Journal of Financial Economics 122 (2016) 116–134

Contents lists available at ScienceDirect

Journal of Financial Economics

journal homepage: www.elsevier.com/locate/jfec

Disaster recovery and the term structure of dividend strips☆

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ARTICLE INFO

Article history:
Received 27 March 2015
Revised 19 October 2015
Accepted 27 November 2015
Available online 21 June 2016

JEL Classification:
D53
D51
E21
G12
G13

Keywords:
Recovery
Rare disasters
Term structures of equity
Dividend strips
Asset pricing puzzles

ABSTRACT

Recent empirical findings document downward-sloping term structures of equity return volatility and risk premia. An equilibrium model with rare disasters followed by recoveries helps reconcile theory with empirical observations. Indeed, recoveries outweigh the upward-sloping effect of time-varying disaster intensity and expected growth, generating downward-sloping term structures of dividend growth risk, equity return volatility, and equity risk premia. In addition, the term structure of interest rates is upward-sloping when accounting for recoveries and downward-sloping otherwise. The model quantitatively reconciles high risk premia and a low risk-free rate with the shape of the term structures, which are at odds in other models.

1. Introduction

Recent empirical studies show that the term structures of dividend growth risk, equity return volatility, and equity risk premia are downward-sloping (van Binsbergen, Brandt and Koijen, 2012; van Binsbergen, Hueskes, Koijen and Vrugt, 2013).[1] These findings are particularly important because they question the validity of the most successful asset pricing models. Models featuring time-varying disaster risk (Gabaix, 2012; Wachter, 2013) or time-varying expected growth (Bansal and Yaron, 2004) provide convincing foundations for the observed properties of equity return volatility and risk premia, but they assume term structures of dividend growth volatility and, in turn, imply term structures of equity return volatility and risk premia that are inconsistent with the data.

In this paper, we account for the empirically supported fact that dividends recover after disasters (Gourio, 2008; Nakamura, Steinsson, Barro and Ursua, 2013). While either natural or man-made disasters affect both physical and, to a lesser extent, human capital, disaster recovery is easy to understand by means of knowledge conservation. Available technology and know-how allow accelerated post-disaster economic growth. Capital accumulation is easier the second time around because it replicates a known investment pattern. Moreover, disasters induce government

☆ We would like to thank Ilaria Piatti, European Finance Association (EFA) meeting 2015 discussant, G. William Schwert (the editor), and an anonymous referee for comments that significantly improved the quality of the paper. We also would like to acknowledge comments from Giovanna Nicodano, Julien Penasse, and conference participants at the EFA meeting 2015. Financial support from the University of Toronto, the Connaught New Researcher Award, and the Collegio Carlo Alberto is gratefully acknowledged.

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[1] See van Binsbergen and Koijen (2016) for a recent survey on the term structures of equity return.

http://dx.doi.org/10.1016/j.jfineco.2015.11.002
0304-405X/

spending to stimulate the economic environment and foster competition.[2]

We show that disaster recovery helps explain the observed shape of the term structures of equity return. We provide theoretical evidence that recoveries kill the upward-sloping effect of both time-varying disaster risk and time-varying expected growth. The reason is that, in the presence of recoveries, the volatility of dividend growth is larger in the short term than in the long term. In equilibrium, the properties of dividend growth volatility transmit to stock returns and imply empirically consistent downward-sloping term structures of equity return volatility and risk premia.

We base our model on three important properties of the joint dynamics of consumption and dividends for which we provide evidence. First, dividends scaled by consumption are stationary, i.e. consumption and dividends are co-integrated (Lettau and Ludvigson, 2005). Second, the term structure of consumption growth volatility is slightly upward-sloping, and that of dividend growth volatility is markedly downward-sloping (Marfè, 2016). This heterogeneity in the timing of fundamental risk is key to understanding the shape of the term structures of equity return. Third, conditional on a disaster, dividends drop more and recover faster than consumption (Longstaff and Piazzesi, 2004), validating the theoretical predictions of Gourio (2012).

These stylized facts are closely related to each other. Co-integration implies that consumption and dividends face the same permanent shock and that the dividend share of consumption is stationary. However, the dividend share of consumption moves negatively with disasters and positively with recoveries. This implies that disasters are (at least partially) transitory shocks and that dividends drop more and recover faster than consumption. The levered exposition of dividends to transitory risk helps explain the gap between the upward-sloping term structure of consumption growth risk and the downward-sloping term structure of dividend growth risk.

We consider a pure-exchange economy (Lucas, 1978) with a representative investor who has Epstein and Zin (1989) preferences. To model the joint dynamics of consumption and dividends, we consider a rare disaster model with time-varying disaster intensity (Wachter, 2013) and expected growth (Bansal and Yaron, 2004). The key feature of our model is that recoveries take place right after the occurrence of a disaster (Gourio, 2008). We argue that, even though disaster intensity risk and long-run risk imply empirically inconsistent term structures of equity return, extending these models with plausible recoveries helps explain simultaneously several important properties of dividends, consumption, and asset prices.[3]

We show that the presence of recoveries implies a markedly downward-sloping term structure of dividend growth volatility. The reason is that, in the short term (e.g., one day), the dividend faces disaster and expected growth risk, but the horizon is too short to benefit from a significant recovery. In the long term (e.g., 20 years), disaster and expected growth risk are still present, but dividends have a significant amount of time to recover. However, the speed of consumption recovery is not high enough to outweigh disaster intensity risk and expected growth risk, both of which imply a large amount of risk in the long term. Therefore, the term structure of consumption growth volatility is slightly upward-sloping.

In equilibrium, equity returns inherit the properties of dividend growth rates. Therefore, the term structure of equity return volatility and risk premia are, as the term structure of dividend growth volatility, downward-sloping in our model. To understand the dynamic patterns of the term structures of equity return over the business cycle, we define bad (good) economic times as states of the world in which the disaster intensity is high (low). Consistent with van Binsbergen, Hueskes, Koijen and Vrugt (2013), we show that the slopes of the term structures of equity return are pro-cyclical in our model, being smaller in bad times than in good times. The reason is that, in bad times, the disaster intensity is large and is consequently expected to revert back down to its mean in the long term. This implies a significantly larger amount of risk in the short term than in the long term and, therefore, steep downward-sloping term structures of equity return. In good times, however, the disaster intensity is small and eventually reverts back up to its long-term mean. That is, disaster intensity risk is larger in the long term than in the short term. This dampens the downward-sloping effect of recoveries and implies flatter term structures of equity return. The properties of the term structures of equity return hold even for an elasticity of intertemporal substitution (EIS) smaller than one.[4] The reason is that returns inherit the properties of cash flow growth rates as long as the EIS is larger than some lower bound. This lower bound turns out to be smaller than one for equity – the dividend claim – because dividends have a levered exposition on disaster risk.

In line with empirical findings, the risk-free rate is about 0.6% and equity risk premia are about 6.5%. The model generates relatively large risk premia because, in the presence of recoveries, risk premia decrease with the elasticity of intertemporal substitution (Gourio, 2008).[5] Moreover, the ability of the model to solve the risk-free rate and equity premium puzzle and simultaneously capture the negative slope of the term structures of equity return is robust to the setting of investors' preferences. We show that our results hold for an elasticity of

[2] While debate is ongoing about the short-run and long-run impacts of disasters on economic growth, developed economies, such as the US, seem to be able to mitigate adverse effects and exploit growth opportunities. See Cavallo, Galiani, Noy and Pantano (2013) and references therein.

[3] Consistent with the international evidence presented by Gourio (2008) and Nakamura, Steinsson, Barro and Ursua (2013), our calibration implies that consumption partially recovers after large drops (by about 50%) in about five years. This is the joint result of long-run growth and after-disaster excessive conditional growth.

[4] A major critique of long-run risk and rare disasters models is their reliance on a large elasticity of intertemporal substitution (Epstein, Farhi and Strzalecki, 2014).

[5] If disasters are fully permanent, then risk premia increase with the elasticity of intertemporal substitution.