Disclaimer: These questions are intended to guide you in studying for final exams, and, more importantly, the comprehensive exam. These questions are not necessarily representative of the kinds of questions you should expect on the comps, nor should you expect any of these equations to explicitly appear on the comps. I make no claim as to the originality of the problems contained herein; some of these are taken from other sources freely available online.

(1) Definitions: Be able to define the following terms on the fly and discuss (briefly) their significance in modern macroeconomics:

(a) Fisher relationship
(b) Intertemporal elasticity of substitution
(c) Frisch labor supply elasticity
(d) Stationarity
(e) Vector autoregression
(f) Structural vector autoregression
(g) Ricardian Equivalence
(h) Calvo price-stickiness
(i) Taylor rule
(j) Natural rate of interest
(k) Taylor principle
(l) Saddle point stability
(m) Transversality condition
(n) HP filter
(o) ARMA processes
(p) New Keynesian phillips curve
(q) Calibration
(r) Total factor productivity
(s) State space representation
(t) Kalman filter
(u) Method of moments
(v) Balanced growth path
(w) Tax distorted competitive equilibrium
(x) Chamley-Judd result
(y) Complete markets
(z) First and second welfare theorems
(aa) Stochastic discount factor
(bb) Commitment vs. discretion
(cc) Time inconsistency
(dd) Lucas critique
(ee) Cash in advance constraint
(ff) Friedman rule
(gg) Real balances
(hh) Markup
(ii) Cost push shock
(jj) Real business cycle theory
(kk) Rational expectations
(ll) Indivisible labor

(2) CES Production Function: Suppose that the representative firm produces output according to the following function:

\[ y_t = \left( \alpha k_t^{\frac{\varepsilon - 1}{\varepsilon}} + (1 - \alpha) n_t^{\frac{\varepsilon - 1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon - 1}} \]

Assume that \( 0 < \alpha < 1 \) and \( \varepsilon \geq 0 \).

(a) Show that this production function has constant returns to scale.
(b) Show that, as $\epsilon \rightarrow 1$, this production function converges to Cobb-Douglas. Hint: L’Hopital’s rule says that if $\lim_{x \to c} f(x) = g(x) = 0$ then $\lim_{x \to c} \frac{f(x)}{g(x)} = \frac{f'(x)}{g'(x)}$. Double hint: consider taking logs.

(c) Suppose that households have the following preferences:

$$V_0 = \sum_{t=0}^{\infty} \beta^t (\ln c_t + \theta \ln(1 - n_t))$$

The economy-wide resource constraint is:

$$c_t + k_{t+1} \leq y_t + (1 - \delta)k_t$$

Find the first order conditions necessary for an interior solution to this problem.

(d) Solve for the steady state capital to labor ratio.

(3) The Frisch Labor Supply Elasticity: This problem will ask you a few questions about the Frisch labor supply elasticity.

(a) Define, in words, what the Frisch labor supply elasticity is. Can the Frisch labor supply elasticity be less than zero?

(b) What is the approximate volatility of total hours relative to the volatility of output in the data (both series are HP filtered)?

(c) What is the approximate volatility of total hours relative to the volatility of output in a conventional RBC model (both series are HP filtered)?

(d) Making the Frisch elasticity larger would improve the fit of the model relative to the data. However, Prof. Kirk Doran from the University of Notre Dame du Lac says that he has incontrovertible evidence from New York cab drivers that the Frisch elasticity at a micro level is close to zero. Describe (in words and using a little math if you want) an alteration of the conventional RBC model that would be consistent with Prof. Doran’s observation but yet still deliver a very large Frisch elasticity at the macro level.

(4) Government Spending Multipliers: Christina Romer of the Council of Economic Advisors suggests that the government spending multiplier is 1.6 – i.e. that a $1 change in government spending will generate $1.6 additional dollars in real GDP. Suppose that you take a conventional RBC model as a benchmark against which you are going to evaluate this claim.

(a) Suppose that government spending shocks are highly transitory. Use your intuition from the model, plus a diagram showing labor market equilibrium, to discuss what will likely happen to output, consumption, and investment in response to an increase in government spending. What is the approximate spending multiplier?
(b) Instead suppose that government spending shocks are known to be highly persistent. Are your answers any different from (a)? Is it possible that Romer is right? If so, discuss what kind of parameter configuration might lead to such a large spending multiplier.

(5) Distortionary taxation: Consider a world in which a representative household consumes and supplies labor, and can save through accumulating capital. The household pays proportional tax rates on labor and capital income. Let $R_t$ be the rental rate on capital and $w_t$ be the wage rate. Capital depreciates fully each period. The household problem is:

$$\max_{c_t, k_{t+1}, n_t, k_{t+1}} E_0 \sum_{t=0}^{\infty} \left( \ln c_t + \ln (1 - n_t) \right)$$

s.t.

$$c_t + k_{t+1} \leq (1 - \tau^n_t) w_t n_t + (1 - \tau^k_t) R_t k_t$$

Given $k_0$

(a) Find the first order conditions necessary for an interior solution of the household problem.

(b) Firms hire labor and rent capital to maximize profits. Their problem is:

$$\max_{k_t, n_t} k_t^\alpha n_t^{1-\alpha} - w_t n_t - R_t k_t$$

Find the first order conditions for the firm problem.

(c) The government is committed to an exogenous time path of spending, $g_t$. It must finance this with distortionary taxes on capital and labor, and must, by law, balance its budget each period (i.e. there is no government debt). The government budget constraint is:

$$g_t = \tau^n_t w_t n_t + \tau^k_t R_t k_t$$

The aggregate resource constraint is:

$$c_t + k_{t+1} + g_t = k_t^\alpha n_t^{1-\alpha}$$

Assume that the government is benevolent and wants to maximize welfare of its citizens, subject to its required spending. Set up the government’s optimization problem. Show that the government would like to set the tax rate on capital in all future periods (i.e. all periods other than period 0, which is the period in which the optimization occurs).

(d) What would the benevolent government want the capital tax rate to be in period 0?

(e) If the government could re-optimize in period 1, what would it choose the period 1 tax rate on capital income to be? Would this be consistent with its plan from part (c)?

(6) Optimal Price-Setting: Consider a world in which production is split into two stages – intermediate and final goods. The final goods sector is competitive. The final goods firm
bundles intermediate goods together to produce the final good. There is a continuum of intermediate goods firms along the unit interval; the typical intermediate goods firm produces output $y_t(j)$ and charges price $p_t(j)$. The bundler is as follows. Assume that $\epsilon > 1$:

$$y_t = \left[ \int_0^1 y_t(j)^{\frac{\epsilon}{\epsilon-1}} dj \right]^\frac{\epsilon-1}{\epsilon}$$

(a) Set up the final goods firm’s profit maximization problem. Derive a demand curve for each intermediate good, $j$. Use the zero profit condition to derive the aggregate price index as a function of the intermediate goods prices.

(b) Now consider the problem of the intermediate goods firms. Let the total cost function for the intermediate goods firm be given by:

$$TC = \Psi(y_t(j))$$

Assume that $\Psi'(\cdot) > 0$. Assume that the firms can freely choose their price each period. Set up the firm’s optimal price problem and derive the optimal pricing rule.

(c) Define, conceptually, the stochastic discount factor. Suppose that households have CRRA preferences over consumption, so that the flow utility function is $u(c_t) = \frac{c_t^{1-\sigma}-1}{1-\sigma}$ and discount the future by the subjective discount factor $\beta$. What is the stochastic discount factor for these preferences?

(d) Now suppose that firms are not freely able to adjust their prices. In particular, they face a constant hazard, $1 - \phi$, $0 < \phi \leq 1$, of being able to adjust their price in any period. For a firm with the opportunity to change its price in this period, write down the firm’s pricing problem and derive its optimal pricing rule.

(e) Suppose that there is an expected increase in demand at some point in the future, which will raise marginal cost. Holding everything else fixed, what will happen to the prices of firms who can change their prices today? How does the magnitude of this change depend upon $\phi$? Provide some intuition.

(7) Normalizing Variables: Suppose that we have a simple real business cycle model which can be characterized as the solution to the following social planner’s problem:

$$\max_{c_t, k_t, n_t} \quad E_0 \sum_{t=0}^{\infty} \beta^t \left( \frac{c_t^{1-\sigma} - 1}{1 - \sigma} + \theta \frac{(1 - n_t)^{1-\xi} - 1}{1 - \xi} \right)$$

s.t.

$$c_t + k_t \leq a_t x_t k_{t-1}^{\alpha} n_t^{1-\alpha} + (1 - \delta) k_{t-1}$$

(a) Suppose that $a_t$ follows a stationary, mean zero, process in its natural log (so that the mean level is unity). Suppose also that $x_t$ follows a deterministic time trend:
\[ \ln a_t = \rho \ln a_{t-1} + \varepsilon_t \]
\[ x_t = \exp(\gamma t) \]

Propose a method of transforming the variables of the model so as to eliminate the trend growth. Note that labor hours are, by construction, stationary, and thus need no transformation. Find the first order conditions of the transformed variables characterizing the equilibrium solution of the model.

(b) Suppose instead that \( x_t = 1 \ \forall \ t \) and that \( a_t \) follows a random walk with drift in its log:

\[ \ln a_t = \gamma + \ln a_{t-1} + \varepsilon_t \]
\[ x_t = 1 \]

Propose a method of transforming the variables of the model so as to eliminate the trend growth. Note that labor hours are, by construction, stationary, and thus need no transformation. Find the first order conditions of the transformed variables characterizing the equilibrium solution of the model.

(8) **Calibrating labor’s share:** Suppose that a CES production function turns capital and labor into output:

\[ y_t = a_t \left( \alpha k_t^{\epsilon-1} + (1-\alpha)n_t^{\epsilon-1} \right)^{\frac{\epsilon}{\epsilon-1}} \]

Assume that \( 0 < \alpha < 1 \) and \( \epsilon \geq 0 \).

(a) Assuming perfect competition, derive an expression for the real wage.

(b) Use your answer from (a) to derive an analytical expression for labor’s share of total income (i.e. \( \frac{w_t n_t}{y_t} \)).

(c) If labor’s share in the data is approximately constant at \( \frac{2}{3} \), what must be true of \( \epsilon \) and \( \alpha \)?

(9) **Estimating Parameters of Labor Supply:** Suppose a researcher is interested in estimating the aggregate labor supply elasticity. Suppose that you write down a model in which the following first order condition holds:

\[ \theta n_t^\xi = c_t^{-\sigma} w_t \]

(a) Take logs of this expression. Derive an estimating equation of the form:

\[ \ln n_t = a + b \ln c_t + d \ln w_t \]

What should \( a, b, \) and \( d \) equal in terms of the parameters of your model?

(b) What is the economic interpretation of the parameter given above by \( d \)?
(c) Suppose a researcher estimates the following regression:

\[ \ln n_t = f + g \ln w_t \]

Will an OLS regression produce the correct estimate of \( d \) from the model (i.e. will \( E(\hat{g}) = E(\hat{d}) \))? Why or why not? Explain.

(10) **Comment on the following statement:** The real business cycle model has a weak internal propagation mechanism.

(11) **Measuring TFP:** Suppose that firms solve the following optimization problem:

\[
\max_{k_t,n_t,u_t} \quad a_t (u_t k_t)^\alpha n_t^{1-\alpha} - w_t n_t - (r_t + \delta(u_t)) k_t
\]

\( u_t \) denotes capital utilization. The cost of increased capital utilization is faster depreciation, and hence a higher rental rate on capital. Assume that the depreciation function takes the following functional form:

\[ \delta(u_t) = \delta_0 u_t^\phi, \quad \phi > 1, \quad 0 < \delta_0 < 1 \]

(a) Find the first order conditions characterizing the solution to the firm’s problem.

(b) Suppose that a researcher gathers data on output, capital, and employment. The researcher defines log TFP as:

\[ \ln \hat{a}_t = \ln y_t - \alpha \ln k_t - (1 - \alpha) \ln n_t \]

Suppose the researcher computes the standard deviation of \( \ln \hat{a}_t \). Will this be a correct estimate of the volatility of \( \ln a_t \)? If not, in which direction will it be biased? How does your answer depend on the parameter \( \phi \) (intuition only, please).

(12) **Multi-Product Menu Costs (Midrigan (2006)):** Many price changes are large (10-20%), but many others are small (1-2%). Models of price-setting with menu costs have difficulty matching these observations: the first observation is consistent with menu costs being large, while the second is consistent with menu costs being small.

Suppose a firm produces two different goods, but prints a single price menu for both prices. Put differently, if a firm decides to adjust prices, it can do so for the prices of both goods at the same cost. Call the goods good 1 and good 2. Let within period profits be:

\[ \Pi_t = \Pi - \alpha (p_{1,t} - x_t)^2 - \gamma (p_{2,t} - y_t)^2 \]

\( x \) and \( y \) can be interpreted as “demand shifters” for goods 1 and 2, respectively. These variables are stochastic and obey stationary AR(1)s:

\[
\begin{align*}
x_t &= (1 - \rho) \overline{x} + \rho x_{t-1} + \varepsilon_{x,t} \\
y_t &= (1 - q) \overline{y} + q y_{t-1} + \varepsilon_{y,t}
\end{align*}
\]
Assume that $0 < \rho, q < 1$ and that the two shocks are iid with mean zero. If the firm changes either price it pays a fixed cost equal to $M > 0$. If it doesn’t pay this fixed cost, it keeps the previous period’s prices. Firms discount the future at constant rate $\frac{1}{1+r}$.

(a) What are the state variables for the firm?

(b) Write down the Bellman equation describing the firm’s profit maximization problem.

(c) Can this model explain the co-existence of both large and small price changes? Explain.

(13) **Time to Build:** Consider the following model. A social planner maximizes the lifetime utility of a representative agent subject to constraints:

\[
V = E_0 \sum_{t=0}^{\infty} \beta^t (\ln c_t + \theta \ln(1 - n_t))
\]

s.t.

\[
\begin{align*}
y_t &= c_t + i_t \\
y_t &= k_t^\alpha n_t^{1-\alpha} \\
k_{t+T} &= i_t + (1-\delta)k_{t+T-1}
\end{align*}
\]

$T \geq 1$ is the time required for investment to become operational (i.e. there is “time to build”).

(a) Set up the dynamic optimization problem associated with this economy. What are the first order conditions?

(b) What is the Euler equation for this problem? What is the economic interpretation of the Euler equation?

(c) What is the steady state capital to labor ratio for this economy? How does it depend on $T$? What is the intuition for this relationship?

(d) Solve for steady state labor supply. How does it depend on $T$?

(14) **Management Fads:** A representative household seeks to maximize the following utility function:

\[
E_0 \sum_{t=0}^{\infty} \beta^t \left( \frac{c_t^{1-\sigma} - 1}{1-\sigma} - \phi \frac{n_t^{1+\theta}}{1+\theta} \right)
\]

s.t.

\[
c_t + b_t = w_t n_t + (1 + r_t)b_{t-1} + \Pi_t
\]
$b_{t-1}$ is the stock of real savings with which the household enters period $t$. $\Pi_t$ denotes real profits and other non-wage income, which the household takes as given.

(a) Set up the problem with a Lagrangian and find the first order conditions.

(b) There are a continuum of firms populating the unit interval that behave competitively. Assume that each firm has the production function:

$$y_t(j) = n_t(j)^\alpha \quad j \in [0, 1] \quad 0 < \alpha < 1$$

Aggregate output is just the sum of individual output:

$$y_t = \int_0^1 y_t(j) dj$$

The price level and the prices of individual firms are all normalized to unity. Write down the optimization problem for the typical firm and derive the firm’s labor demand curve. Argue that $n_t(j) = n_t(i)$ (i.e. all firms hire the same amount of labor).

(c) Will these firms earn profit in equilibrium? Why or why not?

(d) Write down the definition of a competitive equilibrium.

(e) The labor market-clearing condition is:

$$n_t = \int_0^1 n_t(j) dj$$

The goods market-clearing condition is:

$$y_t = c_t$$

Show that, in equilibrium, $y_t = n_t^\alpha$ and that $b_t = 0 \ \forall \ t$.

(f) Find expressions for the non-stochastic steady state values of $n$ and $(1 + r)$ in terms of the model’s parameters. Assume that $\alpha < \phi$.

(g) How does $n^*$ vary with $\theta$, $\alpha$, and $\sigma$. What is the intuition for these effects?

(h) Instead of assuming that firms maximize profits, suppose they choose employment according to “management fads”. That is, trends in business schools lead to deviations of firm level employment decisions from the profit maximizing level. Let $n_t^*(j)(w_t)$ be the optimal labor demand from above and let $m_t$ be the current “management fad”. The firm’s decision rule is to hire:

$$n_t(j) = m_t^{-\alpha} n_t^*(j)(w_t)$$

The fad follows an AR process:
\[ m_t = (1 - q) + q m_{t-1} + v_t \]

0 < q < 1, and \( v \) is a mean zero iid shock. What is the unconditional mean of \( m_t \)?

(i) Solve for employment as a function of the current management fad.

(j) Consider a 1 percent positive shock to the management fad. Sketch out the impulse responses of \( n_t \) and \( c_t \). What happens to the real interest rate following this shock?

(h) If fluctuations in production were driven by such shocks, would you expect profits to be pro or countercyclical? Would the real wage be procyclical? Would welfare be higher in booms or in recessions? Explain.

(15) Evaluate the following claim: A real business cycle model is incapable of matching the negative correlation between the price level and output which we observe in the data.

(16) In a model with Calvo style price stickiness, would a welfare maximizing central bank increase, decrease, or leave the money supply unchanged in response to a positive technology shock? Explain.

(17) Suppose that we have a New Keynesian model with a Phillips Curve and IS equation as follows:

\[
\tilde{\pi}_t = \gamma \tilde{x}_t + \beta E_t \tilde{\pi}_{t+1} \\
\tilde{x}_t = E_t \tilde{x}_{t+1} - \frac{1}{\sigma} \left( \tilde{\pi}_t - \tilde{\pi}_t^f \right) \\
\tilde{\pi}_t^f = \rho \tilde{\pi}_{t-1}^f + \varepsilon_t
\]

Suppose that the central bank like neither inflation nor output gaps, and has the following quadratic loss function:

\[
\frac{1}{2} E_0 \sum_{t=0}^{\infty} \beta_t (\tilde{\pi}_t^2 + \omega \tilde{x}_t^2)
\]

(a) What does it mean for the central bank to use discretion or commitment? Explain.

(b) Set up the central bank’s problem under discretion. Provide some intuition for the resulting first order condition.

(c) Repeat (b), but this time under the case of commitment.

(d) Propose a policy rule that would be optimal in each case.

(e) Are there any welfare gains from commitment? Why or why not? Discuss a variation on the model in which your conclusion would be different.

(18) Evaluate the following statement: A flexible price real business cycle model cannot generate monetary non-neutrality.
(19) **Methodology:** Many linearized rational expectations models can be written in the form:

\[ E_t X_{t+1} = M X_t \]

The elements of the vector \( X_t \) include jump variables, endogenous state variables, and exogenous state variables. The only structural shocks in the system are to the exogenous state variables. \( M \) is a matrix whose elements are comprised of primitive parameters from the model.

(a) Argue that the system can equivalently be written:

\[ X_{t+1} = M X_t \xi_{t+1} \]

Here \( \xi_{t+1} \) is mean zero and serially uncorrelated.

(b) What is the economic interpretation of the vector \( \xi_{t+1} \)? Are all of its elements structural shocks?

(c) Evaluate the following claim: “The above equation is the solution to the model, because we can use it trace out the expected value of the system simply by looking at \( E_t X_{t+k} = M^k X_t \).”

(20) **Identifying monetary policy shocks:** Suppose you are a researcher interested in characterizing the dynamic response of real GDP and inflation to monetary policy shocks.

(a) Explain in a few words why this is not as simple as looking at the correlation between interest rates/money supply and output and inflation.

(b) Suppose that you believe that the central bank adjusts its operating target (say, the Fed Funds rate) immediately to changes in real GDP and inflation, but that exogenous changes in interest rate policy only affect output and prices with a lag of one quarter/period. Propose a VAR system to estimate, and discuss how you would orthogonalize the innovations so as to identify the shock of interest.

(21) **News Shocks in a New Keynesian Model:** Suppose that we have a New Keynesian model, the solution of which can be represented by the following log-linearized equation:
\[
\tilde{\pi}_t = \gamma \left( \tilde{y}_t - \tilde{y}_f^t \right) + \beta E_t \tilde{\pi}_{t+1} \\
\tilde{y}_t = E_t \tilde{y}_{t+1} - \tilde{\pi}_t \\
\tilde{\eta}_t = \tilde{a}_t + \tilde{m}_t \\
\tilde{\nu}_t = -\tilde{y}_t + \zeta \tilde{w}_t \\
\tilde{w}_t = \tilde{a}_t + \tilde{m}_t \\
-v\tilde{m}_t = -\tilde{y}_t + \delta \tilde{t} \\
\tilde{m}_t - \tilde{m}_{t-1} = \rho_m (\tilde{m}_{t-1} - \tilde{m}_{t-2}) + \rho_m \tilde{\pi}_{t-1} + v_t \\
\tilde{\pi}_t = \tilde{\eta}_t - E_t \tilde{\pi}_{t+1} \\
\tilde{a}_t = \rho_a \tilde{a}_{t-1} + e_{t-q}
\]

Assume that \( q > 0 \), so that technology shocks are anticipated by agents in advance.

(a) Explain where each of the above equations are and where they come from.

(b) Solve for an analytical expression for \( \tilde{y}_f^t \).

(c) Suppose that there is a positive expected technology shock in period \( t \) that predicts an increase in technology \( q \) periods from now. Use graphical intuition to show what should approximately happen to output, inflation, and the real interest rate as a result?

(d) Would a welfare maximizing central bank want to increase or decrease the money supply in response to a positive news shock? Explain why in light of your answers on parts (c) and (b).

(e) Many New Keynesian economists argue that the exclusion of capital from the model is not a big deal. Do you think the presence of capital would affect your answers on (b) and (c) in an important way? Explain, perhaps referencing a simple real business cycle with flexible prices and news shocks.

(22) Consider a representative agent economy in which there is no physical capital. Preferences of the representative household are given as follows:

\[
U = E_0 \sum_{t=0}^{\infty} \{ \ln c_t + \ln (1 - n_t) + \ln m_t \}
\]

Here \( m_t \equiv \frac{M_t}{p_t} \), i.e. real money balances. Output is produced according to the simple production function:

\[
y_t = a_t n_t
\]

The representative household has two means by which it can transfer resources across time – by holding money or risk-free nominal bonds. Let \( B_{t-1} \) and \( M_{t-1} \) denote holdings of the bonds and money with which households enter period \( t \). Bonds carried over from period \( t - 1 \) to \( t \) pay nominal interest \( 1 + i_{t-1} \). The nominal wage rate is \( W_t \). Households are price-takers.
(a) Write down the flow budget constraint for the representative household in nominal terms. Let $p_t \Pi_t$ denote nominal transfers and other non-wage income which the household takes as given.

(b) Defining $m_t \equiv \frac{M_t}{p_t}$, $b_t \equiv \frac{B_t}{p_t}$, $w_t \equiv \frac{W_t}{p_t}$, and $1 + \pi_t = \frac{p_t}{p_{t-1}}$, rewrite the household’s flow budget constraint in real terms.

(c) Find the first order conditions characterizing the solution to the household’s problem. With perfectly competitive firms, find an expression for the equilibrium real wage.

(d) Now consider the social planner’s problem. What is the flow budget constraint for the economy as a whole?

(e) Find the first order conditions characterizing the solution to the planner’s problem.

(f) Under what condition(s) are the solutions to the planner’s problem and the decentralized problem the same? Provide some intuition for your answer.

(23) Durable Leisure: Consider the problem of an individual maximizing lifetime utility. There is no uncertainty, and the real interest rate is constant and obeys: $1 + r = \beta^{-1}$.

$$\max_{c_t, l_t, b_{t+1}} \sum_{t=0}^{\infty} \beta^t \left( u(c_t) + v(l_t) \right)$$

s.t.

$$1 = n_t + l_t$$
$$c_t + b_{t+1} \leq w_t n_t + (1 + r) b_t$$

Assume that wages obey the following (deterministic) pattern:

$$w_t = \begin{cases} w^H & \text{for } t = 1, 3, 5, 7, \ldots \\ w^L & \text{for } t = 0, 2, 4, 6, \ldots \end{cases}$$

$$w^H \geq w^L$$

(a) Suppose that within period utility is: $\ln c_t + \ln l_t$. What is the time path of $n_t$? How does it depend on the magnitudes of $w^H$ and $w^L$?

(b) Now suppose that preferences over consumption and leisure are not time separable. In particular, let the within period utility function be: $\ln c_t + \ln (\frac{m_t + n_t - 1}{2})$. What is the optimal time path of $n_t$? How does it depend on the magnitudes of $w^H$ and $w^L$?

(c) Business cycle models typically have problems generating sufficiently large variations in labor hours in response to shocks? Does durable leisure help to solve this problem?