# Literature Review

ECON 4008-01: Macro-Modeling

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Robert Lucas (1978) examines the stochastic behavior of equilibrium prices in a representative, pure exchange, single good economy with identical consumers.[1] His paper first examines the behavior of asset prices in a one-good pure exchange economy with identical consumers and introduces a method of constructing equilibrium prices. Lucas later defines the general equilibrium as a pair of functions: a price function and an optimum value function. To reach a competitive equilibrium, all output must be consumed, all asset shares must be held, and all asset prices must solve the dynamic program. Thus, the general equilibrium and market clearing price for trees at time $t$ must satisfy the following: $s_t^* = 1, a_t^* = p_t$, and $c_t^* = d_t$. Hence, the equilibrium price of the asset must satisfy $p_t = E_t \{\sum_{n=1}^{\infty} \beta^n \frac{u'(d_{t+n})}{u'(d_t)} d_{t+n}\}$.[2] Lucas' paper was the first of its kind to model risky asset ownership decisions and determine how risk premiums are incorporated in the price of an asset.

Subsequent to the publication of the Lucas Asset Pricing Model, Mehra and Prescott (1985) present the equity premium puzzle. They find that in a competitive pure exchange economy, the average annual yield of equity is, at most, four-tenths of a percent higher than that of short-term debt. In stark contrast, the historical yield observed by Mehra and Prescott has a premium of six percent when accounting for U.S. business cycle fluctuations and reasonable risk aversion levels. They conclude that the historical U.S. equity premium, the return earned by a risky security in excess of that earned by a relatively risk-free U.S. Treasury Bill, is not only irrational but also inexplicable.[3] According to Nada (2013), the economies used in Mehra and Prescott's study have a "stationary equilibrium for growth rate process on consumption as well as returns"[4]. Nada

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[1] Lucas, Robert E. 1978. "Asset Prices in an Exchange Economy." *Econometrica* 1429-1445.

[2] Ibid.

[3] Prescott, Edward, and Rajnish Mehra. 1985. "The equity premium: A puzzle." *Journal of Monetary Economics* 145-161.

[4] Nada, Sara. 2013. "Equity Premium Puzzle: Not solved yet. ." *International Conference on Economics and Business Administration.* 48-61.

maintains that the elasticity of substitution between consumption in time period $t$ and time period $t+1$ is sufficiently small to yield a six percent average premium, but the magnitude of the covariance between the marginal utility of consumption and equity returns is not sufficiently large enough to justify the equity premium observed. Mehra and Prescott's equity premium puzzle ignited an extensive research effort within the fields of macroeconomics and finance. A plethora of theoretical speculations and plausible explanations for this anomaly have been presented, but no single solution has been widely accepted by economists.

Traditionally, studies that replicate the equity premium puzzle with a Lucas Asset Pricing Model examine the excess returns of a risky security or index relative to those of risk-free assets or treasury bonds. Although virtual currencies resemble the role of money and create an alternative environment for conducting business, it was not until 2016 that cryptocurrencies were unacknowledged by academics. Cryptocurrencies are commonly used as methods of payments, but it is heavily debated whether they truly function as currencies. Since the role cryptocurrency plays is unclear to many, how cryptocurrency is regulated by financial institutions is controversial. Vandezande (2017) claims that it is increasingly important to analyze the behavior of cryptocurrencies as financial tools because there are few explanations for the current behavior of cryptocurrencies as investment tools. He analyzes the extent to which virtual currencies are regulated within the European Union and ascertains that cryptocurrencies have the highest risk among all types of virtual currencies. Although Vandezande (2017) does not include empirical tests, he further maintains that investors are not fully informed about the risk relating to cryptocurrency investments due to the absence of regulatory bodies and the enforcement of protection mechanisms[5]. He lastly suggests that legal frameworks used for traditional currencies

[5] Vandezande, Niels. 2017. "Virtual currencies under EU anti-money laundering law." *Computer Law & Security Review* 341-353.

and financial investments are applicable to the various types of virtual currencies and cryptocurrency service providers.

Much of the financial literature contains ambiguous results concerning the behavior of cryptocurrencies. Thus, the debate about whether cryptocurrencies are a speculative investment asset or a currency remains ongoing. Corbet, Meegan, et al. (2018) examine the relationships between cryptocurrencies and other financial assets with the Diebold and Yilmaz methodology[6], Barunik and Krehlik methodology[7], and a standard Multivariate Generalized Autoregressive Conditional Heteroskedasticity model with dynamic conditional correlations (MVGARCH-DCC) model. They hypothesize that, "cryptocurrency markets, i.e. Bitcoin, Ripple, and Litecoin, are strongly interconnected and demonstrate similar patterns of return and volatility transmission with other assets."[8] To study the return and volatility transmission among Bitcoin, Ripple, and Litecoin and research the excess return and volatility transmission to gold, bond, equities, and the global volatility index (VIX), they measure changes in the correlations of the aforementioned assets' volatilities and returns. Their findings demonstrate that cryptocurrencies are relatively isolated from market shocks and decoupled from popular financial assets, despite the fact that the performance of each cryptocurrency is correlated to the performance of other cryptocurrencies. Corbet, Meegan, et al. (2018) also find that Bitcoin, Ripple, and Litecoin are highly sensitive to industry regulations and technological malfunctions. Ergo, the interconnectedness among cryptocurrencies indicates that substantial changes in cryptocurrency prices are attributable to

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[6] Francis, Diebold, and Kamil Yilmaz. 2012. "Better to give than to receive: Predictive directional measurement of volatility spillovers." *International Journal of Forecasting* 57-66.

[7] Barunik, Jozef, and Thomas Krehlik. 2016. *Measuring the frequency dynamics of financial and macroeconomic connectedness.*

[8] Corbet, Shaen, Andrew Meegan, Charles Larkin, Brian Lucey, and Larisa Yarovaya. 2018. "Exploring the Dynamic Relationships between Cryptocurrencies and Other financial Assets." *Economics Letters.*

speculative activity. These results suggest that cryptocurrencies can be effective tools for portfolio diversification.

Although cryptocurrencies may serve as useful portfolio diversifiers their returns do not behave similarly to standard asset classes.[9] Liu and Tsyvinski (2018) investigate whether the cryptocurrency market behaves similarly to the stock market. They do so by determining whether or not the returns of cryptocurrency are compensated by risk factors derived from the stock market and analyzing CAPM alphas, CAPM betas, and Eugene Fama and Kenneth French's five risk factors. Thereafter, they study the exposure of cryptocurrency returns to the Australian Dollar, Canadian Dollar, Euro, Singaporean Dollar, and UK Pound. Although major national currencies strongly comove with one another, the exposures of all cryptocurrencies to major currencies are not statistically significant. Hence, Liu and Tsyvinski (2018) fail to reject the null hypothesis that cryptocurrency serves as another medium of exchange. They also examine the exposure of cryptocurrency returns to precious metal commodities and test whether or not cryptocurrencies serve as a store of value. Again, they find that the exposure of cryptocurrencies is insignificant. Traditional currencies fulfill three objectives: a unit of account, a store of value, and a medium of exchange. However, the implementation of empirical asset pricing models and the analysis of co-movements among Bitcoin, Ripple, Ethereum, stocks, currencies, commodities, macroeconomic factors, and cryptocurrency market specific factors show that cryptocurrencies can be assessed using simple financial tools, but they behave in a radically different manner than traditional assets. Liu and Tsyvinski (2018) lastly conclude that only cryptocurrency market specific factors including momentum and investor attention consistently explain market returns.

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[9] Liu, Yukun, and Aleh Tsyvinski. 2018. "Risks and Returns of Cryptocurrency." *NBER Working Paper Series.* National Bureau of Economic Research, August.

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