DOES THE BUFFER STOCK MODEL EXPLAIN THE HOUSEHOLD SAVING RATE IN POLAND?

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Abstract
Household saving behavior is a key factor influencing the economic outlook. This paper contributes to a vast strand of the literature on the effects of uncertainty on households saving by addressing the issue of buffer stock saving in Poland. Following the reduced-form buffer stock saving model proposed by Carroll et al. (2012) three determinants of the household saving rate are identified: household net financial wealth, credit conditions, and the unemployment risk faced by households. An analysis of data for the period 2003-2016 finds that all three explanatory variables play a statistically significant and economically important role. Thus, it supports the hypothesis that the increased uncertainty causes greater savings in the presence of credit constraints and reveals that the buffer stock model explains substantial part of variation in the household saving rate.
Keywords: credit, household saving, precautionary motive, uncertainty, wealth. JEL codes: E21, E44.

1. Introduction
The development of household saving is an issue of great interests to forecasters, policymakers, financial markets, and the business community. The vast strand of the literature addresses the effect of uncertainty on households saving behavior. This is a long-standing topic in research on household saving (e.g. Skinner 1988; Dynan 1993). In the seminal works of Carroll (1997) and Deaton (1991) assets play the role of a buffer stock, and a consumer saves and dissaves in order to smooth consumption in the face of income uncertainty. The precautionary motive ("to build up a reserve against unforeseen contingencies") has assumed an important place in the literature on household saving (e.g. Hubbard et al. 1994; Bertaut and Haliassos 1997; Carroll and Samwick 1997; Lusardi 1998; Cagetti 2003; Lee and Sawada 2007; Gunning 2010; Mody et al. 2012; Mishra et al. 2012; Bande and Riveiro 2013; Ceritoğlu 2013; Chamon et al. 2013; Deidda 2014; Limosani and Millemaci 2014; Mastrogiacomo and Alessie 2014; Aizenman et al. 2015; Fulford 2015; Bouyon 2016). A fresh interest in precautionary saving as a potential explanation of the sharp increment in household saving rates during the Great Recession has emerged recently. For example, Bouyon (2016) using panel data for 13 European countries of the period 2007-2013 confirms the prominent role played by the precautionary motive during the financial crisis of 2008-2009, which is reflected in the strong impact of unemployment rates and
housing prices upon household saving rate. Bande and Riveiro (2013) using Spanish regional data for the period 1980-2007 reveals that part of the increase in saving rates is related to a precautionary motive and that increased uncertainty causes greater savings rates.

Carroll et al. (2012) argue that the long stability of the U.S. personal saving rate from the 1960s through the early 1980s, subsequent steady decline from the 1980s to 2007, and recent substantial increase in 2008-2011 can all be interpreted using a parsimonious buffer stock model of optimal consumption in the presence of labor income uncertainty and credit constraints. Their model's key insight is that, in the presence of income uncertainty, optimizing households have a target wealth ratio that depends on the usual theoretical considerations (risk aversion, time preference, expected income growth, etc.) as well as the degree of labor income uncertainty and the availability of credit. Their model's estimated coefficients imply that a substantial contribution to the decline in consumption during the Great Recession was due to the increase in precautionary saving. The perceived labor income risk is measured by the households' unemployment expectations using the Thomson Reuters/University of Michigan's Surveys of Consumers. The households' unemployment expectations are assumed to be a better proxy of labor income risk than the unemployment rate.

Broadway and Haisken-DeNew (2017), using household-level panel data, distinguish between 'real' income uncertainty the household is actually exposed to, and 'perceived' income uncertainty. They find that the latter substantially increases precautionary savings above and beyond the effect of 'real' income uncertainty.

Carroll (1992) and Carroll et al. (2012) show the dynamics of the saving rate adjustment to a permanent increase in uncertainty. In response to a permanent worsening in economic circumstances, consumption initially 'overshoots' its ultimate permanent adjustment. This reflects the fact that, when the target level of wealth rises, not only is a higher level of steady-state saving needed to maintain a higher target level of wealth, an immediate further boost to saving is necessary to move from the current (inadequate) level of wealth up to the new (higher) target. It means that an immediate jump in the saving rate is followed by a gradual decline toward a new equilibrium rate that is higher than the original one.

Most studies investigating household saving at the macroeconomic level focus on developed economies. Studies of former socialist economies in Central and Eastern Europe (CEE) are sparse. However such an analysis is of great importance for the CEE countries, which have had at the same time both relatively low and fluctuating saving rates and also a very volatile macroeconomic environment with large fluctuations in growth rates, unemployment and inflation rates (Kukk and Staehr 2015). Libecka (2015) investigates Polish investment needs for domestic and foreign savings and reveals that an improvement of the net international investment position of Poland requires the domestic saving rate to be raised, while the share of households savings in domestic savings demonstrates a declining trend. In this context the research on determinants of Polish household financial behavior is particularly relevant.
This paper reveals a macroeconomic analysis of household saving in Poland in the period between 2003 and 2016. The period of analysis is determined by the availability of data. Some aspects of changes in Polish household saving behavior were discussed by, among others Dębski and Świderski (2016), Klopocka (2017), Kolasa and Libera (2015), Kośny (2013).

The aim of this study is to measure the relative importance of the precautionary, wealth, and credit effects on the Polish household saving rate using the model proposed by Carroll et al. (2012). This paper contributes to filling the gap in the literature by addressing the issue of buffer stock saving in Poland.

The rest of the paper is organized as follows. Section 2 briefly describes the data and the methodology of the research. Section 3 presents and discusses the empirical findings of regression analysis. Section 4 concludes with some remarks.

2. Data and Method

The gross household saving rate (SR) is calculated by dividing household gross saving by household gross disposable income, the latter being adjusted for the change in the net equity of households in pension funds reserves. The SR published by Eurostat (ESA2010) is employed here. To smooth the series, the variables are calculated as the moving sum of the value of the quarter concerned and of the three preceding quarters. Therefore, the developments concern the past four quarters (“moving year”).

In general, the proxies applied in this paper follow up those used by Carroll et al. (2012). To capture the wealth channel, the ratio of household net financial assets to gross income (FW), published by Eurostat is used.

To measure the credit supply conditions, the credit conditions index (CC) is constructed using the terms for new consumer credit offered to households taken from the question of the National Bank of Poland’s Senior Loan Officer Opinion Survey. The survey-participating banks evaluate seven factors of consumer credit terms, as follows:

- spread on average loans (wider spread – tightened, narrower margin– eased),
- spread on riskier loans,
- non-interest loan costs (fees, etc.) (higher costs – tightened, lower costs – eased),
- security/collateral requirements,
- maximum size of the loan/credit line (smaller – tightened, larger – eased),
- maximum loan maturity (shorter – tightened, longer – eased),
- other terms.

Each factor is rated using the following scale:
- - tightened considerably
- tightened somewhat
= remained basically unchanged
+ eased somewhat
++ eased considerably
N/A not applicable

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The so-called net percentage is calculated for each factor, that is the difference between the percentage of responses “eased considerably” and “eased somewhat” and the percentage of responses “tightened considerably” and “tightened somewhat”. A negative index indicates a tendency of tightening the credit standards. The credit conditions index ($CC$) is the arithmetic average of the indexes calculated for each of the above-mentioned seven factors of consumer credit terms. To smooth the fluctuating series, a four-quarter average is applied. Further information on Senior Loan Officer Opinion Survey methodology is included in (NBP 2017).

As a proxy for unemployment risk the unemployment expectations index ($UE$) is used. The index is based on survey data generated within EU Programme of Business and Consumer Surveys. The question applied to construct the index is: “How do you expect the number of people unemployed in this country to change over the next 12 months?” The index values range from $-100$ if all respondents choose the answer “fall sharply” (positive consumer sentiment, low unemployment risk) to $+100$, if all respondents choose the option “increase sharply” (negative consumer sentiment, high unemployment risk). Detailed information on consumer survey methodology is presented in European Commission (2016).

Moreover, in the robustness check phase the following variables that can provide an additional or alternative explanation for the household saving rate are used:

- the real gross household disposable income ($IC$) in billions (a thousand millions) of national currency (PLN) (current values are deflated by the HICP, published by Eurostat);

- the real 3-month interest rate ($IR$) (a representative short-term interest rate series for the domestic money market deflated by the HICP, published by Eurostat);

- the real GDP growth ($GDP\_g$), published by the Central Statistical Office;

- the all-items Harmonized Index of Consumer Prices ($HICP$) (moving 12-months average rate of change), published by Eurostat; and

- the unemployment rate ($UR$) as a percentage of the active population (seasonally adjusted), published by Eurostat.

The dataset covers quarterly observations from 2003Q4 to 2016Q2. The period under analysis is determined by the availability of data. The descriptive statistics of the variables are presented in Table 1.

Initially, Augmented Dickey-Fuller tests are performed in order to determine the order of integration of the variables. Most variables are found to be integrated of order one or I(1) (GDP growth is the exception as it is I(0)). Therefore, all variables are first-differenced and changes in household saving rate are modeled as a function of changes in other economic variables.
### Table 1. Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Symbol</th>
<th>Mean</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Household Saving Rate (percentage)</td>
<td>SR</td>
<td>4.01</td>
<td>3.61</td>
<td>1.49</td>
<td>10.36</td>
<td>2.08</td>
</tr>
<tr>
<td>Household Net Financial Assets to Gross Income Rate (percentage)</td>
<td>FW</td>
<td>86.47</td>
<td>85.43</td>
<td>58.94</td>
<td>109.79</td>
<td>12.36</td>
</tr>
<tr>
<td>Credit Conditions Index (points)</td>
<td>CC</td>
<td>2.22</td>
<td>2.33</td>
<td>-20.34</td>
<td>13.58</td>
<td>8.82</td>
</tr>
<tr>
<td>Unemployment Expectations Index (points)</td>
<td>UE</td>
<td>17.26</td>
<td>19.13</td>
<td>-17.73</td>
<td>50.13</td>
<td>16.94</td>
</tr>
<tr>
<td>Real Gross Household Disposable Income (billion PLN)</td>
<td>IC</td>
<td>849.19</td>
<td>866.26</td>
<td>606.48</td>
<td>1097.31</td>
<td>166.03</td>
</tr>
<tr>
<td>Real Interest Rate (percentage)</td>
<td>IR</td>
<td>4.13</td>
<td>4.23</td>
<td>1.68</td>
<td>6.57</td>
<td>1.39</td>
</tr>
<tr>
<td>Real GDP Growth (percentage)</td>
<td>GDPg</td>
<td>3.94</td>
<td>3.66</td>
<td>0.14</td>
<td>7.71</td>
<td>1.86</td>
</tr>
<tr>
<td>Harmonized Index of Consumer Prices (percentage)</td>
<td>HICP</td>
<td>2.25</td>
<td>2.60</td>
<td>-0.70</td>
<td>4.20</td>
<td>1.58</td>
</tr>
<tr>
<td>Unemployment Rate (percentage)</td>
<td>UR</td>
<td>10.99</td>
<td>9.70</td>
<td>6.20</td>
<td>19.80</td>
<td>4.02</td>
</tr>
</tbody>
</table>

Source: author's own calculations.

To investigate whether the determinants implied by a standard buffer stock model can explain the gross household saving rate in Poland, I estimate regressions along the lines of Carroll et al. (2012). To allow for the possibility that the impact of the regressors on household saving is not purely contemporaneous but is also lagging to some extent, models with the contemporaneous values and four lags of dependent variables are considered. The decision which of four lags to use is made based on the evidence provided by Akaike’s Information Criterion (AIC). The baseline specification takes the following form:

$$\Delta SR_t = \gamma_0 + \gamma_{\Delta FW_{t-1}} \Delta FW_{t-1} + \gamma_{\Delta CC_{t-1}} \Delta CC_{t-1} + \gamma_{\Delta UE_{t-1}} \Delta UE_{t-1} + \varepsilon_t \tag{1}$$

where $i = 0,1,...,4$, $t$ is a time subscript, $FW$ represents household net financial assets to gross income rate, $CC$ stands for credit conditions index, $UE$ symbolizes unemployment expectations index and $\varepsilon_t$ is the error term. In the second step of the analysis robustness check is performed. For this purpose the baseline model is extended with additional variables as follows:

$$\Delta SR_t = \gamma_0 + \gamma_{\Delta FW_{t-1}} \Delta FW_{t-1} + \gamma_{\Delta CC_{t-1}} \Delta CC_{t-1} + \gamma_{\Delta UE_{t-1}} \Delta UE_{t-1} + \ldots \gamma_{\Delta X_{t-1}} \Delta X_{t-1} + \varepsilon_t \tag{2}$$
where the vector $X$ collects drivers of saving that are outside the scope of the buffer stock model (i.e., income $IC$, interest rate $IR$, real GDP growth $GDPg$, inflation $HICP$, and unemployment rate $UR$).

3. Empirical Results

The following section presents and discusses the empirical findings of a regression analysis. Tables 2 and 3 reveal the results of several variations on equation (1) and equation (2), respectively.

**Table 2. Preliminary Saving Regressions acc. to equation (1)**

\[
\Delta SR_t = \gamma_0 + \gamma_{\Delta FW_{t-1}} \Delta FW_{t-1} + \gamma_{\Delta CC_{t-1}} \Delta CC_{t-1} + \gamma_{\Delta UE_{t-1}} \Delta UE_{t-1} + \epsilon_t
\]

<table>
<thead>
<tr>
<th>Model</th>
<th>Financial Wealth $\Delta FW$</th>
<th>Credit Conditions $\Delta CC$</th>
<th>Unemployment Risk $\Delta UE$</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\gamma_0$</td>
<td>$-0.154$ (0.099)</td>
<td>$-0.054$ (0.089)</td>
<td>$-0.085$ (0.084)</td>
<td>$-0.070$ (0.064)</td>
</tr>
<tr>
<td>$\gamma_{\Delta FW_{t-1}}$</td>
<td>0.034*** (0.016)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\gamma_{\Delta CC_{t-1}}$</td>
<td></td>
<td>$-0.072$*** (0.028)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\gamma_{\Delta UE_{t-1}}$</td>
<td></td>
<td></td>
<td>0.030*** (0.008)</td>
<td>0.019*** (0.007)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.054</td>
<td>0.095</td>
<td>0.141</td>
<td>0.363</td>
</tr>
<tr>
<td>AIC</td>
<td>96.828</td>
<td>76.793</td>
<td>84.698</td>
<td>63.525</td>
</tr>
<tr>
<td>F stat p val.</td>
<td>0.033</td>
<td>0.015</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>N</td>
<td>49</td>
<td>43</td>
<td>47</td>
<td>43</td>
</tr>
</tbody>
</table>

Notes: The table reports coefficients and their standard errors (in parentheses). Hypothesis tests were conducted using a heteroskedasticity and serial correlation robust covariance matrix. ***, **, * represent statistical significance at the 1%, 5%, and 10% levels respectively.

Source: author's own calculations.

The first three columns of Table 2 show univariate specifications in which the changes in household saving rate are in turn regressed on changes in each of the three determinants: wealth, credit conditions, and unemployment risk. Univariate regressions capture up to 14 percent of the variation of household saving rate changes. The highest explanatory power is found for the model with perceived unemployment risk that reflects precautionary effect. In the baseline model the three key variables of interest are significant at the 1% level and jointly explain 36 percent of the variation of the regressand.
Table 3. Additional Saving Regressions – Robustness to Explanatory Variables acc. to equation (2)

\[
\Delta SR_t = \gamma_0 + \gamma_{\Delta FW_{t-1}} \Delta FW_{t-1} + \gamma_{\Delta CC_{t-1}} \Delta CC_{t-1} + \gamma_{\Delta UR_{t-1}} \Delta UR_{t-1} + \ldots
\]

\[
\ldots + \gamma_{\Delta IC_{t-1}} \Delta IC_{t-1} + \gamma_{\Delta IR_{t-1}} \Delta IR_{t-1} + \gamma_{\Delta GDP_{t-1}} \Delta GDP_{t-1} + \ldots
\]

\[
\ldots + \gamma_{\Delta HICP_{t-1}} \Delta HICP_{t-1} + \gamma_{\Delta UER_{t-1}} \Delta UER_{t-1} + \varepsilon_t
\]

<table>
<thead>
<tr>
<th>Model</th>
<th>Baseline</th>
<th>Income ΔIC</th>
<th>Interest Rate ΔIR</th>
<th>GDP Growth ΔGDPg</th>
<th>HICP ΔHICP</th>
<th>Unemployment Rate ΔUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \gamma_0 )</td>
<td>-0.070</td>
<td>-0.759***</td>
<td>-0.090</td>
<td>-0.067</td>
<td>-0.091</td>
<td>-0.049</td>
</tr>
<tr>
<td></td>
<td>(0.064)</td>
<td>(0.147)</td>
<td>(0.066)</td>
<td>(0.066)</td>
<td>(0.061)</td>
<td>(0.074)</td>
</tr>
<tr>
<td>( \gamma_{\Delta FW_{t-1}} )</td>
<td>0.051***</td>
<td>0.034***</td>
<td>0.044***</td>
<td>0.047***</td>
<td>0.045***</td>
<td>0.049***</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.010)</td>
<td>(0.016)</td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>( \gamma_{\Delta CC_{t-1}} )</td>
<td>-0.084***</td>
<td>-0.030</td>
<td>-0.081***</td>
<td>-0.075***</td>
<td>-0.076***</td>
<td>-0.086***</td>
</tr>
<tr>
<td></td>
<td>(0.026)</td>
<td>(0.025)</td>
<td>(0.026)</td>
<td>(0.023)</td>
<td>(0.025)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>( \gamma_{\Delta UR_{t-1}} )</td>
<td>0.019***</td>
<td>0.010***</td>
<td>0.016**</td>
<td>0.016**</td>
<td>0.019**</td>
<td>0.018**</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.005)</td>
<td>(0.008)</td>
<td>(0.007)</td>
<td>(0.007)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>( \gamma_{\Delta IC_{t-0}} )</td>
<td></td>
<td>0.064***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.010)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \gamma_{\Delta IR_{t-1}} )</td>
<td></td>
<td></td>
<td>-0.218</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.163)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \gamma_{\Delta GDP_{t-1}} )</td>
<td></td>
<td></td>
<td></td>
<td>-0.153</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.097)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \gamma_{\Delta HICP_{t-1}} )</td>
<td></td>
<td></td>
<td></td>
<td>-0.310**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.150)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \gamma_{\Delta UER_{t-1}} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.081</td>
<td>(0.085)</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>0.363</td>
<td>0.615</td>
<td>0.365</td>
<td>0.401</td>
<td>0.385</td>
<td>0.353</td>
</tr>
<tr>
<td>AIC</td>
<td>63.525</td>
<td>42.783</td>
<td>64.307</td>
<td>61.734</td>
<td>62.904</td>
<td>65.117</td>
</tr>
<tr>
<td>F stat p val</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>N</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>43</td>
</tr>
</tbody>
</table>

Notes: The table reports coefficients and their standard errors (in parentheses). Hypothesis tests were conducted using a heteroskedasticity and serial correlation robust covariance matrix. ***, **, * represent statistical significance at the 1%, 5%, and 10% levels respectively. Source: author's own calculations.

Table 3 presents a set of specification checks of the baseline model with other potential determinants of saving. Although the inclusion of changes in interest rate (IR), real GDP growth (GDPg), and unemployment rate (UR) does not substantially affect the estimates obtained under the baseline specification. The coefficient on the contemporaneous changes in HICP is statistically significant at the 5% level, still the estimated coefficients on the three key variables remain broadly unchanged compared with the baseline specification. The greatest improvement of the model is obtained when the contemporaneous changes in IC
are added. This is the only model in which one of the three pivotal regressors (i.e., CC) ceases to be statistically significant. In all remaining specifications the coefficients on the baseline series (wealth, credit conditions, unemployment expectations) remain highly statistically significant. To sum up, the analysis reveals the importance of the precautionary, wealth, and credit effects on saving behavior of Polish households. Thus, it supports the hypothesis that the buffer stock model explain substantial part of variation in household saving rate in Poland.

4. Conclusion

Following the reduced-form buffer stock saving model proposed by Carroll et al. (2012), three determinants of the household saving rate are identified: household net financial wealth, credit available for households, and unemployment risk faced by households. An analysis of the household saving rate in Poland (2003Q4-2016Q2) finds that all three explanatory variables play a statistically significant role. It reveals the importance of the precautionary, wealth, and credit effects on saving behavior of Polish households. Thus, it supports the hypothesis that the buffer stock model explain substantial part of variation in household saving rate in Poland.

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