FUCAPE FUNDAÇÃO DE PESQUISA E ENSINO

DANIEL GONÇALVES GALVÊAS

ACCOUNTING FOR THE PREDICTABILITY OF CONSUMPTION GROWTH IN LATIN AMERICAN COUNTRIES

VITÓRIA
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Dissertação apresentada ao Programa de Mestrado Acadêmico em Administração e Contabilidade, da Fucape Fundação de Pesquisa e Ensino, como requisito parcial para obtenção do título de Mestre em Administração e Contabilidade – Nível Acadêmico.

Orientador: Dr. Eurilton Araújo.

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ABSTRACT

Consumption in Latin American countries is scarce in the literature of macroeconomics. Hence, using a Generalized Method of Moments (GMM), this study tests for the presence of habit formation, credit-constrained consumers and non-separability between consumption and leisure in countries with the region. Results show evidence that Brazilian and Chilean consumers follow the rule-of-thumb. Chileans present habit formation and Mexicans have non-separable preferences between leisure and consumption and value future consumption more than the other studied countries.

Keywords: Consumption; Latin America; GMM; Rule-of-thumb.

RESUMO

Consumo na América Latina é pouco explorado pela literatura de macroeconômica. Assim, usando o Método Generalizado dos Momentos (GMM), este estudo testa para a presença de formação de hábito, consumidores restritos a crédito e não-separabilidade entre consumo e lazer em países dessa região. Os resultados encontrados evidenciam que os consumidores brasileiros e chilenos seguem o comportamento de regra-de-bolso. Chilenos apresentam formação de hábito e mexicanos têm preferências não-separáveis entre consumo e lazer, e valorizam o consumo futuro mais do que os outros países aqui estudados.

Keywords: Consumo; América Latina; GMM; Regra-de-bolso.

SUMÁRIO

Chapter 1

1 INTRODUCTION

Consumption is a central aspect of both macroeconomics and finance, hence, being a bridge in between both fields. Given assumptions on an inter-temporal discount factor and a utility function, one can easily derive the price of a future payoff at any moment in time:

$$p_t = \mathbf{E}\left(\beta \cdot \frac{u'(c_{t+1})}{u'(c_t)} \cdot x_{t+1}\right)$$

where β is the intertemporal substitution rate, $u(\cdot)$ is an utility function, c represents consumption and x is the asset payoff.

As stated, consumption is a key element at the Consumption Capital Asset Pricing Model (CCAPM), as shown by Cochrane (2009), thus being crucial to the Asset Pricing theory. It comes naturally seeing how important the study of consumption theory is, if one wants to understand the world of finance. And it can go as far as the findings of Delikouras and Kostakis (2019), in which it shows that a single-factor consumption-based model can explain return as good as the three-factor celebrated model by Fama and French (1993), reducing hugely forecasting costs, especially in developing countries where data on SMB (small minus big) and HML (high minus low) types of firms are, if not absent at all, rarely found.

Latin American countries have a higher consumption volatility, when compared to more developed countries and regions, as seen in figure 1. Although this study do not compute all countries in the region, it uses a sample of 4 of the top 5 countries with

the largest GDP (in constant 2017 PPP) in Latin America[1] and those 4 countries rank among the top 10 highest Per Capita GDP in the region, excluding countries with a smaller GDP than US$ 50 billions (in 2019)[2]. Due historical facts, geographical factors, cultural and development aspects, the region is highly heterogeneous in per capita income, GDP and other economic characteristics, and this study finds evidence that supports such heterogeneity.

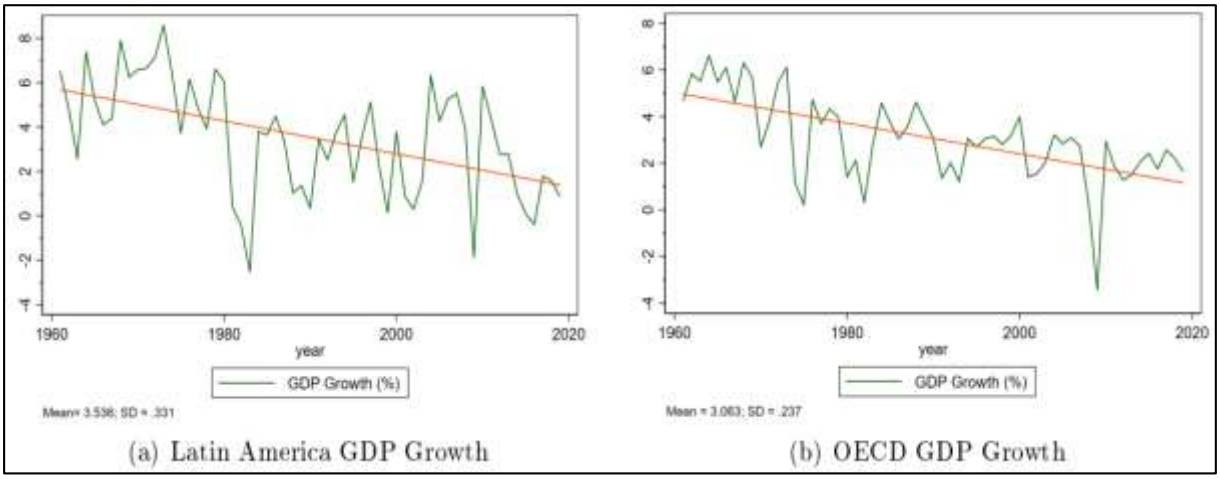

Figure 1: GDP Growth
Source: World Bank

Few studies focus on the consumption of Latin American countries through macroeconomics lens (Barros Júnior et al., 2018; Gomes, 2010; Paz, 2006; Gomes & Paz, 2004; Gomes, 2004), though more recent studies discuss energy, alcohol and food consumption. Therefore, this study aims to investigate the presence of habit formation, credit-constraint (rule-of-thumb behavior) and the separability between consumption and leisure in Latin American countries, using the method shown by Kiley (2010). Following this, it will also contribute to mitigating this literature gap with useful information for market players and future researchers.

[1] Data for GDP can be found at http://bit.do/latin_america_gdp.
[2] Data for Per Capita GDP can be found at http://bit.do/latin_america_gdp_percapita.

The results of this study agree with Barros Júnior et al. (2018), that a rule-of-thumb behavior occurs in Brazilian consumers. Considering the weak instrument test with higher power (CLR), Chilean consumers follow the rule-of-thumb as well. Chileans present habit formation and Mexicans have non-separable preferences between leisure and consumption, but do not follow a rule-of-thumb behavior. However, other results depend on the used instrument.

This study is organized as follows. Section 2, in which is discussed the previous findings of the consumption literature; Section 3 where it is presented the supporting theory to the empirical model; Section 4 shows the empirical procedure; Section 5 presents the results found; and Section 6 contain the final remarks.

Chapter 2

2 A GLANCE ON CONSUMPTION LITERATURE

In seminal work, Hall (1978) proposes a different version of the life cycle-permanent income hypothesis given by Friedman (1957). With data from the US economy, it was found that forecasting consumption using historical data could only go as far as an AR(1) process - considering a dataset with quarterly frequency. Building on that, Mankiw (1981) finds that real interest rate should be significant in a consumption growth though lagged disposable income growth should not, but was confronted with Hall (1988), which finds that the intertemporal substitution elasticity is close to zero and, hence, consumption is lowly correlated with interest rate. Though researchers used, conveniently, the assumption that consumption and leisure are separable, like substitute goods, Basu and Kimball (2002) breaks such assumption and find evidence of non-separability, concluding that a permanent increase in real wages have marginal effect on labor hours. Studying Habit formation, Weber (2002) shows the importance of habit formation for explaining consumption growth, but it rejects that a fraction of disposable income goes to rule-of-thumb households.

Making the first model to test for habit formation, non-separable preferences and rule-of-thumb behavior, Kiley (2010) studies the US economy and bring evidence of the existence of habit persistence and rule-of-thumb behavior, using weak instruments. Everaert and Pozzi (2014) test for habit formation, intertemporal substitution, rule-of-thumb and non-separabilities between private consumption and both hours worked and government consumption on OECD countries, finding that income growth is the only variable for predicting aggregate consumption growth. Lecznar and Lubik (2018) studies the dynamics of consumption, the real interest rate

in Japan (low interest rate environment), finding that Japanese households became less risk averse and exhibited a higher degree of habit formation, rejecting nonseparable preferences. Finally, Havranek and Sokolova (2020) uses a meta-analysis of 144 studies to analyze rule-of-thumb behavior, rejecting such trait among consumers. Although, they detect a publication bias in the studied sample, in which negative estimates where omitted. Moreover, the study concludes that a standard heterogeneous agent model with incomplete markets and occasionally binding liquidity constraints forms a pretty good approximation of the actual consumer behavior.

Studies on Latin America consumption are scarce, though Gomes and Paz (2004) analyzes South-American countries, arguing that the model proposed by Campbell and Mankiw (1989), allowing credit-constrained consumers, explains consumption better than permanent income and rational expectation models, in which Argentina and Chile have the most fraction of consumers with such restriction and Peru with the lesser number of credit-constrained consumers. Other studies focus on the Brazilian economy: Gomes (2004) finds that habit formation does not explain consumption growth in Brazil, though there is evidence of rule-of-thumb and credit constrained consumers. Gomes (2010) analyzes optimization behavior, myopia and credit constraint, rejecting all three hypotheses, confronting the latter study. Finally, Barros Júnior et al. (2018) uses the model proposed by Kiley (2010) and does not reject the rule-of-thumb consumer hypothesis for the Brazilian economy, in which consumers aren't sensitive to changes in interest rate and a high share of income belongs a group who are credit-constrained, therefore most income is transformed into consumption.

Chapter 3

3 THEORETICAL MODEL

Following the method used in (Kiley, 2010), given the consumer,

$$\mathbf{E}_t \left[\sum_{j=0}^{\infty} \beta^j u(c_{t+j}) \right] \tag{1}$$

and considering a constant relative risk aversion (CRRA) utility function, such that $u(c) = {c^{1-\sigma}}/{1-\sigma}$, our consumer will, then, maximize

$$\mathbf{E}_t \left[\beta \left(\frac{c_{t+1}}{c_t} \right)^{-\sigma} (1 + r_{t+1}) \right] = 1 \tag{2}$$

where σ is the relative risk aversion parameter and r_t is the interest rate

Using a first order Taylor expansion in (2), we have

$$\Delta \ln(c_{t+1}) = \mu + \sigma^{-1} r_{t+1} + \varepsilon_{t+1} \tag{3}$$

Not all consumers follow Euler's equation and smooth consumption. Campbell and Mankiw (1989) argues about the existence of the rule-of-thumb consumer who consume only his disposable income due to credit constraints. Thus, considering a fraction λ of income that belongs to credit-constrained consumers.

$$\Delta c_{t+1}^r = \lambda \Delta Y_{t+1}$$

where c_t^r is the consumption of rule-of-thumb consumers.

Hence, the hypothesis test of a lack of constrained consumers can be done using

$$\Delta \ln(c_{t+1}) = \lambda \Delta \ln(Y_{t+1}) + (1-\lambda)(\mu + \sigma^{-1} r_{t+1} + \varepsilon_{t+1}) \tag{4}$$

where c_t represents aggregated consumption.

For habit formation, a forward-looking consumer follows

$$\mathbf{E}_t \left[\sum_{j=0}^{\infty} \beta^j u(c_{t+j} - h_{t+j}) \right] \tag{5}$$

where h represents the habit component.

Kiley (2010) considers an economy with both type of consumers, habit formation and nonseparability between leisure and consumption. For forward-looking consumers:

$$\mathbf{E}_t \left[\sum_{j=0}^{\infty} \beta^j \frac{(c_{t+j} - h_{t+j})^{1-\sigma}}{1-\sigma} \right] \mathrm{e}^{(\sigma-1)v(\ell_{t+j})} \tag{6}$$

where $v(\cdot)$ represents the desutility of labor l.

$$h_t = \mathrm{e}^{A(L)\ln(C_{t-1})} \tag{7}$$

where $A(L)$ is a polynomial in the lag operator and C_{t-1} is the past aggregated consumption. Thus, the Euler equation of this consumer is related to investing in a nominal bond given by

$$(c_t - h_t)^{-\sigma} e^{(\sigma-1)v(l_t)} = \beta \mathbf{E}_t \left[\left(\frac{1+i_{t+1}}{1+\pi_{t+1}} \right) (c_{t+1} - h_{t+1})^{-\sigma} \mathrm{e}^{(\sigma-1)v(\ell_{t+1})} \right] \tag{8}$$

where i_{t+1} and π_{t+1} are the nominal interest rate and inflation rate from t to $t+1$. Log-linearizing equation (8) around the steady-state, we obtain

$$\begin{aligned} \mathbf{E}_t [\Delta \ln c_{t+1}] \approx & \frac{1}{\sigma} \frac{C-H}{C} \ln \beta + \frac{1}{\sigma} \frac{C-H}{C} \mathbf{E}_t [r_{t+1}] + \\ & + \frac{H}{C} \mathbf{E}_t [A(L) \Delta \ln C_t] + \frac{\sigma - 1}{\sigma} \frac{C-H}{C} v'(L) L \mathbf{E}_t [\Delta \ln \ell_{t+1}] \end{aligned} \tag{9}$$

where H, C and L are the steady-state values of habit, aggregated consumption and labor supply, respectively. Equation (9) illustrates that the predictability of consumption growth does not imply deviations from optimal behavior if that predictability comes from predictable movements in interest rates (that is, intertemporal substitution), the effects of habits, or the effect of nonseparable preferences between consumption and leisure. The coefficients on the habit and labor supply are related to that on the (ex-ante real) interest rate, a set of restrictions across coefficients (Kiley, 2010).

Thus, based on equation (9), and the hypothesis that a fraction λ of income belongs to rule-of-thumb consumers, we can rewrite the expected variation of aggregate consumption

$$\begin{aligned} E_t\left[\Delta \ln C_{t+1}\right] = (1-\lambda)\Bigg\{ & \frac{1}{\sigma}\frac{C-H}{C}\ln\beta + \frac{1}{\sigma}\frac{C-H}{C}E_t\left[r_{t+1}\right] \\ & + \frac{H}{C}E_t\left[A(L)\Delta \ln C_t\right] + \frac{\sigma-1}{\sigma}\frac{C-H}{C}v'(L)LE_t\left[\Delta \ln \ell_{t+1}\right]\Bigg\} \\ & + \lambda E_t\left[\Delta \ln Y_{t+1}\right] \end{aligned} \tag{10}$$

where Y_{t+1} is the disposable income.

Finally, the empirical part will consider habit as a function of a lag in aggregate consumption, and we can rewrite the last equation as

$$\begin{aligned} \mathbf{E}_t[\Delta \ln C_{t+1}] = (1-\lambda)[\alpha \ln\beta + \alpha \mathrm{e}_t(r_{t+1}) + \theta \mathbf{E}_t(\Delta \ln C_t) + \\ + (1-\alpha-\theta)\gamma \mathbf{E}_t(\Delta \ln \ell_{t+1})] + \lambda \mathbf{E}_t[\Delta \ln Y_{t+1}] \end{aligned} \tag{11}$$

where

$$\alpha = \frac{1}{\sigma}\frac{C-H}{C}, \qquad \theta = \frac{H}{C}, \qquad \gamma = v'(L)L$$

and then we can test the habit formation ($\theta \neq 0$) the non-separability between consumption and leisure ($\gamma \neq 0$) and the presence of credit-constrained consumers ($\lambda \neq 0$) and the intertemporal substitution elasticity of consumers ($\alpha \neq 0$).

Chapter 4

4 EMPIRICAL PROCEDURE

In this study it will be used quarterly observations spread between 1995 Q1 (Mexico) and 2005 Q4 (Colombia) to 2019 Q4 from 5 countries (table 1) in Latin America. The used variables will, thus, be per capita income as disposable income proxy, gathered from OECD; private consumption from OECD, real GDP growth from Bloomberg and annual population from OECD as per capita consumption proxy; worked hours from OECD and World Bank and interest rates from IMF for each country[3]; and inflation from Bloomberg. Particularly, the Brazilian consumption data is gathered from IBGE and Chilean inflation rate is from FRED St. Louis[4]. The data stops at 2019 Q4 because of the exogenous shock cause by the COVID-19 pandemic. Data was selected considering each country data restriction, e.g., though Mexico has available data from 1995 Q4, it is used from 1999 Q1 and forth for the country was facing a crisis from 1982 to 1994[5].

TABLE 1: COST OF EQUITY, GDP GROWTH RATE, AND AUTOCORRELATION COEFFICIENTS

Country	Sample Period	Observations
Brazil	2001 Q4 – 2019 Q4	68
Chile	2003 Q1 – 2019 Q4	63
Colombia	2005 Q1 – 2019 Q4	55
Mexico	1999 Q1 – 2019 Q4	79

Following on equation (11), will be used a GMM to deal with non-linearity and small sample size, with the moment conditions given by

[3] This study considers only the base interest rate for each country.
[4] Inflation data for Chile was gathered from FRED St. Louis for there was no data for it in Bloomberg, nor FRED St. Louis had the same data for the studied countries.
[5] The Mexican Crisis of 1982 resulted in a new monetary policy that changed the calculation of indexes used in this study after 1999, hence biasing data from before the monetary reform (Meza, 2018).

$$\begin{aligned}\mathbf{E}_t[(\Delta \ln C_{t+1} - (1-\lambda)[\alpha \ln \beta + \alpha r_{t+1} + \theta \Delta \ln C_t + \\ +(1-\alpha-\theta)\gamma \Delta \ln \ell_{t+1}] - \lambda \Delta \ln Y_{t+1}) \otimes Z] = 0\end{aligned} \tag{12}$$

Where Z is a vector of weak instruments given by

$$\begin{aligned}(1): &\quad \{i_{t-l}, \Delta \ln C_{t-l}, \Delta \ln Y_{t-l}, \Delta \ln \ell_{t-l}\}_{l=2}^{3} \\ (2): &\quad \{i_{t-l}, \Delta \ln C_{t-l}, \Delta \ln Y_{t-l}, \Delta \ln \ell_{t-l}, \pi_{t-l}\}_{l=2}^{3} \\ (3): &\quad \{i_{t-l}, \Delta \ln C_{t-l}, \Delta \ln Y_{t-l}, \Delta \ln \ell_{t-l}\}_{l=2}^{4}; \\ (4): &\quad \{i_{t-l}, \Delta \ln C_{t-l}, \Delta \ln Y_{t-l}, \Delta \ln \ell_{t-l}, \pi_{t-l}\}_{l=2}^{4}\end{aligned}$$

Chapter 5

5 RESULTS

To test the assumptions of the consumption processes in Latin America it is used the iterated GMM. This method is used to deal with non-linear model, but also with a finite sample. The moment condition used in the estimations is given by equation (12). Thus, it is used the J test proposed by Hansen (1982) to test if the moment constraints are over-identified. Please note, as Barros Júnior et al. (2018) indicates, that there are temporal aggregation problems in the consumption of income series. That is, despite the lagged instruments in one period being considered strong in general cases, this does not happen when aggregated data on consumption and income are used simultaneously.

Following Barros Júnior et al. (2018), it is used 2 groups of instruments: Group 1: second and third lag of the interest rate and of the growth rate of consumption, income, and hours worked. Group 2: second and third lag of the interest rate and inflation and of the growth rate of consumption, income, and hours worked. Group 3: second to fourth lags of the interest rate and of the growth rates of consumption, income, and hours worked. Group 4: second to fourth lags of the interest rates and inflation and growth rates of consumption, income, and hours worked. The lags of inflation rate are used to evaluate the robustness of the found results. Summarizing the instruments:

$$
\begin{aligned}
(1): &\quad \{i_{t-l}, \Delta \ln C_{t-l}, \Delta \ln Y_{t-l}, \Delta \ln \ell_{t-l}\}_{l=2}^{3} \\
(2): &\quad \{i_{t-l}, \Delta \ln C_{t-l}, \Delta \ln Y_{t-l}, \Delta \ln \ell_{t-l}, \pi_{t-l}\}_{l=2}^{3} \\
(3): &\quad \{i_{t-l}, \Delta \ln C_{t-l}, \Delta \ln Y_{t-l}, \Delta \ln \ell_{t-l}\}_{l=2}^{4}; \\
(4): &\quad \{i_{t-l}, \Delta \ln C_{t-l}, \Delta \ln Y_{t-l}, \Delta \ln \ell_{t-l}, \pi_{t-l}\}_{l=2}^{4}
\end{aligned}
$$

Tables 2 shows the estimations for the parameters of equation (12) for each

country. Due to the usage of GMM, the result is qualitative dependent on the instruments used, in which the method handles different results for different sets of instruments. Brazil, Chile and Colombia presented evidence on rule-of-thumb behavior[6]. For the formulations tested, results indicate that a large portion of the Brazilian consumers are credit-constrained (40.7% to 71.2%, depending on the used instrument), i.e., are rule-of-thumb consumers. Chilean consumer appears to also follow the rule-of-thumb at a high degree and have habit formation in their consumption utility. The case of Colombian consumers is only described by an even higher degree of rule-of-thumb behavior. All previous populations, but Mexico, present separability between consumption and leisure. The Mexican consumer has a long-term consumption orientation with (positive α) and does not separate labor and leisure.

TABLE 2: GMM ESTIMATIONS BY COUNTRIES AND INSTRUMENTS

	Brazil				Chile			
Parameter	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
λ	0.407***	0.712***	0.423***	0.683***	0.401***	0.459***	0.394***	0.467***
	(0.081)	(0.204)	(0.039)	(0.088	(0.069)	(0.095)	(0.047)	(0.083)
α	0.140***	-0.146	0.119***	-0.211	0.359	0.093	0.733***	0.717*
	(0.034)	(0.383)	(0.035)	(0.172	(0.366)	(0.409)	(0.135)	(0.402)
θ	0.682***	2.416	0.399***	1.460***	0.373***	1.153***	0.445***	1.167***
	(0.041)	(1.902)	(0.399)	(0.544	(0.124)	(0.282)	(0.058)	(0.188)
γ	2.583**	0.742	2.116***	-0.83	-10.971	18.844	15.946	5.283**
	(0.893)	(0.657)	(0.199)	(3.723	(22.011)	(45.778)	(13.127)	(2.075)
N	68	68	67	67	63	63	62	62
J test (p-value)	0.9544	0.8297	0.9995	0.9923	0.9439	0.7841	0.9992	0.9875

	Colombia				Mexico			
Parameter	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
λ	0.780***	0.647***	0.732***	0.631***	-0.023	-0.041	0.004	-0.0261

[6] Although Mexico has not presented such result, there is evidence that Mexicans do not separate consumption and leisure and this might be a similar result as the rule-of-thumb behavior, because since theoretically income is a function of labor hours, and considering equation (4), consumption variation is also a function of labor hours. Hence, the effect of rule-of-thumb behavior might be captured by the γ parameter, as discussed in Basu and Kimball (2002).

	(0.141)	(0.227)	(0.224)	(0.15	(0.023)	(0.026)	(0.015)	(0.019)
α	0.343	0.649	0.360*	0.559	0.184***	0.152***	0.166***	0.156***
	(0.631)	(0.866)	(0.215)	(0.554	(0.031)	(0.039)	(0.022)	(0.028)
θ	-1.118	-0.190***	-0.376**	-0.338	0.07	0.170***	0.195***	0.141
	(1.116)	(0.433)	(0.177)	(0.322	(0.054)	(0.062)	(0.041)	(0.047)
γ	-0.439	-0.817	-0.557***	-0.313	1.131***	1.440***	1.198***	1.048***
	(0.181)	(1.624)	(0.169)	(0.36	(0.117)	(0.144)	(0.109)	(0.129)
N	55	55	54	54	79	79	78	78
J test (p-value)	0.9574	0.8435	0.9993	0.9909	0.9989	0.9851	1	0.9996

*** indicates estimations that are statistically different from zero at a significance level of 1%. ** indicates a significance level of 5% and * indicates significance level of 10%. Standard error (in brackets) corrected for heteroskedasticity and first order autocorrelation. Group of instruments: (1) second and third lag of the interest rate and of the growth rates of consumption, income, and hours worked, (2) second and third lag of the interest rates and inflation and of the growth rate of consumption, income, and hours worked, (3) second to fourth lag of the interest rate and the growth rates of consumption, income, and hours worked, (4) second to fourth lag of the interest rates and inflation and of the growth rates of consumption, income, and hours worked.

5.1 WORKING WITH WEAK INSTRUMENTS

In this part, it is used tests that are robust to weak instruments. If the instruments are weak, i.e., poorly correlated with the endogenous variables, then the estimated parameters of the GMM and the hypothesis tests are not reliable. In such case, one needs to use other tests to be able to make a robust to weak instruments inference.

Since this study does not aim to estimate all the structural parameters of the model, one can rewrite the non-linear equation 11 in a linear form, giving the following equation

$$\mathbf{E}_t\left[\Delta \ln C_{t+1}\right] = \delta_0 + \delta_1 \mathbf{E}_t\left[r_{t+1}\right] + \delta_2 \mathbf{E}_t\left[\Delta \ln C_t\right] + \delta_3 \mathbf{E}_t\left[\Delta \ln \ell_{t+1}\right] + \lambda \mathbf{E}_t\left[\Delta \ln Y_{t+1}\right] \qquad (14)$$

where

$$\begin{aligned}
\delta_0 &= (1-\lambda)\alpha \ln \beta \\
\delta_1 &= (1-\lambda)\alpha \\
\delta_2 &= (1-\lambda)\theta \\
\delta_3 &= (1-\lambda)(1-\alpha-\theta)\gamma
\end{aligned}$$

Thus, following equation can be estimated

$$\Delta \ln C_{t+1} = \delta_0 + \delta_1 r_{t+1} + \delta_2 \Delta \ln C_t + \delta_3 \Delta \ln \ell_{t+1} + \lambda \Delta \ln Y_{t+1} + \varepsilon_{t+1} \qquad (15)$$

Note that the initial structural interpretation for the λ parameter still holds, i.e., it is the fraction of income that belongs to rule-of-thumb consumers, and it is possible to identify the parameters found in previous estimations.

Table 3 reports the estimation of equation (15), with the instrumental variables (IV) method. They indicate that the Craig-Donald statistic is low for all countries and instruments, which indicates the presence of weak instruments.

TABLE 3: IV ESTIMATIONS BY COUNTRIES AND INSTRUMENTS

	Brazil				Chile			
Parameter	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
ΔC_t	0.408*	0.68	0.232	0.455	0.225	0.622	0.27	0.618
	(0.241)	(0.521)	(0.181)	(0.330)	(0.353)	(0.512)	(0.334)	(0.492)
r_{t+1}	0.086	-0.025	0.073	-0.06	0.231	0.55	0.445	0.375
	(0.128)	(0.212)	(0.124)	(0.189)	(0.645)	(0.781)	(0.440)	(0.607)
Δl_{t+1}	0.268	-0.176	0.586*	0.099	-1.826	-2.545*	-1.773*	-2.496*
	(0.417)	(0.910)	(0.332)	(0.683)	(1.198)	(1.513)	(1.049)	(1.369)
ΔY_{t+1}	0.403**	0.66	0.419**	0.665**	0.412*	0.466*	0.400*	0.470*
	(0.205)	(0.403)	(0.191)	(0.325)	(0.228)	(0.279)	(0.210)	(0.260)
Constant	-0.126	0.047	0.335	0.786	-0.308	-4.169	-2.502	-4.397
	(1.395)	(1.731)	(1.273)	(1.494)	(2.487)	(3.245)	(2.160)	(2.936)
Cragg Donald (statistic)	1.049	0.214	0.716	0.211	0.592	0.759	0.736	0.673
N	68	68	67	67	63	63	62	62
J test (p-value)	0.5532	0.3184	0.6016	0.4865	0.339	0.1149	0.3154	0.1093

	Colombia				Mexico			
Parameter	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
ΔC_t	-0.218	-0.02	-0.097	-0.109	0.065	0.17	0.19	0.139
	(0.334)	(0.367)	(0.257)	(0.264)	(0.246)	(0.253)	(0.214)	(0.230)
r_{t+1}	0.049	0.164	0.093	0.178	0.191	0.159	0.167	0.161
	(0.284)	(0.293)	(0.257)	(0.264)	(0.155)	(0.157)	(0.147)	(0.153)
Δl_{t+1}	-0.009	-0.154	-0.155	-0.085	0.865**	1.022**	0.763*	0.764*
	(0.302)	(0.361)	(0.257)	(0.271)	(0.431)	(0.440)	(0.378)	(0.389)

ΔY_{t+1}	0.740*	0.549	0.731***	0.598**	-0.020*	-0.04	0.005	-0.025
	(0.350)	(0.433)	(0.264)	(0.284)	(0.087)	(0.088)	0.082'	(0.085)
Constant	1.322	0.831	0.817	0.83	-0.245	-0.121	-0.406	-0.098
	(1.633)	(1.711)	(1.445)	(1.483)	(1.077)	(1.084)	1.016'	(1.055)
Cragg Donald (statistic)	0.514	0.421	0.59	0.706	0.929	1.151	0.838	0.961
N	55	55	54	54	79	79	78	78
J test (p-value)	0.5892	0.6224	0.5832	0.6038	0.1643	0.171	0.2334	0.1974

*** indicates estimations that are statistically different from zero at a significance level of 1%. ** indicates a significance level of 5% and * indicates significance level of 10%. Standard error (in brackets) corrected for heteroskedasticity and first order autocorrelation. Group of instruments: (1) second and third lag of the interest rate and of the growth rates of consumption, income, and hours worked, (2) second and third lag of the interest rates and inflation and of the growth rate of consumption, income, and hours worked, (3) second to fourth lag of the interest rate and the growth rates of consumption, income, and hours worked, (4) second to fourth lag of the interest rates and inflation and of the growth rates of consumption, income, and hours worked.

In table 4 it is shown the results for the Anderson and Rubin (1949) (AR)7, Conditional Likelihood Ratio (CLR) and Wald statistics. For the CLR statistic it is applied the Kleibergen and Paap (2006) methodology. The CLR allow the testing of H_0 : δ_i = λ = 0 for *i* ∈ {0, 1, 2, 3} (assuming exogeneity of the instruments) and presents good properties; in particular, it is the most powerful test for the linear model under homoskedasticity (within a similar invariant class of tests), meaning that it is testing if consumption is a random walk. Aside testing H_0, the AR statistics acts as a complement of the CLR test, due to testing both the parameters and the exogeneity of the instruments, although it has more power in a just identified model and commonly does not reject H_0 when the model is over-identified (Andrews et al., 2019). The Wald test is reported due to it being a common test of H_0.

The Wald test is reported due to it being a common test of H_0. The results in tables 10 to 13 point that H_0 should be rejected at a 5% level of significance for Brazil, though H_0 in all other countries should not be rejected.

TABLE 4: ROBUST INFERENCE FOR WEAK INSTRUMENTS FOR COUNTRIES: P-VALUE

	Brazil	Chile

Parameter	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
AR	0.0266	0.003	0.0301	0.028	0.1858	0.1255	0.2682	0.1599
CLR	0.0001	0.0031	0	0.0001	0.0346	0.0224	0.0182	0.0116
Wald	0	0.0088	0	0	0.0525	0.0961	0.0207	0.0415

	Colombia				Mexico			
Parameter	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
AR	0.1551	0.3798	0.13	0.281	0.1621	0.1305	0.1707	0.2637
CLR	0.0301	0.5741	0.0013	0.4356	0.0177	0.0245	0.0116	0.0734
Wald	0.0809	0.568	0.0333	0.3041	0.1877	0.1336	0.0883	0.1821

AR and CLR represent the Anderson-Rubin and Conditional Likelihood Ratio tests, respectively. Group of instruments: (1) second and third lag of the interest rate and of the growth rates of consumption, income, and hours worked, (2) second and third lag of the interest rates and inflation and of the growth rate of consumption, income, and hours worked, (3) second to fourth lag of the interest rate and the growth rates of consumption, income, and hours worked, (4) second to fourth lag of the interest rates and inflation and of the growth rates of consumption, income, and hours worked.

Thus, considering both the AR and CLR tests, there is evidence that Brazilian consumers follow a rule-of-thumb behavior. Except for Colombia, considering only the CLR test, this study finds evidence that consumption in Latin American countries is not a random walk.

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Chapter 6

6 FINAL REMARKS

Reinforcing results found by previous literature, this study presents evidence of rule-of-thumb behavior of Brazilian consumers. Also, it shows evidence that Chilean consumers follow the rule-of-thumb as well, Chileans present habit formation and Mexicans have non-separable preferences between leisure and consumption and value future consumption more than the other studied countries. Though the result on non-separable preference for Mexico might be evidence on rule-of-thumb behavior. Consumption in Colombia is not a random walk, but it is not possible to distinguish which consumption trait is present. Therefore, this study shows that consumers heterogeneity is a marked characteristic in Latin America and brings evidence that bundling Latin American countries in one "underdeveloped" group is not a good approach for studying the region.

Future studies can build on Delikouras and Kostakis (2019) by studying Latin American countries fitness to the model studied. Thus, validating the effort of the present work on consumption predictability.

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