

# Statement on Scholarship

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I am an applied macro-financial economist researching expectation formation, productivity, economic fluctuations and asset pricing. A majority of my work has used expectations data and learning models to understand large fluctuations. Additionally, I have studied R&D productivity exploiting a unique Chinese data set, and unemployment fluctuations.

## 1. Research on Expectations

My research has demonstrated some puzzling facts about ordinary individuals' unemployment expectations, namely they fail to expect predictable changes in the unemployment rate. In "Unemployment Expectations and the Business Cycle" (*BE Journal of Macro*), I document statistical facts about the unemployment series and contrast them with facts about individuals' expectations. First, unemployment is mean reverting; when it is above its average it tends to fall and when it is below its average it tends to rise. Second, at peaks and troughs of unemployment, statistical forecasts correctly anticipate this reversal. However, mean reversion in unemployment is missed by individuals. At the peak of unemployment one-third to one-half of the population expects unemployment to rise. In fact, more people expect unemployment to rise at the end of the recession than at the beginning of the recession. I also show models of extrapolation capture these expectations better than models of sticky information, education and income do little to mitigate these errors, and making a pessimistic error, is correlated with believing it is a bad time to make a major purchase. This paper contributes to the literature on how agent's expectations depart from rational expectations in predictable ways.

To model inattention to mean reversion, I have introduced a novel learning model. In this model agents are unsure if time series are trend stationary (so shocks are temporary) or difference stationary (so shocks are permanent) and need to learn over time. I applied this model in a paper, "Credit Constraints, Learning, and Aggregate Consumption Volatility" (*Macro Dynamics*). This paper documents that my learning model is key for understanding the changing relationship between consumption and income. The paper establishes three facts about consumption and income. First, the volatility of consumption growth *relative* to income growth rose from 1947 to 1960, then fell about 50% between 1960 and 2000. Second the correlation between consumption growth and income growth fell 50% over the same time period. Finally the absolute deviation of consumption from its mean exhibits a significant level break in the US time series.

To explain these facts I use my model where agents are unsure if shocks are permanent or temporary. Agents learn from a productivity series derived from aggregate US income data. Agents view productivity as increasingly non-stationary beginning in 1955 until 1970,

and therefore see shocks as more permanent and react more. Afterwards, income data look remarkably stationary. The model is consistent with the consumption facts outlined above. This paper expands the existing literature on expectations and aggregate consumption. The facts in the paper are new. It is an example of how relaxing rational expectations for learning can dramatically change a model's predictions. Finally, it shows that expectations are key to understanding the relationship between aggregate consumption and income.

I have explored the ability of this model of expectations to explain puzzles in finance, housing and business cycles as well. The model generates excessive optimism and pessimism and is an explanation for booms and crashes in asset prices. In "Equity Return Predictability, Time Varying Volatility and Learning About the Permanence of Shocks" (*JEBO*) I consider a consumption based asset pricing model where agents do not know that the true process for dividends. They put positive probability on both stationary and non-stationary processes and learn over time observing the data. This model helps explain asset pricing puzzles. In the model, agents confuse temporary movements in the dividend with permanent changes. After a positive shock there is a positive return and the PE-ratio and consumption increase. However, because agents have overreacted, these changes are partially reversed in the future. As such, the model is able to explain why medium run returns (2-5 years out) are forecastable with the PE-ratio, current returns and current consumption growth. The model also generates a negative correlation between the current PE-ratio and future consumption growth. Finally, a novel result of this approach is that it generates endogenous time varying volatility.

In a second paper, "Long Run Expectations, Learning and the U.S. Housing Market" (*Eastern Economic Journal*) I extend this analysis to housing. While housing assets are different from equity, there are several similarities, in the data, between equity and housing returns. The housing price-to-rent ratio negatively forecasts future returns and rent growth and returns on housing exhibit time varying volatility. I develop a model where the housing price is driven by shocks to housing preference. I show that the price of housing equals the present discounted value of expected future levels of housing demand. If agents are unsure about the future level of aggregate housing preference then the model is able to replicate many features of the data. The price-to-rent ratio negatively forecasts future housing returns and rent growth. The model also generates time varying volatility.

In "The Business Cycle Implications of Fluctuating Long Run Expectations" (*Journal of Macro*), I embed this model of expectations into an RBC model and show the resulting model better explains key facts about business cycles. Eusepi and Preston (2011) showed that consumption in an RBC model depends on the present discounted value of labor and capital income. This result is a natural setup for a model where agents are unsure about the long-run effects of shocks. I consider the RBC model but allow agents to forecast both labor and capital income with uncertainty about the stationarity of these processes. They learn over time depending on

the realization of labor and capital income. This learning mechanism improves the model on several dimensions. First over a rational expectations benchmark, the model generates twice the volatility of output. In addition, the model better matches the relative volatilities of investment and hours. This model is able to generate positive autocorrelation in output, consumption and investment generated only with expectations. The model also generates realistic time varying volatility endogenously.

My most recent work has examined the interaction between expectations implied from financial market data, actual outcomes, and risk premia. In “Arbitrage in International Sovereign Debt Markets?” (*JMCB* w/A. Kita) we study the spread between nominal and inflation protected sovereign debt for six countries. This spread is often used to imply inflation expectations however the spread differs from inflation expectations implied from inflation swaps. As a result, in all these countries there is a substantial arbitrage opportunity (mispricing) if a trader buys inflation protected debt and swaps and sells nominal debt. We explore if this arbitrage strategy is exposed to risk in the short run and show that it is. Additionally, when arbitrageurs’ capital increases the mispricing does not narrow suggesting that exploiting this arbitrage opportunity has short run risks. We conclude that standard methods of extracting inflation expectations from nominal and inflation protected debt using arbitrage free, risk-based factor models are well founded.

In, “Same Firm, Two Volatilities” (*Journal of Corp Fin*, 2nd round R&R w/A. Kita) we examine market expectations of future stock and credit market volatility. For stocks, one can calculate a variance risk premium (VRP) the difference between option implied volatility and a statistical forecast of actual stock market volatility. Additionally, we calculate a credit VRP by examining implied volatility from the actuarial fair prices of credit default swap (CDS) insurance on corporate debt to forecasted volatility of CDS returns. We examine if the VRP is a true risk premium or a systematic bias in expectations. We find evidence consistent with the VRP being a true risk premium. The VRP is correlated with and forecasts future stock market returns. Additionally, credit-VRP forecasts stock market returns over and above equity-VRP.

In a recent project, “A Theory of Social Impact Bonds” (w/D. Bloom, P. Kirby and J. Regan; *Working Paper*<sup>1</sup>) we study why governments do not always fund preventative measures with expected future cost savings outweighing their initial costs. We consider a model where the government’s subjective expectations about the probability a project fails are more pessimistic than the private sector. We show that the government would be willing to use a financial instrument called a social impact bond, where payments to investors are contingent on the project’s outcome, to finance the project when they would not be willing to use traditional debt.

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<sup>1</sup>All working papers referenced in this statement are available online at: <https://www.holycross.edu/academics/programs/economics-and-accounting/faculty/daniel-tortorice>

## 2. Research on Unemployment & Productivity

To better understand business cycles, I have ventured to improve models of unemployment fluctuations directly. In “Endogenous Separation, Wage Rigidity and the Dynamics of Unemployment,” (*Journal of Macro.*) I consider if wage rigidity in the Mortensen-Pissarides model combined with an endogenous, job-separation rate can explain volatility in the unemployment rate. It is important to explore these mechanisms in tandem because models without endogenous separation will overstate the needed degree of wage stickiness to match unemployment volatility. I find that endogenous separation and wage rigidity are enough to allow the model to capture 90% of the variance of unemployment. I also examine if the degree of required wage rigidity is counterfactually high and found that it is not.

An important driver of productivity growth is R&D. To better understand this process, I examine R&D in China. In “Restructuring China’s Research Institutes” (*Econ. of Transition* w/R. Jiang and G. Jefferson) we study the restructuring and privatization of the country’s 5,000 research institutes beginning in 1999. We show that research institutes reclassified as Science & Technology enterprises had large productivity gains. Productivity increased by 7% and non-governmental revenue per worker increased 35%. Similarly, for institutes converted to non-profit research institutes, productivity increased by 18%. The paper also provides evidence that these effects are casual using event study and propensity score methods.

It is likely these gains will have increased spillovers into the macroeconomy as faster productivity growth. To investigate this issue we use detailed administrative data on these research institutes collected by China’s Ministry of Science and Technology, in “Knowledge Spillovers Within China’s System of Research Institutes” (*Working Paper Under Review*). Specifically, we know their location and are able to calculate the distance between the research institutes. We find evidence that when R&D expenditure increases in one’s province and industry, the institute’s own research productivity increases. Additionally, these spillovers are attenuated by distance from other institutes.

In a related project “Have China’s Unconverted Research Institutes Been Left Behind?” (*Working Paper Under Review*) we explore the fate of the research institutes that were not converted as part of the restructuring program. We found they were more likely to exit the research institute system and had lower productivity growth than other institutes. However, they were able to keep up in terms of patenting and revenue growth.

## 3. Future Work

I will continue my work on expectations and learning. I am exploiting the expectations questions of the Michigan Survey of Consumers to measure economic literacy. Then I am using these measures to examine the relationship between financial literacy and stock market participation. In another project (joint w/ Justin Svec), we consider optimal monetary policy when agents are learning about the degree to which the central bank is independent.