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The permanent income hypothesis and the Covid-19 pandemic in Europe

Abstract: This paper investigates to what extent the permanent income hypothesis holds during the Covid-19 pandemic. Multiple economic datasets about European households and datasets about the government measures to control the spread of the virus are used to determine this effect. The estimation method consists of a fixed effects regression and a fixed effects IV-regression, where consumption growth is regressed on income growth. In all regressions, an interaction term between income growth and a pandemic dummy is included. This interaction term denotes whether the fraction of people who base their consumption expenditure on current income changed after the outbreak of the Covid-19 virus compared to the period before the pandemic. This paper finds no evidence against the permanent income hypothesis during the period before the outbreak of the pandemic. However, the hypothesis does not hold during the pandemic. In fact, consumption growth increases with 186% if income growth increases with 100% in the most extreme case, especially during periods of lockdowns. During periods of the pandemic without lockdowns, this excess sensitivity of consumption to current income was much lower or insignificant.

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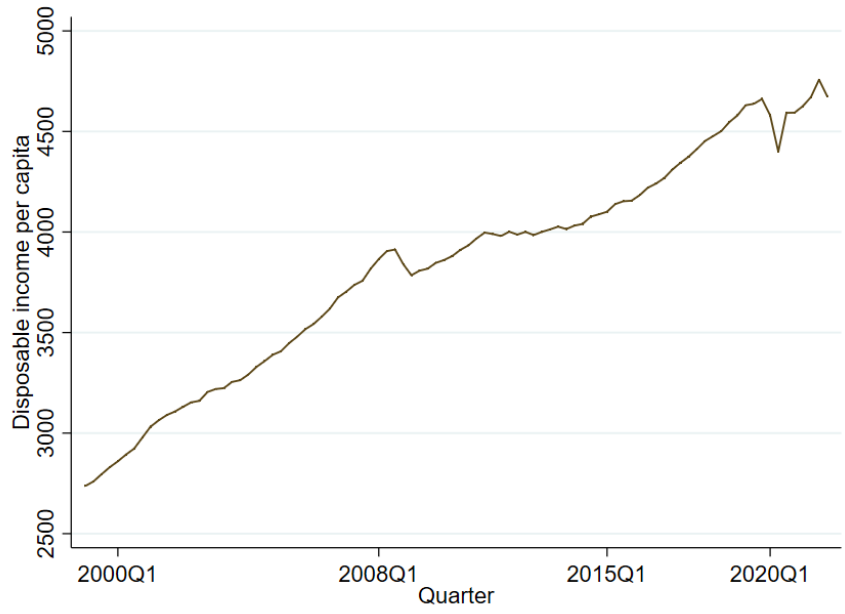
I. Introduction

"We will do whatever is necessary to support the Europeans and the European economy", president of the European Commission Ursula von der Leyen promised during a press conference in March 2020 (European Commission, 2020). This press conference was organized to announce the economic measures that the EU would take as a response to the outbreak of the Covid-19 virus in Europe. An example of these economic measures was the SURE initiative to prevent losses in income (KPMG, 2020). While the effects of these measures are not the topic of this research, it is relevant to analyse the pattern of the average disposable income per capita of several European countries between 1999 and 2022, as presented in Figure 1. There is only a decline after the first quarter of 2020, compared to the same quarter in the previous year. After this decline, the disposable income per capita is restored.

Figure 1. Disposable income per capita in Europe

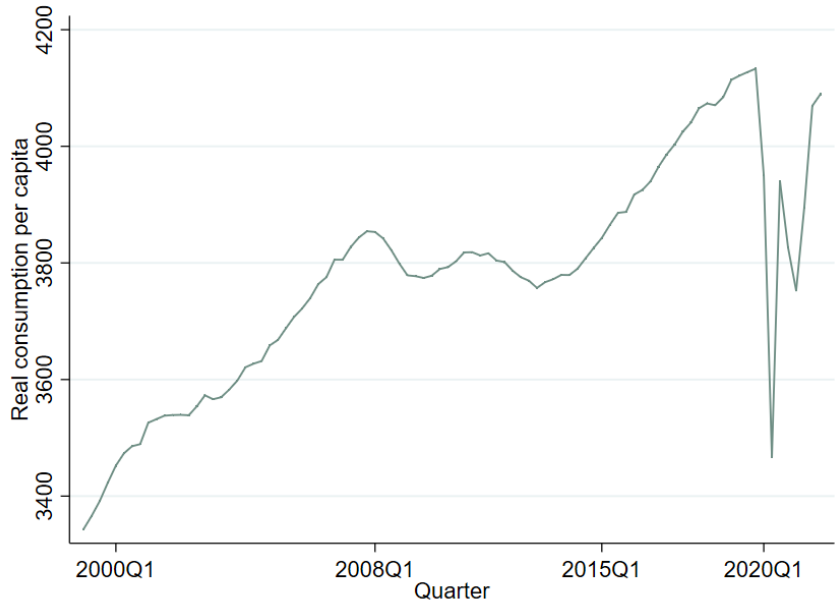


Note: This figure shows the average disposable income per capita in euros per quarter in Europe between 1999 and 2022.

If the consumption expenditure of European households is based on their current income, the level of consumption should also be restored after the first quarters of 2020. However, this was not the case. According to Figure 2, there was a large drop in real consumption per capita after the first quarter of 2020. This was the quarter in which Covid-19 first broke out in Europe. The fact that consumption did not restore completely after the first quarters of the outbreak is partly explained by the introduction

of lockdowns. These lockdowns included forced closures of stores causing this drop in consumption. However, these lockdowns were not in effect during the whole period and even in the last quarter of 2021, consumption was not restored to pre-pandemic levels. Therefore, current income and lockdowns could have not been the only determinants in the consumption behaviour of European households.

Figure 2. Real consumption per capita in Europe



Note: This figure shows the average real consumption per capita in euros per quarter in Europe between 1999 and 2022.

Milton Friedman already argued that households do not base their consumption on their current income. Friedman (1957) developed the permanent income hypothesis/model, which explains that consumption is based on the average lifetime income of households. This permanent income could also have been affected due to the pandemic-induced uncertainty. Income losses can increase uncertainty among banks about their borrowers' ability to repay their debts, which can increase liquidity constraints among European households. Due to these pandemic-induced uncertainties, the time of the Covid-19 pandemic is an interesting period to measure the permanent income hypothesis for European countries. Therefore, I want to investigate the following research question:

To what extent was the consumption of households dependent on their permanent income in Europe during the Covid-19 pandemic?

To measure whether this dependence changed for European households during the pandemic, I will base my estimation methods on the paper of Campbell and Mankiw (1990). My adjusted estimation methods contain a fixed effects regression and a fixed effects regression including IV-instruments. Furthermore, adding control variables and focusing on the periods of lockdowns instead of the full period of the pandemic will act as robustness checks. This paper shows two main results. First, the fraction of European households that consumes according to their current income, the rule-of-thumb consumers, is insignificant before the outbreak of the pandemic. Therefore this paper does not find evidence against the permanent income hypothesis during this period. Second, the fraction of consumers who base their consumption expenditure on current income changes during the pandemic, especially during lockdowns. In the most extreme scenario, a 100% increase in income growth leads to an increase of 186% in consumption growth. However, this excess sensitivity of consumption to current income is much lower in periods of the pandemic without lockdowns. Uncertainty could be an explanation of this result, but that goes beyond the scope of this paper.

This paper will extend the literature that I will discuss in the literature review in multiple ways. First, I will contribute to the work of Campbell and Mankiw (1990) by applying their technique to European countries and to another period. Second, my findings will contribute to papers that test whether the permanent income hypothesis holds or not, such as Weber (2000). Moreover, I will test whether the fraction of rule-of-thumb consumers changed due to the pandemic instead of only testing whether the permanent income hypothesis holds or not, such as in most of the existing literature. The findings of my paper are also important for policy makers. If governments want to boost the economy during a crisis, it is useful to know to what extent households' consumption is based on current income or permanent income. In the case of a large fraction of rule-of-thumb consumers, governments can lower taxes to increase disposable income and boost the economy. However, this does not work if this fraction is small. In this case, tax cuts are maybe seen as deferred tax increase. Because of this, the permanent income is not changed and therefore there is no increase in current consumption.

The paper is constructed in the following way. The literature review will be discussed in Section II and the estimation methods and the data will be discussed in Section III. Furthermore, the results will be discussed in Section IV and the robustness

checks will be discussed in Section V. Finally, the conclusion will be discussed in Section VI.

II. Literature review

This section shows the state of the art in the research fields of the permanent income model/hypothesis and economic topics related to the Covid-19 pandemic. The literature review is subdivided in three main parts. First, existing literature about the theory of the permanent income model will be discussed. This part will summarize the permanent income model of Friedman (1957) and the random walk result of Hall (1978). Second, I will discuss the main results from existing papers that tested this model empirically. In this section, I will begin with discussing Havranek and Sokolova (2020) who performed a meta-analysis of the papers that tested the permanent income hypothesis. Then, Campbell and Mankiw (1990) will be discussed, because in this paper the same technique will be used that they employed to test the permanent income hypothesis in a different setting. In addition, papers will be discussed that tested components of the permanent income model or that applied this model to different settings. Third, literature about the relation between the Covid-19 pandemic and households' consumption will be discussed.

1. Permanent income model: Theory

This paper builds on the permanent income model. The model is developed by Friedman (1957) and explains that households' consumption depends on the average lifetime income, which is called the permanent income. Therefore, according to this model, consumption should respond to shocks in permanent income instead of shocks in current income. Stated differently, households will only change their consumption if their expectations about future income are adjusted. The permanent income hypothesis is built on three equations: 1) $c_p = k(i, w, u)y_p$, 2) $y = y_p + y_t$, 3) $c = c_p + c_t$. 1) denotes permanent consumption, which is the average lifetime consumption. This is a fraction of permanent income y_p. The size of this fraction k depends on i, w and u, which are the interest rate, wealth and preferences respectively; 2) denotes income, which consists of permanent income y_p and transitory income y_t, where the latter component is the difference between measured income and permanent income; 3) denotes total consumption, which is also divided in a permanent and a transitory part. These transitory components can be negative or positive and average out so that

the means of these components are zero. In addition, Friedman assumed that the permanent components are uncorrelated with the transitory components and that transitory income is uncorrelated with transitory consumption. Taking these assumptions into account, the bundle of the three equations shows that consumption changes because of variation in permanent income (Appendix A).

Hall (1978) tested Friedman's permanent income model using data on the U.S. Hall maximized expected marginal utility of households and showed that only current consumption played a role in predicting consumption in the next period. The coefficient of current consumption differed from zero and only denoted the trend. This current consumption already captures predictable changes in future income. The change in consumption only depends on the error term. This error term is a proxy for new information, which is unpredictable and acts as a shock. Therefore if households' consumption growth depends on an unpredictable shock, it follows a random walk.

However, Flavin (1981) argued that Hall used a reduced form to test the permanent income hypothesis. This reduced form is the conditional expectation of current consumption given lagged income. Flavin built a structural model of consumption, where consumption depends on changes in permanent income and current income. This model used an autoregressive moving average representation to measure the change in permanent income due to a change in current income. The error term acts as the unpredicted shock as was the case in Hall (1978). By using this structural model, the author was able to estimate the coefficient of the excess sensitivity of consumption to current income. Flavin found that this coefficient is statistically significant and therefore consumption changes with changes in current income.

2. Permanent income model: Empirics

2.1 Havranek and Sokolova

The permanent income model has been tested in multiple studies. Havranek and Sokolova (2020) compared the results of 144 studies that studied excess sensitivity of consumption to current income in their meta-analysis. The consumers who caused this excess sensitivity spend their whole current income on consumption and are called the rule-of-thumb consumers. The authors found that three factors cause the significant fraction of these rule-of-thumb consumers in aggregate consumption: publication bias, macro data and credit constraints. Publication bias is

due to the removing of negative estimates of income growth on consumption growth. This leads to an upward bias in the income coefficient. Another factor that causes the significant fraction of rule-of-thumb consumers is macro data. The authors examined studies that used macro data and studies that used micro data. The estimates of the excess sensitivity to consumption in papers that used micro data were more precise and lower than the ones that used macro data. Consequently, controlling for publication bias and bias from macro data reduced the fraction of rule-of-thumb consumers. Furthermore, the authors investigated the role of credit constraints in the permanent income model. They did this by only including households that were wealthy enough to be able to borrow to smooth their consumption. Havranek and Sokolova found that the coefficient of the fraction of rule-of-thumb consumers became insignificant after controlling for credit constraints.

2.2 Campbell and Mankiw

Campbell and Mankiw (1990) is the most important research to consider for this paper. The authors constructed a formula to test whether Hall's random walk result holds for households in the U.S between 1953 and 1985. As Flavin (1981), the authors made a distinction between changes in consumption that were caused by changes in permanent income and current income. This is done by creating two different groups. One group of consumers consumes their current income and are called the rule-of-thumb consumers. The other group consists of consumers that consume their permanent income. The formula that was used by the authors to test whether the permanent income model holds was the following: $\Delta C_t = \mu + \lambda \Delta Y_t + (1 - \lambda)\varepsilon_t$, where λ is the share of aggregate consumption that is done by consumers that spend their current income. These are the rule-of-thumb consumers. $(1 - \lambda)$ is the share of consumption that is done by consumers that spend their permanent income. As mentioned in Hall (1978), the error term denotes new information and acts as unpredictable shocks. Therefore, the consumption growth of this group follows a random walk. To test the equation, Campbell and Mankiw (1990) used lagged economic variables, such as lagged consumption growth, as instrumental variables. The authors found that 50% of aggregated consumption was based on current income. Therefore, the authors concluded that there was a significant departure from the permanent income hypothesis due to this large fraction of rule-of-thumb consumers.

2.3 Literature building on Campbell and Mankiw

Many authors used the work of Campbell and Mankiw (1990) to test the permanent income hypothesis in a different context. Weber (2000) investigated the fraction of rule-of-thumb consumers in aggregate consumption by separating the interest rate into an intertemporal substitution and a risk aversion component. Moreover, Weber used generalized method of moments (GMM) instead of the log linear equation approach by Campbell and Mankiw. Using GMM, Weber found that the coefficient of the fraction of rule-of-thumb consumers was insignificant. Consequently, Weber did not find excess sensitivity to current income in his analysis. Therefore, the author did not find any evidence to reject the permanent income hypothesis.

Madsen and McAleer (2000) focused on the omission of uncertainty in testing the permanent income model in existing literature. According to the authors, because of uncertainty not every consumer is able to meet the permanent income hypothesis. The authors argued that banks do not provide loans to every potential borrower, due to the risk that a borrower might not pay off his or her debt. Consequently, some consumers experience credit constraints. These constraints prevent this group of consumers to smooth their consumption. Furthermore, an increase in expected inflation leads to more uncertainty among consumers. This increases savings, because consumers' future purchasing power can be negatively affected. Moreover, uncertainty about the future in general is also taken into account by the authors. Madsen and McAleer controlled for these uncertainties in the regressions of Campbell and Mankiw (1990) and showed that the coefficients of expected inflation and uncertainty in general were statistically significant. The size of the coefficient of the rule-of-thumb consumers declined to only 0.16 when the authors controlled for expected inflation, uncertainty in general and credit constraints. This coefficient was still statistically significant, but the authors found it too small to use this result as evidence against the permanent income hypothesis.

2.4 More on liquidity constraints

Runkle (1991) investigated whether the permanent income hypothesis held if liquidity constraints were taken into account. First, the author investigated whether this hypothesis holds in general. Like Weber, Runkle used GMM to examine the effect of (lagged) income variables on consumption growth. The coefficients of the income variables were all statistically insignificant which implied that rule-of-thumb consumers

played no role in aggregate consumption. Therefore, the author found no evidence to reject the permanent income hypothesis. Second, the author investigated the role of liquidity constraints in the permanent income model. As Havranek and Sokolova (2020), Runkle split the sample into households that experienced credit constraints and households that did not face these constraints. Again, the coefficients of the income variables were not significant in both groups and therefore the author concluded that liquidity constraints do not play a role in the permanent income model.

Souleles (1999) also investigated the role of liquidity constraints in the permanent income model. First, the author investigated excess sensitivity of consumption to current income by analysing income tax refunds. According to the permanent income model, consumption growth can only be affected by an unpredictable shock in permanent income. However, these tax refunds are an expected increase in income and therefore these refunds should not have an effect on consumption growth. Nevertheless, the author did find a positive and significant effect of this refund on consumption growth. To test whether liquidity constraints played a role in this result, the author used the same technique as Runkle (1991). Souleles split the sample based on liquid wealth and showed that the effect of tax refunds on consumption is bigger for households that experienced liquidity constraints. Therefore, as Madsen and McAleer (2000), Souleles indicated that liquidity constraints played a role in the permanent income model. However, the latter author also found a significant effect for the group of unconstrained consumers. Therefore, Souleles found evidence against the permanent income hypothesis.

2.5 More on rule-of-thumb consumers

Galí, López-Salido and Vallés (2007) wanted to find out why an increase in government expenditures leads to more consumption according to empirical evidence. The authors found that a combination of rule-of-thumb consumers, sticky prices and tax-financed government expenditures could be an explanation for this finding. An increase in these expenditures causes more sensitivity to current income by consumers. Furthermore, this results in more employment, more working hours and a decrease in the marginal product of labour. Therefore, consumption should decrease. However, due to sticky prices, real wages increase and therefore consumption of the rule-of-thumb consumers increases. This mechanism explains the relation between government expenditures and consumption.

Baxter and Jermann (1999) explained why excess sensitivity of consumption to current income is a common finding in empirical literature. The authors argued that papers only focus on market income and market consumption. However, these papers do not include household production and consumption. An increase in market income leads to substitution towards market production and market consumption. On the other hand, this leads to a decrease in household production. Baxter and Jermann mentioned childcare as an example for substitution. When the market wage increases, it is more likely that people will pay for childcare instead of taking care of them themselves. Consequently, an increase in market income causes an increase in consumption. This is also the case for consumers that based their consumption on permanent income. Therefore, the authors argued that since the excess sensitivity of consumption to current income is due to substitution, it does not go against the permanent income model.

3. Covid-19

This part of the literature review concerns the role of the Covid-19 pandemic in the permanent income model. Due to the scarce literature on this topic, I will discuss this role in a broad context. Therefore, I will mention papers that examined the effect of the pandemic on households' consumption.

Chen, Qian and Wen (2021) investigated this effect in China from January 2020, when the lockdown in Wuhan was imposed, to April 2020. The authors used difference-in-differences with the consumption growth in the same period in 2019 as counterfactual. They found that offline consumption decreased by 32% during the first four months after the outbreak of the virus. Not surprisingly, this effect increased with the number of Covid infections. Besides the fact that the lockdowns prevented a part of aggregate consumption, the authors found that consumption changed more frequently than government measures that were installed to control the spread of the virus. They argued that the part of the consumption drop that was not explained by government restrictions, was due to uncertainty among households caused by the pandemic.

Baker et al. (2020) investigated the effect of the pandemic on households' consumption in the U.S in March 2020. The authors found that in the first half of this month, consumption increased due to stockpiling. As a reaction to upcoming mobility restrictions, American consumers increased their consumption by 40% compared to

the first weeks of 2020. However, consumption decreased again by 25 to 30% in the second half of March. Piyapromdee and Spittal (2020) examined the effect of the outbreak of the Covid-19 pandemic on income and consumption of households in the UK. They split the sample into groups based on earnings and showed that earnings of households with the lowest incomes decreased the most, relatively. They concluded this by comparing pre-crisis income with expected income due to the pandemic. This expected income is calculated by multiplying the chance on job status with the corresponding income. Furthermore, the authors found that the group with the lowest income was less able to afford consumption due to the pandemic. About 70% of the people in this group has not enough financial resources to meet pre-pandemic consumption. Consequently, this inability to consume increased uncertainty among these constrained households.

Li et al. (2020) investigated the effect of the outbreak of the Covid-19 pandemic on these household credit constraints in China. These credit constraints arise due to uncertainty among banks about the ability of potential borrowers to repay their loans. To measure the effect of the pandemic, the authors used a linear probability model where the intensity of the pandemic acted as the main independent variable. The dependent variable is a dummy that equals one if a household is liquidity constrained. A household is marked as liquidity constrained if respondents characterized their current financial situation as very tight or quite tight in a survey. The effect of the pandemic intensity variable on the liquidity constraint variable was positive and significant. Therefore, the authors concluded that the number of people with liquidity constraints increased with the intensity of the pandemic.

Uncertainty also plays a role in the saving behaviour of households. Dossche and Zlatanos (2020) investigated household saving rates in the EU during the Covid-19 pandemic. They showed that savings sharply increased after the outbreak of the pandemic and came with two explanations for this increase. As a response measure to control the spread of the virus, governments introduced lockdowns. These lockdowns caused that people could not consume due to closed stores and therefore people were forced to save. The authors called this saving behaviour forced savings. On the other hand, uncertainty about the future, such as future employment, leads to more savings due to possible lower income later. This uncertainty-induced saving behaviour are labelled as precautionary savings. The authors proxied these precautionary savings by expected aggregate unemployment and assumed that the

residual in savings is due to forced savings. The authors found that both saving motives explained the increase in savings during the pandemic, where forced savings were marked as the main driver of this increase.

III. Methodology

1. Estimation

This section describes the methodology that will be used to examine to what extent the permanent income hypothesis holds during the Covid-19 pandemic. I will apply Campbell and Mankiw's (1990) technique to European countries and to the period between 1999 and 2022. As mentioned in the literature review, the authors tested Hall's random walk result for the permanent income model under uncertainty. This random walk result implies that consumption growth depends on the error term and is therefore unpredictable. Only consumption in the previous period has predictive power for current consumption, because it already captured predictive changes in future income. This means that there should be no significant correlation between income growth and consumption growth. To test this, I consider two groups of consumers as in Campbell and Mankiw (1990). One group consists of the rule-of-thumb consumers, who consume their current income. The other group consists of the permanent income consumers, who consume their average lifetime income. Throughout this paper, income growth will be measured by the disposable income growth per capita and consumption growth will be measured by real consumption growth per capita. To measure the effect of the Covid-19 pandemic, I add a dummy variable that equals one between the first quarter of 2020 and the fourth quarter of 2021. The pandemic dummy is not the only thing that is different from the work of Campbell and Mankiw (1990). The authors only investigated one country, while I will use panel data from multiple European countries. I will only use fixed effects regressions throughout the paper, because of the panel dataset with multiple European countries that is used. Using fixed effects, the bias that is due to country-specific time-invariant characteristics will be removed.

1.1a Baseline fixed effects regression

The first regression that will be executed is the baseline fixed effects regression, which is represented by the following formula:

$$\Delta C_{i,t} = \mu_i + \lambda_1 \Delta Y_{i,t} + \beta P_t + \lambda_2 (P_t \times \Delta Y_{i,t}) + \epsilon_{i,t} \qquad (1)$$

$\Delta C_{i,t}$ and $\Delta Y_{i,t}$ are the differences between two periods in real consumption per capita and in disposable income per capita in a country i, respectively. According to Campbell and Mankiw (1990), the time series of income and consumption are not stationary. Therefore, they adjusted the variables in two different ways. In the first approach, they scaled consumption and income growth to lagged income. The growth rate of income is stationary and therefore scaling consumption change to lagged income ensures that ΔC is proportional to income growth rates. In their second approach, the authors took the logs of the two variables. In the light of symmetry, I will take the growth rates of income and consumption instead of taking logs.

Going back to the definitions of the variables in regression 1, P is a dummy variable that equals one if the Covid-19 virus was present in time t. β is the coefficient that denotes the effect of the pandemic on consumption growth for both groups of consumers. λ_1 is the share of consumption that is done by consumers who spend their current income in each quarter. To test whether the share of rule-of-thumb consumers changes due to the pandemic, the interaction term between the pandemic dummy and the change in current income is included in the model. I expect that the coefficient of this term, λ_2, will be positive and significant. The fraction of rule-of-thumb consumers should have increased after the outbreak of the pandemic, because less households were able to borrow during the pandemic. The total size of the fraction of rule-of-thumb consumers will be determined by the sum of λ_1 and λ_2. Lastly, μ_i denotes country fixed effects and $\epsilon_{i,t}$ is the error term.

1.1b Instrumental variables

Controlling for time-invariant country-specific characteristics is not enough to interpret the upcoming results of regression 1 as causal. It is likely that there are omitted variables that vary over time and affect income and consumption growth. As Campbell and Mankiw (1990) did, I will add lagged values of ΔC and ΔY as instrumental variables to regression 1. These variables should be valid due to their, theoretically, strong first and second stage. It is very likely that income growth in the previous quarters is correlated with current income growth (Flavin, 1981). Furthermore, it is also likely that lagged consumption growth affects current income growth. According to the permanent income hypothesis, households include all information about future income in their current consumption expenditure. Therefore, consumption growth in the

previous period partly explains current income growth.

To avoid serial correlation, I will lag the variables at least two quarters to act as valid instruments. To determine the number of lags, I will analyse the Bayesian Information Criterion (BIC) of the lagged variables on income growth. The lag length with the lowest BIC-value will be used. This lag length has the most explanatory power with the fewest possible lags. For a strong second stage, the instruments should not be correlated with the error term in the main regression (regression 1). As mentioned earlier, the error term represents the unpredictive shocks that influence consumption growth. It is unlikely that lagged income and lagged consumption growth are correlated with "current" unpredictable shocks on consumption growth. Therefore, the instrumental variables only influence consumption growth through the variation in the independent variables. Consequently, the coefficient of the fraction of rule-of-thumb consumers and the coefficient of the interaction term between current income growth and the pandemic dummy will be unbiased. To measure this, I will execute the Sargan-Hansen test. This test shows whether the instruments are correlated with the error term of the main regression.

1.2a Control variables

In the robustness checks section, liquidity constraints and interest rates growth will act as control variables. As mentioned in the literature review, more households faced liquidity constraints after the outbreak of the Covid-19 pandemic. An increase in the interest rate probably leads to a decrease in current consumption. With a higher interest rate it is more expensive to borrow and more attractive to save which is a form of intertemporal substitution. Testing the permanent income hypothesis with the control variables will follow the same procedure as above. First, the control variables will be added to the baseline fixed effects regression:

$$\Delta C_{i,t} = \mu_i + \lambda_1 \Delta Y_{i,t} + \beta P_t + \lambda_2 (P_t \times \Delta Y_{i,t}) + \gamma_1 I_{i,t} + \gamma_2 LC_{i,t} + \epsilon_{i,t} \quad (2)$$

In this equation, $I_{i,t}$ denotes interest rate growth in a country i in time t. γ_1 is the coefficient that denotes the effect of this variable on consumption growth. Furthermore, $LC_{i,t}$ denotes liquidity constraints and γ_2 is the coefficient that denotes the effect of this variable on consumption growth. Moreover, as Campbell and Mankiw (1990) did, I will use lagged values of interest rate growth as instruments in the IV-regressions.

1.2b Lockdown dummy

Finally, as another robustness check, I will only focus on the periods when lockdowns were in effect. Up to now, the pandemic dummy equals one for all quarters in 2020 and 2021. However, the Covid-19 pandemic did not have the same effect on consumption growth in all quarters. As mentioned in the literature review, consumption declined when the pandemic intensified. These were the periods of strict lockdowns. To proxy this intensity, I will change the pandemic dummy into the lockdown dummy which equals to one in the quarters of strict lockdowns. These lockdowns contain periods of stay-at-home orders and the closure of non-essential stores. The parameter ζ will denote the effect of lockdowns on consumption growth and the parameter ρ will denote the effect of lockdowns on the fraction of rule-of-thumb consumers. I expect that the coefficient of the interaction term between the lockdown dummy and income growth will be lower than with the pandemic dummy. Periods with strict lockdowns are the quarters with the lowest consumption expenditures due to the forced closure of stores. Consequently, consumption growth was probably less affected by income growth and therefore the fraction of rule-of-thumb consumers should be lower than the fraction with the pandemic dummy.

2. Data

To test the effect of the Covid-19 pandemic on the permanent income hypothesis in Europe, I will use data on economic indicators from Eurostat (2022). This source provides quarterly panel data for 18 European countries between the first quarter of 1999 and fourth quarter of 2022. These countries are almost all members of the EU and are listed in Table 7 (Appendix B). The definitions of the economic indicators are listed in ESA 2010 (2013). The first variable that is collected from Eurostat is households' consumption. This is the final consumption expenditure in million euros and is adjusted for seasonality. According to ESA 2010 (2013), this consumption variable is defined as "expenditures that cause immediate satisfaction of needs". Consumption in chain linked volumes is used to correct this consumption expenditure for inflation. Chain linking measures consumption by using prices from the previous year. Therefore, the price effects will be removed and consumption will be measured in real terms. Second, current income will be measured by disposable income in million euros, adjusted for seasonality. This is the income that households are able to spend after income redistribution procedures have taken place, such as tax

deductions. Third, long-term government bond yields are used as a proxy for interest rates. An increase in interest rates lowers the demand and price for bonds and therefore yields increase. Fourth, the population per country per quarter is retrieved from this source to measure the effect of income growth on consumption growth per capita.

To control for liquidity constraints, I will use business and consumer surveys from the website of the European Commission (2022). This source contains quarterly data on multiple expectation and uncertainty indicators for each EU country based on national surveys. For this paper, the answers on the following question are used as a proxy for liquidity constraints: “Are you planning to buy or build a home over the next 12 months?”. The respondents had to answer this question in the following way: ++ stands for “yes, definitely”, + stands for “possibly”, - stands for “probably not”, -- stands for “no” and N stands for “don’t know”. Thereafter, the balance of these answers is calculated which led to a number for each quarter. More information about the consumer surveys is explained in the guidelines (European Commission, 2022).

To identify when Covid measures were taken in the European countries, the dataset from the European Centre for Disease Prevention and Control (2022) will be used. This dataset reports all measures that governments have taken to control the spread of the virus during the pandemic.

IV. Results

This part shows the results from the empirical analysis and is divided into two main parts. First, the results from the baseline fixed effects regression will be discussed. Second, the results from the fixed effects regression including the instrumental variables will be analysed. Before discussing the results, a decision about the standard errors should be made. To determine what kind of standard errors should be used, the Breusch-Pagan test will be executed. The 0-hypothesis of this test states that the variance stays constant for each level of income growth. According to Table 8 (Appendix C), the 0-hypothesis is rejected on a one percent significance level with scaled consumption growth and the consumption growth rate as the dependent variables. Therefore, this paper uses robust standard errors throughout the paper.

1. Baseline fixed effects regression results

1.1 Fraction rule-of-thumb consumers

Table 1 shows the results from the baseline fixed effects regression (regression 1) using two different measures for consumption growth. As in Campbell and Mankiw (1990), the results in Column 1 are from the regression with consumption growth scaled to lagged income. Column 2 shows the results with the consumption growth rate as the dependent variable.

As mentioned before, λ_1 is the share of rule-of-thumb consumers in aggregate consumption before the Covid-19 pandemic. According to the permanent income hypothesis, the coefficient should be insignificant, which would mean that income growth does not influence consumption growth. However, this is not the case according to the results in Row 1 in Column 1 and Column 2. The coefficients of income growth are 0.065 and 0.056 respectively and are statistically significant on a one percent significance level. This implies that about 6% of consumption growth is explained by the consumption of rule-of-thumb consumers.

1.2 Pandemic dummy

According to both columns in Row 2, the coefficient of the pandemic variable on consumption growth is -0.011 and statistically significant on a one percent significance level. This implies that consumption growth was 1.1% lower in the period of the pandemic, compared to the period before the outbreak of the Covid-19 virus.

1.3 Interaction effect

According to Row 3 in Table 1, the coefficients of the interaction term are positive and statistically significant on a one percent significance level. This is in line with my expectations. As mentioned before, less households were able to borrow during the pandemic. Therefore, more people consumed their current income during the pandemic than before the outbreak of the virus. The coefficients are 0.875 and 1.119 which implies a massive increase in the fraction of rule-of-thumb consumers after the outbreak of the Covid-19 pandemic. To measure this fraction, the coefficients λ_1 and λ_2 should be combined. This would mean that the excess sensitivity of consumption to current income increased to 94% in Column 1 and 117,5% in Column 2. The F-statistic is higher in Column 1 than in Column 2. This means that the joint significance of the variables is bigger for the dependent variable in Column 1 than the

dependent variable in Column 2.

However, the results in Table 1 have no causal interpretation due to endogeneity problems. It is likely that there are omitted variables that affect income and consumption growth. Therefore, the coefficients in Table 1 are biased and do not show causal effects.

Table 1. Baseline fixed effects results

Row	**Item**	$\Delta C/Y_{t-1}$	$\Delta C/C_{t-1}$
		(1)	**(2)**
(1)	$\boldsymbol{\lambda_1}$	0.065***	0.056***
		(0.020)	(0.018)
(2)	$\boldsymbol{\beta}$	-0.011***	-0.011***
		(0.001)	(0.002)
(3)	$\boldsymbol{\lambda_2}$	0.875***	1.119***
		(0.159)	(0.204)
(4)	**F-Statistic**	34.99	23.98
(5)	**Observations**	1,545	1,545

Note: In this table the results are shown from the baseline fixed effects regression of real consumption growth per capita on income growth per capita. The independent variables are income growth per capita, the pandemic dummy and the interaction term between these two variables. The corresponding parameters are $\boldsymbol{\lambda_1}$, $\boldsymbol{\beta}$ and $\boldsymbol{\lambda_2}$, respectively. The value of these coefficients are denoted under the two columns. Scaled consumption growth is the dependent variable in Column 1 and the consumption growth rate is the dependent variable in Column 2. Row 4 presents the F-statistics and the last row denotes the number of observations. Finally, the robust standard errors are written in parentheses and the level of significance is presented in $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

2. Baseline fixed effects regression results with instruments

2.1 Lag length IV-regression and first stage

As mentioned in the methodology section, I want to remove the omitted variable bias by using instrumental variables. These variables are the lagged values of income growth and consumption growth. Table 9 (Appendix D) shows the Bayesian Information Criterion (BIC) for each lag length of the instrument. The lag length with the lowest BIC-value is reported in italics. According to Table 9, the number of lags should be two for income growth per capita, two for scaled consumption growth and two for the consumption growth rate.

Table 2 shows the results of the first stage from the baseline IV-regressions. This stage denotes the effect of the instruments on the instrumented variable. As in

Campbell and Mankiw (1990), these instruments are the lagged values of income and consumption growth. The optimal lag length of these variables are determined by the lowest reported value of the BIC in Table 9. Row 1 in Table 2 shows the results from the first stage using lagged values of income growth as instruments. Row 2 denotes the result using the lagged value of scaled consumption growth as an instrument and Row 3 denotes the results using the lagged value of the consumption growth rate as an instrument. According to Table 2, lagged income growth has no significant effect on current income growth. Therefore, this variable is not suitable as an instrumental variable. On the other hand, the lagged values of scaled consumption growth and the consumption growth rate do have a significant effect on income growth. The value of the F-statistic indicates the strength of the first stage. A F-statistic above 10 is determined as a joint significant result. According to Row 4, the F-statistic is above 10 in both columns and therefore the sets of instrumental variables have a strong first stage. Due to the insignificant effect of the lagged income growth rate, only the lagged value of scaled consumption growth and the consumption growth rate will be used as instruments.

Table 2. First stage results baseline IV-regression

Row	**Item**	$\Delta Y/Y_{t-1}$	$\Delta Y/Y_{t-1}$
		(1)	**(2)**
(1)	$\Delta Y_{t-1}/Y_{t-2}$	-0.002 (0.059)	
(2)	$\Delta C_{t-1}/Y_{t-2}$	1.193*** (0.199)	1.192*** (0.200)
(3)	$\Delta C_{t-1}/C_{t-2}$	-0.944*** (0.184)	-0.944*** (0.185)
(4)	**F-Statistic**	17.62	25.14
(5)	**R^2**	0.033	0.033
(6)	**Observations**	1,511	1,511

Note: This table shows the first stage results from the baseline IV-regression. The reported coefficients show the effect of the lagged values of income growth and consumption growth on income growth. In Row 1 the lagged value of income growth is used as an instrument, in Row 2 the lagged value of scaled consumption growth is used as an instrument and in Row 3 the lagged value of the consumption growth rate is used as an instrument. Furthermore, Row 4 reports the F-statistic, Row 5 denotes the R^2 and Row 6 denotes the number of observations. Finally, the robust standard errors are written in parentheses and the level of significance is presented in *p < 0.10, **p < 0.05, ***p < 0.01.

2.2 Fraction rule-of-thumb consumers

As Campbell and Mankiw (1990) did, this paper executed the IV-regression with lagged values of consumption growth. However, I did not use the lagged value of income growth as an instrument. According to Row 1 in Table 2, this variable has no significant effect on current income growth and is therefore not relevant as an instrumental variable. Table 3 reports the results of the IV-regressions and is constructed in the same way as Table 1.

According to Row 1 in Table 3, the coefficients of income growth are statistically insignificant in both columns. This implies that there is no statistical evidence that these coefficients differ from zero. Therefore, the fraction of rule-of-thumb consumers is zero, which means that the permanent income hypothesis cannot be rejected.

2.3 Pandemic dummy

According to Row 2 in Table 3, the coefficients of the pandemic dummy are again significant on a one percent significance level in both columns. In this case, consumption growth is 1.4% to 1.6% lower during the pandemic than before the outbreak of the pandemic.

2.4 Interaction effect

The coefficients of the interaction term are denoted in Row 3 in Table 3. This term indicates whether there is a change in the fraction of rule-of-thumb consumers between the period before the outbreak of the Covid-19 virus and the time of the pandemic. According to Table 3, the coefficients are statistically significant on a one percent significance level and consumption growth was highly dependent on the growth in income. A 100% increase in income growth leads to an increase of 120% to 171% in consumption growth.

2.5 Second stage

As mentioned earlier, the lagged consumption growth values are relevant instruments due to their high F-statistic. To be valid instruments, the instrumental variables also have to have a strong second stage. In order to have this, these variables should be uncorrelated with the error term in the main regression (regression 1). To test this, I executed the Sargan-Hansen test. The P-values of this test are reported in Row 5 in Table 3. The 0-hypothesis states that the instruments are exogenous which would imply that the instrumental variables have a strong second

stage. According to Row 5, the results are significant on a 10% significance level in both columns. This implies that the lagged values of scaled consumption growth and the consumption growth rate are correlated with the error term in the main regression. Therefore, these variables have no strong second stage.

Table 3. Baseline IV-regression results

Row	**Item**	$\Delta C/Y_{t-1}$	$\Delta C/C_{t-1}$
		(1)	**(2)**
(1)	λ_1	-0.256 (0.331)	-0.536 (0.382)
(2)	β	-0.014*** (0.003)	-0.016*** (0.003)
(3)	λ_2	1.195*** (0.408)	1.709*** (0.477)
(4)	**F-Statistic**	34.39	22.45
(5)	**Sargan-Hansen**	0.082*	0.052*
(6)	**Observations**	1,511	1,511

Note: In this table the results are shown from the baseline IV-regression of real consumption growth per capita on income growth per capita. The independent variables are income growth per capita, the pandemic dummy and the interaction term between these two variables. The corresponding parameters are λ_1, β and λ_2, respectively. Income growth is instrumented by scaled consumption growth and the consumption growth rate, both lagged two quarters. The values of the coefficients are denoted under the two columns. Scaled consumption growth is the dependent variable in Column 1 and the consumption growth rate is the dependent variable in Column 2. Row 4 presents the F-statistics and Row 5 denotes the P-values from the Sargan-Hansen test. The last row denotes the number of observations and the robust standard errors are written in parentheses. Finally, the level of significance is presented in $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

3. Overview results

The results in Table 1 show that the fraction of rule-of-thumb consumers is only 6 to 7% and is statically significant on a one percent significance level. In fact, the corresponding coefficient turns into an insignificant result in Table 3. This means that this fraction is very low or equal to zero and therefore there is no evidence to reject the permanent income hypothesis. This would mean that the permanent income hypothesis holds in Europe before the pandemic. This result differs a lot from the result from Campbell and Mankiw (1990) who reject this hypothesis for the U.S. According to Row 3 in Table 1 and Table 3, the sensitivity of consumption to current income massively increased during the pandemic compared to the period before the outbreak

of the pandemic. A 100% increase in income growth results in a 171% in consumption growth in the most extreme scenario. As expected, the excess sensitivity of consumption to current income increased during the pandemic. The baseline results show that the permanent income hypothesis holds before the outbreak of the pandemic and does not hold during the periods of the pandemic.

To test whether the excess sensitivity of consumption to current income was lower during periods of lockdowns, the pandemic dummy will be replaced by the lockdown dummy. As mentioned in the methodology section, consumption decreased even more during periods of lockdowns due to the forced closure of stores. Therefore, the coefficient of the interaction term should be lower than in Table 1 and Table 3. Furthermore, the fixed effects regressions do not control for time variant omitted variables and the IV-regressions have a weak second stage. Therefore, control variables should be added first to the model, before the results with the lockdown dummy will be discussed.

V. Robustness checks

1. Control variables results

The first control variable that is added to the model is the interest rate growth. According to Campbell and Mankiw (1990), changes in interest rates have predictive power for income changes. The second control variable that is added to the model is liquidity constraints. Madsen and McAleer (2000) showed that the fraction of rule-of-thumb consumers decreased when liquidity constraints were included in the model.

1.1 Fixed effects regression with control variables

Table 4 shows the results from the fixed effects regression including the two control variables. Column 1 and Column 2 show the results with scaled consumption growth to lagged income as the dependent variable. Column 3 and Column 4 show the results with the consumption growth rate as the dependent variable. Additional to Table 1, the coefficients of the interest rate growth and the liquidity constraints are included in Row 4 and Row 5 of Table 4, respectively. The coefficients of the independent variables from the main regression are almost unchanged. Moreover, the size of the effect of liquidity constraints is very low and the coefficients of interest rate growth are insignificant. Therefore these variables do not contribute to the model.

Table 4. Fixed effects results with control variables

Row	Item	$\Delta C/Y_{t-1}$	$\Delta C/Y_{t-1}$	$\Delta C/C_{t-1}$	$\Delta C/C_{t-1}$
		(1)	**(2)**	**(3)**	**(4)**
(1)	λ_1	0.075*** (0.020)	0.054*** (0.016)	0.066*** (0.019)	0.050*** (0.016)
(2)	β	-0.012*** (0.001)	-0.012*** (0.001)	-0.013*** (0.002)	-0.012*** (0.002)
(3)	λ_2	0.900*** (0.164)	0.961*** (0.169)	1.150*** (0.209)	1.229*** (0.216)
(4)	γ_1	-0.000 (0.001)		-0.001 (0.001)	
(5)	γ_2		0.000*** (0.000)		0.000*** (0.000)
(6)	**F-statistic**	23.35	40.98	18.27	28.00
(7)	**Observations**	1,432	1,432	1,432	1,432

Note: In this table the results are shown from the fixed effects regression of real consumption growth per capita on income growth per capita. The independent variables are income growth per capita, the pandemic dummy and the interaction term between these two variables. The corresponding parameters are λ_1, β and λ_2, respectively. Additionally, the interest rate growth and liquidity constraints act as control variables. The corresponding parameters are γ_1 and γ_2, respectively. The value of these coefficients are denoted under the four columns. In Column 1 and Column 2, consumption growth scaled to lagged income is the dependent variable. In Column 3 and Column 4, the consumption growth rate is the dependent variable. Row 6 presents the F-statistics and the last row denotes the number of observations. Finally, the robust standard errors are written in parentheses and the level of significance is presented in $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

1.2 Lag length and first stage: interest rate growth

As in Campbell and Mankiw (1990), the lagged values of the interest rate growth act as instruments in the IV-regression. To determine the number of lags, the lag length with the lowest BIC will be chosen. According to Table 10 (Appendix E), the lagged length of two quarters will be used. The results from the first stage of the IV-regression with the lagged value of interest rate growth as instrument are reported in Table 11 (Appendix E). According to the results, the coefficient of lagged interest rate growth is significant on a one percent significance level. Again, the F-statistic is above the threshold value 10. This implies that the first stage including the lagged value of interest rate is strong and therefore this variable will be added to the instruments in the IV-regression.

1.3 IV-regression including lagged interest rate growth

Table 5 shows the results from the IV-regression including the interest rate growth lagged two quarters as an instrument. Moreover, the same lagged values of scaled consumption growth and the consumption growth rate as in the baseline results act as instrumental variables. Table 5 is constructed in the same way as Table 3. Compared to the results from the IV-regression in Table 3, the main outcomes remain the same. The fraction of rule-of-thumb consumers does not statistically differ from zero. Furthermore, the coefficients of the pandemic dummy are exactly the same as in Table 3. This implies that the consumption growth decreased during the time of the pandemic compared to the period before the outbreak of the virus. Finally, the coefficients of the interaction term stay significant on a one percent significance level in both columns. According to Row 3 in Table 5, consumption growth increases with 132 to 186% if income growth increases with 100%. In contrast to the results in Table 3, the P-value of the Sargan-Hansen is now above 0.100 in both columns. This implies that the second stage in both columns is strong which leads to more reliable results.

Table 5. IV-regression results with interest rate growth

Row	**Item**	$\Delta C/Y_{t-1}$	$\Delta C/C_{t-1}$
		(1)	**(2)**
(1)	$\boldsymbol{\lambda_1}$	-0.324 (0.367)	-0.616 (0.432)
(2)	$\boldsymbol{\beta}$	-0.014*** (0.003)	-0.016*** (0.003)
(3)	$\boldsymbol{\lambda_2}$	1.316*** (0.437)	1.857*** (0.515)
(4)	**F-Statistic**	33.46	23.34
(5)	**Sargan-Hansen**	0.301	0.187
(6)	**Observations**	1,400	1,400

Note: In this table the results are shown from the IV-regression of real consumption growth per capita on income growth per capita. The instruments are scaled consumption growth, the consumption growth rate and the interest rate growth. Every instrument is lagged two quarters. The independent variables are income growth per capita, the pandemic dummy and the interaction term between these two variables. The corresponding parameters are $\boldsymbol{\lambda_1}$, $\boldsymbol{\beta}$ and $\boldsymbol{\lambda_2}$, respectively. The value of the coefficients are denoted under the two columns. Scaled consumption growth is the dependent variable in Column 1 and the consumption growth rate is the dependent variable in Column 2. Row 4 presents the F-statistics and Row 5 denotes the P-values from the Sargan-Hansen test. The last row denotes the number of observations and the robust standard errors are written in parentheses. Finally, the level of significance is presented in $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

2. Lockdown dummy results

The tables discussed in this section show the results of the regressions when the pandemic dummy is replaced by the lockdown dummy. As mentioned earlier, the baseline IV-results with the pandemic dummy show that the fraction of rule-of-thumb consumers massively increased during the pandemic compared to the period before the outbreak of the virus. The expectation was that this fraction would increase during the pandemic due to liquidity constraints. However, lockdowns could cause a countereffect, due to a larger drop in consumption growth than in periods of the pandemic without lockdowns. To measure whether this was the case, the lockdown dummy will be introduced. Table 12 (Appendix F) shows the results of the fixed effects regression without the instruments and Table 13 (Appendix F) shows the fixed effects regression including the control variables. The results are comparable with the results of Table 1, but with different sizes for the coefficients. The fraction of rule-of-thumb consumers increases to 14 and 18%. The coefficients of the interaction term increase with 58 to 73% during the pandemic compared to the period before the outbreak of the virus. I will not discuss these tables in detail, because they have no causal interpretation.

2.1 Fraction rule-of-thumb consumers

Table 6 shows the results from the IV-regression with the lockdown dummy instead of the pandemic dummy. For the IV-regression the same instruments will be used as in Table 5. This means that the instrumental variables are lagged scaled consumption growth, the consumption growth rate and interest rate growth. All these variables are lagged two quarters. As before, Column 1 denotes the coefficients of the variables with consumption growth scaled to lagged income as the dependent variable and Column 2 reports the coefficients with the consumption growth rate as the dependent variable.

According to Row 1 in Table 6 the coefficient that denotes the fraction of rule-of-thumb consumers is insignificant in both columns. Again, this means that there is no evidence to reject the permanent income hypothesis.

2.2 Lockdown dummy

According to Row 2 in Table 6, the coefficients of the lockdown dummy are negative and statistically significant on a one percent significance level. The consumption growth is 4 to 5 percent lower in periods of lockdowns compared to

periods without lockdowns. This drop in consumption growth can probably be explained by the forced closure of stores as mentioned in the methodology section.

2.3 Interaction effect

According to Row 3 in Table 6, the coefficients of the interaction term are significant on a five percent significance level in both columns. These coefficients are 1.039 and 1.452 in Column 1 and in Column 2 respectively. This implies that consumption growth increases with 104 to 145% if income growth increases with 100%. This result rejects the permanent income hypothesis. This result will be discussed further and compared to the previous results below Table 6.

Table 6. IV-regression results with lockdown dummy

Row	**Item**	$\Delta C/Y_{t-1}$	$\Delta C/C_{t-1}$
		(1)	**(2)**
(1)	λ_1	-0.293 (0.456)	-0.542 (0.550)
(2)	ζ	-0.043*** (0.006)	-0.052*** (0.006)
(3)	ρ	1.039** (0.504)	1.452** (0.592)
(4)	**F-Statistic**	41.14	34.94
(5)	**Sargan-Hansen**	0.110	0.054*
(6)	**Observations**	1,400	1,400

Note: In this table the results are shown from the IV-regression of real consumption growth per capita on income growth per capita. The instruments are scaled consumption growth, the consumption growth rate and the interest rate growth. Every instrument is lagged two quarters. The independent variables are income growth per capita, the lockdown dummy and the interaction term between these two variables. The corresponding parameters are λ_1, ζ and ρ, respectively. The value of the coefficients are denoted under the two columns. Scaled consumption growth is the dependent variable in Column 1 and the consumption growth rate is the dependent variable in Column 2. Row 4 presents the F-statistics and Row 5 denotes the P-values from the Sargan-Hansen test. The last row denotes the number of observations and the robust standard errors are written in parentheses. Finally, the level of significance is presented in $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

3. Overview robustness checks

Table 5 and 6 show more or less the same results. According to the results from the IV-regressions, the fraction of rule-of-thumb consumers does not statistically differ from zero. Therefore, this paper finds no evidence against the permanent income hypothesis during periods before the pandemic. Again, this result is very different from

the results from Campbell and Mankiw (1990), who found that the fraction of rule-of-thumb consumers was 50% in the U.S. However, the permanent income hypothesis also does not hold in Europe during the pandemic and especially during lockdowns. According to the results in Row 3 of Table 5 and 6, most of the increase in the excess sensitivity of consumption on current income is during periods of lockdowns. This goes against my expectations. The drop in consumption growth should lead to less sensitivity of consumption to current income. The fact that this group of consumers increased is probably due to the changes in income growth. According to the papers in the literature review, income also declined during the periods of lockdown. Table 14 (Appendix G) shows the fixed effects regression of income growth on the pandemic and lockdown dummy. The results from this table confirms the decline in income growth during lockdowns. Therefore, this dependency of consumption on current income is high due to the forced closure of stores. Moreover, Table 14 also shows that income growth increased during the time of pandemic without lockdowns compared to the period before the pandemic. The fact that the fraction of rule-of-thumb consumers is lower or insignificant during this period compared to the periods of lockdowns implies that the sensitivity of consumption to current income declined during the periods of the pandemic without lockdowns. This is probably not due to liquidity constraints, because income increased in periods without lockdowns during the pandemic. It could be the case that households did not increase their consumption expenditures much due to uncertainty about the future, which is called precautionary saving. However, this is beyond the scope of this research.

VI. Conclusion

This paper investigated to what extent the permanent income hypothesis holds during the Covid-19 pandemic. According to this model households base their consumption on permanent income instead of current income. To measure whether this was the case for European households, an adjusted technique of Campbell and Mankiw (1990) was used. This entails a fixed effects regression of consumption growth on income growth and a fixed effects IV-regression with lagged values of consumption growth and interest rate growth as instrumental variables. The coefficients of the income growth variable in the IV-regressions are insignificant. This implies that the fraction of rule-of-thumb consumers does not statistically differ from zero during the period before the Covid-19 pandemic. Therefore, this paper shows no evidence

against the permanent income hypothesis in Europe during this period.

The effect of the Covid-19 pandemic on the fraction of rule-of-thumb consumers is measured by adding an interaction term to the regressions. This interaction term contains the income growth and a dummy that equals one in the quarters of the Covid-19 pandemic. The results show that the coefficient of this term was high and significant in the IV-regressions. In the most extreme case, consumption growth increases with 186% if income growth increases with 100%. However, this high dependency mainly appears during the periods of lockdowns. Due to the forced closure of stores consumption growth decreased. However, according to the data, income growth also declined during this period but at a lower level. During the periods of the pandemic without lockdowns, there was an increase in income growth and a lower sensitivity of consumption to current income compared to the periods of lockdowns. It could be the case that households did not increase their expenditures much due to uncertainty about the future, which is called precautionary saving.

All in all, this paper shows that the permanent income hypothesis holds in Europe before the outbreak of the Covid-19 virus and does not hold during the pandemic. However, this paper does not investigate why the results of the fraction of rule-of-thumb consumers differs so much compared to the results from Campbell and Mankiw (1990). According to the authors, the fraction was 50% for the U.S while this paper found that this fraction was zero for Europe before the outbreak of the Covid-19 pandemic. Therefore, this paper recommends to investigate whether there is a difference in consumption behaviour between American and European households or whether this difference lies in something else. Moreover, this paper does not investigate why the permanent income hypothesis does not hold during the periods of the pandemic and especially during the periods of lockdowns. Therefore, future research is needed on this topic to investigate whether this is due to uncertainty or due to something else.

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Appendices

Appendix A

The permanent income model of Friedman (1957) consists of three equations:

1) $c_p = k(i, w, u)y_p$,

2) $y = y_p + y_t$,

3) $c = c_p + c_t$.

Furthermore, the author assumes that there is no correlation between the permanent and transitory components. Therefore, Cov(y_p, y_t) = 0. To measure the effect *b* of a change in income on a change in consumption, Friedman used OLS:

$$b = \frac{Cov(y,c)}{var(y)} = \frac{\sum(y-\bar{y})(c-\bar{c})}{\sum(y-\bar{y})^2}$$

Plugging equation 2) and 3) into the numerator leads to the following formula:

$$Cov(y,c) = \sum(y-\bar{y})(c-\bar{c}) = \sum(y_p + y_t - \bar{y}_p - \bar{y}_t)(c_p + c_t - \bar{c}_p - \bar{c}_t)$$

$$= \sum(y_p - \bar{y}_p)(c_p - \bar{c}_p) + \sum(y_t - \bar{y}_t)(c_p - \bar{c}_p) + \sum(y_p - \bar{y}_p)(c_t - \bar{c}_t) + \sum(y_t - \bar{y}_t)(c_t - \bar{c}_t)$$

Plugging equation 1) into the formula leads to the following:

$$\sum(y_p - \bar{y}_p)(ky_p - k\bar{y}_p) + \sum(y_t - \bar{y}_t)(ky_p - k\bar{y}_p) + \sum(y_p - \bar{y}_p)(c_t - \bar{c}_t) + \sum(y_t - \bar{y}_t)(c_t - \bar{c}_t)$$

$$= k\sum(y_p - \bar{y}_p)^2 + k\sum(y_t - \bar{y}_t)(y_p - \bar{y}_p) + \frac{1}{k}\sum(c_p - \bar{c}_p)(c_t - \bar{c}_t) + \sum(y_t - \bar{y}_t)(c_t - \bar{c}_t)$$

Friedman argues that the last three terms become zero due to two reasons. First the transitory parts of income and consumption are zero on average. Second, the correlation between the permanent and transitory parts and the correlation between transitory consumption and income are assumed to be zero. This results in the following formula to measure the effect of a change in income on consumption growth:

$$b = \frac{Cov(y,c)}{var(y)} = k\frac{\sum(y_p - \bar{y}_p)^2}{\sum(y-\bar{y})^2}$$

According to this equation, *b* is large if the variance in income is mainly due to a variance in permanent income. Therefore, consumption should respond to changes in permanent income instead of transitory income.

Appendix B.

Table 7. European countries in the dataset

Austria	Ireland
Belgium	Italy
Czechia	Netherlands
Denmark	Norway
Finland	Poland
France	Portugal
Germany	Spain
Greece	Sweden
Hungary	Switzerland

Appendix C.

Table 8. Breusch-Pagan test

Row	**Dependent variable**	**Breusch-Pagan test**
	(1)	**(2)**
(1)	$\Delta C/Y_{t-1}$	0.000***
(2)	$\Delta C/C_{t-1}$	0.000***

Note: This table denotes the results from the Breusch-Pagan test, where consumption growth is regressed on income growth. Column 1 denotes the dependent variables, where scaled consumption growth to lagged income is the dependent variable in Row 1 and the consumption growth rate is the dependent variable in Row 2. The corresponding P-values of the Breusch-Pagan test is denoted in Column 2. The level of significance is presented in *p < 0.10, **p < 0.05, ***p < 0.01.

Appendix D.

Table 9. Bayesian Information Criterion: baseline

Lag length	$\Delta Y/Y_{t-1}$	$\Delta C/Y_{t-1}$	$\Delta C/C_{t-1}$
	(1)	**(2)**	**(3)**
$t-2$	*-6822. 938*	*-6829.068*	*-6824.664*
$t-3$	-6673.826	-6739.407	-6734.759
$t-4$	-6652.107	-6666.313	-6659.849
$t-5$	-6565.660	-6579.699	-6573.109
$t-6$	-6476.822	-6485.564	-6479.160

Note: This table shows the Bayesian information criterion values of the lagged values of income growth and consumption growth. Column 1 denotes the BIC-value for each lag length of income growth, Column 2 denotes the BIC-value for each lag length of consumption growth scaled to lagged income, and Column 3 denotes the BIC-values for each lag length of the consumption growth rate. The lowest BIC-value per column is in italics.

Appendix E.

Table 10. Bayesian Information Criterion: interest rate growth

Lag length	***I***
	(1)
$t-2$	*-6449.308*
$t-3$	-6361.264
$t-4$	-6277.052
$t-5$	-6199.143
$t-6$	-6123.095

Note: This table shows the Bayesian information criterion values of the lagged values of the interest rate growth. Column 1 denotes the BIC-value for each lag length of the interest rate growth. The lowest BIC-value is in italics.

Table 11. First stage results IV-regression with interest rate growth

Row	Item	$\Delta Y/Y_{t-1}$
		(1)
(1)	$\Delta C_{t-1}/Y_{t-2}$	1.194***
		(0.171)
(2)	$\Delta C_{t-1}/C_{t-2}$	-0.950***
		(0.162)
(3)	$\Delta I_{t-1}/I_{t-2}$	-0.001***
		(0.000)
(4)	**F-Statistic**	22.85
(5)	**R^2**	0.033
(6)	**Observations**	1,368

Note: This table shows the first stage results from the lagged values of scaled consumption growth, the consumption growth rate and the interest growth in the IV-regression. Row 1 reports the coefficient of the scaled consumption growth lagged two quarters. Row 2 denotes the coefficient of the consumption growth rate lagged two quarters. Row 3 reports the coefficient of the interest rate growth lagged two quarters. Furthermore, Row 4 reports the F-statistic, Row 5 denotes the R^2 and Row 6 denotes the number of observations. Finally, the robust standard errors are written in parentheses and the level of significance is presented in *p < 0.10, **p < 0.05, ***p < 0.01.

Appendix F.

Table 12. Fixed effects results with lockdown dummy

Row	Item	$\Delta C/Y_{t-1}$	$\Delta C/C_{t-1}$
		(1)	**(2)**
(1)	λ_1	0.142***	0.161***
		(0.041)	(0.051)
(2)	ζ	-0.039***	-0.046***
		(0.004)	(0.005)
(3)	ρ	0.602***	0.745***
		(0.162)	(0.186)
(4)	**F-Statistic**	39.51	34.44
(5)	**Observations**	1,545	1,545

Note: In this table the results are shown from the baseline fixed effects regression of real consumption growth per capita on income growth per capita. The independent variables are income growth per capita, the lockdown dummy and the interaction term between these two variables. The corresponding parameters are λ_1, ζ and ρ, respectively. The value of these coefficients are denoted under the two columns. Scaled consumption growth is the dependent variable in Column 1 and the consumption growth rate is the dependent variable in Column 2. Row 4 reports the F-statistics and the last row denotes the number of observations. Finally, the robust standard errors are written in parentheses and the level of significance is presented in $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 13. Fixed effects results with lockdown dummy and control variables

Row	Item	$\Delta C/Y_{t-1}$	$\Delta C/Y_{t-1}$	$\Delta C/C_{t-1}$	$\Delta C/C_{t-1}$
		(1)	**(2)**	**(3)**	**(4)**
(1)	λ_1	0.159*** (0.043)	0.153*** (0.047)	0.178*** (0.055)	0.184** (0.062)
(2)	ζ	-0.039*** (0.004)	-0.040*** (0.004)	-0.046*** (0.005)	-0.047*** (0.005)
(3)	ρ	0.583*** (0.161)	0.595*** (0.165)	0.726*** (0.185)	0.728*** (0.190)
(4)	γ_1	-0.001 (0.001)		-0.001 (0.001)	
(5)	γ_2		0.000*** (0.000)		0.000*** (0.000)
(6)	**F-statistic**	35.62	35.83	30.94	26.52
(7)	**Observations**	1,432	1,432	1,432	1,432

Note: In this table the results are shown from the fixed effects regression of real consumption growth per capita on income growth per capita. The independent variables are income growth per capita, the lockdown dummy and the interaction term between these two variables. The corresponding parameters are λ_1, ζ and ρ, respectively. Additionally, the interest rate growth and liquidity constraints act as control variables. The corresponding parameters are γ_1 and γ_2, respectively. The value of these coefficients are denoted under the four columns. In Column 1 and Column 2, consumption growth scaled to lagged income is the dependent variable. In Column 3 and Column 4, the consumption growth rate is the dependent variable. Row 6 reports the F-statistics and the last row denotes the number of observations. Finally, the robust standard errors are written in parentheses and the level of significance is presented in $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Appendix G.

Table 14. Income growth during the pandemic without lockdowns and with lockdowns

Row	Item	$\Delta Y / Y_{t-1}$
		(1)
(1)	$\boldsymbol{NL}$	0.011***
		(0.004)
(2)	$\boldsymbol{L}$	-0.016***
		(0.005)
(3)	**Observations**	1,545

Note: In this table the results are shown from the fixed effects regression of income growth per capita on the pandemic dummy and the lockdown dummy. Row 1 denotes the change in income growth during the pandemic without lockdowns, denoted by $\boldsymbol{NL}$ (No lockdown), compared to the period before the pandemic. Row 2 denotes this change during the period of lockdowns, denoted by $\boldsymbol{L}$ (lockdown), compared to the period without lockdowns. Row 3 reports the number of observations. Finally, the robust standard errors are written in parentheses and the level of significance is presented in $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.