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Consumption over the Life Cycle: Evidence from the Czech Republic

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Declaration of Authorship

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Contents

Abstract

The main goal of this thesis is to analyze life-cycle consumption using Czech microeconomic data from the 2000-2008 Household Budget Survey (HBS). Inspired by Gourinchas and Parker (2002), who analyzed life-cycle consumption on American data, we construct the Czech average household life-cycle consumption and income profiles. It is found that the Czech average consumption profile is increasing over the whole life-cycle and there is no hump-shape in the profile, contrary to the American results. Consumption tracks income early in life and a breakpoint in household behavior is identified at age 45. Czech evidence on household consumption is interpreted in the context of the Certainty-Equivalent Life-Cycle Hypothesis Model and in the context of the Gourinchas & Parker (2002) Model of life-cycle consumption under income uncertainty, which brings a significant value-added for interpretation of the Czech profiles. The household behavior is interpreted by varying strengths of the precautionary (assuring against income uncertainty) and retirement motives for savings over the life. It is found that the Czech household life-cycle behavior can be interpreted in the similar way as the behavior of the US households.

JEL Classification: D11, D12, D91, E21
Keywords: Consumption, Life-cycle, Household Behavior, Motives for Savings, Income Uncertainty, Household Budget Survey

Abstrakt

Tato diplomová práce si klade za cíl provést analýzu spotřeby během životního cyklu na základě českých mikroekonomických dat ze Statistiky rodinných účtů. Hlavní inspirací je analýza spotřeby na amerických datech, kterou provedli Gourinchas & Parker (2002). V práci jsou sestrojeny průměrné české profily spotřeby a příjmů během životního cyklu. Český profil spotřeby na rozdíl od amerického profilu nemá konkávní tvar a roste během celého života; spotřeba až přibližně do věku 45 let sleduje příjem, poté následuje zlom v chování domácností. Zjištěná fakta ohledně spotřeby českých domácností jsou v této práci interpretována v rámci standardní hypotézy životního cyklu za jistoty a především v rámci modelu spotřeby během života za nejistoty budoucích příjmů, který představili Gourinchas & Parker (2002). Tento model přináší významnou přidanou hodnotu pro interpretaci českých výsledků, když chování domácností je zde vysvětleno na základě proměnlivé síly dvou motivů úspor během životního cyklu - opatrnostního motivu (jištění se proti nejistotě budoucích příjmů) a životního motivu (spoření na důchod). Je zjištěno, že chování českých domácností během životního cyklu může být interpretováno v souladu s dříve zjištěným chováním amerických domácností.

JEL klasifikace: D11, D12, D91, E21

Klíčová slova: spotřeba, životní cyklus, motivy spoření, nejistota příjmů, mikroekonomická data, Statistika rodinných účtů

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Abbreviations

CEQ-LCH	Certainty-equivalent life-cycle hypothesis
CEX	Consumer Expenditure Survey
CPI	Consumer Price Index
CZSO	Czech Statistical Office
GDP	Gross Domestic Product
HBS	Household Budget Survey
PSID	Panel Study on Income Dynamics
US	United States

1. Introduction

Topic of this thesis is consumption over the life cycle. Consumption and its drivers have always been an important topic in economic science, both at the micro and macro level. As to the consumption over the life-cycle, the two most important theories dealing with forward-looking consumer behavior are the Permanent Income Hypotheses of Milton Friedman and the Life Cycle Hypothesis of Franco Modigliani, both dating back to 1950s. Since that time, both theories have been well studied by other authors and many times modified to incorporate rational expectations, different types of liquidity constraints, bequest motive or specific forms of utility functions and preferences. The empirical testing did not stay behind and the question of life-cycle consumption has been empirically analyzed using at first aggregate data and more recently individual-level data.

Even though the topic of consumption can be viewed as an evergreen in economics, its importance is not diminishing. On the contrary, with the rise of consumer society, the role of consumption has become even more important and its drivers and constraints should be studied carefully. On the aggregate level, household consumption is the most important GDP component in all developed countries, accounting for more than 50% of GDP; in the US, it is even around 70% of GDP[1]. Weak household demand is one of the main arguments used by economic analysts while describing the recent economic recession and slow revival. The fact that household consumption is one of the key concepts also at the microeconomic level does not have to be stressed.

Furthermore, some new issues have arisen in the analysis of household consumption, e.g. what is the role of consumer credit or of the housing market. Recent studies of consumption deal with issues such as consumer preferences and behavior being determined by cultural and economic factors, various sources of uncertainty, financial wealth, and interactions between consumers or between consumers. Moreover, as the demographic structure of population in developed countries has changed and will be changing further, it is important to understand what impact on life-cycle consumption the population ageing will have. It is possible that the average life-cycle profiles will change because of the effect the necessary pension reforms could have on household income in retirement. These potential changes may have important macroeconomic consequences.

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[1] The data are from EcoWin.

For all the above stated reasons, it is crucial that we understand household consumption behavior over the life-cycle and its motives. Individual-level data should be the starting point of the analysis. It should be taken into account that household behavior and its motives can be different across countries, especially when comparing developed countries like the US and some emerging markets. Not much evidence has been provided on emerging economies so far.

The main inspiration for this thesis is the article "Consumption over the life cycle" by Gourinchas and Parker that was published in Econometrica in 2002[2]. This influential article brought some new insight into the development of consumption over the life cycle under income uncertainty. Gourinchas and Parker construct life-cycle consumption and income profiles using a dataset from US Consumer Expenditure Survey (CEX) for years 1980-1993. They provide a theoretical model of life-cycle consumption under income uncertainty and estimate the model parameters using empirical data. The fitted model can capture the actual life-cycle development of consumption quite well, better than the standard certainty-equivalent life-cycle hypothesis model (CEQ-LCH model). The results show that the data do not support fully the consumption smoothing hypothesis as two different phases can be distinguished over the life cycle, with a typical turn point around age 40. The two phases can be explained by varying importance of precautionary and life-cycle savings motives over the life-cycle. Early in life, households save to insure themselves against uncertainty of future incomes. Only the second phase of life – where the life-cycle motive for savings becomes crucial - is more or less consistent with the predictions of the CEQ-LCH model.

The main goal of this thesis is to analyze life-cycle consumption using Czech microeconomic data from the 2000-2008 Household Budget Survey (HBS). In particular, the Czech average household life-cycle consumption and income profiles are to be constructed and compared to the US profiles obtained by Gourinchas & Parker (2002). These profiles are adjusted for changing family size over the life-cycle and for several other effects, so that they capture – according to the model of Gourinchas & Parker (2002) – only the household preferences on intertemporal substitution (discount rate and risk aversion rate) and uncertainty about future labor income. The results are to be interpreted

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[2] Gourinchas & Parker (2002).

in the context of the CEQ-LCH model and in the context of the model of life-cycle consumption under income uncertainty provided by Gourinchas & Parker (2002).

The original research hypothesis was that the average life-cycle consumption profile for Czech households would be close to the American profile described by Gourinchas & Parker (2002). However, as the two societies differ in many aspects that can potentially influence discount rates, risk aversion or labor income uncertainty, distinct average profiles would not be a big surprise either. We expected that the Czech consumer behavior would be consistent with the certainty-equivalent life-cycle hypothesis at least for some part of the life cycle, but that the model of life-cycle consumption under income uncertainty would be able to explain the household behavior better than the standard CEQ-LCH model. Based on the American results, we also expected that some different phases of consumption behavior could possibly be distinguished during the life cycle.

The structure of this thesis is as follows:

A survey of relevant literature is undertaken in Chapter 2, overviewing briefly different theories about life-cycle consumption, as well as presenting empirical tests (using macro or micro data) of the hypotheses the theories form.

In Chapter 3, the structural model of optimal life-cycle consumption expenditures in the presence of realistic labor income uncertainty by Gourinchas & Parker (2002) is formally introduced at first. The life-cycle consumption and income profiles obtained from American data (CEX Survey) are presented next. Afterwards, estimation of the model parameters and the results using the American data is described, together with the results and implications for household behavior over the life cycle.

The Czech individual-level data on household consumption and income from the Household Budget Survey are introduced in Chapter 4. Data adjustment is described and different estimation samples are defined. Next, the measures of income and consumption and the most important household characteristics are presented.

In Chapter 5, the construction methodology of life-cycle consumption and income profiles is formally described. Afterwards, the obtained Czech average life-cycle profiles are presented and their shape is compared with the American profiles. The Czech life-cycle profiles by education and by occupation of the households are also introduced. The chapter continues with explaining how the different adjustment steps (for family-size, cohort etc.) affect the shape of the life-cycle profiles and how the presented life-cycle profiles should be understood. Robustness checks are provided at the end.

Chapter 6 interprets the Czech life-cycle profiles in the context of the model of Gourinchas & Parker (2002) and in the context of the CEQ-LCH model. Moreover, the empirical determinants of household consumption are identified from the data – variables suggested by different consumption theories are used as potential explanatory variables. The chapter concludes with suggesting some more topics for research concerning life-cycle consumption, potentially using the Czech individual-level data from the HBS again.

Chapter 7 concludes.

2. Consumption over the Life Cycle – Literature Survey

The two most important theories dealing with forward looking consumers and therefore analyzing consumption over the whole life cycle are the Permanent Income Hypotheses of Milton Friedman from 1957 and the Life Cycle Hypothesis of Franco Modigliani from 1954. The predictions of the two models are similar – in the simplest version with no uncertainty, intertemporal optimization of consumption/saving decisions leads to consumption smoothing over the life-cycle. Since 1950s, both theories were well studied by other authors and many times modified to incorporate rational expectations, different types of liquidity constraints, bequest motive or specific forms of utility functions and preferences. Attanasio (1999) represents the most complete summary of the two original models, their extensions and empirical evidence. For the surveys of early studies, see Deaton (2005) or Lusardi (1996).

As to the empirical testing of the hypotheses, aggregated data were used at first. Analyses were performed with various modifications in the utility function form, in the development of interest rates etc. – the survey of relevant studies can be found in Campbell & Mankiw (1991).

As an example of estimation using aggregate data, Campbell & Mankiw (1991) test the Permanent Income Hypotheses using the US quarterly data for years 1948-1985 against an alternative model, where certain fraction of households consumes their current rather than permanent income. Using instrumental variables approach, Campbell & Mankiw (1991) estimate this fraction to be significantly different from zero, interpreting it as a rejection of the permanent income hypothesis.

More recently, the individual-level data have become of greater importance. At first, mainly the Panel Study of Income Dynamics (PSID)[3] was used as a data source, later the focus moved more to the Consumption Expenditure Survey (CEX)[4]. Lusardi (1996) discusses the advantages and disadvantages of each dataset. Various versions of life-cycle models have been estimated using individual-level data, using specific preferences (e.g. Attanasio & Weber (1995)), focusing on various categories of consumption goods

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[3] More information available at http://psidonline.isr.umich.edu.
[4] CEX is to be discussed in more detail in Chapter 3.

(e.g. Fernández-Villaverde & Krueger (2002)) or dealing with income uncertainty (see Gourinchas & Parker (2002) for a survey). As these studies are linked the most closely to research done in this thesis, we discuss them in greater detail:

Attanasio & Weber (1995) conclude that consumption patterns found using individual-level data from the CEX Survey are in line with some of the predictions of their model of consumer intertemporal optimization. They specify consumer preferences in a way that can capture demographic changes or interactions with labor supply and that is simple enough to be estimated using microeconomic data on household consumption. They also argue that too simplifying assumptions as well as aggregated or incomplete consumption data can lead to misleading results. Attanasio & Weber (1995) explicitly argue against the use of food consumption as a measure of consumption as the utility function does not have to be separable in foods and other goods, as food is a necessity, and as more appropriate measures are available.

Lusardi (1996) opens the question of data to be used to address the rational-expectations permanent income hypothesis, and he concentrates on the individual level-data. Most of the earlier studies were based on the Panel Study of Income Dynamics that however provides only limited data on consumption expenditures - only food consumption is reported. Later studies started to prefer data from the Consumer Expenditure Survey that provides detailed data on consumption expenditures. However, Lusardi (1996) argues that as information about income in the CEX is less detailed and of lower quality than the income data from PSID, it would be ideal to combine these two datasets for the purpose of Euler equation estimation. He uses the two-sample instrumental variable estimation and finds out that the estimated coefficients of excess consumption sensitivity to income changes are significantly positive, thus against the consumption smoothing hypothesis.

Work of Fernandez-Villaverde & Krueger (2002) is to some extend similar to the study of Gourinchas & Parker (2002) which is the baseline study for this thesis and will be discussed in detail in the next chapter. Fernandez-Villaverde & Krueger (2002) also estimate life cycle consumption profiles using data from the CEX. They however focus mainly on results using different types of consumer measures, distinguishing total, nondurable and durable consumption. The found hump-shaped consumption profiles

cannot be explained only by varying family size and the authors conclude that the usual life-cycle consumption model cannot account for their results.

Household consumption and savings is a topic on a border of microeconomics and macroeconomics; approaches of the two disciplines are often combined. As an example, Attanasio & Browning (1993) try to analyze household life-cycle consumption development – mainly the excess sensitivity of consumption to income they identify – in context of business cycles. Browning & Lusardi (1996) try to link theories about household individual consumption behavior (motives for savings etc.) to observed macroeconomic data about household consumption. Dynan et al. (2009) aboard the question what effect the population ageing may have on consumption and savings on aggregate level, taking individual-level data from the CEX Survey as the starting point for their analysis.

With the rise of consumer society, the role of consumption has become even more important, with some new issues arising.

Slacalek (2009) and Hansen & Imrohoroglu (2006) discuss the role of financial wealth, annuities and housing in life-cycle consumption.

The interdependencies of household credit and consumption and impact of credit constraints on household life-cycle behavior have become an important topic recently. Grant (2007) estimates credit-constraints of US households using individual level-data and Crook & Hochguertel (2007) enrich the discussion by a cross-country comparison on household debt and credit constraints. Muellbauer, J. (2008) focuses on household housing credit and constraints. A question whether the households are credit constrained will be relevant also for interpretation of the Czech evidence on household life-cycle behavior, see Chapter 6.

Behavior in retirement is another major topic in recent literature on household consumption. The consumption usually drops significantly in retirement, which cannot be easily explained by simple life-cycle models. This is why some authors even describe the observed behavior as Retirement-Consumption Puzzle. Some suggested solutions describe consumers as not necessarily optimizing and forward-looking agents, but rather as agents using "rules of thumb" for their decisions. See for example Bernheim et al. (2004) and Hurd & Rohwedder (2006). Also, the role different pension systems have on household savings, credit constraints and consumption can be studied; Campbell et al. (2000) provide

a nice insight into this topic, discussing several settings of Social Security tax. Furthermore, incorporating bequest motives into household decision making can help to explain household saving/consumption behavior. However, it is often difficult to separate bequest motives from precautionary motives and also to determine whether the bequests were intentional or accidental. See Mok (2010) and Ameriks (2010) for recent discussion on bequest motives and for survey of earlier studies.

As to research that is more far from treating households as standard rational, optimizing agents with constant preferences, some studies have already been mentioned; recall Attanasio & Weber (1995), Bernheim et al. (2004), or Hurd & Rohwedder (2006). We would however like to emphasize some more topics:

In general, it holds that social interactions may affect individual behavior – Manski (2000) represents an introduction into economics of social interactions. Interactions among consumers and their implications on consumer behavior are studied in Cowan & Cowan & Swann (2004) or in Binder & Pesaran (2001).

The topic of social interactions and peer effects is related to the economics of networks. Barabasi (2002) or Economides (1996) provide background information about the discipline, while Brocas & Carrillo (2006) is an example of practical use of network economics for studying life-cycle consumption.

Dynan (2000) deals with the issue of downward inelasticity of household consumption - she discusses evidence from American data (PSID and CEX) on habit formation in consumer preferences.

Bagchi (2009) studies overconfidence of consumers regarding the mean return of their savings and its impact on life-cycle consumption/savings behavior of households. It is found that under some parameters settings, overconfidence can help to explain the hump-shape of the US adjusted life-cycle consumption profiles.

3. Model of Consumption over the Life Cycle under Labor Income Uncertainty

In this chapter, the structural model of optimal life-cycle consumption expenditures in the presence of realistic labor income uncertainty developed by Gourinchas & Parker (2002) is presented, together with the results obtained by estimating parameters of the model using the data from the American CEX Survey and from the PSID. According to Gourinchas & Parker (2002), the life cycle consumption profile constructed from the empirical data do not support fully the consumption smoothing hypothesis as they identify two distinct phases over the life cycle, with a typical turning point around age 40 of the household. These two phases are connected with varying role of precautionary savings (savings because of future-income uncertainty) and the life-cycle savings (savings for retirement) over the life-cycle.

3.1 Model – Formal Description

This section overviews the life-cycle consumption model with income uncertainty from Gourinchas & Parker (2002). For more details, please refer to the original article.

The model is a discrete time model. Consumer living for N periods and working for T periods, $T<N$, maximizes his expected utility (3.1) subject to budget constraint (3.2)[5]. Given an initial level of wealth W_1, the consumer in each period t receives income Y_t and decides about current consumption C_t and savings. W is the only asset in the economy, bringing interest rate R, with the condition for terminal wealth $W_{N+1} \geq 0$. Value function V_{N+1} of this terminal wealth allows inclusion of possible bequest motives. Utility $u(.)$ is a function of consumption and of a vector of household characteristics Z_t. Utility function is supposed to be of the form (3.3), so that it is multiplicatively separable in Z [6]. β is the standard discount factor, $1/\rho$ is the intertemporal elasticity of substitution.

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[5] In this model, consumers decide only about current consumption and savings. Labor income is exogenous (see below for development of the income process) – consumers do not choose their labor supply in this model.

[6] For the estimation purpose, Gourinchas & Parker (2002) assume that $v(z_t)$ in equation (3.3) is the same for all households of the same age t, and that its evolution depends only on changing family size.

$$E\left[\sum_{t=1}^{N}\beta^t u(C_t, Z_t) + \beta^{N+1}V_{N+1}(W_{N+1})\right] \tag{3.1}$$

$$W_{t+1} = R(W_t + Y_t - C_t) \tag{3.2}$$

$$u(C, Z) = v(Z)\frac{C^{1-\rho}}{1-\rho} \tag{3.3}$$

If this was a model with income certainty, growth rate of consumption would vary during the life cycle only as a consequence of a change in household characteristics Z_t. Only because of these changes could the consumption profile be correlated with the income profile[7].

However, with the setup of income uncertainty, a precautionary savings motive is introduced that could result into changing optimal consumption growth over the life cycle. More concretely, Gourinchas & Parker (2002) model the income uncertainty as follows:

$$ln\, Y_t = ln\, P_t + ln\, U_t \tag{3.4}$$

$$ln\, P_t = lnG_t + lnP_{t-1} + lnN_t \tag{3.5}$$

where the total income Y_t in (3.4) is in each period given as an interaction between the permanent income component P_t and the transitory shock U_t, $ln\, U_t \sim N(0, \sigma_u^2)$ that happens with probability $p \in [0,1]$. Equation (3.5) describes evolution of the permanent income component P_t, where lnG_t is an age specific drift and N_t, $ln\, N_t \sim N(0, \sigma_n^2)$, is a shock to the permanent income component. As Gourinchas & Parker (2002) note, this means that the change in total income, ΔY_t is MA(1) process.

One of the most important results of introducing income uncertainty is that with a zero lower bound on income, consumers cannot borrow against future income[8] (Gourinchas & Parker (2002))

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[7] We will return to the predictions of the certainty-equivalent life-cycle hypothesis model at the beginning of section 3.4.

[8] The positive risk of a zero income in each period and the condition on nonnegative terminal wealth mean that consumer cannot borrow against future income in the next to the last period. By backward induction, the result that consumers can never borrow against their future income is obtained.

Gourinchas & Parker (2002) decide to truncate the consumer problem at the date of retirement; according to them, the lack of information concerning especially the household uncertainty in the retirement period (connected to the time of death, health, future income etc.) does not allow any serious analysis for households in this life-period.

However, the value function after retirement still has to be defined. To reflect better the reality - where the pensions are often the main financial resource after retirement - it is assumed that there exists another asset in the economy that is illiquid and exogenously accumulated[9] over the working-life to become illiquid wealth in the first year of retirement, H_{T+1}. Furthermore, it is assumed that H_{T+1} is a fixed portion, h, of before-retirement permanent income, as expressed by (3.6).

$$H_{T+1} \equiv hP_T \tag{3.6}$$

The retirement value function can be then - for some constant κ - expressed as (3.7), where X_{t+1} are the total liquid financial resources, as defined by (3.8).

$$V_{T+1}(X_{T+1}, H_{T+1}, Z_{T+1}) = \kappa v(Z_{T+1})(X_{T+1} + H_{T+1})^{1-\rho} \tag{3.7}$$

$$X_{t+1} = R(X_t - C_t) + Y_{t+1} = W_{t+1} + Y_{t+1} \tag{3.8}$$

Given (3.4), (3.7) and (3.8), the problem of optimizing consumer then can be expressed as follows, V_τ being the value function at time τ:

$$V_\tau(X_\tau, P_\tau, Z_\tau) = max\ E_\tau \left[\sum_{t=\tau}^{T} \beta^{t-\tau} v(Z_t) \frac{C_t^{1-\rho}}{1-\rho} + \beta^{T+1-\tau} V_{T+1}(X_{T+1}, H_{T+1}, Z_{T+1}) \right]$$

$$s.t.\ X_{t+1} = R(X_t - C_t) + Y_{t+1},$$
$$X_{T+1} \geq 0$$

$$\tag{3.9}$$

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[9] These two assumptions about illiquidity and exogenous accumulation are made to avoid an entrance of another state (or control, respectively) variable into the consumer optimization problem.

3.2 Solving for Optimal Consumer Behavior

Define the lowercase letters as the original variables normalized by the permanent income component, e.g. $x_t = X_t/P_t$ is the normalized cash on hand in period t and $c_t(x_t)$ is the optimal consumption rule at time t that depends on cash on hand in time t (both normalized).

Then the Euler equation (3.10) holds for all $t < T$, while (3.11) applies for the period T.

$$u'\left(c_t(x_t)\right) = \beta R\left[\frac{v(Z_{t+1})}{v(Z_t)}u'(c_{t+1}(x_{t+1})G_{t+1}N_{t+1})\right] \tag{3.10}$$

$$u'(c_T(x_T)) = max\left\{u'(x_T); \beta R\frac{v(Z_{T+1})}{v(Z_T)}u'\left(c_{T+1}(x_{T+1})\right)\right\} \tag{3.11}$$

Gourinchas & Parker (2002) state that the suitably chosen retirement value function (3.7) causes that the optimal consumption rule after retirement C_{T+1} can be expressed as (3.12), which can be reformulated in normalized terms as (3.13). From (3.6) it follows that $\gamma_0 \equiv \gamma_1 h$. Coefficient γ_1 can be interpreted as the marginal propensity to consume out of wealth at retirement.

$$C_{T+1} = \gamma_1(X_{T+1} + H_{T+1}) \tag{3.12}$$

$$c_{T+1} = \gamma_0 + \gamma_1 x_{T+1} \tag{3.13}$$

Using equation (3.13) to derive the optimal consumption rule at the retirement, the above stated Euler equations (3.11) and (3.10) can be solved recursively to obtain a set of optimal consumption rules $\{c_t(x_t)\}_{1 \le t \le T}$.

The obtained optimal consumptions rules can be applied to income profiles[10] and the resulting consumption profiles can afterwards be compared with the empirical consumption profiles the model parameters can be estimated. The method and results

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[10] Either empirical or simulated.

obtained by Gourinchas and Parker are described in section 3.4. Before that, the dataset used in the American study and the consumption profiles constructed form the data will be introduced.

3.3 Consumption and Income Profiles over the Life Cycle – US Data

The principal data source used in Gourinchas & Parker (2002) is the Consumer Expenditure Survey of the US Bureau of Labor Statistics[11]. The data are provided about household income, detailed expenditures and about household characteristics. This dataset serves among others as a baseline for updating the consumer basket used in the consumer price index (CPI) construction. Gourinchas & Parker (2002) use the data for years 1980-1993 for households aged 26 to 65, with total number of observations summing up to nearly 40 000[12]. Household characteristics (education, occupation and birth cohort) refer to the male-head of the household, another important household characteristic being the year of the CEX Survey.

Gourinchas and Parker construct three main types of life-cycle profiles out of the data: a consumption age-profile $\{\bar{C}_t\}_{t=26}^{65}$, an average income-profile $\{\bar{Y}_t\}_{t=26}^{65}$ from which they calculate the expected income growth $\{G_t\}_{t=27}^{65}$ and also the typical household age-specific shifts in utility $\{v(Z_t)\}_{t=26}^{65}$ (Gourinchas & Parker (2002): 62).

For the detailed profile-construction methodology, the original study of Gourinchas & Parker (2002) should be seen. However, a methodology of life-cycle profiles construction using the Czech data is described in section 5.1, which modifies the original methodology only as far as it is necessary due to data differences.

Just to present the main idea in this section, the original consumption of each household (as reported in the dataset) is corrected for the effect of cohort[13], for the year of

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[11] Detailed information about the Consumer Expenditure Survey, aggregated results, as well as some parts of the database can be found at http://www.bls.gov/cex/.

[12] The data preparation and adjustment due to missing or incomplete observations is described in the original article, Gourinchas & Parker (2002).

[13] Gourinchas & Parker (2002) claim that the life-cycle profiles may not be identical for all cohorts (in this case defining cohort as all people born in the same year). According to them, people born later in the 20th century have in general greater initial level of wealth (at age 26), and their income and consumption can thus be higher at every single age compared to life-cycle profiles of someone born earlier. However, they allow life-cycle profiles of different cohorts to vary only in the starting level of income/consumption (by separating the effect of the initial wealth at age 26 into a cohort effect and into the remaining individual effect). To put it otherwise, a shape of the profiles is assumed to be the same for all cohorts, the profiles can however be vertically shifted for different cohorts. How exactly Gourinchas & Parker (2002) adjust for the cohort effect in the profiles' construction is described in section 4.1 for the case of the Czech data.

the interview and for the retirement status. What is even more important, the reported consumption profiles show the household consumption in the situation where the family size would be held constant over the whole life cycle – the profiles correct for the changing family size over the life cycle. This adjustment is done because the model of Gourinchas & Parker (2002) shows that after controlling for all these effects, the resulting profiles should reflect only consumer preferences (discount rate and risk aversion) and uncertainty of future incomes – and these are the parameters Gourinchas & Parker (2002) are interested in. The adjustment and reasons behind it will be explained in more detail in Chapter 5, where the Czech life-cycle profiles are constructed.

The life-cycle consumption and income profiles that Gourinchas & Parker (2002) constructed using the American data are depicted in Figure 3.1[14]. Both income and consumption profiles are hump-shaped even after correcting for all the above mentioned components – family size effect, cohort effect, the effect of the interview year and the retirement status.

The shape of the consumption profile is less dramatic than the one of the income profile. Consumption is close to income early in life. Gourinchas & Parker attribute the fact that consumption lies above income rather for households under age 30 to data misreporting; they claim that households probably do not report the whole assistance they obtain from their families.

Income rises dramatically in the first decades of the working life, with a more significant slowdown in growth after approximately age 40. Household income peaks around age 50 and then starts to decrease gradually (with the shape almost symmetrically to the income growth before age 50). At the age of retirement[15], household income is at about the same level as it was at the age of 35.

The development of consumption is less dramatic compared to income, especially when looking at the life-period between the beginning of the working life[16] and age 45, when the consumption peaks. The peak in consumption therefore occurs some 5-7 years before the peak in income. Consumption profile lies significantly under the income profile later in life, but the distance between the two is more or less stable after age 50.

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[14] Raw consumption is the consumption averaged across households of the same age. Smoothed consumption is obtained by using fifth-order polynomials instead of age dummies in the profiles construction.

[15] Gourinchas & Parker assume this age to be equal to 65, which is equal to US legal retirement age. However, the average US retirement age is lower, at about 62 (according to U.S. Census)

[16] Gourinchas & Parker assume this age to be equal to 26.

Gourinchas & Parker (2002) construct consumption and income profile also for specific subgroups of population, defined in the first case by education level and in the second case by type of occupation. The obtained life-cycle profiles for different education and occupation subsamples can be found in Figure 3.2 and Figure 3.3, respectively[17].

A note should be made that it would be interesting to reconstruct the US consumption and income profiles for years 2000-2008, i.e. the same time interval we will be using for estimation with the Czech data. The database of CEX Survey for recent years is available and can be obtained from the Bureau of Labor statistics – its major part is even available online. However, this is beyond the scope of this text.

Figure 3.1 American consumption and income life-cycle profiles, overall
(thousands of 1987 USD)
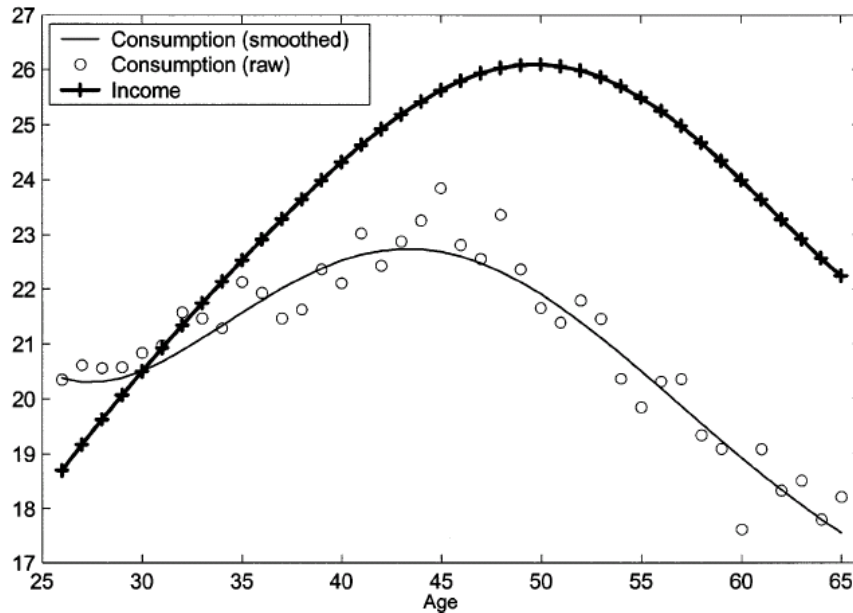
Source: Gourinchas & Parker (2002)

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[17] As to the fitted consumption reported in Figure 3.2 and 3.3, it is the consumption profile obtained by calibrating the model of Gourinchas & Parker (2002).

Figure 3.2 American consumption and income life-cycle profiles, by education
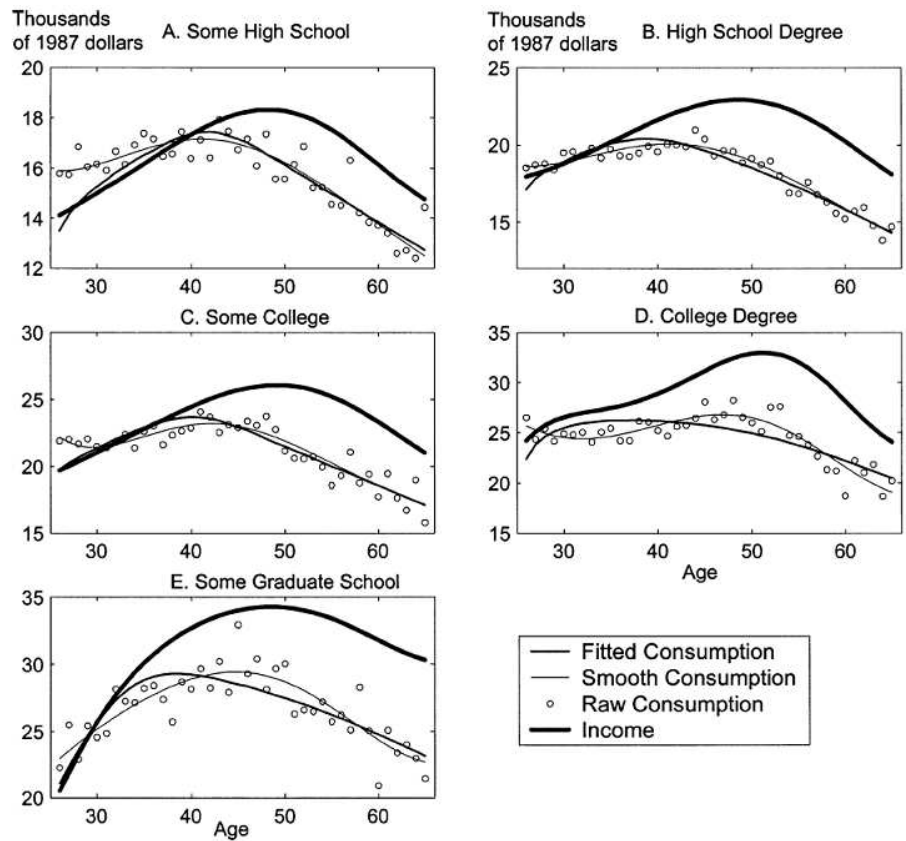
Source: Gourinchas & Parker (2002)

Figure 3.3 American Consumption and income life-cycle profiles, by occupation
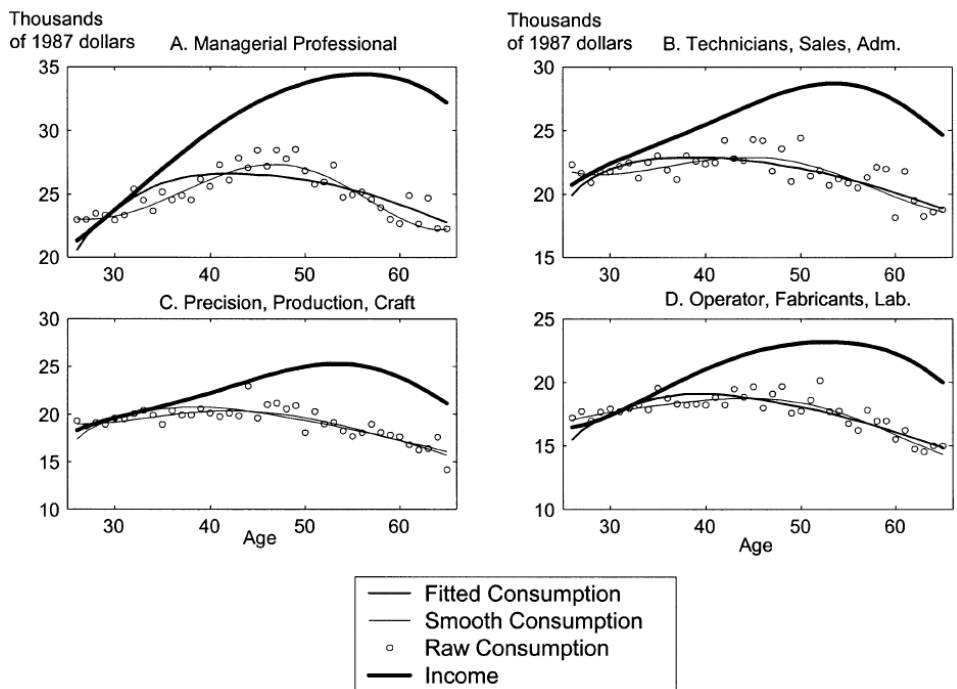
Source: Gourinchas & Parker (2002)

3.4 Estimation of the Model Parameters and Interpretation of Results

Having constructed the average life-cycle consumption and income profiles for average American consumer, Gourinchas & Parker (2002) turn to possible interpretation and conclusions. In this section, we briefly present three steps from their analysis[18]. At first, they study whether the profiles obtained are compatible with the certainty-equivalent life-cycle hypothesis. After a rejection of this hypothesis, Gourinchas & Parker (2002) use the constructed life-cycle profiles and a simulation method to estimate the key parameters of their model of life-cycle consumption expenditures under labor market uncertainty (the model was presented in sections 3.1 and 3.2). Thirdly, Gourinchas & Parker (2002) use the estimated coefficients of their model to reinterpret changing consumption behavior over the life cycle, stressing relative roles of precautionary savings and savings for retirement. We will return to some of these issues in the analysis of the Czech life-cycle consumption, which will be done in Chapter 5 and in Chapter 6.

Compatibility with the certainty-equivalent life-cycle hypothesis model

Gourinchas & Parker (2002) analyze whether the obtained life-cycle consumption profile (as presented in Figure 3.1) is compatible with the life-cycle consumption hypothesis with no income uncertainty. The analysis starts by stressing that with no uncertainty, the consumer problem, as defined by equations (3.1) – (3.3), would have a standard solution: the consumption path at each age t would have to satisfy

$$\frac{C_{t+1}}{C_t} = \left(\beta R \frac{v(Z_{t+1})}{v(Z_t)}\right)^{1/\rho} \tag{3.14}$$

Equation (3.14) implies that - in the situation of no uncertainty and after controlling for individual household characteristics - the growth of consumption has to be constant over the whole working-life:

$$\Delta \ln \bar{C}_t = \frac{1}{\rho} \ln \beta R \tag{3.15}$$

Therefore, the life-cycle consumption profiles predicted by the CEQ-LCH are flat. In contrary, the empirical consumption profiles presented in Figure 3.1 are hump-shaped

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[18] Please refer to the original article of Gourinchas & Parker (2002) for details.

even at first sight. Gourinchas & Parker (2002) reject the hypothesis that consumption profiles are flat also formally, by performing an estimation based on equation (3.15) – the average consumption (adjusted for family-size effects, cohort effects, time effects and retirement status) is estimated in first differences to see whether it is independent on household age.

Because of the discrepancies between the consumption profile predicted by the CEQ-LCH and the empirical one, Gourinchas & Parker (2002) claim that "the certainty-equivalent model performs poorly when it comes to explaining the dynamics of consumption across the life cycle" (Gourinchas & Parker (2002): 70). Instead, they turn to the estimation of their model of life-cycle consumption under labor income uncertainty to see whether this model will be more successful in explaining the observed consumption dynamics.

Model of life-cycle consumption under labor income uncertainty - estimation of the model parameters and results

To estimate the parameters of their model of life-cycle consumption under income uncertainty, Gourinchas & Parker (2002) use a two-step Method of Simulated Moments. The aim of this section is to provide intuitive understanding of the method rather than to present it formally and in detail.[19]

The model of life-cycle consumption under income uncertainty developed by Gourinchas & Parker (2002) was presented in Sections 3.1 and 3.2. The basic idea of how the parameters of the model are estimated can be described as follow:

Gourinchas & Parker (2002) generate 20,000 fictitious[20] life-cycle profiles of income. For any combination of unknown parameters, it is then possible to solve for the optimal consumption rules (as they were described in section 3.2). Then the consumption rule is applied to each fictitious income profile and associated consumption profile is simulated, which assigns consumption level to each age of the (fictitious) household. The simulated average life-cycle consumption profile is then obtained by (log) averaging the

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[19] Please refer to the Section 3 and Section 4 of the original article of Gourinchas & Parker (2002) for the formal description of the method of simulated moments and for the description of the first-stage estimation, respectively.

[20] But realistic in the sense that the income profiles should have characteristics (uncertainty, probability of zero income etc.) similar to the real-life income profiles – the empirical data on income profiles come from the PSID. See later.

20,000 simulated consumption profiles across age. For any combination of the unknown parameters[21], a simulated average life-cycle consumption profiles is obtained. The parameters of the model are then estimated using the method of simulated moment, which minimizes the distance between the simulated consumption profiles and the empirical profile constructed from the CEX Survey (as they were presented in section 3.3).

In practice, however, Gourinchas & Parker (2002) do not estimate all the unknown parameters at once. They rather choose to estimate most of the model parameters in the first-stage and then apply the method of simulated moments only to find the most important ones: the discount factor β, from which the discount rate can be calculated (discount rate $= (\beta^{-1} - 1) \times 100$), the coefficient of risk aversion ρ and the parameters of the retirement rule (3.13) γ_0 and γ_1 (which is the marginal propensity to consume out of wealth in retirement).

All the other parameters of the model are estimated in the first stage, using various data sources[22]. At first, these parameters include the life-cycle profiles constructed using the CEX data[23].. Secondly, the gross after tax interest rate, R, is estimated from the average real return on Moody's AAA municipal bonds over the period of 1980-1993 (which equals 3.44%). Thirdly, the mean $\overline{\omega}_{26}$ and standard deviation $\sigma_{\omega_{26}}$ of the initial distribution of liquid assets at age 26 are calculated from the CEX data[24]. The three other parameters that have to be estimated in the first stage together define the labor income uncertainty: the variance of the shock to the permanent income component, σ_n^2; the probability that the transitory shocks U_t would take value 0, p, and the variance of the transitory shock, σ_u^2. It would be difficult to estimate σ_n^2, σ_n^2, and p from the CEX data, as the households are not necessarily surveyed for more than one year. Instead, Gourinchas & Parker (2002) estimate these parameters using the PSID, which, contrary to CEX, offers a high-quality panel data (there are individuals observed for as much as 36 years[25]).

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[21] In practice, Gourinchas & Parker (2002) estimate some of the parameters already in the first stage. See later.
[22] The estimated values are then used to generate the 20,000 fictitious income profiles so that they are close to reality.
[23] As they were described in section 3.3
[24] The distribution is assumed to be lognormal. In the generation of the 20,000 fictitious profiles, the initial level of assets $\omega_{26,i}$ is randomly drawn from this distribution.
[25] Refer to http://psidonline.isr.umich.edu/ for more information on PSID.

The two-step Method of Simulated Moments described above gives the following results[26]. For the average household, the discount factor β is estimated to be between 0.9569 and 0.9588[27], which corresponds to the discount rate of 4.0-4.5%. The estimated coefficient of the relative risk aversion $\hat{\rho}$ lies between 0.5 and 1.4. As to the consumption rule during retirement, the marginal propensity to consume out of liquid assets, γ_1, is estimated at 6-7%.

The fitted consumption profile is depicted in the Panel A of Figure 3.4. The fitted model of Gourinchas & Parker (2002) is able to generate a life-cycle consumption dynamics that is similar to the dynamics observed in the empirical data – concerning both the hump-shape of the empirical average consumption profile and the fact that consumption more-or-less tracks income early in life[28]. In this sense, Gourinchas & Parker (2002) state that their model of life-cycle consumption under labor income uncertainty can explain the observed consumption dynamics much better than the CEQ-LCH hypothesis model predicting flat consumption profile over the life-cycle.

Before moving to the way Gourinchas & Parker (2002) use the estimated model to reinterpret household consumption behavior over the life cycle, one note has to be made:

It is of great importance to be able to estimate the discount factor β tightly, as its values determine a shape of consumption life-cycle profile to big extent. Table B of Figure 3.4 shows the fitted consumption profile for two other values of β[29], 0.9498 and 0.9698 (which correspond to discount rates of 5.28 and 3.11, respectively), holding all the other parameters at their baseline values (as in Panel A of Figure 3.4). As it can be seen, different discount rates affect greatly the shape of the consumption life-cycle profile. Lower discount rate results in a consumption profile that is almost flat; higher discount rate transforms into the consumption profile that tracks income until much later in the life, compared to the baseline case depicted in Panel A.

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[26] Gourinchas & Parker (2002) also estimate the model parameters separately for different educational/occupational subgroups (no interesting pattern emerges that should be presented here), and test robustness of their results by varying estimation procedure. Please refer to the original article for details.

[27] Depending on the weighting matrix used; the parameters are also estimated with or without the adjustment for uncertainty in the first stage. We report just the baseline results, for details please refer to the original article of Gourinchas & Parker (2002).

[28] However, the fitted consumption profile tracks income profile more tightly than the empirical consumption profile (let us repeat that Gourinchas & Parker (2002) attribute the empirical findings that consumption for households under age 30 lies above income to rather misreporting of income data) and the empirical consumption profile is more flat (and the peak of consumption occurs slightly later in life) than the fitted consumption profile.

[29] That are just one percent away from the baseline estimate of β, which is equal to 0.9598.

This comparative analysis illustrates the fact that low discount rate (relative to the interest rate) can result in a consumption path that is similar to the one predicted by the standard CEQ-LCH model even under income uncertainty[30]. This will be important for interpretation of the Czech consumption profiles constructed in Chapter 5.

Figure 3.4 American consumption and income life-cycle profiles, fitted model
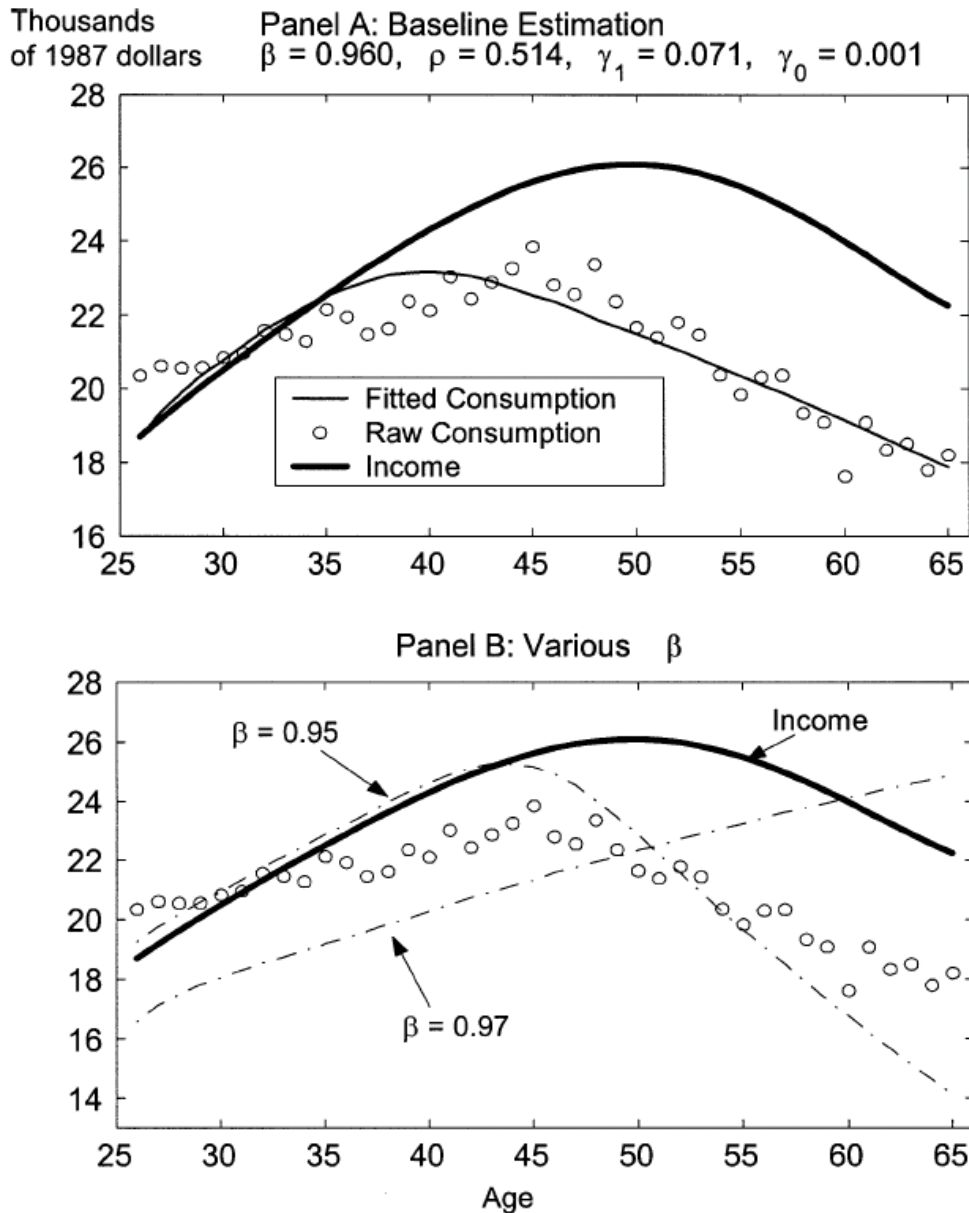
Source: Gourinchas & Parker (2002)

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[30] The second condition for consumption behavior to be close to the one predicted by the CEQ-LCH model is that expected income growth has to be low relative to the interest rate; however, the expected income growth was kept unchanged in the comparative analysis depicted in Figure 3.4.

Interpretation of results and focusing on household behavior over the life cycle

This section presents how Gourinchas & Parker (2002) interpret the changing household consumption behavior over the life cycle using their estimated model. The interpretation links the fitted average consumption profile to changing motives for savings over the life cycle.

Gourinchas & Parker (2002) at first discover that households can be viewed as "target savers", meaning that households have a target level of cash on hand (liquid wealth) for each age and decide about their actual consumption based on whether the actual level of cash on hand is below or above the target level. Using their fitted model, Gourinchas & Parker (2002) find that the target level of cash on hand increases exponentially between the age of 26 and 42 of the household, from relatively low target levels of liquid wealth[31] to levels up to 7 times the permanent component of income.

Gourinchas & Parker (2002) then use their fitted model to construct a measure of precautionary savings (the savings households make to insure themselves against future labor income uncertainty). Afterwards, total savings at each age are decomposed into precautionary savings and life-cycle savings (savings for retirement). An important age-heterogeneity in relative strengths of the precautionary and retirement savings is found, as depicted in Panel A of Figure 3.5. Life-cycle motive for savings has a standard dynamics over the life-cycle; it is motivated by consumption smoothing - young consumers (with lower income) would like to borrow against future income and then the consumers start to save for retirement later in their lives. However, under future labor income uncertainty, a precautionary motive for savings arises, that is the strongest for young consumers and then gradually weakens[32].

Depending on the relative strength of the life-cycle and precautionary motives for savings, Gourinchas & Parker (2002) distinguish two different phases of household behavior over the life-cycle. For young households, the two motives go against each other, resulting in consumption profile that tracks income early in life. These households behave as buffer-stock agents[33] - they have low target level of cash on hand[34]. However,

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[31] Relative to the permanent component of income.

[32] Consumers are able to smooth away the potential negative future income shocks later in their lives, when they have already accumulated enough wealth. Therefore, future labor-income uncertainty becomes less important

[33] Gourinchas & Parker (2002) define buffer-stock households as those with precautionary motive for savings stronger than the life-cycle motive.

Gourinchas & Parker (2002) note that the buffer-stock behavior does not arise from high impatience – the estimated discount rate and risk aversion coefficient are quite modest - but rather from the steepness of expected income profiles at young ages (Gourinchas & Parker (2002):49). Between age 40 and 45 of the household, the future income uncertainty becomes less important, while the life-cycle motive for savings becomes crucial and households start to accumulate wealth for retirement. After this turning point, household behavior is more or less consistent with the behavior predicted by the CEQ-LCH.

Figure 3.5 Changing saving motives over the life cycle
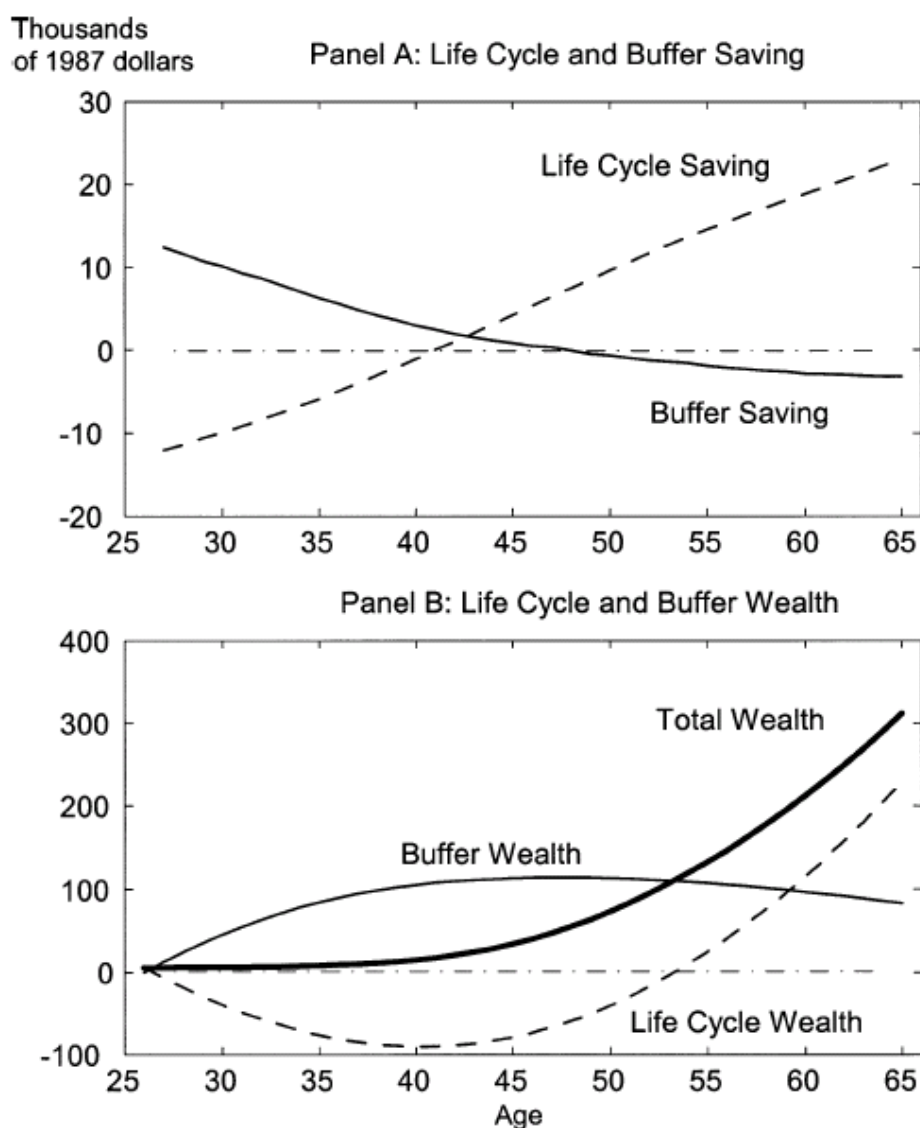
Source: Gourinchas & Parker (2002)

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[34] And therefore are consuming away positive income shocks and smoothing negative income shocks.

To summarize, Gourinchas & Parker (2002) find that there seem to be two distinct phases of consumer behavior during the life-cycle, with a turning point occurring around age 40. Only the second phase can be more or less approximated by the CEQ-LCH behavior; younger households behaving as buffer-stock agents seem to be short-sighted from the CEQ-LCH point of view. According to Gourinchas & Parker (2002), the standard CEQ-LCH fails to explain the observed consumption profiles because it does not capture the changing behavior; the model of Gourinchas & Parker (2002) introducing realistic labor income uncertainty seems to fit the observed life-cycle consumption profiles better.

The following chapters build on the article of Gourinchas & Parker (2002) presented above. The aim is to analyze life-cycle consumption behavior of average Czech household and to compare the results with the American consumption behavior presented in this chapter. Czech and American societies are different in many important aspects, which could show also in the average life-cycle consumption profile.

Chapter 4 presents the Czech individual-level data on household consumption and income from the Household Budget Survey and introduces all the key variables used later in the analysis. Chapter 5 formally describes the construction of life-cycle consumption and income profiles. It also presents the obtained Czech life-cycle profiles, compares them with the American profiles and then concludes with robustness checks. Chapter 6 at first studies whether the obtained Czech consumption profiles are consistent with the CEQ-LCH and with the model of consumption under income uncertainty by Gourinchas & Parker (2002). Afterwards, another approach is taken - possible determinants of household consumption predicted by different theories are taken into account and different specifications are estimated to identify which of the possible determinants empirically affect consumption of the Czech households.

4. Czech Data on Household Income and Consumption

In this chapter, Czech individual-level data on household consumption and income from the Household Budget Survey are introduced. Data adjustment is described and the measures of income and consumption that will be used through the analysis are presented, together with crucial household characteristics. The goal is to get a real insight into the HBS data – it is necessary for proper understanding of the life-cycle profiles construction that will be done in the next chapter and for further analysis of the Czech data coming in Chapter 6.

4.1 Czech Household Budget Survey

The only Czech micro dataset linking household consumption to different household characteristics is the Household Budget Survey of the Czech Statistical Office (CZSO)[35]. Data from the HBS are used in many ways, for example for design and evaluation of public social policies, or for international comparison of consumption and income. Data from HBS are also used to adjust the consumer basket so that the measure of consumer prices is up-to-date.

Every year, CZSO collects information about household characteristics, income, expenses and consumption structure for the basic sample consisting of about 3000 households, with the characteristics corresponding to the structure of Czech society (the main characteristics are economic activity of the head of household, age, occupation, education, net money income, number of dependent children in the household, and pension per person in the households of economically inactive pensioners)[36]. Moreover, a supplementary set of about 400 households with minimum income was created, to provide a more detailed look on the parts of population that are particularly sensitive to social policies.[37]

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[35] More detailed information can be obtained at http://www.czso.cz/csu/redakce.nsf/i/rodinne_ucty (available only in Czech).

[36] Since 2006, several types of households not covered before were introduced into the sample, such as households of unemployed, households of pensioners with economically active member or households without economically active members.

[37] These households are defined to live on at most 1.9 multiple of the subsistence minimum. These households are included in the basic sample as well, only their number is limited as the structure of the basic sample mimics the structure of the society.

To provide better understanding of the data structure, it is useful to look at the aggregate statistics about household income and consumption expenditures, as they are published by the CZSO every year[38]. The statistics are reported based on several indicators, such as the status of economic activity, age of the head of household, the municipality size, or the income brackets. Key statistics on household composition, incomes and expenditures from the 2008 Household Budget Survey, reported for different age groups (brackets of 10 years) are presented in Table 4.1.

In this thesis, the HBS data from years 2000-2008 will be used to analyze how the consumption depends on household age, income and other characteristics and what are the preference parameters (discount rate, risk aversion) of the households. Life-cycle consumption and income profiles of average household will be constructed and analyzed in the next chapter. Furthermore, household consumption will be estimated using several specifications, analyzing how the consumption depends on household characteristics, on (various measures of) income, and on some other variables (e.g. interest rate, wealth) predicted by different consumption theories. Before moving to the analysis itself, the following sections summarize the data adjustment, estimation samples, principal consumption and income measures constructed from the data, and crucial household characteristics.

At this point, it should be stressed that we are not working with panel data, but rather with a pooled-cross section – the CZSO does not necessarily observe one household for more than one year[39]. For the purpose of consumption and income analysis and for construction of life-cycle profiles, the HBS observations from years 2000-2008 are pooled together. All the consumption and income data are converted into 2005 prices, using CPI basic indices published by the Czech Statistical Office (year 2005 = 100), see Table 4.2. This gives the starting number of observations equal to 31,516 – first column of Table 4.3 summarizes the number of households surveyed in each year. However, some of the observations will be dropped; the data adjustment is presented in the next section.

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[38] Czech Statistical Office presents only aggregated data from the Household Budget Survey. The statistics for 2008 HBS are available at http://www.czso.cz/csu/2009edicniplan.nsf/engp/3001-09.

[39] In fact, if we are considering only our baseline sample, 25% of all observations are households that were observed for just one year. 80% of all the observations are generated by households that stayed at most four years in the HBS.

Table 4.1 HBS 2008 - Household composition, incomes and expenditures
(annual averages per capita, CZK)

	Households, total	Age of the head of household					
		under 29	30 - 39	40 - 49	50 - 59	60 - 69	70 and over
Households – weighted (from Microcensus)	2 839	128	568	487	632	549	475
in sample	2 839	149	659	564	718	455	295
Per household averages:							
Members	2.29	1.94	3.06	3.09	2.09	1.74	1.52
economically active (without unemployed)	1.03	1.09	1.36	1.61	1.44	0.53	0.07
dependent children	0.58	0.46	1.32	1.28	0.34	0.02	0.00
pensioners not working	0.52	0.01	0.03	0.05	0.19	1.16	1.44
other members	0.16	0.38	0.35	0.15	0.12	0.03	0.01
Equivalencies (OECD scale)	1.83	1.57	2.22	2.37	1.75	1.52	1.36
Equivalencies (EU scale)	1.58	1.38	1.81	1.95	1.53	1.37	1.26
GROSS MONEY INCOME, TOTAL	156 598	167 742	141 515	148 448	196 709	163 962	122 776
NET MONEY INCOME, TOTAL	137 497	144 465	123 218	127 654	164 675	151 555	121 538
Income from employment	77 464	95 695	80 974	88 687	118 860	45 559	5 791
Income from self-employment	13 227	12 180	15 010	18 533	15 831	7 619	886
Social income	36 755	17 363	16 087	9 326	19 945	89 990	110 577
Pensions	29 158	935	1 802	3 072	14 967	86 814	108 632
Sickness benefits	2 251	3 977	3 177	1 758	2 702	1 886	115
Unemployment benefits	367	531	336	373	502	460	4
State social support benefits	4 150	11 039	10 119	3 203	1 006	461	56
Other social income	829	881	654	920	768	369	1 770
Other income	10 051	19 227	11 147	11 110	10 038	8 386	4 284
including: income from sale of (im)movables	3 477	8 865	3 753	4 846	2 480	3 392	39
gifts from relatives	2 724	5 272	3 311	2 373	2 555	1 813	2 683
GROSS MONEY EXPENDITURE, TOTAL	143 055	157 500	132 124	137 163	174 989	148 152	111 395
Income tax	7 545	9 118	6 410	7 592	13 763	5 686	705
Health and social insurance	11 556	14 159	11 888	13 202	18 272	6 722	533
NET MONEY EXPENDITURE, TOTAL	123 955	134 223	113 826	116 369	142 955	135 744	110 157
by purpose:							
A. Consumption expenditure	112 256	110 239	100 725	106 740	132 771	123 460	99 737
B. Non-consumption expenditure	11 698	23 984	13 101	9 629	10 185	12 283	10 421
by type of expenditure:							
Food, beverages, public catering	28 895	26 953	24 185	27 102	33 309	33 199	30 836
Other consumer goods	38 333	42 865	40 544	38 239	42 733	37 963	24 073
Services	41 127	42 028	34 709	39 190	48 110	45 773	41 336
Payments and other expenditure	15 600	22 377	14 388	11 838	18 803	18 808	13 912
INCOME IN KIND	7 200	12 936	7 815	5 998	7 195	7 117	6 376
EXPENDITURE IN KIND	6 244	3 976	3 185	3 498	8 554	12 495	7 587
BALANCE ITEMS							
Balance of deposits withdrawn and deposits made	-10 783	-14 286	-6 382	-9 486	-17 889	-12 148	-8 043
Balance of loans received and credits repaid	-1 622	5 558	-2 312	-1 026	-2 816	-2 225	-679

Source: Czech Statistical Office

Table 4.2 CPI basic indices, (2005=100)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Annual average CPI	89.4	93.6	95.4	95.5	98.1	100.0	102.5	105.4	112.1

Source: Czech Statistical Office

Table 4.3 Samples used in the analysis, observations by year of HBS

Year	Original sample	Baseline sample	Sample A1	Sample A2	Sample A3
2000	3,717	2,695	3,261	2,765	2,443
2001	3,710	2,752	3,328	2,811	2,501
2002	3,706	2,744	3,314	2,801	2,537
2003	3,515	2,610	3,044	2,674	2,370
2004	3,450	2,740	3,170	2,798	2,513
2005	3,436	2,703	3,138	2,788	2,423
2006	3,377	2,530	2,971	2,621	2,237
2007	3,334	2,476	2,908	2,578	2,199
2008	3,271	2,352	2,783	2,489	2,048
Total	31,516	23,602	27,917	24,325	21,271

Conditions that the households have to fulfill to stay in the sample

12 months in the HBS		√	√	√	√
Age between 26-65		√		√	√
Income measures not in the upper and lower 1%		√	√		
Income measures not in the upper and lower 5%					√

4.2 Data Adjustment and Estimation Samples

This section describes how the original sample - obtained by merging all the HBS data from years 2000 -2008 - is adjusted to obtain the baseline estimation sample used in the upcoming analysis of life-cycle consumption. The methodology of Gourinchas & Parker is followed where possible so that the results of the analysis could be compared with the findings on American data.

Apart from introducing the baseline sample, some alternative samples are presented, that will be used mainly in robustness checks - these tests will be extremely important as their role is to convince that the Czech results[40] are robust.

To obtain the baseline estimation sample, the first step is to eliminate all the households that were not in the HBS for a whole year (12 months) [41]. This is the case for

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[40] Which are quite different from the results obtained using the American data – see Chapter 5.

2,756 households, so the sample is down from the original 31,516 observations to 28,760 observations.

Second, the approach of Gourinchas & Parker (2002) is applied in the sense that most of the analysis is focused on working-life only, defined to be between age 26 and 65. Therefore only households of this age[42] are included in the baseline sample, meaning we drop additional 4,435 observations (24,325 observations are left). Households of age lower than 26 or higher than 65 will be included in the sample only while doing some robustness checks.

Last but not least, it is preferable to drop some observations being extreme in terms of income. The measures of income - "labor income" and "broad income" - that will be used in the analysis are presented in Section 4.3. These two measures provide different information about the household resources; we do not want the households to be extreme in any of the two measures. Our suggestion is to define the extremes in terms of the per capita variables[43]. A percentile - 1% in the baseline case[44] - is chosen and households with either measure of income in this (upper or lower) percentile are dropped. Table 4.4 presents the "labor income" and the "broad income" statistics in per capita values, identifying the 1% boundaries for each of these two measures[45]. This approach has an advantage that the results can be presented as generally valid for all households with income not equal to some percents of extreme values[46]. Therefore, we exclude from our baseline sample all the households that have labor income or broad income in the top or

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[41] This is done mainly as it is not clear whether the data (consumption, income etc.) are reported as a total for the period the household actually stayed in the HBS, or whether the data are already adjusted for the number of months in the survey (if lower than 12). From the data it seems that rather the first case holds – therefore the data would have to be adjusted before use. As the number of observations with this problem is only limited (compared to the whole sample), they are dropped instead. A potential problem can of course arise, steaming from the possibility that households could drop off the HBS early in a way that was nonrandom. However, we will work mainly with average values and the estimation sample is really large, so the effect of dropping these observations should be insignificant. The results are to be presented as applicable to the whole population in an only limited way anyway (this is in line with what CZSO writes about the whole HBS – even if the households are chosen in a way to represent the population based on many characteristics, the data obtained cannot be viewed directly as describing the whole population).

[42] Referring to the age of the head of the household; see Section 4.4 for description of household characteristics used in the analysis.

[43] Which can be obtained for each household by dividing the income measures by a family size.

[44] 5% will be used as a robustness check (Sample A3).

[45] The percentiles are identified on the already adjusted sample – taking only households with 12 months in the survey and with the head of the household aged 26-65 (24,325 observations).

[46] On the other hand, some outliers may persist. Another possibility would be to define outliers (probably again in terms of per capita income measures) in some standard statistical software, and drop only these observations. However, the first approach is chosen for its simplicity and clear interpretation.

bottom 1%, which means we drop additional 723 observations[47]. This brings the baseline sample down to 23,602 observations.

We do not drop households with other than male head, contrary to what Gourinchas & Parker (2002) do – this should not cause any problems and our results should be more general. See also Section 4.4.

Table 4.4 Income measures per capita, finding 1% percentile boundaries

Labor income				
Basic statistics		**Percentile**	**Value of percentile**	**Extreme observations**
Observations	24325	1%	29495.09	4 smallest observations
Mean	101096.2	5%	39295.61	-20297.56
Std.deviation	50300.47	10%	45227.57	-15074.93
		25%	63670.86	-10370.97
				-1476.36
		50%	91181.2	
				4 largest observations
		75%	128842.9	411454.9
		90%	168709.5	420268.5
		95%	194756.9	468227.5
		99%	254912.8	501684

Broad income				
Basic statistics		**Percentile**	**Value of percentile**	**Extreme observations**
Observations	24325	1%	35923.94	4 smallest observations
Mean	107944.5	5%	43310.59	14046.39
Std.deviation	61450.77	10%	48615.82	17583
		25%	67731.17	20433.84
				21340.42
		50%	96211	
				4 largest observations
		75%	135134.9	1470306
		90%	178060.2	1489056
		95%	206808	1576950
		99%	281245.3	1659024

Note: Sample A2 is used - taking only households with 12 months in the survey and with the head of the household aged 26-65. See Section 4.3 for definitions of "labor income" and "broad income" (by construction, the income measures can be negative in extreme cases). The per capita values refer to the income measures divided by the family size. The highlighted values define the boundaries of the upper and lower 1% of observations - households with either income measure in the lower/upper percentile are not included in the baseline sample. See discussion in text.

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[47] This means that 2.97% of observations are dropped due to being extreme in terms of income (as about 1% of observations is extreme in both income measures).

To summarize, our baseline sample – which will be used during most of the analysis - includes households that spent twelve months in the HBS, who are aged 26-65 and who are not in the top or bottom 1% of either income measure. This brings our baseline sample down from the original 31,516 observations to 23,602 observations.

In the robustness checks, three alternative samples will be used to analyze whether the results are not dependent on the conditions we have specified for our baseline sample. Sample A1 expands the baseline sample to the whole-life period[48], while the conditions on number of months in the HBS and on income stay untouched[49]; the sample has 27,917 observations. Sample A2 fulfills the condition on age to be between 26-65 and the condition on being 12 months in the HBS, but it has no condition on income – no households with extreme income values are omitted; the sample has 24,325 observations. Sample A3 is the same as the baseline sample in the condition on age and in the condition on number of months in the HBS. Nevertheless, it applies the income condition more strictly than the baseline case - all the households that have labor income or broad income in the top or bottom 5% (instead of 1%) are excluded. Sample A3 has 21,271 observations.

Table 4.3 summarizes the conditions that have to hold for different samples (the baseline sample and the alternative ones), and also presents how many observations come from different HBS years in each sample.

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[48] We repeat that the baseline samples deals only with households aged 26-65 as it focuses just on the working life. This age condition is relaxed for Sample A1, there are observations for households aged 19-90 available in the HBS. However, the number of observations declines significantly as the age goes down to 19 or up to 90. Therefore, the average age-profiles that will be constructed over the whole life-cycle should be taken as less reliable - especially for households with age close to 20 or for ages over 80 (in the extreme, we see just one observation for age 19; there are at least 8 observations for all other age-categories).

[49] The condition on income stays unchanged in the sense that all the households that have labor income or broad income in the top or bottom 1% are excluded. The critical levels of 1 percentile have of course changed, as observations with age outside the 26-65 interval are included in the sample.

4.3 Measures of Consumption and Income

One measure of household consumption and two measures of household income that will be used through the analysis are presented in this section. The methodology of Gourinchas & Parker is followed where possible, to allow future comparison of results.

Measure of consumption

As to the consumption measure, very detailed consumption structure is available in the HBS, going into the basic items. For the purpose of our analysis, however, more aggregated measures will be used. A starting point is the Classification of Individual Consumption by Purpose (CZ - COICOP), which the Czech Statistical Office uses since 1997 and which is based on international standards. In this classification, individual expenditures are divided into thirteen categories, of which twelve are for consumption expenditures and the last one being expenditures not classified as consumption. The twelve consumption categories are the following ones[50]:

1. Food and non-alcoholic beverages; 2. Alcoholic beverages, tobacco; 3. Clothing and footwear; 4. Housing, water, electricity, gas and other fuels; 5. Furnishing, household equipment and routine household maintenance; 6. Health; 7. Transport; 8. Communication; 9. Recreation and culture; 10. Education; 11. Restaurants and hotels; 12. Miscellaneous goods and services.

The category 13. - Non-consumption expenditures consist mainly of purchase or (re)construction of dwelling. Some other items included are for example expenditures on private entrepreneurship, gifts to relatives, purchases of stocks and bonds etc.

In the construction of the consumption measure, the basic expenditure items are at first aggregated into the thirteen categories mentioned above. For this aggregation, methodology from the last year considered, 2008, is applied for years 2000-2007, so that the same item falls into the same category across all the years[51]. The starting measure of household consumption expenditures is then the sum of the twelve consumption categories, which is called "total household consumption expenditures" by the CZSO.

However, this is not yet the consumption measure that will be using in our analysis - we need to get closer to the measure of Gourinchas & Parker (2002) if the results from

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[50] On the top of these categories, the HBS provides data also on consumption in kind; data on income in kind and expenditures in kind are provided as well. After considering the incorporation of consumption in kind into the total consumption measure, we decided not to do so. Similarly, income in kind is not part of the income measure.

[51] This is to deal with the changes in the HBS expenditures classification across years (these changes concern mainly the basic first-level expenditures items) in a consistent way.

the Czech data are to be compared with the American ones. Gourinchas & Parker (2002) define their measure of consumption as total household expenditures less those on education, medical care, and mortgage interest payments; they view the subtracted items as investment or negative income shocks rather than consumption (Gourinchas & Parker (2002): 66).

Therefore, household expenditures on education and health (categories 10 and 6 from the COICOP-CZ, respectively) are subtracted from the total household consumption expenditures described above. This gives the baseline measure of consumption to be used in the analysis, which is referred to as "consumption ex education ex health" or simply as "household consumption" from this point on. Histogram of household consumption for the baseline sample of 23,602 households is provided in Figure 4.1.

Figure 4.1 Household consumption distribution, baseline sample
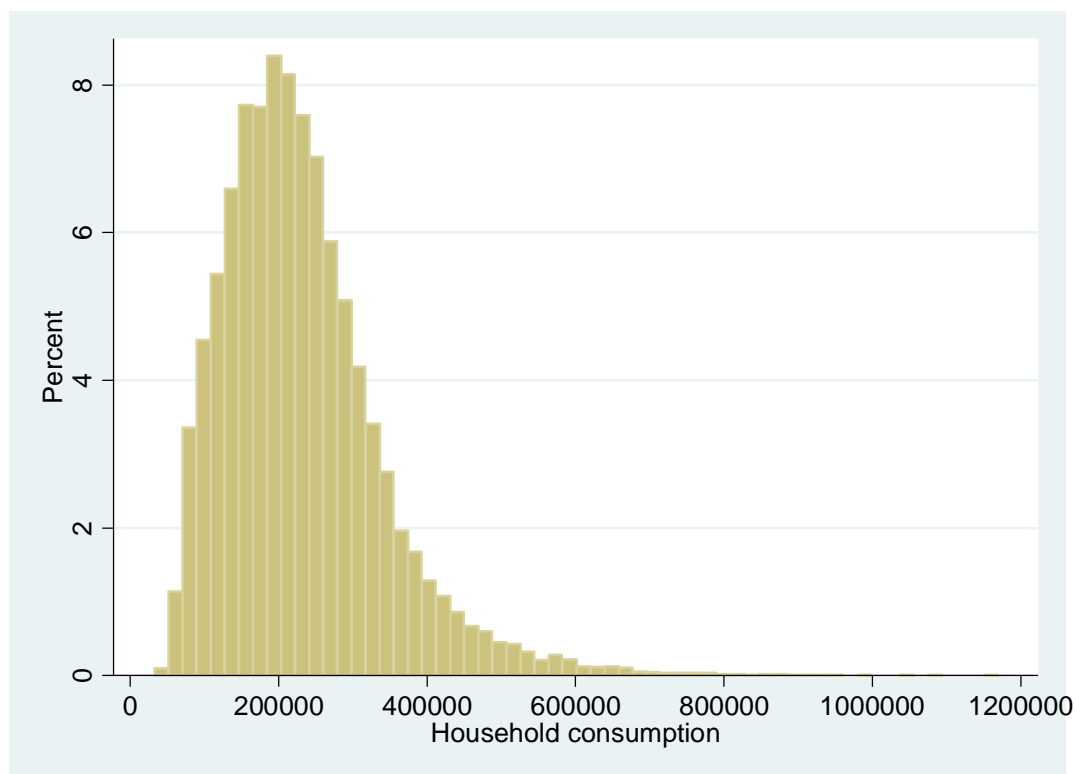
Measures of income

Gourinchas & Parker define their measure of household disposable labor income as after-tax family income less Social Security payments, less pension contributions, and less after-tax asset and interest income. Furthermore, as they do not include health and education expenditures in their measure of consumption, these items have to be subtracted from the measure of income as well (Gourinchas & Parker (2002): 66-67).

As to the measures of income available in the HBS, the dataset contains detailed information on household's money income, allowing us to distinguish income from employment (for the whole household, or separately for different members of the household[52]), income from self-employment, or different sources of social income (pensions, sickness benefits, unemployment benefits, state social support benefits). Other types of income include among others capital income, income from sale of (im)movables and gifts from relatives. A special category of money income consists of intertemporal transfers, such as deposits withdrawn, loans received or hire purchase (leasing).

It is a question which of these components of household income should be included in the income measure used in the life-cycle profiles construction. To deal with the problem, two different income measures are constructed. The first one consists of labor and social income only (income from employment, income from self-employment and social income), identifying components of income being stable and certain to some extent. The second measure adds all other sources of money income[53] (except for the income from intertemporal transfers as specified above), which is the measure CZSO refers to as (gross) total money income. Total household money income is better described by this measure; on the other hand, these extra components are mostly one-time, uncertain and their effect on household's decisions (for example consumption) can be complex[54]. The second measure includes significantly more extreme values (mainly in the upside) than the first measure and the standard error is therefore significantly larger. However, for our baseline sample, where the observations extreme in terms of both income measures are not

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[52] For the head of the household, his wife (if family-type household) and for other members of the household.
[53] Namely capital income (sales of bonds and stocks, dividends etc.), sales of agricultural products, sales of (im)movables, gifts from relatives, compensations from insurance companies, returned regulatory fees (paid within the Czech health-care system), other social benefits, and other income – using the methodology of the 2008 HBS.
[54] Moreover, it can be questionable whether to incorporate all these other income sources directly into the one time period when they occur (consider for example income from selling a house).

included, the two income measures come much closer, as can be seen in Figure 4.2 or in Table 4.7.

Both income measures used in the analysis are net - the income tax expenditures and health and social (mandatory) insurance are subtracted - to better catch household's disposable income. Furthermore, health and education expenditures have also been subtracted (as they were from the consumption measure) to obtain measures comparable to those of Gourinchas & Parker (2002)[55].

In the analysis, the first measure (net labor and social income, ex health and education expenditures) will be taken as the baseline, as it captures the more stable components of household income. This measure will be called "labor income" from now on. However, the results will be provided for the second income measure as well; it adds some nontrivial information about total household resources and represents a robustness check. This second measure of income (which includes other income sources) will be referred to as "broad income".

Histograms for the two household income measures - for the baseline sample of 23,602 households - are provided in Figure 4.2.

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[55] Therefore, the household income measures can in principle be negative. In fact, five households from the original dataset (before adjusting for the extremes in income, as described in section 4.2) have the "labor income" at negative values. However, as these are in the bottom 1% of the labor income measure, they are dropped. After adjusting for extremes in income, the minima of both income measures are reasonably above zero, see Table 4.7.

Figure 4.2 Labor income and broad income distribution, baseline sample
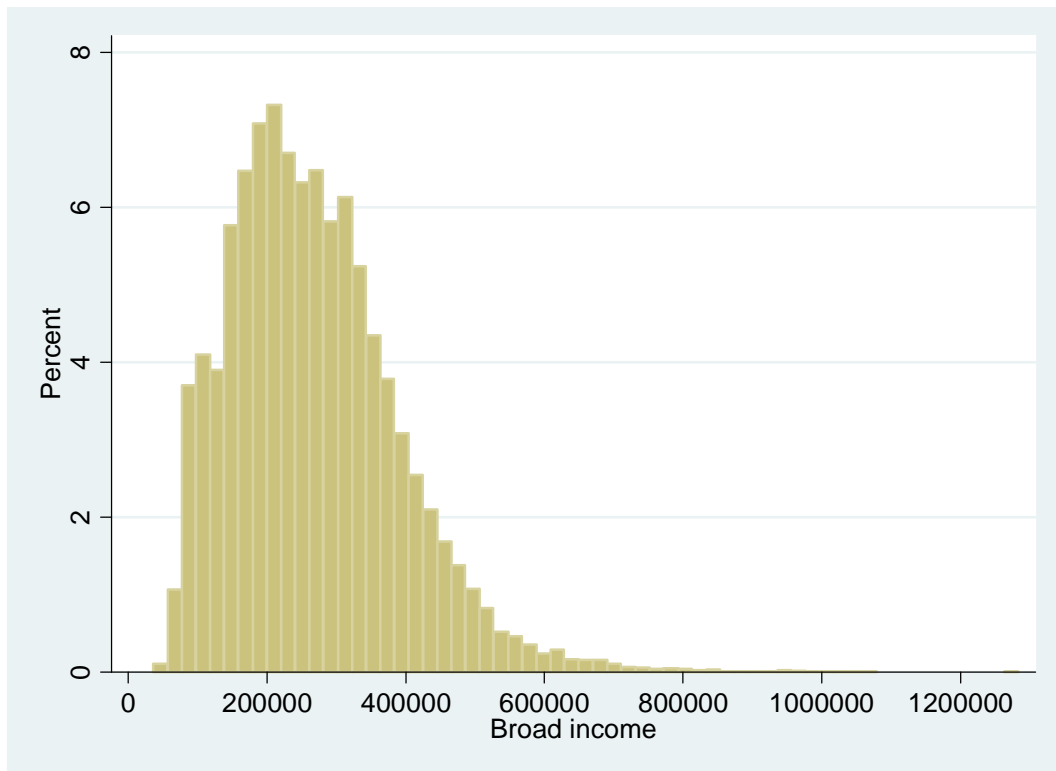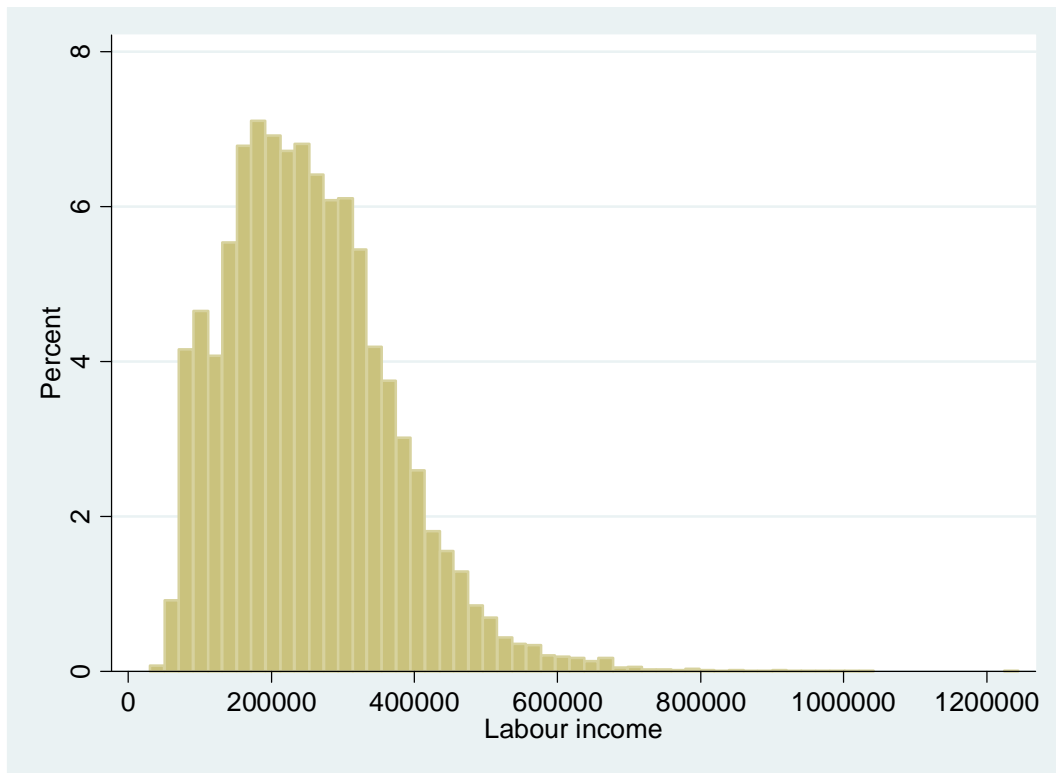
4.4 Household Characteristics

Based on the characteristics provided in the HBS, each household is assigned age group, birth cohort, education group, occupation group, region, interview year and a family size measure. As these are the crucial household characteristics that will be used through the whole analysis, the following section presents the measures and their construction.

All the characteristics are assigned based on the information HBS provides for the head of the household. The head of household is specified in the HBS as a male in complete families, as a parent in incomplete families (with economically inactive children) and as a person with the highest income in other types of families. This approach slightly differs from the one undertaken by Gourinchas & Parker (2002), who use information about the reference person to assign household to different groups. However, they do so only if the reference person is a male - if it is a woman, information about spouse is used and if the spouse does not exist (or the information about his characteristics are not provided), the household is dropped. The sample Gourinchas & Parker (2002) use in their analysis therefore misses a significant portion of households (mainly incomplete families with female heads). For this reason, the methodology of Gourinchas & Parker is not used at this point and the HBS concept of the head of household is applied instead. Doing so, no type of households is left out.

The age of household therefore refers to the age of the head of household, as reported in the HBS. Most of the time, only households aged 26-65 will be taken into account, as the analysis is focused mainly on a working-life of a household. This is in line with what Gourinchas & Parker (2002) do. Apart from the age measure, each household is assigned also to a birth-cohort depending on the year of birth. This measure is constructed simply as the difference of the year of the survey (being between 2000 and 2008) and of the age of the household[56]. This measure will be used to account for the cohort effect (in both income and consumption) later in the analysis. The age structure of households in our baseline sample of 23,602 observations is depicted in Figure 4.3. The number of households of the same age ranges from 294 (age 65) to 758 (age 38). Therefore, we have enough observations for each year to be able to construct reliable average consumption and income life-cycle profiles (which is done in Chapter 5).

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[56] This does not necessarily give a year of birth (it can be plus minus a year), but it is the best information available - the approach follows the one of Gourinchas & Parker (2002).

Size of the household (family size) is constructed from a variable "number of household members" stated in the HBS, which provides an average household size over the given time period. For the purpose of this analysis, the provided averages are rounded to whole numbers and all households with more than 8 members are reported to have a family size of 8. Family-size structure of our baseline sample is summarized in Table 4.5.

The education category is constructed from the data provided in the HBS in the following way. At first, our sample is divided according to the education level reported for the head of the household. Contrary to the US data, only the highest completed level of education matters[57]. The nine original categories used by the CSO are collapsed into three major ones: *Primary education or lower, Secondary education,* and *University*. The number of observations in each subgroup reflects the education structure of the Czech society, so the category *Secondary education* has by far the largest content; for our baseline sample, it is 20,117 out of 23,602 households. The number of observations in the other categories is significantly smaller[58], suggesting that the results for these subgroups should be taken as less reliable.

As to the occupation categories, occupation of the head of the household is provided in detail in the HBS. From these data, we aggregate the occupations into the 11 basic categories[59] to reconstruct life-cycle consumption profiles for households with different occupation. These categories are presented in Table 4.6, together with the percents of observations from our baseline sample falling in each category. However, for the construction of life-cycle profiles by occupation, ten categories are too much[60]. This is why the occupations are divided into four main types[61], see third column of Table 4.6.

For life-cycle profile constructions by education/occupation groups, the observations in each category have to be well dispersed by the age of the household. As to the education, this holds fortunately even for the Primary education category and for the University category - using the sample of 2000-2008, HBS allows us to obtain enough observations for each age/education combination and to construct life cycle income and

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[57] E.g. a person reported as *Some High School* in the US dataset would have been reported as *Primary education.* The same goes for the *Some College* category, which is included in Czech *Secondary education* category.

[58] For the baseline sample, the numbers are equal to 827 and 2,658 households for Primary education and University, respectively.

[59] These categories are defined by the Czech Statistical Office, following the guidelines of EUROSTAT.

[60] There must be enough observations for each age/occupation combination.

[61] Plus Army - it does not really fit in any of the four categories, so it is kept aside. However, as there are too few observations in the Army category, life-cycle profiles will not be constructed for it.

consumption profiles for the different education categories. The profiles' construction procedure and results obtained are presented in the next section. Life-cycle profiles will also be constructed for different occupational categories, so the same rule – enough observations for each age/category combination – has to hold. This is ensured by using the four occupation types instead of the original 10 occupation categories, as was explained above.

The same exercise could easily be done for different geographic categories or categories with respect to the size of municipality in which the household lives etc. However, this text will only focus on the overall consumption/income profiles and on the profiles with respect to education and occupation categories.

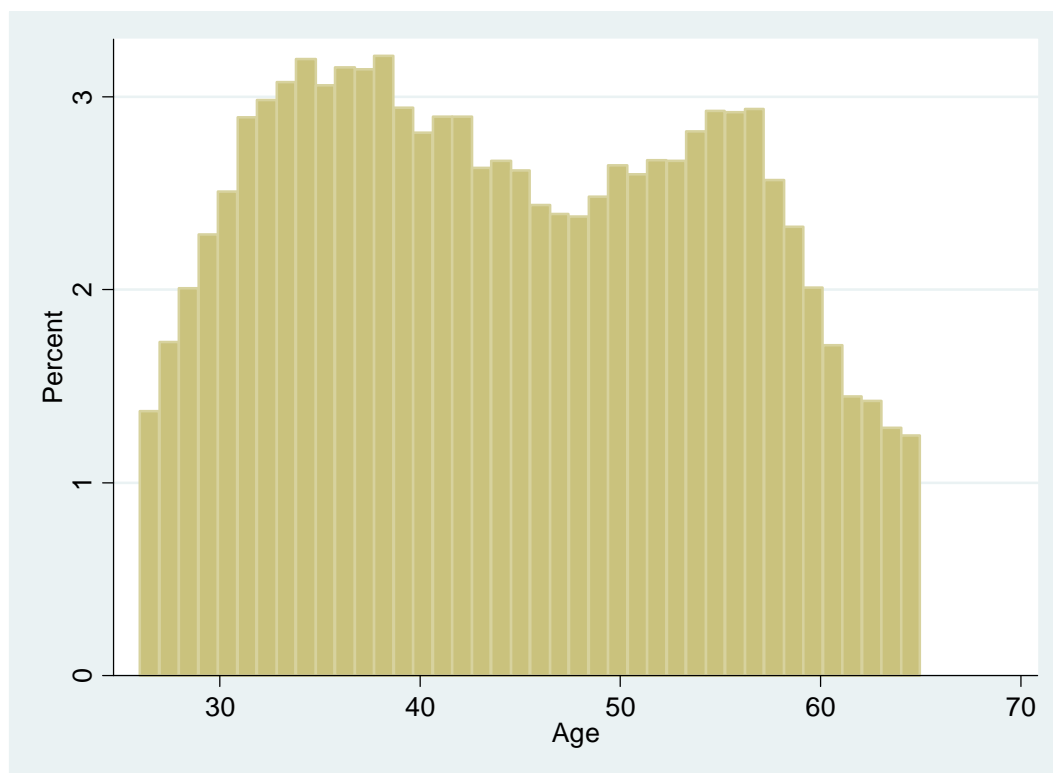**Figure 4.3 Age structure of households, baseline sample**

Table 4.5 Family-size structure, baseline sample

Family size	Number of observations	% of the baseline sample
1	3,470	14.70
2	7,139	30.25
3	5,050	21.40
4	6,464	27.39
5	1,243	5.27
6	178	0.75
7	43	0.18
8 or more	15	0.06
Total	**23,602**	**100.00**

Table 4.6 Occupation of the head of household, baseline sample

Occupation categories	% of the baseline sample	Occupation category type
01 Legislators, senior officials and managers	3.2	A. Managerial, Professionals
02 Professionals	6.5	
03 Technicians and associate professionals	13.7	B. Technicians, Sales, Administration
04 Clerks	12.1	
05 Service workers and shop and market sales workers	6.0	
06 Skilled agricultural and fishery workers	4.8	C. Production, Craft, Operators
07 Craft and related trades workers	25.0	
08 Plant and machine operators and assemblers	12.6	
09 Elementary occupations	4.5	D. Unskilled, economically inactive
00 The head of household not economically active (including unemployed)	11.0	
10 Armed forces	0.5	
Total number of households	**23,602**	

Table 4.7 Key variables summary, baseline sample

Variable	Observations	Mean	Std. Deviation	Min	Max
Household consumption	23602	231349.9	107562.5	33042.93	1169968
Labor income	23602	254273.4	116278.9	30392.2	1244460
Broad income	23602	267974.8	121769	36245.86	1263596
Age of the household	23602	44.54817	10.63171	26	65
Size of the household	23602	2.815778	1.205875	1	8

Table 4.7 summarizes the all the key variables for the baseline sample of 23,602 observations – consumption measure, the two income measures (labor income and broad income) and key household characteristics.

In the next chapter, the HBS data presented here will be used to construct average Czech consumption and income life-cycle profiles. These profiles are then compared with the profiles obtained by Gourinchas & Parker (2002) on American data and the results are interpreted.

5. Czech Consumption and Income Life-cycle Profiles

The construction methodology of life-cycle consumption and income profiles is formally described at the beginning of this chapter. Afterwards, the obtained Czech average life-cycle profiles are presented and their shape is compared with the American profiles. The Czech life-cycle profiles by education and by occupation of the households are also introduced. The chapter continues with explaining how the different adjustment steps affect the shape of the life-cycle profiles. Robustness checks are overviewed at the end of this chapter.

5.1 Profile Construction Methodology

The construction of Czech life-cycle profiles follows very closely the method used by Gourinchas & Parker (2002). The Czech life-cycle profiles that will be presented in the Section 5.2 are already adjusted for the changing household size over the life cycle, for the cohort effects, for the year-of the-survey effects and for whether the household is retired or not. The adjustment is done for that the profiles capture only the intertemporal substitution parameters (discount rate, risk aversion) and the labor income uncertainty, as these are the crucial parameters we are interested in. This section presents the construction methodology in detail.

Life-cycle consumption profile

The empirical specification that will be developed in this section stems from the model of life-cycle consumption under uncertainty presented in Chapter 2. Gourinchas & Parker (2002) at first define the marginal utility of household i at age t in the following way.

$$\lambda_{i,t} \equiv v(Z_{i,t})C_{i,t}^{-\rho} \tag{4.1}$$

Using the Euler equation (3.10), and defining $\eta_{i,t}$ as a multiplicative innovation to the marginal utility of wealth, they obtain that

$$\lambda_{i,t} = \frac{1}{\beta R}\lambda_{i,t-1}\eta_{i,t} \tag{4.2}$$

By iterating backwards and substituting for consumption, consumption of household i of age t, $27 \leq t \geq 65$, can be written

$$C_{i,t} = \left(\frac{v(Z_{i,t})}{v(Z_{i,26})}\right)^{1/\rho} (\beta R)^{(t-26)/\rho} \left(\prod_{l=27}^{t} \eta_{i,l}^{-1/\rho}\right) c_{26} P_{26} \qquad (4.3)$$

Effect of household characteristics (in this model described only by varying family size) on consumption are captured by the first term. The second term is the change in marginal utility depending on interest rate, discount factor and on the intertemporal elasticity of substitution $1/\rho$. The third term captures the effect of uncertainty and precautionary savings up to the age t on household consumption. The last two terms reflect differences between initial cash on hand and initial permanent income component across households, respectively (Gourinchas & Parker (2002): 62-63).

After developing equation (4.3), Gourinchas & Parker (2002) make a few further assumptions. At first, the classical multiplicative measurement error in consumption is assumed. Secondly, time (year of the survey) effects are multiplicatively included as year-specific factors influence average household consumption in practice. Third, variation of income profiles across cohorts is allowed for, by assuming that the household's initial wealth partially depends on the cohort[62] - the remaining variation in initial wealth is assumed to be idiosyncratic. This is formally done by decomposing the initial permanent component of income (P_{26} in equation (4.3)) into a cohort effect P_{26}^{cohort} and an individual component $\tilde{P}_{i,26}$.

Under these assumptions, and denoting the year of the survey as τ and observed household consumption in the survey as $\tilde{C}_{i,t,\tau}$, equation (4.3) can be in logarithm written as:

$$ln\,\tilde{C}_{i,t,\tau} = 1/\rho \, ln\left(\frac{v(Z_{i,t})}{v(Z_{i,26})}\right) + 1/\rho \, E_{26}\left[ln\left((\beta R)^{t-26}\left(\prod_{l=27}^{t} \eta_{i,l}^{-1}\right)\right)\right] + lnP_{26}^{cohort}$$
$$+ \xi_\tau + \epsilon_i \qquad (4.4)$$

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[62] Gourinchas & Parker (2002) define cohort as all people born in the same year. Assuming that different initial wealth of the households depends partially on the household's cohort means that the cohort can affect only the distance between the life-cycle profiles, not the shape of the life-cycle profile itself. See section 3.3 for argumentation why Gourinchas & Parker (2002) adjust for the cohort effect.

The first term in equation (4.4) represents the effect of household characteristics (family size) on consumption. The second term is just a function of age that describes the effect of intertemporal substitution and labor income uncertainty (which affects precautionary savings) on consumption. The third term reflects the effect of cohort. The fourth term, ξ_τ, represents the time (year of the survey) effect on consumption. The error term, ϵ_i, captures both variation in household's initial conditions (cash on hand c_{26}; individual permanent income component $\tilde{P}_{i,26}$) and the classical measurement error.

The empirical specification used in the life-cycle profiles construction is based on equation (4.4). Household characteristic (family size), age variable, cohort variable, year of the HBS variable, and a retirement indicator variable[63] are included among the explanatory variables to capture the effects described above.

However, it is impossible to include the year of HBS directly into the regression together with the age and cohort variables[64]. An assumption of Gourinchas & Parker (2002) that time (year of the survey) effects are due to the state of regional economy only is followed. As it was the case for the regression on American data, regional unemployment rates are included into the regression to capture these time effects[65]. Equation (4.3) therefore transforms into following empirical specification:

$$\ln \tilde{C}_i = f_i \pi_1 + a_i \pi_2 + b_i \pi_3 + u_i \pi_4 + Ret_i \pi_5 + \varepsilon_i \qquad (4.5)$$

where f_i is a complete set of family-size dummies (except the median family size - equal to 2 - dummy), a_i is a complete set of age dummies, b_i is a complete set of cohort dummies (less the middle cohort, which is 1959 in our case), u_i is a region average unemployment rate in year τ, Ret_i is a dummy variable equal to one for retired households. The error term captures all the individual effects.

The regression equation (4.5) is estimated for our baseline sample of 23,602 Czech households. Following the procedure of Gourinchas & Parker (2002), we then reconstruct household-level consumption that is uncontaminated by cohort and time effects and from which the within-age variation on family size is removed, using the estimated coefficients from equation (4.5):

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[63] To correct for the households that retire before age 65 as equation (4.3) describes household behavior during working life only.

[64] By construction of the variables (see Section 3.4), this would lead to perfect multicollinearity.

[65] The data on Czech regional unemployment rates are taken from the database of Czech Ministry of Labor and Social Affairs, available at http://portal.mpsv.cz/sz/stat/nz/mes. Yearly averages are reconstructed from monthly data and they are assigned to households depending on region they live in (which can be identified from the data).

$$\ln C_i \equiv \bar{f}_t \hat{\pi}_1 + a_i \hat{\pi}_2 + \bar{u} \hat{\pi}_4 + \hat{\epsilon}_i \tag{4.6}$$

The equation therefore defines the actual household's consumption in case the household would be born in the middle cohort (year 1959), would face the average unemployment rate $\bar{u}$, would not be retired and would have the typical age-dependent family size $\bar{f}_t$. This last measure is reconstructed from the data, the average age-dependent family size is equal to 2 for households aged 26 and 27, equal to 3 for household age 28-30, equal to 4 for household aged 31-49 and equal to 1 for households with a head older than 49.

Average age-profiles of consumption could then be constructed by averaging the consumption defined by equation (4.6) across households of the same age:

$$\ln C_a \equiv \bar{f}_t \hat{\pi}_1 + a \hat{\pi}_2 + \bar{u} \hat{\pi}_4 \tag{4.7}$$

However, this consumption would still reflect the typical age-dependent family size. Therefore, a profile of per-household-equivalent consumption is generated instead. We use the methodology of Gourinchas & Parker (2002) and replace the typical age-dependent family size, $\bar{f}_t$, in equation (4.6) by the sample average family size, $\bar{f}$[66] , for each household. Only after doing so, we average across all the households of the same age:

$$\ln C_{a,\ per-household-equivalent} \equiv \bar{f} \hat{\pi}_1 + a \hat{\pi}_2 + \bar{u} \hat{\pi}_4 \tag{4.8}$$

The per-household-equivalent consumption measure from equation (4.8) is the one we use when displaying the constructed life-cycle consumption profiles. The results are only converted back to Czech crowns by taking an exponential of $(\ln C_{a,\ per-household-equivalent})$. We report these profiles that are adjusted for changing family-size, effect of cohort, and the year of HBS, as equation (4.4) shows that after controlling for all these effects, the resulting profiles should reflect only consumer preferences (discount rate and risk aversion) and uncertainty of future incomes – and these are the parameters of main interest.

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[66] This average is equal to 3.15 and therefore is rounded down to 3, as the coefficients estimated from equation (4.5) can be applied on a family size rounded to whole numbers only.

Life-cycle income profile

The income profiles are reconstructed in a similar way. We take logarithm of our baseline income measure[67], which is labor income; the process will be repeated for the broad income as a robustness check. Adjustment for cohort effects, time effects (year of HBS)[68], and for the variation in family size is done, in exactly the same way as for consumption. Per-household-equivalent labor income is constructed by applying average household size to all households. The labor income for particular age is then obtained by averaging the data across households of the same age. The life-cycle labor income profiles are to be displayed in CZK rather than in logarithm, so the results are converted back by taking an exponential.

Life-cycle profiles for different educational/occupational groups

When constructing the life-cycle profiles separately for different educational groups, interaction terms between education dummies and age dummies, and education dummies and the retirement status dummy are added into equation (4.5). Besides that, the procedure is analogous to the one described above.

Life-cycle consumption and income profiles for different occupational groups are constructed in the same way.

To summarize, the Czech life-cycle consumption and income profiles that are presented in the next section are already adjusted for the changing household size over the life cycle, for the effect of cohort, for the effect of the year of the HBS survey, and for whether the household is retired or not. It is important to realize this fact for a correct interpretation of the profiles – see also the discussion in Section 5.2 related to Figure 5.5. These adjusted profiles should reflect only household's discount rate, risk aversion and labor income uncertainty, which are the parameters we are interested in.

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[67] See Section 3.3 for definitions of different income measures.
[68] Again by using the regional unemployment rates as proxy.

5.2 Life-cycle Consumption and Income Profiles

The life-cycle consumption and income profiles constructed using 23,602 observations[69] from the Czech Household Budget Survey (years 2000-2008) are depicted in Figure 5.1. Both income and consumption profiles are increasing over the whole life-cycle, after correcting for the changing household size over the life cycle, for the effect of cohort, for the effect of year of the HBS survey, and for whether the household is retired or not. These profiles therefore reflect only household intertemporal preferences (discount rate, risk aversion) and labor income uncertainty. There is no hump-shape in the consumption profile or in the income life-cycle profile, compared to what was observed by Gourinchas & Parker (2002) on American data (compare Figure 5.1 with Figure 3.1).

Figure 5.1 Household consumption and income over the life cycle
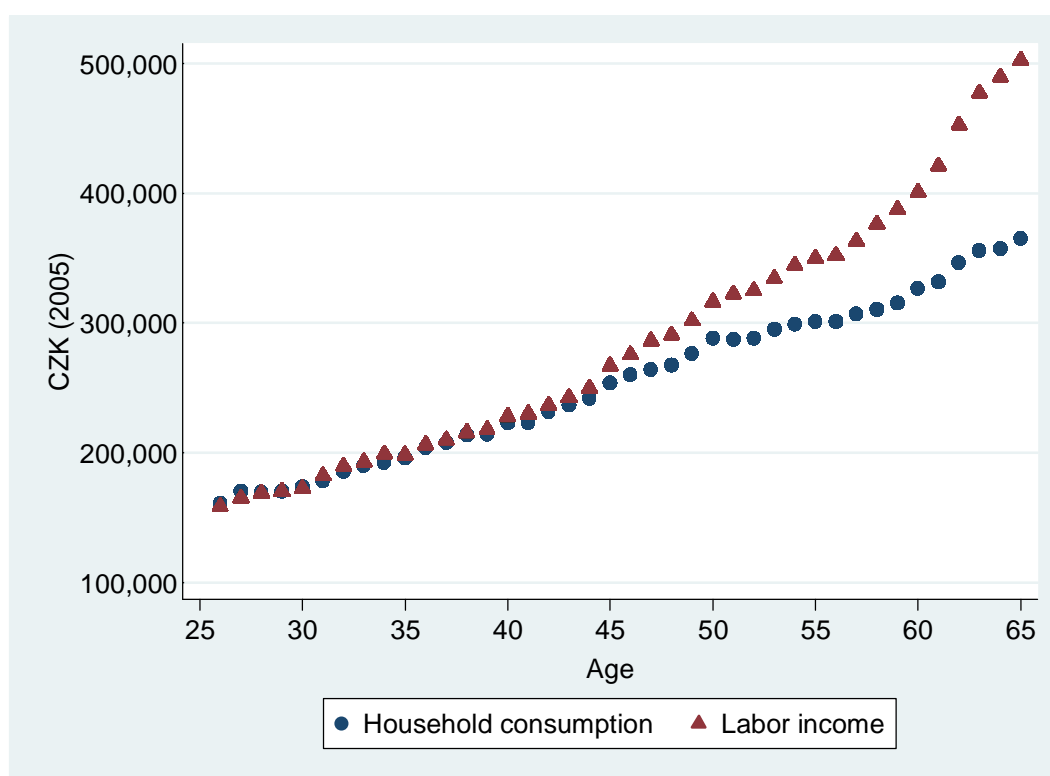
The shape of the consumption profile is less dramatic than the one of the income profile. For that the life-cycle development of consumption is visible in more detail, we depict the consumption profile alone, in Figure 5.2. It even seems that the consumption profile could be well approximated by a profile linearly increasing over the whole life-cycle, which is what the CEQ-LCH would predict. The discussion whether the obtained consumption profile is consistent with the CEQ-LCH model is done in Section 6.1.

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[69] Our baseline sample.

However, it also seems that there could be a breaking-point around age 50 of the households. This alternative hypothesis comes also from Figure 5.2 – it seems that while the development of consumption seems to be almost linear for households under 50 (or maybe for households aged 29-50), the development of consumption is much less obvious later in life[70].

Figure 5.2 Household consumption over the life cycle
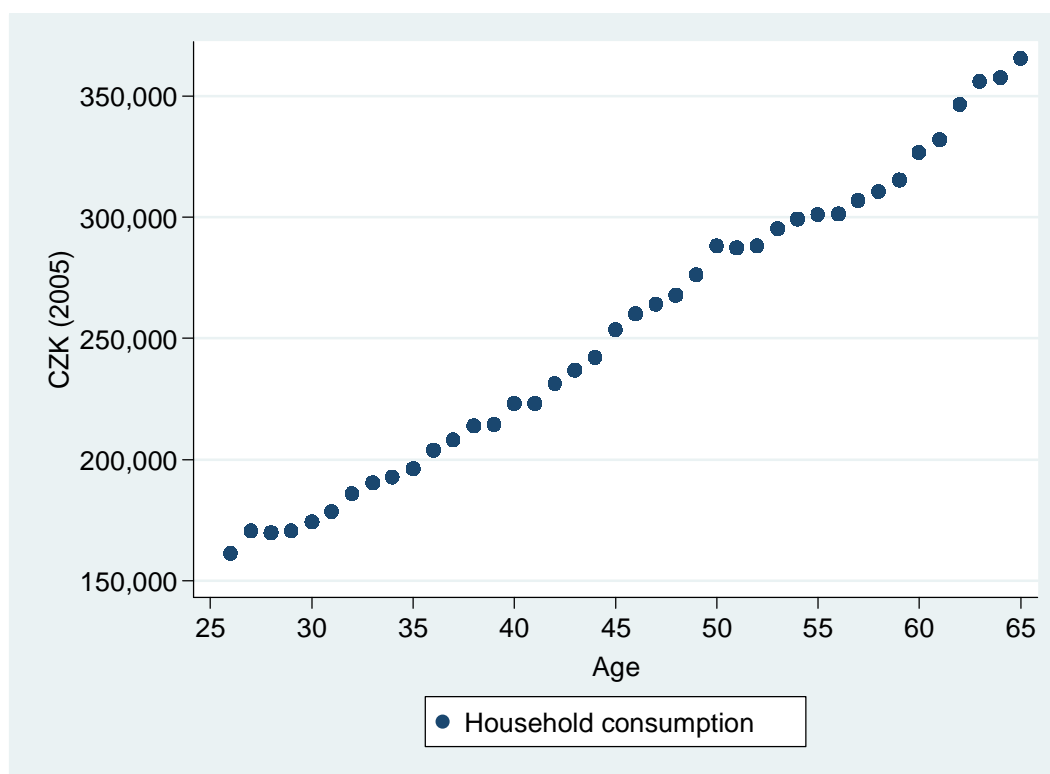
The development of the household (labor) income over the life cycle is less stable, compared to consumption. It seems that the income profile could not be represented by a profile linearly increasing over the whole life-cycle; it may be possible for a life-cycle period under age 45 of the household. Later in life, the household income increases much faster (a difference of CZK 235 000 between households aged 65 and 45, compared to the difference of CZK 108 000 between households aged 45 and 26), and the development does not seem to be linear. For several years preceding the age 65, the income profile is concave - growth of the labor income slows down.

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[70] It seems that the consumption profile is then increasing also linearly, but with a different time-trend than before 50. Or, the profile could be increasing exponentially for a while, developing into a concave shape later, which would to some extent correspond with the development of the income profile.

As to the relative position of the consumption and income profiles, the consumption tracks labor income for the first twenty years of life - until approximately the age 45. The result that consumption tracks income early in life is similar to the one obtained by Gourinchas & Parker (2002) using American data; see the fitted consumption profile and the income profile in Panel A of Figure 3.4[71]. However, the Czech consumption profile follows the income profile for much longer - for the American case, the tracking (using the fitted consumption profile) occurs only up to the age 35 of the households.

A break-point seems to occur around the age 45 of the households, where the average income profile starts to rise significantly above the consumption profile; the differential widens as we move to higher household age. For some period, development of the consumption profile itself looks to stay unchanged even after the age 45; the shape of the profile seems to change only after age 50 of the households (see discussion above).

What is remarkable, the timing of this breaking point in Czech data (age 45 of the households) corresponds almost exactly to the peak of the American consumption profile. According to Gourinchas & Parker (2002), this peek in consumption approximately signals a turning point in household behavior – the households, being buffer-stocks agents before, start to behave more like CEQ-LCH model predicts and begin to accumulate wealth for retirement[72].

Therefore, even if the shape of the Czech and American life-cycle profiles is different at first sight, the message can be similar. Also the Czech households start to accumulate wealth for retirement at approximately the age of 45, only in this case the wealth is accumulated thanks to income increasing faster than consumption (not due to a drop in consumption, which is what occurs in the American case). See Section 6.1 for detailed interpretation of results in the context of the Gourinchas & Parker (2002) model and in the context of the CEQ-LCH model.

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[71] We look at the fitted American consumption profile rather than at the empirical one; the latter lies above the income profile early in life (however, only due to data misreporting, according to Gourinchas & Parker (2002) - see discussion in Section 3.3). Fortunately, it seems that the income misreporting early in life is not a problem for Czech data, at least when looking at the average profiles.
[72] See Section 3.4 for the discussion of these two main lice-cycle phases, as they were identified by Gourinchas & Parker (2002).

Life-cycle profiles for different educational/occupational groups

Apart from constructing average life-cycle profiles together for the whole baseline sample, the life-cycle profiles are also constructed separately for different educational/occupational groups[73]. By doing so, we allow different subgroups of our sample to have distinct preferences (e.g. discount rate, risk aversion), which is important if these are really not unique across the whole population.

Life-cycle consumption and income profiles for households with different education level are depicted in Figure 5.3. The profile for households with secondary education does not differ significantly from the overall results presented above, as a big majority of households in our baseline sample have this level of education[74]. The life-cycle profiles for households with primary or university-level education are noisier and should be taken as less reliable, due to lower number of observations in these categories. However, some general patterns can still be distinguished.

Figure 5.3 Household consumption and income over the life cycle, by education

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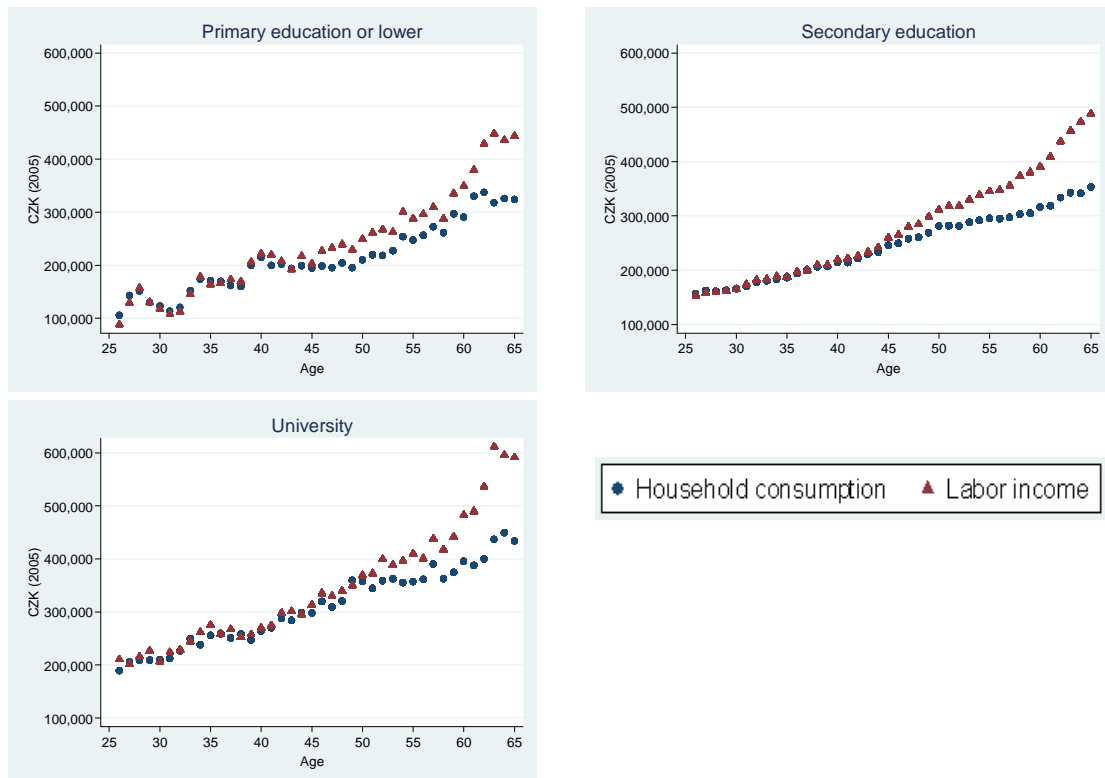
[73] As they are presented in Section 4.4.
[74] More than 20,000 observations out of 23,602. See Section 4.4 for exact number of observation in each subgroup.

In both cases, consumption still tracks income early in life; however, the shape of the profiles is further from being linear even in this life-period, compared to the households with secondary education. Moreover, the breaking-point where income starts to increase significantly above consumption occurs at different ages. For the secondary education, the age of 45 is the turning point[75], while it occurs a little earlier for households with primary education and significantly later (around age 50 of the households) for the households with university-level education.

According to what intuition predicts, the life-cycle profiles of different educational subgroups are also shifted vertically. Households with primary education have lower initial level of income/consumption compared to those with secondary education, and also their income and consumption at retirement (age 65) is lower. On the other hand, life cycle profiles of households with university-level education lie above the profiles of households with secondary education (and therefore also above those with primary education). The relative effect of age on income/consumption is therefore the most important for households with primary-level education; for them, consumption at age 65 is at 306% of the consumption at age 26. For the two other groups, this ratio is almost the same – 226% for the households with secondary education and 229% for the households with university-level education.
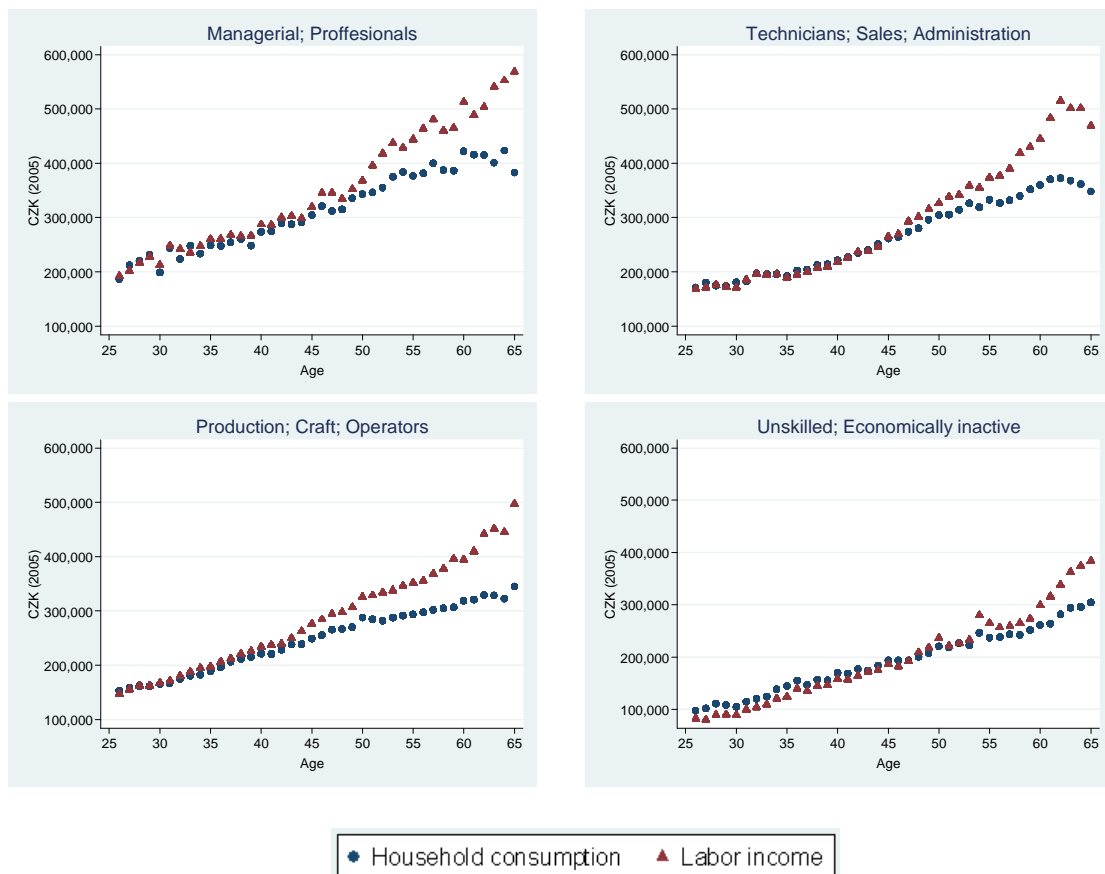
As to the life-cycle consumption and income profiles by different occupation categories, they are depicted in Figure 5.4. There are relatively less observations in the Managerial & Professionals category and in the Unskilled/economically inactive category, which is why the profiles for these subgroups are noisier.

Otherwise, the results seem to be consistent with what we found for different educational groups. The profiles are vertically shifted in the sense that the life-cycle profiles (both income and consumption) of more qualified types of occupations lie above the profiles of less-qualified occupations. Except for the Unskilled/economically inactive category, consumption tracks income early in life, with a turning point (age after which income rises above consumption) slightly differing. As to the Unskilled/economically inactive category, consumption profile lies above the income profile until about the age 45 of the household; the more standard pattern of income being above consumption is reached only after that. This result is possible, as our income measure describes only the labor

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[75] See the discussion for the overall profiles above.

income and the social income[76], other sources of income (gifts from relatives, loans etc.) are not included. Plus, it is a question whether households in Unskilled/economically inactive category report all their "unofficial income" (coming from shadow economy) to the HBS. This source of income is probably more important for this category, relatively to the other types of occupations. Therefore, the reported income may underestimate the true household income for this category.

Figure 5.4 Household consumption and income over the life cycle, by occupation

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[76] See the definitions of different income measures in Section 4.3.

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Life-cycle profiles – different steps of adjustment

Section 6.1 presents the Czech consumption and income profiles in the context of the model of life-cycle consumption under income uncertainty developed by Gourinchas & Parker (2002). For their interpretation, it is important to understand well what kind of profiles we are presenting.

As it has been emphasized in Section 5.1 already, the life-cycle consumption and income profiles - both American ones presented in Section 3.3 and Czech ones presented in this section - are already adjusted for the changing household size over the life cycle, for the effect of cohort, for effect of the year of the survey, and for whether the household is retired or not. This is because the adjusted profiles should reflect only the preference and uncertainty parameters that are of main interest.

In line with the intuition, the original household life-cycle profiles (without any adjustments) are hump-shaped for both the Czech and the American data. Therefore, the difference between the Czech and American data should be understood in a way that the American profiles stay hump-shaped even after adjusting for all of the effects mentioned above. Contrary to that, the Czech life-cycle profiles become steadily increasing over the whole life-cycle.

To illustrate how the profiles should be understood, Figure 5.5 is provided. It depicts the life-cycle consumption and income profiles for different steps of adjustment (using the baseline sample)[77]. Panel A shows the original life-cycle profiles (without any adjustment) that are constructed from the HBS survey. Panel B shows the original profiles after controlling for whether each household is retired or not (profiles as if none of the households was retired). This adjustment already wipes out some of the original hump-shape. Panel C adjusts the profiles further, by controlling for the year of the HBS[78]. However, the profiles in Panel B and Panel C are virtually the same, suggesting that year of the HBS does not have significant effect on the average profiles. Going from Panel C to Panel D, the profiles are adjusted for cohort effect[79]. Doing so, some additional variation is removed from the profiles. However, the profiles in Panel D are still not adjusted for

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[77] Formally, each step means including the relevant variable in the equation (4.5) and then constructing the life-cycle profiles analogously to what was presented in Section 5.1.

[78] As explained in Section 5.1, regional annual unemployment rates are used as the proxy for the year of the HBS in the profiles construction. The profiles in Panel C show the households as if there were facing the average unemployment (8.51%). By doing so, the effect of the HBS year is eliminated.

[79] For the fact that households were born in different years, assuming that birth cohort affects initial wealth. See the discussion about the cohort effect in Section 3.3.

varying family size over the life-cycle. Only when we control for the changing household size, by depicting the profiles as if all the households had family-size equal to three, the adjusted life cycle profiles are obtained; they are depicted in Panel E.

Figure 5.5 Household consumption and income life-cycle profiles: Different adjustment steps
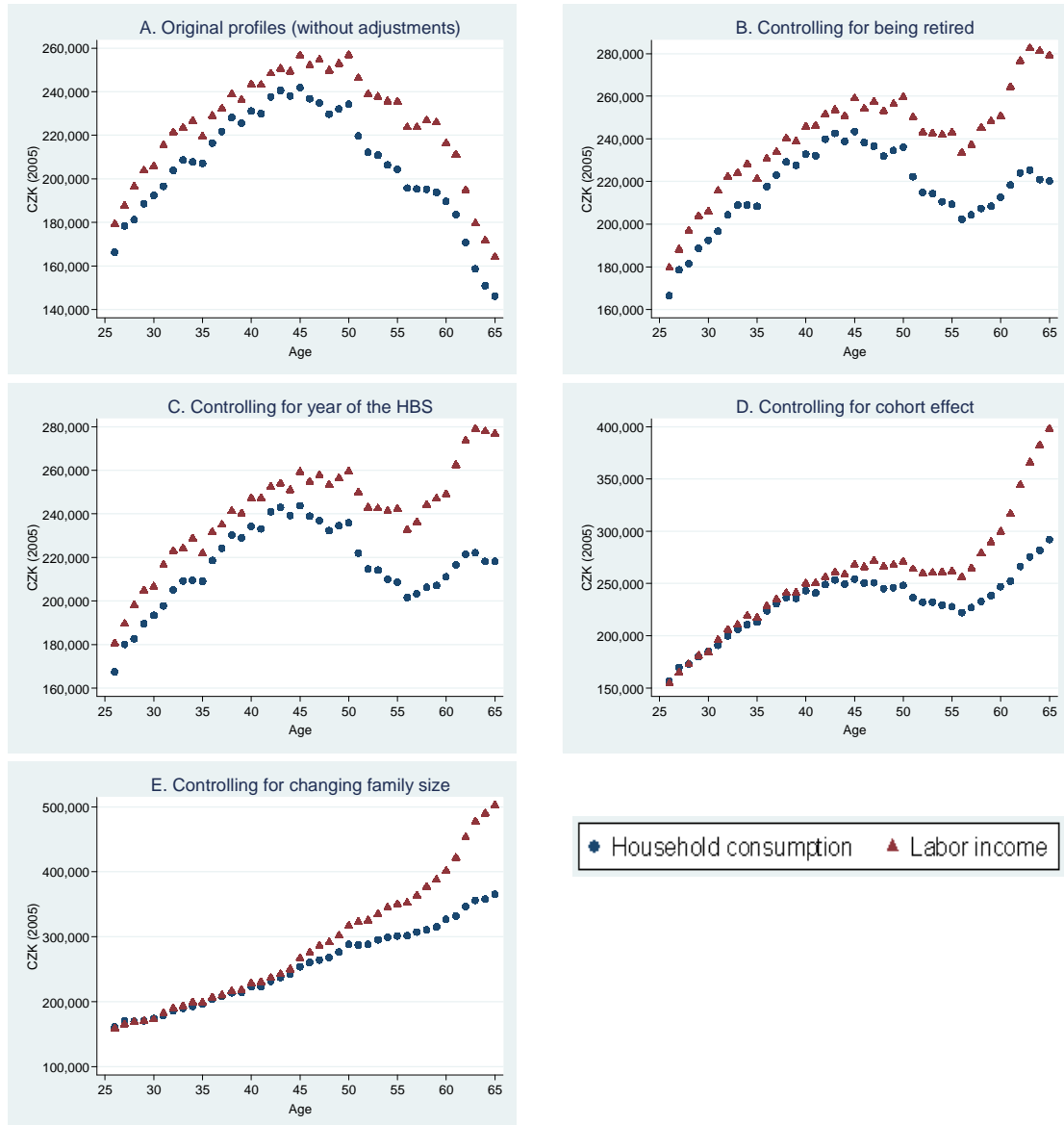
Note: See the explanation of different adjustments steps provided in the text.

The adjusted profiles in Panel E are the household consumption and life-cycle profiles we have presented in this chapter. All the figures in this chapter refer to the adjusted life-cycle profiles – the ones that are obtained from the original profiles by controlling for all the effects mentioned above[80]. These adjusted profiles can be used to analyze household life-cycle consumption behavior in terms of discount rate, risk aversion and effect of income uncertainty.

5.3 Robustness checks

In this section, the robustness of our results is evaluated – we study whether the life-cycle profiles change if some of the conditions we have applied are modified.

At first the life-cycle profiles are constructed with the income measure changed (using the broad income measure instead of the labor income[81]), the profiles are depicted in Figure 5.6. As the broad income measure captures the labor income plus some other sources of money income, the result that the broad-income profile lays slightly above the labor income profile is not surprising. Otherwise, the shapes of the two profiles do not differ significantly.

Secondly, the estimation samples are altered to analyze whether the constructed life-cycle profiles are not dependent on the conditions we have specified for our baseline sample. Figure 5.7 shows the life-cycle profiles for the whole life, not just for the working-life (Sample A1 is used)[82]. It can be seen that the profiles for households out of the working life are consistent with what has been found for household aged 26-35. Average adjusted income for age 19 and 90 seems to be out of the general trend, but the results should not be taken too seriously, due to the low number of observations for this particular age.

Two additional figures show how the profiles change when the condition on income - omitting households with extreme values - is modified. Figure 5.8 presents the profiles when the income condition is completely relaxed (Sample A2 is used), while Figure 5.9 depicts the case when it becomes stricter[83] (Sample A3 is used). Relaxing the income condition changes the life-cycle profiles only to a minimum extent. Dropping more

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[80] Therefore, they depict average life-cycle consumption and income for households as if they were not retired, as if they were born in the middle cohort, as if they would face average unemployment, and as if they had household size equal to three.
[81] The different income measures are presented in Section 4.3.
[82] The alternative samples A1-A3 are described in Section 4.2.
[83] All the households that have labor income or broad income in the top or bottom 5% (instead of 1% used for the baseline sample) are excluded.

important portion of observation does not change the relative position of the income and consumption profile. The obtained life-cycle profiles are only more flat than the ones of the baseline sample – consumption and income profiles lay above the baseline profiles early in life and move slightly below them later in life.

Last but not least, we study whether the life-cycle profiles that we have obtained are time-invariant. This is done by reconstructing the profiles using two subsets from our baseline sample. Average life-cycle profiles constructed using only observations from years 2000-2003 of the HBS are depicted in Figure 5.10. On the other hand, Figure 5.11 shows the profiles constructed using only observations for years 2005-2008 of the survey. It can be seen that the general pattern identified on the overall sample holds for both time-subsamples - the profiles are always increasing, consumption more-or-less tracks income early in life, and the income profile raises above the consumption profile around the age 45 of the households. Small difference to be mentioned is that consumption and income profile starts at lower levels for 2005-2008 observations. Also, consumption profile seems to be closer to the income profile for age 45-55 of the households if the observations from 2005-2008 HBS are used, compared to observations from years 2000-2004. Furthermore, income profile is above the consumption profile for the households around age 30, when we look at the second sample. This could be potentially connected to the fast growth of mortgages in the Czech Republic. The mortgages are often taken by households of this age and as the expenses on housing and the repayments of the mortgages are not considered as consumption expenditures, they are not visible in the consumption profile; however, they still have to be financed from the reported income[84].

Overall, it seems that the constructed Czech life-cycle income and consumption profiles are robust to changing income measures and to varying estimation samples.

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[84] It is true that mean of the loans on housing taken by households aged 30-40 increases significantly between years 2000-2003 and 2005-2008. So did the standard error, but this would not be seen in the average data.

**Figure 5.6 Household consumption and income over the life cycle:
2 different income measures, baseline sample**
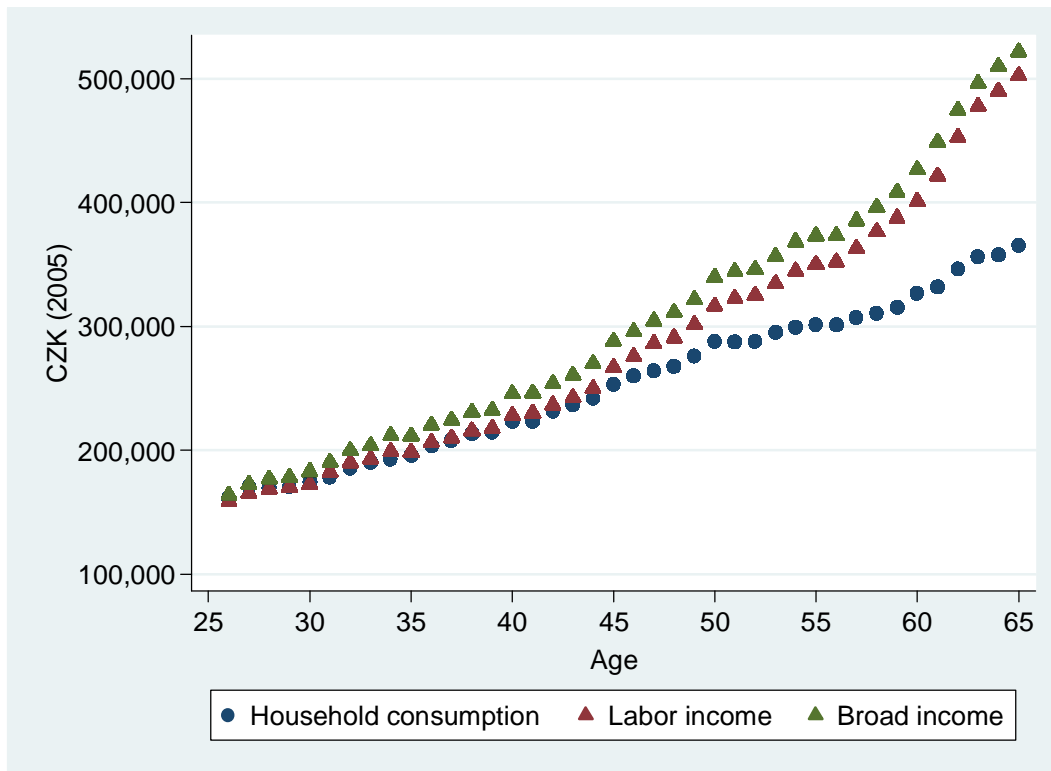
**Figure 5.7 Household consumption and income over the life cycle:
Extending to the whole life-cycle, Sample A1**
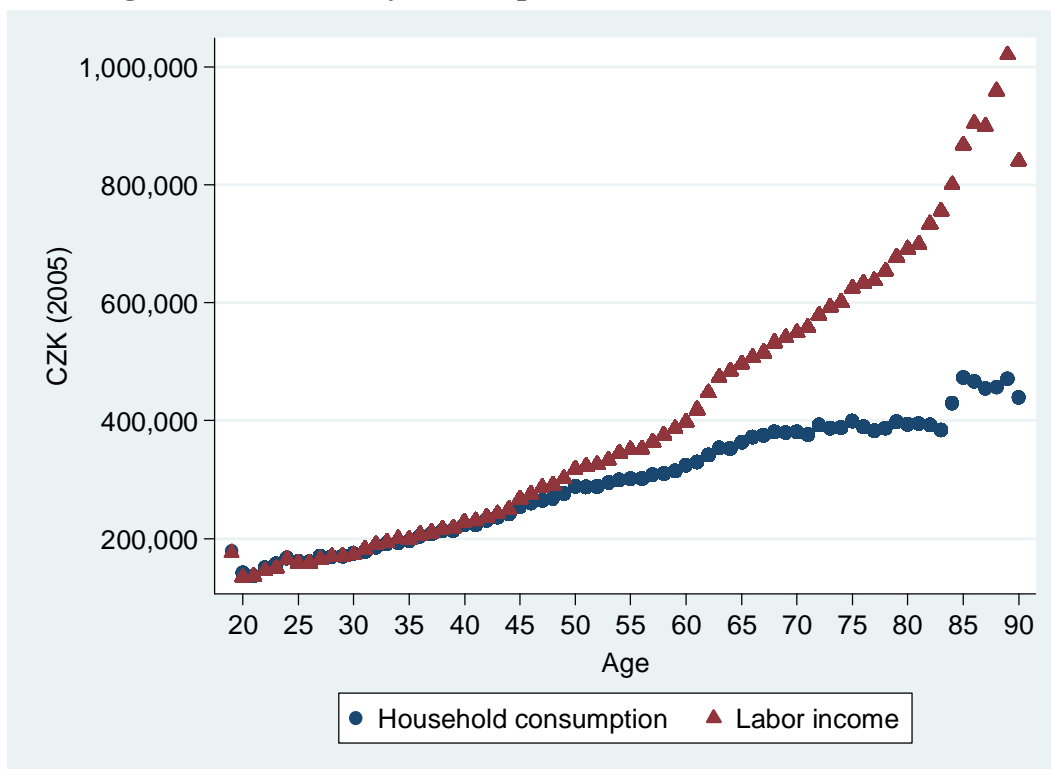
**Figure 5.8 Household consumption and income over the life cycle
No income condition (not omitting any extreme income values), Sample A2**

**Figure 5.9 Household consumption and income over the life cycle
Stricter income condition (income not in the upper and lower 5%), Sample A3**

**Figure 5.10 Household consumption and income over the life cycle
Using only years of HBS 2000-2003, baseline sample (10,801 observations)**
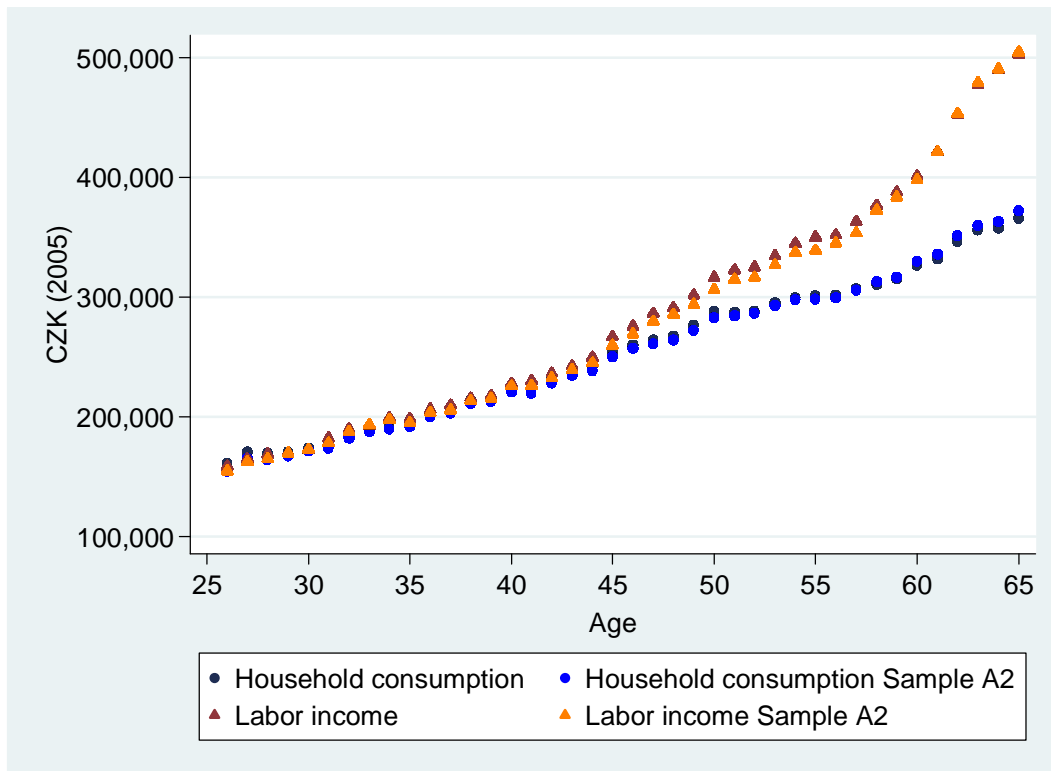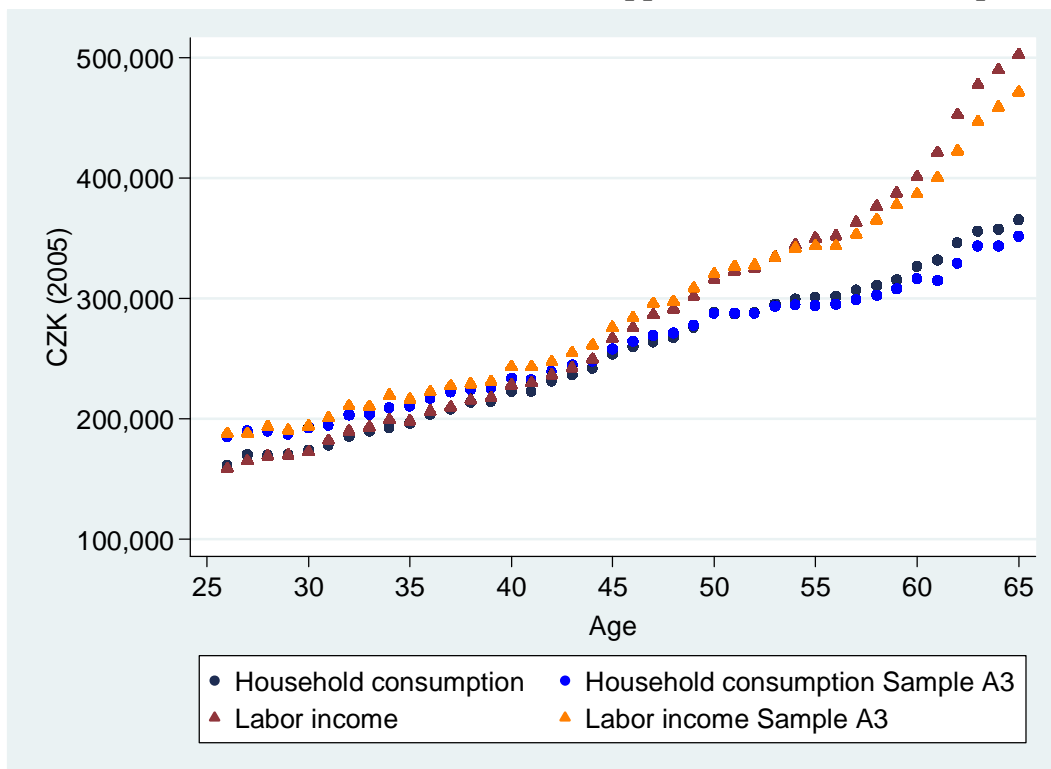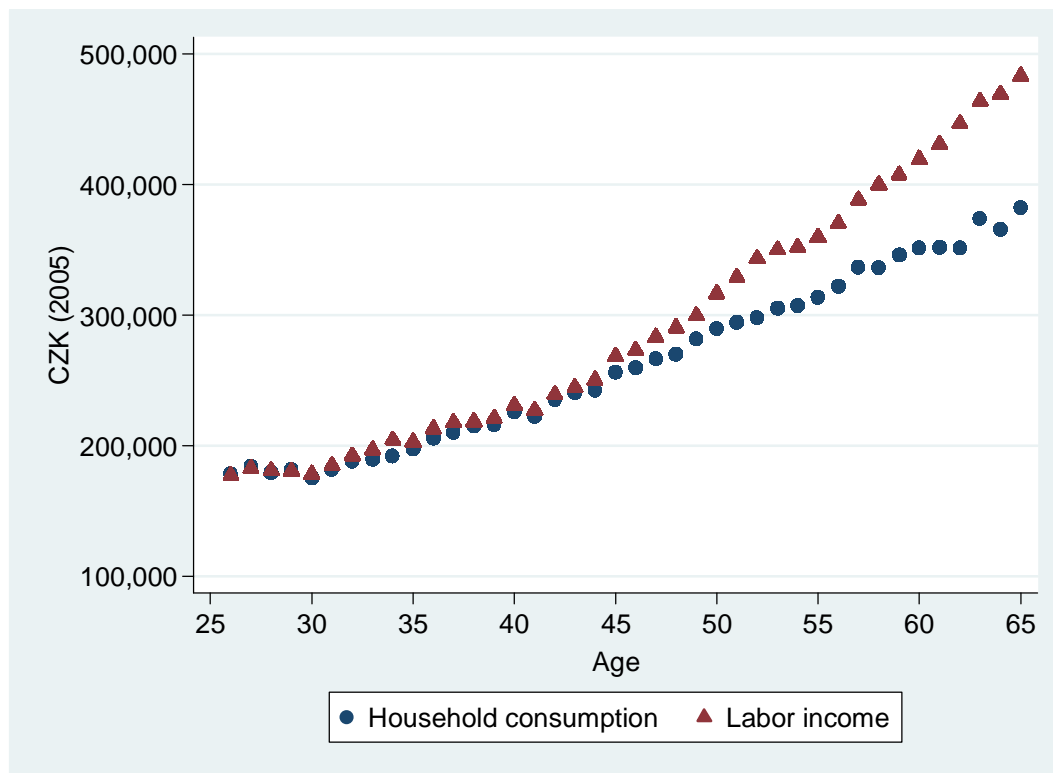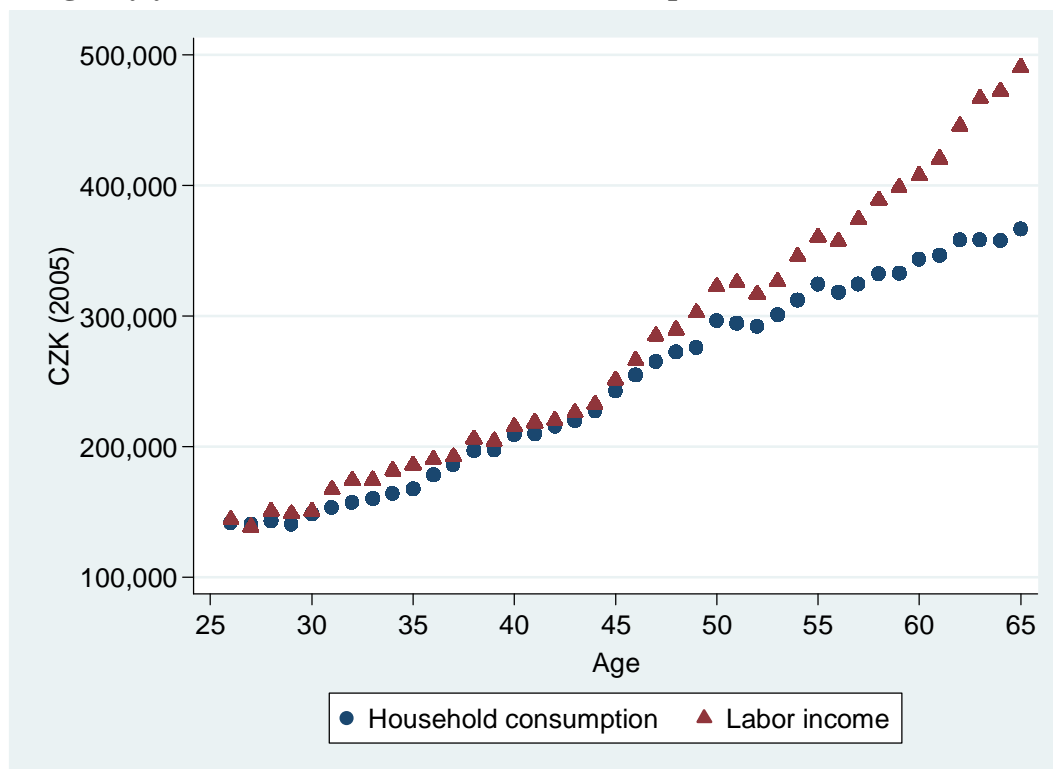

**Figure 5.11 Household consumption and income over the life cycle
Using only years of HBS 2005-2008, baseline sample (10,801 observations)**

6. Czech Evidence on Life-cycle Consumption in the Context of Different Consumption Models

In this chapter, the Czech consumption and income life-cycle profiles are interpreted within the framework of the Gourinchas & Parker (2002) model of life-cycle consumption under income uncertainty and within the framework of the CEQ-LCH model. Moreover, the empirical determinants of household consumption are identified from the data – variables suggested by different consumption theories are used as potential explanatory variables. The chapter concludes with suggesting some more topics for research concerning life-cycle consumption using the Czech individual-level data from the HBS.

6.1 CEQ-LCH Model vs. the Model of Life-cycle Consumption under Income Uncertainty

This section analyzes the Czech life-cycle profiles in the context of the Gourinchas & Parker (2002) model of consumption under income uncertainty and in the context of the CEQ-LCH model. The aim is to use the models to reinterpret the life-cycle consumption and savings behavior of the households.

6.1.1 Compatibility with the Certainty-equivalent Life-cycle Hypothesis Model

Compatibility with the standard CEQ-LCH model is analyzed at first. This model describes a situation with no uncertainty about household's future labor income. The predictions of the model are that in the situation of no uncertainty and after controlling for individual household characteristics, the growth of consumption has to be constant over the whole working-life. To put it otherwise, consumption profile should be independent on the income profile. See also Section 3.4 for discussion of the CEQ-LCH model predictions.

At first sight, Czech life-cycle consumption profile seems to be more consistent with the CEQ-LCH model than the American profile. CEQ-LCH predicts the adjusted consumption profile[85] to be flat and the Czech average consumption profile looks like approximately flat at the first sight (contrary to the US profile). However, if we look at the Czech average life-cycle consumption profile in more detail and study the first differences

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[85] Controlling for varying household characteristics over the life-cycle

in average consumption - that are supposed to be constant under the CEQ-LCH model (see equation 3.15) - we can reject the hypothesis of consumption growing constantly.

Furthermore, if we look at the relative positions of the Czech consumption and income profile, it reveals that households do not borrow against their future income early in life, contrary to what the CEQ-LCH would predict (in the situation of no labor-income uncertainty). Plus, Section 6.2 reveals that income does significantly affect consumption. The observed pattern that household consumption tracks income early in life and the fact that income determines consumption can be explained in only one way within the context of the CEQ-LCH model - there are as strict credit constraints that the households simply cannot borrow against future income.

To summarize, even if the Czech life-cycle consumption profile seems to be relatively consistent with the CEQ-LCH model at first sight, the obtained Czech profiles can be interpreted in the context of the model only if we believe that strict credit constraints prevent households form borrowing early in life.

6.1.2 Compatibility with the Model of Life-cycle Consumption under Income Uncertainty by Gourinchas & Parker (2002)

We have shown in Section 3.4 that the model of Gourinchas and Parker can produce both the life-cycle consumption profiles that are hump-shaped and life-cycle profiles that are flat. The parameters that determine the shape of the adjusted profiles are mainly uncertainty of future labor income, risk-aversion and discount rate[86]. The last mentioned parameter is probably the most important in the sense that a small change in the discount factor β can change the shape of the consumption profile significantly, all other parameters kept unchanged – see also the discussion related to Figure 3.4.

Estimation of the Gourinchas & Parker (2002) model – impossible for Czech data

The optimal way to evaluate the model of Gourinchas & Parker (2002) on how well it can explain the Czech evidence would be to estimate the model's parameters, reconstruct a fitted consumption profile and then compare the fitted profile with the Czech empirical consumption profile (obtained from the HBS data). Unfortunately, the two-step Method of

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[86] This stems from equation (4.4).

Simulated Moments that Gourinchas & Parker (2002) used to estimate the model parameters on American data cannot be followed[87].

The problem can be stated as that there is not enough information to estimate the first-stage parameters. Estimation of the gross after tax interest rate, R, is the smallest problem, as it can be estimated for example from the average real return on Czech 5-year government bonds over the period of 2000-2008 (which is equal to 4.07%[88]). However, there is no information in the HBS on the liquid wealth of the households, so the mean $\overline{\omega}_{26}$ and standard deviation $\sigma_{\omega_{26}}$ of the initial distribution of liquid assets at age 26 cannot be calculated. Moreover, the parameters that define the labor income uncertainty (the variance of the shock to the permanent income component, σ_n^2; the probability that the transitory shocks U_t would take value 0, p, and the variance of the transitory shock, σ_u^2) cannot be estimated. In the HBS, the vast majority of households are observed for less than four years, which is too short to make more general statements about long-term income dynamics and the income uncertainty. Unfortunately, there is no survey focused on income dynamics in the Czech Republic, so the solution of Gourinchas & Parker (2002) - who estimated the parameters using the American Panel Study on Income Dynamics instead of using the CEX Survey - cannot be followed to overcome this problem.

Therefore, the parameters of main interest - discount factor β (from which the discount rate would be calculated) and the coefficient of risk aversion ρ – cannot be estimated for the Czech data.

Reasons behind different shapes of Czech and US life-cycle consumption profiles

However, we can still try to interpret the Czech evidence on life-cycle consumption by comparing the Czech life-cycle profiles (presented in Chapter 5) to the American profiles (presented in Chapter 3). We will go through three main explanations that the model of Gourinchas & Parker (2002) offers concerning why the Czech consumption profile can have shape different from the US profile. After that, we will identify whether the changing household behavior identified on American data can be used to explain the shape of the Czech life-cycle consumption profile.

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[87] The method was explained in Section 3.4.
[88] Using data from the public database ARAD (which is a part of the Czech National Bank's information service). See www.cnb.cz/cs/statistika/ARAD1.

We have already presented the parameters that affect the shape of the adjusted profiles according to the Gourinchas & Parker (2002) model – these are especially discount rate, risk-aversion rate and uncertainty of future incomes.

First result to be highlighted from the comparative analysis of the Czech and American consumption profiles is that the average life-cycle income profiles[89] are significantly different for Czech and American households. Again, the difference between the Czech and American data should be understood in a way that the American profiles stay hump-shaped even after the adjustment, while the original hump-shape in the Czech data disappears when controlling for all the above mentioned effects. The fact that the adjusted Czech life-cycle income profile increases over the whole working-life period is for sure at least partially behind the result that the Czech consumption profile is not hump-shaped either. The model of Gourinchas & Parker (2002) can potentially produce concave average consumption profiles, but only given that the income profiles are hump-shaped as well (Gourinchas & Parker (2002): 49). What exactly is causing this difference between adjusted Czech and American life-cycle income profiles is not clear from the analysis. However, the labor markets in the two countries differ significantly in many aspects[90], mainly in the overall flexibility of the market. Other aspects to mention are for example legal retirement age, dispersion of wages, or some institutional aspects such as wages depending on seniority in the Czech public sector.

Apart from the shape of the income profiles, there are two other major interpretations in the framework of the Gourinchas & Parker (2002) model why the Czech consumption profiles can be more-or-less flat. The first of them is that relatively low uncertainty of future incomes can lead to consumption profiles that are more compatible with the CEQ-LCH (predicting constant growth of consumption). It seems likely that the uncertainty about future incomes is lower for households employed at the Czech rigid labor market, compared to the situation in the US. On the other hand, the relative position of the Czech income and consumption profiles can be explained only by assuming at least some income uncertainty (or alternatively strict credit constraints), see the discussion in Section 6.1.3. Therefore, we can conclude that the possibility of lower labor- market uncertainty cannot explain fully the shape of the Czech consumption profile.

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[89] Adjusted for changing family-size over the life, for retirement status of the household and for the effect of cohort (different initial wealth).

[90] This holds even after the employment and unemployment rates became closer recently.

Apart from the above mentioned explanations, we have shown in Section 3.4 that under relatively low discount rate, the model of Gourinchas & Parker (2002) can predict flat consumption profiles even in the situation of future-incomes uncertainty. Due to - among others - 40 years under the totalitarian regime, Czech households very probably have different discount rates compared to the US households, even after 10-20 years of fast economic transition. We cannot really test the hypothesis using the available data, but it seems possible that the Czech households are more patient compared to American ones.

Which of the above-mentioned factors is behind the increasing-shape of the Czech consumption profile cannot be said; it could as well be a combination of all three.

6.1.3 Household Consumption Behavior over the Life-cycle

Interpretation of the household life-cycle behavior however depends rather on the relative position of the consumption and income profiles, not only on the shape of the consumption profile. As it was already mentioned in Section 5.2, the comparison of Czech and American life-cycle consumption and income profiles reveals an interesting fact - in both cases, there seems to be a turning-point in household behavior around age 40-45 of the households. The relative positions of the consumption and income profiles suggest that households in both countries start to accumulate wealth for retirement at this age.

Gourinchas & Parker (2002) interpret this change in behavior of US households in the sense that the households, who are buffer-stocks agents early in their life (meaning that they safe more for precautionary motives than for retirement), start to behave more like the CEQ-LCH model predicts - saving for retirement later in life. A question is whether this interpretation can be used for the Czech evidence too. Despite the fact that the absolute shapes of Czech and US profiles differ, the answer is yes; see the following arguments.

If there was no labor-income uncertainty, the Czech households would behave according to the CEQ-LCH and borrow against their future income early in life (according to the CEQ-LCH). The fact that household consumption instead tracks household income until age 45 of the household can be explained in two ways.

One is within the framework of the CEQ-LCH model as discussed earlier, suggesting that there are strict credit constraints and households cannot borrow because of these constraints.

The second explanation involves labor income uncertainty, as introduced in the model of Gourinchas & Parker (2002). If future incomes are uncertain, households may want to save for precautionary reasons, especially early in life (recall Figure 3.5). Allowing for existence of future-incomes uncertainty, the model of Gourinchas & Parker (2002) offers an explanation of Czech household behavior early in the life cycle; households behave like buffer-stocks agents (save for precautionary motives), even if they would actually like to borrow against future income (to smooth consumption over the life-cycle). Altogether this can result into a consumption profile that tracks income profile early in life. After the age of approximately 45, precautionary motive for savings becomes less important, while the life-cycle motive – saving for retirement – becomes crucial. Households start to accumulate wealth for retirement and bequest motives and their behavior becomes more consistent with what is predicted by the CEQ-LCH model.

Therefore, the Czech life-cycle profiles, despite the fact that their shape is different from the US profiles, can in fact describe the same household life-cycle behavior that was identified on American data by Gourinchas & Parker (2002).

To summarize, the obtained Czech life-cycle profiles can be interpreted in the context of the CEQ-LCH model, but only if we believe that strict credit constraints prevent households from borrowing against their future income. The alternative interpretation provided by the Gourinchas & Parker (2002) model of life-cycle consumption under income uncertainty may sound more likely. This model interprets household consumption behavior by describing dominant saving motives at different ages, identifying two distinct periods in household's life cycle. Early in their life-cycle, households save mainly for precautionary motives, assuring themselves against future income uncertainty. Later in life, the household behavior becomes closer to what the CEQ-LCH predicts – the life-cycle motive for savings (saving for retirement) becomes essential. The turning point comes approximately at the age of 45. Together, we can say that the model of Gourinchas & Parker (2002) brings significant value-added for interpretation of the household life-cycle behavior observed in the data, compared to the standard CEQ-LCH model.

6.2 Determinants of Household Consumption

The goal of this section is to identify empirical determinants of household consumption, using again the Czech HBS data; different estimation samples and all the variables are presented in Chapter 4. Variables suggested by different consumption theories will be taken as potential explanatory variables.

We will start by considering the variables that should influence household consumption according to the model of Gourinchas & Parker – age (coefficient on age should reflect household's discount rate, risk aversion and uncertainty of future income), household characteristics (at first using only family size[91]), birth-cohort (affecting initial wealth of the households), HBS year (using regional unemployment as a proxy) and retirement status. We perform the estimation for our baseline sample[92], as well as for Sample A1 (extending to whole life-cycle).

As many theories - starting with the basic Keynesian consumption function – argue that household consumption is affected by current income, the measures of income (trying in turn labor and broad income) are included in subsequent regressions.

Next, other household characteristics - education dummies and occupation dummies - are included in the regression.

Household wealth is often regarded as determining household consumption. Unfortunately, there is no variable describing household wealth in the HBS, but we still try to simulate the effect of wealth – we do it by including a variable measuring number of cars the household owns. Last but not least, real interest rate is supposed to affect intertemporal decisions of households and therefore also their current consumption. We try to measure this effect by including a variable describing real return on Czech 5-year government bonds for each year. However, as this variable is the only one included in the regression that varies only by year[93], there is a risk that the coefficient will capture to some extent the effect of the HBS year, not just the effect of the changing interest rate.

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[91] As in the original model, family size is assumed to fully describe the household characteristics.

[92] As the model of Gourinchas & Parker (2002) is supposed to describe the working life only, which is assumed to be between age 26-65.

[93] Unemployment rates vary by year and by region.

Estimation results for several regression specifications are summarized in Table 6.1. The reported standard errors are robust. Household age, family size and retirement status are all found to affect consumption significantly. Household birth cohort is found to be significant only in less complex models. What is important, household income influences household consumption significantly, confirming again that the standard CEQ-LCH model (which predicts no relationship between consumption and current income) can explain the Czech evidence to only a limited extent. Estimated elasticity of consumption to income is higher when the broad income is used, compared to the labor income. The effects of family-size, age and income on household consumption are estimated to be quadratic.

Educational dummies and occupational dummies are all significant, confirming that more educated households/households with more qualified types of occupations have higher consumption. Our proxy for wealth – number of cars owned by the household – is found to affect consumption positively (as expected) and significantly. Interest-rate measure is not significant in our specification.

Overall, we can say that the estimated coefficients seem to be consistent with intuition - at least regarding the signs.

Even after including all the above mentioned variables, Ramsey test for omitted variables still suggests there could be misspecification or omitted variables.

The specification problem may be due to changing effects of each variable; it is preferable to use dummy variables for age, family size, and cohort effect – as it was done in the construction of the life-cycle profiles. We estimated regressions similar to those in Table 6.1, only using dummy variables for family size (not including the median family size equal to 2), for age (complete set of dummy variables) and for cohort (complete set of dummy variables, except for the middle cohort, being 1959 in our case).

It is found that the effect of age, family-size and birth cohort on consumption indeed varies. All the family-size dummies are significant, while the same is true for only some cohort dummies.

Nevertheless, the significance and coefficient signs of all other variables (regional unemployment, retirement status, income measures, education and occupation dummies, wealth proxy and interest rate) stay unchanged compared to regressions in Table 6.1. Therefore, determinants of household consumption can be identified even using the without-dummies-regressions presented in Table 6.1 that were interpreted above.

Table 6.1 Determinants of household consumption – estimation results

VARIABLES	Model 1 ln(Consumption)		Model 2 ln(Consumption)		Model 3 ln(Consumption)		Model 4 ln(Consumption)		Model 5 ln(Consumption)		Model 6 ln(Consumption)	
Family size	0.212***	[0.0023]	0.222***	[0.0022]	0.0689***	[0.004]	0.0570***	[0.0016]	0.0571***	[0.0016]	0.0989***	[0.0055]
Family size sq.											-0.00746***	[0.0008]
Age	0.0248***	[0.0001]	0.0244***	[0.0009]	0.00289***	[0.0009]	-0.00114**	[0.0006]	0.0154***	[0.0009]	0.0156***	[0.0011]
Age sq.									-0.000170***	[6.98e-6]	-0.000165***	[6.90e-6]
Birth cohort	0.0145***	[0.0001]	0.0167***	[0.0009]	0.00357***	[0.0008]	-0.000937*	[0.0005]	-0.000377	[0.0005]	0.000204	[0.0009]
Unemployment	-0.00980***	[0.0007]	-0.00824***	[0.0006]	-0.00368***	[0.0005]	-0.00274***	[0.0003]	-0.00241***	[0.0003]	-0.00221***	[0.0003]
Retired	-0.409***	[0.0096]	-0.502***	[0.0078]	-0.0958***	[0.0125]	-0.0455***	[0.0055]	0.0420***	[0.0067]	0.0302***	[0.0066]
ln(Broad Income)							0.762***	[0.0047]	0.735***	[0.0051]	2.012***	[0.165]
ln(Broad income) sq											-0.0538***	[0.0067]
Primary education									-0.0408***	[0.0057]	-0.0271***	[0.0056]
University									0.0416***	[0.0053]	0.0427***	[0.0052]
Managerial occup.									0.0203***	[0.0062]	0.0277***	[0.0061]
Technicians occup.									-0.0236***	[0.0035]	-0.0404***	[0.0034]
Unskilled occup.									-0.0379***	[0.0053]	-0.0341***	[0.0052]
Number of cars											0.0749***	[0.0029]
Interest rate											0.000715	[0.0015]
ln(Labor income)							0.678***	[0.0199]				
Observations	24325		28760		28752		28760		28760		28760	
Adjusted R-squared	0.348		0.441		0.757		0.801		0.808		0.816	

Note: Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1; Baseline sample is used in all models except Model 1 (Sample A1)

6.3 Topics for Further Research on Life-cycle Consumption

This section suggests some ways for future research, in some cases using again the Czech individual-level data from the Household Budget Survey.

At first, it would be interesting to monitor how the average life-cycle profiles change across time. The analysis could be repeated every few years - the overall life-cycle consumption profiles, as well as life-cycle profiles for different time subsamples (for example 2000-2008 vs. 2009-2017) could be constructed and compared. It would be interesting to see whether there is some time trend, as the Czech economy converges closer to European average in terms of the purchasing power[94] and as the demographic structure of the Czech Republic changes (referring mainly to population ageing).

Another suggestion is related to the fact that it would be optimal to have a long-running panel data rather than the repeated cross-section[95] as a source for research. Using the cross-section data, we can reconstruct the average household life-cycle profiles only by averaging across households of the same age and then looking at these consecutive averages. If many households were studied over their whole life-cycle and the average life-cycle profile was reconstructed from these individual life-cycle profiles, we could be more confident that the average profile captures the real life-cycle dynamics of individual households. Unfortunately, the long-term panel data are unavailable. However, the matching method could potentially be used to deal with this problem. The idea is that some types of households could be defined (depending on a combination of education, occupation, and family-size development, for example) and households from the HBS that have the same type but different age would be matched. By doing so, a situation closer to observing one household during the whole life-cycle would be obtained. However, it would not be easy to match the households in a way that the characteristics changing over the life cycle would develop consistently (for example family size) and that the "matched household" would satisfy the life-cycle budget constraint.

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[94] According to Eurostat, Czech GDP per capita in Purchasing Power Standards moved from 68.5% in 2000 to 80.4% in 2008, where EU27=100%. This trend is expected to continue.

[95] Or short, unbalanced panel as the HBS can be perceived also in this way.

Furthermore, it would be interesting to concentrate on the way households borrow and save during their life. Potential credit-constraints can have important impact on household consumption – the households may not be able to smooth their consumption over the life-cycle even if they wanted to do so. American CEX Survey has been used for this kind of research; some literature is presented in Chapter 2. However, the data from the HBS are not optimal for research on household credit. Only information about loans taken and loans repaid in the year of the HBS is provided; information about household total debts in unavailable. What can be studied using the data available is what parameters influence whether the households take loans in the year of the HBS[96].

The CEQ-LCH model, as well as the model of life-cycle consumption under income uncertainly by Gourinchas & Parker assumes that the two crucial parameters - the discount rate and the risk aversion rate – stay constant over the whole life-cycle. However, behavioral/experimental economics suggests that this may not be true. It would be interesting to at first compare the estimated parameters that Gourinchas & Parker (2002) have obtained with results of field experiments concerning individual discount rates and their determinants. Furthermore, some experiments could be repeated in the Czech environment and the results could be compared to discount/risk aversion rates obtained in other countries. If some major changes in discount/risk aversion rates during the life-cycle are identified, they can help to explain the turning-point in household life-cycle consumption behavior we have identified.

The last research topic to be mentioned is also connected to behavioral economics. Under this approach, consumers are no more regarded as rational agents following some optimal consumption rule. Instead, some part of households is for example taken as simply consuming a fixed proportion of their income. Also, the issues of consumption persistency (consumption being inelastic downwards) or of interactions among consumers (for example the "keeping up with the Joneses" behavior) can be studied. These topics could be analyzed using the agent-based approach – defining consumption rules for individual households and then simulating their interactions during the life-cycle. The resulting individual consumption behavior could then be used to reconstruct aggregated life-cycle consumption profiles. Simulated profiles under different conditions could then be compared to the empirical profiles constructed form the HBS data.

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[96] The fact that the HBS data are a short-term, unbalanced panel – some observations are observed for more than one period – could be exploited at this point.

7. Conclusion

Development of household consumption over the life-cycle is a very important topic - the motives of household consumption at different age should be analyzed in detail, as they have both microeconomic and macroeconomic consequences.

However, consumption over the life cycle is also a very complex topic to analyze. Household consumption and savings incentives have to be understood, as well as decisions concerning labor supply and leisure, role of society in terms of institutions, social standards or peer effects or intergenerational solidarity affecting initial wealth and strength of bequest motives. All the above mentioned factors, and potentially many others, affect household consumption behavior over the life-cycle.

This complexity explains why cross-country comparison should be taken as an important method for research on household life-cycle behavior. The incentives of household behavior could be understood better if households in developed and less-developed countries, facing different historical as well as institutional backgrounds could be compared. The Czech individual-level data from the Household Budget Survey present a good opportunity to study life-cycle consumption for a country just after transition.

In this thesis, we have analyzed the life-cycle consumption of Czech households in the framework of the certainty-equivalent life-cycle hypothesis model and mainly in the context of life-cycle consumption model dealing with income uncertainty, which was developed by Gourinchas & Parker (2002). The results on household life-cycle behavior from the Czech economy have been compared to those obtained by Gourinchas & Parker (2002) on American data. We have shown that the comparative analysis of the Czech and American life-cycle profiles reveals indeed some interesting points concerning household life-cycle behavior and preferences.

We have found that the Czech average consumption profile is increasing over the whole life-cycle, after adjustments done for the changing household size over the life cycle, for the effect of cohort, for the effect of year of the HBS survey, and for whether the household is retired or not. The reason of those was to capture only the intertemporal substitution parameters (discount rate, risk aversion) and the labor income uncertainty, as these are the crucial parameters we are interested in.

There is no hump-shape in the consumption profile or in the income life-cycle profile, compared to what was observed by Gourinchas & Parker (2002) on American data. There are several factors that can be behind this different shape of the Czech consumption profile. At first, the shape of the Czech life-cycle income profile differs significantly from the one of the American profile, which could be due to different labor market characteristics in the two countries. Another reason could be that the Czech households may face lower future income uncertainty, compared to households at the American elastic labor market. Last but not least, Czech households may be more patient than the American households – they could have lower discount rate. This could be due to different institutional and historical backgrounds.

As to the relative position of the Czech consumption and income profiles, the consumption profile tracks labor income for the first twenty years of life - until approximately the age 45. The result that consumption tracks income early in life is similar to what was obtained by Gourinchas & Parker (2002) on American data; the difference is that in the US, the tracking occurs for a shorter period of time – only up to the age 35 of consumer.

After the age of approximately 45, there is a break-point in Czech household behavior. The Czech income profile starts to increase above the consumption profile and households start to accumulate wealth for retirement. It is remarkable that the timing of this breaking point in Czech data corresponds almost exactly to the peak of the American consumption profile. According to Gourinchas & Parker (2002), this peek in American consumption also signals a turning point in household behavior – the households start to accumulate wealth for retirement. Therefore, even if the shape of the Czech and American life-cycle profiles is different at first sight, the interpretation can be similar. Also, the Czech consumers start to accumulate wealth for retirement at approximately the age of 45, only in this case the wealth is accumulated thanks to income increasing faster than consumption (not due to a drop in consumption, which is what occurs in the American case).

The obtained Czech life-cycle profiles can be interpreted in the context of the CEQ-LCH model, but only if we believe that strict credit constraints prevent households to borrow against their future income.

The alternative interpretation is provided by the Gourinchas & Parker (2002) model of life-cycle consumption under income uncertainty. This model interprets the observed Czech life-cycle profiles in a way that consumers do not behave according to the CEQ-LCH early in life – they would like to borrow against their future income but they save for precautionary reasons instead (assuring themselves against future income uncertainty), which together leads to consumption tracking income early in life. The turning point comes at about the age of 45, when the precautionary motive for saving is overrun by the life-cycle motive for saving – households start to accumulate wealth for retirement (and for bequest motives). From this age on, the household consumption can be more-or-less viewed as consistent with what the CEQ-LCH model predicts. Overall, incorporating income uncertainty into the model of life-cycle consumption helps to explain some of the empirically observed patterns on Czech data.

The Gourinchas & Parker (2002) model of life-cycle consumption under income uncertainty brings a significant additional insight for the interpretation of the Czech household life-cycle profiles. The Czech profiles are consistent with regarding agents as saving for precautionary motives early in life and behaving consistently to the CEQ-LCH model (saving for retirement and bequest motives) later in their life-cycle. The Czech household life-cycle behavior can thus be interpreted in a similar way as the behavior of the US households, even if the average life-cycle consumption profiles for the two countries are different at first sight.

Comparative analysis of developed and emerging economies can bring an important insight to the complex question of household behavior over the life-cycle and its motives. This is why the research using the Czech individual-level data on household consumption should continue – it provides an important counterpart to research using for example American data.

Future research on household life-cycle consumption should concentrate on more complex issues such as the role of credit-constraints on household consumption or on the importance of bequest motives. It would be interesting to relax the assumption of the Gourinchas & Parker (2002) model that the two crucial parameters - the discount rate and the risk aversion rate – stay constant over the whole life cycle. Approaches of behavioral and experimental economics should be undertaken, as the household behavior over the life-

cycle could in reality be quite far from the behavior of rational, optimizing agent with constant preferences over the life-cycle – the standard theories use all these assumptions.

Proper understanding of household life-cycle consumption and its motives is essential for the analysis of impacts of population ageing on the macroeconomic level. The research on household consumption is therefore important for economic policy as well.

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Project of Diploma Thesis

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Preliminary title: Consumption over the Life Cycle - Evidence from the Czech Republic

Characteristics of the topic:

The topic of this thesis will be the consumption over the life cycle, the main inspiration being the article by Gourinchas and Parker published in Econometrica in 2002 (Gourinchas, P.O. & Parker, J. A., Consumption Over the Life Cycle (2002): Econometrica, Vol. 70, pp. 47-89). The thesis will be composed of three separate parts.

At the beginning, a survey of relevant literature and of different theories concerning consumption over the cycle will be undertaken.

In the second part, the structural model of optimal life-cycle consumption expenditures in the presence of realistic labor income uncertainty by Gourinchas and Parker will be presented at first. Their results obtained by estimating parameters of the model using the American data from the Consumer Expenditure Survey will follow. Gourinchas and Parker conclude that the data do not support fully the consumption smoothing hypothesis as they can distinct two different phases over the life cycle with a typical turn point around age 40 of the agent. Basic goal of the second part is then to obtain Czech micro dataset on household consumption (Family accounts by CSO) and construct life cycle consumption profiles, separately for different education and occupation groups. These empirical profiles using Czech data will then be compared to their theoretical counterparts given by Gourinchas´ and Parker´s model to obtain estimates of the model's parameters. Estimated parameter values for Czech consumption problem will be compared to those obtained by Gourinchas and Parker using the American data.

In the third part, different approach to consumption over the life cycle will be chosen. Gourinchas and Parker approach views the consumers as optimizing over their life cycle given specific constraints and the solution of the consumer problem consists of a set of consumption rules. The data are used to estimate parameters of the model. This section will address consumption over the life cycle in a different manner – data analysis being the starting point and taking agents´ decisions as not necessarily optimal. Key parameters influencing consumption profiles (family composition, education, occupation etc.) will be identified using the data and effects of these parameters will be enumerated where possible. Having the key parameters identified, consumption-savings decisions over the agent´s life cycle will be simulated allowing for non-optimizing features such as consumption level persistence, interactions with other agents ("keeping up with the Joneses" behavior) or behavior that is random to a certain extend. The simulations will be done in MATLAB and in multi-agent programmable modeling environment NetLogo and several settings will be tried. Consumption profiles obtained by the simulations will be compared to empirical profiles with the aim to discover whether the simulation results are consistent with the data.

Research hypotheses

Consumption profiles constructed using Czech family survey will be similar to those constructed by Gourinchas and Parker using American Consumer Expenditure survey. Czech consumer behavior will be consistent with the certainty-equivalent life-cycle hypotheses for a part of the life cycle. Estimation of the main parameters from the Gourinchas and Parker model using the Czech data will yield results similar to estimation using American data. Simulated consumption profiles when allowing for not always optimizing consumer behavior will be at least in some cases consistent with consumption profiles constructed from the data.

Basic outline:
1. Introduction
2. Literature Survey on Life Cycle Consumption
3. Model of Gourinchas and Parker
    a. Formal model description
    b. US consumption profiles for different categories, estimation of model parameters using US data
    c. Czech consumption profiles for different categories; estimation of model parameters using US data
    d. Results comparison
4. Simulating consumption decisions over the life cycle based on the data
    a. Data analysis – finding key determinants of consumption behavior
    b. Simulations of consumption decisions over the life cycle (MATLAB, NetLogo)
    c. Results discussion – consistency with empirical data?
5. Conclusion

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