HANK meets Ramsey: Optimal Coordination of Monetary and Labor Market Policies*

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Abstract

We study the design of coordinated labor market and monetary policy in a heterogeneous agent model with incomplete markets, search frictions, and nominal rigidities. We allow for self-insurance through savings and moral hazard in search behavior. In such a model a rise in labor market risk during a recession causes an increase in desired precautionary savings by households leading to a fall in aggregate demand which amplifies the initial downturn. Increasing unemployment benefits or cuting interest rates can both help to counteract this amplification effect. Therefore, gains from coordinating policies arise which are the focus of our analysis. Extending recent methods for the solution of heterogenous agent models with aggregate risk we solve a sequence of Ramsey problems with a varying sets of policy instruments in this economy to quantify the effects of policy coordination and optimal policy behavior over the business cycle.

JEL Classification: E21, E24, E32, E52, E62, J64
Keywords: Search and Matching, Unemployment, Precautionary Savings, Monetary Policy, Fiscal Policy, Aggregate Demand

Preliminary and Incomplete
Please do not circulate

*The views expressed in this paper are those of the authors. They do not necessarily coincide with the views of the Board of Governors or the Federal Reserve System.

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1 Introduction

During recessions policymakers in the United States have relied on a mixture of interest rate cuts and discretionary fiscal policy measures to increase aggregate demand and stabilize the economy. A prominent role in these measures is assigned to labor market related policies, like increases in the generosity of unemployment insurance benefits to boost aggregate demand and provide insurance[1] or hiring subsidies to boost labor demand. Naturally, this raises the question, what is the optimal mix between these and other labor market policy measures and monetary policy. What are the gains from coordinating such policies and how should they vary over the business cycle? Little is know about the answer to these questions.[2]

In this paper we solve for the optimal Ramsey plan for monetary policy, unemployment benefits, and hiring subsidies in a heterogeneous agent New Keynesian model with labor market frictions. Here, households are subject to employment risk and a subset of them can only insure against this risk through self-insurance by trading bonds among themselves and with better insured, richer agents. As unemployment is modeled as the result of search and matching frictions, labor market risk is responsive to aggregate shocks and policy changes. Household react to rising risk by increasing their desired precautionary saving target leading to a fall in aggregate demand. Through nominal rigidities in price adjustment declining aggregate demand causes a further fall in economic activity and additional employment risk. This externality in aggregate demand creates an additional motive for policy intervention relative to other frictions in the model, i.e. price rigidities, search and matching friction with potentially socially inefficient wage setting, and the decision of households how much effort to exert in finding a new job once unemployed.

We combine the approach of Winberry (2016) to solve heterogeneous agent models with aggregate risk using perturbation and a parameterized distribution with the method to find optimal Ramsey plans discussed in Schmitt-Grohé and Uribe (2012). We first solve for the deterministic steady state of the model with policies set to the level that maximizes utilitarian welfare, approximating the distribution of households using the family of distributions introduced in Algan, Allais, and Den Haan (2008). Then, we approximate the aggregate dynamics around this steady state together with the Ramsey planner's objective function using second order perturbation building on the work in Reiter (2009).

We focus on three policy instruments: the policy rate, the level of unemployment benefits, and hiring subsidies.[3] The policy maker uses them to maximize utilitarian welfare in the economy after

[1] The costs and benefits of such policies remain controversial. Theoretically, while, for example, Kekre (2015) and Landais, Michaillat, and Saez (2016) argue for benefital effects of countercyclical generosity due to nominal rigidities, Mitman and Rabinovich (2015) show that, at least in the absence of such rigidities, optimal benefits can be procyclical. This debate is mirrored on the empirical side see Hagedorn, Karahan, Manovskii, and Mitman (2013) and Chodorow-Reich, Coglianese, and Karabarbounis (2017).

[2] Jung and Kuester (2015) study the optimal mix of labor market policies, but abstract from aggregate demand effects and monetary policy. As monetary polciy has played the first line of defense in post war U.S. recessions it is important to understand its effect on the policy mix.

[3] A future extension will alow for endogenous layoffs and analyse the role of layoff taxes.

demand and supply shocks, balancing the costs associated with price and wage rigidities, incomplete insurance against unemployment, socially inefficient changes in precautionary savings, job search effort, and vacancy posting. We compare the effects of the resulting policy mix to an economy in which these policies follow their 'empirical' pattern and to a sequence of economies in which the policy maker can only use a subset of them.

Exact results to be added.

After reviewing the relevant literature we present the model in section 2. Section 3 discusses how we handle the distribution to reduce the complexity of the problem, characterizes the private equilibrium and discusses how we solve for the policies under the Ramsey plan. Section 4 discusses the calibration. Results can be found in section 5, while section 6 concludes.

Relationship with the literature: The paper contributes to the rapidly growing literature studying heterogenous agent new Keynesian models (see, for example, Kaplan, Moll, and Violante (2016) and McKay and Reis (2016)). With this literature it is particularly close to papers that stress the role of countercyclical income risk and the resulting demand externality (Bayer, Luetticke, Pham-Dao, and Tjaden (2015), Challe, Matheron, Ragot, and Rubio-Ramirez (2017), Cho (2016), Guerrieri and Lorenzoni (2017), Ravn and Sterk (2016), Ravn and Sterk (2017)). Relative to these papers we analyse the optimal policy mix of a Ramsey planner in response to the externality and other frictions. In this sense the paper is close to Gornemann, Kuester, and Nakajima (2016) and Luetticke (2015), who study the welfare implications of different monetary policy rules over the cycle, but abstract from other policy responses. Similarly, Kekre (2015) studies optimal unemployment benefits, but under the assumption of constrained monetary policy. Finally, McKay and Reis (2017) and McKay and Reis (2016) analyse the role of automatic stabilizers over the business cycle.

We study a mixture of policy interventions over the business cycle. This differentiates our paper from many papers that study the optimal dynamics of unemployment benefits, like for example Mitman and Rabinovich (2015) and Landais, Michaillat, and Saez (2016) - see also references therein. Closest in this respect is probably Jung and Kuester (2015), who abstract from precautionary savings, price stickiness, and monetary policy. Witin the large literature on Ramsey taxation the most relevant work are Bhandari, Evans, Golosov, and Sargent (2017) and Nuño and Thomas (2016). Both papers consider optimal Ramsey policies in models with heterogeneous agents. Bhandari, Evans, Golosov, and Sargent (2017) studies using repeated second order perturbation optimal monetary policy and labor taxation in a model with nominal rigidities. The algorithm we propose is different as it does not perturb around a steady state with zero idiosyncratic risk and allows therefore for borrowing constraints other than the natural one. In addition, we focus on endogenous labor market risk and policies. Nuño and Thomas (2016) develops a new method to characterize optimal Ramsey policies along a transition path and uses it to study optimal inflation in the presence of long run bonds, making their focus different from ours.

2 Model

2.1 Workers

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta_W^t \left\{ \frac{c_t^{1-\sigma_W}}{1-\sigma_W} - \psi_W^1 s_t^{\psi_W^2} \right\}$$

$$c_t + \frac{b_t(1+\tau^b)}{R_t} = \frac{b_{t-1}}{\pi_t} + (1-\tau_t^l) w_t 1_{e_t} + \omega_t (1 - 1_{e_t})$$

$$b_t \geq -\bar{b}$$

2.2 Entrepreneurs

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta_E^t \left\{ \frac{c_t^{1-\sigma_E}}{1-\sigma_E} - (1 - N_{t-1} + \lambda_t N_{t-1}) \psi_E^1 S_t^{\psi_E^2} \right\}$$

$$C_t + \frac{B_t}{R_t} = \frac{B_{t-1}}{\pi_t} + (1-\tau_t^l) W_t N_t + (1-N_t)\gamma\omega_t + \Pi_t$$

$$B_t \geq -\bar{B}$$

2.3 Employment Agencies and Labor Markets

2.3.1 Individual Employment Agencies

$$j_t = (x_t(1-\tau_t^p) - w_t) + \mathbb{E}_t (1-\lambda_{t+1}) Q_{t|t+1} j_{t+1}$$

$$J_t = (\gamma x_t(1-\tau_t^p) - W_t) + \mathbb{E}_t (1-\lambda_{t+1}) Q_{t|t+1} J_{t+1}$$

$$\kappa^W (1-\tau_t^V) = q_t^W j_t$$

$$\kappa^E (1-\tau_t^V) = q_t^E J_t$$

2.3.2 Wage Setting

$$\frac{\eta x_t(1-\tau_t^p) + (1-\eta)\omega_t}{1-(1-\eta)\tau_t^l} = w_t$$

$$\frac{\eta\gamma x_t(1-\tau_t^p) + (1-\eta)\gamma(1-\eta)\omega_t}{1-(1-\eta)\tau_t^l} = W_t$$

2.3.3 Labor Market Flows

$$f_t^W(a_t)s_t(a_t) = \phi_1^W(V_t^W)^{\phi_2}(\lambda_t \int s_t(a_t)dmu_e(a_t) + \int s_t(a_t)dmu_u(a_t))^{-\phi_2} s_t(a_t)$$

$$f_t^E = \phi_1^E(V_t^E)^{\phi_2}(S_t(1 - N_t + \lambda_t N_t))^{-\phi_2}$$

$$q_t^W = \phi_1^W(V_t^W)^{\phi_2 - 1}(\lambda_t \int s_t(a_t)dmu_e(a_t) + \int s_t(a_t)dmu_u(a_t))^{1-\phi_2}$$

$$q_t^E = \phi_1^E(V_t^E)^{\phi_2 - 1}(S_t(1 - N_t + \lambda_t N_t))^{1-\phi_2}$$

$$n_t = n_{t-1}(1 - \lambda_t) + q_t^W V_t^W$$

$$N_t = N_{t-1}(1 - \lambda_t) + q_t^E V_t^E$$

2.4 Final Good Producer

$$Y_t = \left(y_{i,t}^{\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}}$$

2.5 Intermediate Good Producer

$$J_{I,t}(P_{j,t-1}) = \underset{P_{j,t}}{may} y_{t,j}(P_{j,t}) \left(\frac{P_{j,t}}{P_t} - \frac{\phi_P}{2} \left(\frac{P_{j,t}}{P_{j,t-1}} - \bar{\pi} \right)^2 \right) - x_t L_{j,t} + \mathbb{E}_t Q_{t|t+1} J_{I,t+1}(P_{j,t})$$

$$y_{t,j}(P_{j,t}) = Z_t L_{j,t}$$

2.6 Dynamics of the Distribution

2.7 Market Clearing

2.8 Government Policy and Private Equilibrium

Monetary and fiscal policy are given by state dependent sequences of the policy rate R_t, the vacancy subsidy τ_t^V, the unemployment benefits ω_t, the production tax τ_t^p and the labor tax τ_t^l. We assume that the production tax finances the vacancy subsidy and the labor tax finances unemployment benefits. [4]

This implies

[4] Lump sum taxes from the entrepreneur, that in equilibrium are zero, allow the monetary policy to finance its open market operations.

$$\tau_t^l(w_t n_t + W_t N_t) = \omega_t(1 - n_t + \gamma(1 - N_t))$$

and

$$\tau_t^p x_t(\gamma N_t + n_t) = \tau_t^V \kappa(V_t^E + V_t^W).$$

3 Approximated Distribution Dynamics and Characterization of the Private Equilibrium

3.1 Approximate Distribution Dynamics

We follow ? and ? by approximating the probability density function of assets of employed workers at the beginning of the period as

$$g^E(a) = g_{0,t}^E exp\left(g_{1,t}^E * (a - m_{1,t}^E) + g_{2,t}^E * ((a - m_{1,t}^E)^2 - m_{2,t}^E) + g_{3,t}^E * ((a - m_{1,t}^E)^3 - m_{3,t}^E)\right) \quad (1)$$

and

$$g^U(a) = g_0^U exp\left(g_1^U * (a - m_1^U) + g_2^U * ((a - m_1^U)^2 - m_2^U) + g_3^U * ((a - m_1^U)^3 - m_3^U)\right). \quad (2)$$

The parameters of the distributions are then pinned down such that

$$1 = \int g^E(da) \quad (3)$$

$$m_1^E = \int a g^E(da) \quad (4)$$

$$m_2^E = \int (a - m_1^E)^2 g^E(da) \quad (5)$$

$$m_3^E = \int (a - m_1^E)^3 g^E(da) \quad (6)$$

$$1 = \int g^U(da) \quad (7)$$

$$m_1^U = \int a g^U(da) \quad (8)$$

$$m_2^U = \int (a - m_1^U)^2 g^U(da) \quad (9)$$

$$m_3^U = \int (a - m_1^U)^3 g^U(da) \tag{10}$$

3.2 Characterization of the Private Equilibrium

$$\begin{aligned} W_t(a_t) = (1-\lambda_t)\left(\frac{c_t^{1-\sigma_W}}{1-\sigma_W} + \beta_W \mathbb{E}_t W_{t+1}(a_{t+1})\right) \\ +\lambda_t s_t f_t \left(\frac{c_t^{1-\sigma_W}}{1-\sigma_W} - \psi_W^1 s_t^{\psi_W^2} + \beta_W \mathbb{E}_t W_{t+1}(a_{t+1})\right) \\ +\lambda_t (1 - s_t f_t)\left(\frac{c_t^{1-\sigma_W}}{1-\sigma_W} - \psi_W^1 s_t^{\psi_W^2} + \beta_W \mathbb{E}_t U_{t+1}(a_{t+1})\right) \end{aligned}$$

$$\begin{aligned} U_t(a_t) = s_t f_t \left(\frac{c_t^{1-\sigma_W}}{1-\sigma_W} - \psi_W^1 s_t^{\psi_W^2} + \beta_W \mathbb{E}_t W_{t+1}(a_{t+1})\right) \\ +(1 - s_t f_t)\left(\frac{c_t^{1-\sigma_W}}{1-\sigma_W} - \psi_W^1 s_t^{\psi_W^2} + \beta_W \mathbb{E}_t U_{t+1}(a_{t+1})\right) \end{aligned}$$

$$\psi_W^1 \psi_W^2 s_t^{\psi_W^2 - 1} = f_t \left(\left(\frac{c_t^{1-\sigma_W}}{1-\sigma_W} + \beta_W \mathbb{E}_t W_{t+1}(a_{t+1})\right) - \left(\frac{c_t^{1-\sigma_W}}{1-\sigma_W} + \beta_W \mathbb{E}_t U_{t+1}(a_{t+1})\right)\right)$$

$$\beta_W \mathbb{E}_t c_{t+1}^{-\sigma_W} \frac{R_t}{(1+\tau^b)\pi_{t+1}} \leq c_t^{-\sigma_W}, = \text{if } b_{t+1} > -\bar{b}$$

$$c_t + \frac{b_t(1+\tau^b)}{R_t} = \frac{b_{t-1}}{\pi_t} + (1-\tau_t^l) w_t 1_{e_t} + \omega_t (1 - 1_{e_t})$$

$$V_t^E = \frac{c_t^{1-\sigma_E}}{1-\sigma_E} - (1 - N_{t-1} + \lambda_t N_{t-1}) \psi_E^1 S_t^{\psi_E^2} + \beta_E \mathbb{E}_t V_{t+1}^E$$

$$\psi_E^2 \psi_E^1 S_t^{\psi_E^2 - 1} = f_t^E V_t^{E,S}$$

$$V_t^{E,S} = (W_t(1-\tau_t^l) - \gamma\omega_t) + \mathbb{E}_t \left[Q_{t|t+1}(1-\lambda_{t+1}) V_{t+1}^{E,S}\right]$$

$$\beta_E \mathbb{E}_t C_{t+1}^{-\sigma_E} \frac{R_t}{\pi_{t+1}} = C_t^{-\sigma_E}$$

$$C_t + \frac{B_t}{R_t} = \frac{B_{t-1}}{\pi_t} + (1-\tau_t^l) W_t N_t + (1 - N_t)\gamma\omega_t + \Pi_t$$

$$j_t = (x_t(1-\tau_t^p) - w_t) + \mathbb{E}_t (1-\lambda_{t+1}) Q_{t|t+1} j_{t+1}$$

$$J_t = (\gamma x_t(1-\tau_t^p) - W_t) + \mathbb{E}_t(1-\lambda_{t+1})Q_{t|t+1}J_{t+1}$$

$$\kappa^W(1-\tau_t^V) = q_t^W j_t$$

$$\kappa^E(1-\tau_t^V) = q_t^E J_t$$

$$\frac{\eta x_t(1-\tau_t^p) + (1-\eta)\omega_t}{1-(1-\eta)\tau_t^l} = w_t$$

$$\frac{\eta\gamma x_t(1-\tau_t^p) + (1-\eta)\gamma(1-\eta)\omega_t}{1-(1-\eta)\tau_t^l} = W_t$$

$$f_t^W(a_t)s_t(a_t) = \phi_1^W(V_t^W)^{\phi_2}(\lambda_t \int s_t(a_t)g_e(a_t) + \int s_t(a_t)g_u(a_t))^{-\phi_2}s_t(a_t)$$

$$f_t^E = \phi_1^E(V_t^E)^{\phi_2}(S_t(1-N_t+\lambda_t N_t))^{-\phi_2}$$

$$q_t^W = \phi_1^W(V_t^W)^{\phi_2-1}(\lambda_t \int s_t(a_t)dg_e(a_t) + \int s_t(a_t)g_u(a_t))^{1-\phi_2}$$

$$q_t^E = \phi_1^E(V_t^E)^{\phi_2-1}(S_t(1-N_t+\lambda_t N_t))^{1-\phi_2}$$

$$n_t = n_{t-1}(1-\lambda_t) + q_t^W V_t^W$$

$$N_t = N_{t-1}(1-\lambda_t) + q_t^E V_t^E$$

$$Q_{t|t+1} = \beta_t^E \left(\frac{C_{t+1}}{C_t}\right)^{-\sigma_E}$$

$$(1-\epsilon)Y_t + \frac{x_t}{Z_t}\epsilon Y_t - \phi_p\pi_t(\pi_t - \bar{\pi})Y_t + \mathbb{E}_t Q_{t|t+1}Y_{t+1}\phi_p\pi_{t+1}(\pi_{t+1}-\bar{\pi}) = 0$$

$$Y_t = Z_t(\gamma N_t + n_t)$$

$$\Pi_t = (x_t(1-\tau_t^p) - w_t)n_t - \kappa^W(1-\tau_t^V)V_t^W + (\gamma x_t(1-\tau_t^p) - W_t)N_t - \kappa^E(1-\tau_t^V)V_t^E + Y_t - x_t(n_t + \gamma N_t)$$

$$\tau_t^l(w_t n_t + W_t N_t) = \omega_t(1 - n_t + \gamma(1 - N_t))$$

$$\tau_t^p x_t(\gamma N_t + n_t) = \tau_t^V \kappa(V_t^E + V_t^W).$$

4 Planner's Problem

5 Calibration and Solution Method

5.1 Calibration

5.1.1 Households

5.1.2 Production

5.1.3 Labor Market

5.2 Solution Method

We follow the approach discussed in Reiter (2009) and Winberry (2016) and compute a second order perturbation to the model equations around the deterministic steady state.

6 Results

7 Conclusion

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