping strategy with income poverty and low household technologies.

In addition to the explanatory variables of interest, there are a few control variables with significant coefficients worth noting. In line with literature, having at least one child under the age of 18 has a positive significant effect on the intensity of simultaneous work (5% significance level in the regressions shown in the first column on Table 4 and Table 5). Much stronger results would mostly likely be found if a variable for having a child under the age of 6 was included instead. Unfortunately the data did not permit this.

In the controls for race, white is the reference category, and the coefficients on the other categories are negative and statistically significant. Given what is discussed above regarding the slightly higher share of white women doing simultaneous activities this is not surprising. It is important to keep in mind that white women are more likely to be engaged in formal service jobs that allow for telecommuting compared to African and colored women. For the results based on the subsample of only African women see Appendix Table A2.

Table 5
Informal vs. formal employment

	Tobit	Marginal effects			Bivariate probit		Structural model		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Sim. activities over total work	Full population	S>0 population	Probability of doing simultaneous activities	Sim. activities over total work	Informal	Informal	Sim. activities over total work	Marginal effects (Bootstrapped SE)
Informal	0.0628***	0.0104	0.0127	0.099				0.087***	0.018***
	(0.0112)							(0.0115)	(0.0027)
Studies after					0.029	-0.417***	-0.339***		
					(0.094)	(0.094)	(0.093)		
Age/10	-0.0592*	-0.0092	-0.0117	-0.090	-0.189	-0.211	-0.416**	-0.048	-0.010*
	(0.0310)				(0.199)	(0.094)	(0.188)	(0.0306)	(0.0059)
Age Sq /100	0.00767**	0.0012	0.0015	0.012	0.029	0.032	0.059**	0.006	0.001*
	(0.00389)				(0.025)	(0.094)	(0.024)	(0.0038)	(0.0007)
Years of school	0.000632	0.0001	0.0001	0.001	-0.014	-0.072***	-0.076***	0.002	0.0004***
	(0.00159)				(0.010)	(0.094)	(0.009)	(0.0016)	(0.0003)
Married	0.00117	0.0002	0.0002	0.002	0.061	-0.043	-0.074	0.002	0.0004
	(0.00999)				(0.064)	(0.094)	(0.059)	(0.0097)	(0.0019)
Has at least one child	0.0393***	0.0056	0.0075	0.057	0.165**	-0.125*	-0.065	0.0358***	0.007***
	(0.0123)				(0.076)	(0.094)	(0.070)	(0.0122)	(0.0024)
Stove (gas or electric)	-0.0535***	-0.0089	-0.0108	-0.085	-0.330***	-0.160**	-0.138**	-0.049***	-0.010***
	(0.0115)				(0.073)	(0.094)	(0.065)	(0.0114)	(0.0024)
Main earner in household	-0.00636	-0.0010	-0.0012	-0.010	-0.171*	-0.400***	-0.354***	-0.007	-0.001
	(0.0157)				(0.095)	(0.094)	(0.089)	(0.0155)	(0.0029)

Table 5 (Cont.)

	Tobit	Marginal Effects			Bivariate probit			Structural model	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Sim. activities over total work	Full population	S>0 population	Probability of doing simultaneous activities	Sim. activities over total work	Informal	Informal	Sim. activities over total work	Marginal effects (Bootstrapped SE)
Low personal income	0.0240	0.0042	0.0050	0.039				0.027	0.006
	(0.0258)							(0.0254)	(0.0046)
Lower mid personal income	0.0107	0.0017	0.0021	0.016				0.013	0.003
	(0.0152)							(0.0151)	(0.0031)
Upper mid personal income	-0.00783	-0.0012	-0.0015	-0.012				-0.002	-0.0005
	(0.0162)							(0.0161)	(0.0031)
African	-0.110***	-0.0222	-0.0242	-0.195	-0.504***	0.761***	0.773***	-0.098***	-0.020***
	(0.0264)				(0.159)	(0.094)	(0.158)	(0.0259)	(0.0049)
Colored	-0.0889***	-0.0100	-0.0156	-0.108	-0.741***	-0.829**	0.245*	-0.077***	-0.016***
	(0.0224)				(0.273)	(0.094)	(0.149)	(0.0221)	(0.0040)
Indian	-0.186	-0.0125	-0.0272	-0.147	-0.621***	0.242*	-1.067**	-0.189***	-0.039
	(0.0667)				(0.146)	(0.094)	(0.444)	(0.0659)	(0.6026)
English	0.0129	0.0021	0.0026	0.020	0.060	0.157	0.121	0.013	0.003
	(0.0199)				(0.129)	(0.094)	(0.126)	(0.0196)	(0.0040)
Isixhosa	0.0670***	0.0131	0.0145	0.118	0.317**	0.170	0.242*	0.060**	0.012**
	(0.0257)				(0.170)	(0.094)	(0.147)	(0.0253)	(0.0052)
Isizulu	0.0357	0.0062	0.0073	0.058	0.120	0.215	0.133	0.032	0.007
	(0.0254)				(0.166)	(0.094)	(0.142)	(0.0250)	(0.0054)
Other African language	0.0409*	0.0068	0.0083	0.065	0.164	-0.032	-0.071	0.037	0.008
	(0.0244)				(0.159)	(0.094)	(0.136)	(0.0240)	(0.0051)
Constant	-0.0199	-0.0031	-0.0039	-0.030	-0.159	0.313	0.679	-0.047	-0.010
	(0.0638)				(0.402)	(0.094)	(0.377)	(0.0632)	(0.0120)

Table 5 (Cont.)

	Tobit	Marginal Effects			Bivariate probit			Structural Model	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Sim. activities over total work	Full population	S>0 population	Probability of doing simultaneous activities	Sim. activities over total work	Informal	Informal	Sim. activities over total work	Marginal effects (Bootstrapped SE)
σ	0.156***							0.164***	
	(0.00657)							(0.0161)	
ρ					0.226***		0.226***		
					(0.039)		(0.039)		
N	2391				2391	2391	2391	2391	2391

Standard errors in parantheses. * p<0.10, ** p<0.05 *** p<0.01.
Note: Reference group for type of employment is formal employment.
Source: South African 2000 Time Use Survey, own calculations.

7 Conclusion

In South Africa, as in many other developing contexts, women face the challenge of balancing multiple demands on their time with often-limited resources. The analysis of this paper support the argument that women in certain types of employment namely small agriculture and informal employment, combine paid and unpaid work more often and intensively than women working in more formally structured jobs. Doing simultaneous paid and unpaid work can be viewed as a positive non-pecuniary benefit of certain types of employment with higher time and space flexibility or can be seen as a sign of women coping with strict time constraints and limited choices. The results also provide evidence that women use the simultaneous activities as a coping strategy with income poverty and low household technologies.

The results suggest that economic development policies should take into account female patterns of time allocation in order to achieve the policy targets and ensure their beneficial effects to all household members. Specifically, given that women working in small agriculture spend more time on doing paid and unpaid work, agricultural extensification programs should be accompanied by nutritional programs and development of utility infrastructure. Otherwise the programs providing an increase of the size of households' plots can have a negative effect on women's well-being through deterioration of their health and consequent decrease of their household and market productivity.

To the contrary, the effects of the programs targeting development of utility infrastructure can be underestimated without considering time allocation dimension and multitasking pattern. An additional welfare channel in this context is increasing quality of work within informal employment by alleviating care and unpaid household work constraints and consequent decrease of work intensity in particular via a decrease of time spent on paid and unpaid work simultaneously.

Finally, increase in share of informal employment in the labor market may have a particularly negative impact on female workers not only in terms of income earning but also in terms of work intensity given their higher likelihood to engage in simultaneous paid and unpaid activities when holding an informal job. Programs targeting female formal job creation have therefore an additional benefit from the perspective of female time allocation and related household wealth.

A limitation of this analysis is that the focus has largely been on the experience of employment and unfortunately, for many in South Africa today, the experience of unemployment is much more familiar. Future research using time use data should investigate coping strategies of both men and women who desire to work but are unable to find an income generating activity.

The empirical focus of this research is South African women. However, the relevance for policy and future research extends much further. This project has set up a framework for analyzing

spheres often excluded in conventional economic analysis, namely unpaid work and informal employment and has demonstrated the importance and usefulness of time use data, which is still often underutilized in policy-oriented research. Women's time allocation and employment decisions affect not only their own health and well-being but the health and well-being of their families and communities. Future research should consider how this methodology can be applied to other contexts so that similar questions can be investigated surrounding women's labor time within and outside the household.

Appendix

Table A1
Descriptive statistics

		Informal				Formal			
Variable	**Description**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**
Simultaneous activities	Minutes spent doing simultaneous or sequential unpaid and paid work activities in the day of the time use survey	14,41	45,41	0	690	4,68	19,65	0	630
Simultaneous activities positive	SimAndSeq greater than zero	0,20	0,40	0	1	0,10	0,30	0	1
Sim. activities over total work	SimAndSeq over the total minutes spent doing unpaid and paid work in day of the time use survey	0,02	0,06	0	0	0,01	0,03	0	1
Small agriculture	Works in agriculture on a farm with 20 or less employees	0,07	0,26	0	1	0,09	0,29	0	1
Large agriculture	Works in agriculture on a farm with more than 20 em-	0,03	0,16	0	1	0,09	0,28	0	1
Industry (Formal)*	Works in manufacturing, mining, construction or utilities,	0,00	0,00	0	0	0,25	0,44	0	1
Industry (Informal)*	Works in manu., mining, constr. or uti., informal	0,14	0,35	0	1	0,00	0,00	0	0
Services (Formal)	Works in services for a firm, formal	0,00	0,00	0	0	0,49	0,50	0	1
Services (Informal)	Works in services for a firm, informal	0,36	0,48	0	1	0,00	0,00	0	0
Private households	Works in a private household	0,38	0,49	0	1	0,04	0,18	0	1
Other work	Works in some other industry not categorized	0,02	0,14	0	1	0,04	0,19	0	1
Woman	Identifies as female	0,63	0,48	0	1	0,39	0,49	0	1
Man	Identifies as male	0,37	0,48	0	1	0,61	0,49	0	1
Age	Age	38,12	11,56	15	65	36,97	10,43	15	65
Married	Married or cohabitating	0,50	0,50	0	1	0,62	0,48	0	1
Has at least one child	Has at least one child under the age of 18	0,67	0,47	0	1	0,69	0,46	0	1
Stove (electric or gas)	Household has an electric or a gas stove	0,42	0,49	0	1	0,63	0,48	0	1
Years of school	Highest grade/standard/class passed (education)	6,31	3,92	0	12	8,44	3,87	0	12
Studies after	Has completed studies after leaving school	0,08	0,27	0	1	0,25	0,43	0	1
Observations		1626				3552			

Table A1 (Cont.)

		Informal				Formal			
Variable	**Description**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**
White	Identifies as white	0,03	0,18	0	1	0,16	0,37	0	1
African	Identifies as black	0,88	0,32	0	1	0,67	0,47	0	1
Indian	Identifies as Indian	0,01	0,08	0	1	0,04	0,19	0	1
Colored	Identifies as coloured	0,08	0,27	0	1	0,13	0,34	0	1
Other Race	Identifies as other race	0,00	0,02	0	1	0,00	0,04	0	1
Afrikaans	Interview conducted in Afrikaans	0,09	0,29	0	1	0,16	0,37	0	1
English	Interview conducted in English	0,08	0,28	0	1	0,23	0,42	0	1
Isindebele	Interview conducted in Isindebele	0,01	0,08	0	1	0,00	0,05	0	1
Isixhosa	Interview conducted in Isixhosa	0,17	0,38	0	1	0,10	0,30	0	1
Isizulu	Interview conducted in Isizulu	0,26	0,44	0	1	0,17	0,38	0	1
Sepedi	Interview conducted in Sepedi	0,08	0,28	0	1	0,08	0,26	0	1
Sesotho	Interview conducted in Sesotho	0,15	0,35	0	1	0,11	0,32	0	1
Siswati	Interview conducted in Siswati	0,03	0,18	0	1	0,04	0,19	0	1
Setswana	Interview conducted in Setswana	0,11	0,31	0	1	0,08	0,28	0	1
Tsivenda	Interview conducted in Tsivenda	0,01	0,10	0	1	0,01	0,10	0	1
Xitsonga	Interview conducted in Xitsonga	0,01	0,09	0	1	0,01	0,08	0	1
Other language	Interview conducted in another language	0,00	0,00	0	0	0,00	0,02	0	1
Main earner in the household	Individual's income is greater than 60% of household income	0,09	0,29	0	1	0,23	0,42	0	1
Share earner in the household	Individual's income is between 30% and 60% of household income	0,28	0,45	0	1	0,26	0,44	0	1
Low personal income	Individual's income is less than 500 rand per month	0,06	0,23	0	1	0,02	0,14	0	1
Lower mid personal income	Individual's income is between 500 and 1000 rand per month	0,63	0,48	0	1	0,25	0,43	0	1
Upper mid personal income	Individual's income is between 1000 and 5000 rand per month	0,19	0,39	0	1	0,21	0,41	0	1
High personal income	Individual's income over 5000 rand per month or unspecified	0,13	0,33	0	1	0,52	0,50	0	1

Table A1 (Cont.)

		Informal				Formal			
Variable	**Description**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**
Age Scaled	Age/10, used for structural model	3,81	1,16	1,50	6,50	3,70	1,04	1,50	6,50
Age Sq Scaled	(Age Sq)/100, used for structural model	15,87	9,25	2,25	42,25	14,75	8,32	2,25	42,25
Observations		1626				3552			

*Manufacturing, construction, mining or utilities. Sample: Employed, ages 15-65.
Source: South African 2000 Time Use Survey, own calculations.

Table A2
Small agriculture vs. formal industry –
Sample of only African women

	Tobit	Marginal effects		
	Sim. activities over total work (1)	**Full population (2)**	**S>0 population (3)**	**Probability of doing simultaneous activities (4)**
Small agriculture	0.114***	0.0220	0.0246	0.1876
	(0.0343)			
Large agriculture	0.0744**	0.0143	0.0160	0.1222
	(0.0345)			
Formal services	0.0492*	0.0095	0.0106	0.0809
	(0.0296)			
Informal services	0.156***	0.0301	0.0336	0.2569
	(0.0288)			
Informal industry	0.159***	0.0307	0.0342	0.2613
	(0.0381)			
Private households	0.0724**	0.0140	0.0156	0.1191
	(0.0282)			
Other work	0.139**	0.0269	0.0300	0.2292
	(0.0585)			
Age	0.000580	0.0001	0.0001	0.0010
	(0.00379)			
Age Sq	0.000000194	0.0000	0.0000	0.0000
	(0.0000473)			
Years of school	0.000281	0.0001	0.0001	0.0005
	(0.00183)			
Married	0.000499	0.0001	0.0001	0.0008
	(0.0117)			
Has at least one child	0.0167	0.0032	0.0036	0.0274
	(0.0145)			
Stove (gas or electric)	-0.0385***	-0.0074	-0.0083	-0.0633
	(0.0128)			
Main earner in household	-0.0215	-0.0042	-0.0046	-0.0354
	(0.0225)			

Table A2 (Cont.)

	Tobit	**Marginal effects**		
	Sim. activities over total work (1)	**Full population (2)**	**S>0 population (3)**	**Probability of doing simultaneous activities (4)**
Low personal income	0.0472	0.0091	0.0102	0.0775
	(0.0307)			
Lower mid personal income	0.0346*	0.0067	0.0074	0.0568
	(0.0192)			
Upper mid personal income	-0.0118	-0.0023	-0.0025	-0.0194
	(0.0208)			
Constant	-0.347***			
	(0.0941)			
σ	0.167***			
	(0.00758)			
N	1747			

Standard errors in parenthesis, * p<0.10, ** p<0.05, *** p<0.01.
Control variables not shown here: Ten language dummies.
Source: South African 2000 Time Use Survey, own calculations.

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Tax-reforms, normal and actual working hours and welfare in the beginning of the 20th's Denmark

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Abstract

We estimate a labor supply function and the impact of tax-reforms on men and women's labor supply using normal and actual working hours. The data stem from the Danish Time-Use Surveys in 2001 and 2008/09 which include information from stylized survey questions and time-use diaries. The results suggest that the wage-rate effects are larger when using normal working hours compared to actual working hours, and that income effects are less sensitive to working hour measures. We also find that the associations between marginal tax rate and normal and actual working hours are smaller for men and women satisfied with their leisure time than for unsatisfied men and women. Lastly, an increase in the normal labor supply was greater for the tax-reform treated group than for the control group, while increase in the actual labor supply was smaller for the treated group. The last findings are not significant, however, probably due to a small number of observations.

JEL-Codes: J22, C33

Keywords: Labour supply, Time allocation, Panel data

1 Background

The economic literature studying how labor supply responds to economic incentives continues to produce very different results. Even the latest wave of studies applying very sophisticated estimation techniques repeats this tradition of not being very conclusive (see e.g. Smith et *al*., 2003, Saez et *al*., 2012, Klevin & Schultz, 2014). This is unfortunate in general and in particular for active policy makers and governments, because labor supply is a very important political issue in (almost) all modern welfare states. And any government would like to know how the supply of labor can be influenced.

One reason for the inconclusiveness of the literature could be that the estimations of wage rate and income effects are assumed to be data dependent, see e.g. Klevmarken (2005) and Juster & Stafford (1991) for time-allocation measure issues in general. Hence, information on normal working hours stemming from labor force surveys and tax authorities do not take every day deviations in working time into account. Applying time-use data improves the analysis of labor supply by explicitly including competing leisure time activities and home production, which is found of particular importance for women's labor supply. From a productivity point of view actual working hours are also more appropriate to use than contracted and normal working hours (Bonke, 2014).

The aim of this paper is to study tax effects on labor supply considering normal and actual working hours controlling for various observable characteristic.

The data used here stem from two Danish Time-Use Surveys, where the first one was conducted in 2001 (DTUS-01) and the next one in 2008/09 (DTUC). Both surveys were based on random samples for the entire adult population and included stylized information on normal working hours as well as diary information on actual working hours for both spouses in a family. Besides socio-economic information from the surveys information on personal income and household income, educational background, etc. are from administrative registries at Statistics Denmark.

In the next paragraph the overall hypothesis referring to the dependence of the working hour information on labor supply is raised. Then follows in chapter 3 an introduction to the Danish tax-system in the two years under consideration, and chapter 4 presents the data used in the analyses. Some descriptive statistics are to be found in chapter 5, and in chapter 6 is a presentation of the model used in the empirical analyses. The results are shown in chapter 7, and the conclusion given in chapter 8.

2 Labor supply and different measures of working hours

The purpose of this paper is to analyze labor supply using different measures of working hours while relying on the assumption that the choice of specification is important for what determines labor supply. Hence, because of progressive income taxes, see chapter 3, higher income is expected to imply that the actual working time is significantly smaller than the normal (scheduled or agreed) working time, compared to what applies to lower marginal tax rates where the difference is expected to be smaller. In order to illustrate whether this could be the case, Table 1 shows the difference between normal and actual working hours for employees with high gross incomes – 3rd and 4th quartile – and employees with low gross incomes – 1st and 2nd quartile. The table shows that employees with high incomes have a significantly greater difference between their actual and normal working hours than employees with low incomes. The relative difference however, is not significantly different for the two income groups.

Table 1
The relationship between normal and actual working hours for different income groups, 2008/09

Gross income	Difference between normal and actual working time (Hours per week)	Relative difference between normal and actual working time (Percent)
1st and 2nd quartile	6.416	0.9134
3rd and 4th quartile	8.554*	0.8436

Source: Danish Time Use Survey 2001 and Danish Time Use and Consumption Survey 2008/09, own calculations.

The significant difference between actual and normal working hours for people with high and low incomes illustrates that labor supply will be determined by different factors, depending on the specification of working hours and the business cycle (Bonke, 2014). In addition, actual working hours are considered to be a better measure of the actual production input. It also provides a better illustration of labor productivity in different sectors, and how it has evolved over time.

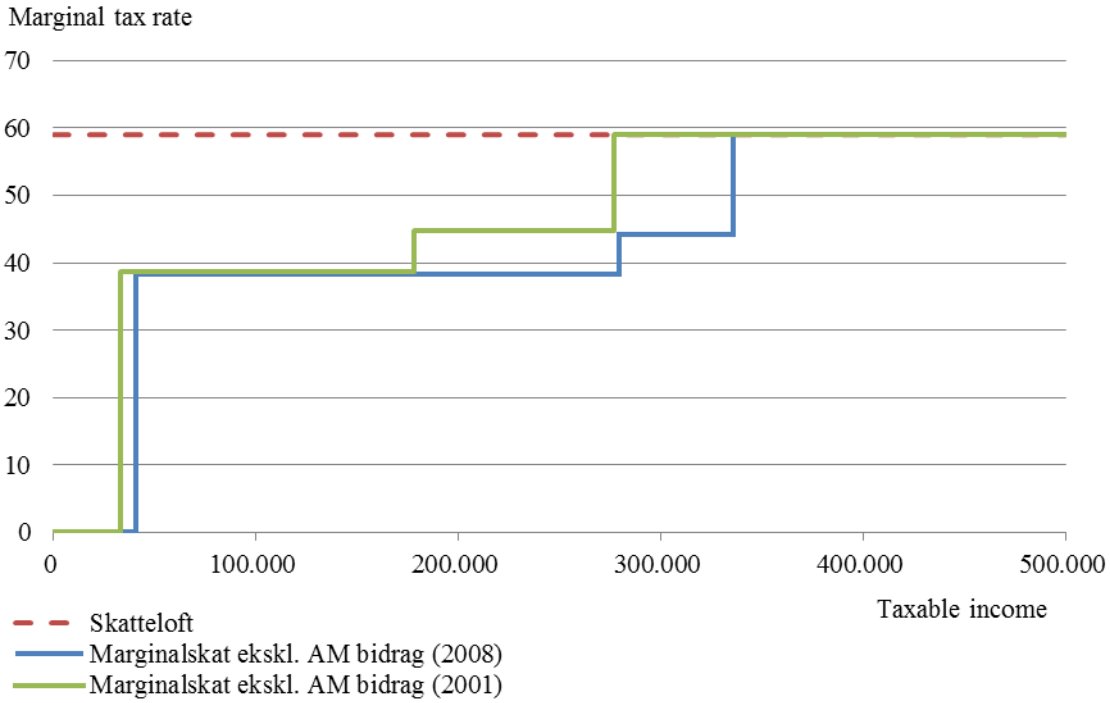
3 The Danish tax system

Denmark has a substantial income tax along with a widespread system of public benefits, which together contribute to a large redistribution between different income and age groups.

With many benefits decreasing with the size of taxable income, some people have a very high marginal tax rate despite having a relatively low income. However, the Danish tax system is also progressive, which means that the marginal tax rate is greater for high-income earners. Further, there is no tax deduction for married people because of individual income taxation in Denmark.

During the last ten years a number of reforms have aimed at reducing marginal tax rates. In particular, between the two survey years 2001 and 2008, two major tax reforms have been carried out: "The spring package" in 2004 and "Lower tax on income" in 2007. Both reforms have been aimed at reducing marginal tax rates on earned income through an increase in deductions (incl. the earned income tax deduction) and income limits for the middle and top tax brackets. The structural reform from 2007 also changed the geographic division of Denmark by dissolving the counties and transforming the different county tax rates to a uniform health contribution of 8 percent while at the same time reducing the "bottom" tax rate.

Figure 1
Marginal income tax rate, 2001 and 2008



Source: Danish Time Use Survey 2001 and Danish Time Use and Consumption Survey 2008/09, own illustrations.

Denmark has three income tax brackets. The income limit for the lowest tax bracket was 33,400 DKK in 2001 and 41,000 DKK 2008. Income above this limit was subject to a tax rate (municipality tax, county tax in 2001, the health contribution in 2008 and state tax) of 38.8 and 38.3 percent. The next tax bracket contained income above 177,900 DKK and 279,800 DKK and were subject to tax rates of 44.8 and 44.3 percent in 2001 and 2008 respectively. The last and highest tax brackets contained incomes above 276,900 DKK and 335,800 DKK

and were subject to a maximal tax rate of 59.0 percent (the tax ceiling). Adding the labor market contribution of 8 percent, the maximal tax rate was 63.4 and 63.0 percent in 2001 and 2008 respectively, see Figure 1.

The marginal tax rate is also affected by the size and design of a number of transfers, such as unemployment benefits, social assistance, housing assistance and daycare subsidies. You could also include commodity taxes, VAT and other taxes outside the income tax system when calculating the effective tax rate, see Jacobsen Kleven & Thustrup Kreiner (2007). This is however not the case in this paper since these taxes are not considered to be crucial for the actual and normal labor supply.

4 Data

We use data from Statistics Denmark's registries as well as the Danish Time Use Panel Survey 2001–2008/09 (DTUP), which is a merged dataset of The Danish Time Use Survey 2001 and The Danish Time and Consumption Survey 2008/09, both drawn randomly among 18–74-year-olds from administrative registers held by Statistics Denmark. Respondents in 2001 were asked to also participate in 2008/2009 - up to the age of 74 years - by giving diary information on the same weekday and weekend day.

In the Danish time-use surveys in 2001 (DTUS-01) and 2008/09 (DTUC) the respondents were asked about their household composition, educational background, personal income and household income, etc. as well as about their own and their partner's (if relevant) normal working hours in primary as well as secondary employment, including whether they have a fixed amount of working hours. Furthermore, DTUS-01 and DTUC contain diaries which are filled out by the respondent and his or her partner on the same weekday and weekend day. The time required for a given activity in the course of a day then becomes the sum of 10 minute sequences, where these activities occur, and the weekly time consumption becomes the sum of 5 times the weekday time and 2 times the weekend time. The calculated working hours are hereafter referred to as the actual working time.

2,739 and 6,091 interviews were conducted in 2001 and 2008/09 respectively. A detailed description of the DTUS-01, DTUC and DTUP can be found in Bonke (2002) and Bonke & Fallesen (2010) where the response rates among others are specified.

Information from Statistics Denmark's registries on personal characteristics, educational background and income has been added to both of the time-use surveys. The respondents' hourly wages, which are included in the calculation of the labor supply, also originate from these registries by dividing the annual gross income by the "normal" number of weekly hours from DTUS-01 and DTUC or from Statistics Denmark's wage registry. In other words the wages reflect an average hourly wage – assuming the employees have a fixed amount of weekly or monthly working hours.

In order to obtain the net wage we need the marginal tax rate, which is calculated on the basis of the Danish tax system including deductions, capital income and income from shares for the individual respondents. The effective marginal tax rate is then found by adding the phase-out of public benefits in the form of housing assistance and daycare/preschool subsidies.

The estimations also contain the so-called virtual income, see Blundell & MaCurdy (1999) and Klevmarken (2005), which is defined as the respondents' non-labor income. The virtual income is thus calculated as the sum of capital income, income from shares, unemployment benefits and other public benefits after taxes, i.e. virtual income A. The virtual income for respondents who are married also includes the spouse's net income, i.e. virtual income B, remembering that there is no tax deduction for married people in Denmark.

5 Descriptive statistics

Tables 2 shows the descriptive statistics for the two data sets (2001 and 2008/09). Overall, there is, as mentioned earlier, a negative difference between the actual and normal working hours, as the number of normal working hours seems to be overestimated. It is also clear from looking at the tables that the difference is greater in 2008/09 than in 2001 for both sexes, due to the fact that the number of normal working hours has increased while the number of actual working hours has decreased. In addition, the difference between the actual and normal working hours is greater for women than for men. Women thus worked 4.9 and 7.0 hours less than their normal working time in 2001 and 2008/09 respectively.

Looking at the average income level for the respondents, men earned significantly more than women in both 2001 and 2008. The average gross wage for men was 338,000 DKK in 2001, while being 264,000 DKK for women. The corresponding net income was 236,000 DKK for men and 181,000 DKK for women. The same pattern exists in 2008, where men had an average gross income of 430,000 DKK, and women had an average gross income of 333,500 DKK. While net income amounted to 302,000 and 242,000 DKK The gross income for both sexes and men's net income increased by 27-28 percent from 2001 to 2008, while women's net income increased by 34 percent during 2001-2008.

The tables above also show that the virtual income B is higher than the virtual income A, which obviously is because B only includes married respondents and therefore also their spouse's net income, even if they do not work. The virtual income B also is higher for women than for men, due to the fact that men have a higher average net income than women. Furthermore, women's average virtual income B is higher than their own average net income.

Table 2
Descriptive statistics for 25-64 year olds in 2001 and 2008/09

	Men				Women			
	2001		2008/09		2001		2008/09	
	Avg.	Std. dev.	Avg.	Std. dev.	Avg.	Std. dev.	Avg.	Std. dev.
Weekly normal working hours	40,11	8,88	42.20	9.25	36.30	7.89	35,40	6,32
Weekly actual working hours	38,52	16,33	36.82	21.13	29.28	19.31	30,52	16,03
Gross income (DKK per year)	338.03	194.59	429.86	253.27	333.50	153.58	263.59	91.00
Net income (DKK per year)	236.20	157.46	302.20	165.53	242.09	166.15	180.66	104.16
Virtual income A (DKK per year)	223.28	178.03	189.52	150.90	268.80	453.31	275.45	318.46
Virtual income B (DKK per year)	281.96	184.73	269.92	119.45	367.35	517.42	369.25	364.18
Marginal tax rate	0,51	0,10	0.50	0.128	0.45	0.11	0,47	0,09
Effective marginal tax rate	0,51	0,10	0.50	0.126	0.46	0.11	0,47	0,09
Children (share)	0.40	0.49	0.46	0.50	0.50	0.50	0.45	0.50
Children: Ages 0 to 2 (daycare)	0.11	0.31	0.11	0.31	0.11	0.31	0.11	0.32
Children : Ages 3 to 6 (preschool)	0.15	0.35	0.15	0.36	0.15	0.36	0.17	0.38
Children: Ages 7 to 17	0.30	0.46	0.34	0.47	0.39	0.49	0.35	0.48
Observations	522		1368		585		1352	

Source: Danish Time Use Survey 2001 and Danish Time Use and Consumption Survey 2008/09, own calculations.

A partial reason for the small difference between the marginal and the effective marginal tax rate is the low share of respondents who have children in the daycare or preschool age groups (14 and 15 percent of the observations in 2001 and 2008/09). Thus there are relatively few people who are potential beneficiaries of subsidies and housing assistance, which are phased out for higher-income taxpayers and create the difference between the marginal and the effective marginal tax rate. The share of respondents who had children aged 0 to 17 years was slightly higher in 2008/09 than in 2001.

The number of observations is smaller than the total dataset because the sample is limited in terms of age and only includes respondents, who reported their actual and normal working hours.

6 Empirical model

In order to estimate the correlation between the effective marginal tax rate and the number of working hours we use a standard OLS, taking into account the virtual income A, marital status, children and whether the respondent is an employee or self-employed. In accordance with several other papers, for example the basic model is the following:

$$(1) \qquad h_i = \beta_0 + \beta_1 mtax_i + virtuelindkomstA_i + \beta x + \varepsilon_i$$

Where *h* is the number of weekly working hours (normal or actual), $mtax_i$ is the effective marginal tax rate and ***x*** contains the personal characteristics mentioned above.

Since both the effective marginal tax and the virtual income are influenced by the number of working hours, the regressions have also been carried out using the natural logarithm of these two variables. The coefficients however do not significantly change, nor is the interpretation of the results different to that given by using the marginal net wage rate, see Klevmarken (2005), instead of the marginal tax rate used here. An interpretation of the labor supply function above, as a result of a behavioral model which assumes utility maximization can be found in Blundell and MaCurdy (1999).

In order to analyze the coordination and influence between spouses, model 1 is expanded in order to include the spouse's effective marginal tax rate $mtax_{sp,i}$ and other individual and family related characteristics. The regression is then carried out for respondent's who are married.

$$(2) \qquad h_i = \beta_0 + \beta_1 mtax_i + \beta_2 mtax_{sp,i} + virtuelindkomstB_i + \beta x + \alpha z + \varepsilon_i$$

The individual characteristics ***x*** include self-assessment of health in general, satisfaction with the amount of leisure time and whether the respondent is self-employed. Family related characteristics ***z*** include the age of the youngest child (using age intervals of 0 to 2, 3 to 5 or 7-17).

7 Results

7.1 Taxes, working hours among spouses

Table 3 shows the estimation results for married male respondents. The effective marginal tax rate is negative and significant with regard to normal working hours and actual weekend working hours. Lowering the effective marginal tax rate with 1 percentage-point is thus associated with an increase in the normal working week of 3.0 to 4.6 minutes and an increase in the actual weekend working hours of 1.6 minutes. The spouse's marginal effective tax rate is insignificant for both the normal and actual working week, while the weekly virtual income B is significant and negative for the actual working time, indicating that an increase in the non-

labor income or the spouse's income of 1,000 DKK leads to a decrease in the actual working time of 0.38 to 0.39 hours per week.

Table 3
Multivariate OLS estimation for married men, 2008/09

	Normal weekly working time			Actual weekly working time		
Effective marginal tax rate[1]	-5.14**	-7.38**	-7.73**	-7.31	-4.28	
	(2.52)	(2.41)	(2.41)	(5.78)	(3.69)	(3.71)
Spouse's effective marginal tax rate[1]	0.12	-0.84	-0.87	-1.27	-0.67	-0.72
	(1.46)	(1.39)	(1.39)	(3.34)	(2.13)	(2.13)
Virtual income B (1,000 DKK, per week)	0.05	-0.09	-0.06	-0.49	-0.39*	-0.38*
	(0.15)	(0.14)	(0.14)	(0.34)	(0.22)	(0.22)
Self-employed		5.49***	5.45***		4.60**	4.55**
		(1.16)	(1.16)		(1.78)	(1.78)
Satisfaction with leisure time		-1.83***	-1.90***		-0.83**	-0.85**
		(0.24)	(0.25)		(0.37)	(0.38)
Health		-2.03***	-2.05***		-1.04*	-1.04*
		(0.38)	(0.38)		(0.58)	(0.59)
Positive actual working time		0.31	0.35		43.44***	43.46***
		(0.80)	(0.80)		(1.23)	(1.23)
Youngest child: Age 0-2			-1.75*			-0.07
			(1.02)			(1.58)
Youngest child: Age 3-5			-0.75			-1.03
			(1.10)			(1.69)
Youngest child: Age 6-17			0.66			0.46
			(0.70)			(1.08)
Constant	44.86***	57.89***	58.31***	42.78***	9.82**	9.91**
	(1.39)	(2.11)	(2.19)	(3.18)	(3.24)	(3.36)
R^2	0.01	0.11	0.12	0.01	0.60	0.60
Observations	864					

Standard error in parenthesis, * p<0.1, ** p<0.05, *** p<0.001.
[1]Coefficients/100 express an hourly change per week from a 1-percent change in the tax rate.
Source: The Rockwool Foundation Research Unit, Danish Time Use and Consumption Survey 2008/09, own calculations.

Table 4
Multivariate OLS estimation for married women, 2008/09

	Normal weekly working time			Actual weekly working time		
Effective marginal tax rate[1]	15.44***	11.77***	11.41***	9.12*	1.04	0.16
	(2.23)	(2.14)	(2.13)	(5.46)	(3.37)	(3.35)
Spouse's effective marginal tax rate[1]	-1.88**	-1.84**	-1.75*	-4.87**	-1.85	-1.54
	(0.94)	(0.90)	(0.89)	(2.32)	(1.41)	(1.40)
Virtual income B (1,000 DKK, per week)	-0.08**	-0.07**	-0.07**	-0.13**	-0.01	-0.01
	(0.03)	(0.02)	(0.02)	(0.06)	(0.04)	(0.04)
Self-employed		4.65**	4.46**		8.25**	7.96**
		(1.86)	(1.86)		(2.94)	(2.92)
Satisfaction with leisure time		-1.61***	-1.72***		-0.27	-0.51
		(0.20)	(0.20)		(0.32)	(0.32)
Health		-1.42***	-1.52***		-0.96**	-1.17**
		(0.29)	(0.29)		(0.46)	(0.46)
Positive actual working time		1.95**	1.80**		36.88***	36.67***
		(0.60)	(0.60)		(0.95)	(0.95)
Youngest child: Age 0-2			-2.28**			-3.76**
			(0.87)			(1.37)
Youngest child: Age 3-5			-1.80*			-5.61***
			(0.94)			(1.49)
Youngest child: Age 6-17			0.56			-1.02
			(0.54)			(0.85)
Constant	30.20***	39.96***	41.07***	27.74***	3.32	6.39**
	(1.11)	(1.67)	(1.74)	(2.73)	(2.64)	(2.74)
R^2	0.07	0.17	0.19	0.02	0.64	0.65
Observations	903			903		

Standard error in parenthesis, * p<0.1, ** p<0.05, *** p<0.001.
[1]Coefficients/100 express an hourly change per week from a 1-percent change in the tax rate.
Source: The Rockwool Foundation Research Unit, Danish Time Use and Consumption Survey 2008/09, own calculations.

The dummy-variable indicating that the observations have a positive weekly working time is still significant and positive for the actual working hours on both weekends and weekdays. On

average men whose youngest child is 0-2-year's old work 1.8 hours less per week. The other family related variables are insignificant for men.

Table 4 shows the estimation results for married women. In general, a larger part of the family and spouse related variables are significant for women than for men. Contrary to men, the effective marginal tax rate is only significant for the normal working week, where a tax change of 1 percentage-point corresponds to an increase in working time of 6.6 to 9.2 minutes. The tax rate is also significant for the actual working hours, except on weekends, but only when individual characteristics are excluded. The effective marginal tax rate thus varies significantly across measures of working hours, except when the individual and family characteristics are included. In this case it is not possible to reject the hypothesis that the coefficients are the same.

The spouse's marginal effective tax rate correlates negatively with the normal weekly working hours. This is surprising since a higher marginal tax rate for the spouse is expected to increase the working hours of the respondent whose tax rate is now relatively lower. However, the virtual income B is also affected by the spouse's marginal effective tax rate as it includes his/her income after tax, i.e. an increase of 1000 DKK is associated with a decrease in the normal and actual weekly working time of 4.2-4.8 and 7.8 minutes, which might out-weight the direct negative impact of the spouse's marginal effective tax rate on the working hours.

Women's working time is negatively affected by having children aged 0-2 and 3-5 (daycare and preschool age groups), and the coefficient is significantly higher for women than for men. Women with their youngest child aged 0-2 thus have a normal and actual working week of 2.3 and 3.8 fewer hours. For the normal working time, the effect is greatest for 0-2 year-olds, while the effect is largest for 3-5 year-olds with regard to the actual working time.

Men's normal working time is also negatively affected, whereas their normal working time is unaffected by having children aged 0-2. Carling & Flood (1997) also found that Swedish fathers to minor children reduced their actual working time while their normal working hours were the same as for men who didn't have younger children.

As in previous regressions, the inclusion of the variable for positive actual working time increases the explanatory power significantly for the actual working hours

Table 5
Multivariate OLS estimation for married respondents by leisure satisfaction, 2008/09

	Normal weekly working time (hours per week)				Actual weekly working time (hours per week)			
	Men, unhappy (1-3)	**Men, happy (4-6)**	**Women, unhappy (1-3)**	**Women, happy (4-6)**	**Men, unhappy (1-3)**	**Men, happy (4-6)**	**Women, unhappy (1-3)**	**Women, happy (4-6)**
Effective marginal tax rate[1]	-10.75**	-5.53**	15.18**	11.30***	-16.30**	-0.05	-1.76	1.74
	(5.07)	(2.77)	(5.24)	(2.39)	(7.65)	(4.24)	(6.88)	(3.88)
Spouse's effective marginal tax rate[1]	0.97	-1.19	-0.71	-2.08**	3.93	-1.74	-1.81	-1.32
	(2.79)	(1.63)	(2.13)	(1.01)	(4.21)	(2.50)	(2.80)	(1.63)
Virtual income B (1,000 DKK, per week)	-0.42	-0.00	0.09	-0.09***	-1.29**	-0.21	-0.45**	0.00
	(0.39)	(0.16)	(0.15)	(0.02)	(0.58)	(0.24)	(0.20)	(0.04)
Self-employed	7.27**	4.44**	6.73**	2.56	11.02**	2.23	11.70**	4.25
	(2.31)	(1.37)	(2.95)	(2.58)	(3.49)	(2.10)	(3.87)	(4.20)
Satisfaction with leisure time	-1.10	-2.39***	-1.92**	-1.35***	-0.25	-1.17*	-1.49*	-0.98*
	(0.77)	(0.45)	(0.66)	(0.33)	(1.15)	(0.69)	(0.87)	(0.54)
Health	0.81	0.20	1.90	2.09**	43.45***	43.10***	36.80***	36.71
	(1.55)	(0.95)	(1.39)	(0.68)	(2.34)	(1.45)	(1.83)	(1.11)
Positive actual working time	-3.51*	0.40	-4.65**	-0.52	3.13	0.13	-3.79*	-3.65**
	(1.82)	(1.27)	(1.72)	(1.04)	(2.75)	(1.95)	(2.26)	(1.70)

Table (Cont.)

	Normal weekly working time (hours per week)				Actual weekly working time (hours per week)			
	Men, unhappy (1-3)	**Men, happy (4-6)**	**Women, unhappy (1-3)**	**Women, happy (4-6)**	**Men, unhappy (1-3)**	**Men, happy (4-6)**	**Women, unhappy (1-3)**	**Women, happy (4-6)**
Youngest child: Age 0-2	-1.05	0.19	-1.68	-1.56	0.61	-0.58	-6.50**	-5.09**
	(2.01)	(1.33)	(1.88)	(1.13)	(3.03)	(2.04)	(2.46)	(1.84)
Youngest child: Age 3-5	0.11	1.11	-1.41	1.41**	3.94*	-0.37	-3.00*	-0.38
	(1.44)	(0.81)	(1.30)	(0.61)	(2.17)	(1.25)	(1.71)	(0.98)
Youngest child: Age 6-17	54.64***	48.00***	34.70***	31.93***	13.10**	3.90	10.25**	2.46
	(3.75)	(2.01)	(3.53)	(1.51)	(5.65)	(3.08)	(4.64)	(2.45)
Constant	0.10	0.07	0.17	0.12	0.63	0.60	0.71	0.63
	244	620	211	693	244	620	211	693

Standard error in parenthesis, * p<0.1, ** p<0.05, *** p<0.00. 1Coefficients/100 express an hourly change per week from a 1-percent change in the tax rate.
Source: The Rockwool Foundation Research Unit, Danish Time Use and Consumption Survey 2008/09, own calculations.

7.2 Taxes working hours and satisfaction with leisure time for spouses

Table 5 divides the regression of tax rates on working hours by satisfaction with leisure time based on the assumption that a greater level of satisfaction is associated with a smaller labor supply effect from the marginal tax rate. Hence, there is no problem here about using subjective information on both side of the equation, see Hamermesh (2004). Satisfaction with leisure time is assessed on a scale from 1 to 6 - from not at all satisfied to very satisfied. The respondents are defined as "unhappy" if they answered 1-3, and "happy" if they answered 4-6.

As shown in Table 3, the effective marginal tax rate is significant and negative with regard the normal working time of men, however, the coefficient numerically higher among men who are not satisfied with their current level of leisure time (Table 5). Conversely, the effective marginal tax rate is positive and significant with regard to the normal working time of women, and the coefficient is greater for the unhappy observations. As expected the "effect" of the marginal tax rate is smaller among respondents who are satisfied with their current level of leisure time.

In contrast to earlier, the effective marginal tax rate is significant and negative for the actual working time among men, who are unhappy with their current level of leisure time. At the same time, this coefficient is significantly greater than that for the normal working hours, which shows that the actual adjustment of working hours is greater than the adjustment of the "normal" working hours, when the tax rate changes. The spouse's effective marginal tax rate is significant for the normal weekly working time of women who are satisfied with their current level of leisure. Thus, an increase in the spouse's tax rate is associated with a decrease in the actual working time of 0.1 hours per week.

Likewise, the virtual income B is significant and negative for the normal working hours among women who are satisfied with their current level of leisure, as well as for the actual working time among men and women who are dissatisfied with their current level of leisure. The effect is greatest for the actual working time among men who are unhappy with their current level of leisure, where an increase in the virtual income B of 1,000 DKK per week is equivalent to a reduction of the actual working time of 1.3 hours.

7.3 Tax change and working hours, 2001-2008/09

In order to analyze whether there is a link between tax cuts and labor supply, i.e. whether the substitution effect is greater than the income effect, we use information from respondents who participated in both DTUS-01 and DTUC-08/09 and thus were a part of the Danish Time Use Panel (DTUC). We then divided the respondents into two groups based on their taxable income in 2001. The first group – the treatment group – had an income, which would be affected by the tax changes. The second group – the control group – had an income, which would

not be affected by the tax changes, see Kleven & Schultz, 2014 for another study of taxable income responses to Danish tax Reforms.

Table 6
Normal and actual working hours for the treatment and control group (income groups), 2001-2008/09

	Low income groups		High income groups	
	T-group [1]	C-group[2]	T-group [3]	C-group[4]
Normal working hours, 2001	37.74	36.33	37.57	39.23
Actual working hours, 2001	33.03	32.78	40.52	34.75
Normal working hours*	1.491 (0.495)	1.182 (0.775)	1.694 (1.119)	1.359 (0.365)
Actual working hours*	0.508 (1.472)	0.872 (1.974)	-3.677 (3.281)	0.136 (1.003)
Normal and actual working hours*	0.983 (1.524)	0.311 (2.134)	5.371 (3.200)	1.223 (1.055)
Observations	190		285	

Note: Taxable income in 2001: [1]177,900-279,800 DKK [2]33,400-177,889 DKK [3]279,800-335,800 DKK. [4]>335,800 DKK, *Difference 2001-2009 .
Source: Danish Time Use Survey 2001 and Danish Time Use and Consumption Survey 2008/09, own calculations.

Since the tax reductions in 2001-2009 were only relevant to incomes from 177,900 to 335,800 DKK, Table 7.5 is divided into two groups: the first contains respondents with an annual taxable income of 177,900-279,800 DKK while the second contains respondents with an annual taxable income of 279,800-335,800 DKK. The former was affected by the change in income levels for the top and middle tax bracket and the latter was affected by both the change in income levels and the reduction of the top tax rate. We then compare the first group to a control group containing respondents who had a taxable income of less than 177,900 DKK. The second group is compared to a control group containing respondents who had a taxable income of more than 335,800 DKK.

As shown in Table 6, respondents with taxable income of less than 279,800 DKK in 2001 (Low income group) increased their normal labor supply by more than one hour per week, while the actual labor supply increased by 0.5 hour per week. Furthermore, the increase in the normal labor supply was greater for the treated group than for the control group, while the increase in the actual labor supply was smaller for the treated group. In total this suggests, that the difference between the normal and actual labor supply was greater for the treatment group than for the control group. A similar pattern is found for respondents with taxable income above 335,800 DKK, where the difference between the normal and actual labor supply was also greatest for the treatment group.

Since none of these differences are significant, it is, however, not possible to conclude that the tax reforms have affected the supply of labor for the respondents. This conclusion should be used with caution due to the limited number of observations.

Table 7
Normal and actual working hours for the treatment and control group (men and women), 2001-2008/09

	Men		Women	
	T-group [1]	**C-group[2]**	**T-group [1]**	**C-group[2]**
Normal working hours, 2001	39.63	42.04	36.17	35.72
Actual working hours, 2001	38.71	39.75	30.82	29.71
Normal working hours*	2.256	2.469	0.942	0.345
	(.771)	(.577)	(.529)	(.361)
	(.744-3.768)	(1.336-3.602)	(-.097-1.981)	(-.364-1.055)
Actual working hours*	0.565	0.562	-0.853	0.075
	(2.075)	(1.267)	(1.764)	(1.258)
	(-3.507-4.638)	(-1.924-3.049)	(-4.314-2.609)	(-2.394-2.543)
Normal and actual working hours*	1.691	1.907	1.795	0.271
	(2.172)	(1.410)	(1.775)	(1.279)
Observations	216		259	

[1]Taxable income in 2001: 177,900-335,800 DKK.
[2]Taxable income in 2001: 33,400-177,889 and +335,800.
Source: Danish Time Use Survey 2001 and Danish Time Use and Consumption Survey 2008/09, own calculations.

It is expected that men and women respond differently to tax cuts. Table 7 also shows that both the normal and actual working hours have increased more for men than for women while the increase in the normal working time has been greater than the increase in the actual working time for both sexes. Comparing the change in normal and actually working time for respondents whose tax rate was reduced and respondents whose tax rate was constant there is no significant difference for either men or women probably due to the relatively few respondents in the survey.

8 Conclusion

The purpose of this project was to study the relationship between family circumstances and normal versus actual family labor supply in order to understand how the income tax and welfare system frame the economic incentives for the supply of working hours given different measures of working hours.

The data stemmed from two Danish Time-Use Surveys conducted in 2001 and 2008/09 – including re-interviews giving a balanced panel DTUP – which included stylized information on normal working hours as well as diary information on actual working hours for both spouses in a family. The surveys were merged with information about income, educational

attainment etc. from administrative registers at Statistics Denmark making it possible to calculate spouses' marginal tax rates and their virtual incomes in the two years under consideration.

The results suggest that the effective marginal tax rate is significant and negative for men's normal working hours and actual weekend working hours. A tax reduction of 1 percentage points is therefore associated with an increase in normal working hours and actual weekend working hours. The effective marginal tax rate is insignificant for the actual weekday working hours and for the overall actual weekly working hours. For women we do not find a significant relationship between the effective marginal tax rate and the actual working hours, while the normal working hours are positively correlated with the effective marginal tax rate. This indicates, that the coefficient of the effective marginal tax rate varies across measures of working hours, even though it is a surprising finding, that the overall actual weekly working hours is unaffected by the effective marginal tax rate.

If we compare these Danish results to those from Sweden obtained in 1993, there are large similarities. Both papers find that the correlation between the effective marginal tax rate/net wage rate and working hours is larger for the normal weekly working hours than for the actual weekly working hours for both sexes.

We also found that the effective marginal tax rate is significant and negative for the actual working time among men, who are unhappy with their current level of leisure time, and that it is significantly greater than that for the normal working hours. The spouse's effective marginal tax rate is significant for the normal weekly working time of women who are satisfied with their current level of leisure.

As there were two major tax reforms reducing the marginal tax rate and increasing the highest tax bracket during the period of 2001-2008/09, we investigated the impact on working hours by dividing the respondents into a group affected by the reforms and an unaffected group. We found that the increase in the normal labor supply was greater for the treated group than for the control group, while the increase in the actual labor supply was smaller for the treated group. This suggests, that the difference between the normal and actual labor supply was greater for the treatment group than for the control group.

We also found that both the normal and actual working hours have increased more for men than for women while the increase in the normal working time has been greater than the increase in the actual working time for both sexes. However, there is no significant difference for either men or women for which reason it is not possible here to conclude that there is a correlation between a change in the marginal tax rate and the normal and actual working time of men and women.

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Time for shopping – Social change of time use for shopping activities 1990-2012

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Abstract

The daily shopping, so activities that aim at the acquisition of mainly household-related goods, food and services, is a constituent element of modern consumer society. In addition to the monetary aspect of the extraction of goods and services from the market, the temporal aspect weighs in as opportunity costs for shopping activities, . Against the background of a postulated social change in recent decades that has led to an increase in the daily pace of life, the question is whether and how these accelerating changes have also transformed the time patterns of everyday shopping, such as shopping frequency and shopping time. To investigate this question, data of the time use surveys of the Federal Statistical Office from 1991/92, 2001/02 and 2012/13 is analyzed. The results suggest that both the average shopping frequency as well as the average shopping duration has increased during that period of time. It is discussed how these results are consistent with the hypothesis of an extensive social acceleration.

JEL-codes: D01, C13,C40, J22

Keywords: Time-Use, Shopping Activities, Cohort Analysis, Sequence Analysis, Social Change, Social Acceleration, German Time Use Survey

1 Introduction

Shopping – the market shaped mediated acquisition of goods and services for private use (see Rosa/Lorenz (2009)) – can be considered as a constitutive element of a functioning economic system in modern consumer society. In this sense, shopping activities are to be understood as a link between the economic spheres of production and consumption. At the same time they represent an important facet of everyday household organization.

In addition to such monetary resources, shopping activities require the use of time resources, particularly in the coordination with other activity demands of everyday life. So time can be regarded as an additional possibility-structuring factor that can determine the opportunities and restrictions of shopping activities. In this context the phenomenon of time poverty (see Reisch/Bietz (2014)) appears to be relevant, which is considered as a new element of increasing relevance of modern society. The so-called theory of social acceleration (Rosa 2009) argues that in late modern society especially the increased speed of everyday activities represents a determinative aspect. So far, in this context, temporal aspects of working time (see Merz/Burgert (2004)) or leisure activities (see Kloas (2001)) have been studied. For example, Merz and Burgert (2004) have found in an empirical study of the temporal change of working time arrangements that several working episodes a day and working hours at the end of the day have increased since the early 1990s. So far, empirical studies of the social change of time use for shopping activities are hardly available. The studies of Hufnagel (2004) and Grossmann (2007) are aimed to to identify different household managing styles by combining time use of shopping activities with time use for other household related activities like cleaning, etc.. They make use of a cluster-analytical methodology for the determination of household managing styles in 2001/02 (see Hufnagel (2004)). Findings on change in the time use of shopping activities cannot be inferred from these studies, because time use for shopping activities is subsumed under clusters encompassing several different activities.

If one looks on economic research literature, one finds little dealing with time use for shopping, which seems a central element in economic processes. Recently, some research by Hurst and collegues seems to try to incorporate time use data into their theorizing about labor force (Hurst 2016, Aguiar/Hurst 2015), but actually they do focus on leisure time use, not on shopping activities.

Against this background, the present paper deals with the question of how time spent on shopping activities has changed in recent decades in Germany and how this change can be interpreted as a facet of social acceleration in the framework of Rosa's theory of an unfolding high-speed society.

2 On the theory of high-speed society and its application to shopping activities

The approach taken by Hartmut Rosa's theory of social acceleration focuses on changes in social time structures. Rosa claims that the logic of structural and cultural changes of modernity can only be adequately understood if the analysis of change processes in technology, economy and social institutions like education or labor systems is supplemented by a temporal perspective (see Rosa (2009)).

Social acceleration, as a significant time dimension of modernization, is a key differentiator between modern and post- or late modern societies (see Wajcman (2008)). Acceleration is an inherent feature of rationalization (costs and barriers in economic production system are reduced thereby production of goods is achieved in shorter time periods), differentiation (production processes and paralleled by professionalization is underline specialization which allows faster goods and services supply) , individualization (as people are freed form social normative preconditions to achieve accepted social status, they can change their education or marital status in a much faster way) e, and finally instrumental domestication of nature (by overriding sustainability aspects of taking into account slow ecological ressources development, consumption of natural ressources is faster than its recovery) (see Rosa (2009)).

Rosa distinguished three interlocking acceleration processes in social change: Technological Acceleration, Acceleration of Social Change and Acceleration of everyday pace of life (see Rosa (2010)).

Among technological acceleration Rosa subsumes the speed changes due to technological progress of transportation, communication and production. So, over 20^{th} century transportation speed increased by a factor of 10^2 and the communication speed by a factor of 10^7 (see Geißler (1999)). Catalyzed through technical innovations, this particular form of social acceleration has far-reaching consequences for social reality (see Rosa (2009)):

„For example, the "natural" (…) priority of space over time in human perception (…) seems to have been inverted: in the age of globalization of the Internet, time is increasingly conceived as compressing or even annihilating space. Space, it seems, virtually "contracts" and loses its significance for orientation in the late modern world. Processes and developments are no longer located, and locations become "non-lieux", without history, identity, or relation." (see Rosa (2009, p.82))

The deeper causes of technological acceleration in late modern society can be found in the logic of market-oriented economy. (Working) time is an important factor of production, so time savings lead to profit maximization. This inherent logic of capitalist economies finds its idealized expression in Benjamin Franklin's well-known equation: Time is money. Thus, in the context of a competitive market economy, time projections with regard to the introduction of new technologies are of profit-maximizing significance: "when time is money, then faster

is better" (see Adam (2004, p.39)). These functional mechanisms of growth-oriented systems imply a steady acceleration of the cycle of production, distribution and consumption, and thus explain the restless competition for productivity-enhancing technological acceleration (see Rosa (2009)). "Thus, social acceleration in general and technological acceleration in Particular is a logical consequence of a competitive capitalist market system." (see Rosa (2010)).

While technological acceleration can be understood as a acceleration process within society, acceleration of social change can be characterized as an acceleration process of society itself. The underlying idea is that the change rate of social change itself accelerates. This accelerated rate of cultural and social innovations results in a phenomenon that Hermann Lübbe (2009) called the contraction of the present: The acceleration of social change is therefore defined by rising decay rates of reliability of experiences and expectations and the consistent contractions of that period, which can be referred to as presence (see Rosa (2009)).

The causes of the acceleration of social change can be found in a central structural principle of postmodern societies – namely in functional differentiation. Such a differentiation of society into functional subsystems like professional subgroups with specific norms of entry and certification , different systems of educational training tracks results in an increase of societal complexity and ultimately in a growing contingency of the living environment (see Treibel (2006)). There arise constantly new labor market sectors, new forms of social relations and new types of social identities.

The process of acceleration of the pace of life can be regarded as an acceleration process at the individual level. This acceleration process refers to the increasing speed of actions and experiences in everyday life (see Rosa (2009)). An accelerated pace of life thus implies an increasing number of experience and action episodes per unit of time. This particular acceleration process appears to be in a paradoxical relationship with the process of technological acceleration. Since technological acceleration implies a decrease in the need of time for everyday processes and actions, the consequent increase in available free time should lead to a decrease in the daily pace of life (see Rosa (2009)).

However, cultural factors relating to the ideals of modernity play a decisive role and swing round the extension of available time in the direction of an increased pace of life. Rosa argues that in the course of secularization the conceptions of a good, fulfilling and happy life have changed: "To taste life in all its heights and depths and in its full complexity becomes a central aspiration of modern man." (see Rosa (2010)). The growing openness of human life experience is accompanied by the subjective desire of seeking to achieve more actions in ever shorter intervals of time. According to Rosa (2009), this need drives individuals to respond more quickly to different courses of action – in some sense have quicker decisiveness and action – which will result in accomplishing more endeavors within a period of time. This contributes to an increased speed in pace of everyday life.

"The options offered always outgrow those realizable in an indivdual's life; or, in Blumenberg's terms, the perceived time of the world (*Weltzeit*) and the time of an individual life (*Lebenszeit*) dramatically diverge for individuals in the modern world. Acceleration of the pace of life appears to be a natural solution to this problem: if we live twice as fast, if we take only half the time to realize an action, goal, or experience, we can double what we can do within our lifetime. Our "efficiency", the proportion of realized options to potentially realizable options, doubles." (see Rosa (2009, p.91))

The consequent acceleration of everyday pace of life thus can be regarded as a response to the conception of a "good" life, as a life rich of experiences and realized options.

Interaction of the Acceleration Processes

Technological acceleration through innovations leading to faster and more convenient auto mobility and communication do also transform patterns of every day life organization . Based on faster social exchanges by fastercommunication and mobility new labor market sectors, new patterns of social interaction and new forms of social identity evolved, that lead to life orientations and action evaluations under high time pressure (see Rosa (2009)). This is typified in the so called "slippery-slope" phenomenon:

„[T]he capitalist cannot pause and rest, stop the race, and secure his position, since he either goes up or goes down; there is no point of equilibrium because standing still is equivalent to falling behind, as Marx and Weber pointed out. Similarly, in a society with accelerated rates of social change in all spheres of life, individuals always feel that they stand on a slippery slope: taking a prolonged break means becoming old-fashioned, outdated, anachronistic in one's experience and knowledge, one's equipment and clothing, one's orientations, and even one's language." (Rosa 2009, 88)

In this sense, actors in postmodern societies are always trying to keep up with the increasing speed of social and technological change in order to prevent the loss of potentially valuable opportunities. This would result in pressured tendency towards realizing more options in the same amount of time.

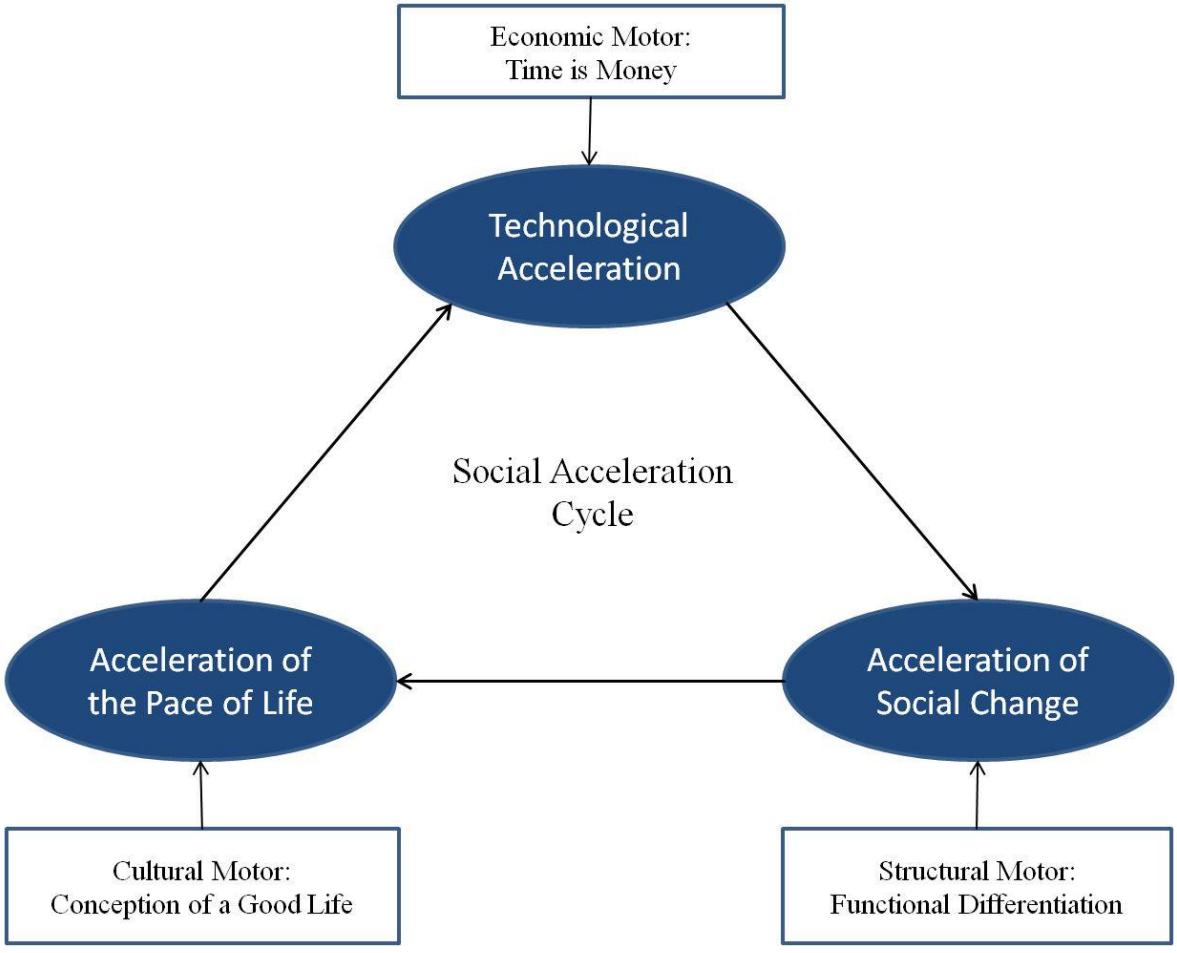
Technological acceleration in turn, can be understood as social response to the perceived problem of time poverty (caused by the acceleration of the daily pace of life). Within Rosa's theory technological l changes arise due the motivation to reduce the time needed for everyday activities and therefore decrease the perceived time pressure or stress. So an accelerated life pattern is not only pushed by technological changes but also pushes technological changes towards acceleration by saving time by means of more efficient communication, transportation and access to goods (Rosa 2009).

In summary, the acceleration cycle can be illustrated through the causal diagram in figure 1: The economic motor, the capitalist principle of competition, results in technological acceleration. This in turn creates new forms of social structure with increasing speed and thus determines the acceleration of social change. Furthermore the acceleration of social change is

driven by the structural motor of functional differentiation. It seems to get a clear and concrete meaning of Rosa's concept of "structural motor" in contrast to technological changes. It seems that he thinks of structural changes for example in educational training systems, which for example is pushed by the EU wide Bologna process of harmonization of educational tracks and certification. One side effect is, that in this process a multitude of specialized educational tracks are institutionalized, accompanied by shorter educational training time.

This in turn leads to an acceleration of the individual pace of life, which is also driven by the cultural motor, the conception of a good life as a life rich of experiences and realized options. The resulting problem of time poverty finds its solution again in the process of technological acceleration – the acceleration cycle closes.

Figure 1
Acceleration cycle



Source: Rosa 2009, p.93.

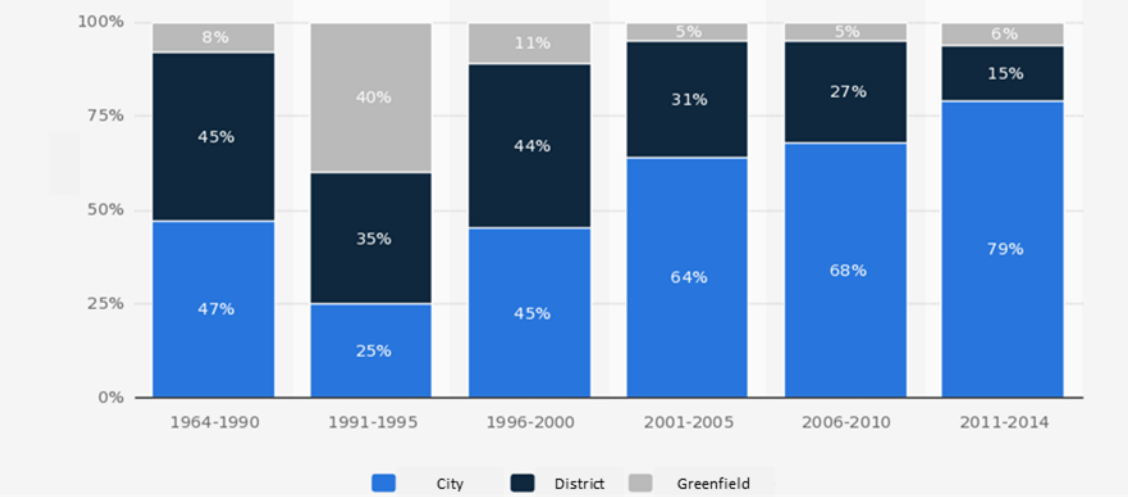
Change of the Structural Context of Shopping Activities

Since the presented theory of social change in the direction of a high-speed society refers to temporal changes of everyday activities and generally postulates an increasing pace of life, it

also implies changes in the time use of shopping activities. So the question is posed, whether we could observed structural changes in a period of social change of the German society which is assumed to reflect acceleration processes to relevant for shopping activities.

First, one can observe, that purchase access to products and commodites is expanded not only by increased number of different products but also by the interaction of improved mobility with the concentration and extension of shopping facilities. While concentration and extension of shopping facilities is facilitated by establishing them to urban peripheries with large area access, this shopping opportunities could got accessed only by individualized mobility with automobiles. If one looks at how the locations of shopping centers have developed since the 60s, one may find that the expansion of shopping centers to peripheral areas ("Greenfield") has been promoted since the early 1990s (see figure 2).

Figure 2
Distribution of shopping centers in Germany from 1964 to 2014



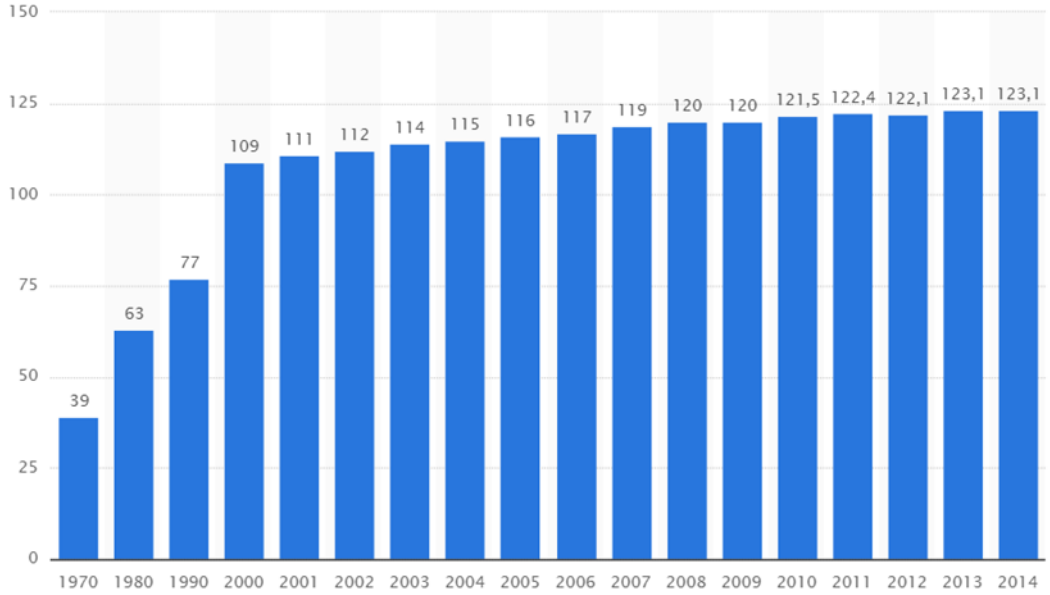
Source: EHI Retail Institute © Statista 2016.

Towards the end of the 1990s, one can identify an increased expansion of shopping centers in the city, which additionally facilitates the access to the product range, especially in combination with the expansion of the public transportation infrastructure.

Also relevant in this context is the fact that the retail space in store retailing, which may be regarded as an indicator for the variety and quantity of offered goods (see figure 3), steadily increased between 1970 and 2000, but in particular, experienced significant growth between 1990 and 2000. From 2000 on, only small gains in retail space can be observed.

In addition to economic technological structural changes, changes in the social and legal framework of closing times are relevant for the time use for shopping activities. Looking at the history of closing time regulations in Germany, one can observe a tendency towards deregulation since the end of the 1950s (see table 1).

Figure 3
Sales area of retail trade in Germany
from 1970 to 2014 (given in million square meters)



Source: HDE © Statista 2016.

Legally the store opening times were mainly expanded in 1996 and then again in 2003. Overall, this resulted in retail shops being opened longer than 6 pm, which widened the temporal scope in which households are able to carry out their shopping activities.

In this respect, one can divide this social development in the Federal Republic of Germany into three stages. The first phase is characterized by a strong regulation of store opening times and can be dated to 1957 to 1996, whereby one has to consider that by extending the opening times with the "Long Thursday" a certain de-regulation already begun 1989. With the law of 1996, the opening times were extended to 8 pm. From 2003 onwards, opening times have been extended to 8 pm on Saturday. Finally, in 2007 the legislative competence was shifted to the "Länder" and opening times were extended to 24 hours a day (with Rhineland-Palatinate, Saarland and Saxony as exceptions).

In a long social phase (from beginning to the midth of the 20th century), households had to base their everyday shopping at relatively tight timeframes. These restrictions have been reduced particularly marked in 1996 and then in 2003 and 2007.

Table 1
History of the Legal Regulation of Store Opening Hours in Germany

19th Century	Stores are generally opened seven days a week between 5 am and 11 pm.
October 1, 1900	First legal regulation of closing hours in the German Empire. Stores may open on weekdays (Monday to Saturday) from 5 am to 9 pm. Convention: Stores close at 8 pm. Special permits for groceries, kiosks and bakeries.
1919	New legal regulation. Stores may open on weekdays between 7 am and 7 pm. Sunday as closing day.
November 28, 1956 (effective since 1957)	New legal regulation: „Gesetz über den Ladenschluss“ Stores may open from Monday to Friday between 7 am and 6:30 pm and on Saturdays until 2 pm.
July 17, 1957	New legal regulation: „Long Saturday“ On first Saturday of the month stores additionally may open until 6 pm.
October, 1989	New legal regulation: “Long Thursday” Stores may open until 8:30 pm on every Thursday.
November 1, 1996	Stores may open on weekdays between 6 am and 8 pm and on Saturdays until 4 pm.
March 13, 2003 (effective since July 1, 2003)	New legal regulation: Opening prohibitions for stores: - Monday to Saturday from 8 pm to 6 am - Sundays and public hollidays Exceptions and special rules: - Stores in railway stations, airports and in certain tourist destinations - Up to four sale open Sundays per year are possible
June 30, 2006	The German parliament approves the federalism reform. Legislative competencies regarding store closing hours are given to the “Länder”. The “Länder” can adapt closing hours to the needs of the regional population by their own regulations. Opening hours between the “Länder” are equalized. The following rules were applied in 2006/2007 (with the exception of North Rine Westphalia, where the rules applied since 2013): - Stores were allowed to open all around the clock from Monday to Friday (in all of the “Länder” except Rhineland-Palatinate, Saarland and Saxony, where stores were only allowed to open between 6 am and 10 pm) - Also stores were allowed to open all around the clock on Saturdays (in all “Länder” except Rhineland-Palatinate, Saarland, Saxony and Bavaria (6am to 10pm) and North Rine Westfalia (from midnight to 10 pm))

Source: https://de.wikipedia.org/wiki/Ladenöffnungszeit.

Due to an enhanced attitude of demand, which is aimed at the realization of as many options as possible, it can be presumed that the time use for shopping activities varied considerably in these phases of change. It can be assumed that, with the omission of opening time restrictions after 1996 and after 2003 and 2007, daily shopping activities have become more frequent (hypothesis 1). In the sense of acceleration theory it can also be expected that the expanded time available for shopping have led consumers to carry out their shopping activities with shorter duration (hypothesis 2).

Rosa’s approach is largely oriented on cross-transformation phases, which capture the societies’ behavior over the whole population range. In this conception of social change, however,

he ignores change processes, which are carried by the succession of generations according to Karl Mannheim's (1928) concept. Generations are socially defined by "generation experiences", i.e. historical events that are experienced similarly in a formative development time of childhood and youth. In this sense, social change unfolds as a result of generation layers, which for example are determined by joint birth cohort.

3 Data and Methods

The theory of a high-speed society postulates changes in the time use for everyday activities and thus also implies changes in time use for shopping activities. To verify these statements one needs longitudinal time use data, whereby the collection of such data at best appears to be adequate by means of a diary method (see Schulz/Grunow (2007)). In addition, a database is required, in which such diary data of time use have been collected at different points of time within the relevant time historic section.

In this sense, the German Time Use Surveys (GTUS) of the Federal Statistical Office represent an adequate data basis. In these surveys the actual time use is captured by means of the diary method and thus they provide information about how much time is spent for which activities of everyday life and at what time during the day certain activities are carried out (see Maier (2014)). The data were collected on the basis of representative samples over the course of an entire calendar year. As these time use surveys were repeated in the years 1991/92, 2001/02 and 2012/13, they continue to provide a basis for the investigation of social change of time used for daily activities.

All members of a household within the sample that were at least 10 (GTUS 2001/02 and GTUS 2012/13) or 12 years old (GTUS 1991/92) were asked to document their personal daily routine with respect to the activities carried out in their own words into a standardized diary at two (GTUS 1991/92) or three day a week (GTUS 2001/02 and 2012/13). Here, the duration of each activity has been captured in 5 minutes (GTUS 1991/92) or in 10 minutes intervals (GTUS 2001/02 and 2012/13) (see Ehling (2004)). Then, for the purpose of comparability, the activities, which were described by respondents in their own words, were categorized by the Federal Statistical Office on the basis of a differentiated activity list (see Ehling (2004)).

Here a differentiated classification scheme of the daily activities has been created, which allows the investigation of the time use for very specific activities, such as shopping activities. In this paper exclusively traditional shopping activities, not conducted by telephone or internet, are investigated. Accordingly, for German Time Use Survey of 1991/1992, 2001/2002 and 2012/2013 following activity codes are collapsing into our dependent variable "shopping activities":
GTUS 1991/1992: code 050 "
Shopping mainly for housekeeping domain/housekeeping secor

", code 150 *"Shopping mainly for craftsmanship/artisanal sector"*

GTUS 2001/2002: code 361 "*shopping"*

GeTUS 2012/13: code 461 *shopping* (Since the variables age, year of birth and period/time are linearly determined by each other, a complete isolation of the individual effects is only possible if one factor is replaced by exogenous data as historical time series or attitude impressions. In this study, these data were not available and the time series with three points in time is too short to separate time historical co-varying event factors. Therefore, in the multivariate analysis one of the independent variables (time/period, birth cohort, or age) had to be omitted in each model. The inferential comparison of the different models was trying to reach an approximation to a separation of period, cohort and age effects.

With the cross-sectional data of the three GTUS surveys there are indicators available for all three phases of the social acceleration of framework conditions of shopping activities. Data from 1991/92 could still stand for the regulated, restrictive conditions of shopping activities, while the actual social change should be visible in the data from 2001/02. Finally one would expect that due to the legal changes from 2006/07 the data from 2012/13 should show a further acceleration of shopping activities in the sense of more frequent and shorter shopping episodes.

In order to map the changes in the temporal pattern of shopping activities within the generation sequence, the birth cohorts 1930-34, 1935-39, 1940-44, 1945-49, 1950-54, 1955-59, 1960-64 and 1965-1969 are considered. Later birth cohorts could not be include, because it seems meaningful to secure a minimal level of observational data. As one GTUS is from 1991/1992 birth cohort 1965-1969 would just allow for some data variation with people aged between 23 and 27. Including younger cohorts would mix up this cohort also with people in more adolescent life age with less household related shopping behavior, which would make interpretation less uniequivocal. Accordingly, to take account of age differences, age groups in 5 year intervals were formed: 20-24 year olds, 25-29 year olds, 30-34 year olds, 35-39 year olds, 40-44 year olds, 45-49 year olds, 50-54 year olds and 55- 59 year-old.

The temporal order of everyday-related activities, such as shopping activities, is also influenced by individually differing time regimes, which individuals are subject to, inter alia because of their employment situation. In order to keep the analysis free of overlapping effects by full-time employees, part-time time employees and unemployed persons, the data base is limited to full-time employees only. In addition only shopping activities between Monday and Friday which were carried out between 8 am and 8 pm are considered. Also only data of the first diary that was filled out by a respondent is taken into account.

Accordingly, the following empirical analysis is based on the following sub-sample of the GTUS surveys.

So one can assume, that given store opening hours as well as their regulatory changes have then been reflected in habitual shopping activities as they have been experienced in a specific

formative stage of life, in which shopping or household activities are an essential component of everyday action. Form this perspective it seems meaningful, to capture social changes in shopping activities not only just by comparing them for different time episodes (period effects), but also to take into account generational effects by socialization and habituation in formative ages. Operationally this aspect calls for separating cohort from period effects, which therefore will be considered in our empirical social change analysis of shopping activities. Called as "cohort analysis", in this approach also age effects have to be considered, at least as control variable in trying to isolate period an d cohort effects.

Table 2
Selected indicators of the analysis sample

	Survey Time 1991/1992	Survey Time 2001/2002	Survey Time 2012/13
Shopping Frequency (mean)	0.47	0.53	0.51
Shopping Duration in Minutes (mean)	55.56	63.39	71.16
Age (percentages)			
20-24	8.9	8.4	7.7
25-29	9.2	4.1	5.0
30-34	13.9	8.8	6.5
35-39	17.3	16.2	10.4
40-44	16.4	21.0	17.9
45-49	12.8	19.7	21.8
50-54	13.8	13.8	17.9
55-59	7.8	7.9	12.9
Birth Cohort (percentages)			
1930-34	4.1	0.1	0,0
1935-39	11.2	1.2	0.1
1940-44	15.2	6.9	0.3
1945-49	13.3	11.6	1.8
1950-54	18.3	18.7	11.5
1955-59	16.5	24.1	20.9
1960-64	12.9	22.1	29.9
1965-69	8.5	15.3	35.6
Sample Size n	5430	2977	3491

Source: FDZ der statistischen Ämter des Bundes und der Länder, (GTUS), (1991/1992), (GTUS), (2001/2002) und (GTUS), (2012/2013), own calculations.

The following exploratory analysis examines how shopping episodes are distributed during a day (between 8 am and 8 pm) and how these time patterns of shopping activities have changed between the time periods (survey times) and between birth cohorts or age groups.

In a second step, separate regressions for the frequency and the length of shopping episodes are calculated, whereby period, cohort and age effects are modeled as dichotomized predic-

tors. As there is a linear interdependence of these three, a model with the simultaneous determination of their partial effects cannot be estimated. Therefore, we estimate separate reduced regression models, combining pairwise period, age and cohort effects. We use the following regression equations with survey period, birth cohorts and age groups as predictors:

(1) Y(number of shopping episodes per day) = constant + p1*period2001_02 + p2*period2012_13 + b1*birth_cohort1935_39 + b2*birth_cohort1940_44 + b3*birth_cohort1945_49 + b4*birth_cohort1950_54 + b5*birth_cohort1955_59 + b6*birth_cohort1960_64 + b7*birth_cohort1965_69

(2) Y(number of shopping episodes per day) = constant + p1*period2001_02 + p2*period2012_13 + a1*age25_29 + a1*age25_29 + a1*age25_29 + a1*age25_29 + a1*age25_29 + a1*age25_29+ a1*age25_29

(3) Y(number of shopping episodes per day) = constant + b1*birth_cohort1935_39 + b2*birth_cohort1940_44 + b3*birth_cohort1945_49 + b4*birth_cohort1950_54 + b5*birth_cohort1955_59 + b6*birth_cohort1960_64 + b7*birth_cohort1965_69 + a1*age25_29 + a1*age25_29 + a1*age25_29 + a1*age25_29 + a1*age25_29 + a1*age25_29+ a1*age25_29

(4) Y(shopping episode duration) = constant + p1*period2001_02 + p2*period2012_13 + b1*birth_cohort1935_39 + b2*birth_cohort1940_44 + b3*birth_cohort1945_49 + b4*birth_cohort1950_54 + b5*birth_cohort1955_59 + b6*birth_cohort1960_64 + b7*birth_cohort1965_69

(5) Y(shopping episode duration) = constant + p1*period2001_02 + p2*period2012_13 + a1*age25_29 + a1*age25_29 + a1*age25_29 + a1*age25_29 + a1*age25_29 + a1*age25_29+ a1*age25_29

(6) Y(shopping episode duration) = constant + b1*birth_cohort1935_39 + b2*birth_cohort1940_44 + b3*birth_cohort1945_49 + b4*birth_cohort1950_54 + b5*birth_cohort1955_59 + b6*birth_cohort1960_64 + b7*birth_cohort1965_69 + a1*age25_29 + a1*age25_29 + a1*age25_29 + a1*age25_29 + a1*age25_29 + a1*age25_29+ a1*age25_29

As reference categories in these dummy predictor models were use period 1991_92, birth cohorts 1930-1934 and age group 20-24.

Estimation of models of *shopping episode duration* was based on single shopping episode spells, therefore one has to take into person-clustering of observations. Person-clustering is also given for number of shopping episode, because the participants provided repeatedly diary data, namely for three selected days. Therefore robust standard error estimation was calculated using the vce method in Stata14 (see Cameron/Miller (2015)).

4 Results

4.1 Exploring period and cohort changes by sequence index plot

In order to explore by a close, not preconditioned view of the empirical reality of shopping activities throughout the day, full information about the temporal characteristics of shopping activities (occurance for each time unit of the day span) is analyzed in a first step. To avoid information loss by aggregation, a graphical visualization of shopping sequences over the day is done by mapping all shopping activities sequence individually in a daytime graph (sequence index plot). Subjects with any reporting of shopping activities are excluded from this graphical visualization.

We use a graphical technique, which can be named as sequence index plot, which means that each individual's sequence of shopping and non-shopping activity is represented as a horizontal line according the duration of the activity (x-axis). On the y-axis individual sequences represented in a are hierarchically sorted way by shopping activity (yes/no) and its occurrence at observation units of the daytime (namely 10 minute intervals).
In figure 4 the sequence index plot of shopping activities is shown for the survey periods of 1991/92, 2001/02 and 2012/13 separately, for subjects aged 45-49 years old only. This means that differences between three time period patterns can be read as changes in the succession of specific birth cohorts, namely birth cohorts 1942-1947, 1952-1957 and 1963-1967. Of course one has to keep in mind, that these inter birth cohort changes do reflect also changes between time periods.

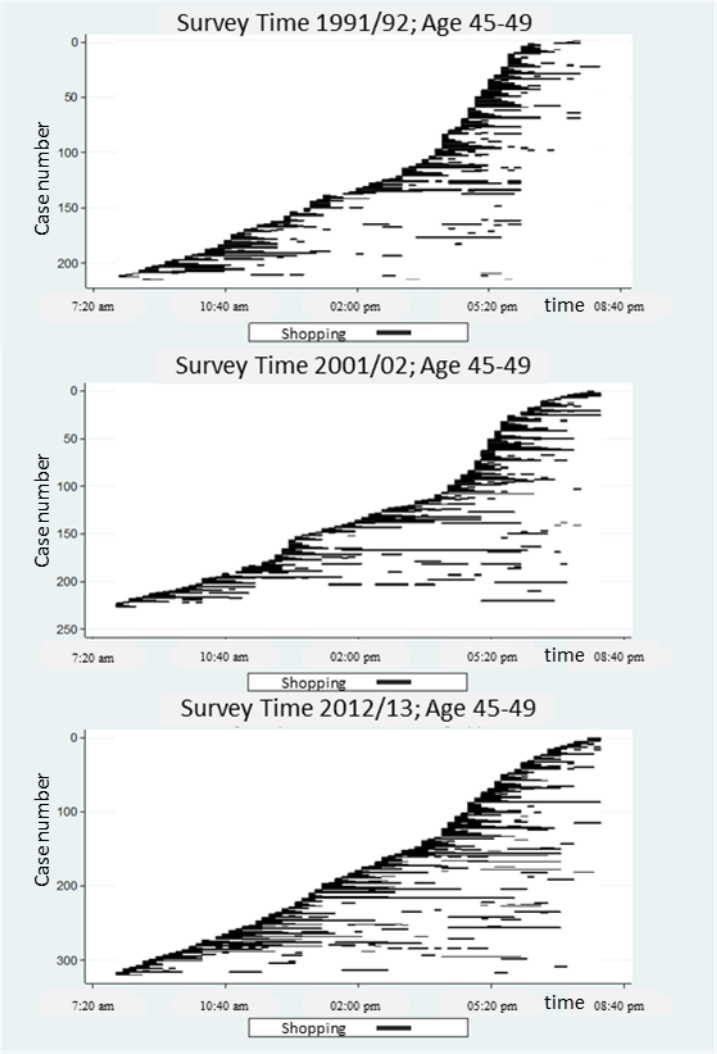
As it can be seen in figure 4, a significant change in temporality of shopping activities seems to characteristic for birth cohort of 1963-67: a formerly observable daytime concentration of shopping activities between 5 and 6 pm seemed to have been leveled out. Moreover, it seems that shopping activities are more frequent and with longer episode durations.

Overall, it seems that shopping episodes got more frequent and more evenly distributed throughout the day. As far as an increase of shopping activity per day can be interpreted as a kind of increasing speed (more activities in the same daytime interval) this finding can be understood as being consistent with the social acceleration resp. changes toward high-speed society.

In relation to shopping duration there is seemingly no change between the time periods observed. Quite the opposite shopping duration seems to have increased rather than decreased between the birth cohorts considered. This gets quite clear by finding long shopping episodes in the late morning (around 11 o'clock) and at noon in the survey period of 2012/13.

In sum with latest survey period and/r younger birth cohort, repetition of shopping episodes as well as their duration seems to have increased. Furthermore, shopping activities seem to have got increasingly independent of the time of day.

Figure 4
Sequence index plot of Shopping Activities, different periods/cohorts, same age group

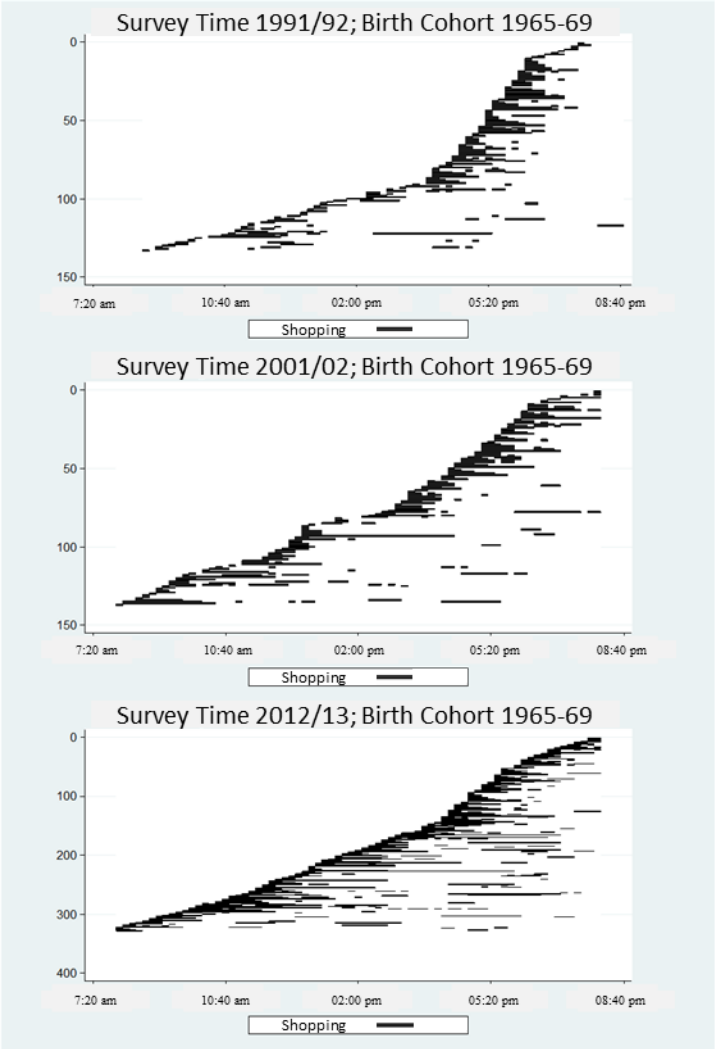


Source: FDZ der statistischen Ämter des Bundes und der Länder, (GTUS), (1991/1992), (GTUS), (2001/2002) und (GTUS), (2012/2013), own illustrations.

In the next exploration step, we look at shopping activity sequences of one birth cohort, namely born 1965-1969 ared over the three survey periods 1991/92, 2001/02 and 2012/13. By this we focus social change effects to the changes between survey periods confounded with an age effect (see figure 5).

We see that the temporal concentration of shopping activities between 5 and 6 pm is pronounced only with the survey of 1991/92. In periods 2001/2002 and 2012/2013, the shopping activities seem to more equally distributed over the day. This change pattern is similar to the change pattern in figure 4, so obviously a period effect on temporal patterns seems to be more prevailing as age effect.

Figure 5
Sequence index plot Shopping Activities,
same birth cohort/ different ages/periods



Source: FDZ der statistischen Ämter des Bundes und der Länder, (GTUS), (1991/1992), (GTUS), (2001/2002) und (GTUS), (2012/2013), own illustartions.

With regard to frequency and duration of shopping activities the following can be observed: no clar change in the frequency pattern of shopping activities between the survey periods 1991/92 and 2001/02 can be observed. However, in survey period 2012/13, it is clearly visible that the individual activity sequences contain more multiple shopping activities. Given that significant structural changes have taken place before 2000, an age effect interpretation seems to be more adequate than a period effect interpretation.

4.2 Quantitative cohort analysis of the time use for shopping activities

In order to get more generalizable results, not just restricted to one birth cohort or one age group, we estimated overall age, cohort and period effects as predictors according the regression equations specified above.

Frequency of Shopping Activities

The regression results for the daily number of purchasing activities are reported in table 3 (see below).

We found that daytime shopping was more frequent in 2001/02 than in 1991/91. This results remains significant even after control for age or birth cohort. This means that between the decades 1991/92, 2001/02 and 2012/13 the shopping frequency has risen first and then became smaller again.

With regard to the age effect, we more frequent shopping activities at older ages, namely at the age group of the 45-49 year old, who seem to be particularly strong in shopping activities.

We also find a birth cohort effect, as an increase of shopping frequency with birth cohort 1940-44 compared to those born before, as well another increase connected with the 1960-64 (model 1 and model 2 in table 3). This birth cohort and age effect pattern seemingly remains the same even after control for each other (model 3 in table 3).

Table 3
Regression analysis of shopping frequency

Predictor	Model 1	Model 2	Model 3
Survey Time[a] 2001/2002	0.0504***	0.0431**	
	(0.0190)	(0.0209)	
Survey Time[a] 2012/2013	0.0224	0.0328	
	(0.0182)	(0.0236)	
Age 25-29[b]	0.178***		0.139*
	(0.0392)		(0.0743)
Age 30-34 [b]	0.140***		0.149**
	(0.0350)		(0.0725)
Age 35-39 [b]	0.183***		0.203***
	(0.0326)		(0.0699)
Age 40-44 [b]	0.159***		0.186***
	(0.0316)		(0.0700)
Age 45-49 [b]	0.218***		0.236***
	(0.0319)		(0.0678)
Age 50-54 [b]	0.153***		0.180**
	(0.0326)		(0.0712)

Table 3 (Cont.)

Predictor	Model 1	Model 2	Model 3
Age 55-59 [b]	0.119***		0.188**
	(0.0360)		(0.0741)
Birth Cohort 1935-39 [c]		0.124*	0.0712
		(0.0655)	(0.0875)
Birth Cohort 1940-44 [c]		0.218***	0.168*
		(0.0623)	(0.0886)
Birth Cohort 1945-49 [c]		0.137**	0.0831
		(0.0622)	(0.0875)
Birth Cohort 1950-54 [c]		0.208***	0.162*
		(0.0603)	(0.0870)
Birth Cohort 1955-59 [c]		0.208***	0.166*
		(0.0601)	(0.0851)
Birth Cohort 1960-64 [c]		0.214***	0.194**
		(0.0605)	(0.0871)
Birth Cohort 1965-69 [c]		0.230***	0.211**
		(0.0615)	(0.0882)
Constant	0.338***	0.308***	0.177
	(0.0272)	(0.0562)	(0.108)
Observations	10,813	9,146	8,736
R^2	0.006	0.004	0.005

Notes: a) Survey Time 1991/1992 (Group of Reference), b) Age 20-24 (Group of Reference), c) Birth Cohort 1930-34 (Group of Reference),
Standard Error in Parantheses ** p<0.01, ** p<0.05, * p<0.1,
Model 1 and 2 quasi-bivariately incorporate only age and birth cohort additionally to period effects , whereas in Model 3 age and birth cohort are joined in the model simultaneously, but without period effects. By this and by comparisons to estimates in models 1 and 2 we try to separate cohort from age effects,
Source: FDZ der statistischen Ämter des Bundes und der Länder, (GTUS), (1991/1992), (GTUS), (2001/2002) und (GTUS), (2012/2013), own calculations.

Overall, we do not find a linear period effect on shopping frequency starting with the period 1991/92, but find a partial period effect with 2001/02. About ten years with perios 2012/13 shopping frequency dropped to the level of 1991/92. The expansion of opening times by law of 1996 appears to be reflected in these results.

The cohort effect of increased shopping frequency at two moments of the cohort succession, namely from cohort 1944-49 and cohort 1960-64, however, shows rather a progressive pattern, which can be interpreted as impact of extended shopping hours and easier access to goods at the millenium. So, birth cohort successive changes in shopping frequency points to a societal pattern of social accelerating.

Duration of Shopping Episodes

Now we consider cohort analysis of shopping episodes durations (table 4). Have in mind, that units of duration stand for 10 minutes intervals.

Table 4
Regression analysis of shopping duration

Predictor	Model 1	Model 2	Model 3
Survey Time[a] 2001/2002	0.685**	0.380	
	(0.325)	(0.318)	
Survey Time[a] 2012/2013	1.797***	1.307***	
	(0.392)	(0.426)	
Age 25-29[b]	-0.884		1.288*
	(1.064)		(0.707)
Age 30-34[b]	-1.202		1.111
	(1.046)		(0.697)
Age 35-39[b]	-1.027		2.239***
	(0.999)		(0.717)
Age 40-44[b]	-1.317		2.508***
	(1.009)		(0.683)
Age 45-49[b]	-0.724		3.447***
	(1.053)		(0.709)
Age 50-54[b]	-1.249		3.209***
	(1.081)		(0.826)
Age 55-59[b]	-1.923*		2.810***
	(1.071)		(0.765)
Birth Cohort 1935-39[c]		-1.192	1.335
		(1.421)	(1.007)
Birth Cohort 1940-44[c]		-1.252	1.007
		(1.280)	(0.765)
Birth Cohort 1945-49[c]		-1.059	1.531**
		(1.279)	(0.754)
Birth Cohort 1950-54[c]		-1.262	1.758**
		(1.269)	(0.715)
Birth Cohort 1955-59[c]		-0.410	2.885***
		(1.290)	(0.680)
Birth Cohort 1960-64[c]		-0.508	3.163***
		(1.297)	(0.831)
Birth Cohort 1965-69[c]		-0.597	3.153***
		(1.311)	(0.834)

Table 4 (Cont.)

Predictor	Model 1	Model 2	Model 3
Constant	6.531***	6.317***	0.905
	(0.918)	(1.237)	(0.945)
Observations	3915	3374	3249
R^2	0.029	0.023	0.035

Notes: a) Survey Time 1991/1992 (Group of Reference), b) Age 20-24 (Group of Reference), c) Birth Cohort 1930-34 (Group of Reference),
Standard Error in Parantheses ** p<0.01, ** p<0.05, * p<0.1,
Model 1 and 2 quasi-bivariately incorporate only age and birth cohort additionally to period effects , whereas in Model 3 age and birth cohort are joined in the model simultaneously, but without period effects. By this and by comparisons to estimates in models 1 and 2 we try to separate cohort from age effects,,
Source: FDZ der statistischen Ämter des Bundes und der Länder, (GTUS), (1991/1992), (GTUS), (2001/2002) und (GTUS), (2012/2013), own calculations.

Table 5
Regression analysis of shopping duration without period effects

Predictor	Model 1	Model 2	Model 3
Survey Time[a] 2001/2002	0.891***	0.428	
	(0.326)	(0.328)	
Survey Time[a] 2012/2013	1.818***	0.844**	
	(0.384)	(0.401)	
Age	0.0464***		0.0402**
	(0.0153)		(0.0191)
Year of Birth		0.0464***	0.0866***
		(0.0153)	(0.0182)
Constant	7.390***	-84.95***	-165.1***
	(0.631)	(29.97)	(36.08)
Observations	3915	3374	3249
R^2	0.027	0.027	0.027

Notes: a) Survey Time 1991/1992 (Group of Reference), b) Age 20-24 (Group of Reference), c) Birth Cohort 1930-34 (Group of Reference),
Standard Error in Parantheses ** p<0.01, ** p<0.05, * p<0.1,
Model 1 and 2 quasi-bivariately incorporate only age and birth cohort additionally to period effects , whereas in Model 3 age and birth cohort are joined in the model simultaneously, but without period effects. By this and by comparisons to estimates in models 1 and 2 we try to separate cohort from age effects,,
Source: FDZ der statistischen Ämter des Bundes und der Länder, (GTUS), (1991/1992), (GTUS), (2001/2002) und (GTUS), (2012/2013), own calculations.

With controlling for age or birth cohort as dichotomous variables, we find significant increase in shopping duration in period 2012/13 compared to the period 1991/92. Increase change from period 1991/92 to period 2001/2 obviously are due to cohort effects (see model 2 in ta-

ble 4). But age and birth cohorts in these models controlling for period effects do not show up as significant, except for the 55-59 year old ones, who spend significantly less time for shopping activities then those age 20-24 years.

Modelling shopping episode duration without period effects, but with age and birth cohorts as dummy variables show significant effects. There seemed to be two phases of shopping duration increase over cohort succession, namely starting first with birth cohort 1945-49 and then getting an additional increase with birth cohort 1955-59.

Because this might be due to actual number of observations in regression cell tabulation, we re-estimate the models with birth cohort and age as continuous variables (table 5). The results, which seem to be more robust, confirm the finding, that shopping duration changed only with 2012/2013 period, after having controlled for age and birth cohort effects. Further we find significant positive age and birth cohort effects, net of each other. In terms of a social change in the amount of time that is invested for shopping activities, we can say that there has been an increase latest with period 2012/13, but also over birth cohort succession.

5 Conclusion

Following a cohort analysis approach we found on the one side, that daily shopping activities have become more frequent between the periods 1991/92 and 2001/2002, but not thereafter in period 2012/13. We also found changes of shopping frequency over birth cohort succession, actually beginning with birth cohort 1940-44, but steadily with birth cohort 1950-54.

On the other side, looking on duration of shopping episodes, we found a significant period change only with period 2012/13 (after controlling for age and cohort effects). The birth cohort succession effect seemed to start with birth cohort 1945-49 and getting accelerated over the successive birth cohort until birth cohort 1960-64, with no further increases in birth cohort 1965-69.

Overall, these results show the impact of legislative events, by which retail opening times were extended starting beginning in the years 1996 and then in 2006/2007. Paralleled by increasing store facilities in the 1990s and expansion of sales area of retail trade at the millennium this might led people to go more often for shopping as well as to be more time occupied with activities.

While increasing shopping frequencies over periods and birth cohort sucession could be interpreted in favor of the thesis of increasing social acceleration (meaning that over historic periods more activities are done in shorter or at least same time), increased shopping duration seems not to be consistent with a thesis on social acceleration towards high-speed pace of life.

The increase of shopping frequency in the context of an extended scope for shopping activities can be interpreted in the sense of a key statement of acceleration theory: The more free

time and the more opportunities the socio-economic system offers, the faster the pace of life, for example measured in terms of shopping frequency per day.

The finding that consumers between 1990 and 2012 invest more and more time in their shopping activities is rather not consistent with the hypothesis of an accelerating everyday life. This finding does not fit into the image of a stressed and harried man, who repeatedly visits stores and other shopping places in order to meet the accepted expectations for consumer maximization.

Further, results of the present cohort analysis approach underlines a feature, which seems not be considered in social acceleration theorizing. It was shown, that additionally to period differences, also cohort succession changes contribute to the social change in time use for shopping behavior. So one has to take into account aspects of generational formation of behavioral habits like shopping, to get a deeper understanding of how structural changes on legislative and economic supply side do have an impact on the pace of life. It seemed that a least in the period time covered from 1991 to 2013 countervailing trends got effective in frequency and duration of shopping episodes.

Of course, the results presented in this paper cannot be used to refute the full-scaled theory of social acceleration. It may be possible – consistent with the assumptions of the theory – that longer shopping durations are accompanied with the fact that consumers shop in different places, and – on a different level of action – show an accelerated shopping behavior. Moreover, it should be examined whether, in addition to shopping as main activity also other kinds of activities are pursued, such as interactions with children or shopping as leisure time activity.

Diary-based time use data would allow for extending the cohort analysis to other diurnal activities and thereby to provide more widely applicable tests of the generalized thesis on high-speed society. As cohort analysis results do indicate, for testing the social acceleration thesis it seem also necessary to longer period data series available with shorter inter-period intervals. This would make it possible to take into account detailed socio-economic time series data as exogenous variables, so that structural context changes could estimated as part of a parametric model with more fine-granular birth cohort group definitions.

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time-pieces

news on time use research in the
electronic **International Journal of Time Use Research**

New developments in time technology – projects, data, computing and services

REPORT FROM THE 2ND INTERNATIONAL TIME-GEOGRAPHY CONFERENCE, SEPTEMBER 21-23, 2016 IN LINKÖPING, SWEDEN

Caroline Kramer
Karlsruher Institut für Technologie (KIT), Institut für Geographie und Geoökologie (IfGG), Lehrstuhl Humangeographie, Karlsruhe

The 2nd International Time-Geography Conference took place in September 2016 in Linköping. The conference was organized by Prof. Dr. Kajsa Ellegård (Technology and Social change, Linköping University, Sweden), perfectly prepared and offered an ideal platform for the mutual exchange of expertise and knowledge between researches from various from various disciplines and nations with interest in the time-geographic approach.

The main themes for the 2nd International Time-Geography Conference were

- Urban planning and development – facilitating sustainable urban life
- Mobility, transportation and migration – connection processes
- Supporting health and wellbeing in everyday life – considering the individual perspective
- The human in the environment development process – policies and actions
- New technologies – 1) social interaction in the physical an virtual worlds, 2) the collecting, analyzing and visualizing big data

Key note speakers from Sweden, Netherlands, USA, Japan and China presented their latest scientific findings using time-geographic methods and concepts. A plurality of issues were discussed during the conference in different ways i.e. presentations and in in-depth discussions with presenters and participants in small groups. We all enjoyed not only the professional or-

ganization but also the warm hospitality and familiar atmosphere of the conference - in remembrance of the 100th birthday of Torsten Hägerstrand.

Following the conference a special issue of a the Geografiksa Annaler, Series B, Human Geography, will be edited with a selection of papers presented at the Conference.

Scource: http://www.tema.liu.se/tema-t/tidsgeografi/?l=en

RESIDENTIAL MULTI-LOCALITY – RESEARCH ON A SOCIAL PRACTICE IN TIME AND SPACE

Caroline Kramer
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In the last years a considerable amount of research has been carried out on the subject residential multi-locality. Residential mobility is a manner of life which is located between the two poles of a mobile and a settled lifestyle. The key characteristic of a multi-local life is the relational interplay which exists between the factors stability, immobility and settledness, and the factors mobility, dynamics and transitoriness. A multi-local life between here and there tends to lead to a rhythmicized presence, physical co-presence and absence. It is not only significant whether a person is present at a certain time at a certain place. In addition, absence from a particular place at a particular time can have far reaching consequences in a familial and household-related context, as well as in relation to the spatial-infrastructural setting.

When taking into consideration that children whose parents are separated often lead multi-local lives, that young adults after officially having moved out of their parent's home continue to spend the night there, that „living apart together"-couples also must be included in the group of multi-locals – to name just a few variations – then we must realize that an increasing number of people are living as residential multi-locals. They have to organize their daily and weekly time budget in a well-planned way and have to coordinate it with the present and absent household members. So their time use in a life between two or more places is a quite new and challenging research topic.

A special issue of the "Journal of Economic and Social Geography" (September 2015, Vol. 106, No. 4) addresses this topic from different perspectives: theoretical approaches, quantification, methodologies and empirical studies. Two German journals have also produced special issues on multi- or trans-locality ("Geographische Rundschau" 11/2014 and "Berichte. Geography und Landeskunde" 4/2015) and an anthology (with papers in English) has been published by Peter Weichhart and Peter A. Rumpolt (eds.)(2015): Mobil und doppelt sesshaft. Studien zur residenziellen Multilokalität. Wien. (= Abhandlungen zur Geographie und Regionalforschung 18). Most of the authors are members of the international and interdisciplinary network multi-

locality which has been established in the last decade and which is open to interested researchers (https://www.uni-muenster.de/Geographie/Multilokalitaet/multilokalitaet/home.html).

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Book notes

by Kimberly Fisher

Bonke, J.
Ajassa kiinni ja irrallaan – Arbejdstid og familien – Arbejdstidsønsker, arbejdstif og skat, børn og skilsmiss, pensionering og samvær (Working hours and the family – Working preserences, economic incentives, chidcare and divorce, retirement and Time-Use) (2016)

Publisher: Syddansk Universitetsforag
ISBN: 978-87-7674-922-4
Website:
www.rockwoolfonden.dk/app/uploads/2016/http://www.universitypress.dk/shop/working-hours-and-3504p.html
Languages Available: English with a summary in Danish

Primary author, Jens Bonke, is a long-time contributor to IATUR and the Harmonised European Time Use Surveys project. This book explores adult time use across the life course using the Danish Time Use Panel Survey, which includes nearly 3000 adults aged up to 74 by 2009 who participated in both the 2001 and the 2008-09 national time use surveys. The book covers bargaining in couples at the point of couple formation, birth of children, divorce for those couples who separate, and the transition to retirement for those who remain together for the long term.

Carriero, R. and L. Todesco
Indaffarate e soddisfatte – Donne, uomini e lavoro familiare in Italia (Busy and satisfied? – Women, men, and family care in Italy) (2016)

Publisher: Carocci Editore
ISBN: 978-88-430-7390-0
Website:
http://www.ordineavvocatitorino.it/node/131694
Languages Available: Italian

This book uses Italian Harmonised European Time Use Survey data to explore the distribution of paid and unpaid work tasks, as well as other daily activities of Italian women and men. The authors then use Multinational Time Use Study versions of data from Australia, Canada, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Slovenia, Spain, Sweden, the UK and the USA to analyse gendered time use in Italy in an international context. This book serves as a significant overview of family sociology research as well as a guide to comparative analysis of time use.

Davis, G. C. and E. L. Serrano
Food and nutrition economics – Fundamentals for health sciences (2016)

Publisher: Oxford University Press
ISBN: 978-01-9937-911-8
Website:
https://foodandnutritioneconomics.com/about/ Supplementary materials – click on the FNE tab on
http://www.aaec.vt.edu/people/faculty/davis-george.html
Languages Available: English

This book sets out the state of the art of the economics of eating in five parts: nutrition and wellbeing; food consumption; food production; food prices; and finally a cost-effective and cost-benefit analysis. Though only one chapter (6 – convenience and time) primarily focusses on time, references to time use research recur throughout the book. This text offers significant analysis on one activity in which most people engage on most days.

Garfield, S.
Timekeepers – How the world becomes obsessed with time (2016)

Publisher: Canongate Books
ISBN: 978- 17-8211-319-5
Website:
http://www.goodreads.com/book/show/30984097-timekeepers
Languages Available: English

Simon Garfield is a British journalist who already has written a number of books on daily life. This volume, aimed at a general audience, offers a series of vignettes of people whose artistic or manufacturing efforts aimed to change the way we view or measure time. The book then explores the contemporary parlance about time, commenting on how the way we talk about time reflects contemporary anxieties.

Cornwell, B.
Social sequence analysis – Methods and applications (structural analysis in the social sciences) (2015)

Publisher: Cambridge University Press
ISBN: 978-1-107-50054-9
Languages Available: English

Benjamin Cornwell's sole authored exploration of sequence analysis follows the theoretical development of this family of techniques. Cornwell shows how network methods contribute to sequence analysis. He offers guidance on identifying sequence structures, and analysis of a range of social sequences and microsequences. Chapters 4 (identifying sequences) and 5 (comparing whole sequences) make the most use of time use data as examples.

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Knight, S.
The life-changing magic of not giving a FK – How to stop spending time you don't have doing things you don't want to do with people you don't like (2016)**

Publisher: Quercus
ISSN: 978-17-8429-846-3
Languages Available: English

Many volumes offer advice on how to better organise your time, but few offer a more eye-grabbing title. A majority of Amazon reviews describe this as both a useful and also hilarious read.

Muller, R. A.
Now – The physics of time (2016)

Publisher: W. W. Norton & Company
ISBN: 978- 03-9328-523-98
Website:
http://books.wwnorton.com/books/now/
Languages Available: English

University of California at Berkeley Physicist Richard Muller's book both offers an insight for popular science readers interested in time. The book also serves as a textbook for physics students that defines the concept of the present in a way that facilitates student experiments.

Payne, C. S.
Changes in the value and division of unpaid care work in the UK – 2000 to 2015 (2016)

Publisher: UK Office for National Statistics
ISBN: 978-1-628-65101-0
Website:
https://www.ons.gov.uk/economy/nationalaccounts/satelliteaccounts/articles/changesinthevalueanddivisionofunpaidcare-workintheuk/2000to2015
Languages Available: English

This is the first of what will be a series of reports on the distribution and value of unpaid care and other unpaid household production using British HETUS-format time use data. Women perform over 2/3rds of the unpaid care work, and their efforts had a value of over £140 billion in 2015. This report includes innovative on-line presentation to make results accessible to time use, policy, and more general audiences.

Wuppuluri, S. and G. Ghiardi
Space, time, and the limits of human understanding – The frontiers Collection (2016)

Contributing Authors: Abhilash, L., Allori, V., Auxier, R. E., Bailey, D. H., Barbour, J., Bergonzi, M., Biagioli, F., Borwein, J. M., Brown, J. R., Dewdney, A. K., da Costa, N. C. A., Doria, F. A., Duquette, J., Ernest, P., Ghiardi, G., Grelland, H. H., Hersh, R., Hooft, G., Isenberg, J., Janelle, D. G., Kasturirangan, R., Kato, G. C., Leng, M. Luisi, P. L., Mar, G., Maxwell, N., McDevitt, T., Musser, G., Petkov, V., Ramaubramanian, K, Reichenbach, D. J., Sadun, L., Salmon, N., Sharma, V. K., Sieroka, N., Silberstein, M., Straumann, N., Stuckey, W. M. , Sudarshan, E. C. G., Sudbery, A., Swade, D., Tally Jr., R. T., Unnikrishnan, C. S., Vaccaro, J. A., Wells Jr., R. O., Witzel, M., Wuppuluri, S. and N. Yanchevskaya
Publisher: Springer
ISBN: 978- 33-1944-417-8
Website:
http://www.springer.com/gp/book/9783319444178
Languages Available: English

The thirty nine chapters in this book explore how humans understand and experience space and time, as well as the limitations on our capacity to think about time. Contributors from philosophy produce the first nine chapters. Then physicists, mathematicians, biologists, cognitive scientists, logic and computing scientists, linguists, and social geographers explore the different ways in which people organise their labour and activities in space and time. This book makes a significant contribution to explaining how the way we understand these concepts shape our behaviour.

electronic ***International Journal of Time Use Research***
2015, Vol. 12, No. 1, 91-111 dx.doi.org/10.13085/eIJTUR.10.1.91-111

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