David deVyver
Project Proposal:

I want to design, create, optimize, and analyze a DSGE model that captures the impact of downward nominal wage rigidity (DNWR), or the phenomenon that people want wages greater than or equal to their previous one. I want to do so by building a New Keynesian Model with general wage rigidities, so we can fully examine the impact of the DNWR.

I plan on recreating and simulating the model used by Fernandez-Villaverde et al. (2011) that contains interesting wage-setting behavior. Specifically, the model contains heterogeneous labor types and quadratic Rotemberg wage adjustment costs. These rigidities will allow me to capture household wage setting behavior in the absence of a DNWR and the behavior of a central bank given those wages. I plan on coding this model into MATLAB and Dynare and generating relevant summary statistics on output, the interest rate, the wage rate, and inflation to properly parameterize the model to generate similar proportions to real life. I will save this data to compare to both the DNWR model and to the real life corresponding data. One of my primary goals will be to analyze how these rigidities impact the shapes of the Phillips curve and wage Phillips curve, two important relationships in economics.

With this model, I will introduce a downward nominal wage rigidity to capture variation in wage setting behavior from the household. When a central bank sets the interest rate, they consider the economy's output. Since output is directly impacted by the wage rate, the introduction of the DNWR will have an impact on optimal interest rate setting. I plan on introducing this rigidity into the households problem, by adding an additional DNWR constraint to the households problem and having them optimize their wage setting behavior with respect to the constraint.

Downward nominal wage rigidity models are not new; they have been used historically to capture setting wage behavior. Schmitt-Grohé-Uribe (2016) is one of the landmark papers on the topic. They study the impact of DNWR's on optimal currency pegs, specifically, they examine how DNWR's can distort "classic" results from trade. Cited 861 times, the paper is a basis for many future DNWR papers. The paper is cited for its simple yet effective approach to a DNWR, just the requirement that tomorrow's wage must be 98% or more of today's. This simple solution makes the paper a common citation for DNWR models.

Abbritti-Fahr (2013) builds a New Keynesian model with a DMP style labor market to analyze business cycle asymmetry. Abbriti-Fahr (2013) captures this by using asymmetric wage adjustment costs in monopolistically competitive firms. In doing so, they are able to understand why the business cycle behaves asymmetrically. They got their results by comparing third moments for macroeconomic variables with and without the rigidity and they found that the

asymmetric wage adjustment costs were necessary to get accurate third moments for the wage rate and output in their model. One aspect I may implement is a labor market, and a simple Abbriti-Fahr (2013) style model would allow for easy comparison to check for model validity.

Amano-Gnocchi (2017) considers the interactions between the DNWR and the zero lower bound restriction on the interest rate. They build a standard New Keynesian Model with some wage stickiness and a DNWR constraint. They include a DNWR by introducing the constraint into the household's problem to see how this style of model impacts a DNWR. This paper is the basis of how I made my DNWR constraint. It is very uncommon for models to use this approach, and it has allowed me to learn about constrained optimization. As a result, I want to make a similar model to this paper, with a stronger focus on the Phillips curve and more rigidities in the form of wage adjustment costs.

Shen-Yang (2018) builds a New Keynesian model that explores the unemployment impacts of a DNWR and the overall impact of the DNWR and unemployment on government spending multipliers. They build a model where the household experiences self-inflicted unemployment when the wage rate is less than the previous period wage rate. They introduce an inequality comparing the nominal wage in this period to the previous period. If the current wage rate is less than last periods, the consumer works less than they would have at the previous period's wage, allowing for the model to analyze unemployment dynamics. This approach changes the DNWR, making it impact both the wage rate and the market's total employment. However, the rigidity is applied ad hoc, not as constraint on the consumer's problem, which is something I will attempt to avoid when modeling.

Rouillard (2017) uses downward nominal wage rigidities to analyze the credit market. They build a model with workers and entrepreneurs and they study how the DNWR, when applied, impacts the entrepreneurs choices for labor and who decides to be an entrepreneur at all. They apply the DNWR ad hoc, just requiring that wage growth needs to be greater than or equal to zero. This combines to a model that allows Rouillard (2017) to analyze the credit market and they found that the introduction of a DNWR exacerbates the impacts of a collateral constraint on the firm's demand for labor in the short run.

In 2023, the NBER released Schmitt-Grohe-Uribe (2023), a paper analyzing how downward nominal wage rigidities can cause non-linearity within the wage Phillips curve. They utilize a simple model with households supplying heterogenous labor to firms and they impose the restriction that their individual corresponding wage to their labor type must exceed their previous periods. This provides a more heterogeneous approach to the model. The economy as a whole experiences variation in wages, but the rigidity only applies to wages for individual labor types. This an effective starting point for analyzing DNWR's, however, the paper does not have

additional wage rigidities. This leaves room for additional contributions and study into the traditional price Phillips curve.

I plan on combining the results from these papers into a simple New Keynesian model that will allow me to introduce new components to add to model complexity. My hope is that the model will allow me to examine the impacts of DNWR's on various systems and, at least initially, I want to study how they impact central banks' choices.

My primary contribution will involve examining the Phillips curve and wage Phillips curve. I will consider how the DNWR in the household's problem can vary the slope of the Phillips curve. I may also introduce a labor market into the model, which will allow for examination of employment dynamics. These components will allow for a more holistic examination of the DNWR's impacts on the two curves as a whole, as opposed to an isolated approach examining just the DNWR or just the labor market's contributions to its shape.

With this, I will need to code the model into MATLAB, a program that allows for economic modeling. The past year, I have been a research assistant for Professor Throckmorton and this experience has further familiarized me with the program and how to code in it. I have coded a much simpler DNWR model into MATLAB and I have learned the debugging process. I plan on building programs that will aid me in modeling and optimize the program for my computer. One optimization I have created this summer is utilizing the LogExpSum function to approximate the max function. Max functions are nearly universal in economic analysis, from DNWR's to ZLB's their existence is common. However, these functions are not differentiable at the kink, and using the completely differentiable LogExpSum function may make finding solutions substantially faster. I plan to use this, maybe with a household using the LogExpSum function instead of their max function, or by having a more smooth ZLB constraint, allowing for more accurate examinations of the household's decision making.

With my coding, I will also learn more about optimization techniques and attempt to implement them into modeling. So far, I have started taking notes on Stanford's class on optimization problems, and have begun learning about the Interior Point Method and KKT conditions for constrained convex optimization. I will continue to learn about this so I can further model wage rigidities and find accurate results. I plan on finishing Stanford's course on the topic during the school year.

So far, I have begun to create a model based on Fernandez-Villaverde et al. (2011) and I have begun simulating it into Dynare to get elementary results. So far I have not included a DNWR, but my plan is to learn how to use the OccBin Method to find solutions to occasionally binding constraint problems. I have been testing and implementing the ZLB, and have successfully used the LogExpSum function to avoid having to use it for that.

I have performed an elementary literature review on the topic. I have read twenty-five or more papers on: New Keynesian modeling, the Wage Phillip's Curve, Rotemberg Wage adjustment costs, and DNWR's. I plan on continuing to do research in these topics until I am able to fully build my research question based on the work I have been doing so far.

Ultimately, I want to make a project that will allow me to design and build a DSGE model and I believe that wage rigidities are a simple yet novel way of doing so. I plan on combining the literature above and more to build a simple yet accurate model that I can code and analyze. My hope is that I will uncover how households' decision making changes when they self impose the DNWR constraint and a simple model with heterogenous labor will allow me to do so.

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