What is the size of rule-of-thumb consumers in South Africa: Estimation and Implications*

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Abstract

The paper estimates the share of rule-of-thumb consumers in South Africa using theoretical foundations from the Permanent income hypothesis. The contribution of this paper in South African literature is particularly important for the design of fiscal and monetary policy. I carry out this exercise by estimating the basic permanent income model first proposed by Campbell & Mankiw (1989). The empirical tests indicate that the fraction of rule-of-thumb consumers could be as large as 85%. In the presence of a large of share of rule-of-thumb consumers, monetary policy that follow simple interest rules may be too weak as a criterion for price stability. In fiscal policy, a high rule-of-thumb parameter bodes well, as consumption responds positively, offsetting negative wealth effects from tax increases.

JEL-Classification: E21, E61, C26
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1 Introduction

Friedman (1957)'s permanent income hypothesis (henceforth PIH) states that the choices made by consumers regarding their consumption patterns are determined not by current income but by their longer-term income expectations or real wealth. However, formal empirical studies have also presented evidence that supports a departure from the PIH. In this world, consumption does not follow a random walk: predictable changes in income lead to predictable changes in consumption depending on the prevalence of rule-of-thumb (henceforth ROT) consumers. The seminal work from Campbell & Mankiw (1989) presents a simple model separating consumers into two groups, those who adhere to the PIH and those who's consumption patterns rejects the PIH or ROT consumers. The empirical tests from this study accord with the reality of "excessive" dependence of consumption on current income, ergo, rejecting the PIH.

Although no parallel study exists (before the current paper) in South Africa, we can draw some inference on this topic from Orthofer (2016)'s work using South African Revenue Service data on individual personal income tax. The study presents evidence that shows that 10 percent of South Africa's population own 90 percent of the wealth, whence furnishing an acceptable disavowal of the hypothesis and a gateway to conduct this study. In other literature, Campbell & Mankiw (1991) extend their earlier work to evaluate other developing nations - United Kingdom, Canada, France, Japan and Sweden. The estimates of the results indicate differences across countries in the effect of current income and consumption. To surmise, consumption is affected least by current income in Canada(≈ 0.236), but more in the US(≈ 0.363), Sweden(≈ 0.357), UK(≈ 0.372) and most of all in the France(≈ 0.974). In Japan(≈ 0.035), the null hypothesis that current income and permanent income are equal cannot be rejected, and thus the results bare no fruit.

Mankiw (2000) asserts that the outcomes of these studies call for an abandonment of a single representative consumer in macroeconomic models in favour of models incorporating the presence of ROT consumers. Paramount to this climate of opinion is that several studies in fiscal and monetary policy have shown that the presence of ROT consumers often results in policy implications that do not always manifest in plain-vanilla dynamic stochastic general equilibrium (henceforth DSGE) models.

In monetary policy, guidance is provided by Amato & Laubach (2003)'s early work that study the importance of ROT behaviour on the part of consumers for optimal monetary policy and simple interest rate rules design. It was shown that the existence of these consumers makes inflation shocks more persistent and therefore makes shocks to inflation more lasting. Conversely, the presence of ROT dampens the effects of shocks on inflation by reducing the sensitivity of inflation to the output gap. Moreover, the study shows that monetary authorities should pursue policies that seek to stabilize the first difference of inflation above its goals of inflation and output gap stabilization. This approach helps to contribute to the reduction in the variance of inflation in equilibrium. However, the output gap becomes more volatile because monetary policy is less effective in influencing current and expected real interest interest rates due to greater persistence in expected inflation.

In Gali et al. (2004), the authors show that the presence of ROT consumers may alter the properties of simple interest rate rules, and upend some conventional results found in literature. In particular, the study shows that when a central bank follows a policy rule that requires nominal interest rates to respond to variations in inflation, the magnitude of the inflation coefficient required to rule out a multiple equilibria solution is an increasing function of the weight of ROT consumers in the economy (for any given output coefficient). In context, the paper shows that when the number of rule-of-thumb consumers is large enough, rules like the *Taylor Principle* become too weak a criterion for price stability.

In fiscal policy, most macroeconomic models predict that a positive government spending shock will have an expansionary effect on output, but those models often differ on the implied effects on consumption. The latter being the largest component of GDP, it is considered a key determinant of the government spending multiplier. Owing to disparities in literature over the direction and magnitude of consumption post fiscal shocks, Galí et al. (2007) propose a remedy that accounts for ROT behaviour by some households in a New-Keynesian DSGE model. The analysis suggests that the coexistence of sticky prices and ROT consumers is a necessary condition for a positive government spending shock to raise aggregate consumption. In particular, ROT consumers insulate part of aggregate consumption from the negative wealth effects generated by the higher levels of taxes needed to finance the fiscal expansion, while making it more sensitive to current labor income.

In this paper I estimate the fraction of ROT consumers in South Africa using the Campbell & Mankiw (1989) methodology. There are three broad empirical predictions that result from this exercise. The first is that expected changes in income and consumption are not associated lagged income. The second prediction is that movements in interest rates are not associated with changes in consumption. This means predictable movements observed in consumption cannot be explained as a rational response to movements in interest rates. This also means forward-looking consumers do not adjust their consumption in response to interest rates. Lastly, lagged consumption forecasts income and consumption more strongly, and estimates of the share of ROT consumers from those instruments is reported to be between 0.75 - 0.85.

The rest of the paper is as follows. Section 2 describes the Campbell & Mankiw (1989) econometric model in more detail and briefly goes through some estimation issues. Section 3 presents the empirical results of the estimated model. Section 4 summarizes the main findings of the paper. Section 5 concludes the paper.

2 Methodology

2.1 The Campbell-Mankiw Model

The Mankiw & Campbell (1989) framework starts off with the Euler consumption equation. The representative consumer maximizes:

$$E_t \sum_{s=0}^{\infty} (1-\delta)^{-s} U(C_{t+s}) \quad U' < 0, U'' < 0 \tag{1}$$

Where C is consumption, δ is the subjective rate of discount, E_t is the expectation conditional on information available at time t. If the representative consumer can borrow and lend at the real interest interest, r, then the first order condition necessary for an optimum is:

$$E_t U'(C_{t+1}) = \left(\frac{1+\delta}{1+r}\right) U'(C_t) \tag{2}$$

This says that marginal utility today is, up to constant multiple, the forecast of marginal utility tomorrow. If we assume $r = \delta$ and that marginal utility is linear, then we obtain the random walk result, $E_t Ct + 1 = Ct$. Consumption today is the optimal forecast of consumption tomorrow. This implies:

$$\Delta Ct = \epsilon_t \tag{3}$$

Where ϵ_t is a rational forecast error, the innovation in permanent income. According this formulation of the PIH, consumption is unforecastable.

To evaluate this model, Campbell & Mankiw (1989) consider a simple economy where there are two groups of consumers with disposable income y_{2t}, for ROT consumers, and y_{2t}, for Ricardian consumers (those who adhere to the permanent income hypothesis), respectively. Total disposable income is denoted by $Y_t = y_{1t} + y_{2t}$. The first group, ROT consumers, are allotted a fixed share λ of the disposable income. The second group, Ricardian consumers, or those that adhere to the PIH, receive $1 - \lambda$ of the total disposable income. So, the two income groups can be denoted by $y_{1t} = \lambda Y_t$ and $y_{2t} = (1 - \lambda)Y_t$.

Applying the general principle governing ROT consumers, their derived consumption equation becomes: $C_{1t} = y_{1t}$. Differencing the equation gives: $\Delta C_{1t} = \Delta y_{1t} = \lambda \Delta Y_t$. Ricardian consumers, who are characterized by their expected long term average income, consume their permanent income to generate a consumption function of the form: $C_{2t} = Y^p_{2t} = (1 - \lambda)y^p_{2t}$. Following Flavin (1981) and Hall (1978), differencing this consumption equation results in: $\Delta C_{2t} = \mu + (1 - \lambda)\epsilon_t$. The μ is a constant, while the consumers' assessment of total permanent disposable income between time $t - 1$ and t is measured by the innovation ϵ_t. The innovation ϵ_t is orthogonal to any lagged variable that is in the consumers' information set.

Using these facts, the changes in aggregate consumption can be written as:

$$\Delta C_t = \Delta C_{1t} + \Delta C_{2t} \tag{4}$$

This can further be rewritten as:

$$\Delta C_t = \lambda \Delta Y_t + (1 - \lambda)\epsilon_t \tag{5}$$

Equation (5) says that change in aggregate consumption is a weighted average of the change in current income and the unforecastable innovation in income. A λ value close to zero implies that the permanent income hypotheses cannot be rejected. In effect, the model reduces to permanent income hypothesis as λ approaches zero. Conversely, if λ is found to be large, this would imply rejection of the permanent income hypothesis.

The model cannot be directly estimated using ordinary least squares methods since the error term ϵ_t may be correlated with ΔY_t. This is the same as the completeness or Omitted Variable Problem. To resolve the issue, the equation is estimated using instrumental variables (IV). The choice of instruments can be any lagged stationary series orthogonal to ϵ_t and correlated with ΔY_t. Following Mankiw & Campbell (1989), the IV is applied to the equation:

$$\Delta C_t = \mu + \Delta y_t \tag{6}$$

The main instruments for the estimation are lagged values of income, Δy_t, consumption, Δc_t, interest rates, Δi_t and savings, computed as $c_t - y_t$. The minimum lag used is two and maximum is six, *i.e.* $Y_{t-2}, ..., Y_{t-6}$. The savings variable is only lagged twice as an instrument.

2.2 Estimation Issues

There are two issues that arise from the nature of the aggregate time series on consumption and income. The discussion thus far has been couched in terms of levels and differences on the raw C_t and Y_t. This form is appropriate if the data follows a homoskedastic linear process in levels, with or without unit roots. However, consumption and income have been shown to be more log-linear than linear. Following from this, Campbell & Mankiw (1989) simply take logs of all variables to correct the problem.

The second issue is that consumption has a first-order serial correlation problem which can lead to us rejecting the model even if it is true. They solve the problem by lagging the instruments more than one period, so that there's a two-period gap between the instruments and the variables in the equation.

3 Data and Unit Root Test Results

To estimate the model, the paper uses seasonally adjusted quarterly data from 1994 - 2017 from the South African Reserve Bank for:

- Disposable income of households (y_t);
- Final consumption expenditure by households: Non-durable goods and services (c_t)
- Interest rate (i_t).
- Savings ($c_t - y_t$) (s_t)

Results from the Augmented Dickey-Fuller unit root test show that c_t and y_t integrated of order 1, $I(1)$, are stationary. Interest rates are stationary in their levels. Savings are stationary in the levels, albeit at the 10% level of statistical significance and at 1% when integrated once. The results are summarized in Table 1 in the appendix.

4 Empirical Results

Table 2 presents results for the 1994Q1 : 2017Q1 sample period. The table has six columns. The first column is just the row number and lists the instruments used. (A constant term is included as both an instrument and a regressor but is not reported in the tables.) The third and fourth columns report the adjusted

R^2 statisticsfor OLS regressions of the scaled $\Delta C_t, /Y_{t-1}$ and $\Delta Y_t, /Y_{t-1}$ respectively, on the instruments. In parentheses, I report the $p - value$ for a Wald test of the hypothesis that all coefficients in these regressions are 0 except the intercept. The fifth column gives the IV estimate of λ,with the t-statistcs in the parentheses. The final column gives the adjusted R^2 statistic for an OLS regression of the residual from the IV regression on the instruments. In parentheses I report the $p - value$ for a Wald restriction test.

Row 2 and 3 use lagged income growth as instruments. Both instruments are not strongly jointly significant in explaining income or consumption growth. The results show that 12% of lagged income growth can explain current income growth, whereas the longer lags explain only 18%. Lagged income growth is not significant in explaining consumption growth all together. Both, short and longer lag instruments are insignificant. The weak forecasting power of the lagged instrumental variables in Row 2 and 3 are seen in the estimated λs, which is negative and insignificant.

Lagged consumption growth, in Row 4 and 5, reports modest results, showing forecasting power for both consumption and income growth. Lagged consumption forecasts consumption more strongly than itself. This is a departure from most international studies. However, these Rows produce most intriguing λ estimates. These suggest that consumers do not have much insight on income growth, and thus cannot respond to future expected earnings by increasing their consumption. Using shorter lags, the share of ROT consumers is estimated at 85%. When the lags are extended, the share declines to 75%.

Next, I consider some financial linked variable as an instrument, in this context, the repo rate. The results show that interest rates have no forecasting power on consumption or income growth. Even when instrument lags are extended, consumption growth is not responsive to interest rate cycles. However, the estimated λ coefficient, 0.4, is positive and significant at the 5% level. From a monetary policy perspective, this raises questions on several transmission mechanisms that should stimulate consumption.

Finally, Row 8 and 9 present the restricted error-correction models for consumption and income. Row 8 has lags of consumption, income and the saving rate, calculated as $\Delta ct - \Delta yt$. The results are broadly consistent, although the share of ROT consumers estimated with these instruments is relatively smaller in magnitude.

In table 3, I follow Campbell & Mankiw (1991) by estimating a log specification of the model. The transformation distorts the magnitude of the ROT estimate through significantly lower parameters. However, there is some still some consistencies. Consumption as an instrument still has a larger forecasting power on the growth of consumption. Interest rates are still not significant in explaining consumption or income growth. The U.S. study by Campbell & Mankiw (1991) exhibited similar properties when logs were used for a robustness check.

In conclusion, the study finds striking evidence against the PIH. The results from the instrumental variable tests are not favourable to the PIH model. Instruments that are jointly significant in explaining both income and consumption produce a λ estimate of between 75% and 85%.

4.1 Lessons For Monetary Policy

Policy analysis in the context of DSGE models and other forms of structural models often assume a single representative consumer. However, advances in literature have incorporated ROT consumers owing to their reported impact on policy. Two seminal studies link the ROT parameter to monetary policy.

In the first instance, I look at how a high ROT parameter affects optimal monetary policy and simple interest rules in the scheme of Amato & Laubach (2003). They calibrate a standard dynamic Keynesian model with ROT consumers, setting λ at $=$ 1, 0.6 and 0.2. and using Taylor (1993)'s standard baseline values ($\sigma_{pi} = 1.5\, and\, \sigma_y = 0.5$) The study shows that following a natural rate shock, inflation response is stronger when λ is set at 1 compared to lower ROT parameters. This implies that when the shock occurs, the increase in the nominal interest rate leads to a larger increase in expected real interest rate which mitigates the effect on the output gap and inflation itself. When λ is set at the lower bound, the same nominal interest rate is associated with a relatively minute increase in the real interest rate.

In another study, Gali et al. (2004) examine the impact of ROT on simple interest rules using a New Keynesian model with ROT consumers. The intuition of the study is simple: when central banks follow a rule that implies an adjustment of the nominal interest rate in response to variations in current inflation and output, the size of the inflation coefficient that is required in order to rule out multiple equilibria is an increasing function of the weight on rule-of-thumb consumers. In particular, it is shown that when ROT is significantly large enough, as in the case of South Africa, a *Taylor principle* type rule must imply a change in the nominal interest in response to a change in inflation that is above unity in order to guarantee a unique equilibrium. This means the *Taylor principle* is a significantly weak criterion for stability when the share of ROT consumers is large enough. Conversely, when prices are shown to be flexible and the share of ROT consumers is small, the existence of a unique equilibrium following a simple interest rate rule is guaranteed. The contra transpires with sticky prices and high ROT parameter. To surmise, it is shown that in a country like South Africa with a substantial share of ROT consumers and strong nominal rigidities, the *Taylor principle* may no longer be a useful criterion for the design of interest rate rules.

4.2 Lessons For Fiscals Policy

The seminal work in fiscal policy analysis that incorporates ROT consumers comes from Galí et al. (2007) who extend the standard New Keynesian model to allow for the presence of ROT consumers. The question is, what are the effects of government purchases of goods and services on aggregate economic activity? Unfortunately, these remains an open-ended question in theoretical and empirical studies. Real Business Cycle (RBC), Neoclassical and Keynesian models all reach opposing conclusions with regards to the magnitude and direction of household consumption post fiscal shocks. By incorporating ROT consumers in a simple DSGE model, the paper shows that ROT consumers mitigate the adverse impact of negative wealth effects generated by higher levels of taxes needed to finance fiscal expenditure while making it more sensitive to labour income. In the presence of sticky prices, real wages increase despite a fall in productivity and high employment. This increase in the real wage raises current labor income and stimulates the consumption of rule-of-thumb households. This creates a positive respond from consumption post a government spending shock.

Jooste et al. (2013)'s primus inter pares in South African literature uses this approach to analyse the effect of aggregate government spending and taxes on output. The authors use a DSGE model that follows Smets & Wouters (2003) Galí et al. (2007). At the time of writing, there was no literature on the size of λ in South Africa. To circumvent this issues, the paper employs different sizes of λ. To be precise, Jooste et al. (2013) set $\lambda = 0.1$, 0.5 and 0.8 respectively. The results show that, in the presence of a high ROT parameter, similar to the one estimated in the current paper, consumption increases due to the large of response of these ROT consumers. For the opposite case, consumption declines. Conclusively, the size of the ROT parameter, λ, dictates the response of consumption after a government spending shock in a ROT-DSGE framework. The study further shows that, when ROT consumers are large, $\lambda = 0.8$, outputâs response is close to unity, which suggests that fiscal policy has the potential to effectively stimulate demand.

5 Summary and Conclusion

In the proceeding analysis I estimate the share of ROT consumer in South African employing the Campbell & Mankiw (1989) permanent income model. The results show that lagged income growth is significant in forecasting current income growth, albeit very weak. On the other hand, lagged income is not significant in explaining consumption growth. A Financial instrument, denoted by the repo rate in this example, is not significant in explaining both current income growth and consumption. This sheds some light on our understanding of the monetary policy transmission mechanism. More importantly, estimates of the share of ROT consumers when instrumented by lagged consumption show that λ is anywhere between 0.75 - 0.85.

The high share of ROT consumers impact monetary authorities' use of simple interest rate rules like the *Taylor Principles*. High estimates of λ create endogenous persistence of inflation and output. The path of interest rates following a shock is sensitive to the degree of ROT consumption behaviour in an economy. In fiscal policy, a high ROT parameter produces fiscal multipliers that are close to unity in a DSGE setup. Although the country has committed to fiscal consolidation, in times of dampened demand, fiscal authorities can turn to government spending to boost demand. Future research should look into the monetary policy transmission mechanism in the face of this large share of ROT consumers. A lot of households cannot borrow or save, and this clogs some transmission mechanisms. In fiscal policy, this paper supports the suggestion by Jooste et al. (2013) to study fiscal shocks that deviate from a rule and how ROT consumers, as with monetary policy, might affect the equilibrium outcome of those results.

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A Derivation of the Permanent income hypothesis

The idea of PIH dates back to the consumption studies of Modigliani & Brumberg (1954) who studied the choices households made with regards to savings and consumption. They concluded that households decide on how much they want to spend their income at each stage in their lives, limited only by the resources available to them. The latter notion which introduced future expectations in household consumption led to Friedman (1957)'s PIH. The hypothesis states that the consumption decisions that households make are largely determined by changes in their permanent income, rather than changes in their temporary income. Hall (1978) formalized this idea by taking into account a concave utility curve, showing that consumers smooth their income over time. Flavin (1981) expands this proof to accommodate future expectations. The textbook represention of the aforementioned is presented as follows:

The Euler equation is presented as follows:

$$\beta(1+r)E_t u'(c_{t+1}) = u'(c_t) \tag{7}$$

with a budget constrain of the form:

$$a_{t+1} = (1+r)a_t + y_t - ct \tag{8}$$

Where a_t is the consumer's asset holdings at time t. y_t is the stochastic labour income. r is the market interest in a one period bond. $\beta \in (0,1)$ is the consumer's discount rate where $\beta = \frac{1}{1+\rho}$ and ρ is the discount rate.

Following this, we make the following assumptions:

$$\beta(1+r) = 1 \tag{9}$$

and also assume a linear marginal utility[1], which results in the following Euler equation:

$$u'(E_t c_{t+1}) = E_t u'(c_{t+1}) = u'(c_t) \tag{10}$$

From this, Hall (1978)'s results that shows consumption is a martingale arises,

$$E_t C_{t+1} = C_t \tag{11}$$

Incorporating the idea that the expected value of consumption differs from its realization, the above can be rewritten as:

$$c_{t+1} = c_t + \eta_{t+1} \tag{12}$$

Where $E_t \eta_{t+1} = 0$ and η_{t+1} is i.i.d. Equation (12) sates that consumption is a random walk.

Iterating the budget constraint, and using a no Ponzi game condition, we can show that the PIH can be stated as:

$$c_t = r(at + H_t) \equiv y_t^p \tag{13}$$

[1] A quadratic function of the form $u(c_t) = -(\gamma - c_t)^2$ is often used

Where $H_t = \frac{1}{1+r} \sum_{j=0}^{\infty} \left(\frac{1}{1+r} \right)^j E_t yt + j$ represents human wealth, the consumer's expected future earnings and a_t is the financial welath. y_t^p is the consumer's permanent income.

Appendix

Table 1: Results of the stationarity testing

	Augmented Dickey-Fuller	
Variable	t-statistics	Conclusion
c_t	-5.015093*	Stationary, $I(1)$
y_t	-13.95426*	Stationary, $I(1)$
i_t	-2.923110**	Stationary, $I(0)$
s_t	-14.77556*	Stationary, $I(1)$

Significance levels: * 1%, ** 5%, *** 10%

Table 2: Regression results of the Campbell and Mankiw model (scaled levels).

Row	*Instruments*	Δc *equations*	Δy *equations*	λ estimate (s.e.)	*Test of restrictions*
1	None (OLS)	-	-	0.197* (4.131)	-
2	$\Delta y_{t-2}, ..., \Delta y_{t-4}$	0.055 (0.0445)	0.121 (0.000)	-0.108 (-0.880)	0.030 (0.1236)
3	$\Delta y_{t-2}, ..., \Delta y_{t-6}$	0.038 (0.1385)	0.185 (0.0002)	-0.106 (-0.887)	0.011 (0.3087)
4	$\Delta c_{t-2}, ..., \Delta c_{t-4}$	0.336 0.000	0.193 (0.0001)	0.862* (3.162)	-0.007 (0.5162)
5	$\Delta c_{t-2}, ..., \Delta c_{t-6}$	0.389 (0.000)	0.179 (0.0004)	0.750* (3.316)	0.0283 (0.1865)
6	$\Delta i_{t-2}, ..., \Delta i_{t-4}$	0.020 (0.1882)	-0.029 (0.9455)	0.463 (0.063)	0.010 (0.2706)
7	$\Delta i_{t-2}, ..., \Delta i_{t-6}$	0.075 (0.0368)	0.018 (0.2559)	0.401** (0.2.054)	0.024 (0.2112)
8	$\Delta y_{t-2}, ..., \Delta y_{t-4}$ $\Delta c_{t-2}, ..., \Delta c_{t-4}$ $c_{t-2} - y_{t-2}$	0.360 (0.000)	0.395 (0.0000)	0.226* (3.151)	0.323 (0.0000)
9	$\Delta y_{t-2}, ..., \Delta y_{t-4}$ $\Delta c_{t-2}, ..., \Delta c_{t-4}$ $\Delta i_{t-2}, ..., \Delta i_{t-4}$ $c_{t-2} - y_{t-2}$	0.434 (0.000)	0.380 (0.0000)	0.240* (3.260)	0.404 (0.0000)

Significance levels: * 1%, ** 5%, *** 10%

Note: Column 3 and 4 reports the adjusted R^2 for the OLS regression of the two variables (in logs) on the instruments. In the parentheses is the p-value for the null that all the coefficients except the constant are zero. The results are achieved through a basic Wald restriction test. The column labelled "λ *estimates*" reports the IV estimate of λ, share of ROT, and in the parentheses are the standard errors. The column "*Test of restrictions*" report the adjusted R^2 of the OLS regression of the residuals on the instruments, in parentheses is the p-value of the null that all the coefficients are zero.

Table 3: Regression results of the Campbell and Mankiw model (Logs).

Row	*Instruments*	Δc *equations*	Δy *equations*	λ estimate (s.e.)	*Test of restrictions*
1	None (OLS)	-	-	0.890* (4.131)	-
2	$\Delta y_{t-2}, ..., \Delta y_{t-4}$	0.047 (0.0621)	0.190 (0.001)	-0.058 (-0.633)	0.034 (0.1075)
3	$\Delta y_{t-2}, ..., \Delta y_{t-6}$	0.032 (0.1654)	0.177 (0.0005)	-0.059 (0.-0.646)	0.017 (0.2599)
4	$\Delta c_{t-2}, ..., \Delta c_{t-4}$	0.186 0.0001	0.062 (0.0392)	0.508* (2.781)	-0.007 (0.4293)
5	$\Delta c_{t-2}, ..., \Delta c_{t-6}$	0.216 (0.0001)	0.073 (0.0392)	0.373* (2.825)	0.062 (0.0596)
6	$\Delta i_{t-2}, ..., \Delta i_{t-4}$	-0.028 (0.9219)	-0.029 (0.9453)	-0.130 (-0.1789)	-0.029 (0.9536)
7	$\Delta i_{t-2}, ..., \Delta i_{t-6}$	0.015 (0.2718)	0.018 (0.2542)	0.302*** (1.887)	-0.031 (0.8225)
8	$\Delta y_{t-2}, ..., \Delta y_{t-4}$ $\Delta c_{t-2}, ..., \Delta c_{t-4}$ $c_{t-2} - y_{t-2}$	0.185 (0.0008)	0.352 (0.0000)	0.118 * (1.8268)	0.1767 (0.0012)
9	$\Delta y_{t-2}, ..., \Delta y_{t-4}$ $\Delta c_{t-2}, ..., \Delta c_{t-4}$ $\Delta i_{t-2}, ..., \Delta i_{t-4}$ $c_{t-2} - y_{t-2}$	0.217 (0.0015)	0.351 (0.0000)	0.137** (2.2990)	0.1947 (0.0043)

Significance levels: * 1%, ** 5%, *** 10%

Note: Column 3 and 4 reports the adjusted R^2 for the OLS regression of the two variables (in logs) on the instruments. In the parentheses is the p-value for the null that all the coefficients except the constant are zero. The results are achieved through a basic Wald restriction test. The column labelled "λ *estimates*" reports the IV estimate of λ, share of ROT, and in the parentheses are the standard errors. The column "*Test of restrictions*" report the adjusted R^2 of the OLS regression of the residuals on the instruments, in parentheses is the p-value of the null that all the coefficients are zero.