Chapter

The Life Cycle Hypothesis and Uncertainty: Analyzing Aging Savings Relationship in Tunisia

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Abstract

This research empirically checks the effect of uncertainty on aging-saving link that is indirectly captured by an auxiliary variable: the unemployment. It looks at the nexus population aging and savings by bringing out the unemployment context importance in determination saving behavior notably in a setting of unavailability of unemployment allowance. To better estimate population aging, it considers the old-age dependency ratio besides the total dependency one, which is the usually indicator used. Applying the Structural VAR model, the variance decomposition technique and the response impulse function, on Tunisia during 1970–2019, it puts on show that elderly do not dissave in a context of enduring unemployment and unavailability of unemployment allowance. Unemployment is an important factor able to shaping the saving behavior and to distort the life cycle hypothesis's prediction. Consequently, the life cycle hypothesis cannot be validated under uncertainty. Hence, aging does not to alter savings systematically. The nature of aging-saving relationship is upon to social and economic context.

Keywords: Aging, Unemployment, Saving, life cycle hypothesis, SVAR, Tunisia

1. Introduction

There is a great concern about the increase of elderly proportion follow-up the aging population process over the world. It is likely to create important macroeconomic issues and involve new policies challenges as it will put downward pressure on saving according to the life cycle hypothesis (LCH) prediction formulated by Modigliani and Brumberg [1]. Indeed, the saving decline is well recognized to be associated with lower rates of capital accumulation and growth in the economy. Saving is crucial for investment and the maintenance of strong and sustainable economic growth. In addition, saving is one of the essential aspects of building wealth and having a secure financial future. It gives a way out from uncertainties of life and enjoy a quality of life.

Hence, it is of great interest to look at the demographic changes impact on saving in order to seek how to prevent saving from such an eventual decline. The empirical studies in the topic, generally, have relied on the life cycle model; as it better explains the varying rates of savings in societies with relatively younger or older populations. However, the LCH's prediction was not often empirically validated to argue that saving will be automatically depressed consequence of the population aging process. There is evidence that the social and economic conditions limit the scope of the LCH.

This study reviews the LCH to emphasize the most significant factors that may distort its prediction. It focuses on the uncertainty to explain the aging-saving relationship. It tries to check empirically whether uncertainty consideration may distort the LCH. Thereby the aging population do not put a down pressure on saving systematically.

However, given the difficulty to directly and objectively estimate uncertainty extent on saving behavior, we indirectly capture by an auxiliary variable the unemployment. We seek to highlight the influence of the precautionary motive related to the risk of unemployment. Thus, we try to give information about the transmission mechanism between aging population and saving considering the unemployment savings pattern as a determinant of saving behavior in a setting of unavailability of unemployment allowance. So, we draw attention that unemployment is an important factor up to distort the life cycle model's prediction.

Unlike previous studies, we build our estimates not only on the total dependency ratio (the proportion of population aged less than 15 years and aged 60 years or more versus the proportion aged 15–59) as an aging indicator, but also on the old-age dependency ratio (the proportion of population aged 60 years or more versus the proportion aged 15–59). This will allow us to make comparison and to deduce the effect of the child dependency ratio (the proportion of population aged less than 15 years versus the proportion aged 15–59). Besides, we focus on national saving to avoid narrowing the population aging impacts since the corporate and the government saving are sensitive to population aging as the household saving.

In addition, given the lack of researches on this issue on developing countries (which economic and social environment greatly differ from the developed countries) we devote our study to Tunisian case. Tunisia is an interesting case of study because it is a well advanced in the aging process. As well, it suffers from an enduring and high unemployment rate and an inefficient pension system (as detailed in Section 3). Furthermore, it is characterized by a strong altruistic familial intergenerational relationship [2–4].

To check out the relationship between aging, unemployment, national saving and economic growth we apply a time series modeling approach over the period 1970–2019. We carry out a Structural VAR model, as defined by Sims [5]. We analyze the impulse response functions (IRFs) of different shocks for all variable's fluctuations. We also apply the bootstrap methods to construct the confidence intervals of the IRFs. Additionally, we complete our dynamic analysis by the variance decomposition.

This study represents the first attempt to model the Tunisian aggregate national saving by considering both the impact of demographic changes and of unemployment.

In what follows, we give, in Section 2, an overview of the life cycle hypothesis and its bounds. In Section 3 we give some sight of the demographic change and the saving evolution occurred in Tunisia. In Section 4, we specify the econometric model and in Section 5 we discuss the results found. Finally, we end, in Section 6, with the main findings and policy recommendations.

2. Life cycle pattern overview

In this section we state the life cycle's savings to emphasize the social and economic conditions that may constrain its validation.

2.1 Life cycle hypothesis

The life cycle theory pinpoints the intertemporal allocation of time, effort and money. In its simple form, the standard life cycle hypothesis's (LCH) formulated by Modigliani and Brumberg [6], suggests that individuals save during working life for their consumption needs when they retire, dissave after retirement, and die without wealth. Hence, individuals will smooth consumption over their lifetime regard to the expected lifetime resources. They accumulate wealth during the pre-retirement period by consuming less than their disposable income. So, during retirement, they de-cumulates wealth to finance its consumption. That is, the saving rate should follow a hump-shaped over the life cycle as shown by the **Figure 1** (in the Appendix).

Therefore, one very important implication of the LCH is that the demographic profile of a population should be an important factor influencing the aggregate saving rate. Given that population aging is defined as a shift in the population age distribution towards old age, so a change of the balance between youth and elderly proportion (defined in the following as a person aged over 60 years-old) causes society to age and subsequently to affect the saving pattern.[1] Such a change may change the savers proportion in the economy and diminish the aggregate saving rate according to the LCH.

If there is a large proportion of the population working, then, the saving rate should be high. However, if there is a large population proportion over retirement age or very young, the saving rate would be low. This suggests that aggregate saving rate should be negatively correlated with total dependency ratio.

Even though the theoretical conclusion of the life cycle model is clear, the empirical evidence is not often proved and stays controversial until today as it was decades ago. There is evidence that elderly may not dissave, at least not to the extend hypothesis suggested by the pure life cycle model which abstracts a number of factors that would complicate its prediction.

2.2 The life cycle hypothesis bounds

The Life cycle theoretical conclusion is understandable given its simplifying assumptions such as no uncertainty, a finite decision horizon, no inheritance and perfect financial market with no credit constraint [7]. According to the LCH, individual takes decisions basically depending to events and fact that are known with certainty in each period of life (such future income, death date, and interest rate). Nevertheless, these assumptions are considered too restrictive. Indeed, events are uncertain [8, 9] and financial market is imperfect with credit constraint. Uncertainty affects consumption and savings behavior as consumers are generally cautious. Moreover, according to the Kotlikoff [10] dynastic model of savings, individuals do not act in a finite horizon, but in an infinite one. In addition, they have a dynastic behavior characterized by a strong preference to let, at their death, a very limited capital de-cumulation [11–13]. Thus, parents, having an altruistic motive, seek to not decumulate wealth to leave inheritance to their children. Consequently, the population aging may not automatically depress national saving. Kotlikoff and Summers [14] conclude that the "life cycle saving" cannot account for more than 20 percent of U.S. capital formation, and the intergenerational transfers

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[1] Population aging arises from two demographic phenomena the birth and the mortality decline. As for declining fertility, it reduces the number of children, which is generally considered a main explanation of growing aging. For mortality decline, it increases the longevity and the number of elderly.

play a dominant role in wealth accumulation, accounting for 80 percent or more of observed wealth.

Additionally, it is worth noting that the conflicting evidence on the life cycle saving may also be due to the econometric approaches used and the aging indicator chosen. Indeed, the micro econometric analysis invalidates life cycle model's prediction to support the Kotilkoff hypothesis but their results are difficult to aggregate because of severe problem of heterogeneous behavior at the household level. Conversely, studies based on macro data for a country generally support the prediction. However, most of them refer to developed societies while in developing societies people face different economic challenges and social conditions, which may lead to different evidences. In that way, these studies could not be very useful for understanding saving behavior in developing countries. The difference through countries is in the design of pension systems and health care, taxes and transfers as well as labour market conditions, which are unavoidably depend to the population age distribution. As well, they may alter individual economic behavior and so could be the origin of the inconsistency LCH's evidences.

Also, the choice of the population aging indicator to estimate is crucial. The total dependency ratio which is generally used does not accurately reflect the aged population since it composed of both the old and the child dependency ratio. It is more fitting to use the old-age dependency ratio to explicitly consider the effect of aged population on savings rate [15]. With more cautious in the aging indicator use, the life cycle model's prediction is likely to be endorsed also in macroeconomic approach.

2.3 The life cycle hypothesis and uncertainty

The LCH analysis has been gradually enriched, to focus on three reasons for accumulation: the foresight for retirement, the intergenerational altruism and inheritance and the wariness of the saver face to risk (of income, health and lifetime span). In this work, we focus more on the third reason of accumulation by looking at how uncertainty, about future income affects the behavior of the individual' saving. Uncertainty consideration has made it possible to highlight precautionary behavior as the future work income is random; consumption (otherwise savings) depends not only on expectation, but also on the variance of the expected income. A risk-averse or aware consumer will save more. In fact, savings play an insurance role against the hazards affecting the household, especially the hazards related to income (unemployment, loss of wages, etc.) [16]. Thus, uncertainty about future income affects the behavior of the individual 'saving by increasing the demand for precautionary assets, and hence savings amount.

As well, there is precautionary behavior as to face health care expenditure at advanced aged when the risk of health problems is potentially great; notably in the context of inefficient health care system [17]. As a result, households are saving not only to offset lower future income, but also to insure against all sorts of risks.

However, empirically it is not easy to estimate uncertainty extent on saving behavior. It is difficult to quantify this relationship given the difficulty to directly and objectively estimate uncertainty. Empirically there are no quantitative measurements of uncertainty that could be used directly. In the case studies, income uncertainty is usually measured indirectly by auxiliary variables such as inflation rate, unemployment rate or a derivative of these variables. In this case of study, we focus on unemployment as an income uncertainty indicator to better understand the aging impact on saving and to find an answer to the crucial question: do population aging depress savings?

Unemployment inevitably alters the savings behavior by its two aspects: (1) a high rate and (2) an increase in the average age of unemployed [18].

(1) The high and persistent unemployment rate weights on household confidence, prompting them to increase their precautionary savings. Such behavior is accentuated in a setting of unavailability of unemployment allowance (like in Tunisia) [19]. Thus, for precautionary reasons and to finance unexpected income losses, unemployment is viewed as an income uncertainty given the probability to become unemployed alters the savings behavior. Faure et al. [20] shown that unemployment and the deterioration of household confidence accounted for almost 20% of the aggregate consumption decline.

(2) The increase of the unemployed average age implies that the working population becomes occupied at advanced age. Consequently, they would save a less amount of wealth and they would form a low retirement pension. To offset at this lack of savings they do not immediately dissave at the beginning of the retirement. They would even compensate their low pension by working further after retirement, mainly at the beginning of the period (as long as they stay in better health) to face the future' uncertainties. Also, given the granting difficulties for credit liquidity at the retirement period, this insufficient pension nudges them to continue to save to keep up a certain level of consumption. It increases, in addition, the need for retirement savings from private sources.

Furthermore, the high and enduring unemployment increases inter-vivos transfers, which represents a form of precautionary saving [21]. With a dynastic behavior (which is ignored by the LCH) the old generation (parents) saves more throughout the life cycle to help the young generation (their offspring) to facing uncertainty and hard-economic conditions related for instance to unemployment's conditions. Thus, if intergenerational transfers (by purely altruistic incentive or following a kind of implicit contract between parents and children) are an important motive for savings; elderly rarely decumulate their wealth.

Henceforth, given uncertainty about the future income and lifespan, liquidity constraints, and the wish to leave bequests (a dynastic savings) population aging would not drive the decrease of savings. Therefore, aging economic impact on the household saving and so on the cumulative and on national saving, may not be large [22].

Hence, for our empirical evaluation of the life cycle hypothesis, we analyze the aging-savings relationship in a developing country, in particular, Tunisia. It greatly differs, economically and socially, from the developed countries, by its altruistic familial intergenerational relationship, the enduring and high unemployment rate and the inefficient pension system; as detailed in the section below.

3. The Tunisian demographic and economic setting

3.1 Demographic shifts and age structure evolution

Tunisia after has shortly ended its demographic transition regime, it has well undertaken the population aging process. During the period 1960–2019, the mortality rate fell from 35 to 40 per thousand to a low rate 5.9. Likewise, fertility which was nearby 8 children per woman fell to 2.17. Thus, the life expectancy has attained an average close to that of developed countries 75.4 years (78.1 years for woman and 74.5 years for man) in 2017.

Accordingly, the population age distribution has shifted towards aging. This fertility decline has narrowed the bottom of the age pyramid by the decline of the younger generation size, while the mortality decline has enlarged the top of the pyramid through the life expectancy gain. Thus, the age range proportion less than 15 years-old becomes less important (passing from 46.5 percent to 24.7) and it is likely to continue its decline. In the contrary, a remarkable increase is recorded for the proportion of person aged over 60 years-old (from 5.5 percent to 12.6) and is expected to increase by 10 points over the future three decades. Therefore, during 1966–2019, the child dependency ratio has sharply declined (from 96.27 percent to 39.36) while the old-age dependency ratio has increased (from 11.60 percent to 20.08). Consequently, the total dependency ratio has decreased (from 107.86 percent to 59.44).

3.2 Economic setting

Tunisian economy recorded a high and enduring unemployment. Over the period 1966–2000, it has increased by 6.1 points to pass from 12.5 percent to 18.6, and then fell slightly to stabilize during the last two decades (2000–2019) around 15.3 percent. Additionally, aging has hit the age composition of the unemployed. Indeed, the modal age range of the unemployed population has moved from less than 25 years-old (by about 29 percent) to 25–29 years-old (by about 34.2 percent) during 2005–2011. It is worth noting here that Tunisian authorities do not distribute any unemployment allowance.[2]

For the national saving, it has evolved with some fluctuations. During the period 1970–2010, the national saving rate (of gross national disposable income) was relatively stable around an average of 22.8 percent then progressively fell to achieve 9.3 in 2019, mainly due to a steady loss of purchasing power.[3]

According to the Islamic Development Bank, the behavior of Tunisian investors appears to be driven by factors related to consumer demand and/or the income effect [23]. The financial changes in interest rates have more effect on the savings structure than on its volume. Indeed, the financial liberalization policy adopted (since the structural adjustment plan in 1986) has not succeeded to stimulate private savings through the increasing of the real interest rates [24]. In Tunisia, saving behavior seems to comply more to the Keynesian approach.

However, an interest for the long-term financial savings is recorded. During 2010–2017, the listed companies increase from 56 to 81 with a broad sectors diversification. Likewise, the life insurance, as a long-term saving vehicle, has undergone an important increase; the average annual growth rate was 18 percent in 2017. Its share in the insurance market has climbed from 12.05 percent in 2009 to 20.2 in 2017; however, it remains far from the international standards (about 56.2 percent).

This interest for the long-term savings is explained by the failure of the pension system the pay-as-you-go system and the bankruptcy of the provident fund as well as the authority's future intention to withhold a proportion of the retirement pension.[4] Thus, the insured people are driven to form a complementary retirement pension under others retirement savings forms through voluntarily paying into saving schemes in private financial institutions. This savings form is encouraged by the financial authority through the establishment of tax benefits.

Concerning the non-financial savings, it is allocated to buy housing, jewelry or land by household and productive assets by individual corporate. Household saving is particularly oriented to housing savings which has experienced a growth rate of about 5.5 percent during 2000–2017.

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[2] Source: NIS employment 1966, 2005, 2007, 2010, 2011.

[3] During 2011–2019 inflation rate has passed from 3.7 percent to 6.2.

[4] For instance, during 2010–2017, the overall financial situation of the three funds of the social security recorded a very serious drop going from 40MD in 2010 to −1326 MD.

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4. Econometric model and data specification

To look at the relationship between population aging and savings in an unemployment context in Tunisia over the period 1970–2019, we apply a structural VAR model, as defined by Sims [25]. This enables us to approach a multivariate causal setting allowing the coexistence of both short and long-term forces derived from the aging influences on saving decisions. Finally, we deepen our dynamic analysis by application the techniques of impulse response functions (IRFs) of different shocks for all variable's fluctuations and of the variance decomposition (VDC).

4.1 Data specification

To undertake the aggregate saving model estimating, we use as an independent variable the national savings rate unlike previous studies, which generally referred to the household savings rate. National saving is important as it is a source of investment and one of the major determinants of macroeconomic growth. Also, as it is closely related to the demand for financial and real assets and it may affect asset price formation. In addition, we seek to avoid narrowing the aging impact as its takes into account companies and public sector saving (related to social sector, health, education and pensions). On another side, the household savings refers to survey measure which undervalues personal income as it provides information related to expenditure than to income sources. Likewise, it does not capture the same share of total saving for persons at different ages, so the estimate of relationship between savings and age may be fallacious.

As a definition, between the two known alternative measures of savings (S) we adopt that of national account (as income minus consumption expenditure) given data availability.[5] Explicitly, we use the savings rate with respect to the gross national income disposable income[6].

For independent variables, we refer to the main population aging indicators. We consider the mortality rate (MR) and fertility rate (FR) to capture demographic changes and its impact on the age structure composition, and likewise on the dependency ratio. We consider the old-age dependency ratio (EDR) to accurately look at the effect of aging besides the broadly used the total dependency ratio (TDR). Then, we could deduce if the aging impact is due to the fertility decline or to the longevity increase.

Concerning economic variables, we include three macroeconomic variables. (1) Basing to the neoclassical approach we introduce the interest rate (MMR) in particular the money market rate as a driver of the real interest rate (credit and debit). (2) As a one quantitative measure of aggregate income uncertainty we consider the aggregate unemployment rate (U). (3) In order to check the economic effect of saving, we examine the economic growth (G) measured by the GDP per capita at constant domestic prices. It is computed by dividing GDP per capita at current domestic prices by the consumption price index (base 1990). Hence, the inflation rate is indirectly considered.

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[5] The second defines savings as the changes in net wealth. Net wealth accumulation includes capital gains and losses, adjusted for general inflation, and is more relevant for purposes of measuring changes individual's economic well-being.

[6] Gross national income equal to the gross national income minus the current transfers (current taxes on income and wealth, social security contributions, social security benefits) paid to non-residents units plus the current transfers received from the rest of the world by the residents.

The main statistical characteristics of these variables used are summarized in **Table 1** (in the Appendix). Data are drawn from the Central Bank of Tunisia (CBT), the National Institution of Statistics (NIS) and Tunisian Institute of competitively and quantitative study (ITCQS).

4.2 Econometric models

Our analysis is based on the identification and estimation of structural vector autoregressive (SVAR). The SVAR model is used in macroeconomic analysis in order to check the effect of exogenous shocks (of the demographic change, for instance) on macroeconomic variables.

Our basic model VAR is the following:

$$Y_t = \Gamma(L)\ Y_t + \nu_t \tag{1}$$

where Y_t is a column vector of stationary variables considered in the estimate.

The selection and order of independent variables are essential in the SVAR estimate. Thus, the independent demographic variables are introduced with caution following the demographic transition theory. As mortality decline brings that of fertility, so we first introduce the mortality rate (MR) followed by the fertility rate (FR). Then, we integrate the dependency ratio as an indicator of the population aging and the age structure change following the demographic transition.

After what, we consider the economic variable exogenous effect on saving. So, we insert the interest rate (MMR) as a saving determinant and the aggregate unemployment rate (U) as a measure of aggregate income uncertainty. Lastly, we introduce the national savings rate (S) followed by the economic growth (G) to check the aging impact on economic growth through the savings evolution.

As we use two dependency ratios, we estimate two distinct vectors autoregression. A vector includes the total dependency ratio which reflects the effect of both the mortality and fertility evolution as a result of the demographic policy as follows (MR_t, FR_t, TDR_t, U_t, MMR_t, S_t, G_t).

The second vector includes the old-age dependency ratio and takes the mortality choc as the main cause of the elderly proportion evolution as follows (MR_t, EDR_t, U_t, MMR_t, S_t, G_t).

Otherwise, $\Gamma(L) = \Gamma_1 L^1 + \Gamma_2 L^2 + \ \dots\ + \Gamma p.\ L^p$ is a lag operator in the form of polynomial matrix and ν_t is a vector of idiosyncratic errors, where $\nu_t = (\mu^1{}_t, \dots, \mu^5{}_t)'$. These errors are not auto correlated and are homoscedastic. Then, the representation (1) can be written in the form of a moving average of infinite order VMA (∞) (representation theorem of Wald):

$$Y_t = C(L)\ v_t \tag{2}$$

where $C(L) = [I - \Gamma(L)]^{-1}$.

The structural form (SF) of the model (1) can be written as follows:

$$Y_t = A(L)\ \varepsilon_t \tag{3}$$

where $A(L) = C(L)\ H$ is the coefficient matrix (a_{ij}) of (7×7 or 6×6 for the two vectors respectively) size, and more precisely it represents the impulse response functions of the elements of Y_t following the various shocks. Moreover, H is the transition matrix and ε is the vector of structural shocks where $E(\varepsilon_t \varepsilon_t') = I_N$.

However, the identification of these shocks requires the Cholesky decomposition in the order to identify the structure of the shocks. As a result, the decomposition of the variance covariance matrix of the reduced form residuals is written in a lower triangular matrix A(L). The number of constraints imposed on A (L) is equal to 21 i.e. n × (n-1) / 2 with n = 7 variables and where some of the structural shocks do not have contemporaneous impact on other variables.

Additionally, the Cholesky decomposition assumes that series listed earlier in the VAR order impact the others variables contemporaneously. But series listed later in the VAR order impact those listed earlier only with lag. Therefore, the variables listed early in the VAR order are considered more exogenous. As mentioned above, the order of endogenous variables is central to the identification of structural shocks, i.e. it determines the structure of the shocks. More precisely, the first variable has impacts on all the variables that are below it, but it does not receive any impacts from these variables. This rule applies to all subsequent variables. For instance, the triangular matrix A(L), for the case of n = 7 variables, is as follows.

$$\mathrm{A(L)} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ C21 & 1 & 0 & 0 & 0 & 0 & 0 \\ C31 & C32 & 1 & 0 & 0 & 0 & 0 \\ C41 & C42 & C43 & 1 & 0 & 0 & 0 \\ C51 & C52 & C53 & C54 & 1 & 0 & 0 \\ C61 & C62 & C63 & C64 & C65 & 1 & 0 \\ C71 & C72 & C73 & C74 & C75 & C76 & 1 \end{pmatrix} \tag{4}$$

Henceforth, we have to estimate four matrixes: a matrix (Alt1) for the total dependency ratio and one for the old-age dependency ratio (Alt2). Two others matrixes are also estimates as a robustness test by omitting the unemployment rate, respectively the matrixes (Alt3) and (Alt4).

To undertake the SVAR estimate model, we first study the stationarity of all variables using the Phillips-Perron test [26]. As reported in **Table 2** (in the Appendix) all the considered variables are I(0) suggesting that a long-run (cointegration) relationship could exist between the considered variables.

Then we determine the order p of the VAR process to remember. To do this, we consider various processes for VAR lag orders p ranging from 1 to 4. For each model, we calculate the Akaike information criteria (AIC) and Schwarz (SC), and the log-likelihood (LV) to hold the p lag (=4) that minimizes these criteria as indicated in **Table 3** (in the Appendix).

Accordingly, four alternatives are estimated, respectively with the identification of cointegration relationships by using the cointegration test of Johansen [27] as well as the structural factorization (with 500 iterations).

Finally, to examine the dynamic of the model, we refer to the impulse response function (IRF). It helps us to judge and to appreciate the channel(s) of population age structure change transmission. It allows to see if there is really a robust, stable and predictable relationship between aging and savings. In this respect, we will identify the different responses of all the variables in the model to various shocks. It should be noted that we focused on the effects of the shock on 10 periods and that errors are generated by Monte Carlo with 100 repetitions. Such analysis is strengthened with the variance decomposition analysis (VDC), which however, indicates the proportion of the variable changes due to own shocks versus shocks on the other variables. Namely, the variance of the forecast error of the change in savings rate is partitioned among the contributions of the innovations in each variable of the system.

5. Results interpretation

Interestingly, results put forward that the LCH prediction is not automatically confirmed, but it is up to the economic uncertainty extent. Indeed, the LCH is not validated in the unemployment setting, which is considered in our study as an indirect measure of income uncertainty.

5.1 The SVAR results interpretation

The SVAR's estimate results (reported in **Table 4** in the Appendix) points out that uncertainty encourages saving. Indeed, for the two aging indicators used (TDR and EDR) the LCH prediction is not validated once unemployment is introduced unlike Ahmedova's [28] findings. As we note from matrixes Alt1 and Alt2, the two indicators present a significant positive effect on savings rate in the context of enduring unemployment without allowance, like in Frini' work [29]. However, this effect is found more significant for old-age dependency ratio, unlike in Wong and Tang [30] and Loumrhari's [31] findings.

In contrast, the LCH prediction is validated by the estimate omitting the unemployment rate, however, for only the total dependency ratio. Indeed, a significant negative effect is found in the matrix Alt3.

Such results confirm that the demographic changes impact on saving depends on the perception of the economic context and the confidence towards future. Furthermore, the LCH's validation appears to be, as well, empirically related to the aging indicator used in the estimate. This confirms our proposal that the old-age dependency ratio indicator seems more efficient to explicitly check the effect of aging.

The unemployment which hints uncertainty about future income pushes the savers to keep up savings. It reduces confidence and intensifies incentives for precautionary saving so that, it prevents savings from decline. Indeed, the unemployment rate displays a significant and positive coefficient. The weight of the future uncertainty boosts the employed population to form a precautionary savings. This precautionary saving is important to offset the small amount of wealth accumulated after an enduring unemployment without any allocation benefit. When enduring a long unemployment period and facing great difficulties for credit liquidity at old age, elderly try to continue to save to keep up a certain level of consumption. Such behavior is very pronounced in Tunisia since retired do not benefit from a sufficient pension in a distressed pay-as-you-go system. The insufficiency of pension and medical care benefits entails the elderly saving's behavior adjustment by continuing to work and to save at the beginning of the retirement period (as long as they remain in better health). As pointed out by Frini [32, 33] the new retirees or the youngest elderly (which share, generally, weighs more than that of the old retirees or the old elderly) maintain their savings mainly for precautionary motives in high uncertainty economic environment.

This Tunisian elderly saving behavior may in part be strengthened by the intentional transfers motivation of the old generation towards the young one. Indeed, Tunisian families, as stressed by Mahfoud [34] and Frini [35, 36], are strongly linked and directed by an intergenerational altruistic motive. So, the old generation do not seek to cut savings so as to help the young generation to face uncertain environment and hard economic conditions.

As expected, mortality drop induces a fertility decline, putting on show the demographic transition theory. This fertility decline increases the savings rate. It seems that the youth share decrease outweighs the small increase in the elderly share since the aggregate savings rate increases. Household with fewer children are likely to incur less expenditure in respect to their income for looking after them and then would save more. In addition, a reduced family size leads to a competition between children as a mean of transferring income from present to future and as a financial asset.[7] Henceforth, by the fall of fertility rate, the demand of financial and capital market as a substitute of youth assurance service will increase and thus savings. Additionally, the decline of government expenditures for youth (given their share decline), seems to make up or even more the government expenditures increase for elderly (due to their share increase) to not lead savings decrease.

Considering uncertainty, mortality evolution positively influences savings rate when considering the economic and social facts, but negatively when they are neglected. The increase of mortality risk and health problem intensifies precautionary behavior to face health care expenditure at old age.

The uncertainty related to interest rate affects positively the savings rate. An increase in interest rate will make saving more attractive. Finally, like in AbuAl-Foul's [37] work results show that no long-run relationship exists between saving and GDP growth. This in part due to that saving is, generally, done in real estate, which is known as a small creator of wealth with a small ripple effect.

5.2 The IRF's and VDC's results interpretation

Likewise, the IRF's and VDC's results underline that population aging on savings evolution changes respect to the economic uncertainty context. Savings positively respond to age structure changes once unemployment is taken into account. The different graphs of impulse responses (**Figure 2** in the Appendix) show that savings respond quickly to demographic changes (mortality rate, fertility rate and dependency ratio jointly), but weakly to the shock of the money market rate. The response due to unemployment rate shock can be judged as significant with a return to equilibrium in the long-term. The saving response to economic growth innovations is, however, slow and limited. This analysis is corroborated out by the variance decomposition as displayed in **Table 5** (in the Appendix).[8] In detail, a relatively constant proportion of the change in savings rate variance is recorded for both ratios. The total dependency ratio shock is by about 3.75 percent for Alt1 and by 4.26 percent for Alt3 after three years. The old-age dependency ratio shocks are, however, of a less proportion by 1.42 percent for Alt2 and 0.16 percent for Alt4 over ten years. The noteworthy result is that savings evolution follow-up a shock of the total dependency ratio is more significant (by three times more) than of the elderly one. This fact is also proved by the dynamic response path. Fewer children lower the dependent population and consumption without contribution to income. The decrease of the youth dependent proportion out weights the increase of the elderly dependent in the proportion, which limits saving rate depression. This brings up the role of relative weight of the youth share to the elderly share on savings evolution. Further, the increase of elderly proportion appears not to cut savings rate. Thus, savings rises when fertility declines and longevity increases, but less intensively. In the contrary, to the LCH prediction, the old-age dependency ratio shock instantaneously and positively affects saving rate, however, more weakly than the total dependency ratio.

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[7] Children is treated as pure capital goods and a kind of safety assets which returns are "elderly assurance".

[8] The VDC indicates the proportion of the variable changes due to own shocks versus shocks on the other variables. The Cholesky decomposition method is used in orthogonalizing the innovations across equation. Percentage of forecast variances is explained by innovations.

Remarkably, once we ignore the labour market unbalance (or uncertainty) of the estimates the relationship between aging and savings becomes consistent with the LCH prediction. The total dependency ratio shocks present a negative short-term impact on saving to disappear at long-run (after eight years). However, no impact is found for the old-age dependency ratio. This discrepancy in estimated magnitude through the two dependency ratios used refers back to our assumption that aging impact may be sensitive to the measurement used to describe it.

Moreover, demographic indicators shocks trace the variance of savings innovations. Mortality rate explains saving variance by almost the same small proportion (by about 2.30 percent) for all alternatives in the variance decomposition, but relatively less without the unemployment rate. In the impulse function graph, a negligible positive impact is found of mortality shock. Hence, with the rise of longevity and elderly proportion savings may not decline. Fertility decline significantly contributes in the savings change variance (by about 5.16 percent in Alt1) and even much more when forsaking the unemployment rate (by about 17.79 percent in Alt3). The corresponding impulse function displays a negative influence over six years to reverse positively after.

However, saving is less sensitive to interest rate shock. Money market rate contribution is more pronounced for the total dependency ratio than the elderly one. The same evidence is observed through the impulse function graph shown a very small positive influence which disappears in the long-term. This small impact of the real interest rate on saving may hide the offsetting of its two effects (of income and substitution). In other hand, it may be related to the Tunisian household's behavior which seems to comply more with the Keynesian approach.

Finally, in the long-term, savings shocks seem to produce an effect on economic growth, but weakly when the imbalance labour market is considered (as reported in **Table 6** in the Appendix). As mapped out by the response functions this dynamic is non-instantaneous. In contrast, a very small 'feed-back' seems to be produced of economic growth over three years on saving.

6. Conclusion

This study puts on show that the life cycle prediction of a downward pressure on saving by aging population could not be proved under uncertainty. Population aging is, on contrast, found to exert a long-term upward pressure on saving in an unemployment context. The economic environment's uncertainty (such income uncertainty) quantified, in our case of study, by the unemployment phenomenon, looks to be an essential factor of the change in the life cycle pattern of savings. It is able to shaping the saving behavior and to distort the LCH. The impact of the demographic change seems strongly related to the economic confidence factors. Accordingly, the social and economic conditions limit the scope of the LCH. Thus, population aging will not necessarily spell disaster on national saving. Consequently, studies' findings on developed countries could not be representative of saving behavioral in developing countries; where pension and medical insurance schemes are less developed and the persistent unemployment is without unemployment allowance benefit. Furthermore, it seems that the empirical findings checking the LCH depend on the aging indicator used. In fact, the use of the total dependency ratio could not validate the LCH, but it is validated by the old-age dependency ratio use. So, with more caution on the population aging measure, the evidence that elderly do not dissave may be found and the life cycle prediction may not be endorsed. Henceforth, the life cycle hypothesis may not be validated in macroeconomic approach as in the micro-econometric approach.

Finally, as policy implications, several measures are needed to sustain saving rate or to prevent it from an eventual decline. In addition to the strategy applied lately to postponing the retirement age to 62 years-old, Tunisian Policy-makers have to accelerate the move from the pay-as-you-ago public pension system towards the funded pension system to cut costs of increasing old-age benefits. As well, to mobilize more savings, they should shift the liquid savings towards long-term products. Accordingly, it is important to reconsider the long-term savings strategy to meet the household's needs as well as the huge potential investment's needs. Therefore, major economic and financial reforms should be undertaken to restructure public corporates and the partial openness of their capital, to strengthen the pension plans, to develop the insurance sector and promote life insurance, and to improve the framework of the stock market and the bond market and diversify product of savings.

Appendix

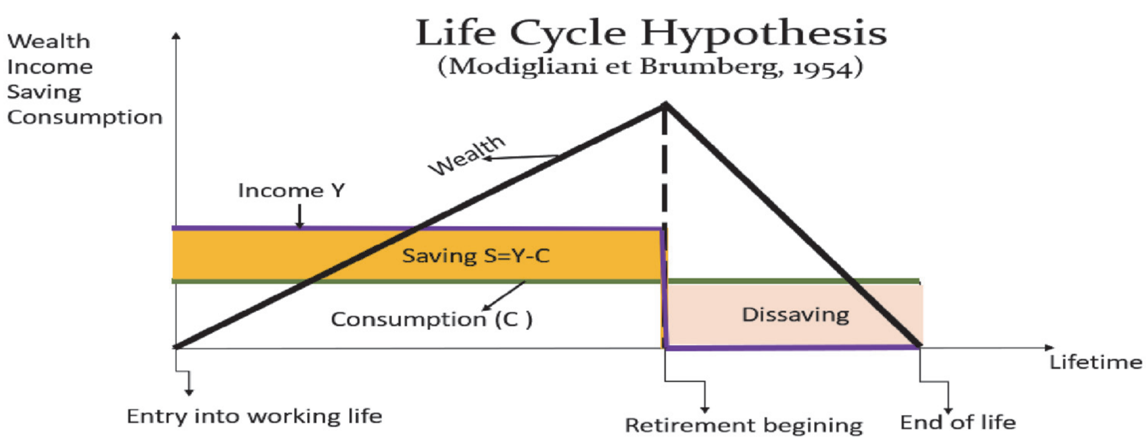


Figure 1.
Consumption,consumer income, wealth and saving over the life cycle.

	S	MR	FR	EDR	TDR	G	U	TMM
Mean	20.73	0.68	3.55	14.21	75.70	4.52	15.28	6.85
Median	21.75	0.59	3.01	14.35	77.05	4.67	15.60	6.40
Maximum	26.40	1.34	6.29	20.08	108.69	17.74	18.30	11.79
Minimum	9.40	0.55	2.00	11.15	50.51	−1.92	12.40	3.00
Std. Dev.	3.94	0.19	1.51	1.93	18.76	3.35	0.86	2.34
Observations	50	50	50	50	50	50	50	50

Table 1.
Descriptive statistics variables.

Series	level	1st difference
MR	0.06*	0.00*
FR	0.34	0.00*
TDR	0.80	0.00*
EDR	0.52	0.00*
U	0.01*	0.00*
TMM	0.19	0.00*
S	0. 02*	0.00**
G	0.04*	0.00**

Note: The null hypothesis for the ADF test is that the series are non-stationary i.e. there is presence of unit root. The values in the table indicate the p-values of this test. Using the Phillips-Perron test, the results were the same.
** and **denotes that the null hypothesis of unit root is rejected at the 5% level and 10% level respectively.*

Table 2.
Unit root test of ADF.

The lag number p	AIC	SC	LV
Alternative 1 (MR_t,FR_t, TDR_t, U_t, MMR_t, S_t, G_t)			
1	4.56	5.62*	−36. 29
2	3.98	8.43	25.03
3	3.61	10.30	80.48
4	−1.48*	7.69	211.19*
Alternative 2 (MR_t, EDR_t, U_t, TMM_t, S_t, G_t)			
1	1.73	3.03*	31.44
2	0.18	4.51	94.32
3	−0.75	5.33	165.21
4	−3.84*	4.64	266.06*
Alternative 3 (MR_t,FR_t, TDR_t, TMM_t, S_t, G_t)			
1	2.22	3.48*	0.35
2	1.34	4.27	47.13
3	1.12	6.74	86.61
4	−0.87*	6.67	187.23*
Alternative 4 (MR_t, EDR_t, TMM_t, S_t, G_t)			
1	1.36	0.89*	68.74
2	−2.34	1.58	118.97
3	−2.89	2.72	166.54
4	−4.62*	1.85	225.99*

Note: LV denotes the log-likelihood; the asterisk indicates P order to retain according to the criterion used.

Table 3.
Choice of the lag number of VAR (p) process.

$$Alt1(L)=\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.87^{***} & 1 & 0 & 0 & 0 & 0 & 0 \\ -0.44 & 3.62^{***} & 1 & 0 & 0 & 0 & 0 \\ 0.67 & -5.85^{***} & -0.79^{***} & 1 & 0 & 0 & 0 \\ 1.32^{***} & 0.70^{***} & 0.32^{**} & -0.44 & 1 & 0 & 0 \\ 3.23^{***} & -1.63^{***} & 0.52^{*} & 0.56^{**} & 0.72^{**} & 1 & 0 \\ 0.10 & 0.12 & -0.00 & 0.01 & 0.00 & -0.00 & 1 \end{bmatrix}$$

Vector autoregressive estimated is: MR_t, FR_t, TDR_t, U_t, MMR_t, S_t, G_t.

$$Alt2(L)=\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ -0.85^{***} & 1 & 0 & 0 & 0 & 0 \\ 0.27 & -1.79^{***} & 1 & 0 & 0 & 0 \\ 1.86^{***} & 1.32^{***} & -0.44 & 1 & 0 & 0 \\ 3.53^{***} & 1.42^{*} & 0.56^{**} & 0.72^{**} & 1 & 0 \\ 0.10 & -0.00 & 0.01 & 0.00 & -0.00 & 1 \end{bmatrix}$$

Vector autoregressive estimated is: MR_t, EDR_t, U_t, MMR_t , S_t, G_t)

$$Alt3(L)=\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0.78^{***} & 1 & 0 & 0 & 0 & 0 \\ 5.76^{***} & -0.86^{***} & 1 & 0 & 0 & 0 \\ 0.23 & -0.59^{***} & 0.02 & 1 & 0 & 0 \\ -6.36^{***} & -1.12^{*} & -1.34^{***} & 2.52 & 1 & 0 \\ 0.00 & 0.06 & -0.00 & 0.00 & 0.04 & 1 \end{bmatrix}$$

Vector autoregressive estimated is: MR_t, FR_t, TDR_t, MMR_t, S_t, G_t.

$$Alt4(L)=\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ -0.35 & 1 & 0 & 0 & 0 \\ -0.45 & 0.07 & 1 & 0 & 0 \\ -6.21 & 3.25^{***} & 2.44^{***} & 1 & 0 \\ 0.03 & -0.05 & 0.06 & 0.01 & 1 \end{bmatrix}$$

Vector autoregressive estimated is: MR_t, EDR_t, MMR_t , S_t, G_t.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 4.
SVAR estimates results for the four alternatives.

Alt1								
Period	**S.E.**	**MR**	**D(FR)**	**D(TDR)**	**U**	**D(MMR)**	**S**	**G**
1	1.82	0.04	0.50	1.58	29.01	1.00	67.63	0.00
2	2.39	2.03	5.90	1.10	24.92	1.23	61.03	3.75
3	2.71	1.83	6.76	2.93	21.94	1.85	61.39	3.27
4	2.78	1.75	8.16	3.32	21.51	2.06	59.98	3.18
5	2.86	1.77	7.53	3.07	29.72	1.94	53.01	2.93
6	3.17	1.97	6.57	3.77	35.50	1.68	47.87	2.60
7	3.48	2.12	5.44	3.77	42.08	1.51	42.85	2.20
8	3.68	2.27	4.98	3.89	42.84	1.65	42.32	2.01
9	3.70	2.36	4.90	3.83	42.67	1.88	42.43	1.89
10	3.86	2.39	5.16	3.75	41.77	2.06	42.98	1.851

Alt2							
Period	**S.E.**	**MR**	**D(EDR)**	**U**	**D(MMR)**	**S**	**G**
1	1.94	0.11	0.11	28.54	2.95	67.59	0.00
2	2.43	1.44	0.28	26.42	1.95	60.16	5.58
3	2.58	1.38	0.89	24.00	2.00	60.68	5.15
4	2.66	1.87	1.42	24.84	1.89	57.50	5.03
5	2.81	2.04	1.60	30.82	1.75	51.97	4.66
6	2.97	2.27	1.56	35.23	1.56	48.47	4.49
7	3.11	2.28	1.48	37.45	1.46	47.10	4.36
8	3.19	2.30	1.43	37.67	1.44	47.07	4.34
9	3.21	2.30	1.41	37.34	1.45	47.31	4.349
10	3.22	2.29	1.42	37.24	1.46	47.25	4.33

Alt3							
Period	**S.E.**	**MR**	**D(FR)**	**D(TDR)**	**D(MMR)**	**S**	**G**
1	1.74	0.00	0.20	0.91	4.79	94.08	0.00
2	2.35	2.18	6.64	0.64	4.72	81.92	3.87
3	2.68	1.94	9.56	4.19	5.43	75.81	3.04
4	2.84	1.88	13.29	3.86	6.08	72.04	2.81
5	2.95	1.92	15.14	4.39	6.51	69.28	2.72
6	3.00	1.93	16.46	4.28	6.89	67.74	2.66
7	3.02	1.94	17.15	4.31	7.08	66.81	2.68
8	3.04	1.93	17.53	4.27	7.16	66.38	2.69
9	3.05	1.93	17.71	4.27	7.20	66.17	2.70
10	3.05	1.92	17.79	4.26	7.22	66.07	2.71

Alt4						
Period	**S.E.**	**MR**	**D(EDR)**	**D(MMR)**	**S**	**G**
1	1.89	0.10	0.19	6.90	92.75	0.00
2	2.47	1.14	0.13	4.28	82.12	5.97
3	2.71	1.01	0.15	4.22	79.41	5.21

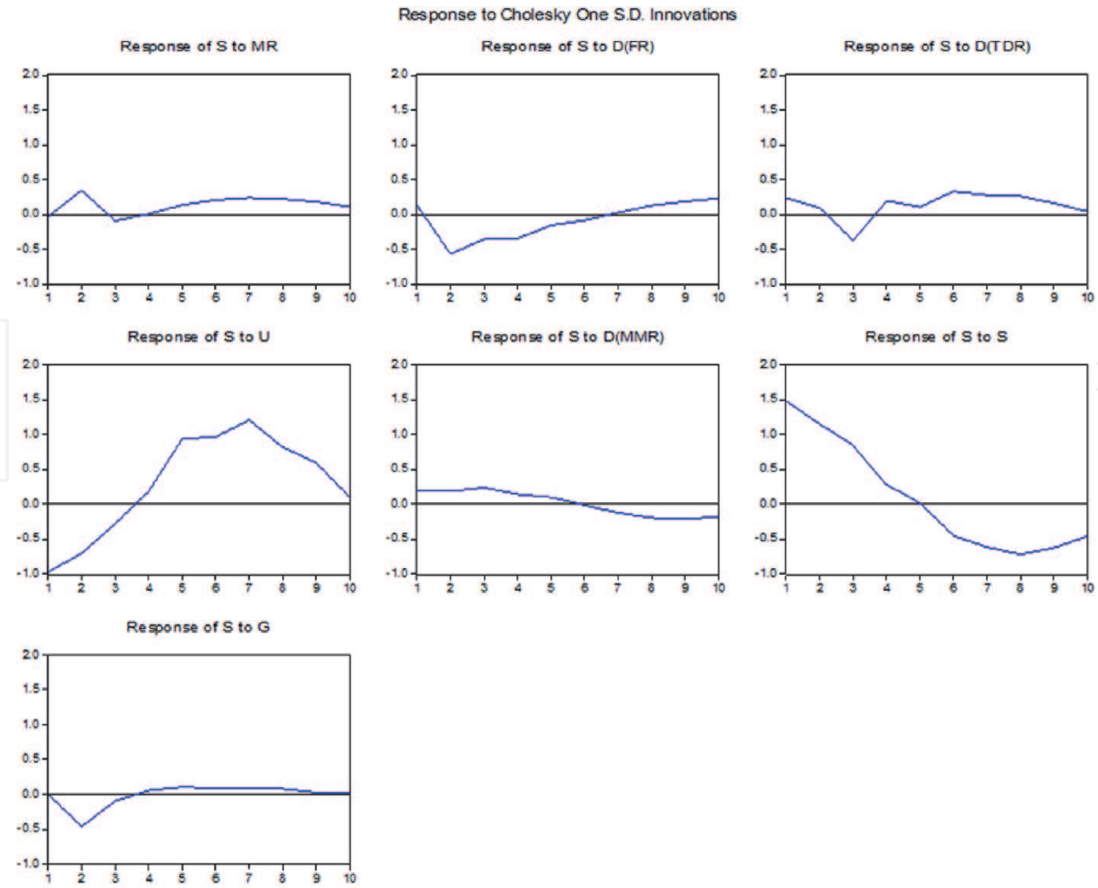
Alt4						
Period	**S.E.**	**MR**	**D(EDR)**	**D(MMR)**	**S**	**G**
4	2.81	0.94	0.15	4.06	76.99	4.85
5	2.85	0.94	0.15	4.02	75.79	4.75
6	2.85	0.93	0.16	4.03	75.35	4.74
7	2.86	0.93	0.16	4.03	75.29	4.77
8	2.86	0.94	0.16	4.02	75.29	4.81
9	2.86	0.96	0.16	4.02	75.26	4.83
10	2.87	0.98	0.16	4.02	75.21	4.84

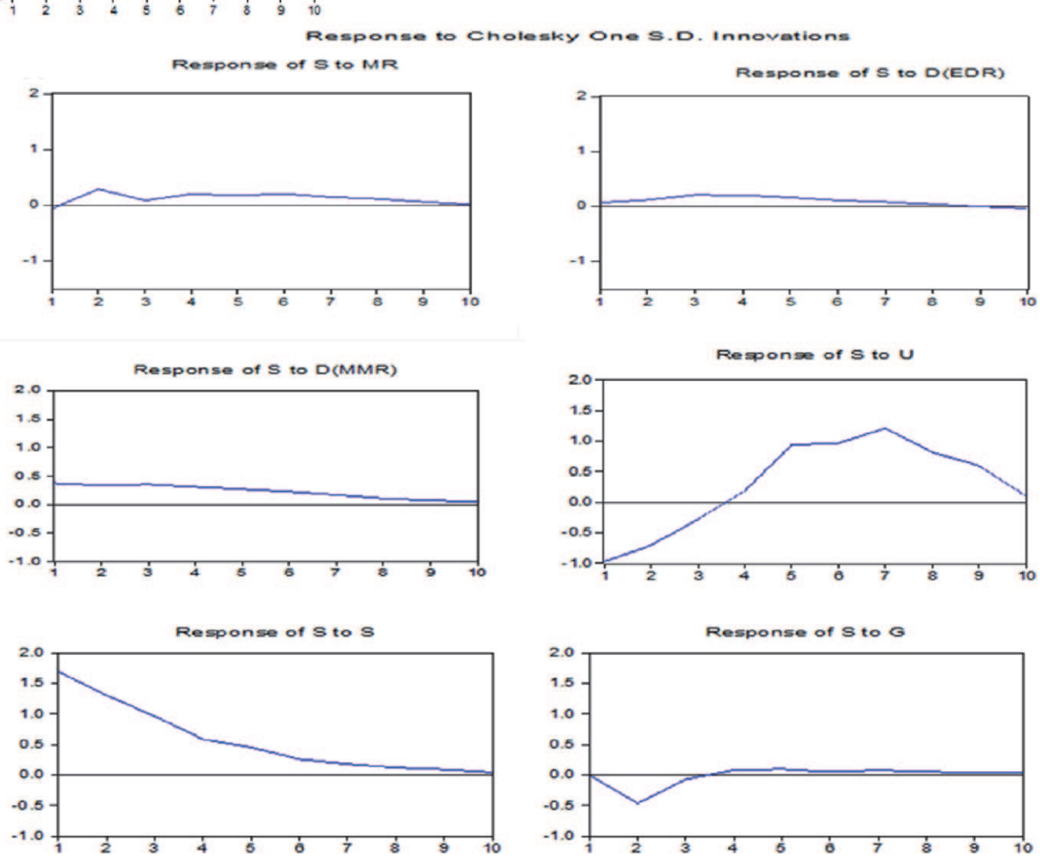
Notes: Cholesky ordering follow that of the four alternatives. The second column (S.E) shows the forecast error of the variable at the given forecast horizon. The source of this forecast error is the variation in the current and future values of the innovations to each endogenous variable in the VAR. The other columns give the percentage of the forecast variance due to each innovation.

Table 5.
Variance decomposition of saving rates (Cholesky ordering).

Alt1	Alt2	Alt3	Alt4
23.54	29.50	27.41	33.20
22.72	27.47	27.69	32.28
20.20	24.18	25.27	31.54
21.88	26.15	25.43	32.72
21.19	26.48	25.37	32.70
21.56	26.46	25.37	32.63
21.75	26.38	25.35	32.60
22.03	26.29	25.35	32.60
21.97	26.22	25.35	32.61
21.74	26.21	25.34	32.

Table 6.
Variance decomposition of economic growth to saving rates.


Response to Cholesky One S.D. Innovations
Response of S to MR
Response of S to D(FR)
Response of S to D(TDR)
Response of S to U
Response of S to D(MMR)
Response of S to S
Response of S to G


Response to Cholesky One S.D. Innovations
Response of S to MR
Response of S to D(EDR)
Response of S to D(MMR)
Response of S to U
Response of S to S
Response of S to G

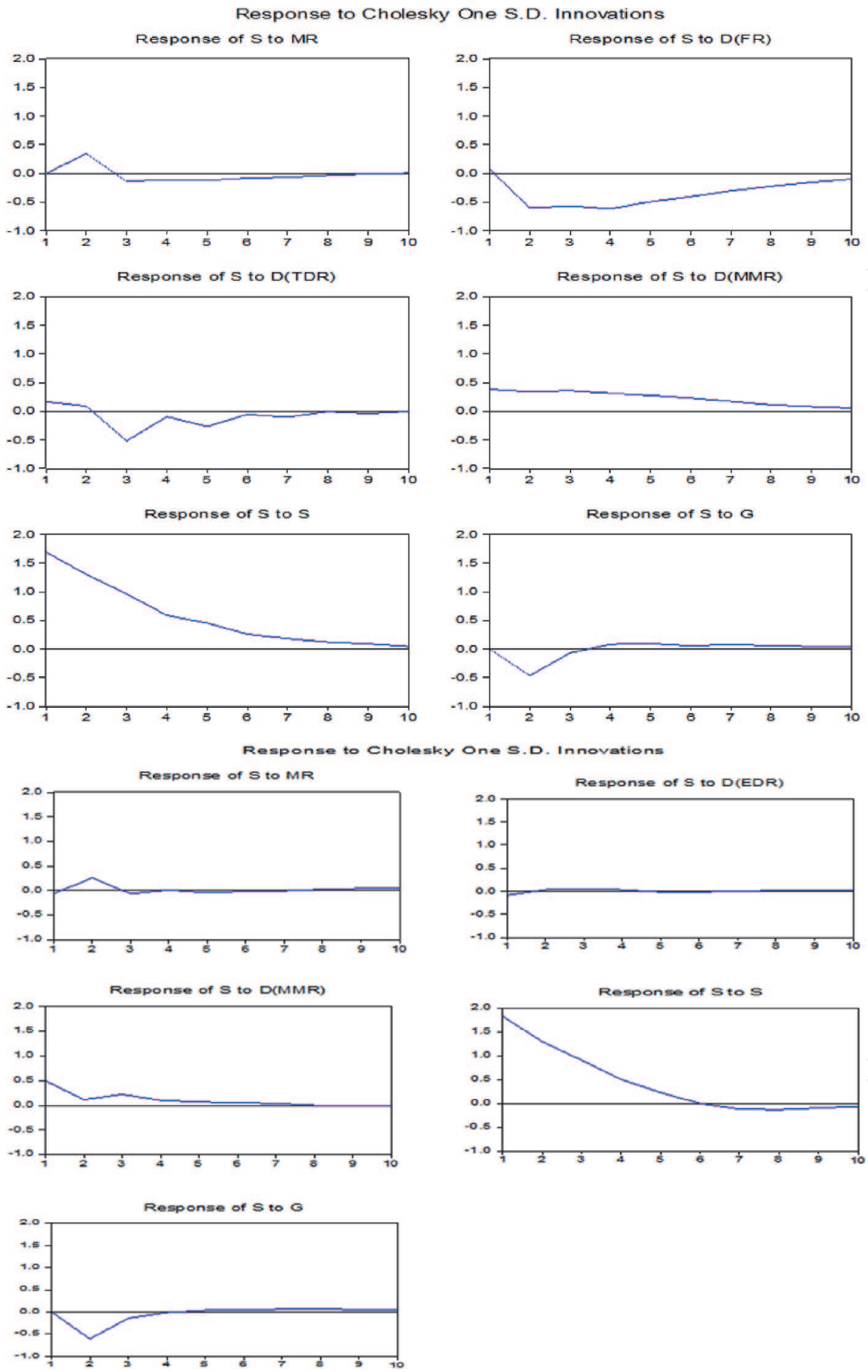


Figure 2.
Estimated impulse response functions. Response to Cholesky one S.D. innovations.

Classifications

JEL Classifications: J1, E2, C3

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