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Risk, uncertainty, and the dynamics of inequality☆

Kenneth Kasa*, Xiaowen Lei

Department of Economics, Simon Fraser University, Canada

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The dynamics of wealth inequality are studied in a continuous-time Blanchard/Yaari model. Investment returns are idiosyncratic and subject to Knightian uncertainty. In response, agents formulate robust portfolio policies. These policies are nonhomothetic; wealthy agents invest a higher fraction of their wealth in uncertain assets yielding higher mean returns. This produces a feedback mechanism that amplifies inequality. It also produces an accelerated rate of convergence, which helps resolve a puzzle recently identified by Gabaix et al. (2016). An empirically plausible increase in uncertainty can account for about half of the recent increase in top wealth shares.

1. Introduction

It is well known that models of idiosyncratic labor income risk, in the tradition of Aiyagari (1994), cannot explain observed inequality. Although these models shed some light on the lower end of the wealth distribution, they cannot generate sufficient concentrations of wealth in the right-tail Huggett (1996).[1] In response, a more recent literature considers models of idiosyncratic investment risk. These so-called ‘random growth’ models *can* generate the sort of power laws that characterize observed wealth distributions.[2]

Although investment risk models are successful in generating empirically plausible wealth distributions, they suffer from two drawbacks. First, existing applications focus on *stationary* distributions. However, what is notable about recent US wealth inequality is that it has increased. This suggests that some parameter characterizing the stationary distribution must have changed. It’s not yet clear what changed. Second, Gabaix et al. (2016) have recently shown that standard investment risk models based on Gibrat’s Law cannot account for the *rate* at which inequality has increased. Top wealth shares have approximately doubled over the past 35–40 years. Standard model parameterizations suggest that this increase should have taken at least twice as long.

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* Corresponding author.
E-mail address: kkasa@sfu.ca (K. Kasa).

[1] Benhabib et al. (2017) note that models based on idiosyncratic labor income risk cannot generate wealth distributions with fatter tails than the distribution of labor income.

[2] The original idea dates back to Champernowne (1953) and Simon (1955). Recent examples include Benhabib et al. (2011) and Toda (2014). Gabaix (2009) provides a wide ranging survey of power laws in economics and finance. Benhabib and Bisin (forthcoming) survey their application to the distribution of wealth.

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Our paper addresses both of these drawbacks. The key idea is to assume that agents confront (Knightian) uncertainty when investing. Following Hansen and Sargent (2008), agents have a benchmark model of investment returns. In standard random growth models, agents fully trust their benchmark model. That is, they confront risk, not uncertainty. In contrast, here agents distrust their model, in a way that cannot be captured by a conventional Bayesian prior. Rather than commit to single model/prior, agents entertain a *set* of alternative models, and then optimize against the worst-case model. Since the worst-case model depends on an agent's own actions, agents view themselves as being immersed in a dynamic zero-sum game. Solutions of this game produce 'robust' portfolio policies. To prevent agents from being unduly pessimistic, in the sense that they attempt to hedge against empirically implausible alternatives, the hypothetical 'evil agent' who selects the worst-case model is required to pay a penalty that is proportional to the relative entropy between the benchmark model and the worst-case model.

This is not the first paper to study robust portfolio policies. Maenhout (2004) applied Hansen–Sargent robust control methods to a standard Merton-style consumption/portfolio problem. He showed that when the entropy penalty parameter is constant, robust portfolio policies are nonhomothetic, i.e., portfolio shares depend on wealth levels. He went on to show that homotheticity can be preserved if the penalty parameter is scaled by an appropriate function of wealth. Subsequent work has followed Maenhout (2004) by scaling the entropy penalty, and thereby confining attention to homothetic portfolio policies.

Here the entropy penalty parameter is *not* scaled. The problematic long-run implications of nonhomotheticity are not an issue, since we study an overlapping generations economy. If the coefficient of relative risk aversion exceeds one, robustness concerns dissipate with wealth. As a result, wealthier agents choose to invest a higher fraction of their wealth in higher yielding assets.[3] This produces a powerful inequality amplification effect. It also provides a novel answer to the question of why inequality began increasing around 1980, not just in the US, but in many other countries as well. Many have argued that the world became more 'turbulent' around 1980. Some point to increased globalization. Others point to technology. Whatever the source, micro evidence supports the notion that individuals began to face greater idiosyncratic risk around 1980.[4] Given this, it seems plausible that idiosyncratic uncertainty increased as well.[5]

Idiosyncratic uncertainty also helps resolve the transition rate puzzle of Gabaix et al. (2016). They show that models featuring scale dependence, in which shocks to growth rates depend on the level of income or wealth, produce faster transition rates than traditional random growth models based on Gibrat's Law. Robust portfolio policies induced by uncertainty produce a form of scale dependence. Inequality dynamics are analytically characterized using the Laplace transform methods popularized by Moll and his co-authors. Although the model itself is nonlinear, this nonlinearity only arises when the inverse of the entropy penalty parameter is nonzero. For small degrees of uncertainty the parameter is close to zero. This allows us to employ classical perturbation methods to obtain approximate analytical solutions of the Laplace transform of the Kolmogorov–Fokker–Planck (KFP) equation, which then yield approximations of the transition rates.

To illustrate the quantitative significance of uncertainty induced inequality, we suppose the US economy was in a stationary distribution without uncertainty in 1980. Even without uncertainty wealth is concentrated at the top due to a combination of investment luck and longevity luck. Assuming agents live/work on average about 40 years, the wealth share of the top 1% is 24.3%, roughly equal to the observed 1980 share. Uncertainty is then injected into the economy by setting the (inverse) entropy penalty parameter to a small nonzero value, while keeping all other parameters the same. This increases the top 1% wealth share to 36.9%, close to its current value of about 40%. If this increased inequality had been generated by a change in some other parameter, the transition rate at the mean level of wealth would be only 1.14%, implying a *half-life* of more than 60 years. Thus, assuming the economy is currently at least 90% of the way to a new stationary distribution, it should have taken 200 years to get here, rather than the observed 35–40 years! However, if increased inequality was instead generated by increased uncertainty, the transition rate at the mean more than triples, to 3.85%. This reduces the model implied transition time from 200 years to about 60 years; still longer than observed, but significantly closer.

Aoki and Nirei (2017) also study the dynamics of wealth inequality in a Blanchard–Yaari OLG model. A portfolio composition effect is also the key force behind increased inequality in their model. However, their paper features several important differences. First, they focus on income inequality rather than wealth inequality. Second, their model lacks a natural perturbation parameter, so they resort to numerical solutions of the KFP equation. They find that if the variance of idiosyncratic productivity shocks is calibrated to those of publicly traded firms, the model produces transition rates that are comparable to those in the data. However, if privately held firms are included, which is more consistent with the model, transition rates are too slow. Third, and most importantly, the underlying mechanism in their paper is different. They argue that reductions in top marginal income tax rates were the trigger that produced increased inequality. In support, they cite Piketty et al. (2014), who report evidence on top income shares and tax rates from 18 OECD countries for the period 1960–2010. They show that countries experiencing the largest reductions in top marginal income tax rates also experienced the largest increases in top income inequality. We do not dispute the role that tax policy likely played in growing inequality. However, an interesting additional result in Piketty et al. (2014) is that if you split the sample in 1980, the link between taxes and inequality in-

[3] Although there is widespread agreement that wealthier individuals earn higher average returns, it is not clear whether this reflects portfolio composition effects, as here, or whether it reflects higher returns *within* asset categories. See below for more discussion.

[4] See, e.g., Gottschalk and Moffitt (1994), Ljungqvist and Sargent (1998) and Kambourov and Manovskii (2009).

[5] Note, here it is sufficient that agents *perceive* an increase in risk. The increase itself might not actually occur, but fears of its existence would still be relevant if they are statistically difficult to reject.

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