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# **The Timing of Daily Demand for Goods and Services – Multivariate Probit Estimates and Microsimulation Results for an Aged Population with German Time Use Diary Data**

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## **Abstract**

Though consumption research provides a broad spectrum of theoretical and empirical founded results, studies based on a daily focus are missing. Knowledge about the individual timing of daily demand for goods and services, opens – beyond a genuine contribution to consumption research – interesting societal and macro economic as well as individual personal and firm perspectives: it is important for an efficient timely coordination of supply and demand in the timing perspective as well as for a targeted economic, social and societal policy for a better support of the every day coordination of life. Last not least, the individual daily public and private living situations will be visible, which are of particular importance for the social togetherness in family and society. Our study contributes to the timing of daily consumption for goods and services with an empirical founded microanalysis on the basis of more than 37.000 individual time use diaries of the nationwide Time Budget Survey of the German Federal Statistical Office 2001/02. We describe the individual timing of daily demand for goods and services for important socio-demographic groups like for women and men, the economic situation with income poverty and daily working hour arrangements.

The multivariate microeconomic explanation of the daily demand for goods and services is based on a latent utility maximizing approach over a day. We estimate an eight equation Multivariate/Simultaneous Probit Model, which allows the decision for multiple consumption activities in more than one time period a day. The estimates quantify effects on the timing of daily demand by individual socio-economic variables, which encompasses, personal, household, regional characteristics as well as daily working hour arrangements within a flexible labour market.

The question about individual effects of an aged society on the timing of daily demand for goods and services is analyzed with our microsimulation model ServSim and a population forecast for 2020 by the German Federal Statistical Office.

Main result: There are significant differences in explaining the timing of daily demand for goods compared to services on the one hand and in particular for different daily time periods. The conclusion: without the timing aspects an important and significant dimension for understanding individual consumption behaviour and their impacts on other individual living conditions would be missing.

**JEL:** J29, D12, C25

**Keywords:** *timing of daily consumption/demand for goods and services, shopping hours, consumption and service activities, German Time Budget Survey 2001/2002, time use diaries, multivariate probit estimation, microsimulation model ServSim*

## **Zusammenfassung**

Obwohl die Konsumforschung ein breites Spektrum theoretisch und empirisch fundierter Ergebnisse bietet, fehlen doch Studien mit einem Fokus auf die tageszeitliche Lage des Konsums. Das Wissen über die tageszeitliche Lage der individuellen Güter- und Dienstleistungsnachfrage eröffnet – über den genuinen Beitrag zur Konsumforschung hinaus – interessante gesellschaftliche und makroökonomische, sowie auch personenbezogene und Firmenperspektiven: es ist sowohl für eine effiziente zeitliche Koordination von Angebot und Nachfrage als auch für eine an dem Ziel einer besser Zeitkoordination des Alltags orientierte Wirtschafts-, Sozial- und Gesellschaftspolitik notwendig. Nicht zuletzt, werden die täglichen individuellen Lebenssituationen öffentlich und privat sichtbar, die von einer besonderen Bedeutung für das soziale Zusammenleben in Familie und Gesellschaft sind. Unsere Studie ist ein Beitrag empirischer Beitrag (basierend auf 37.000 individuellen Zeittagebüchern der Deutschen Zeitbudgeterhebung 2001/2002) zur Forschung zur tageszeitlichen Koordinierung der Nachfrage nach Gütern und Serviceleistungen. Wir beschreiben die individuelle tageszeitliche Lage der Nachfrage nach Gütern und Dienstleistungen für wichtige sozio-ökonomische Gruppen, wie für Frauen und Männer, abhängig von der Einkommenssituation und für Gruppen unterschiedlicher Arbeitszeitregelungen.

Die multivariate mikroökonometrische Erklärung von der täglichen Nachfrage nach Gütern und Dienstleistungen basiert auf einem latenten Nutzenmaximierungsansatz über einen Tag. Wir schätzen ein acht-gleichungs multivariates/simultanes Probit-Modell, das eine Schätzung multipler Konsumaktivitäten, also in mehr als einer Zeitperiode pro Tag, ermöglicht. Die Schätzer quantifizieren den Einfluss individueller sozio-ökonomischer Variablen, die sowohl private, haushaltliche, regionale Eigenschaften, sowie tägliche Arbeitszeitübereinkommen in einem flexiblen Arbeitsmarkt umfassen, auf die Zeitplanung der täglichen Nachfrage.

Mithilfe unseres Mikrosimulations-Modells ServSim und einer Bevölkerungs-Prognose für 2020 des Statistischen Bundesamts analysieren wir die Frage nach Effekten einer alternden Gesellschaft auf die Zeitverwendung für die tägliche Nachfrage nach Gütern und Dienstleistungen.

Hauptresultat: Es gibt signifikante Unterschiede in der Erklärung der tageszeitlichen Lage der Güter- gegenüber der Dienstleistungsnachfrage und auch in der Erklärung der Nachfrage in unterschiedlichen Zeitabschnitten. Ohne diese zeitlichen Aspekte der Nachfrage würde also eine wichtige und signifikante Dimension für das Verständnis individuellen Konsumverhaltens und dessen Auswirkungen auf andere individuelle Lebensbedingungen fehlen.

**JEL:** J29, D12, C25

**Schlagwörter:** *tageszeitliche Lage der Nachfrage nach Gütern und Dienstleistungen, Ladenöffnungszeiten, Konsum- und Dienstleistungsaktivitäten, Deutsches Zeit-Budget-Studie 2001/2002, Zeittagebücher, multivariate Probit Schätzung, Mikrosimulationsmodell ServSim*

# 1 Introduction

The analysis of the timing of daily demand for goods and services opens interesting individual and societal perspectives besides a genuine contribution to consumer research in general: considering the *individual perspective* of demand and supply the knowledge of the timing of daily demand is important for time specific efficient match of supply and demand not only under regulation of shopping hours but perhaps even more important in times of shopping hours liberation. Timing relevant information is offered to individual suppliers of shopping goods and services – e.g. the service supply of (liberal) professions (i.e. freelancers, the German "Freie Berufe") – to increase their success according to the time of day targeted supply with instruments like time-specific personnel planning, product placement and time of day pricing. We argue, that even in times of “timeless” internet shopping, the wide range of necessary off-line shopping (e.g. with time of the day dependent pricing like for automobile gasoline) and personal “face-to-face” asking for services (e.g. in the health system or general when interacting with liberal professions) is still linked with the daily timing dimension. Broadening the individual perspective, individual targeted social and economic policy needs information about the growing flexibility and its timing consequences of the individual working and leisure life.

Under the *societal perspective* – and beyond the macroeconomic central importance of consumption for business cycles in general – any timing of consumption and therefore economic activity is mixed up with the organisation of daily life and is important for social togetherness within the family and the society in general. Thus, knowledge about the determining factors of the timing of daily demand opens new and broader perspectives for economic as well as for social and communal policies for improved and targeted support for the coordination of daily life. Though to know more about the timing of demand is obvious, empirical based studies are rare. One reason for rare sound empirical based analyses of the timing of activities over a day: they need a demanding microdata base which will be given in our study by time use diary information, an overwhelming advantage compared to any other mean time use information out of traditional surveys.

Our paper will contribute to the topic by quantifying individual determinants of the timing of daily demand for goods and for services. The substantive question we want to answer is, how important are personal, human capital, job and non-market/social network characteristics and activities, household characteristics with the partner’s situation as well as the local and regional situation in explaining the daily timing demand decisions. A stochastic latent utility maximization approach is our microeconomic model for analyzing “when do people shop within a day”. Based on more than 37.000 time use diaries of the actual nationwide German Time Budget Survey we estimate an eight equation Multivariate Probit System which accounts for simultaneous multiple demand activities in different periods of a day. A microsimulation approach finally shows some future timing insights for the aged German population of 2020.

This study is organized as follows: After embedding our work in the literature we characterize in chapter 3 the database with its time use diaries of the German Time Budget Survey 2001/2002 from the German Federal Statistical Office. In chapter 4 we describe individual daily demand patterns separated for goods and services according to important selected socio-economic variables such as gender, age, the economic situation by income poverty and daily working hour arrangements. Chapter 5 develops a multiple discrete choice model of

stochastic utility maximization as the theoretical background for the simultaneous estimation of multiple demand activities within a day. The appropriate Multivariate Probit Model in chapter 6 based on a Simulated Maximum Likelihood Estimator then quantifies the simultaneous probabilities of daily demand for goods and services for different time slots of a day. The simultaneous eight equation system quantifies personal and household effects, regional characteristics as well as the daily working hour arrangements within a flexible employment. Finally, impacts of an aged society on the timing of daily consumption will be analysed with our microsimulation model ServSim. The microsimulation scenario uses the 2020 projections of the population structure from the German Federal Statistical Office.

One main result: there are significant differences in the explanation of the timing of daily demand: on the one hand different for goods compared to services, and on the other hand – and in particular – for different demand periods within a day. Neglecting this timing aspect of daily demand, thus, would fade out an important and significant dimension for understanding individual consumption behaviour and its impacts on other areas of individual ways of life associated therewith.

## 2 Background

Though the literature of empirical consumption and marketing research offers a wide range of analyses, however, (empirical) studies of the timing aspect of consumption are rare. With our study we contribute to the timing of daily demand for goods and services with an empirical founded research on the basis of individual time use diaries. The question we ask, and our contribution, is embedded and will affect a broad range of research areas: from individual consumption behaviour, to labour markets/labour supply, to individual well-being and to time use in general.

*Individual consumption behaviour:* our contribution will expand the research on individual consumption behaviour according to the timing dimension in general and daily timing aspect in particular and is a contribution to a new field of daily demand and its timing of consumption. Traditionally, in the static neoclassical microeconomic consumption-leisure utility maximization approach the allocation between consumption goods and leisure/working hour is concurrent between goods/activities but not between its timing (e.g. Pollak and Wales 1992). This is still the case in the extended versions with the time allocation among different time consuming activities. Also within the Becker 1965 static household production model with non-market time spent to produce commodities there is no goods/activity allocation over a period of time (see Gronau 1986 for a survey on home production). Analyzing the allocation over a certain period of time, however, is the well-known focus of the *intertemporal* neoclassical dynamic optimization model of the consumption-leisure decision (e.g. Hall 1988). The period under investigation there is a full life-cycle perspective rather than a day. However, in principle, this intertemporal microeconomic approach could be the underlying model for the timing of daily demand and its results for the intertemporal substitution. The underlying more long termed assumptions, however, do not really fit into the daily perspective. We therefore will propose another discrete choice based utility framework and model.

The majority of empirically founded consumption analyses – either by a static approach and large cross section data or by an intertemporal approach and panel data – do not focus on the timing aspects but the allocation of expenditures for a number of goods and services and a changing socio-economic background. Empirical based German examples are: Müller (1999)

by examining the individual demand for services with the Sample Survey of Income and Expenditure (Einkommens- und Verbrauchsstichprobe, EVS) from the German Federal Statistical Office; Merz (1980, 1983a) by estimating a complete demand system (FELES) of individual consumption expenditures with an earlier EVS or more recently Buslei et al. (2007) by investigating the effect of demographic changes on the demand for goods and services in Germany until the year 2050, again using the EVS cross sections here from 1993, 1998 and 2003. Furthermore, many other data and surveys (such as those of the “Gesellschaft für Konsumforschung, GfK”) constitute the empirical foundation of numerous national consumption analyses from private companies. Of course, empirical consumption expenditure research is also internationally wide spread.

Though all these studies focus on the expenditure allocation aspect of consumption largely leaving out the time and timing aspect of (daily) demand, there are a few empirically founded studies which consider time aspects of consumption: e.g. Schäffer (2003) with the time use of consumers and its implication for the service marketing; Müller (1995) with time as a background variable for consumption or Aleff (2002) more general with time use and service marketing. The time aspect of consumption plays a role with respect to shopping hours regulation – as mentioned – but again analyzed only by a few empirical based studies: Täger (2000) inspected the acceptance of the liberalization of shopping hours in Germany; Jacobsen and Kooreman (2004) quantified these effects on the buying activities in the Netherlands; Ferris (1990) examined shopping hours liberalization impacts in general and Ferris (1991) for 45 cities in Ontario, Canada; Skuterud (2005) analyzes the impact of Sunday shopping on employment and hours of work. An example for a more general discussion about regulation with respect to longer opening hours can be found in Grandus (1996). Last, but not least, the topic of consumption in connection with the time aspect from a social respective sociological viewpoint is discussed by Gershuny (2002) and Sullivan and Gershuny (2004). Though these studies deal with time aspects of consumption, however, none of these focus on our topic: the timing of daily consumption/demand for goods and services and its microeconomic explanation.

*Labour market/labour supply:* our analysis extends labour market/labour supply research<sup>1</sup> with the explicit consideration of the impacts of daily working hour schedules. Daily working hour arrangements have been addressed only by a few national and international studies: Hamermesh (2002, 1998, 1996) e.g. analysed the timing of daily work. Work schedule studies based on time use dairies have been presented by Harvey (et al.) (2000) (for Canada, the Netherlands, Norway and Sweden) and Callister and Dixon (2001) with their study for New Zealand. The daily timing and fragmentation of work is analysed by Merz and Burgert (2004) as well as by Merz and Böhm (2005) on the basis of the German Time Budget Studies 1991/1992 and 2001/2002. The impacts of daily working hour arrangements on income are examined by Merz, Böhm and Burgert (2004), Merz and Böhm (2005), Merz and Böhm (2008). By quantifying the impacts of the timing and the fragmentation of working hour arrangements on the timing of daily consumption our present study thus belongs to the broader field of labour market implications.

*Individual well-being:* connected with the impacts of daily working hour arrangements, our analysis will ask the impacts of the individual well-being/income situation on the timing of daily consumption. Beyond income which is the central neoclassical budget variable in

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<sup>1</sup> See Ehrenberg and Smith 2003 as well as the overview in the Handbook of Labor Economics (Vol. 1, 2) Ashenfelter and Layard (1987, 1988) and (Vol. 3) Ashenfelter and Card (1999).



explaining consumption expenditures we explicitly ask if the „working poor“ in particular (are forced to) switch to peripheral consumption times.

*Time use research:* last but not least, our topic and analysis is a genuine contribution to the area of time use research, which focuses on time as a comprehensive dimension of describing the universe of daily activities (Merz and Ehling 1999, Harvey 1999, Merz 2002 a,b). Therefore, our contribution is, at the same time, embedded in the analyses about individual ways of daily life.

### **3 The Time Budget Survey 2001/2002 of the German Federal Statistical Office**

The microdata from the nationwide Time Budget Survey of 2001/2002, conducted by the German Federal Statistical Office, serves as our actual available data base Ehling (1999, 2004) with more than 5,400 households, about 12,000 persons and a total of around 37,000 time use diaries. To avoid a seasonal bias the survey was spread from April 2001 until the end of March 2002. All household members wrote their daily ten minute interval activities for three days (two weekdays and a Saturday or a Sunday) in their own words. Each activity then was coded and provided for scientific users. The additional personal questionnaire encompasses information about personal socio-economic information like age, gender, labour force participation etc.; the household questionnaire provides respective information about household composition and the living conditions.

Our analysis concentrates on persons between 15 and 64 to study working condition impacts on the timing of daily demand. The demand for goods follows the code „buying“ (code 361), the demand for services is categorised as „utilisation of service companies and administrative institutions/offices“ (code 362), „personal services“ (code 363) and „medical services (code 364).<sup>2</sup> Thus, the differentiation between goods and services in the data is properly supporting our interest.

### **4 The Timing of Daily Demand for Goods and Services – Descriptive Analysis**

Are there differences in the timing of daily demand for goods and services with respect to central socio-economic characteristics such as gender, age – as a life cycle indicator – and the economic situation including income poverty? How does employment with varying daily work schedules effect the timing of consumption? A first answer can be found in the following descriptive results of selected important variables; the multivariate explanation then quantifies the effects among the competing activities. For the daily division of time we have chosen the time periods (time slots) from 6 a.m. until 9 a.m. (early), from 9 a.m. until 1 p.m. (morning), from 1 p.m. until 5 p.m. (afternoon) and from 5 p.m. until 8 p.m. (late), which adhere to German daily working hour patterns and to the valid shopping opening hours at the time of the German Time Budget Survey (workdays 6 a.m. to 8 p.m.).

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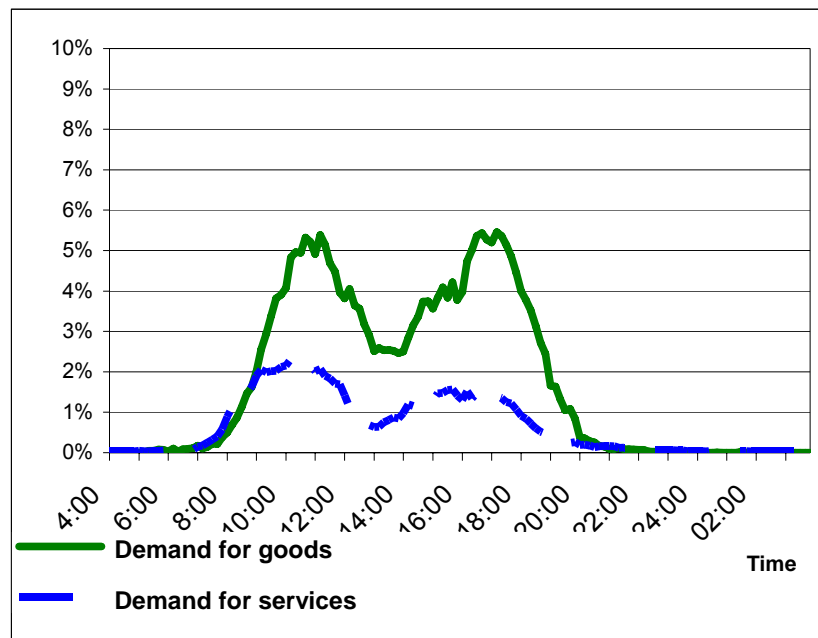
<sup>2</sup> Goods encompass durable or non-durable goods. Services mean visits at service of specialized companies and the utilisation of individual services (e.g. (liberal) professions) which cannot be conferred on any other person and which are not counted among the internal household activities.

#### 4.1 The Timing of Daily Demand – Total Population

The progression of demand over the course of a day – measured as demand frequencies – according to Figure 1 shows a similar profile – but with different levels – for goods and for services with two maxima. Beginning at around 8 a.m. with increasing frequencies a first local maximum is achieved at 11 a.m.. Afterwards the frequency decreases until 2 p.m. and reaches the second local maximum at around 5 p.m.. Due to the limited opening hours 2001/2002 (workdays from 6 a.m. until 8 p.m. but with some exemptions) there is only a marginal demand at night between 8 p.m. and 7 a.m.

There are higher frequencies for the demand for goods than the demand for services throughout the day; the services' maximum is earlier and relatively more pronounced in the morning.

**Figure 1: Demand for goods and services 2001/2002 – total population (in percent)**



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

This global picture shows the expected demand peaks mornings and afternoons; however, an eventually expected higher demand frequency outside of the normal working hour (say after 5 p.m.) will not be visible in the picture of the total population.

Let us now ask for socio-economic group specific behaviour. Since any employment in principle restricts demand possibilities and thus has consequences on the individual consumption, we separate our single group specific analyses into the active population (Table 1 for aggregated time period and Figures 2-5 for the entire course of the day respectively) and the non-active population (Table 2 and Figures 2-5, too).

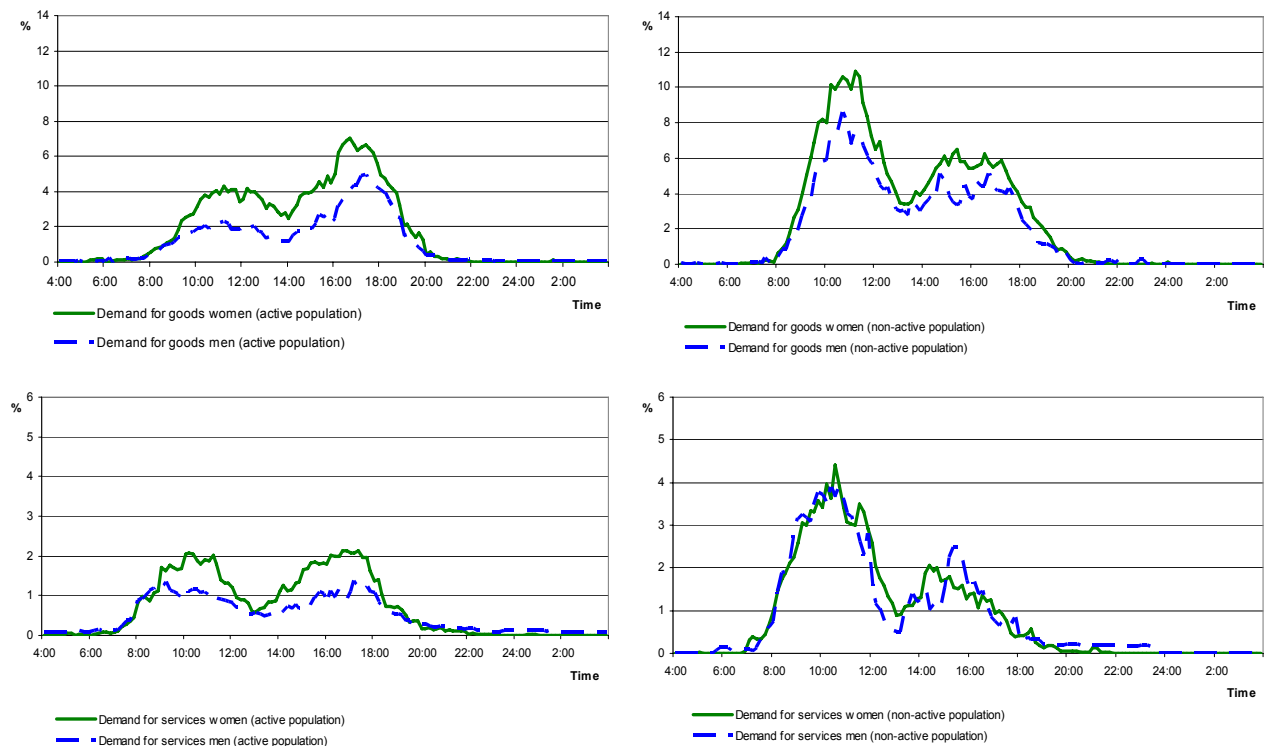
#### 4.2 The Timing of Daily Demand – According to Gender

Men and women are said to have different demand behaviour. With regard to the demand frequencies this can be distinctly confirmed (Figure 2) by our data: at all times of the day and

for goods as well as for services the demand frequencies of the active population are consistently higher among *women* than among men. Less pronounced but more often, too, also *non-active women* buy relatively more often than non-active men: it's the women who are the frequent buyers.

Active persons have two demand peaks, the morning at 11 a.m. and the afternoon at about 5 p.m. (the afternoon peak is more pronounced for goods than for services). The services' peaks are earlier.

**Figure 2: Demand for goods and services 2001/2002 – by sex and status of employment (in percent)**



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

Non-active women and men are more demand active than are active persons: they buy goods more frequent and request services more frequent. Non-active men and women make up the peak mornings.

Thus, gender specific differences with regard to the demand frequency over the day profile are proven in particular for the active population. A reason behind might be a gender difference in part-time and full-time occupation with different shopping possibilities.

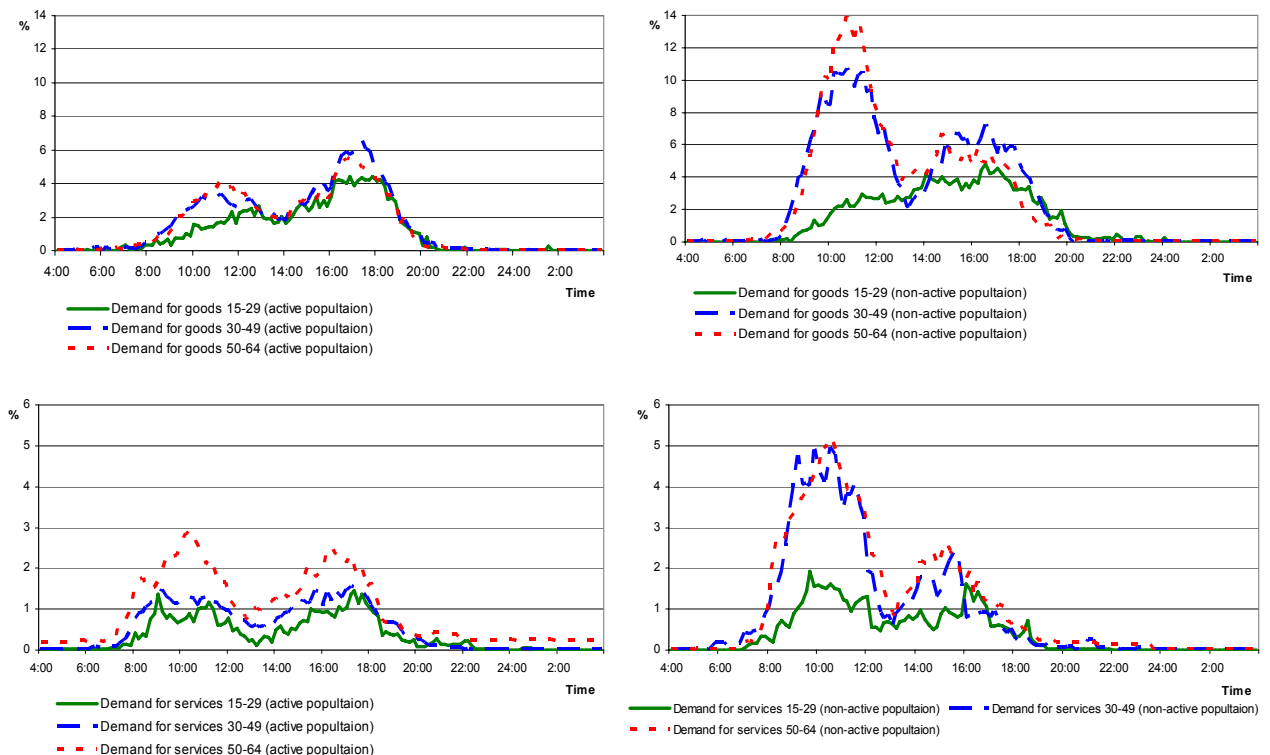
### 4.3 The Timing of Daily Demand – According to Age Groups

Age as a life cycle indicator does not only stand for a changing demand consciousness or a changing need for goods and services, but for a different life style in general as well. With the growing importance of the „Silver Agers“ for the demand for goods, but also with a changing demand for services, e.g. in the health sector, the demand for goods and services are expected

to show a different consumption pattern in general. The question here is whether these life cycle changes also involve an effect on the timing of daily demand behaviour.

Against the background of any *employment* overall there are no remarkable age effects on the timing of daily consumption: a similar timing pattern in all three selected age groups and connected phases of life with two peaks of demand frequencies at around ten to eleven and five o'clock (pronounced for goods in the afternoon; Figure 5) is given. As might be expected, older employed persons (50-64 years of age) compared to younger ones slightly more often ask for services.

**Figure 3: Demand for goods and services 2001/2002 – by age groups and status of employment (in percent)**



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

For the *non-active population*, however, differences according to age appear: younger non-employed people (15-29 years of age) shop in the mornings and seek services in the afternoons. In contrast, the older non-active persons clearly prefer the mornings (for goods and service demand).

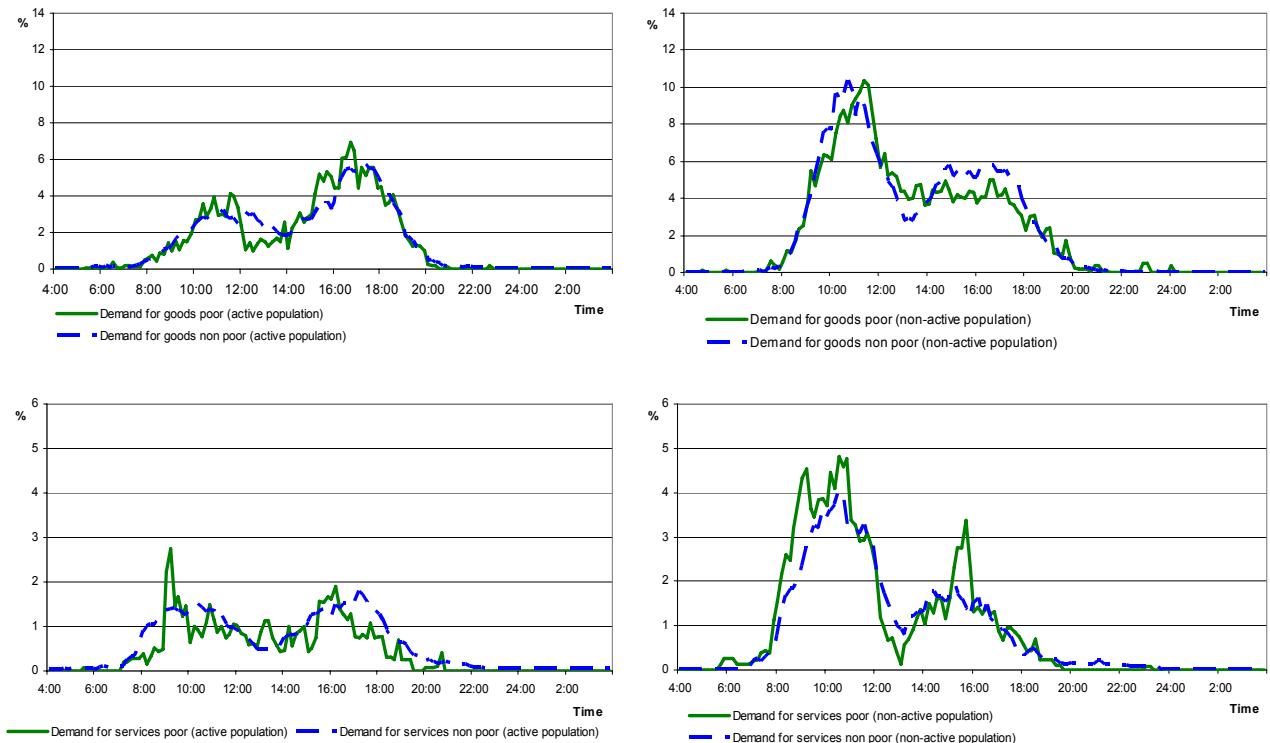
Thus, age-dependent differences in life style and those of life situations have an effect on the timing of daily demand patterns pronounced for the non-active but less visible for the economically active. Thus, and it might be expected, any employment restricts the timing of daily demand activities in the same way for younger as well as for older persons.

#### 4.4 The Timing of Daily Demand – According to the Economic Situation: Income Poverty

Income traditionally is *the* economic resource of demand and a central factor in microeconomic (neoclassical) consumption explanation. In addition, socio-economic factors of the consumers themselves and their environment are known and proven in many empirical studies. The question here is if the economic situation not only effects the level of spending but also the timing of daily demand behaviour; and in particular, if the consumption timing and/or frequency of persons from poor and non-poor households differ.

*Active population:* a similar demand timing profile appears between the „working poor“ – active persons from poor households<sup>3</sup> – with that of all other active persons (Figure 4). The timing profile of the demand for services of the „working poor“, however, is more irregular over the course of the day and less „smooth“ than that of the other active persons.

**Figure 4: Demand for goods and services 2001/2002 – by income poverty and status of employment (in percent)**



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

*Non-active population:* again, the timing profiles of the demand for goods and services of the poor and non-poor are similar in general but less “smooth” for the poor non-active.

Noticeable differences in the timing profiles in general are found again between the active and non-active population – no matter if poor or not poor: non-employed persons mainly

<sup>3</sup> A person is counted as poor if they only have 60% of the median of the equivalised household net income (at-risk-of-poverty rate (Laaken indicator), new OECD-equivalence scale). Our Time Budget Survey of 2001/2002 shows a poverty line of 784.80€.

prefer their demand in the morning while active persons prefer to shop and ask for services in the afternoon (with peak again around 5 o'clock).

The economic situation with emphasis on the poor all over shows no distinct different timing profiles, however, the timing profile of the poor is less "irregular". With regard to income, thus, the working conditions have more or less the same effects to the "working poor" than to other active persons. A possible peripheral daily consumption because of low money income thus is not pronounced visible. A possible working time intensity and consequence of being poor because of low wages is another aspect which will be regarded in the following.

#### **4.5 The Timing of Daily Demand – According to Daily Working Hour Arrangements**

Working hour in general limit, at times prevent, the possibilities for shopping. A traditional full-time job obligating the person over the entire day is known to be receding, giving way to newer forms of daily working hour arrangements (key word: flexibility). The question here is whether different daily working hour arrangements which among others allow for intermissions with daily demand during working hour.

According to the timing and the fragmentation of the working day Merz and Burgert (2004) differentiated four daily working hour arrangements and showed that there are significant structural differences in the labour market accompanying this categorisation.

*Timing of work in a day:* Any description of working hour characteristics include information about the beginning, the duration and/or the end of the working hour. Here and in line with others we define the time between 7 a.m. and 5 p.m. as the core working hour.<sup>4</sup> Therefore, there are two types of working days with respect to the timing of work: first, a working day in which the job is executed mainly during the core working hour, and second, a working day in which the work is performed mainly outside of the core working hour.

*Fragmentation of a working day:* A second dimension of a working day is its fragmentation. Fragmentation might be illustrated by the number of work intermissions. Then, it is possible to differentiate between a not fragmented work day, on the one hand, in which persons work in one „stretch“ and a fragmented work day, on the other hand, in which a person's work is interrupted by at least one „abnormal“ break. In order to not define short breaks (such as coffee breaks etc.) as important work intermissions, we assess breaks of more than one hour as important intermissions which allow some consumption time and/or a potential job change.

With the combination of both dimensions, timing and fragmentation, four basic working hour arrangements can be derived:

**Category I (cat 1):** not fragmented core working hour („normal“ working day) (65.2%)<sup>5</sup>

**Category II (cat 2):** fragmented core working hour (25.1%)

**Category III (cat 3):** not fragmented non-core working hour (6.4%)

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<sup>4</sup> In Germany most working days begin between 7am and 8am and end between 4 p.m. and 5 p.m.. This restriction on the core working hour complies with international studies (see e.g. Harvey et al, 2000).

<sup>5</sup> Percent of all employees 2001/2002 (Source: German Time Budget Survey; own calculations).

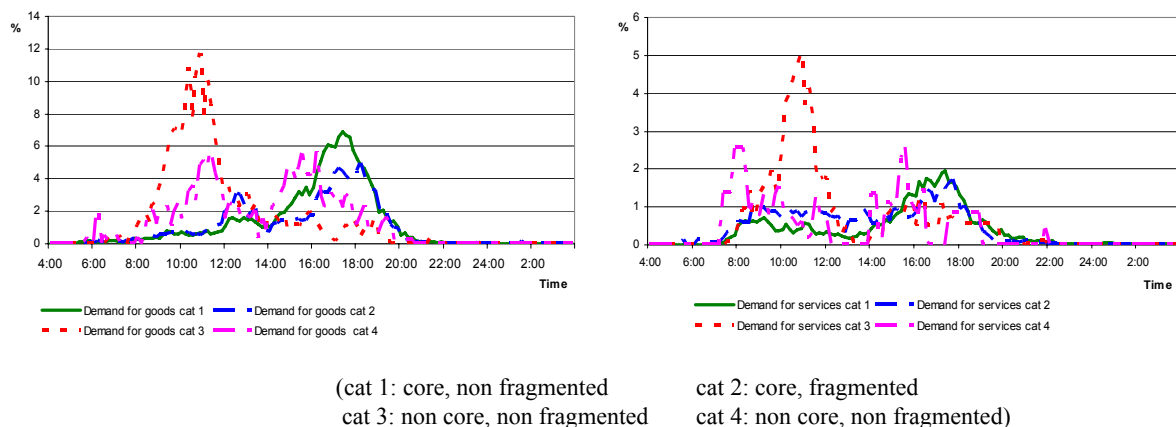
**Category IV (cat 4):** fragmented non-core working hour (3.3%)

For 2001/2002 more than one third (34.8%) of the working days are „atypical“ if the continuous core working hour are still viewed as normal and typical.

As Merz, Burgert and Böhm (2008) have shown, these daily working hour arrangements not only form the basis for significant differences in the individual explanation of working hours, but also have significant and varying impacts on income.

The question now is: do different working hour arrangements and thus a flexibility of the working conditions also have an impact on the daily demand? The answer: obviously (Figure 5) the demand for goods and services is influenced in different ways by the daily working hour schedules. The influence of the core working hour is as expected: if the core working hour are throughout the day („normal“ work day), the demand frequency moves to the evening (cat 1 and 2) and vice versa (cat 3 and 4). A fragmented work day, of course, allows for shopping during the course of the day; the respective category 2 and 4 confirm this. Noticeable is that active persons whose core working hour are after 5 p.m. and who have a fragmented work schedule (most atypical job), shop and demand services in the morning or before job starting in the afternoon. The shop opening hours of the survey year, not allowing late shopping certainly, is obviously limiting.

**Figure 5: Demand for goods and services 2001/2002 – by working hour arrangements (in percent)**



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

All together, socio-economic differences in daily demand behaviour have become apparent with these first descriptive results of singular factors (further quantitative information can be found in Tables 1 and 2). These results already indicate a contribution of gender, age, some income/poverty and daily working hour arrangements to a multivariate explanation which we intend to approach with further competing explanation factors in our microeconomic section.

**Table 1: Demand for goods and services 2001/2002 of the active population in daily time periods (in percent)**

Characteristic	Demand for goods				Demand for services			
	6 - 9 o'clock	9 - 13 o'clock	13 - 17 o'clock	17 - 20 o'clock	6 - 9 o'clock	9 - 13 o'clock	13 - 17 o'clock	17 - 20 o'clock
<i>Sex</i>								
Women	3,71	19,18	24,67	18,80	2,41	8,24	8,18	5,00
Men	3,21	9,84	13,98	14,32	2,33	4,40	4,57	3,52
<i>Age</i>								
15 – 29	2,17	9,78	15,36	13,13	1,22	5,01	4,01	3,27
30 – 49	3,84	14,86	19,66	18,03	2,41	5,48	6,21	4,40
50 – 64	3,65	16,11	19,85	15,17	3,38	8,83	8,30	4,55
<i>Poverty</i>								
Working poor	2,91	14,48	19,93	14,59	1,05	7,01	5,97	2,07
Working non poor	3,55	14,09	18,74	16,66	2,45	6,06	6,14	4,41
<i>Working hour arrangements</i>								
cat 1 (not fragmented/core)	2,54	6,88	18,87	19,28	1,33	2,68	5,78	4,77
cat 2 (fragmented/core)	2,51	9,51	13,21	15,69	2,30	5,31	5,17	4,04
cat 3 (not fragmented/non-core)	5,63	32,77	8,80	4,61	1,79	12,67	2,92	1,27
cat 4 (fragmented/non-core)	6,80	15,26	16,03	6,32	3,69	4,32	4,78	0,85
<i>All active population</i>	3,43	14,02	18,76	16,32	2,36	6,12	6,19	4,18
<i>All</i>	3,82	20,12	20,08	14,76	2,86	8,69	6,90	3,43

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

**Table 2: Demand for goods and services 2001/2002 of non-active persons in daily time periods (in percent)**

Characteristic	Demand for goods				Demand for services			
	6 - 9 o'clock	9 - 13 o'clock	13 - 17 o'clock	17 - 20 o'clock	6 - 9 o'clock	9 - 13 o'clock	13 - 17 o'clock	17 - 20 o'clock
<i>Sex</i>								
Women	4,72	34,82	24,45	13,04	3,68	13,16	8,07	2,08
Men	4,30	26,78	19,82	10,06	3,98	14,04	8,48	1,90
<i>Age</i>								
15 – 29	1,12	11,37	17,53	11,58	1,24	5,59	6,05	1,50
30 – 49	6,19	38,52	25,32	14,90	4,75	16,41	7,60	2,23
50 – 64	5,81	40,60	24,18	10,11	4,92	16,98	10,07	2,21
<i>Poverty</i>								
Poor	4,34	32,25	22,71	11,76	5,39	14,49	8,80	2,47
Non poor	4,64	31,76	22,51	12,06	3,32	13,24	8,13	1,95
<i>All non-active population</i>	4,55	31,54	22,55	11,82	3,80	13,52	8,24	2,00
<i>All</i>	3,82	20,12	20,08	14,76	2,86	8,69	6,90	3,43

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

## 5 A Microeconomic Model for the Timing of Daily Demand for Goods and Services

Microeconomic household theory and its extension by Becker's 1965 household production approach explains the demand for goods and services by an agent's utility maximising process over goods and leisure (respective commodities) restricted by the budget and by the time constraint when extended. The results are optimal quantities of the goods' bundle to buy. The intertemporal microeconomic approach deals with the timing of consumption over the



life cycle (e.g. Hall 1998, Epstein and Zin 1989) quantifying the consumption substitution between life periods. The result of the static and intertemporal microeconomic modelling first of all is a set of demand equations explaining the optimal quantities/expenditures/activity durations by its (shadow) prices and income.

Our question about the timing of demand, however, focus rather on “when” (and not on the quantity of how long) within a time period a certain demand activity is done and seeks for explanation by socio-economic factors. In principle, the mentioned neoclassical intertemporal approach could be the microeconomic model for our timing focus. However, the more compact daily view and its activity time interdependencies ask for a more specific approach. We argue, in particular, that the interdependencies between single time periods of a day should be quantified by a simultaneous equation approach allowing period specific socio-economic explanation under interdependency rather than by an explicit more general time preference equation of the intertemporal neoclassical approach.

With the question “what drives to do shopping and the demand for services at a distinct time within a day” we face a typical discrete choice problem. Analogous to a complete demand system under the quantity perspective, we face something like a complete demand period system in the sense, that goods and services can be demanded by one person more than one time a day. So we face possible simultaneous demand in the morning and/or in the afternoon etc.

Considering this simultaneousness and based on a microeconomic utility maximisation approach, a rational decider will maximise his overall utility with regard to the utilities out of the choices to be active in one or more demand periods a day ( $t=1, \dots, T$ ).

$$(1a) \quad u_i^* = u_i^*(u_{ig1}^*, u_{is1}^*, \dots, u_{igT}^*, u_{isT}^*) = \max! ,$$

assuming a latent utility index  $u_i^*$  with demand period related stochastic utility indices

$$(1b) \quad \begin{aligned} u_{igt}^* &= \beta_{gt}' x_i + \varepsilon_{ijt} \\ u_{ist}^* &= \beta_{st}' x_i + \varepsilon_{ijt} \end{aligned} \quad (t = 1, \dots, T)^6$$

for the demand of any goods (index g) and for the demand for any services (index s) with  $x_i$  as a vector of socio-economic variables of the individual i (for example age, gender, income).  $\beta_{gt}$  and  $\beta_{st}$  are the two parameter vectors for goods and services to be estimated for each demand period  $t=1, \dots, T$ . The residuals  $\varepsilon_{ijt}$  will capture the interdependencies by *multivariate* distributed error terms. Without loss of generality the set of explanatory variables  $x_i$  might be different for goods and for services.

A demand period related activity then is observed if the respective latent utility index exceeds a threshold with

$$(2) \quad y_{ijt} = \begin{cases} 1 & \text{if } u_{ijt}^* > 0 \text{ resp. } \beta_{jt}' x_i > \varepsilon_{ijt} & j = g, s \\ 0 & \text{if } u_{ijt}^* \leq 0 & t = 1, \dots, T \end{cases} .^6$$

<sup>6</sup> The symmetry of the assumed normal distribution allows the specification  $\beta_{jt}' x_i < \varepsilon_{ijt}$  instead of  $\beta_{jt}' x_i > -\varepsilon_{ijt}$ .

The error terms  $\varepsilon_{ijt}$  over all demand periods a day will be multivariate normally distributed with a respective expected value of zero ( $E(\varepsilon_{ijt}) = 0$ ) and a variance-covariance matrix  $V$ , with ones on the main diagonal and otherwise the correlations  $\rho_{tk} = \rho_{kt}$  ( $t, k = 1, \dots, T, t \neq k$ ).

The demand probability in one demand period a day then is

$$(3) \quad P_{jt}(y_{ijt} = 1) = P_{jt}(u_{ijt}^* > 0) = P_{jt}(\varepsilon_{ijt} < \beta'_{jt} x_i) = \Phi_{2T}(\beta'_{jt} x_i)$$

with  $\Phi_{2T}(\cdot)$  as a  $2 \cdot T$ -dimensional standard normal distribution. This demand probability is at the core of the following analysis.

One might argue that the timing of shopping does not spend direct utility as comparable to actually buying and consume something. However, restricted by time in general, a decision finally has to be done, when shopping will happen. So, there is a typical discrete choice problem with some underlying and latent individual utility tackle which finally – by exceeding a critical level – yields the observable decision to shop or demand for services within a certain period a day.

## 6 Multivariate Explanation of the Timing of Daily Demand for Goods and Services

Following our microeconomic model for the timing of daily demand for goods and services (equations 1-3) we estimate the demand probabilities for demand periods a day by a Multivariate/Simultaneous Probit Model (MPV)<sup>7</sup>. As it is well known, a respective Maximum Likelihood estimation based on a multidimensional normal distribution is very expensive with regard to the non-analytical solution of the multidimensional normal integral. We have used the Stata procedure (“multivariate probit regression”) from Capellari and Jenkins (2003) which follows the Geweke-Hajivassiliou-Keane (GHK) approach for a simulation estimator. The GHK simulator has advantageous characteristics: the estimated coefficients are unbiased, the simulated probabilities lie in the interval (0;1) and are a continuous and differentiable function of the model parameter (Börsch-Supan and Hajivassiliou (1993)). In addition to the respected correlation over equations we have to deal with expected correlation over observations with our data. Since each person delivers two respective three days with diary data we face clustered data where the error terms are expected not to be distributed independently of the observations. To achieve consistent estimates we therefore use robust White variance estimates accounting for clustering.<sup>8</sup>

The following estimation of the probabilities of the timing of daily demand for goods and services – as with our descriptive analysis – will consider simultaneously four ( $T=4$ ) demand periods a day: early (6a.m.-9a.m.), mornings (9 a.m.to 1 p.m.=13 o'clock), afternoons (1 p.m.-5 p.m.=17 o'clock) and evenings (5 p.m.-8 p.m.=20 o'clock) ( $t=1, \dots, T$  with  $T=4$ ). These definitions follow typical opening hours in Germany at the survey time 2001/2002. If there is

<sup>7</sup> In the literature, discrete choice models use the term “multivariate” in a simultaneous sense though “mutivariate” often refers only to multiple influencing factors.

<sup>8</sup> Considering computing expenses: Our Simulated Maximum Likelihood estimates with eight dimensional integrals to be solved for each observation and each iteration was quite time consuming with about 100 hours (full four days and nights) for a one group eleven iteration solution with respective 25 simulation draws and a PC with a Genuine INTEL 2160 1,8 GHz processor and 512 MB RAM.

more than one consumption activity in one of our three hour demand periods a day then they are considered as a single combined demand activity. As the descriptive results has shown the timing of the demand for goods is different than the timing of the demand for services. So we will have four different equations for goods and four different equations for services, which, however, are allowed to be correlated each other within the simultaneous eight equation system.

The choice of the explanatory variables, and thus the hypotheses about socio-economic influences to be tested, are based on hypotheses of theoretical and empirical consumer and labour economics (see Blackwell et al. 2001, Blundell et al. 1993) and results of our descriptive analyses. As mentioned, microeconomic consumer theory relies on prices for goods and on income when explaining optimal allocated consumption quantities. With our cross-sectional data prices are not available; income as an important explanatory factor in consumer goods' quantity analyses, however, will be tested here for the timing of demand. In addition, the explanation will be extended by the following set of individual socio-economic variables with personal, household and regional characteristics.

**Personal set:** we test *personal characteristics* (like gender, age as a proxy for the life cycle situation), *human capital variables* roughly describing all day management skills, *time spent for non-market activities* (as competing in time allocation) at the observed day and *working conditions* for persons in the labour market<sup>9</sup> (like being self-employed with an expected time sovereignty, personal monthly net income, commuting time and daily working hour arrangements with timing and fragmentation work characteristics).

**Household/family set:** we test the partner's employment influence (like the partner's full or part-time hours of work), household characteristics (like household size and children) and the economic situation of the household to be poor or not as well as the household residual income (without the individual personal income under investigation) as a proxy for the available household wealth;

**Regional set:** we are able to test the still expected general different living conditions and shopping/demand possibilities between West and East Germany.

**Local demand:** we test whether shopping and services possibilities within walking distances are influencing.

Since it has already been shown in the descriptive analysis that any employment has an explicit effect on the timing of demand for goods and services, separate estimations for the active and non-active population will be carried out.<sup>10</sup> Both estimations therefore will differ with respect to the employment situation in particular. Because of this we only include persons at the working age between 15 and 64 years old. We concentrate on the work week (Monday to Friday) because the demand behaviour on the weekends differs considerably from that of the work week.

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<sup>9</sup> With competing non-market and paid working time as exogeneous, independent x-variables we assume that demand activities are the result of these non-market and paid working allowing to buy goods and services. This might be a problem when the duration of demand would be analyzed (concurrent time allocation) but will be of minor importance by our analysis of the timing of demand.

<sup>10</sup> To be employed or not here is based on the general information of the personal questionnaire of the German Time Budget Survey. In addition, employed persons who did not work on the diary day are not included in the analysis.

### 6.1 Goodness of Fit and the Importance of Simultaneous Over-the day Demand

The timing of the daily demand (as a further used shortcut for the probability of the timing of daily demand for goods respective services) overall is significantly explained by our model, not only for the active population but also for the non-active population (Likelihood Ratio test with  $\alpha = 0.1\%$ ); see Tables 3 and 4. The final correlation matrix of the error terms for the Multivariate Probit estimation for the active population in Table 3 and the non-active population in Table 4 is organized in a goods' and services' block structure for its four time periods. Early and morning shopping as well as afternoon and evening shopping is highly correlated showing overlapping demand activities. This is true also for the demand for services. The interdependence between shopping for goods and asking for services is strong for each daily period (highly significant positive correlation).

**Table 3: Correlation Matrix for the Multivariate Probit estimation of the demand for goods and services by time of the day for the active population**

	Goods 6-9 $\epsilon_1$	Goods 9-13 $\epsilon_2$	Goods 13-17 $\epsilon_3$	Goods 17-20 $\epsilon_4$	Services 6-9 $\epsilon_5$	Services 9-13 $\epsilon_6$	Services 13-17 $\epsilon_7$	Services 17-20 $\epsilon_8$
$\epsilon_1$	1	0.253 ***	-0.003	0.048	0.231***	0.114	-0.014	-0.012
$\epsilon_2$		1	-0.008	-0.072 *	0.178***	0.293***	-0.072	-0.064
$\epsilon_3$			1	0.285 ***	-0.161**	-0.261***	0.192***	-0.009
$\epsilon_4$				1	0.013	-0.203***	0.026	0.096**
$\epsilon_5$					1	0.386***	-0.021	0.063
$\epsilon_6$						1	0.05	0.141*
$\epsilon_7$							1	0.441***
$\epsilon_8$								1
LR-Test : $H_0: V=I_8$		$\chi^2(28)$		518.4 ***				

\* p-value<0,05 / \*\* p-value<0,01 / \*\*\* p-value<0,00

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

Two daily demand regimes, the whole morning till 13:00 hours and the whole afternoon till 20:00 hours, will be visible with almost no overlapping demand activities. Thus shopping and the demand for services are done closely together either mornings or in the afternoon but not spread over the whole day. This strong picture for the active population (caused probably by working hour restrictions) is given to a certain extent for the non-active population, too. However, over-the-day demand with morning shopping and afternoon asking for services will become visible for the non-active population.

**Table 4: Correlation Matrix for the Multivariate Probit estimation of the demand for goods and services by time of the day for the non-active population**

	Goods 6-9 $\epsilon_1$	Goods 9-13 $\epsilon_2$	Goods 13-17 $\epsilon_3$	Goods 17-20 $\epsilon_4$	Services 6-9 $\epsilon_5$	Services 9-13 $\epsilon_6$	Services 13-17 $\epsilon_7$	Services 17-20 $\epsilon_8$
$\epsilon_1$	1	0.331 ***	-0.013	-0.086	0.339***	0.017	0.043	-0.009
$\epsilon_2$		1	0.061 *	-0.064	0.251***	0.255***	0.030	-0.052
$\epsilon_3$			1	0.410 ***	-0.090*	0.003	0.188***	0.096
$\epsilon_4$				1	-0.058	-0.098*	0.127**	0.201***
$\epsilon_5$					1	0.522***	0.075	0.142
$\epsilon_6$						1	0.134**	0.116
$\epsilon_7$							1	0.532***
$\epsilon_8$								1
LR-Test : $H_0: V=I_8$		$\chi^2(28)$		719.5 ***				

\* p-value<0,05 / \*\* p-value<0,01 / \*\*\* p-value<0,00

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

Though we face two prominent daily demand regimes we will see that the single significant results and differences of the demand period specification support the prominent importance of the chosen four daily demand period thresholds.

## 6.2 Microeconomic Results of the Probabilities for the Timing of Daily Demand – Active Population

### 6.2.1 Daily Demand for Goods – Active Population

Let us start with the consumption situation, the *demand for goods*, of the active population. Which hypotheses then are of particular meaning for the probability to shop in a certain daily demand period? Table 5 shows the results. Out of the set of *personal characteristics* gender and age show a significant influence for all demand periods from 9 o'clock on but in different magnitudes.<sup>11 12</sup> The significant shopping probability of women – with the exemption of early in the morning – is always greater than that of men. Age, as a course of life indicator, is a significant predictor with non-linear importance in particular in the afternoon and in the evening. The combined non-linear age influence shows an increasing probability effect until 46 to 48 years (and then decreasing) for the morning and afternoon/evening shopping. The family status to be married neither restricts nor fosters shopping in any demand period. Interestingly, a hypothesis of human capital influences via expected management skills cannot be confirmed.

<sup>11</sup> The underlying descriptive statistics of the database for estimation can be found in the Appendix Table 14.

<sup>12</sup> The single estimated coefficients can be interpreted according to their significance and with some restrictions according to the sign of their impacts; as known, a direct probability contribution, however, is not always visible by the coefficients only. There are two reasons that an estimated coefficient cannot be interpreted directly as a probability contribution: One reason is the non-linearity of the probit approach in general. The second reason is that the calculation of marginal probabilities always include the (mean) values of all other variables.

**Table 5: Multivariate Probit Estimates – Demand for goods and services by time of the day for the active population**

	Goods 6-9	Goods 9-13	Goods 13-17	Goods 17-20	Services 6-9	Services 9-13	Services 13-17	Services 17-20
<b>Personal characteristics</b>								
- Woman	-0.0445	0.2727***	0.2831***	0.1407**	0.2065*	0.1755*	0.2995***	0.2407***
- Age	0.0511	0.0497**	0.0553***	0.0629***	0.0398	0.0070	0.0192	0.0814***
- Age <sup>2</sup> 10-2	-0.0509	-0.0510*	-0.0587***	-0.0673***	-0.0425	0.0028	-0.0112	-0.0897***
- Married	-0.0698	-0.0635	-0.0602	-0.0589	-0.2895	-0.2877*	-0.0622	-0.0282
<b>Human capital</b>								
- High school diploma (Abitur)	-0.0070	0.0775	0.0096	0.1084*	-0.1311	-0.0425	-0.0255	-0.0733
- University degree	0.0013	-0.0018	0.0655	-0.1549*	-0.0325	-0.0226	-0.0634	0.0818
- Further education	-0.1153	0.0220	0.0310	0.0260	0.0119	0.1376*	0.0200	0.0238
- Student	0.4597*	0.1654	-0.1656	0.0494	0.0803	-0.0957	0.2135	-0.2364
<b>Job characteristics</b>								
- Self-employed	0.0137	-0.1353	-0.2871***	-0.2972***	0.3672**	0.2928**	-0.0310	-0.1759
- Personal monthly net income * 10 <sup>-3</sup>	-0.1350*	0.0168	0.0108	0.0179	0.1512***	0.0451	0.0737*	0.0253
- Commuting time * 10 <sup>-2</sup>	0.0983	-0.0770	-0.3878***	0.1141	0.1607	0.0972	-0.3035*	-0.0218
- Daily hours of work	-0.0536**	-0.1014***	-0.1261***	-0.0414***	-0.1071***	-0.1375***	-0.1441***	-0.0443**
- cat 2 (fragmented/core)	0.0162	0.2547***	-0.1418**	-0.1031*	0.2563**	0.3108***	-0.0625	-0.0387
- cat 3 (not fragmented/non-core)	0.4082**	1.0676***	-0.8740***	-0.9079***	0.3467*	0.7416***	-0.6453***	-0.5114**
- cat 4 (fragmented/non-core)	0.6236***	0.5711***	-0.1730	-0.3739**	0.2590	0.3436	-0.3193	-3.7706***
<b>Non-market activities/ social network</b>								
- Domestic work	0.0489	0.0469*	-0.0024	-0.0672***	-0.0353	-0.0085	-0.0405	-0.1349***
- Do-it-yourself activities	-0.0370	-0.0221	-0.0807	-0.1297**	-0.5966	-0.1105	-0.0224	-0.1998*
- Home care	0.1913	-0.0441	0.1190	0.0117	-1.0352	-0.1557	-0.1255	-0.1099
- Active personal help	0.0145	-0.0395	-0.0771	-0.2257***	-0.0064	-0.0450	-0.1124	-0.1911
- Child care	-0.0336	0.0252	0.0162	0.0358	-0.0853	-0.0593	0.0103	-0.0303

Table 5 (cont.)

	Goods 6-9	Goods 9-13	Goods 13-17	Goods 17-20	Services 6-9	Services 9-13	Services 13-17	Services 17-20
<b>Partner's employment status</b>								
- Full time	0.0270	0.1764*	0.2100**	0.1456*	0.1610	0.2093	0.0821	-0.0881
- Part time	-0.3513**	0.0597	-0.0048	0.0350	0.2046	0.2161	0.1978*	0.0177
- No partner	-0.0787	0.0822	0.0836	0.1200	0.1069	0.0519	0.1158	0.1258
<b>Household characteristics</b>								
- Hh-size	0.0320	-0.0522	-0.0577*	-0.0573*	0.0060	0.0411	0.0076	-0.0185
- Hh with children	-0.0786	0.0680	0.1737**	0.0651	-0.0135	-0.1046	-0.0308	0.0115
- Hh under poverty line	-0.4406*	-0.2873	0.0171	0.1151	-0.4495	-0.3773	0.0566	-0.2440
- Hh residual net income 10 <sup>-3</sup>	-0.0437	0.0068	-0.0186	0.0063	0.0347	-0.0220	0.0078	0.0008
<b>Region</b>								
- East germany	-0.1495	0.0247	0.0907	0.1768***	0.2637**	0.0562	0.0942	0.2810***
<b>Local possibilities for...</b>								
- shopping	-0.2456	-0.1451	0.1220	0.1070	0.2231	0.0469	0.1928	0.0338
- service demand	0.1572	-0.0807	-0.0787	-0.0163	0.0487	-0.0054	0.0522	-0.0753
<b>Constant</b>	-2.3187***	-1.9368***	-1.2224***	-2.0056***	-2.9418***	-1.6415***	-1.6029***	-3.0372***
Wald - $\chi^2$ (240)	5427.7***							
Log pseudolikelihood	-13244.5							
n	7079							

p-value&lt;0,05 / \*\* p-value&lt;0,01 / \*\*\* p-value&lt;0,00

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

As to our hypothesis, the dominance of a working day will influence the timing of shopping. The hypothesis that a self-employment with a higher degree of time sovereignty than being an employee prefers a “within the day shopping” is only indirectly confirmed: a self-employment significantly reduce the probability of an afternoon and evening shopping. Daily working hour arrangements with its timing and fragmentation overall have significant impacts on the timing of shopping goods. In comparison to the reference category cat I (core working hour throughout the day), all other categories increase the demand probability until noon and decrease it afterwards with categorical-specific differences. Thus a fragmented work day and non-core working, as expected, enable shopping over the day accordingly.

There is one astonishing result according the economic situation: neither the personal monthly net income nor the available further income resources of the household have a significant influence on the shopping probability in the demand periods of a day. The minor exemptions: significantly ( $\alpha=5\%$ ) less early shopping for all workers and significantly ( $\alpha=5\%$ ) less morning shopping hours for the poor, here the "working poor". Thus, consumer theory based income influence might be a driving factor for consumption expenditures respective consumption quantities, however, income is not prominent and distinctive for the probability to shop in neither daily demand period, a remarkable result.

**Household/family situation:** the timing of daily shopping seems to be independent from competing hours spent in non-market activities like child care and nursing other household members. Domestic work is in favour for shopping in the morning for the burden of the evening. Active personal help in social networks will be done in the afternoon and diminishes the respective shopping probability significantly. The partner's full time employment has significant impacts on the shopping timing in the afternoon and in the evening. Together with the working day situation of the person under investigation partner shopping will be visible later the day. Further household characteristics as the size, a household with children, and the economic situation of the household including being poor are not significant.

**Regional differences** in the timing of daily shopping between West and East Germany are only significant in the evenings with significant greater evening shopping probabilities living in East Germany. It would be interesting what will be behind; the data here only allows speculation.

**Local demand possibilities:** The hypothesis, that the timing of shopping is influenced by nearby local shopping possibilities cannot be confirmed.

### 6.2.2 Daily Demand for Services – Active Population

As we have already seen in the description, the daily *service demand* differs from the goods' demand in its frequency level and over the day profile. In contrast to the demand for goods, it is noticeable that gender only has a significant impact with active persons; non-active women and men show a similar timing of the demand for services (see Table 6). Probably due to working hour restrictions economically active older persons increasingly (until 45 years) ask for services in the evenings. To be married or not is not significant for the demand for services probably because of husband independence of genuine personal belongings.

Working characteristics are again of great importance. So, self-employment significantly increases the probability for morning demand for services. Working hour arrangements with



reference to the timing and fragmentation are also notably decisive for the timing of the daily demand for services.

The economic situation and main microeconomic demand resource – personal income as well as the household residual income – had surprisingly no effects on the timing of shopping hours (with the early exemption of personal income of active persons,  $\alpha=5\%$ ). Here again, neither personal nor household income effect the timing of daily demand for services (with the early exemption of personal income of active persons,  $\alpha=0,1\%$ ). Similar to restrictions of a paid work, unpaid work in a household or personal help for others is restricting and do significantly influence the timing of the daily demand for services.

So, domestic work or do-it-yourself reduce the evening demand for active and non-active population. Also an engagement in social networks by helping others will reduce the probability of evening demand for services. In addition, the assumption, that services are often person-associated and therefore not transferable, is supported by the finding that the partner's employment as well as the further household situation, show no significant influence on the daily demand for services. As with the demand for goods, some regional influences on the timing of daily demand for services can be observed: in East Germany the respective probability after core working hour (before 9 a.m. and after 5 p.m.) is greater than in West Germany (workers).

### 6.3 Microeconometric Results of the Probabilities for the Timing of Daily Demand – Non-Active Population

#### 6.3.1 Daily Demand for Goods – Non-Active Population

Microeconometric results for the probability for the timing of daily demand for the non-active population are shown in Table 6. **Personal characteristics** as gender and age (non-linear) again are significant in explaining the demand probabilities in all daily demand periods for persons not in the labour force. Non-active women prefer to go shopping in the afternoon. For all periods a day the increasing non-linear age influence is significant and in favour for the respective period in the day. However, the respective year when the influence starts to decrease is different for each period: early 53 years, morning 57 years, afternoon 51 years and evening 44 years. Thus the influence of the elderly in the afternoon and evening is less pronounced than early and mornings.

Similar to the active population, **human capital** variables do not influence significantly the timing of goods' demand. In some contrast to the active persons, however, **non-market activities and an engagement in social networks** have different impacts on the timing of shopping over the day: those activities can be and are done without paid working restrictions within a full day and thus influence the shopping probabilities significantly over the day. Children will rise the probability of morning shopping probably because of being in school in the morning. The partner's employment status and all **further household characteristics** including the residual income show no significant influences except of a full-time partner's work which is in favour of common shopping with the partner in the evening. There are no significant general **East-West German** differences in the timing of shopping for the non-active population. Closer regional influences as **local shopping possibilities** also show no effects here.

**Table 6: Multivariate Probit – Demand for goods and services by time of day for the non-active population**

	Goods 6-9	Goods 9-13	Goods 13-17	Goods 17-20	Services 6-9	Services 9-13	Services 13-17	Services 17-20
<b>Personal characteristics</b>								
- Woman	-0.0827	0.1435**	0.2259***	0.1661**	-0.0318	-0.0004	0.0676	0.0990
- Age	0.0912***	0.0935***	0.0571***	0.0516***	0.0809***	0.0964***	0.0378**	0.0512**
- Age <sup>2</sup> 10-2	-0.0859***	-0.0815***	-0.0560***	-0.0581***	-0.0782***	-0.0946***	-0.0312	-0.0591*
- Married	-0.1829	0.1858	0.0981	-0.0991	0.1705	0.0451	0.1957	-0.0615
<b>Human capital</b>								
- High school diploma (Abitur)	0.0332	0.1403	0.1242	0.1669	0.0653	0.1984*	0.0629	0.1129
- University degree	0.1848	-0.0308	0.1164	-0.0797	0.3233*	-0.1165	-0.1608	-0.0475
- Further education	-0.1233	-0.0108	0.0128	0.0533	0.0798	-0.0209	-0.0035	0.1348
- Student	0.1910	-0.0490	0.0268	0.0036	-0.2051	-0.2154	-0.1469	-0.1843
<b>Non-market activities/ social network</b>								
- Domestic work	0.0048	-0.0124	-0.0412***	-0.0459***	-0.0204	-0.0960***	-0.0495***	-0.0549**
- Do-it-yourself activities	-0.0316	-0.0870*	-0.0765*	-0.0102	-0.1046	-0.1330*	-0.0442	0.0649
- Home care	-0.2311	-0.0396	-0.1165	0.0098	-0.1289	0.0250	-0.0614	-0.7180
- Active personal help	0.0315	-0.0765***	-0.0834***	-0.0817*	-0.0902	-0.1467***	-0.1116**	-0.0418
- Child care	0.0397*	0.0585***	-0.0032	0.0036	-0.0587	0.0238	-0.0096	-0.0232

Table 6 cont.

	Goods 6-9		Goods 9-13		Goods 13-17		Goods 17-20		Services 6-9		Services 9-13		Services 13-17		Services 17-20	
<b>Partner's employment status</b>																
- Full time	0.1928		0.0809		-0.0372		0.2189**		0.1456		0.1198		0.0355		0.1336	
- Part time	0.0574		-0.0829		-0.1014		0.1014		0.0968		-0.0370		-0.0189		-0.0099	
- No partner	-0.2134		0.0984		0.1379		0.0739		0.2706		0.0072		0.3910*		0.1834	
<b>Household characteristics</b>																
- Hh-size	0.0424		-0.0080		-0.0020		0.0027		-0.0777		-0.1378***		-0.0239		0.0298	
- Hh with children	-0.0602		0.0598		0.0978		0.0435		0.2207		0.0937		0.0552		-0.0770	
- Hh under poverty line	0.1190		0.0516		-0.0358		-0.1023		0.0907		0.0348		-0.0617		-0.1842	
- Hh residual net income 10 <sup>-3</sup>	0.0267		-0.0077		-0.0154		-0.0206		-0.0307		0.0010		-0.0198		-0.0836*	
<b>Region</b>																
- East germany	0.1733*		0.0983		0.0367		-0.0976		0.3269***		0.1197		0.0614		0.1293	
<b>Local possibilities for...</b>																
- shopping	-0.0795		0.1565		0.1230		-0.0624		0.1351		0.0922		0.0958		-0.2164	
- service demand	0.0504		0.0970		-0.0571		0.1554		-0.0489		0.0537		-0.0026		0.2178	
<b>Constant</b>	-3.9027***		-3.3185***		-2.2245***		-2.2544***		-3.8132***		-2.9023***		-2.5067***		-2.8040***	
Wald - $\chi^2$ (184)	1210.2***															
Log pseudolikelihood	-11273.6															
n	4743															

p-value&lt;0,05 / \*\* p-value&lt;0,01 / \*\*\* p-value&lt;0,00

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

### 6.3.2 Daily Demand for Services – Non-Active Population

Gender does not influence the timing for the demand for services in all periods of a day. Age again is important and is different in explaining the time when services are asked. The years when the **non-linear age effect** starts to decrease is about 50 years in the morning but 43 years in the evening which is in favour for morning services. **Non-market activities** like domestic work or active personal help for others decrease the demand for services in the mornings and evenings in some favour for early and late voluntary support of other persons. Some morning restrictions are visible: a larger **households** asks for morning activities which reduce the demand for services. Furthermore, early demand for services in East Germany is more probable among non-active persons. Here it can be speculated that a former long-term high employment rate of the population and generally other working hour conditions in East Germany would lead to a higher demand for services at the edges of a day. **Local availability of services** has no influence again in all periods of a day.

### 6.4 Some general conclusions

The simultaneous modelling and estimation has proven as to be necessary and important for the active as well as for the non-active population in explaining its different timing of daily demand for goods and services. The single results have shown that the timing decision differently depend on socio-economic respective socio-demographic factors.

What is the general picture behind all these single influences? Any paid employment indeed has impacts mainly via its timing restrictions on the daily shopping hours for goods and the demand for services. Also by the results of the non-active population, there are indirect impacts of available time from diverse non-market and social network unpaid work and activities for the timing demand pattern. In contrast to consumer theory and many empirical studies on consumption expenditure, neither the personal income nor the household's residual income as the economic resource for consumption show significant influence on the timing of demand for goods and services; a remarkable result both for the active and the non-active population. There are significant regional differences with increased demand probabilities for goods and services early or late a day in East Germany. However, human capital, the family status and further household characteristics do not have an overall significant influence with regard to the demand for goods and services; once again a remarkable result for the active and the non-active population. It is rather gender, the course of life, time spent in paid market and/or own non-market activities, the partner's situation and some regional aspects which differently influence the timing of daily demand for goods and services

## 7 Aging Society and Daily Demand Behaviour – Microsimulation for the Year 2020

With an aging society like that of Germany and the growing importance of the “Silver Agers” for consumption in general, noticeable consequences on the timing and the demand frequency over the course of the day are to be expected in the future. As apparent to our discussion above, age as one indicator of different life styles has a definite impact on the distribution and intensity of the timing of daily demand for goods and services. In order to more closely

examine future impacts of the aging society on the timing of demand we have applied a microsimulation approach. Since the pioneering work by Orcutt (1957) microsimulation has proven itself as an especially suitable and efficient instrument for individual analysis of policy impacts and changing scenarios. A general description of a microsimulation approach can be found in Merz (1991); international approaches and developments in Orcutt et al. (1976), Orcutt et al. (1986), Atkinson and Sutherland (1988), Brunner and Petersen (1990), Citro and Hanushek (1991a, b), Hancock and Sutherland (1992), Spahn et al. (1992), Harding (1996) and Gupta and Kapur (2000) as well as in Mitton et al. (2000).

Our microsimulation model ServSim utilises a changed German demographical structure for the year 2020 as predicted by the German Federal Statistical Office (2006) by a moderate variant 1-W1 with cross-border migration of 100,000 persons and eleven gender-specific age groups.

The demographic forecasting of the Time Budget Survey of 2001/2002 up to 2020 occurs via new demographic weightings. This „static aging“-approach here uses simultaneously the 22 gender and age specific characteristics. The microsimulation model ServSim utilises our program package ADJUST (Merz and Stolze (2005))<sup>1</sup> for the new simultaneous weightings (individual adjustment factors). This program package is based on an information theoretical approach according to the „minimum information loss“-principle (Merz 1983a, 1985, 1994) and delivers the individual comprehensive weights effectively.

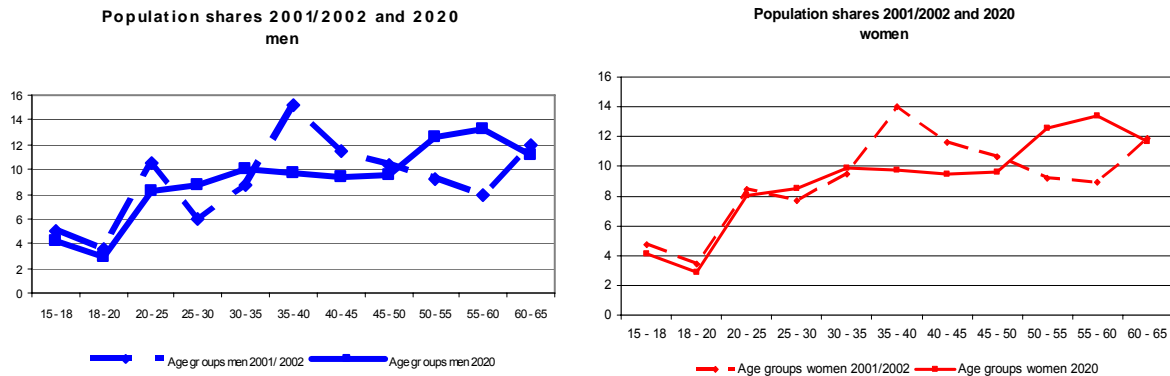
Though the microeconomic estimates from above allow behavioural response within a microsimulation analysis we restrict the following simulation exercise to static aging influences without a targeted altering of explanatory variables within the behavioural equations.

The demographic effect of the growing elder German population results in a general different age profile of the population and not only by more elderly. Figure 6 shows the gender specific age profiles at the survey time 2001/2002 and at the forecasted year 2020. As expected within these 20 years the former most frequent 35-40 years old persons then are in their 55-60ies; all younger cohorts, however, will be less frequent in 2020.

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<sup>1</sup> For the adjustment it should be considered that the Time Budget Survey consists of person-days; each participant kept a diary for three days. A demographic adjustment (weighting) concentrates on the structural constellation of persons from a demographic standpoint; in other words, its focus is not on the person-days as singular datasets but rather on the persons behind these datasets. Therefore, our new adjustment represents the person-structure. Further information for solving this adjustment problem can be found in Merz, Hanglberger and Rucha (2007).

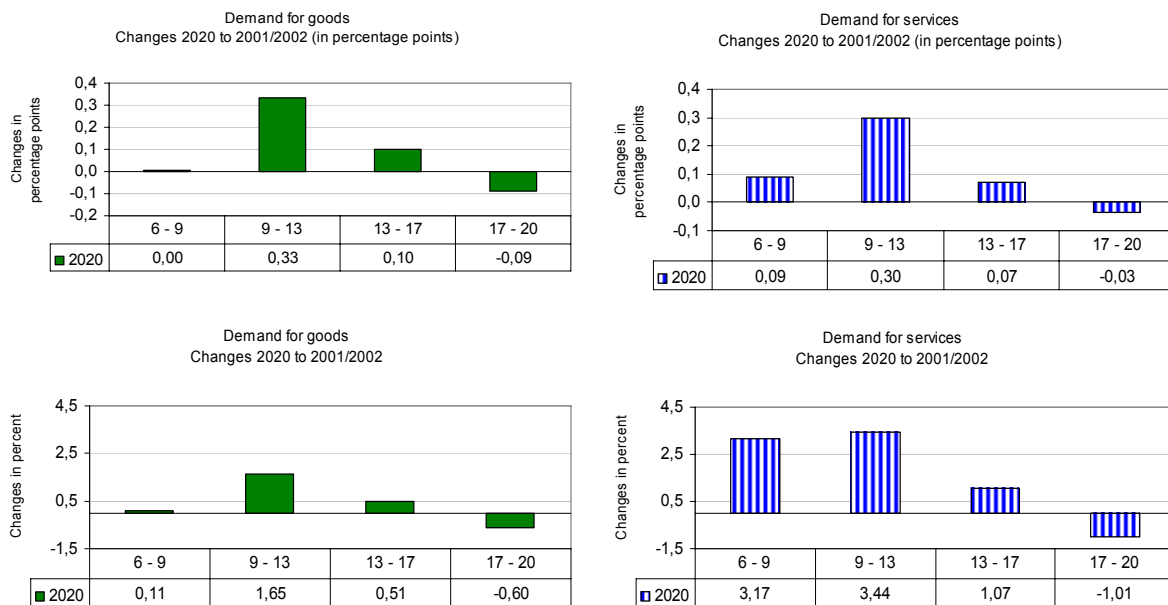
**Figure 6: Population shares 2001/2002 and 2020 (in percent)**



Source: German Time Budget Survey 2001/2002 and population projections by the German Federal Statistical Office, own calculations

What are the demographic effects on the timing of daily consumption with the different age structure as of 2020? Against some common expectation, the demand for goods as well as for services will shift with the 2020 aged population to mornings: between 9 a.m. and 1 p.m. More people will shop and will request personal and medical services more often in the morning as Figure 7 is illustrating. Some increase in the afternoon is considerably lower. After 5 p.m. the demand for goods and services generally will decrease.

**Figure 7: ServSim simulation 2020: Demand for goods and services in daily time periods in 2020 compared to 2001/2002 (changes in percentage points and in percent)**

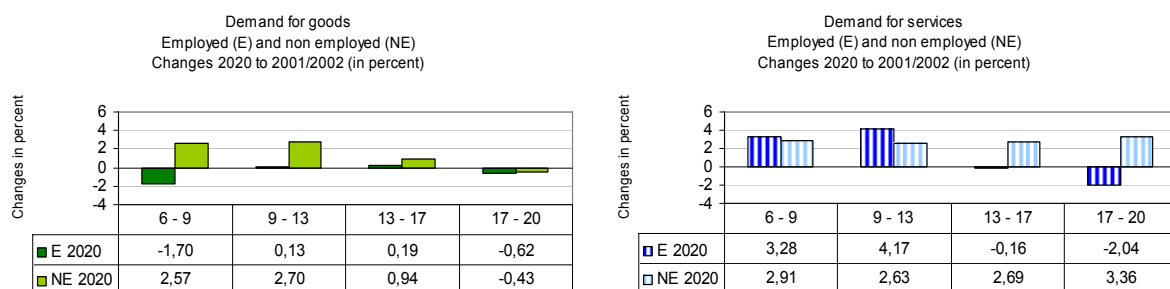


Source: German Time Budget Survey 2001/2002 and population projections by the German Federal Statistical Office, own calculations

With respect to percentage changes, which take care of different demand frequency levels, the effects for services are particularly more pronounced however due to the lower level of the base year service demand frequencies.

A disaggregated analysis in Tables 7 and 8 and Figure 8 refers to notable group-specific differences in the changing profiles: active persons stamp the changes in the timing of daily service demand, non-active persons stamp the changes of daily goods demand. Thus, the changed demography, which not only effects the older generation, will lead to a different structure of the labour force participation and in the consequence also to a different demand structures. In addition, for active persons the daily working hour arrangements with different impacts play a role in the changes in the timing of the daily demand for goods as well as for services.

**Figure 8: ServSim simulation 2020: Demand for goods and services in daily time periods in 2020 compared to 2001/2002 for employed and non-employed individuals (changes in in percent)**



Source: German Time Budget Survey 2001/2002 and population projections by the German Federal Statistical Office, own calculations

The fact that the demographic change not only results in more older persons is shown in a relatively noticeable decrease for all age groups' demand for services during the afternoon and evening (Table 7).

Further socio-economic breakdowns for the percentage changes are found in Table 7. The demographic change indicates stronger changes in the demand for services for men: more often mornings. Women, on the other hand, more often demand services at all times of the day.

With regard to effects of the economic situation, there is some difference between the „working poor“ and the poor non-active households. Though the effects differ by sign over the day, there is no prominent impact pattern with regard to the demand for goods but a slight impact for the demand for services.

Working hour arrangements for the 2020 population in particular have impacts for the non-core working hour with shifts to mornings' demand for services.

**Table 7: ServSim simulation 2020: Demand for goods and services of the active population in daily time periods in 2020 compared to 2001/2002 (changes in percent)**

Characteristic	Demand for goods				Demand for services			
	6 - 9 o'clock	9 - 13 o'clock	13 - 17 o'clock	17 - 20 o'clock	6 - 9 o'clock	9 - 13 o'clock	13 - 17 o'clock	17 - 20 o'clock
<i>Sex</i>								
Women	-0.67	0.32	-0.32	-1.20	1.78	3.62	2.17	0.35
Men	-2.51	0.71	1.60	0.27	4.54	5.82	-2.75	-4.36
<i>Age</i>								
15 - 29	-0.60	2.25	1.38	1.20	0.30	-0.65	-4.73	-0.26
30 - 49	-0.97	-0.59	-0.10	0.45	-0.56	0.71	-2.79	-3.75
50 - 64	-1.96	-1.88	-0.29	0.45	0.27	-1.29	-2.36	-1.26
<i>Economic situation/Poverty</i>								
Working poor	-9.46	0.39	-1.22	0.25	2.35	4.47	0.09	-8.26
Working non poor	-1.20	0.15	0.31	-0.90	3.39	3.94	-0.45	-2.04
<i>Working hour arrangements</i>								
cat 1 (not fragmented/core)	0.02	1.55	0.63	0.19	4.71	4.71	-0.51	-4.46
cat 2 (fragmented/core)	-5.91	1.23	1.34	-2.75	0.97	1.03	5.14	1.41
cat 3 (not fragmented/non-core)	-12.04	-0.80	3.49	6.48	-13.37	4.86	4.24	-29.24
cat 4 (fragmented/non-core)	-0.60	-1.68	-0.99	6.34	48.13	16.52	12.01	-35.51
<i>All active population</i>	-1.70	0.13	0.19	-0.62	3.28	4.17	-0.16	-2.04
<i>All</i>	0.11	1.65	0.51	-0.60	3.17	3.44	1.07	-1.01

Source: German Time Budget Survey 2001/2002 and population projections by the German Federal Statistical Office, own calculations

**Table 8: ServSim simulation 2020: Demand for goods and services of the non-active population in daily time periods in 2020 compared to 2001/2002 (changes in percent)**

Characteristic	Demand for goods				Demand for services			
	6 - 9 o'clock	9 - 13 o'clock	13 - 17 o'clock	17 - 20 o'clock	6 - 9 o'clock	9 - 13 o'clock	13 - 17 o'clock	17 - 20 o'clock
<i>Sex</i>								
Women	1.39	1.89	-0.97	-1.71	2.88	2.56	2.26	-0.83
Men	4.40	4.11	4.26	1.87	2.99	2.75	3.31	9.99
<i>Age</i>								
15 - 29	15.49	4.42	2.71	0.96	0.40	8.80	6.83	-4.15
30 - 49	1.06	0.08	-0.22	0.61	1.04	-0.10	-2.09	6.17
50 - 64	-1.35	-0.40	-0.10	2.82	0.11	-0.82	-1.12	3.28
<i>Poverty</i>								
Poor	-1.89	1.91	0.46	0.35	0.30	-0.63	3.64	5.87
Non poor	3.68	3.21	1.20	-0.43	5.35	4.08	1.90	1.72
<i>All non-active population</i>	2.57	2.70	0.94	-0.43	2.91	2.63	2.69	3.36
<i>All</i>	0.11	1.65	0.51	-0.60	3.17	3.44	1.07	-1.01

Source: German Time Budget Survey 2001/2002 and population projections by the German Federal Statistical Office, own calculations

With this short excursion to our aging society we can conclude that the demographic change alone with a changed socio-economic population structure already causes group specific impacts in the timing of the daily demand for goods and services. There will be shifts in particular to mornings which are more pronounced for the demand for services. Note that we have only done an alternative calculation and exercise; the expected changes in the individual behaviour, changes in the economy and the society in total will have, of course, further impacts.



## 8 Conclusion

Our study is a contribution to the research on the timing of daily individual consumer behaviour. Our results diminish the gap of extremely rare empirically founded research on the timing of daily demand. As mentioned, empirically sound results of the timing aspect of consumption are of particular importance not only for the knowledge of individual consumption behaviour by itself and for an efficient matching of demand and supply, the timing dimension in addition is of social, economic and social-political importance for the all day coordination of individual life in general.

Based on more than 37,000 time use diaries of the actual German Time Budget Survey of 2001/2002 we were able to analyse the timing of daily demand for goods and services; time use diaries, in particular, allow the investigation of individual daily timing aspects before a socio-economic background.

As the univariate description previously illustrated, socio-demographical characteristics such as age, gender, the economic situation with poverty, as well as working hour arrangements show a differing picture of the timing of daily demand for goods and services.

The ServSim microsimulation analysis with a projected demography for the year 2020 additionally pinpoints that already the changing age structure by itself – not only for the elderly – with differing course of life situations will change the timing of daily demand. Among other results: active persons rather will stamp the changes in the timing of daily service demand, non-active persons will stamp the changes of daily goods demand both in favour for morning demand activities. The shifts to morning's demand are more pronounced for the demand for services than for goods.

To analyze competing demand periods over a day with competing explanation hypotheses we model the timing decision by a latent discrete choice model of utility maximization over the day. Our eight equation Multivariate/Simultaneous Probit estimates, which account for interdependencies between different daily demand periods as well as between the demand for goods and services, revealed differences in the timing of daily demand behaviour between active and non-active persons. Highly significant influences appeared for personal characteristics as well as for the variables describing employment according to its timing and fragmentation. With closer inspection, the age effect, the influence of gender, the daily timing and fragmentation of working hour arrangements and non-market and social network engagements and the partner's working pattern, appeared to be clearly differentiated in their demand period profiles. In addition, significant regional differences with increased demand for services can be found in the edges of a working day (early and evenings) in East Germany.

Surprisingly, income as the central economic resource and important variable in consumer theory and consumption expenditure/quantity analyses is not significant (exemption: personal income, early). Though the univariate descriptive analysis show some minor income effects and influences of the (working) poor, within the competing estimates this single income influence could not put through in competition with others. Since our demand probabilities for a certain daily time period at the same time are participation probabilities to shop respectively to ask for services the results here are a further strong hint that the participation decision to buy/demand something has to be explained differently than the final bought quantity of goods and services (see e.g. the two step explanation for durable goods by Merz 1980, 1983b).

Not expected, human capital, the family status, further household characteristics as well as local shopping and service possibilities do not have an overall significant influence with regard to the demand for goods and services; once again a remarkable result which is valid both for the active and the non-active population. It is rather gender, the course of life, time spent in paid market and/or own non-market activities, the partner and some regional aspects which differently influence the timing of daily demand for goods and services

The estimated correlation structure of the simultaneous time of the day probabilities has shown two regimes of overlapping demand activities: early and mornings against afternoons and evenings. However, two separate daily regimes, whole morning till 13:00 hours and the whole afternoon till 20:00 hours, will be visible with almost no overlapping demand activities. Thus shopping and the demand for services are done closely together either mornings or in the afternoon but not spread over the whole day.

There will be many interesting aspects not yet considered in our paper and left to further research which will have expected influences on the timing of daily demand: like more in depth individual urban and rural shopping circumstances and behaviour (keyword "time geography" aspects), one-time shopping at the weekend or seasonal effects, to mention only a few. Another aspect, which probably will have deep impacts on the timing of shopping is the growing use of the internet. The unrestricted timing dimension for on-line shopping seems to be of minor interest both for the demand and for the supply side. However, if for certain goods, and certainly for personal services, face to face "off-line shopping" is necessary or preferred, then the timing of daily demand remains highly important.

In conclusion, the results support our simultaneous approach and by quantifying the diverse effects it become obvious, that the timing of daily demand for goods and services is different for goods and services, different for active and non-active population and different to the discussed explanatory factors describing the living conditions of the individuals. Without the knowledge of the timing of daily consumption an important aspect would be missing in understanding not only consumption itself but also the all day living situation with its familiar and business coordination and organisation of time dependent activities.

In particular, for any liberalisation of shopping as well as service hours, the knowledge of the actual timing of daily consumption behaviour will become even more important for a suitable and effective supply when the demand for goods and services will not be of the same intensity „round-the-clock“. More in depth knowledge of the timing of daily consumption – e.g. with an even further developed microsimulation model like ServSim – would support efficient market coordination, allow target-oriented marketing and with the provision of general hints on the social coordination of individual daily ways of life would support targeted economic and social policy in general.

A last call: As our data base is of 2001/02 it could be expected, that the meanwhile liberalization of shopping hours in Germany and a changing economic situation in general, like the 2008/2009 upcoming financial and economic crisis, will affect individual consumption behaviour and the importance of single socio-economic factors in a different manner. Thus, an actual new Time Budget Survey in Germany is urgently needed for more actual results for the timing topic and for many other important investigations dealing with the time resource.

## Appendix

**Table A1: Variables included in the Multivariate Probit estimations of demand for goods and services**

<i>Personal characteristics</i>
- Woman
- Age
- Age <sup>2</sup>
- Married
<i>Human capital</i>
- High school diploma (Abitur) (reference: any other or no graduation)
- University degree (reference: any other or no degree)
- Further education (taken part in any professional or further training)
- Student
<i>The models for active population include additional variables describing job characteristics</i>
- Self-employed (reference: employee)
- Personal monthly net income in € 10 <sup>-3</sup>
- Commuting time
- Daily hours of work
- category 2: core, fragmented
- category 3: non core, not fragmented
- category 4: non core, fragmented (reference for working hour arrangements: category 1: core , not fragmented)
<i>Time spent for non-market activities at the observed day as main or secondary occupation (in hours)</i>
- Domestic work
- Do-it-yourself activities
- Nursing at home
- Active personal help in social networks
- Child care
<i>Partner's employment status</i>
- Full time
- Part time
- No partner (reference: partner is non employed)
<i>Household characteristics</i>
- Hh-size
- Hh with children (dummy variable; not: number of children in household)
- Hh under poverty line (household's net equivalent income is below poverty line)
- Hh residual monthly net income * 10 <sup>-3</sup> (household's income minus personal monthly net income)
<i>Region</i>
- East Germany
<i>Local demand possibilities</i>

**Table A2: Demand for goods and services of active population -descriptive statistics (not weighted)**

	Mean	Std.dev.	Min	Max
<i>Demand for goods in daily time periods</i>				
- 6 - 9 o'clock	0,028	0,164	0	1
- 9 - 13 o'clock	0,094	0,291	0	1
- 13 - 17 o'clock	0,196	0,397	0	1
- 17 - 20 o'clock	0,189	0,391	0	1
<i>Demand for services in daily time periods</i>				
- 6 - 9 o'clock	0,019	0,136	0	1
- 9 - 13 o'clock	0,035	0,185	0	1
- 13 - 17 o'clock	0,060	0,237	0	1
- 17 - 20 o'clock	0,043	0,203	0	1
<i>Personal characteristics</i>				
- Woman	0,439	0,496	0	1
- Age	41,227	10,424	15	64
- Age <sup>2</sup> 10 <sup>-2</sup>	18,083	8,281	2,25	40,96
- Married	0,658	0,474	0	1
<i>Human capital</i>				
- High school diploma (Abitur)	0,285	0,452	0	1
- University degree	0,166	0,372	0	1
- Further education	0,652	0,476	0	1
- Student	0,019	0,138	0	1
<i>Working characteristics</i>				
- Self-employed	0,075	0,263	0	1
- Personal monthly net income	1708	1049	0	9500
- Commuting time	24,845	20,810	0	250
- Daily hours of work	7,305	2,239	0	22,83
- cat 2	0,238	0,426	0	1
- cat 3	0,042	0,201	0	1
- cat 4	0,023	0,150	0	1
<i>Non-market activities/ social network</i>				
- Domestic work	1,259	1,374	0	10,5
- Do-it-yourself activities	0,074	0,426	0	8,33
- Nursing at home	0,011	0,102	0	3,67
- Active personal help in social networks	0,059	0,351	0	6,83
- Child care	0,404	0,875	0	10,17
<i>Partner's employment status</i>				
- Full time	0,312	0,463	0	1
- Part time	0,245	0,430	0	1
- No partner	0,295	0,456	0	1
<i>Household characteristics</i>				
- Hh-size	3,198	1,220	1	8
- Hh with children	0,749	0,434	0	1
- Hh under poverty line	0,039	0,193	0	1
- Hh residual net income	1454	1438	0	7500
<i>Region</i>				
- East Germany	0,202	0,401	0	1

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

**Table A3: Demand for goods and services of non-active population - descriptive statistics (not weighted) of the 4743 observations**

	Mean	Std.dev.	Min	Max
<i>Demand for goods</i>				
<i>in daily time periods</i>				
- 6 - 9 o'clock	0,051	0,221	0	1
- 9 - 13 o'clock	0,310	0,463	0	1
- 13 - 17 o'clock	0,234	0,424	0	1
- 17 - 20 o'clock	0,125	0,331	0	1
<i>Demand for services</i>				
<i>in daily time periods</i>				
- 6 - 9 o'clock	0,040	0,196	0	1
- 9 - 13 o'clock	0,123	0,329	0	1
- 13 - 17 o'clock	0,079	0,270	0	1
- 17 - 20 o'clock	0,023	0,150	0	1
<i>Personal characteristics</i>				
- Woman	0,638	0,481	0	1
- Age	40,161	17,415	15	64
- Age <sup>2</sup> 10 <sup>-2</sup>	19,162	13,718	2,25	40,96
- Married	0,532	0,499	0	1
<i>Human capital</i>				
- High school diploma (Abitur)	0,168	0,374	0	1
- University degree	0,060	0,238	0	1
- Further education	0,388	0,487	0	1
- Student	0,056	0,229	0	1
<i>Non-market activities/social network</i>				
- Domestic work	2,797	2,512	0	15
- Do-it-yourself activities	0,105	0,602	0	9,17
- Nursing at home	0,029	0,310	0	10,33
- Active personal help in social networks	0,191	0,896	0	15,83
- Child care	0,718	1,781	0	13,83
<i>Partner's employment status</i>				
- Full time	0,269	0,443	0	1
- Part time	0,068	0,252	0	1
- No partner	0,447	0,497	0	1
<i>Household characteristics</i>				
- Hh-size	3,137	1,328	1	10
- Hh with children	0,670	0,470	0	1
- Hh under poverty line	0,197	0,398	0	1
- Hh residual net income	2506	1437	86	7500
<i>Region</i>				
- East Germany	0,222	0,416	0	1
n	4.743			

Source German Time Budget Survey 2001/2002, own calculations

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