Interdependencies and Modelling of Swiss Household Expenditure Categories

Boris Jäggi, IVT ETH Zürich

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Boris Jäggi
IVT ETH
Zürich

Phone: +41 44 633 33 25
email: boris.jaeggi@ivt.baug.ethz.ch

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Abstract

The Swiss National Income and Expenditure Survey tracks household budgets of one month for 3000 households every year, in a representative sample for Switzerland. In this paper, the expenditures of households in the years between 2001 and 2008 were analyzed, with a focus on transportation expenditures. The expenditures were categorized in 10 categories: Savings and Durable Goods (SaDG), Food (F), Eating Out, Alcohol and Tobacco (EAT), Housing: Rent and Interest (HRI), Housing: Energy (HE), Entertainment (E), Consumer Goods (CG), Communication (C), Public Transportation (PuT), Private Transportation (PrT). The correlations between these categories were analysed for different subgroups of the population.

For every category, a linear least square regression model for the whole data was estimated. The results of the analysis of covariance of the expenditure categories showed that the spending categories are independent from each other and only show very weak interdependencies, but without clear patterns. The results of the linear regressions are very different for every category. Savings are mainly determined by income and household type. Richer households can save considerably more than poorer ones. Food is determined by the no. of persons in the household and by household type. Both categories could be explained considerably well. The other categories had lower explanatory power. Eating out, Alcohol and Tobacco is weakly dependent on income and on age. The finance aspect of housing costs is determined by household type, age (older tenants have lower costs) and geography, but surprisingly almost independent of income. The entertainment spending category is determined by income and household type, as are consumer goods. Communication expenditures are virtually independent of income and almost solely determined by the no. of mobile phone devices in the household. The two transportation categories show a very distinct patterns. While public transportation expenses are almost independent of income and very random (lowest explanatory power of all categories), private transportation is determined mostly through car ownership and household type. Income of course influences car ownership in the first place, but once a household is already a car owner, it does not spend substantially more on fuel, reparations, parking etc. when with higher income.

Keywords

Household expenditure – regression models – income – transportation – houseing – food - categories

1. Introduction

1.1 Context

Microscopic agent based modelling, as used, for example, in models like the SACSIM model of the Sacramento Area, California (Bradley et al., 2010), the ILUTE model in Toronto (Salvini and Miller, 2005), the Albatross model from the Netherlands (Beckx et al., 2009) or MATSim, an overall transport model currently being developed at the Institute of Transport Planning and Systems, (IVT) in collaboration with TU-Berlin (Balmer, 2007; Meister et al., 2009; Balmer et al., 2008), requires detailed microscopic information to model agents. Models with very detailed agents have many advantages, first and foremost the possibility to observe and track single agents in various, reproducible situations and interactions. A major disadvantages however is the need for detailed, disaggregate information. Agent's disaggregate characteristics driving the behaviour and transport related decisions, are to a major part non-observable personal preferences, modelled as random error terms. Other characteristics can be considered as specific combinations, resulting from the individual, close environment of a person, such as family, household, specific residential location, job, social network, car ownership and so on. Irregular working hours, the need to support a family member, diet requirements of a household member, the nature of neighbourhood or street one lives in or status requirements of a job are all examples of perfectly observable but incredibly detailed variables, that are difficult to collect, handle, quantify or implement into a model. Yet they are responsible for a substantial part of transport related decisions. While we can model car ownership, we cannot model car ownership of a young, low income couple living in an urban area close to the public transport system because their hobby requires them to travel to mountains on weekends with a lot of equipment, other than with randomness. These kinds of decisions are still out of reach in both surveying as well as modelling. Making assumption over these variables for a longer time period is near to impossible.

Individual social state of a person, typically the socio part of socio-economic variables, influences transportation behaviour indirectly through influencing the before mentioned environmental and personal characteristics. These are variables like age, gender, education, household composition and profession. They are relatively easy to collect, quantify and understand in surveys and data sets and are usually part of the backbone of transport models. Examples are: Family size increases car ownership, younger people or women use more public transport, higher education increases likelihood for air travel etc. While making assumptions for the long term for some of these variables can be rather difficult, others like gender or age can more easily be assumed or derived from demographic models.

Individual (or household level) economic information consists of income and expenditures, with income as the strongest and most important one. Household or personal income is most widely used as an explanatory variable as it is relatively easy to collect in surveys and can also be assumed with a satisfying accuracy through models of regional economic growth and changes in distribution.

When activity chains and transport demand are to be forecasted over a longer time period, a model is needed that generates future person's households with its characteristics. If the present population is simply scaled up assuming only population growth and known activity chains, then our model can tell us nothing about the dynamics in future of transportation other than an increase in population results in equally more traffic. Müller and Axhausen (2012) provide a state of the art model for the generation of artificial households in Switzerland. These artificial population generators have to make assumptions over the general state of economy and demography in a given year in the future, and based on that generate synthetic households on the basis of current survey and census data. Applying standard models for the simulation or estimation of travel demand or car ownership of these synthetic future households would require information on activity patterns. It is this point, where including economic variables like household income and expenditure can . A model that is based on household expenditures and derives travel demand from transportation expenditure makes it possible to incorporate scenarios of economic and political development through changes in expenditure categories. A steep increase in energy prices could be modelled through energy related expenditures, political development regarding farm subsidies and tariffs through food expenditures and developments in the finance sector through housing expenditures. Such a model could also be implemented in synthetic population generation for example in the case of modelling car ownership.

1.2 Literature

The first comprehensive study on household expenditure patterns was conducted by Houthakker (1957) who compared expenditure elasticities for various international household expenditure surveys.

In (Castro, 2012), household expenditure is categorized in vehicle purchase, gasoline, vehicle insurance, vehicle maintenance, air travel, public transportation and non-transportation related goods, which, as they are chosen by all households, are treated as outside goods in the model. She found that the number of workers in a household increases vehicle related expenses, that

middle and higher income household spend a lower proportion on transportation and that race and household location has a significant impact on public transport related expenses.

Several authors studied transportation expenditure alone or in relation to other expenditure categories. Thakuriah and Liao (2006) for example found a positive relationship between income and transportation expenditure.

Gicheva et al. (2007) show a substitution effect between expenditure for gasoline and for food. Choo et al. (2007b) and Choo et al. (2007a) found a complementary relationship between communication and transportation expenditures using a almost ideal demand system. Other studies working with the almost ideal demand system developed by Deaton and Muellbauer (1980) found a complementary relationship between communication and transportation expenditures. Other studies, focused more on household budget allocation dependent on income sources of multiple worker households are the following: Lundberg et al. (1997) who rejected the hypothesis of income pooling among spouses by saying that a higher income share from the wife resulted in higher expenditures for wife and children.

Browning and Chiappori (1998) present a model framework to determine how a spouses income share influences expenditures of different categories. Browning et al. (1994) showed that the decision process within a household is different according to the household composition. Blundell et al. (1993) estimated parameters for a demand system with seven categories: food, alcohol, fuel, clothing, transport, services, and other. The authors found that an aggregated model performs with similar accuracy than a model based on micro data.

Deaton et al. (1989) tested the existence of adult goods to determine the influence of demography on expenditure patterns using Spanish household expenditure data. In Mokhtarian et al. (2011) the authors looked at trends within the household expenditure categories of communication and transportation between 1984 and 2002. Fan and Zuiker (1998) used annual household expenditure data from the United States for the period from 1980 to 1992 to compare the spending patterns between Hispanic Americans and Non-Hispanic White Americans.

2. Data

2.1 Introduction

The data set used is from the Swiss Household Income and Expenditure Survey (Swiss Federal Statistical Office (BFS), 2008). The Swiss Federal Statistical Office (BFS) conducts an annual survey of between 3.000 and 3.700 households per year in a statistically representative sample of the whole of Switzerland to collect detailed data about the income and the spending habits of households. The data set used here covers all years between 2001 and 2008 with a total number of 27.200 households. Every household had to report on socio-economic information, household composition, housing characteristics etc. and fill in a detailed income and expenditure diary for all household members. The time span for the diary is always one calendar month, making it impossible to track or analyse the course of income and spending of a particular household over a longer time period.

The samples for the Income and Expenditure Surveys are representative for the Swiss population (Swiss Federal Statistical Office (BFS), 2008). In our analysis we focused on the most generic socio-economic variables like household composition, income and residential location. Table 1 gives an overview over the socio-economic and spatial distribution of the households. Couples and families are the most common household type with each around a third of all households. Single household make up nearly a fourth. In terms of residential location we can see that more than half of all households live either in a city or a regional centre or in its suburban surroundings. Unfortunately, the geographical resolution shown in table 1 is the highest possible one. Although addresses, municipalities and cantons of the respondents were collected, we could not obtain this information due to data protection laws. The smallest entity of a geographical variable must contain at least 600 households for every year to ensure total anonymity for all the participants.

Table 1 Socio economic characteristics of sample

Variable	Sample [%]	Variable	Sample [%]
Metropolitan Area of Residence		*Household Type*	
Lake Geneva Area	15.6	Single	26.4
Bern Region	22.8	Single Parent	4.4
North-West Switzerland	13.3	Couple	32.4
Zurich Region	17.4	Family with 1 Child	11.1
East-Switzerland	12.9	Family with 2 Children	16.3
Central Switzerland	9.1	Family with 3+ Children	6.7
Ticino Region	8.8	other Households	2.7
Type of municipality of residence		*Persons per household*	
Regional centre	27.5	1	26.4
Suburban and high Income	34.1	2	36.0

2.2 Descriptive Statistics

Composition of consumer spending is shown in figure 1. The lower four parts of the stacked bar with brighter colours stand for what we assume to be "semi-fixed costs". While households are normally not forced by law to carry these expenses, they are fixed in the sense that they are required in order to maintain a decent or appropriate standard of living. That includes fixed costs (additional educational costs and healthcare spending not covered by insurance such as dental care for example), transportation because of it being absolutely necessary in order to work or engage in social contacts, housing appropriate to the social class, household composition and requirement of living standard, food and communication. While communication in the form of smart-phones for example could be viewed by many not as a necessary communication tool and rather as deliberate entertainment, it is nowadays very difficult to find and get a job without internet access and/or a mobile phone number. Also

recent applications for virtual social networks, such as “Facebook” or “Whatsup”, become more and more important for the organisation of real life social networks, especially for younger persons, who, without these tools, are in danger to be excluded from a significant part of social life.

Expenditure for Consumer Goods such as Clothing, Entertainment (including television devices or computers) and Alcohol, Tobacco and Eating out are considered as deliberate spending and more subjected to ad-hoc decision making than the above described semi-fixed categories. While the share of total consumer spending is smaller for richer households, the opposite is true for the deliberate spending categories which have a higher share of total spending for richer households, resulting in an even bigger absolute amount, as seen in figure 1.

Figure 1 Composition of consumer spending per income class

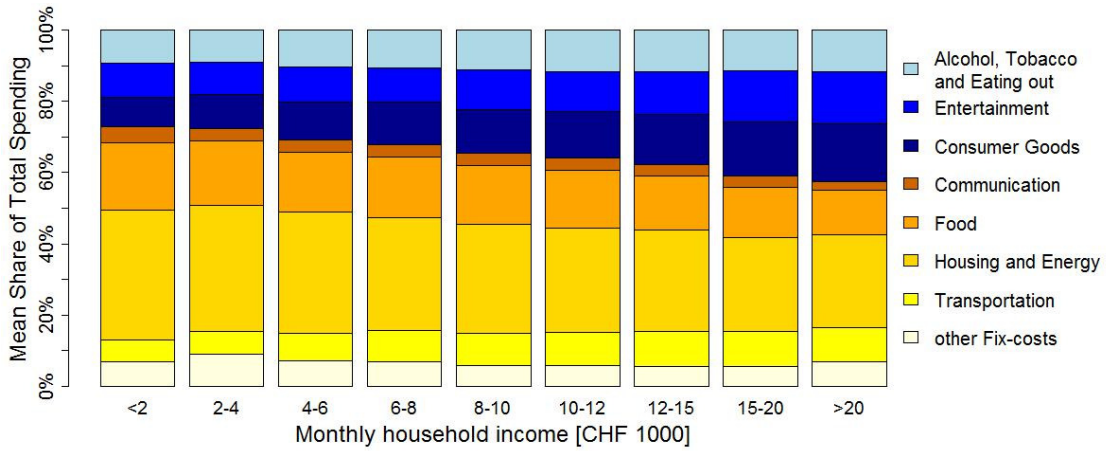


Figure 2 Composition of transportation spending per income class

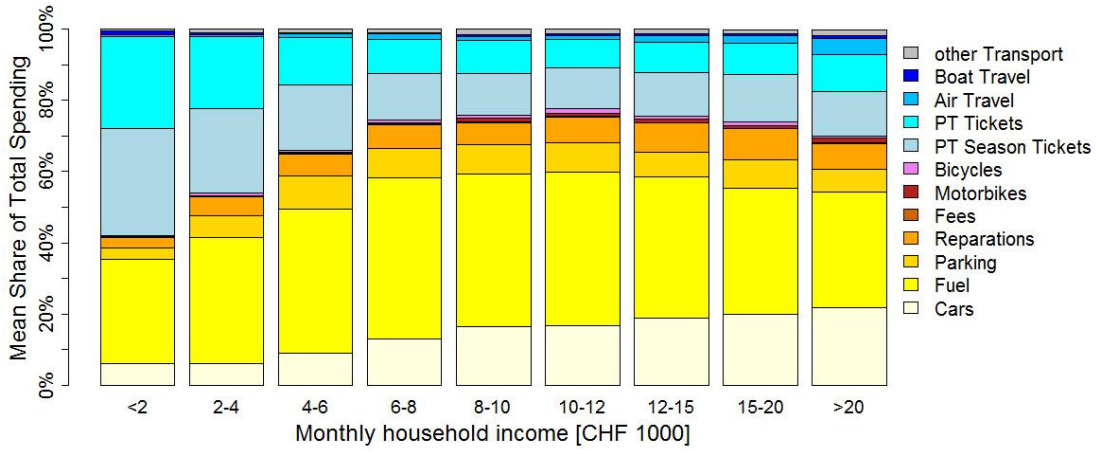


Figure 2 shows the share of the different subcategories of transportation expenses by income classes. Lower income households clearly spend much more for public than for private transport. But also for the two lowest income classes, almost half of average transportation expenses are for private motorized transportation. Interestingly, the middle income households spend the highest share of its transportation budget for private transportation. This is related to the fact, that fuel costs are dominant for private transport expenses but are only linear scalable through a more frequent use of the transport mode in question. For the purchase of cars or air travel or public transport, expenditures can also be scaled by buying higher comfort or quality (luxurious cars, 1. class tickets or taxis). In the case of public transport, the budget is divided in half single tickets and half season tickets for all income classes almost identically.

2.3 Categorization

Table 2 shows categories used for statistical analysis and regression models. Only consumer spending categories were modelled. Donations, taxes, fees, insurances and other transfer spending are taken out of further analysis as they are fixed, often required by law and are not a function of a household's decision.

Table 2 Categorization of consumer expenditure for modelling

Abb.	Category	Includes
F	Food	Food, Lunch and non-alcoholic beverages in canteens
EAT	Eating out, Alc. and T.	Alcohol, Tobacco and Restaurants
HR	Housing: Rent	Rent, Interest and down-Payment, Maintenance
HE	Housing: Energy	Energy, Heating, Water and Waste Disposal
CG	Consumer Goods	Clothing, Shoes, Housekeeping, Kitchen appliances, Dinnerware, Textiles, etc.
Ent	Entertainment	Entertainment, Culture, Accommodation
Com.	Communication	Communication
Pr.T	Private Transportation	Fuel, Reparations, Fees, Parking
Pu.T	Public Transportation	Tickets and Season Tickets

The "Food" category refers to all food and beverages households need to buy in order not to stay hungry. The "Eating out" category refers to all activities and goods seen as luxury food including going out for dinner and drinking alcohol. The third category is the monetary aspect of housing, normally related to location and relative value of the dwelling a household lives in. The next category, "Energy" is more related to the insulation capacity of the building and of individual behaviour of the household. "Consumer goods" is a category that sums up goods that are not especially necessary to survive, but a typical nice-to-have for maintaining a certain standard and style of live. "Entertainment" means all expenditure for things and activities that bring fun and entertainment to their leisure time. That could be a ticket for a sport-event, a day going skiing in the mountains, a board game, a concert or opera ticket or accommodation in a hotel. The "Communication" category contains expenditure for telephoning, internet and mail services. The transportation category is divided in two, to be able to separately analyse private transportation and public transportation.

The category "Fix Costs" is a category of minor importance. It covers additional health care spending and private schooling. In Switzerland, primary and secondary schools are public and free of costs for everybody. Attendants of tertiary or higher education are charged a small fee. Private institutes for specialized further education and advanced training however can be

costly. But overall, only a small percentage of households pay for educational purposes. As for healthcare, the great majority of necessary treatments are covered by the mandatory health insurance, for which the premiums are counted under transfer payments. This category is labelled "Fix Costs" as assumed there costs to be necessary and not traded-off against other goods. When matriculated at a university or when having a health issue the associated cost are viewed as fixed and not the result of a deliberate spending decision.

The last category described in table 2 is "Savings and Durable Goods". The reason to lump together these seemingly unrelated classes comes from the nature of the survey method itself. The survey only covered one month per household. When the household was surveyed in exactly that month in which it may have bought a durable consumer good, i.e. a TV, which in many cases exceeded the normal spending for that category, the household has probably not bought a TV in the previous month, nor would he buy a TV in the next month. If the household borrowed the money for the TV it would be partially paying for the TV in the next months. If the household had the money in cash, it would to have saved for it during the previous months (either explicitly or implicitly). Either way, from a generalized point of view, the household financed the purchase of the durable good (TV) over a time period of multiple months. Attributing this financing solely on the random month during which the TV was actually purchased, overstates the expenditure of this household, and understates the expenditure of a household that was saving for a TV to buy it in a month that was not surveyed. To counter that problem I discounted all expenditures for durable goods in the respective categories and added it to the "Savings and Durable Goods" category.

3. Correlation between Expenditures

To calculate correlation among expenditure categories, the Pearson Correlation Coefficient (PCC) was used. It ranges from -1 (perfect negative correlation) to +1 (perfect positive correlation). 0 means no correlation at all between the two categories. A first insight on how expenditure categories may interact with each other, is given by the correlation matrix, as shown in table 3. The correlations between the expenditure categories are fairly low. The highest value is 0.34 for the correlation between expenditure on Food and expenditure on Consumer Goods. A causal interpretation for these categories is very difficult to make as there is no obvious idea why these two categories should be correlated other than through income and why correlation between these two categories is higher than between other categories.

Table 3 Correlation Matrix for expenditure categories

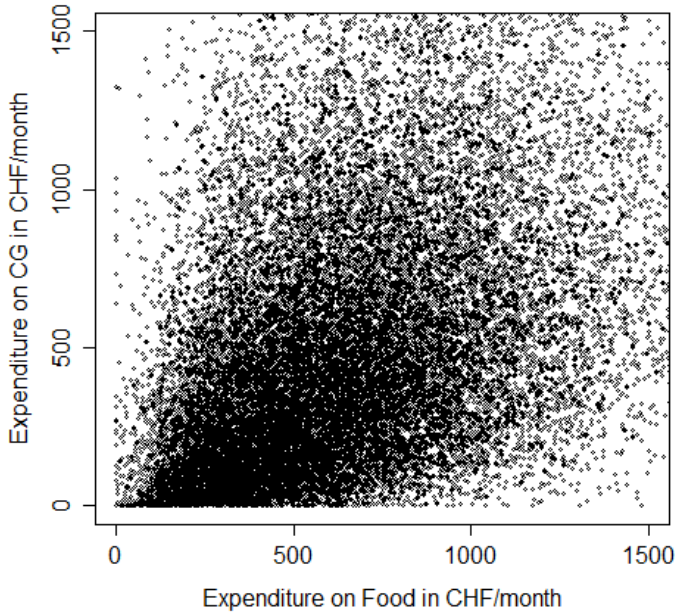
	F	EAT	HR	HE	CG	Ent	Com	PrT	PuT	Fix	SaDG
F	1	0.19	0.14	0.21	0.34	0.22	0.23	0.20	0.12	0.11	0.04
EAT	0.19	1	0.16	0.09	0.30	0.32	0.23	0.23	0.20	0.06	0.00
HR	0.14	0.16	1	0.03	0.21	0.16	0.16	0.13	0.10	0.05	-0.11
HE	0.21	0.09	0.03	1	0.13	0.12	0.09	0.09	0.02	0.05	-0.02
CG	0.34	0.30	0.21	0.13	1	0.31	0.22	0.22	0.17	0.12	-0.05
Ent	0.22	0.32	0.16	0.12	0.31	1	0.17	0.17	0.2	0.11	-0.10
Com	0.23	0.23	0.16	0.09	0.22	0.17	1	0.25	0.12	0.05	0.02
PrT	0.20	0.23	0.13	0.09	0.22	0.17	0.25	1	-0.02	0.06	-0.03
PuT	0.12	0.20	0.10	0.02	0.17	0.20	0.12	-0.02	1	0.08	0.02
SaDG	0.11	0.06	0.05	0.05	0.12	0.11	0.05	0.06	0.08	1	-0.22

But even this correlation, representing the highest correlation of all possible combinations, is still quite weak. Figure 3 shows the scatter plot for the correlation between Food and Consumer Goods, each data point representing a single household. This pattern of low correlation coefficients holds also for various sub-samples. Correlations were calculated for different households types, different income classes and different residential municipality types and no substantially higher correlation coefficients were found. The highest absolute correlations found are the negative correlations between Savings and Durable Goods and other categories for lower income classes. In this case, households with low incomes trade off Savings with other expenditure. The strongest (negative) correlations are found for the income

class with an income of less than CHF 2000 / month, ranging from -0.19 for Public Transport to -0.66 for Consumer Goods and Housing: Rent and Mortgage. These households also have the highest level of negative savings.

The three times three box drawn in the matrix highlights the correlation between communication and transportation. While public transportation is almost not at all correlated to the other two categories, there is weak, but visible correlation between private transportation and communication

Figure 3 Correlation between Food and Consumer Goods



4. Linear Regression Models

As shown in 3, the correlation between the different (dependent) expenditure categories are weak. By applying standard linear least square regressions, we show how independent explanatory variables like socio economic and geographical variables, information about durable consumer goods and information about the time of observation influence expenditure for a given category. These models allow us to understand which of the observable characteristics have an influence on the amount of expenditure and also what the differences or similarities between expenditure categories are. A multivariate linear regression model was estimated for the categories Savings and Durable Goods (SaDG); Food; Eating out, alcohol and tobacco (EAT); Housing: Rent & Mortgage (HR); Entertainment (Ent); Consumer Goods (CG); Communication (Com); Private Transportation (PrT); Public Transportation (PuT). Table 4 gives an overview over the estimated regression models showing its most important influencing variables as well as explanatory power.

Table 4 Summary of regression models

Category	Influence of Income	Main Influence Variable	Adj. R^2
Savings and DG	Strong	Inc. and HH Type	0.40
Food	Weak	No. Of Pers. and HH Type	0.48
EAT	Medium	Inc. and Age	0.19
Housing: R +M	Weak	HH Type, Age and Geography	0.14
Entertainment	Weak	Inc. and HH Type	0.16
Consumer Goods	Weak	Inc. and HH Type	0.23
Communication	Very Weak	Mobile phone devices	0.26
Public Transportation	Very Weak	Car Own. and Geography	0.13
Private Transportation	Weak	Car Own. and Geography	0.17

Table 5 gives the coefficients for the regression model for HR, Ent, CG and EAT. Spending for the housing category is relatively hard to predict given the information available. The best model we could find, only explains 13% of the variance of the data. Age has substantial negative effect of CHF -8 per year of age difference. That fact reflects the increase in land prices in Switzerland where rents and house prices are higher every year for the recent past, which affects households who move into a new place much more as they have to make a new contract, whether they buy a house or rent a flat. The longer one lives in the same home, the cheaper it is compared to the average. Considering household types, it is interesting to see that families spend less for housing than couples or singles. One explanation is that families need the money for other things and as their budget is tighter, housing costs are optimized.

As for residential location, it is very interesting to see that households in suburbs spend considerably more than in other municipality types. The difference for the same upper income household located either in the suburbs of Zurich or in a commuter town in Ticino is 200 + 215 -(-54-72) = CHF 541 per month or almost CHF 6.500 per year according to the model.

Influence of income on entertainment is significant. Households with more persons spend substantially more. The difference between a family with 3 or more children and a retired single is the same as almost CHF 4.000/month of income per month. Durable goods for housekeeping and for entertainment also increase entertainment spending.

For consumer goods, income has a similar significant effect as entertainment or housing with about CHF 50 for every CHF 1.000/month more in income. Housekeeping appliances increase spending for consumer goods by CHF 18 each. A more substantial impact comes from household type, where parenting contributes to consumer goods expenditure.

Expenditure for luxurious food and tobacco is influenced significantly by income (with a slight satiation) and age. The significant influence of household type (already controlled for household size) is that couples spend more and single parents spend less.

Table 6 gives the coefficients for the regression model for SaDG, Food, Com. PuT and PrT.

Savings and expenditure for durable goods depend heavily on household income, more so than in any other category. For every CHF 1.000/month of more income, about 400 go to savings and durable goods when controlled for household type and other variables. This means that large savings is almost exclusively possible for richer households. Families with children can save much less than other households. The income controlled difference between a family with 3 children and a working aged couple is about CHF 1.000/month. The presence of cars and durable goods have also a quite significant impact on savings. A newly bought car decreases savings by about CHF 300 per month, which can be seen as a good proxy for the cost of car in Switzerland.

Table 5 Coefficients of linear regression models – part I

	Housing Rent		**Entertainment**		**Consumer Goods**		**Eat. Alc. Tobacco**	
	Est.	T-Stat	Est.	T-Stat	Est.	T-Stat	Est.	T-Stat
Intercept	916.7	(13.8)	-176.3	(-3.3)	14.3	-0.5	23	(0.6)
Income	51.4	(21.0)	56.7	(28.5)	49.5	-29.6	36.6	(30.7)
No. Pers.	1.3	(0.1)	-18.1	(-1.3)			23.9	(2.8)
Age	-8.3	(-16.0)	2.1	(5.1)	-1.0	(-2.9)	10.6	(10.0)
RS	272.8	(5.4)	42.6	(1.0)	111.2	(4.1)	25.6	(1.0)
WAS	87.1	(1.87)	76.7	(2.0)	58.8	(2.6)	-18.3	(-0.8)
SP	90	(2.3)	150.5	(4.6)	189.3	(7.0)	-43.1	(-2.2)
RC	101.3	(2.8)	123.1	(3.7)	93.2	(4.2)	93.3	(4.4)
WAC	70.1	(1.7)	123.1	(3.7)	118.4	(4.6)	75.1	(4.2)
Fam1	26.0	(0.8)	59.5	(2.1)	167.5	(7.2)	-6.8	(-0.4)
Fam2	18.3	(0.5)	162.5	(5.3)	181.9	(7.8)	13.44	(0.7)
Fam3	-23.3	(-0.43)	240.2	(5.5)	199.8	(7.8)	23.3	(0.9)
Centre Mid	85.1	(4.8)	45.3	(3.1)	46.2	(3.8)	45.9	(5.3)
Centre High	80.2	(2.0)	105.4	(3.2)	144.4	(5.2)	125.9	(6.4)
Subu Mid	108.1	(6.5)	15.4	(1.1)	21.8	(1.9)	29.1	(3.6)
Subu High	215.0	(5.9)	129.0	(4.3)	168.4	(6.7)	64.2	(3.6)
New Car	-35.5	(-3.7)	1.6	(0.2)	32.5	(5.0)		
Used Car	-57.2	(-6.5)	-31.5	(-4.4)	-21.0	(-3.5)		
HHGoods	6.1	(2.5)	12.7	(3.6)	18.4	(6.3)		
FunGoods	22.7	(5.2)	17.4	(8.8)				
Zurich	199.8	(14)						
Central Sw.	114.9	(6.4)						
Ticino	-54.5	(-3.0)						

RS: Retired Single, WAS: Working Age Single; SP: Single Parent; RC: Retired Couple; WAC: Working Age Couple; Fam1/2/3: Family with 1/2/3 or more children; Centre Mid: Middle Income HH in living in regional centre; Centre High: High Income HH living in regional centre. Subu Mid: Middle Income HH living in suburbs; Subu High: High income HH living in suburbs; HHGoods: Number of durable Goods for housekeeping purpose; FunGoods: Number of durable Goods for entertainment.

Table 6 Coefficients of linear regression models – part II

	Savings & DG		Food		Comm.		Pub. Transp.		Priv. Transp.	
	Est.	*T-Stat*	Est.	*T-Stat*	Est.	*T-Stat*	Est.	*T-Stat*	Est.	*T-Stat*
Intercept	673.1	(4.2)	-385.5	(-15.4)	94.7	(11.5)	10.9	(1.1)	17.8	(16.2)
Income	398.5	(61.1)	15.6	(20.0)	3.4	(13.6)	8.5	(24.2)	-6.6	(-0.8)
No. Pers.			143.9	(25.7)	4.6	(2.1)	9.5	(3.9)	-3.0	(-12.2)
Age	-49.5	(-7.8)	21.47	(31)	-0.9	(-14.1)	0.4	(5.4)	-17.3	(-0.7)
RS	191.8	(1.6)	-45.2	(-2.6)	-2.7	(-0.4)	-14.8	(-2.1)	-25.5	(-1.1)
WAS	-237.8	(-2.5)	-71.2	(-4.7)	-4.2	(-0.7)	-2.5	(-0.4)	-80.8	(-4.2)
SP	-741.9	(-6.5)	101.4	(7.9)	-19.5	(-3.9)	3.3	(0.6)	-3.3	(-0.2)
RC	-451.3	(-4.9)	36.1	(2.6)	4.6	(0.9)	-1.1	(-0.2)	-23.6	(-1.2)
WAC	-220.6	(-1.9)	25.3	(2.2)	-15.4	(-3.5)	-7.2	(-1.3)	-17.6	(-1.1)
Fam1	-798.3	(-8.2)	111.5	(10.2)	-14	(-3.3)	-5.3	(-1.1)	-55.1	(-3.0)
Fam2	-956.6	(-6.7)	148.2	(12.1)	-39.8	(-8.5)	-13.3	(-2.5)	-54.8	(-2.1)
Fam3	-1199	(-10.7)	154.4	(8.9)	-48.2	(-7.2)	-10.0	(-1.3)	-14.5	(-1.8)
Centre Mid	-290.5	(-6.1)	15	(2.6)	9.5	(5.0)	36.9	(11.4)	-35.5	(-2.0)
Centre High	-551.8	(-5.3)	24.5	(1.9)	12.1	(2.8)	60.7	(10.5)	1.2	(0.2)
Subu Mid	-173.9	(-4.1)	9.5	(1.8)	6.4	(3.8)	14.2	(4.6)	-5.3	(-0.3)
Subu High	-629.1	(-6.9)	17.9	(1.5)	13.9	(3.8)	26.3	(5.0)	187.2	(42.5)
New Car	-309.2	(-12.9)					-42.5	(-33.2)	115.7	(28.4)
Used Car	-40.5	(-3.5)					-36.6	(-30.9)	197.9	(6.1)
Freezer	83.2	(2.9)	16.78	(5.0)						
Dryer	-301.2	(-8.8)								
Dishw	-341.5	(-9.9)								
Comp	-198.6	(-8.5)			3.9	(3.9)				
Cell Ph	-122.8	(-6.7)			38.4	(50.7)				

RS: Retired Single, WAS: Working Age Single; SP: Single Parent; RC: Retired Couple; WAC: Working Age Couple; Fam1/2/3: Family with 1/2/3 or more children; Centre Mid: Middle Income HH in living in regional centre; Centre High: High Income HH living in regional centre. Subu Mid: Middle Income HH living in suburbs; Subu High: High income HH living in suburbs; New Car: No. of newly bought cars, Used Car: No. of used cars, Freezer/Dryer/Dishw./Comp/CellPh: No. of freezers/dryers/dishwashers/computers/mobile phones.

Expenditure on food is determined largely through the number of persons and family type. Families with more children and a higher average age spend more on food than single or couple households. Income effect is significant, but small compared to household composition. The difference between a working age single and a family with two children is 148 -(-71) + 3 x 144 = CHF 651, which corresponds to a difference in income of 651/16 = CHF 40.000/month. That means, a single household would have to earn 40.000/month more to spend the same amount as family with three children. The explanatory power for the food category is with an adj. R2 of 0.48 the highest of all models.

Expenditure for communication is relatively independent of household income, whiule the number of mobile phones is determining: Every mobile phone increases communication spending by about CHF 38.

Household expenditure for public transportation is almost independent from income with only CHF 8 for every CHF 1.000/month. A rich household with an income of CHF 20.000/month spends in average CHF 136 more on public transportation than a poor household with an income of CHF 4.000/month, a small difference. Public transport expenses are mainly influenced by car ownership, and residential location municipality. The explanatory power of 0.12% of explained variance is the lowest value for all presented expenditure categories.

While car ownership is a function of income, expenditure for private transportation is not, when controlled for the number of car possessed by the household. That means, that richer households have more cars, but they do not spend more money per car! And we should keep in mind that expenses for buying a car are discounted from that category and added to the Savings and Durable Goods category as explained above. Since a big part of transportation expenses are for fuel, that means that richer households do not drive more kilometres per years per vehicle than poorer ones, indicating a very low fuel price elasticity, supported by the findings in (Jäggi et al. 2012). Car ownership has the main influence: Every newly bought car provokes expenses of CHF 187/month.

5. Discussion

The results presented show how data from the national federal survey on income and expenditure can be used to gain insight into the budgeting process of households. To model a households budgeting process, we have to assume that the chosen amount of spending for every category depends on either characteristics of the households or the amount of spending of the other categories. However, the correlation matrices showed very little correlation between the respective expenditure categories, even within more homogeneous subgroups of the population. The only general pattern that could be observed was that higher income means higher spending for all categories.

When analysing the influence of socio economic and geographical characteristics on spending habits, a few patterns and differences between the categories could be observed. Relatively luxurious goods like savings, durable goods, eating out and alcohol and tobacco are more dependent on income then the other categories. Spending on food is mainly driven by the number of persons. Spending on housing however is independent from the number of persons and almost independent of income when controlled for household type. Public transport expenditure, a very important and substantial category in most developing countries, is on a very low level and also very difficult to model. Income has hardly any influence on it, only car ownership and residential location municipality type has a significant and somewhat substantial impact.

Public transportation and housing expenditure are the two categories with the lowest adjusted R2 value meaning that they correlate the least with the available information on household characteristics. Both transportation categories show a different set of significant explanatory variables: While most categories depend on income and household characteristics, transportation is largely a function of car ownership and geography, with expenditures for private transportation being slightly more correlated to income and car ownership, but also with a high variance that remains unexplained. Especially the variables for residential location municipality type, which, in spite of being significant and also with substantial impact, fails to explain a greater part of the variance in transportation spending. That would conclude that mode choice and residential location choice are indeed a matter of personal preferences or conditions in the microscopic level that cannot be observed.

The results of this analysis of spending patterns show two very important things: Firstly, household expenditures show very little correlation among each other and in respect to socio economic variables. Household expenditure are, apart from food that is a function of the number of people to a large degree, of a pronounced individual and random nature. Secondly, transportation expenditure, for both modes, have a very different set of explanatory variables

than the other categories. Both are relatively independent of household composition and income but instead on car ownership and residential location. The analysis showed that every household has its own lifestyle and makes decision based on personal preferences that can be interdependent from each other and different from other households.

6. References

Balmer, M. (2007) Travel demand modeling for multi-agent traffic simulations: Algorithms and systems, Ph.D. Thesis, ETH Zurich, Zurich, May 2007.

Balmer, M., K. Meister, M. Rieser, K. Nagel and K. W. Axhausen (2008) Agent-based simulation of travel demand: Structure and computational performance of MATSim-T, paper presented at *the Innovations in Travel Modeling (ITM'08)*, Portland, June 2008.

Beckx, C., T. A. Arentze, L. Int Panis, D. Janssens, J. Vankerkorn and G. Wets (2009) An integrated activity-based modelling framework to assess vehicle emissions: Approach and application, *Environment and Planning B*, **36** (6) 1086–1102.

Blundell, R., P. Pashardes and G. Weber (1993) What do we learn about consumer demand patterns from micro data?, *The American Economic Review*, **83** (3) 570–597.

Bradley, M. A., J. L. Bowman and B. Griesenbeck (2010) SACSIM: An applied activity-based model system with fine-level spatial and temporal resolution, *Journal of Choice Modelling*, **3** (1) 5–31.

Browning, M., F. Bourguignon, P. A. Chiappori and V. Lechene (1994) Income and outcomes: A structural model of intra household allocation, *Journal of Political Economy*, **102** (6) 1067–1096.

Browning, M. and P. A. Chiappori (1998) Efficient intra-household allocations: A general characterization and empirical tests, *Econometrica*, **55** (6) 1241–1278.

Castro, M. (2012) On generalizing the multiple discrete-continuous extreme value (mdcev) model, Ph.D. Thesis, University of Texas Austin, Austin.

Choo, S., T. Lee and P. L. Mokhtarian (2007a) Do transportation and communications tend to be substitutes, complements, or neither? U.S. 204 Bibliography consumer expenditures perspective, 1984-2002., *Transportation Research Record*, **2010**, 121–132.

Choo, S., T. Lee and P. L. Mokhtarian (2007b) Relationships between US consumer expenditures on communications and transportation using almost ideal demand system modeling: 1984-2002., *Transportation Planning and Technology*, **30** (5) 431–453.

Deaton, A. and J. Muellbauer (1980) An almost ideal demand system, *American Economic Review*, **70** (3) 312–326.

Deaton, A., J. Ruiz-Castillo and D. Thomas (1989) The influence of household composition on household expenditure patterns: Theory and Spanish evidence, *Journal of Political Economy*, **97** (1) 179–200.

Fan, J. X. and V. S. Zuiker (1998) A comparison of household budget allocation patterns between Hispanic Americans and non-Hispanic white Americans, *Journal of Family and Economic Issues*, **19** (2) 151–174.

Gicheva, D., J. Hastings and S. Villas-Boas (2007) Revisiting the income effect: gasoline prices and grocery purchases, *Working Paper*, National Bureau of Economic Research, Cambridge.

Houthakker, H. S. (1957) n international comparison of household expenditure patterns, commemorating the centenary of Engel's law, *Econometrica*, **25** (4) 532–551.

Jäggi, B., A. Erath, C. Dobler and K. W. Axhausen (2012b) Modeling household fleet choice as a function of fuel price using a multiple discrete-continuous choice model, *Transportation Research Record*, **2302**, 174–183.

Lundberg, S. J., R. A. Pollak and T. J. Wales (1997) Do husbands and wives pool their resources? evidence from the united kingdom child benefit, *Journal of Human Resources*, **32** (3) 463–480.

Müller, K. and K. W. Axhausen (2012) Preparing the Swiss Public-Use Sample for generating a synthetic population of Switzerland, paper presented at the *12th Swiss Transport Research Conference*, Ascona, May 2012.

Mokhtarian, P. L., T. Lee and S. Choo (2011) A decomposition of trends in U.S. consumer expenditures on communications and travel: 1984–2002., *Quality & Quantity*, **45** (1) 1–19.

Salvini, P. A. and E. J. Miller (2005) ILUTE: An operational prototype of a comprehensive microsimulation model of urban systems, *Networks and Spatial Economics*, **5** (2) 217–234.

Swiss Federal Statistical Office (BFS) (2008) Haushaltsbudgeterhebung, http://www.bfs.admin.ch/bfs/portal/de/index/infothek/erhebungen__quellen/blank/blank/habe/intro.html.

Thakuriah, P. and Y. Liao (2006) Transportation expenditures and ability to pay: Evidence from consumer expenditure survey, *Transportation Research Record*, **1985**, 257–265.