Dynamic asset allocation and consumption under inflation inequality: The impacts of inflation experiences and expectations[☆]

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ARTICLE INFO

ABSTRACT

Differences in spending patterns and in price increases across goods and services lead to the unequal inflation experiences of households (called inflation inequality). These differences then cause disagreements in inflation expectations and eventually have a significant effect on households' asset allocation and consumption decisions. The asset allocation model in this paper explains how inflation experiences affect household investment and consumption through corresponding inflation expectations, which are characterized by long-term expected inflation, the impact coefficient of the expected inflation and the correlation between expected inflation and the risky return. Using China's economic data, the empirical results show that significant differences in inflation expectation arise from income gap, regional inequality, different inflation measures and economic sector spending differences. Using the estimated coefficients, the calibration results have policy implications that households need more financing channels to resist inflation, especially in rural areas and in the raw material sector.

1. Introduction

Households have different inflation experiences based on their overall spending patterns (called inflation inequality),[1] and interpret its tendency differently. This paper investigates how inflation inequality affects the asset allocation and consumption choices of households. First, we develop an intertemporal asset allocation model considering inflation risk, which suggests that households' investment and consumption should hedge the inflation risk according to the expected inflation dynamic. Second, using China's economic data, we find evidence of inflation inequality among different household groups. Moreover, the China Household Finance Survey (CHFS) data also shows large differences in households' asset allocation ratios and consumption ratios. Third, the estimation coefficients of the constraint vector auto-regression (VAR) model are applied to calculate the asset allocation model's parameters for calibration. Finally, the calibration results for optimal asset allocation and consumption ratios are

consistent with the CHFS data.

This paper is closely related to studies of asset allocation problem by Campbell et al. (2004), Liu (2010), Maenhout (2006), and others. The asset allocation model in this paper adopts a time-varying expected return of production, which extends the asset allocation model in Anderson et al. (2000). Expected return, which is related to the inflation rate, is set as a state variable with an affine structure. It follows a stochastic process that is mean reverting in a price level model setup, which is consistent with the model of Brennan and Xia (2002) and Munk et al. (2004). However, our model extends the asset allocation model by additionally considering inflation risk.

This paper is also related to a growing literature document the inflation effect on the assets allocation problem. For example, Brennan and Xia (2002) developed a framework for the asset allocation problem of a long horizon investor within which a zero-coupon bond bears the inflation risk. Similarly, Munk et al. (2004) proposed a relevant model to resolve the Samuelson puzzle and Canner, Mankiw and Weil puzzle[2].

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[1] Hobijn and Lagakos (2005) used the term inflation inequality to describe households faced different inflation levels.
[2] Investment advisors tend to recommend that younger investors – who have a long investment horizon – invest a higher fraction of their wealth in stocks than older investors should. This piece of investment advice is not consistent with rational portfolio allocation in basic portfolio choice models; and is often referred to as the Samuelson puzzle. The CMW puzzle is when the asset allocations recommended by professional investment advisors systematically display increasingly higher bonds to stocks ratios for increasingly higher risk aversion. This recommendation is at odds with the standard mean-variance two-fund separation results.

Chou et al. (2011) investigated the intertemporal portfolio choice problem by considering interim consumption under stochastic inflation and also compared the optimal allocation strategies of an aggressive investor and a conservative investor. Other literature has discussed the asset allocation problem with inflation risk in pension funds or pension plans (e.g., Han and Hung, 2012; Yao et al., 2013; Zhang and Ewald, 2010). Furthermore, heterogeneous beliefs on asset allocation with inflation risk have recently been discussed in the theoretical literature (e.g., Barberis et al., 2015; Ehling et al., 2013; He and Li, 2012; Piazzesi and Schneider, 2012). Our work is different in that we consider the effect of inflation experiences rather than inflation beliefs on asset allocation and consumption choices. Obviously, inflation experiences of households impact their inflation expectations. Therefore, the introduction of inflation inequality allows to classify and study household investment and consumption. However, there is no significant asset allocation literature in the context of inflation inequality. This paper intends to fill that gap.

Our work is also related to previous studies by Bruin et al. (2010), Bryan and Venkatu (2001a, 2001b), Diamond et al. (2016), Fratzscher et al. (2014), Johannsen (2014), Meyer and Venkatu (2011), Reid (2015), and Xu et al. (2016), among others, which used survey data that showed differences in households' inflation experiences and expectations. As far as we know, only a few studies have examined households' asset allocation and consumption in the context of these differences. This paper emphasizes the effects of inflation inequality on the allocation of financial and physical assets and consumption of household by considering income levels, regions, and economic activities as well as different inflation measures. This paper compares different asset allocation and consumption choices by introducing inflation inequality and correspondingly different inflation expectations to calibrate the model. The numerical results are investigated to determine whether they explain the allocation strategies and consumption choices in the CHFS data. So this paper also contributes to the literature that studied the differences in inflation expectations and inflation experiences through investigating their effects on asset allocation and the consumption ratio.

In this paper, different sets of inflation data are used to denote inflation inequality. Several groups of coefficients are estimated by the constraint VAR model, which represent divergent inflation expectations. By applying these estimated coefficient groups to the strategic allocation and consumption formulae, the calibration results reflect the asset allocation strategies and consumption choices of the households with different inflation experiences and expectations. Our results suggest that diverse inflation expectations caused by inflation inequality result in different allocation and consumption decisions, which is consistent with the CHFS data. Our findings also demonstrate how inflation experiences across different income groups, economic sectors, regions, and measures affect household choices.

The macroeconomic effects of inflation on investment and consumption are also frequently documented in macroeconomic and asset pricing studies. For instance, Bansal and Shaliastovich (2012), Hasseltoft (2012), Mallick and Mohsin (2010, 2016), Piazzesi and Campbell (2006), and others, empirically examined the effect of inflation on investment and consumption. In particular, Mallick and Mohsin (2010, 2016) found that inflation negatively affects investment and consumption, and proposed an open economy model to explain their empirical evidences. This paper contributes to the literature through study of the inflation effect. Our model is not only related to financial asset allocation but is also close to the resource allocation problem in the stochastic growth models.[3] On the one hand, it has an advantage over previous literature to theoretically explain the differences of the investment in either financial assets or physical assets (called allocation in financial assets or physical assets). Our findings generally support the evidences of financial asset allocation seen in the survey data. On the other hand, we find that the effects of inflation on investment and consumption among economic units are related to inflation inequality, which further enrich the homogeneous findings of Mallick and Mohsin (2010, 2016).

The rest of this paper is organized as follows. Section 2 introduces an asset allocation model by considering inflation risk and derives the analytic formulae of asset allocation and the consumption ratio. Section 3 describes the survey data and analyzes several types of inflation experiences by inflation data. Section 4 uses the inflation data to estimate different coefficient groups and then analyzes the different inflation expectations. Section 5 applies the estimation results to the analytic formulae and discusses the calibration results. Section 6 presents the conclusions.

2. An asset allocation model with a mean-reverting inflation dynamic

We consider a modification of the models in Anderson et al. (2000), Brock (1978), Brock and Mirman (1972), and Cox et al. (1985) by adding an inflation process from the traditional price level model.

In this economy, the production sector adopts a linear production technique (a special case of the stochastic growth model) and produces only a numeraire. Multiple technologies can be used to transfer goods from one instant to the next. Capital is freely transferable across the different technologies. Newly produced outputs are split between consumption and new capital that invested in economic sectors with various technologies. We suppose that households determine the consumption ratio and invest in a particular economic sector, which maximize their intertemporal expected utility.

Households attempt to balance the present and future consumption. Furthermore, households are assumed to have recursive preferences over consumption. As such, we use the continuous-time parameterization of Duffie and Epstein (1992a, b):

$$V_t = \int_t^\infty f(\overline{C}_S, V_S) dS,\qquad(1)$$

where $\overline{C}_t$ and V_t denote the real level of consumption and utility, respectively. $f(\overline{C}, V)$ is a normalized aggregator of current consumption and continuation utility.

The continuation utility takes the form

$$f(\overline{C}, V) = \beta(1 - 1/\phi)^{-1}(1 - \gamma)V[((\overline{C}(1-\gamma)V)^{-1/(1-\gamma)})^{(1-1/\phi)} - 1],\qquad(2)$$

where $\beta > 0$ is the rate of the time preference, $\gamma > 0$ is the parameter of relative risk aversion, $\phi > 0$ is the elasticity of intertemporal substitution (EIS) that signifies the time preference value of the utility, $\phi > 1$ indicates that households prefer to save for future consumption rather than current consumption, and $\phi = 1$ means that household are indifferent to consumption allocation in either period.

There are two special cases of the normalized aggregator Eq. (2). If $\phi = 1/\gamma$, then Eq. (2) will be the aggregation of the CRRA utility function. If ϕ approaches 1, then Eq. (2) will be $f(\overline{C}, V) = \beta(1 - \gamma)V[log(\overline{C}) - log((1 - \gamma)V)/(1 - \gamma)]$. Both of these cases allow us to derive the analytic solutions of this optimization problem.

In the production sector, suppose there are two technologies that can convert one good to a different good. Again, we suppose that K_t represents the nominal accumulated wealth. Household could allocate a proportion of new assets to either the riskless technical sector

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[3] Anderson et al. (2000) provided a simple form of the resource allocation problem, based on the stochastic growth model literature, such as Brock (1978), Brock and Mirman (1972), and Cox et al. (1985). Different from Bansal and Shaliastovich (2012), Hasseltoft (2012), Mallick and Mohsin (2010, 2016), Piazzesi and Campbell (2006), the investment and consumption in our model are driven by expected inflation. So, the

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(*footnote continued*)
relationship we study between inflation and investment and consumption is not empirical but theoretical.