Timing, fragmentation of work and income inequality

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Abstract

Traditional welfare analyses based on money income needs to be broadened by its time dimension. In the course of time the traditional full-time work is diminishing and new labour arrangements are discussed (keyword: flexible labour markets). Our study is contributing to economic well-being by adding insights into particular work effort characteristics - the daily timing of work and its fragmentation - and its resulting income distribution. With our focus on 'who is working when within a day with which earnings consequences' we go beyond traditional labour market analyses with its working time division into aggregated full and part time work, working hours spread across a week and weekend, life time working etc.

Whereas the first part of our study is describing the distribution of timing and fragmentation of daily work time and its resulting income based on more than 35.000 diaries of the recent German Time Budget Survey 2001/2002, the second part of our study quantifies determinants of arrangement specific earnings functions detecting significant explanatory pattern of what is behind. The economic theory behind is a human capital approach in a market and non-market context, extended by non-market time use, the partner's working condition, social networking as well as household and regional characteristics. The econometrics use a treatment effects type interdependent estimation of endogenous participation (selection) in a daily working hour pattern (self-selection) and pattern specific earnings function explanation.

The overall result: *Individual earnings in Germany are dependent on and significant different with regard to the daily working hour arrangement capturing timing and fragmentation of work time. Market **and** non-market factors are important and significant in explaining earnings.*

JEL: J22, J23, J24, J30

Keywords: *time use and inequality, timing and fragmentation of work time, working hour arrangements, labour supply, earnings explanation, human capital, market and non-market time use, time use diary data, treatment effects modelling, endogenous self-selection, German time budget survey 2001/2002*

Zusammenfassung

Traditionelle Wohlfahrtsanalysen auf der Basis monetärer Größen erfordern eine Erweiterung um ihre Zeitdimension. Im Laufe der Zeit verringerte sich die Bedeutung von Vollzeitarbeit zugunsten neuer Arbeitsarrangements (Schlagwort: flexible Arbeitsmärkte). Unsere Studie trägt zur ökonomischen Wohlfahrt bei durch die Analyse des spezifischen Arbeitsaufwandes - die tägliche Lage der Arbeitszeit und ihrer Fragmentierung - und seiner resultierenden Einkommensverteilung. Mit unserem Fokus auf ‚Wer arbeitet wann am Tag und mit welchen Einkommenskonsequenzen' gehen wir über traditionelle Arbeitsmarktanalysen hinaus, die sich auf aggregierte Voll-und Teilzeitarbeit, wöchentliche Arbeitszeit, Arbeit am Wochenende, Lebensarbeitszeit etc. beschränkt.

Während der erste Teil unserer Studie die Verteilung der zeitlichen Lage und Fragmentierung der täglichen Arbeitszeit und der resultierenden Einkommen auf der Basis von mehr als 35.000 Zeittagebüchern der aktuellen deutschen Zeitbudgeterhebung 2001/02 beschreibt, quantifiziert der zweite Teil Determinanten arrangementspezifischer Einkommensfunktionen, um signifikante Erklärungsmuster zu finden. Die zugrunde liegende Theorie ist der Humankapitalansatz in einem markt- und nichtmarktmäßigen Kontext, erweitert um nichtmarktmäßige Zeitallokation, die Arbeitsbedingungen des Partners, soziale Netzwerke als auch Haushalts- und regionale Charakteristika. Der ökonometrische Ansatz ist ein ‚treatment effects'-Ansatz mit interdependenter Schätzung der endogenen Partizipation (Selektion) hinsichtlich des täglichen Arbeitszeitmusters (self-selection) und musterspezifischer Erklärung der Einkommen.

Herausragendes Ergebnis: *Die individuellen Einkommen in Deutschland sind abhängig und signifikant unterschiedlich hinsichtlich der täglichen Arbeitszeitarrangements mit der zeitlichen Lage und Fragmentierung der Arbeitszeit. Markt und nichtmarktmäßige Faktoren sind dabei wichtig und signifikant in der Erklärung der Einkommen.*

JEL: J22, J23, J24, J30

Keywords: *Zeitverwendung und Ungleichheit, Lage und Fragmentierung der täglichen Arbeitszeit, Arbeitszeitarrangements, Arbeitsangebot, Einkommenserklärung, Humankapital, Markt- und nichtmarktmäßige Zeitverwendung, Zeittagebücher, 'Treatment effects'-Ansatz, endogene Selbst-Selektion, Zeitbudgeterhebung 2001/02*

Timing, Fragmentation of Work and Income Inequality – An Earnings Treatment Effects Approach

Joachim Merz, Paul Böhm and Derik Burgert [1]

1 Introduction

Economic well-being described by income inequality is a traditional focus of scientific and public interest, the connected time, however, the individual have to spend to earn that income is a rather infant research field.[2] If only the distribution of money income would be regarded, inequality differences would neglect differences in working time efforts with misleading results about ('total') economic well-being.

Our study is contributing to economic well-being by adding insights into particular work effort characteristics and its resulting income distribution. The work effort characteristics we regard is about labour market flexibility[3] with focus on relations between the daily timing of work and its fragmentation, and its consequences on income inequality. With our focus on 'who is working when within a day with which earnings consequences' we go beyond traditional labour market analyses with its working time division into aggregated full and part time work, working hours spread across a week and weekend etc.

Many labour market questions requires just this daily timing of work aspect, like questions about the liberalisation of working time regulations and employment impacts or how (female) labour supply and demand will interact given governmental support in form of governing pre-school and school children. Thus, the underlying policy relevant general question is how labour market rigidities concerning working time resulting in daily fragmented work is influencing individual well-being. Once detected the consequences, more targeted new economic and social policy will be possible.

Analyzing daily timing of work requires a demanding individual data base describing the daily use of time in detail. This data base is now available by the new German Time Budget Survey 2001/2002 with its more than 35.000 individual time diaries and is the micro data base of our study.

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[2] But see Merz 2002a,b, Osberg 2002, Merz and Kirsten 1999, Jenkins and O'Leary 1996, Lee 2001, Doiron and Barrett 1996, Burtless 1993

[3] Flexible labour markets are discussed under various topics. To mention only a few: social policy and the working time (Büssing, and Seifert 1995), firm side working time arrangements (Baur, Groß, Munz and Sayin 2001), time squeeze (Clarkberg and Moen 2000), working hour tension as the tension between desired and actual working hours (Merz 2002, Holst and Schupp 1994) or effects of flexible working hours to leisure and family (Garhammer 1994, Townsend 2001) or tax and transfer policy impacts on the formal and informal economy (Merz 1990).

In the literature the timing of work time is accentuated by Hamermesh 2002, 1999, 1996, showing that with 'appropriate data the analysis of time use, labour supply and leisure can move beyond the standard questions of wage and income elasticities of (aggregate) hours supplied' (Hamermesh 2002, p. 601). The timing and fragmentation of daily work time based on time use diaries from the German 1991/92 Time Budget Survey is analyzed by Merz and Burgert 2003. Further associated international working time arrangement studies based on time use diaries are e.g. Harvey et al. 2000 comparing four countries in the early 90ies (Canada, the Netherlands, Norway and Sweden) or Callister and Dixon 2001 based on the New Zealand Time Use Survey 1998/99.

Combining the time and income dimension, naturally, our study is embedded within its single dimensions, the general time use research area (see the recent survey about research, data and policy topics by Merz and Ehling 1999, Harvey 1999, Merz 2002a or National Research Council 2000), the labour market research (see the surveys by Blundell and MaCurdy 1999, Killingsworth and Heckman 1986, Pencavel 1986 and Killingsworth 1983) and the economic well-being and income distribution literature (e.g. Silber 2001, Champernowne and Cowell 1998, Sen 1992 or Atkinson 1970).

Paper organisation and topics

Based on diary time use data of the German Time Budget Survey 2001/2002 (Section 2) we describe the daily working hour arrangements into two main dimensions: the timing and fragmentation of daily work time considering core and non-core working episodes and number of working episodes (Section 3). We then analyze the consequences of theses working hour arrangements to its income distribution (Section 4). The second part of our study quantifies determinants of arrangement specific earnings functions detecting significant explanatory pattern of what is behind. The economic theory behind is a human capital approach in a market and non-market context, extended by non-market time use, the partner's working condition, social networking as well as household and regional characteristics. The econometrics use a treatment effects type interdependent estimation of participation in a daily working hour pattern (self-selection) and pattern specific earnings function explanation (Section 5). Section 6 concludes.

2 Data: The German Time Budget Survey 2001/2002

The following analysis is based on data from the actual German Time Use Survey conducted by the Federal Statistical Office in 2001/02 (Ehling, Holz and Kahle 2001). The main part of the survey constitutes the time use diaries. The sample contains 35,813 diaries of 11,962 persons (10 years and older) in 5,171 households[4]. The duration of the individual activities in the diaries was created according to the recommendation for the European time budget survey: each activity is marked on a timescale which shows ten-minute steps.

In addition to the diaries the sample also includes information about household and personal characteristics.

The household characteristics can be divided into three groups: The first group contains information about the equipment of the household, e.g. the number of cars, microwave ovens etc. A second group contains household characteristics that cause special time-use for its

[4] Every individual were to write down the course of their day on three days (two weekdays and one Saturday or Sunday).

members, e.g. people in need of special care. The third group of variables reflects the type of household, i.e. household composition or household income.

The personal characteristics include socio-economic information of the respondents as e.g. gender, school leaving certificates, etc. Another part of the German Time Use Survey consists of information about characteristics leading to a particular time use behaviour, for example if and how long a person regularly helps members of other households. A last group of variables reports self-assessment and plans concerning the subject's time use.

Data consideration for our analysis

The data used for the analysis differ slightly from what is provided by the original data set. Although many retirees and children are working, they often have jobs which contribute only a small share to the total household income. For that reason, we restricted our sample to people aged 15 to 65. Apart from that we examined only those cases where respondents did handed in the time use diaries. For the sake of consistency, we deleted all observations reporting activities of gainful employment but not reporting any income. After these restrictions the set contains 26,949 diaries of 9,080 persons in 4,553 households.

To construct the different categories of working hour arrangements in Chapter 3, it is necessary to define those activities belonging to 'work'. In particular, these are:[5] Main gainful employment, additional gainful employment, extended professional qualification during working time, practical placement.

3 Daily Working Hour Arrangements – Timing and Fragmentation of Work

The traditional working day in the course of time is more and more replaced by different working hour arrangements. Whereas there are many studies concerning an overall defined full-time and part-time working arrangement (see our introduction) at least for Germany there is no study which inspect the daily situation (but see Merz and Burgert 2003 as a predecessor of our approach). The very reason is the so far lack of the needed challenging data base, a diary based time use survey, which is just now available by the very recent German Time Budget Survey 2001/2002, the data base of our study.

To analyse the daily working hour arrangements we decided to consider two dimensions: Firstly, an information about the timing of work time (the location of the main working hours), and secondly, an information about the fragmentation of a working day (the number of working episodes). We expect and will investigate its significance if these dimensions of working hour arrangements in particular will result in different income pattern and earnings explanation.

With these two dimensions of different working hour arrangements, the traditional working day can be interpreted as a working day in which work is mainly done within the core period and with only one working episode.

Combining these two dimensions we get four different categories of working hour arrangements, which are in the further focus of our investigation.

[5] We hereby follow as much as possible the definition chosen by Harvey et al. 2000, p.2

Dimension 1: The timing of work

In this dimension the working days are distinguished by the question if the work is mainly done within a certain core period. In Germany, most of the working episodes start between 7am and 8am and end between 4pm and 5pm. Consequently we define the period between 7am and 5pm as the core working period and the time before and after that core period as non-core working period. A working day where work mainly is done at this non-core period is the timing aspect of an irregular and 'non-normal' working day with shift and night work.[6]

Dimension II: The fragmentation of a working day

Our second dimension is the fragmentation of a working day. To get information about the fragmentation, we used the number of working episodes which are interrupted by a break.

But what is a break? Can ten minutes of interrupting the work already be regarded as a break or not? It is obvious that the composition of the categories and our results depends on the definition of a break which forms the basis of the calculations. In the following we interpret – with German workday situations and with respect to the international study of Harvey et al. 2000 - breaks shorter than 60 minutes as a within work period break and thus as an inherent part of the working time. A further inspection of the type of breaks are given in the below section 3.3.

An interruption of the working episode by at least one break then is the second disturber of a 'normal' workday and a characteristic of a 'non-normal' working day.

3.1 Working hour arrangements: Combining timing and fragmentation of work

Combining the two dimensions we get a two by two table of working hour arrangements, which is presented in Table 1.

Category I includes ‚normal' working days, in which work is mainly done within the core working period and which only consist of one working episode (no interruption by breaks). In contrast here upon the categories II and III differ in exactly one dimension from the definition of a ‚normal' working day. So the working days in category II can be described as days with mainly core work, but which are, at the same time, interrupted by at least one break. Working days without breaks showing a work activity mainly outside the core working period are described by category III. Category IV deviates in both dimensions from the normal case. The persons in this category work outside the core period and with at least one interruption.

Table 1 shows the respective numbers of the weighted observations. More than 60% (weighted) of the diaries (16,301 non-weighted cases) have no working episode at all and are therefore not part of the following analysis.

The ‚normal' working day is the most frequent case: 65.1% of all working persons belong to category I while only 3.3% are part of the most irregular working situation category IV. The most important category of a ‚non-normal' working hour arrangement is category II with a share of more than one fourth of all persons. In total only 9.8% of the people are working outside the core period, while at least 28.4% of the working days show at least one interruption per working day.

[6] This is in line with a similar definition in the international study by Harvey et al. 2000.

Table 1: Working hour arrangement categories by timing of work and fragmentation in Germany 2001/2002

	Timing of work		
	mainly core	mainly non-core	Total
	I	**III**	
One episode	**65.1%**	**6.5%**	**71.6%**
	n = 6,884	n = 716	
	N = 40,503,406	N = 4,037,688	
Fragmentation			
	II	**IV**	
two or more episodes	**25.1%**	**3.3%**	**28.4%**
	n = 2,698	n = 350	
	N = 15,605,547	N = 2,026,132	
			n=10,648
Total	**90.2%**	**9.8%**	**N = 62,172,772**

Source: German Time Use Survey 2001/02, own computations

The results vary with different definitions of the minimum length of the breaks.[7] Defining a break as an interruption of 30 minutes and more, only 27.4% of all working days are assigned to category I instead of 65.1% by a 60 minute break. Using a break definition with a larger minimum length the number of breaks decrease and so the number of episodes. This relationship leads to an increasing share within those categories which the uninterrupted working days belong to. For example, using the 60-minute-break definition 65% of all working days belong to category I whereas even 78% of all working days would count to this category if using a 90-minute-break definition. Note that the definition of break depends strongly on the subjective valuation of each person, and therefore can only conditionally be objectified. With respect to the German situation, our 60 minute breaks might be a quite good approximation for a non-normal interruption of a working day, because 'normal' breakfast and lunch time breaks are distinctly less than one hour; more break characteristics are provided in chapter 3.3.

3.2 Characteristics of the Working Hour Arrangements

Let us inspect now some more main characteristics of our four working hour arrangement categories. For a better understanding, we differentiate between working hours ('working'), temporary interruptions of work ('breaks') and hours in which no work is done ('not working'). The non-working time covers both the period until the first working period and the period after the last working period.

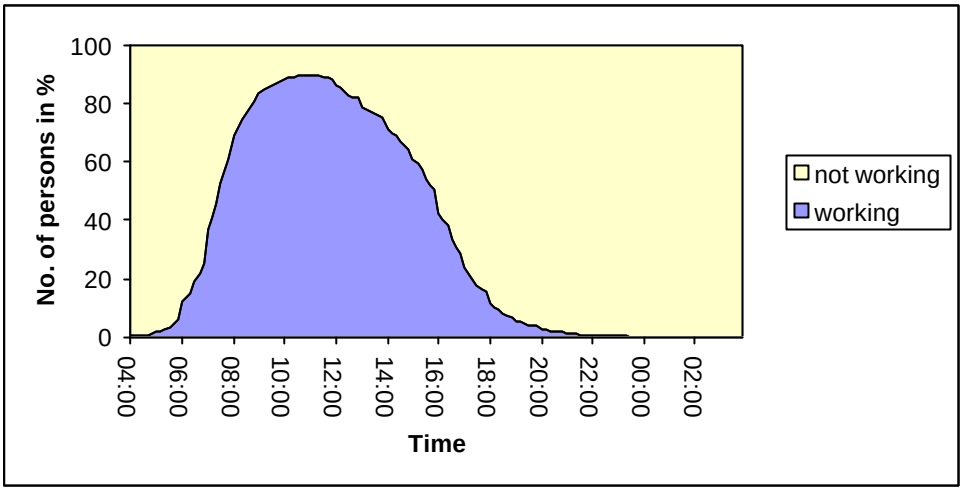
Category I: core/one episode

Within category I which includes the 'normal' working days, a working episode lasts 7h 40min on average. Figure 1 shows the share of persons who work at a certain time. At 7am - the assumed starting point of the core-period - more than one third of the persons are working.

[7] See the sensitivity analysis in the appendix

This share reaches its maximum in the period between 11:10 and 11:20 (90%). At the end of the core-working period, i.e. at 5pm, more than 28% of the people are still working.

Figure 1: Daily timing of work: Category I (core/one episode)



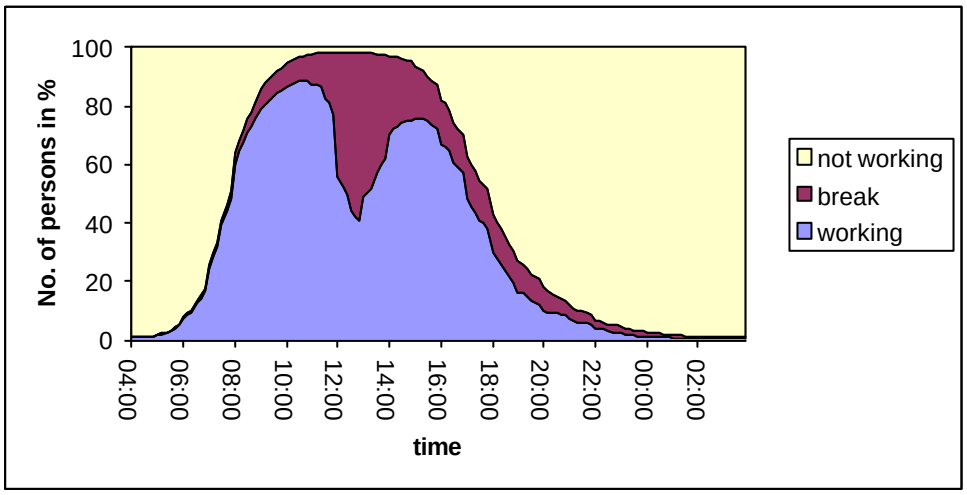
Source: German Time Use Survey 2001/02, own computations

Category II: core/multiple episodes

This category includes all working days showing mainly core-work activity and with at least one interruption (multiple episodes). On average 7h 22min daily are spent for work, whereas almost two and a half hours are spent for breaks on average.

Figure 2 shows the daily timing of work and breaks within this category. At 4am, only 0.7% of the people are working, while at 7am already 24% have started to work. Noticeable are the two peaks of the working curve at 10:40 (share = 88.8%) und at 3pm (share = 75.7%). Between these two peaks, the share of the persons interrupting their working hours reaches its maximum at lunchtime, i.e. in the period between 12:50 and 1pm (share = 57.4%).

Figure 2: Daily timing of work and breaks: Category II (core/multiple episodes)

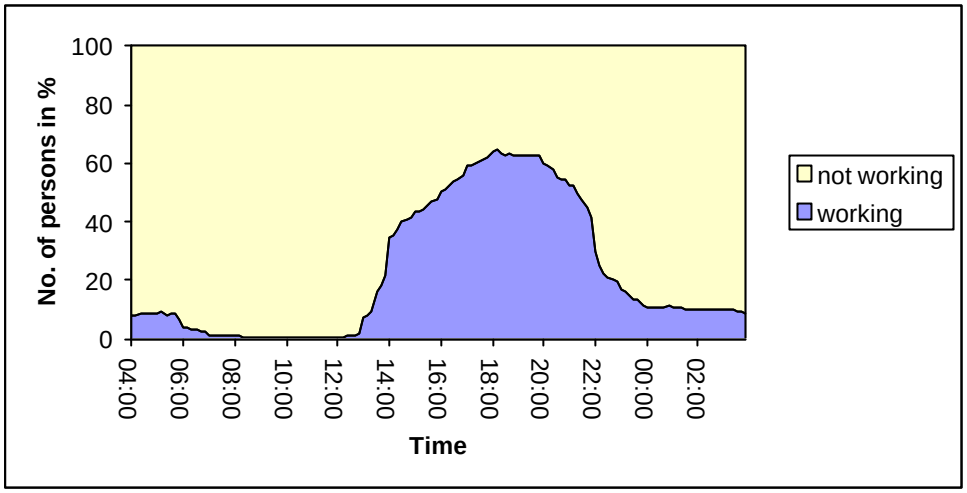


Source: German Time Use Survey 2001/02, own computations

Category III: non-core/one episode

The average working hours in this category is substantially smaller than in the other categories, only five and a half hours are spent for work. Noticeable is that the working hours are situated mainly in the afternoon and evening. The peak of the working curve is at 6pm, when almost two thirds of the people are working (share = 64.5%) (Figure 3).

Figure 3: Daily timing of work: Category III (non-core/one episode)

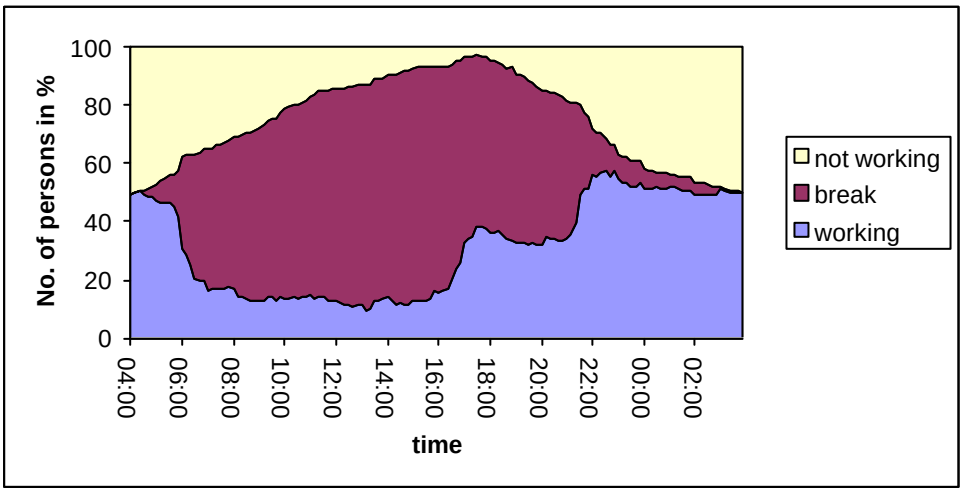


Source: German Time Use Survey 2001/02, own computations

Category IV: non-core/multiple episodes

The structure of the most irregular working day within category IV is relatively fragmentized. Remarkable is the big share of night-work, while the period between 6am and 4pm is mainly used for breaks. Hereby it is necessary to mention that the diaries are recorded from 4am on. Changing this specification the analysis would probably bring different results compared to the representation in Figure 4. In the case of a night-worker, one reason for these expected

Figure 4: Daily timing of work and breaks: Category IV (non-core/multiple episodes)



Source: German Time Use Survey 2001/02, own computations

differences is that, according to our definition, the time between the end (in the morning) and the beginning of a shift (in the evening) has to be interpreted as a break.[8]

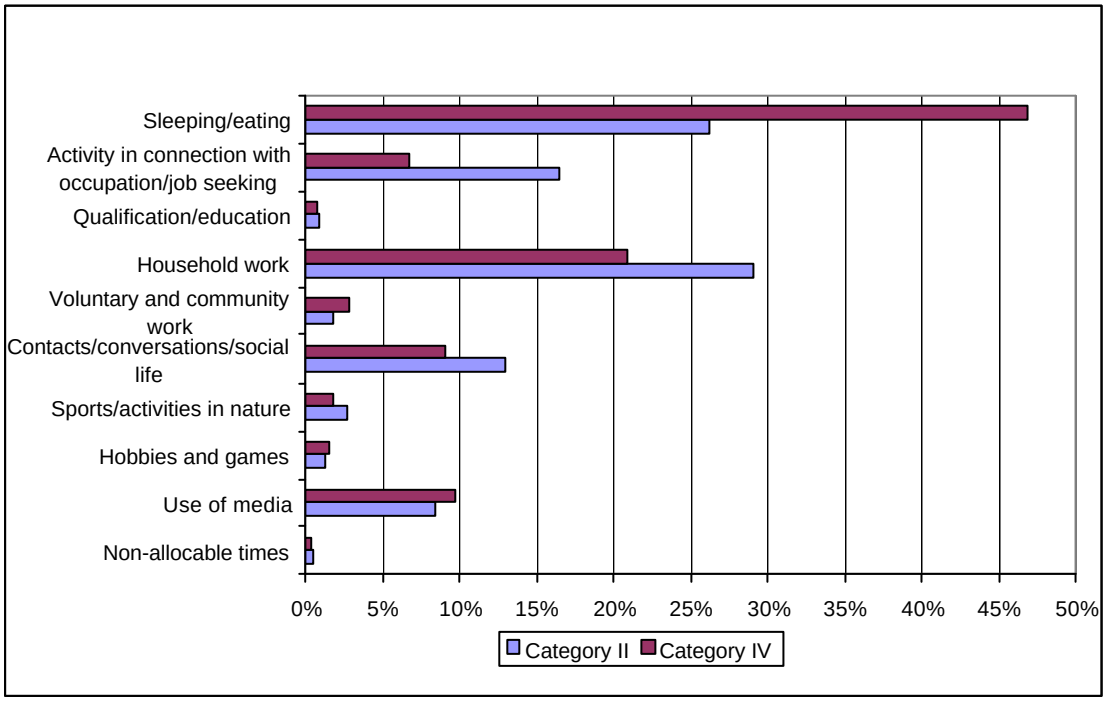
3.3 The activities in the working breaks

The central question with regard to the characterization of multiple episode working days is the character of the respective breaks. Do they break into different working episodes within the same job, or do they mark the switch to another employment? Unfortunately, by the data at hand we can not distinguish between two employments, because a second job flag only is provided in general and not connected by the individual activities of that day in the diary. However, we are able to further characterize the breaks to give some hints of the breaks' characteristics and possible changing employment situations.

As of our categorization, category II (core/multiple episodes) and category IV (non-core/multiple episodes) have more than one working episode. Figure 5 shows the break activities of the persons within these categories. Regardless the core or non-core situation, in both categories the break is mainly used for sleeping, eating and household work. Nevertheless there are partly grave differences between these categories regarding their break activities.

Remarkable is that the persons in the most irregular working situation of category IV (non-core/multiple episodes) use their breaks primarily for sleeping and eating. As we have seen category IV consists mainly of night-workers. As mentioned above, the period between the end of work time (in the morning after 4am) and the start of work (in the evening) of a night-worker has to be interpreted as a break as well, so that the main activities a person is doing in this case is different to others.

Figure 5: Activities in breaks by category



Source: German Time Use Survey 2001/02, own computations

8 In the appendix the graph is shown when night workers are excluded. Without the persons who are working between 3:50 and 4:10am only 198 cases remain in this category.

In contrast to this the persons in category II spend the time between their working episodes besides sleeping and eating mainly with household work and social life.

To conclude, the inspection of the daily breaks' characteristics does not allow to characterize multiple episodes as multiple jobs, though further aspects of the German working situation might provide some respective indication.

4 Working Hour Arrangements and Income Distribution

We assume and want to disentangle that different working hour arrangements result in different income pattern. How do differences in income look like among different working hour arrangements? Are there at all any significant differences in the distribution of net income and what income can be detected when somebody decides for a certain arrangement?

To answer these questions we analyse the income distributions within the four different working hour arrangements by graphic inspection via Kernel density estimates and central distributive measures as well as by Shorrocks' decomposition of inequality.

The income under inspection is personal net income[9] which is a person's reported monthly income from main and additional gainful employment after taxes and social insurance contributions of a person. Note, all income aspects thus are not directly connected with the reported daily activities and working hour arrangement categorization. To avoid biased results we excluded 41 extreme outliers through which the number of analysed diaries is reduced to 10,607.[10] To disentangle the influence of the number of working hours and the wage per hour we divide our analysis into the inspection of the income as well the hours and wage distribution.

4.1 Income distribution and working hour arrangements

A graphical inspection is followed by the discussion of central distributive measures.

Graphic inspection: Kernel income density estimates of working hour arrangement

A first graphical inspection of the respective income distributions by Kernel density estimates of monthly net income for the different working hour arrangements (Figure 6) shows an expected left ascending distribution for all working hour arrangements. However, the pictures are different. The distribution of all working is supported mainly by the normal working activity of category I (core/one episode). More episodes within the core working period result in a shift to right with more frequent higher income. The different peaks remain which is due to the middle class approximation of income reported only by income brackets.

The non-core workdays result in quite different income distributions compared to the normal workday: lower income is more frequent for the one episode case, higher income is more frequent for multiple episodes.

Thus, the first graphical inspection already shows that our working hour arrangement specification is important for the resulting income distribution: different income distributions

[9] Besides announcing his exact monthly income each individual had the possibility to indicate his income in income classes. If bracketed income is given, we replace it by their respective mean.

[10] Among others all diaries with weakly working hours of less than 1 h were deleted.

are the result of different working hour arrangements; in particular for the non-core arrangements the number of working episodes is important for a different income profile.

Distributive results by respective measures

For getting more differentiating results Table 2 provides central income distributive measures[11] for the single working hour arrangements.

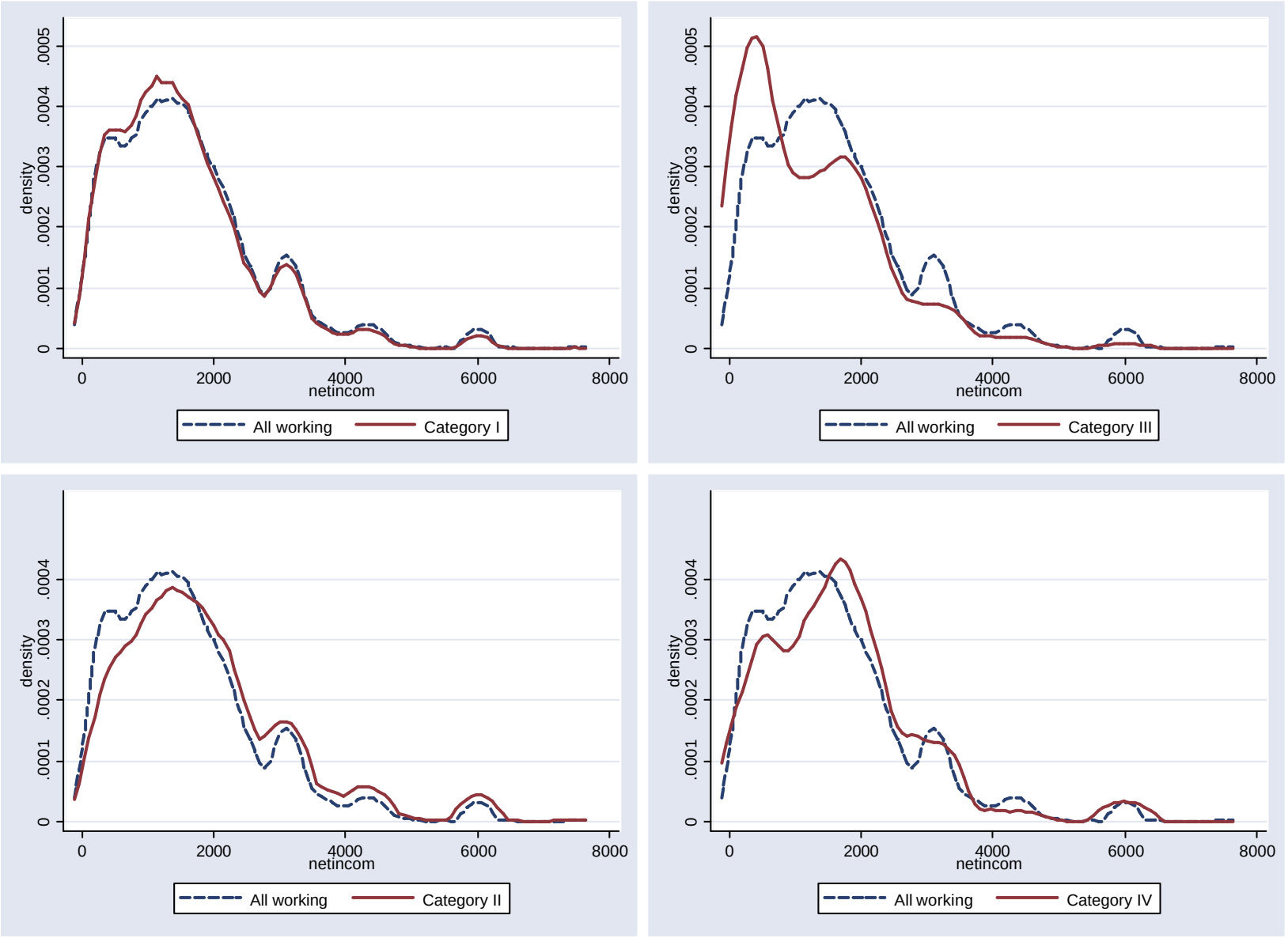
The categories with the highest average income are the categories with multiple episodes (categories II: 1,802 € and IV: 1,787 €). In contrast to this the persons with ‚normal' working hour arrangements (category I) have an average income of 1,552 €, the persons in category III (non-core/one episode) only of 1,320 €. The median for every category is smaller than the mean indicating a left ascending distribution, which is also supported by the positive values of the scewness coefficient.

Since the Gini-coefficient is sensitive for the income region with great population density there are remarkable differences with particular regard to the middle income situation between the four working hour arrangement categories. The Atkinson-Index is calculated with a relative small ($\varepsilon = 1$) and a relative high ($\varepsilon = 2$) inequality aversion to cover a broad spectrum with a multitude of possible normative evaluations. The Atkinson-index is sensitive to changes in the lower part of the income distribution. Both the Gini-coefficient and the Atkinson-Index prove category III (non-core/one episode) as the category with the most unequal income distribution. For this category the Gini-coefficient amounts to 0.36723 which

[11] Distributive measures are discussed in Atkinson 1970, Lüthi 1981 oder Cowell 1995 und Maasoumi 1999.

Figure 6: Kernel density estimates of monthly net income by different working hour arrangements

(core – one episode (1); core – multiple episodes (2); non-core – one episode (3); non-core –multiple episodes (4))



Epanechnikov kernel using optimal band width

Source: German Time Budget 2001/02, own computations (Stata 8.2)

Table 2: Net Income: Distributive Measures by Working Hour Arrangement

	Working	Category I core one episode	Category II core #episodes>1	Category III non-core one episode	Category IV non-core #episodes>1
Mean in €	1,607.69	1,552.22	1,802.42	1,319.72	1,787.20
Median in €	1,431.62	1,380.49	1,556.62	1,252.67	1,636.13
Scewness	1.57	1.51	1.53	1.17	1.76
Kurtosis	4.04	4.07	3.05	2.67	5.10
Variation coefficient	0.63	0.60	0.65	0.68	0.60
Distributive measures					
Gini-Coefficient	0.32563	0.31487	0.33476	0.36723	0.29871
Atkinson-Index					
$\varepsilon = 1$	0.19580	0.18435	0.19528	0.27102	0.18412
$\varepsilon = 2$	0.45425	0.43385	0.43287	0.58784	0.45809
Decile shares in % (Decile limits in €)					
1. Decile	1.77 (511)	1.88 (511)	1.99 (625)	0.98 (230)	1.72 (625)
2. Decile	4.38 (875)	4.53 (875)	4.41 (920)	2.60 (500)	4.57 (1074)
3. Decile	6.17 (1125)	6.33 (1125)	5.93 (1125)	4.76 (750)	7.25 (1375)
4. Decile	7.26 (1253)	7.43 (1227)	6.88 (1351)	6.97 (1100)	7.75 (1500)
5. Decile	8.37 (1432)	8.49 (1381)	8.05 (1557)	8.99 (1253)	8.42 (1636)
6. Decile	9.53 (1625)	9.63 (1585)	9.07 (1770)	10.10 (1432)	9.70 (1875)
7. Decile	10.70 (1875)	10.69 (1790)	10.69(2119)	11.90 (1636)	11.08 (2000)
8. Decile	12.49 (2147)	12.50 (2125)	12.47(2434)	13.40 (1943)	11.66 (2375)
9. Decile	15.40 (3000)	15.18 (2812)	15.87(3170)	15.83 (2250)	14.71 (3125)
10. Decile	23.93	23.35	24.62	24.47	23.13
90/10 Relation	13.52	12.42	12.37	24.97	13.45
Decomposition					
Theil Index	0.18166	0.16983	0.18846	0.23217	0.16407
Inequality shares in %		59.94	29.82	6.93	3.31
Group share in %:					
within	98.09	-	-	-	-
between	1.91	-	-	-	-
n	10,607	6,859	2,689	712	347
N	61,962,578	40,360,174	15,581,494	4,014,101	2,006,809
N in %	100.00	65.14	25.15	6.48	3.24

Source: German Time Use Survey 2001/02, own calculations

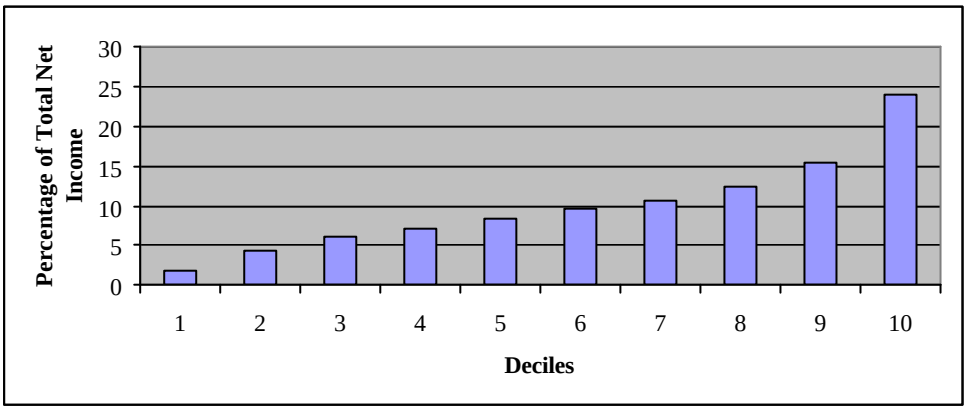
is by 9.7% higher than the Gini-coefficient for category II, by 16.6% higher than the one for category I and by even 23% higher than the one for category IV – the category with the relatively most equal distribution. The Atkinson-Index, sensitive for lower income, confirms this result. Remarkable is the fact that the Atkinson-Index for the categories I, II and IV does not show any big differences which indicates that the lower income profile of these categories is not very different.

A closer look on the income distribution is provided by income shares of the poorer and the richer population. The deviations of the decile shares of the different working hour arrangements compared to the decile shares of all working in percentage points are illustrated in Figure 7; Figure 8 shows the cumulative situation by their Lorenz curves.

One of the decile shares is of particular important: the 50% decile share, the well known median. As of Table 2, the lowest income and most unequal distributed category, category III, also has the lowest median: 50% of those people earn less than 1,252 €; that is 24% of the total income of that group.

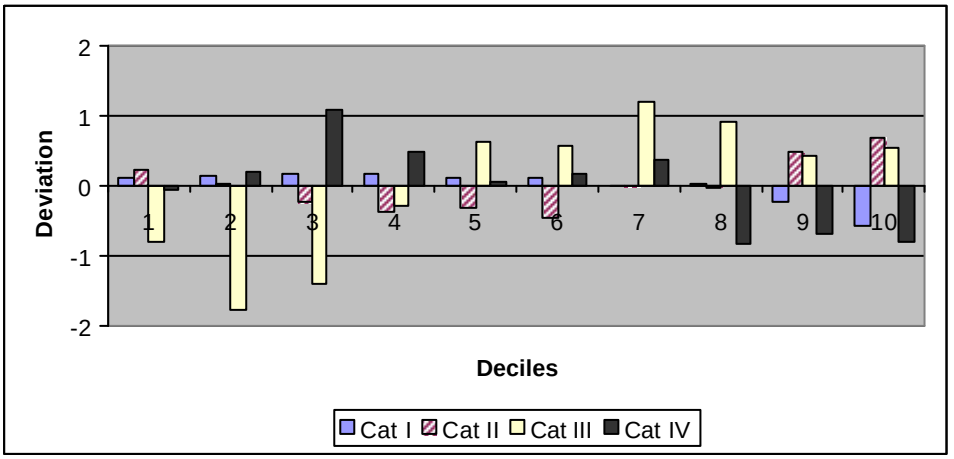
To characterize the income spread with focus on the poorest and the richest, the 90/10 relation shows the multiple of the richest ten per cent income share compared to the income share of the poorest ten percent. Again, category is in particular different to the other categories: the richest 10% there gain 25 times as much as the poorest 10%.

Figure 7a: Net Income: Decile Shares of Working (all Categories)



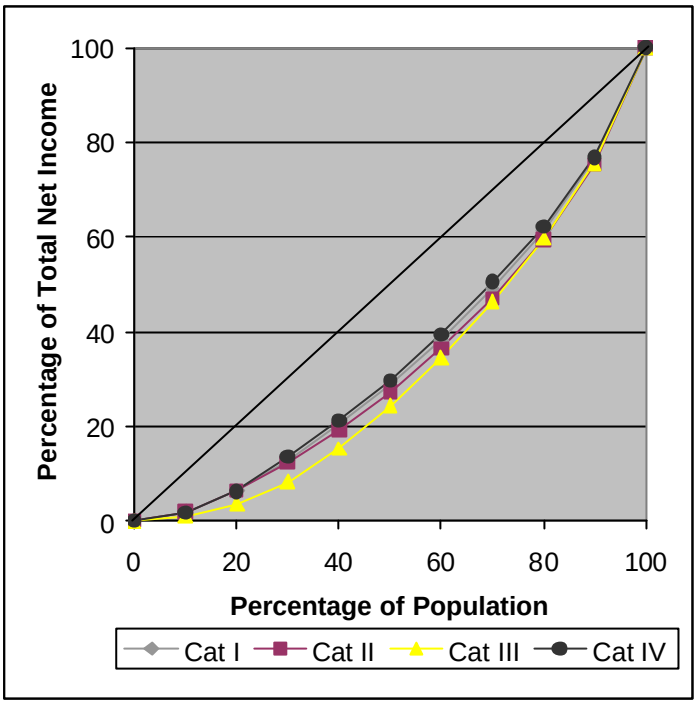
Source: German Time Use Survey 2001/02, own calculations

Figure 7b: Net Income: Deviation of Category Decile Shares compared to the Decile Shares of Working (all Categories) in percentage points



Note: all figures are due to total decile share limits
Source: German Time Use Survey 2001/02, own computations

Figure 8: Net Income: Lorenz Curves by Category



Source: German Time Use Survey 2001/02, own computations

Decomposition of Inequality

To answer the question how much of the overall inequality can be 'explained' by the specific groups a decomposition of the overall inequality into the inequality within groups and the inequality between these groups is required. Such a decompostion is available via a classs of additively decomposable inequality measures (Shorrocks 1980, 1984) with

$$I_{total,c} = I_W + I_B = \Sigma_g I_{Wg} + I_B = \Sigma_g (n_g/n) (\mu_g/\mu)^c I_c(y_g) + I_B$$

where I_W is within and I_B is between group inequality, g is the group index, μ is the overall respective group mean, n is the number of observations, $I_c(y_g)$ is the group inequality index dependend on group's incomes y_g; the group weights $w_g = (n_g/n) (\mu_g/\mu)^c$ only sums to unity when $c = 0$ or $c = 1$. The only class of inequality measures that satisfies the principle of scale invariance when comparing distributions with different means, and that ensure that the decomposition procedure is valid for arbitrary specifications of the partition, belongs to the generalised entropy class. We use the Theil index decomposition by equations providing additive group specific inequality contributions. Group specific inequality shares (%) are calculated as a group specific percentage of I_w, the overall within group inequality part. The between group inequality share (%) is calculated as I_B as a percentage of the overall inequality index $I_{total,c}$.

The inequality of the most frequent group of category I (normal workday) contributes with a share of 60% to a large extent to the overall inequality. Second in line is the inequality contribution of category II with an inequality share of 30%, whereas the inequality of category III adds only 7% and category IV even only 3% to the overall inequality. It is remarkable that the between group inequality is only ca. 2%. Thus there

is not a big difference between the inequality profiles – but as we have seen in the size of inequality - of our working hour arrangement categories.

4.2 The Distribution of Working Hours and Wage

To answer the question which income component – hours worked or wage per hour – is responsible for the overall income distribution discussed we separately analyze the distributions of category specific working hours and wages. Note, with regard to hours worked we do not take into account the diary information but the reported weekly working hours, which is more appropriate to the similar reported monthly income.[12] The wage is a calculated net wage per hour and simply is net monthly personal income divided by weekly working hours times 4.2.

The distribution of working hours

There are remarkable differences in the working hours distributions with regard to the specific working hour arrangements (see the numeric results in the Appendix). So the average working hours in those categories with more than one episode (categories II and IV) amounts to more than 43 hours, while the average weekly working hours in category I is about 38 hours and in category III even only 34 hours per week.

Comparing the distributive measures it is obvious that the categories with those persons working mainly in the non-core period (categories III and IV) have the most unequal distribution of working hours. The Gini-coefficient for category III is 60% higher than the coefficient for the ‚normal' working hour arrangement (category I), which has the most equal distribution of all categories. All further distributive measures confirm the result: the non-core/multiple episodes category III with the lowest hours of work shows the most unequal distribution of working hours; an additional aspect of fragmented working conditions.

The distribution of wages

Are jobs in a non-normal working hour arrangement better paid, or characterizes the non-normal working situations bad jobs with lower wages? Does the timing of work and its fragmentation divide the labour market in good and bad jobs of this kind?

The answer: though the non-core/one episode category III result in the lowest average wage by 9.17 €, the non-core/multiple episode category IV – the most irregular working situation – result in the highest average wage by 10.18 €. Thus, the timing of work time *and* its fragmentation, both, are important to characterize and disentangle the income situation.

Remarkably, category III (non-core/multiple episodes) is in both income dimensions the lowest: people there have the lowest wage and the lowest working hours.

The working hour arrangements with the most unequal wage distribution are the categories II and IV (multiple episodes). The differences of the wage Gini-coefficients between the working hour arrangement with the most unequal wage distribution (category II) and category I – the working hour arrangement with the most equal

[12] Further 106 diaries show no information about the weekly working hours and are therefore not taken into account.

distribution – with a difference of 15% is, however, essentially smaller than that of the income distribution.

The wage 90/10 relations between the categories are not as different than the income 90/10 relations between the categories showing the important influence of the hours worked.

The wage inequality shares are similar to the shares in the income distribution with the normal workday as the determining (and biggest) group of the income inequality profile again.

4.3 Summarizing the income distribution results

Table 3 provides a short summary of the hours and wage results ('+' stands for an above-average value, '-' stands for a value below the average).

The persons with a working hour arrangement of more than one working episode (categories II and IV) do not just work longer hours than the average but also have a higher wage than the average resulting in an above-average net income. At the same time these categories have the most unequal wage distribution.

Table 3: Results of the Income Distribution Analysis

	Net Income				Wage				Working Hours			
Categories	I	II	III	IV	I	II	III	IV	I	II	III	IV
Mean	-	+	-	+	-	+	-	+	-	+	-	+
Gini	-	+	+	-	-	+	-	+	-	-	+	+
Atkinson 1	-	-	+	-	-	+	-	+	-	-	+	+
Atkinson 2	-	-	+	+	-	+	-	+	-	-	+	+
90/10 Relation	-	-	+	-	-	+	-	+	-	-	+	+

Source: German Time Use Survey 2001/02, own computations

The category with the most unequal net income distribution is category III (non-core/one episode) in which also the most unequal working hours distribution could be noticed.

In contrast to this both net income and wage and working hours are relatively equal distributed in category I – the category which includes the persons with 'normal' working hour arrangements (core/one episode).

Altogether: The analyses show, that the distribution of income is remarkably influenced by the working hour arrangement: not only the timing of work time (core vs. non-core) but the fragmentation of the working period (by number of episodes), too, are determining the income situation and the individual economic well-being.

5 Timing and fragmentation of work and earnings: Microeconomic approach and microeconometric estimates of earnings function

The following sections want to quantify the explanatory background of earnings for the different working hour arrangements. Based on the human capital theory in a market and non-market context the microeconometric estimates of the respective earnings functions with a treatment effects approach searches for significant determinants as well as for an overall selectivity effect ('teratment effect') with respect to the daily timing of work time and its fragmentation .

5.1 Theoretical background: Human capital in a market and non-market context

The human capital approach – theoretically and empirically - has been proven a successful way in applied economics explaining the earnings function. The human capital theory explains earnings in terms of job skills aquired in school and on the job. Based on a life-cycle model, earnings are explained as consequences of individual investment decisions in their skills (Mincer 1974, Becker 1975).

The very basic human capital model explains earnings by the following equation,

(1) $$\ln E_t = \ln E_0 + r_s S + a r_p T + b r_p T^2$$

where E_t is capacity earnings in year t, E_0 is ‚original' capacity earnings, S is years of schooling, T is concave years of job experience, and r_s is the rate of return to schooling and r_p is the rate of return of job experience. With observed earnings Y their typical human capital earnings equation is

(2) $$\ln Y_t = a_0 + rS + a_1 T + a_2 T^2$$

and base for the regression analyses.

The central variable is the rate of return to schooling which approximates the per cent increase in earnings resulting from one extra year of schooling. The parameters a indicate whether the earnings function is concave, where with positive a_1 and negative a_2 earnings rise, but at a diminishing rate, peaking at experience level T* (computable from the slope $\partial \ln Y / \partial t = a_1 + 2a_2 T$).

A simple extension of the earnings function is considered in the following: further market and non-market variables to be tested as important for a more in depth socio-economic explanation might be comprised in an additional vector x resulting in and extended earnings equation

(3) $$\ln Y_t = a_0 + rS + a_1 T + a_2 T^2 + x_i' b$$

This is our general model further to be estimated; for numerous other extensions of the basic model see e.g. Polachek and Siebert 1999.

5.2 Econometrics: a treatment effects approach for an interdependent estimation of participation and earnings in different working hour arrangement categories

Within our microeconometric specification we want to disentangle the explanation of the participation in one of the four discussed working hour arrangement categories (covering all core/non-core and one/multiple episodes categories) and the category dependent earnings.

One approach could be in a multinomial (MNL) estimation of the participation probability and in a second stage in a (MNL) selectivity bias corrected earnings estimate following Lee 1983 generalizing the original two stage Heckman 1979 procedure. This was done by Merz and Burgert 2003 for their associated study on a two stage working hours approach with daily working hour arrangements based on the 1991/1992 German Time Budget Survey.

In our study at hand, however, we want to quantify the all over impact of a specific working hour arrangement category on the category specific earnings equations – by maintaining the detailed explanation of the probability to select a certain category. Thereby the interdependence of the participation and the earnings equation should be respected, since there are some common explanatory variables in both equations in particular to be expected.

An extension of the self-selection problem fits into our modelling concept: it is the measurement of **treatment effects** and program effectiveness[13]. Our cross sectional earnings equation of each individual i for one category j (j=1,…,J=4) accounts for the endogenous decision to work in that category j

$$(4) \qquad \ln Y_{ij} = a_0 + rS + a_1 T + a_2 T^2 + x_{ij}' b_j + d_j C_{ij} + e_{ij} \quad (j = 1,...,4),$$

where C_{ij} is a dummy variable indicating whether or not the individual works in category j. The same principal format has been used in any number of other analyses of programs, experiments, and treatments (Greene 2003, pp. 787-89). The question is: Does d_j measure the value and impact of a specific working hour arrangement (assuming that the rest of the regression model is correctly specified)? The answer is no if the typical individual who chooses a specific category would have relatively high earnings whether or not an individual chose that category. The problem is one of self-selection. If our observation is correct, then least squares estimates of d_j will actually overestimate the treatment effect. The same observation applies to estimates of the treatment effects in other settings in which the individuals themselves decide whether or not they will receive the treatment.

Our treatment effects model estimates the effect of the endogenous binary decision to participate in a working hour arrangement category j (treatment) on the continuous earnings variable Y_{ij}, conditional on their respective vector of explanatory variables. The binary decision is modelled as the outcome of an unobserved latent variable C_i^* as:

[13] See Angrist 2001 on whether and how it is possible to measure treatment effects and Maddala 1983

$$(5)\qquad \begin{aligned} &C_{ij}^{*} = w'_{ij}\gamma_j + u_{ij}, \\ &C_{ij} = 1 \;\; if \qquad C_{ij}^{*} > 0, 0 \; otherwise. \end{aligned}$$

Because of the allowed endogenous participation decision, u_{ij} and e_{ij} are correlated bivariate normal with mean zero and covariance matrix

$$\operatorname{cov}(u_{ij}, e_{ij}) = \begin{pmatrix} \sigma_j & \rho_j \\ \rho_j & 1 \end{pmatrix}.$$

Bringing the two equation model together, the category j specific earnings function with socio-economic variables and endogenous participation decision is

$$(6)\qquad \begin{aligned} &E\left[\ln Y_{ij} \mid C_{ij} = 1, S_{ij}, T_{ij}, x_{ij}, w_{ij}\right] \\ &\quad = \alpha_0 + \rho S + \alpha_1 T + \alpha_2 T^2 + x'_{ij}\beta_j + \delta_j C_{ij} + E\left[\varepsilon_{ij} \mid C_{ij} = 1, S_{ij}, T_{ij}, x_{ij}, w_{ij}\right] \\ &\quad = \alpha_0 + \rho S + \alpha_1 T + \alpha_2 T^2 + x'_{ij}\beta_j + \delta_j C_{ij} + \rho_j \sigma_{\varepsilon j} \lambda_j(-w'_{ij}\gamma) \end{aligned}$$

A two step estimator (bivariate probit for the participation decision and treatment corrected OLS for the earnings equation) will account for the self-selected nature of a participation in category j.

One question is still open, how the different categories depend on another. With our model formulation C_{ij} is zero if category j is not chosen. Thus the universe behind of that set comprises all other working categories, so that for every chosen category all other possibilities were taken into account by this universe behind.

The difference in expected ln earnings between participants and non participants is (Greene 2003, p. 788):

$$(7)\qquad E\left[\ln Y_{ij} \mid C_{ij} = 1\right] - E\left[\ln Y_{ij} \mid C_{ij} = 1\right] = \delta_j + \rho_j \sigma_{\varepsilon j}\left[\frac{f_{ij}}{\Phi_{ij}(1-\Phi_{ij})}\right].$$

If the selectivity correction λ_i is omitted from the last squares regression, then this difference is what is estimated by the least squares coefficient on the treatment dummy variable. But since (by assumption) all terms are positive, we see that least squares overestimates the treatment effect.

5.3 Results: Earnings explanation considering timing and fragmentation of daily work

One major result of our descriptive analysis was, that working hour arrangements measured by its daily timing and fragmentation results in category specific income levels as well income distributions. Thus income inequality is influenced by daily working time patterns. The question we want to answer now is, what factors drive these category specific earnings, where earnings as above are measured by monthly net income of active work.

Our microeconometric model discussed above - with an interdependent earnings equation by a treatment effects model and a bivariate probit equation for the endogenous participation probability for each category - will quantify those factors and

show their statistical significance. In addition, the overall category specific influence is quantified and tested for significance.

The substantial hypotheses to be tested are driven by the following strategy:

- *Category participation probability*: explanatory variables include non-market: personal characteristics, non-market time use, partner's employment, household characteristics, income/wealth situation and region) (Table 4a).
- *Earning*' explanatory variables include market factors: human capital and further socio-economic market oriented factors (occupational status, second job indicator, demand side and region) (Table 4b);

The particular single results based on the estimation results are discussed now separately for the earnings estimates and for the participation estimates based on the 2001/2002 German time diary data and circumstances.

5.3.1 Participation in daily working hour arrangements

The explanation of the probability to participate in the respected four working hour arrangements – endogenous to the earnings equation - result with Table 4a in a heterogenous pattern, where at the first glance, the overwhelming significance of the single underlying hypotheses as in the earnings equations is not given anymore. However, and with regard to some coming unexpected results, the participation probabilities here are due to the final decision for a certain working arrangement. With reference only to the working individuals, our coefficients and estimates have nothing to do with the general decision to work or not to work including workers and non workers. Thus, all results have to be interpreted as compared to the average working situation.

Personal demographics: age, as a more or less catch-up variable for the lifecycle situation of a person, is significant only for core jobs; non-core job participation is dependent on other respected factors. Gender differences are visible in a significant manner in the non-core categories with a smaller female probability to participate. On the other hand, the participation probability in a normal workday is smaller for men, whereas there is no gender difference within a fragmented but core job. To be married is in favour for a normal workday.

Education: There is a clear picture that a higher education is less important for odd jobs at non-core times. For core jobs the participation probability is even significant lower when the education is higher. These results are a an important hint to separate the participation decision from the final earnings situation, the way we modelled the working situation.

Non-market time use: Our hypothesis, that non-market time use behaviour has an influence on the choice of the working hour arrangement, is confirmed by significant effects. Time for children seems to be not competitive, whereas time for household work and time for 'do it yourself'-work is significant, but with different sign. More time at home in these activities reduces the fragmented core work but increases non-core engagement. With regard to social networking job participation is merely independent of active help for other households.

Partner's employment: The partner's employment activity as a full time or part time worker seems to be of minor importance for the job participation decision. However, for the most irregular case, non-core/multiple episodes, an additional worker effect outside the normal workday situation becomes visible and significant.

Table 4a: Earnings and timing and fragmentation of work: Endogeneous participation probability estimates by a bivariate probit model for daily working hour arrangements

	Category I		Category II		Category III		Category IV	
	Core One episode		**Core # episodes** ^{3} **2**		**Non-core One episode**		**Non-core # episodes** ^{3} **2**	
PARTICIPATION PROBABILITY								
Personal demographics								
age	.0227389	*	-.0182999		-.0220969		.0306111	
age ^{2}	-.0003184	**	.0003255	**	.0001241		-.0003687	
woman	.1531365	***	-.0199893		-.1680781	**	-.3783944	***
married	.1552043	**	-.1302822	**	-.0212925		-.2004843	*
education								
elemantary	.116942		-.1358193		-.1749561		.254799	
intermediate	.1200956		-.0870726		-.1716882		-.0095316	
spec. upper or upper	-.0835988	**	.1385355	***	-.2079447	***	.1692626	**
university	-.2891626	***	.330533	***	-.1448368		.2736943	**
non-market time use								
time for household	.0000759		-.0015483	***	.0023518	***	.0011799	***
time for child care	.0010501	*	-.000907		-.0001078		-.0011221	
time for do-it-yourself	.000299		-.0026076	***	.0021689	***	.0021063	**
active help (h)	-.0017347		.0013517		-.0014825		.0048663	*
partner`s employment								
partner full time work	-.0763369		.0253924		-.0308513		.3155059	***
partner part time work	-.0887075	*	.0536556		.0915853		.0799004	
Household characteristics								
receiving help (h)	.0007053		-.0020338		.0010574		.0014867	
number of hh members	-.0652222	***	.0669324	***	.0017645		.018666	
young kids	-.0634876		.0857412		-.0448537		.0361543	
Income/wealth situation								
own house	-.0602891		.0840075	*	-.0599845		.049606	
residual income	8.92e-06		-5.52e-06		-6.23e-06		-1.45e-06	
region								
east Germany	.2765265	***	-.2670162	***	.014006		-.2985634	***
constant	.0018567		-.4213718		-.7616166	*	-2.777401	***
Wald chi^2 (16)	1386.03		2525.95		4938.93		6425.18	
p-value for chi^2	.00000	***	.00000	***	.00000	***	.00000	***
n (working: 10607)	6852		2678		719		358	

Significance levels: * 5%, ** 1%, *** 0.1%

Source: German Time Budget Survey 2001/2002, own computations

Household characteristics: The household context is described by the household size and the existence of young children (≤ six years, pre-school age). With greater households the participation probability is diminished for normal workdays. Young kids show no influence on the working arrangement decision, a result not expected.

Receiving support in various ways is on the agenda of recent public labour market policy. So far in 2001/2002 receiving help seems to be of no importance for the participation decision between these categories, but might be of importance for the general decision going to work or not.

Income and wealth situation: To analyse the income and wealth situation of the entire economic situation of the household this influence is tested by household net income minus own net income as residual income and owing the house. Economic opportunities – neither measured by owing the house where the household is living nor by the further available money resources – have an impact on one or the other category decision. Again, nothing is said about a possible influence on the working or not working decision.

Region: Living in the former East Germany significantly increases the probability to choose a standard working hour arrangement with one episode to the burden of a most irregular working pattern of category IV (fragmented non-core jobs).

5.3.2 Earnings by working hour arrangements

Because of the ln earnings specification the estimated coefficients in Table 4b in general approximate the per cent increase in earnings resulting from one extra unit of a variable.

First of all: for all categories the specific working hour arrangement is highly significant in explaining earnings. In addition, the significant selectivity term is highly significant supporting our modelling strategy.

Compared to all workers (the average behaviour), the multiple episode cases (II and IV) result in significant higher earnings – regardless at core or non-core time – and the most in the core/multiple episode category. Contrary to this, the one episode working arrangements result in below average income, the lowest for the 'normal' workday (category I). The separate influence of working time and wages are discussed above. Thus, the non-traditional working hour arrangements overall show higher earnings, a result, which was not expected when non-normal (in this sense) would be attributed to worse labour market conditions.

Reasons behind this phenomenon are disentangled by the single explanatory factors analyzed.

Human capital: While work experience with concave character is highly significant for all arrangements, years of schooling only is important for the non-core segment.

Occupational status: Compared to blue collar all other occupational stati in all categories rise earnings. The exemption of being a helping family member might show some support as an additional worker effect but in non-core categories only.

Multiple jobs: As discussed earlier, our data base only allows to add a general dummy for a second job. The very interesting case of an additional job the day under investigation could not be regarded. Nevertheless, the result is astonishing: nearly by the same size a second job diminishes earnings in all categories indicating the better earnings situation of one job holders in general.

Demand side: As expected earnings outside agriculture are higher. Though the private and public service sector with the most workers is still growing, a job in the industry in all working hour categories result in higher income.

Table 4b: Earnings and timing and fragmentation of work: Earnings estimates by a treatment effects model

	Category I		Category II		Category III		Category IV	
	Core One episode		**Core # episodes**		**Non-core One episode**		**Non-core # episodes**	
	–		**3 2**		**–**		**3 2**	
ln EARNINGS								
Category j d_j	-3.908531	***	2.850709	***	-2.217199	***	1.57194	***
Hazard lambda	2.362135	***	-1.636485	***	1.035406	***	-.6644788	***
human capital								
School years (S)	0052858		.0004131		.0429798	***	.0545976	***
Work experience (T)	.0578081	***	.05921	***	.0444624	***	.0419555	***
Work experience^2 *(T*^{2}*)*	-.0010511	***	-.001103	***	-.0007361	***	-.0006443	***
occupational status								
reference: blue collar	-		-		-		-	
self-employed 0 empl.	.5877811	***	.5590384	***	.7731187	***	.8196024	***
self-employed >0 empl..	.385388	*	.3715193	**	.6535276	***	.7175627	***
liberal professions	.4569893	***	.4563182	***	.5722316	***	.6073045	***
civil servants	.8885734	***	.8803991	***	.9466153	***	.9849433	***
white collar worker	.4029769	***	.3505992	***	.3148965	***	.3512981	***
apprentice	-.3574205	***	-.3627674	***	-.3195913	***	-.2942108	***
helping family member	-.1604767		-.1234818		-.2040246	***	-.2584336	*
multiple jobs								
Second job	-.2356443	***	-.2275196	***	-.2438255	***	-.263097	***
demand side								
ref.: agriculture								
industry	.6705779	***	.6928089	***	.7440246	***	.7576406	***
services	.4377631	***	.430295	***	.447006	***	.4520374	***
region								
Ost	.1744386	**	.0219009		-.2191925	***	-.1931014	***
constant	8.200124	***	5.066563	***	5.595438	***	5.228578	***
Wald chi^2 *(16)*	1386.03		2525.95		4938.93		6425.18	
p-value for chi^2	.00000	***	.00000	***	.00000	***	.00000	***
n (working: 10607)	6852		2678		719		358	

Significance levels: * 5%, ** 1%, *** 0.1%

Source: German Time Budget Survey 2001/2002, own computations

Region: The general dummy for a job in East Germany is significant positive for core working arrangements and negative for non-core working. The traditional timing of work time therefore result in higher income compared to West Germany. Putting it in other words: just non-core working conditions are lesser paid in East Germany.

To summarize : in addition to the significance of human capital, occupational status, the multiple job situation as well as demand side and allover regional factors play a significant role in explaining individual earnings. The pattern is different in different working hour arrangements. Every working hour arrangement category results in significant different earnings emphasizing our modelling strategy.

5.3.3 Summarizing the results of earnings explanation considering timing and fragmentation of daily work

To summarize our results an overview of explanatory factors of earnings considering timing and fragmentation of daily work is given in Table 5.

Table 5: Earnings explanation considering timing and fragmentation of daily work: An overview of explanatory pattern

	Category I **Core One episode** –		Category II **Core # episodes** 3 **2**		Category III **Non-core One episode** –		Category IV **Non-core # episodes** 3 **2**	
	earnings	part.	earnings	part.	earnings	part.	earnings	part.
Category j	***	-	***	-	***	-	***	-
l	***	-	***	-	***	-	***	-
PERSONAL CHARACTERISTICS								
Demographics	-	***	-	**	-	*	-	**
human capital	***	-	***	-	***	-	***	-
education	-	**	-	***	-	**	-	**
occupational status	***	-	***	-	***	-	***	-
multiple jobs	***	-	***	-	***	-	***	-
non-market time use	-	***	-	***	-	***	-	***
demand side: business sectors	***	-	***	-	***	-	***	-
PARTNER'SCHARACTERISTICS								
partner`s employment	-	*	***		-		-	***
HOUSEHOLD CHARACTERISTICS								
Household characteristics	-	**	-	**	-		-	
Income/wealth situation	-		-	*	-		-	
REGIONAL VARIABLES								
region	**	***	-	***	***		***	***

- not specified, blank field: not significant; Significance levels: * 5%, ** 1%, *** 0.1%

Source: German Time Budget Survey 2001/2002, own computations

Interpreting the stylized results of Table 5 we can conclude with the overall hypothesis: The driving factors of so-called 'normal' and ‚non-normal' workdays are quite different: the timing of work time as well as the fragmentation of daily work are significant factors in explaining individual earnings.

The results support our modelling and the two stage explanation in particular: the probability to participate to a certain daily working hour arrangement shows different explanatory pattern than the final earnings as the economic result. This is in line with the findings of Merz and Burgert 2003 for category specific hours of work.

The participation probability of a specific working hour arrangement – given working – shows different explanatory pattern for different arrangements. Demographics, education, non-market time use, partner's and household characteristics as well as regional variables are important but of different influence in explaining working hours in different working hour arrangements.

The earnings function specification results in highly significant – but in size and sign different – coefficients for all variables included, showing the importance of human capital, occupational status, multiple job and demand side factors by business sectors and regional influences.

6 Concluding remarks

Our study is contributing to economic well-being by adding insights into particular work effort characteristics and its resulting income distribution. The work effort characteristics we regard is about labour market flexibility with focus on relations between the daily timing of work and its fragmentation, and its consequences on income inequality.

Descriptive results:

On average: Working hour arrangements with more than one working episode (categories II and IV): they work longer, have a higher wage rate and thus an above – average income

Distribution: All non-normal working hour arrangements (categories II,II,IV) compared to he normal situation (category I) show higher inequalities with regard to hours worked, wage paid, and income achieved; one exception: the most irregular working hour arrangement (category IV) shows the most equally distributed income.

The most unequal net income distribution: category III (non-core/one episode) with the most unequal working hours distribution.

The distributive analysis thus has shown that timing and fragmentation of work time do have distinct consequences on the earnings distribution

Microeconometrics:

The estimates with endogenous self-selection (treatment effects approach) explaining earnings and participation (MNL-approach) in different daily working hour arrangements support our interdependent two stage modelling strategy with the overall result:

Individual earnings in Germany are dependent on and significant different with regard to the daily working hour arrangement capturing timing and fragmentation of work.

The participation probability for the core/non-core and number of episodes working time categories follow different explanatory pattern with regard to personal characteristics (demographics, human capital , education, occupational status, multiple jobs, non-market time use) demand side (business sectors), partner's (employment) and household characteristics (composition, wealth) as well as a regional indicator. Those market and non-market factors also are important and significant in explaining earnings – and thus the income distribution in all daily working hour arrangements, however, in a different pattern.

The detailed findings support targeted modern economic and social policy with regard to non-traditional labour market situation and flexibility.

Further research should deepen these findings and compare them with German time use data of the beginning 90s to disentangle dynamics of flexible labour market situations.

Appendix

Table A1: Number of persons in % by category and different break definition

	Duration of break ≥ 30 minutes			Duration of break ≥ 60 minutes			Duration of break ≥ 90 minutes		
	N in %	N	n	N in %	N	n	N in %	N	n
Category I	27.4%	17,031,821	3,429	65.1%	40,503,406	6,884	78.1%	48,552,582	8,055
Category II	62.9%	39,102,162	6,154	25.1%	15,605,547	2,698	12.2%	7,560,907	1,525
Category III	4.9%	3,073,410	588	6.5%	4,037,688	716	6.7%	4,157,613	743
Category IV	4.8%	2,965,380	477	3.3%	2,026,132	350	3.1%	1,901,671	325
All Categories	100.0%	62,172,772	10,648	100.0%	62,172,772	10,648	100.0%	62,172,772	10,648

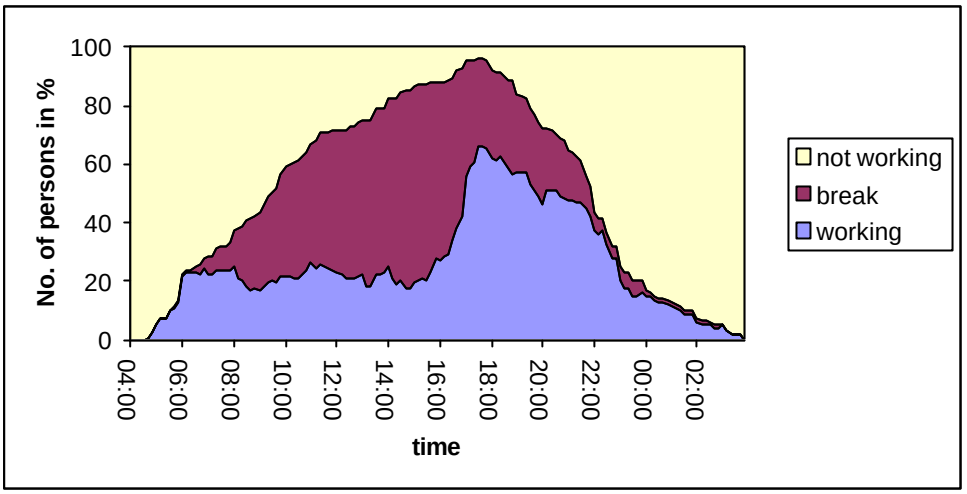
Source: German Time Use Survey 2001/02, own computations

Table A2: Time spent for work, breaks, non work by category

	Category I Core one episode	**Category II** Core multiple episodes	**Category III** Non-core one episode	**Category IV** Non-core multiple episodes
N	40,503,406	15,605,547	4,037,688	2,026,132
n	6,884	2,698	716	350
Average time spent for work	7’40’’	7’22’’	5’24’’	7’31’’
Average time spent for breaks	---	2’23’’	---	10’22’’
Average time spent for non-work	16’20’’	14’15’’	18’36’’	6’07’’

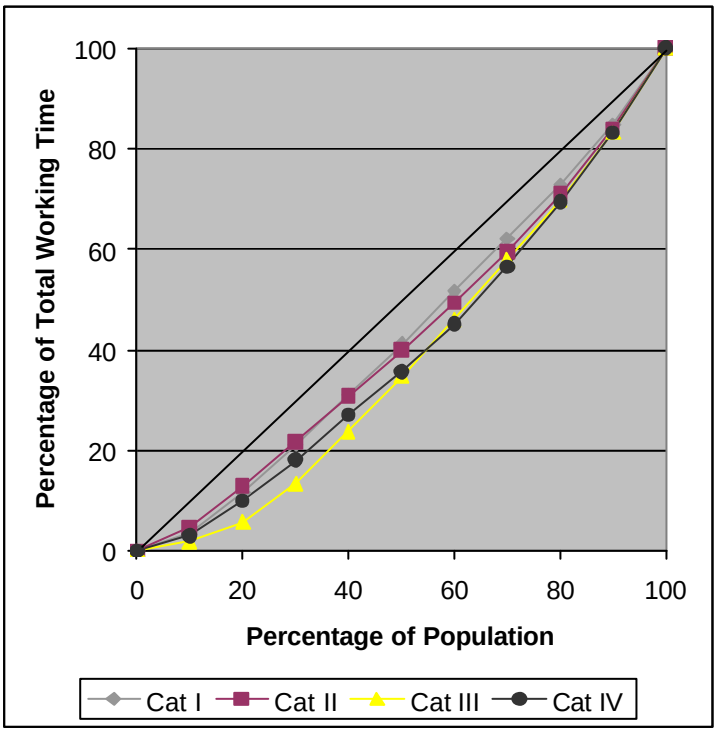
Source: German Time Use Survey 2001/02, own calculations

Figure A1: No. of persons by activity and day time: Category IV (non-core/multiple episodes) - Excluding night-workers.



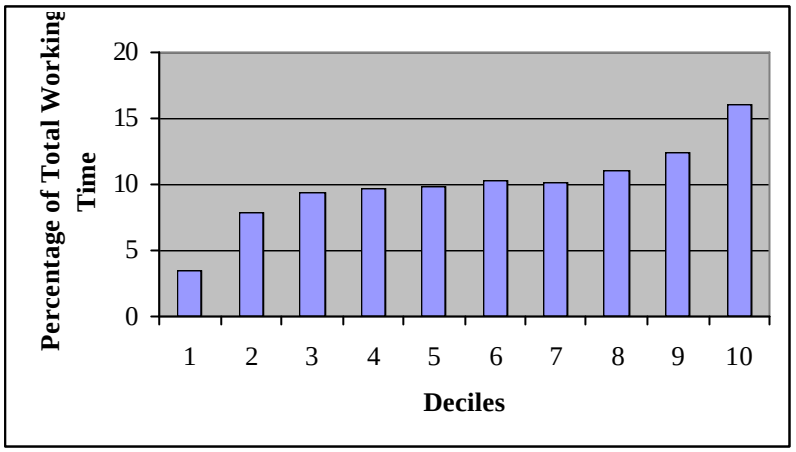
Source: German Time Use Survey 2001/02, own calculations

Figure A2: Working Hours: Lorenz Curves by category



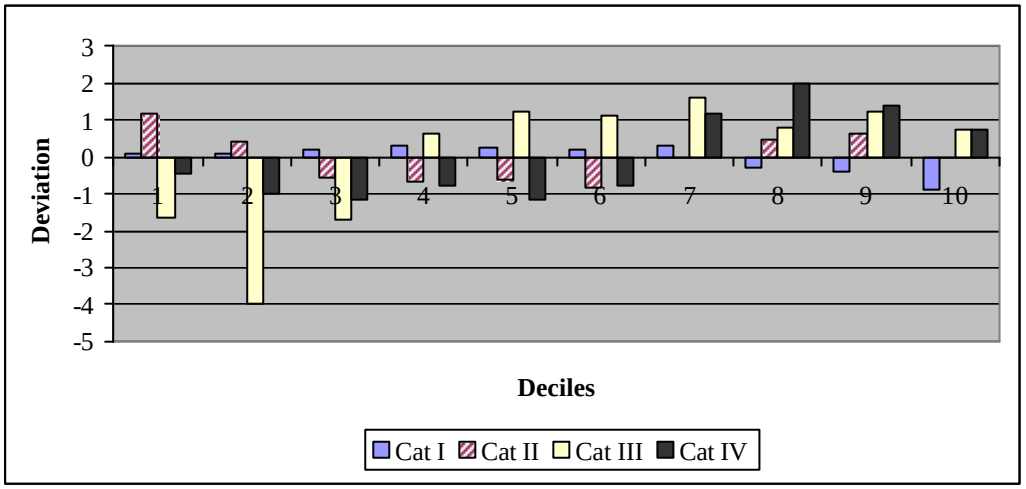
Source: German Time Use Survey 2001/02, own calculations

Figure A3: Working Hours: Decile Shares of all Categories



Source: German Time Use Survey 2001/02, own calculations

Figure A4: Working Hours: Deviation of Decile Shares compared to the Decile Shares of all Categories in percentage points



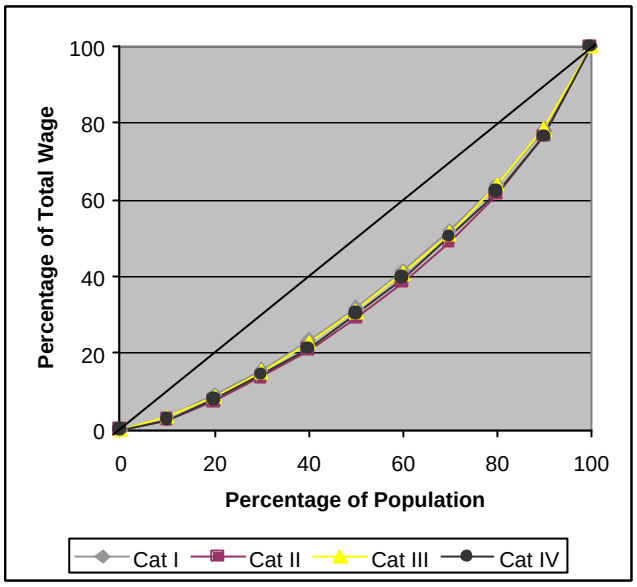
Source: German Time Use Survey 2001/02, own calculations

Table A3: Working Hours: Distributive measures by Category

	Total	Category I (core/ episode)	Category II (core/ #episodes>1)	Category (non-core/ one	Category IV (non-core/ #episodes>1)
Mean in h	39.41	38.18	43.35	34.02	44.21
Median in h	40.00	39.00	40.00	38.50	40.00
Scewness	-0.01	-0.40	0.49	-0.35	0.15
Kurtosis	2.74	2.86	1.42	0.70	0.98
Variation	0.32	0.29	2.51	0.43	0.37
Distributive measures					
Gini-Coefficient	0.15778	0.14342	0.15543	0.22893	0.20019
Atkinson-Index					
ε = 1	0.07333	0.06777	0.05496	0.15147	0.09496
ε = 2	0.23033	0.21972	0.14713	0.42123	0.28201
Decile shares in % (Decile limits in h)					
1. Decile	3.44 (22.0)	3.56 (22.0)	4.6 (32.0)	1.79 (10.0)	2.97 (23.0)
2. Decile	7.86 (35.0)	7.94 (35.0)	8.27 (38.0)	3.88 (20.0)	6.85 (35.0)
3. Decile	9.39 (38.0)	9.59 (38.0)	8.84 (38.5)	7.68 (35.0)	8.24 (38.0)
4. Decile	9.71 (38.5)	10.03 (38.5)	9.05 (40.0)	10.36 (36.0)	8.92 (40.0)
5. Decile	9.84 (40.0)	10.09 (39.0)	9.21 (40.0)	11.08 (38.5)	8.68 (40.0)
6. Decile	10.17 (40.0)	10.39 (40.0)	9.36 (42.0)	11.29 (40.0)	9.42 (45.0)
7. Decile	10.14 (41.0)	10.48 (40.0)	10.15 (46.5)	11.73 (40.0)	11.33 (52.5)
8. Decile	10.97 (45.0)	10.71 (43.0)	11.43 (51.0)	11.79 (42.0)	12.98 (60.0)
9. Decile	12.45 (55.0)	12.06 (50.0)	13.11 (60.0)	13.66 (50.0)	13.84 (64.0)
10. Decile	16.01	15.15	15.98	16.74	16.77
90/10 Relation	4.65	4.26	3.47	9.35	5.65
Decomposition					
Theil Index	0.05608	0.05011	0.04746	0.11097	0.07504
Inequality shares in %		58.94	24.45	11.48	5.13
Group share in %:					
within	95.72				
between	4.28				
n	10,501	6,788	2,662	704	347
N	61,362,471	39,982,330	15,425,900	3,947,433	2,006,809
N in %	100.00	65.16	25.14	6.43	3.27

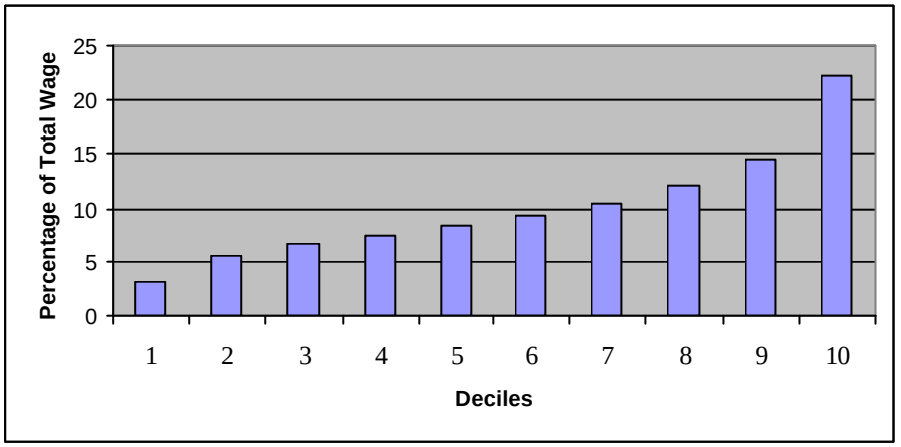
Source: German Time Use Survey 2001/02, own calculations

Figure A5: Wage: Lorenz Curves by category



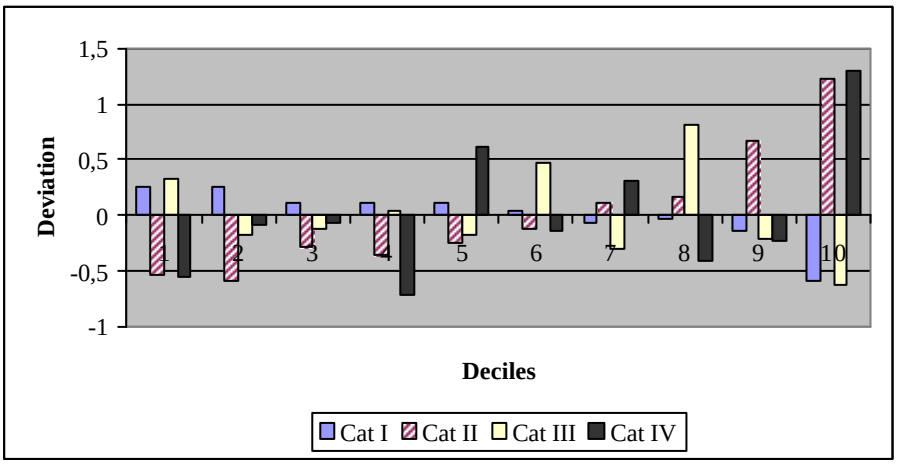
Source: German Time Use Survey 2001/02, own calculations

Figure A6: Wage: Decile Shares of all Categories



Source: German Time Use Survey 2001/02, own calculations

Figure A7: Wage: Deviation of Decile Shares compared to the Decile Shares of all Categories in percentage points



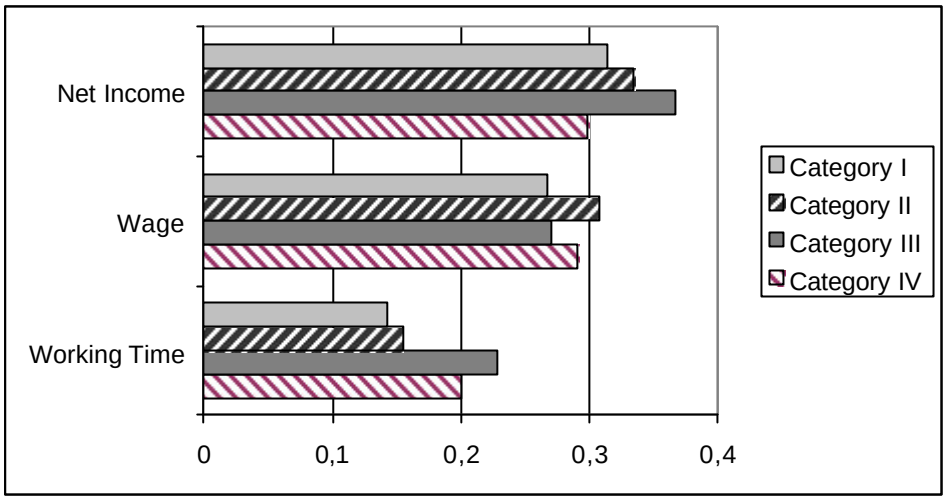
Source: German Time Use Survey 2001/02, own calculations

Table A4: Wage: Distributive measures by Category

	Total	Category I (core/ episode)	Category II (core/ #episodes>1)	Category III (non-core/ one episode)	Category IV (non-core/ #episodes>1)
Mean in €	9.79	9.71	10.10	9.17	10.18
Median in €	8.66	8.63	8.92	8.23	8.62
Scewness	3.00	3.63	1.92	2.75	1.99
Kurtosis	21.56	31.56	6.48	18.96	6.24
Variation	0.58	0.56	0.61	0.54	0.58
Distributive measures					
Gini-Coefficient	0.27981	0.26783	0.30785	0.27126	0.29128
Atkinson-Index					
ε = 1	0.13375	0.12299	0.16215	0.11799	0.14747
ε = 2	0.29146	0.26517	0.35994	0.22803	0.34271
Decile shares in % (Decile limits in €)					
1. Decile	3.09 (4.46)	3.34 (4.82)	2.56 (4.06)	3.42 (4.12)	2.54 (4.17)
2. Decile	5.44 (5.95)	5.69 (6.09)	4.85 (5.80)	5.26 (5.41)	5.35 (6.09)
3. Decile	6.58 (6.94)	6.69 (6.96)	6.29 (6.94)	6.46 (6.45)	6.52 (7.37)
4. Decile	7.53 (7.81)	7.64 (7.85)	7.17 (7.78)	7.57 (7.3)	6.82 (7.97)
5. Decile	8.43 (8.66)	8.54 (8.63)	8.18 (8.96)	8.26 (8.22)	9.05 (8.62)
6. Decile	9.43 (9.74)	9.46 (9.67)	9.31(10.05)	9.90 (9.67)	9.28(10.03)
7. Decile	10.54(11.05)	10.48(10.86)	10.65(11.45)	10.23(10.42)	10.85(11.75)
8. Decile	12.15(12.90)	12.12(12.76)	12.31(13.54)	12.96(11.91)	11.73(12.99)
9. Decile	14.51(16.13)	14.37(15.76)	15.18(17.93)	14.29(14.78)	14.28(15.81)
10. Decile	22.28	21.68	23.51	21.65	23.58
90/10 Relation	7.21	6.49	9.18	6.33	9.28
Decomposition					
Theil Index	0.1375	0.12803	0.16145	0.12499	0.14783
Inequality shares in %		60.32	30.53	5.49	3.66
Group share in %:					
within	99.78				
Between	0.22				
N	10,501	6,788	2,662	704	347
N	61,362,471	39,982,330	15,425,900	3,947,433	2,006,809
N in %	100.00	65.16	25.14	6.43	3.27

Source: German Time Use Survey 2001/02, own calculations

Figure A8: Gini-Coefficients by category



Source: German Time Use Survey 2001/02, own calculations

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