Online Appendix: The Building Blocks of Inflation: The role of monetary policy and the gap between goods and services

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A1 Model Details and Linearized Equations

A1.1 Final-Good Aggregators

There are three types of final-goods aggregators, one for final consumption, one for tradable goods consumption and one for investment. Goods Consumption aggregators are perfectly competitive and produce the final consumption good as a CES aggregate of home goods consumption ($c_{H,t}$) and imported goods consumption ($c_{F,t}$).

$$c_{goods,t} = \left[\gamma_c^{\frac{1}{\lambda_c}} \left(c_{H,t} \right)^{\frac{\lambda_c - 1}{\lambda_c}} + (1 - \gamma_c)^{\frac{1}{\lambda_c}} \left(c_{F,t} \right)^{\frac{\lambda_c - 1}{\lambda_c}} \right]^{\frac{\lambda_c}{\lambda_c - 1}} \tag{A1}$$

where γ_c denotes the share of domestic consumption goods, and λ_c is the elasticity of substitution between home and foreign consumption. Derived demand for home and imported consumption is given by:

$$c_{H,t} = \left(\frac{P_{H,t}}{P_t} \right)^{-\lambda_c} \gamma_c c_{goods,t} \quad \& \quad c_{F,t} = \left(\frac{P_{F,t}}{P_t} \right)^{-\lambda_c} (1 - \gamma_c) c_{goods,t} \tag{A2}$$

where $P_{H,t}$ and $P_{F,t}$ are the prices of home and imported goods, respectively. The aggregate price index, P_t, for consumption goods is given by

$$P_{goods,t} = \left[\gamma_c P_{H,t}^{1-\lambda_c} + (1 - \gamma_c) P_{F,t}^{1-\lambda_c} \right]^{\frac{1}{1-\lambda_c}} \tag{A3}$$

Final Consumption aggregators are perfectly competitive and produce the final consumption good as a CES aggregate of goods consumption ($c_{goods,t}$) and service consumption ($c_{serv,t}$).

$$c_t = \left[(1-\gamma_{serv})^{\frac{1}{\lambda_{type}}} c_{goods,t}^{\frac{\lambda_{type}-1}{\lambda_{type}}} + \gamma_{serv}^{\frac{1}{\lambda_{type}}} c_{serv,t}^{\frac{\lambda_{type}-1}{\lambda_{type}}} \right]^{\frac{\lambda_{type}}{\lambda_{type}-1}} \tag{A4}$$

where γ_{serv} denotes the share of consumption services, and λ_{type} is the elasticity of substitution between goods and services. Derived demand for goods and services consumption is given by:

$$c_{goods,t} = \left(\frac{P_{goods,t}}{P_t}\right)^{-\lambda_{type}} (1-\gamma_{serv})c_t \quad \& \quad c_{serv,t} = \left(\frac{P_{serv,t}}{P_t}\right)^{-\lambda_{type}} \gamma_{serv} c_t \tag{A5}$$

where $P_{goods,t}$ and $P_{serv,t}$ are the prices of goods and services, respectively. The aggregate price index, P_t, for the economy is given by

$$P_t = \left[(1-\gamma_{serv}-\Delta_{hou}) P_{goods,t}^{1-\lambda_t ype} + \gamma_{serv} P_{serv,t}^{1-\lambda_t ype} + +\Delta_{hou} P_{hou,t}^{1-\lambda_t ype} \right]^{\frac{1}{1-\lambda_t ype}} \tag{A6}$$

Final investment good aggregators are given by

$$I_t = \left[\gamma_I^{\frac{1}{\lambda_I}} (I_{H,t})^{\frac{\lambda_I - 1}{\lambda_I}} + (1-\gamma_I)^{\frac{1}{\lambda_I}} (I_{F,t})^{\frac{\lambda_I - 1}{\lambda_I}} \right]^{\frac{\lambda_I}{\lambda_I - 1}} \tag{A7}$$

where γ_I denotes the share of domestic investment goods, and λ_I is the elasticity of substitution between home and foreign investment. Derived demand for home and imported investment is given by:

$$I_{H,t} = \left(\frac{P_{H,t}}{P_{I,t}}\right)^{-\lambda_I} \gamma_I I_t \quad \& \quad I_{F,t} = \left(\frac{P_{F,t}}{P_{I,t}}\right)^{-\lambda_I} (1-\gamma_I) I_t \tag{A8}$$

where $P_{I,t}$ is the aggregate price of investment and is given by: .

$$P_{I,t} = \left[\gamma_I P_{H,t}^{1-\lambda_I} + (1-\gamma_I) P_{F,t}^{1-\lambda_I} \right]^{\frac{1}{1-\lambda_I}} \tag{A9}$$

Final Intermediate Good factor aggregators are given by

$$Int_t = \left[\gamma_{int}^{\frac{1}{\lambda_{int}}} \left(Int_{H,t}\right)^{\frac{\lambda_{int}-1}{\lambda_{int}}} + (1-\gamma_{int})^{\frac{1}{\lambda_{int}}} \left(Int_{F,t}\right)^{\frac{\lambda_{int}-1}{\lambda_{int}}}\right]^{\frac{\lambda_{int}}{\lambda_{int}-1}} \tag{A10}$$

where γ_I denotes the share of domestic investment goods, and λ_I is the elasticity of substitution between home and foreign investment. Derived demand for home and imported investment is given by:

$$Int_{H,t} = \left(\frac{P_{H,t}}{P_t}\right)^{-\lambda_{int}} \gamma_{int} Int_t \quad \& \quad Int_{F,t} = \left(\frac{P_{Int,F,t}}{P_t}\right)^{-\lambda_{int}} (1-\gamma_{int}) Int_t \tag{A11}$$

$$P_{M,t} = \left[\gamma_{int} P_{H,t}^{1-\lambda_{int}} + (1-\gamma_{int}) P_{int,F,t}^{1-\lambda_{int}}\right]^{\frac{1}{1-\lambda_{int}}} \tag{A12}$$

A1.2 Labor Market

Labor supplied are heterogeneous across households, and are combined into an aggregated sectoral labor level by perfectly-competitive labor intermediaries in each sector. Labor services are then rented out to goods producers, service producers and housing producers respectively. The labor demand curve each household (j) faces in sector jj

$$L_{jj,t}(j) = \left(\frac{W_{jj,t}(j)}{W_{jj,t}}\right)^{-\Theta_{w,jj,t}} L_{jj,t} \tag{A13}$$

where $W_{jj,t}$ is the nominal wage rate in sector jj and $\Theta_{w,jj,t}$ is a time-varying elasticity of substitution between the differentiated labor. Sectoral wage cost-push shocks $e_{w,jj,t}$ are centered around the markup of wages over the marginal rate of substitution in each sector, $\theta_{w,jj}$. ($\theta_{w,jj} = \Theta_{w,jj}/(\Theta_{w,jj}-1)$)

The optimality conditions of households with respect to sectoral labor and wages can be combined to derive a log-linearized New Keynesian Phillips curve for wages in each sector

jj given by:

$$\hat{\pi}_{w,jj,t} - \iota_{w,jj}\hat{\pi}_{w,jj,t-1} = \beta E_t[\hat{\pi}_{w,jj,t+1} - \iota_{w,jj}\hat{\pi}_{w,jj,t}] - \frac{\Theta_{w,jj} - 1}{\kappa_{w,jj}}\left(\hat{w}_{jj,t} - \hat{w}_{Household,jj,t}\right) + \hat{e}_{w,jj,t} \tag{A14}$$

where nominal wage inflation in sector jj ($\hat{\pi}_{w,jj,t}$) and the real wage in sector jj ($\hat{w}_{jj,t}$) are defined as:

$$\hat{\pi}_{w,jj,t} - \hat{\pi}_t = \hat{w}_{jj,t} - \hat{w}_{jj,t-1} \tag{A15}$$

and $\hat{w}_{Household,jj,t}$ comes form the labor supply FOC from the households optimization problem and is defined as:

$$\hat{w}_{Household,jj,t} = (\nu_l - \eta_l)\,\hat{L}_t + \eta_l \hat{L}_{jj,t} - \hat{\lambda}_t \tag{A16}$$

All equations hold for the goods, services and housing sectors. (i.e. for $jj = goods, serv, hou$)

A1.3 Domestic Goods Firms

Home final good producers operate in a perfectly competitive market. They buy intermediate goods $y_{goods,t}(i)$, package them into final goods output $y_{goods,t}$. The final good of the economy is a CES production function of a continuum of intermediate goods indexed by i.

$$y_{goods,t} = \left(\int_0^1 y_{goods,t}(i)^{\Theta_{H,t}}\, di\right)^{\frac{1}{\Theta_{H,t}}} \tag{A17}$$

The parameter $\Theta_{H,t}$ is a time-varying elasticity of substitution between the differentiated goods and gauges the monopoly power an intermediate firm has in selling its specific good i. The first order condition of the final good producers profit maximization problem leads to the following demand for good $y_{goods,t}(i)$:

$$y_{goods,t}(i) = \left(\frac{P_{H,t}(i)}{P_{H,t}}\right)^{-\Theta_{H,t}} y_{goods,t} \tag{A18}$$

where $P_{H,t}$ is the home price level. Home price cost-push shocks $e_{H,t}$ are centered around the markup of home prices over marginal cost in the home region, denoted as θ_H. ($\theta_H = \Theta_H/(\Theta_H - 1)$)

Intermediate good producers are the first stage of production. Intermediate firms use utilized capital, labor packaged by the employment agencies other intermediate goods and oil to produce differentiated intermediate goods that they sell to the final goods producers. A continuum of these firms indexed by i exist and use the following CES technology production process:

$$
\begin{aligned}
y_{goods,t}(i) = e_{a,goods,t} \Bigg[& (1 - \alpha_K - \alpha_{O,goods} - \alpha_{M,goods})^{\frac{1}{\tau_{goods}}} L_{goods,t}^{\frac{\tau_{goods}-1}{\tau_{goods}}} + \alpha_{O,goods}^{\frac{1}{\tau_{goods}}} Oil_{goods,t}^{\frac{\tau_{goods}-1}{\tau_{goods}}} + \\
& \alpha_K^{\frac{1}{\tau_{goods}}} K_t^{\frac{\tau_{goods}-1}{\tau_{goods}}} + \alpha_{M,goods}^{\frac{1}{\tau_{goods}}} Int_{goods,t}^{\frac{\tau_{goods}-1}{\tau_{goods}}} \Bigg]^{\frac{\tau_{goods}}{\tau_{goods}-1}}
\end{aligned} \tag{A19}
$$

where K_t is utilized capital[1], $Oil_{goods,t}$ is the oil factor of production by the domestic goods sector, $Int_{goods,t}$ is the bundle of domestic and foreign intermediate goods used in production and $e_{a,goods,t}$ is a stationary stochastic productivity shock that alters the production process. τ_{goods} denotes the elasticity of substitution between the factor inputs in the goods sector.

The intermediate firms' profit in the domestic goods sector at time t is given by:

$$
\begin{aligned}
\frac{\Pi_{H,t}(i)}{P_t} = & \frac{P_{H,t}(i)}{P_t} y_{goods,t}(i) - \frac{W_{goods,t}}{P_t} L_{goods,t}(i) - r_t^k K_t(i) - \frac{P_{M,t}}{P_t} Int_{goods,t}(i) - \\
& \frac{P_{oil,t}}{P_t} Oil_{goods,t}(i) - \frac{\kappa_H}{2} \left(\frac{P_{H,t}(i)/P_{H,t-1}(i)}{\pi_{H,t-1}^{\iota_H} \pi^{1-\iota_H}} - 1 \right)^2 \frac{P_{H,t}}{P_t} y_{goods,t}
\end{aligned} \tag{A20}
$$

where price stickiness is introduced via quadratic adjustment costs with level parameter κ_H and ι_H captures the extent to which price adjustments are indexed to past inflation in the domestic goods sector. A domestic firm's objective is to choose the quantity of labor, capital, intermediate factors, oil intensity and the price of its output each period, to maximize the present value of profits subject to the demand function it is facing with respect to its individual output. The first-order conditions of the firm with respect to labor, oil, capital and intermediates can be combined and linearized to relate capital, labor, oil and intermediate

[1]Utilized capital, K_t, is equal to the capital stock times the utilization rate. $K_t = u_t \bar{K}_{t-1}$

goods demand.

$$\hat{K}_t = \tau_{goods}\hat{w}_{goods,t} + \hat{L}_{goods,t} - \tau_{goods}\hat{r}_t^k \tag{A21}$$

$$\hat{Oil}_{goods,t} = \tau_{goods}\hat{w}_{goods,t} + \hat{L}_{goods,t} - \tau_{goods}\hat{p}_{oil,t} \tag{A22}$$

$$\hat{Int}_{goods,t} = \tau_{goods}\hat{w}_{goods,t} + \hat{L}_{goods,t} - \tau_{goods}\hat{p}_{M,t} \tag{A23}$$

$$\tag{A24}$$

The first-order condition with respect to price yields the linearized New Keynesian Phillips curve for domestic goods prices as:

$$\hat{\pi}_{H,t} - \iota_H\hat{\pi}_{H,t-1} = \beta E_t[\hat{\pi}_{H,t+1} - \iota_H\hat{\pi}_{H,t}] - \frac{\Theta_H - 1}{\kappa_H}\left(\hat{p}_{H,t} - \hat{MC}_{goods,t}\right) + \hat{e}_{H,t} \tag{A25}$$

where $p_{H,t}$ is the relative price of home goods, ($p_{H,t} = \frac{P_{H,t}}{P_t}$), and $MC_{goods,t}$ is the marginal cost of home goods production defined as

$$\hat{MC}_{goods,t} = (1 - \alpha_K - \alpha_{O,goods} - \alpha_{M,goods})\hat{w}_{goods,t} + \alpha_K\hat{r}_t^k + \alpha_{O,goods}\hat{p}_{oil,t} + \alpha_{M,goods}\hat{p}_{M,t} - \hat{e}_{a,goods,t} \tag{A26}$$

A1.4 Domestic Services Firms

Home final services producers operate in a perfectly competitive market. They buy intermediate services $y_{serv,t}(i)$, package them into final services output $y_{serv,t}$. The final services of the economy is a CES production function of a continuum of intermediate services indexed by ii.

$$y_{serv,t} = \left(\int_0^1 y_{serv,t}(ii)^{\Theta_{serv,t}}\, dii\right)^{\frac{1}{\Theta_{serv,t}}} \tag{A27}$$

The parameter $\Theta_{serv,t}$ is a time-varying elasticity of substitution between the differentiated services and gauges the monopoly power an intermediate firm has in selling its specific service ii. The first order condition of the final service producers profit maximization problem leads to the following demand for services $y_{serv,t}(ii)$:

$$y_{serv,t}(ii) = \left(\frac{P_{serv,t}(ii)}{P_{serv,t}}\right)^{-\Theta_{serv,t}} y_{serv,t} \tag{A28}$$

where $P_{serv,t}$ is the services price level. Service price cost-push shocks $e_{serv,t}$ are centered around the markup of services prices over marginal cost in the home region, denoted as θ_{serv}. ($\theta_{serv} = \Theta_{serv}/(\Theta_{serv} - 1)$)

Intermediate service producers are the first stage of service production. Intermediate firms use labor packaged by the employment agencies and oil to produce differentiated intermediate services that they sell to the final services producers. A continuum of these firms indexed by ii exist and use the following CES technology production process:

$$\begin{aligned} y_{serv,t}(i) = e_{a,serv,t} \Bigg[&(1 - \alpha_{O,serv} - \alpha_{M,serv} - \alpha_{M,goods,serv})^{\frac{1}{\tau_{serv}}} L_{serv,t}^{\frac{\tau_{serv}-1}{\tau_{serv}}} + \\ &\alpha_{M,serv}^{\frac{1}{\tau_{serv}}} Int_{serv,t}^{\frac{\tau_{serv}-1}{\tau_{serv}}} + \alpha_{M,goods,serv}^{\frac{1}{\tau_{serv}}} Int_{goods,serv,t}^{\frac{\tau_{serv}-1}{\tau_{serv}}} + \alpha_{O,serv}^{\frac{1}{\tau_{serv}}} Oil_{serv,t}^{\frac{\tau_{serv}-1}{\tau_{serv}}} \Bigg]^{\frac{\tau_{serv}}{\tau_{serv}-1}} \end{aligned} \tag{A29}$$

where $Int_{serv,t}$, are intermediate services used in production, $Int_{goods,serv,t}$ are intermediate goods used in service production. $Oil_{serv,t}$ is the oil factor of production by the domestic service sector and $e_{a,serv,t}$ is a stationary stochastic productivity shock that alters the production process. τ_{serv} denotes the elasticity of substitution between the factor inputs in the service sector.

The intermediate firms' profit in the domestic services sector at time t is given by:

$$\begin{aligned} \frac{\Pi_{serv,t}(ii)}{P_t} = &\frac{P_{serv,t}(ii)}{P_t} y_{serv,t}(ii) - \frac{W_{serv,t}}{P_t} L_{serv,t}(ii) - \frac{P_{serv,t}(ii)}{P_t} Int_{serv,t}(ii) - \\ &\frac{P_{M,t}(ii)}{P_t} Int_{goods,serv,t}(ii) - \frac{P_{oil,t}}{P_t} Oil_{serv,t}(ii) - \frac{\kappa_{serv}}{2} \left(\frac{P_{serv,t}(ii)/P_{serv,t-1}(ii)}{\pi_{serv,t-1}^{\iota_{serv}} \pi^{1-\iota_{serv}}} - 1 \right)^2 \frac{P_{serv,t}}{P_t} y_{serv,t} \end{aligned} \tag{A30}$$

where price stickiness is introduced via quadratic adjustment costs with level parameter κ_{serv}, and ι_{serv} captures the extent to which price adjustments are indexed to past inflation in the domestic service sector. A domestic firm's objective is to choose the quantity of labor, intermediate factors oil intensity and the price of its output each period, to maximize the present value of profits subject to the demand function it is facing with respect to its individual output. The first-order conditions of the firm with respect to labor, intermediate factors and oil can be combined and linearized to relate service labor, intermediate factors and oil demand.

$$\hat{Oil}_{serv,t} = \tau_{serv}\hat{w}_{serv,t} + \hat{L}_{serv,t} - \tau_{serv}\hat{p}_{oil,t} \tag{A31}$$

$$\hat{Int}_{serv,t} = \tau_{serv}\hat{w}_{serv,t} + \hat{L}_{serv,t} - \tau_{serv}\hat{p}_{serv,t} \tag{A32}$$

$$\hat{Int}_{goods,serv,t} = \tau_{serv}\hat{w}_{serv,t} + \hat{L}_{serv,t} - \tau_{serv}\hat{p}_{M,t} \tag{A33}$$

The first-order condition with respect to price yields the linearized New Keynesian Phillips curve for domestic services prices as:

$$\hat{\pi}_{serv,t} - \iota_{serv}\hat{\pi}_{serv,t-1} = \beta E_t[\hat{\pi}_{serv,t+1} - \iota_{serv}\hat{\pi}_{serv,t}] - \frac{\Theta_{serv} - 1}{\kappa_{serv}}\left(\hat{p}_{serv,t} - \hat{MC}_{serv,t}\right) + \hat{e}_{serv,t} \tag{A34}$$

where $p_{serv,t}$ is the relative price of services, ($p_{serv,t} = \frac{P_{serv,t}}{P_t}$), and $MC_{serv,t}$ is the marginal cost of service production defined as

$$\hat{MC}_{serv,t} = (1 - \alpha_{O,serv} - \alpha_{M,serv} - \alpha_{M,goods,serv})\hat{w}_{serv,t} + \alpha_{O,serv}\hat{p}_{oil,t} + \alpha_{M,serv}\hat{p}_{serv,t} + \alpha_{M,goods,serv}\hat{p}_{M,t} - \hat{e}_{a,serv,t} \tag{A35}$$

A1.5 Domestic Housing Firms

Housing producers operate in a perfectly competitive market. They buy intermediate housing $y_{hou,t}(i)$, package them into final housing output $y_{hou,t}$. Final Housing invextment of the economy is a CES production function of a continuum of intermediate housing producers indexed by iii.

$$y_{hou,t} = \left(\int_0^1 y_{hou,t}(iii)^{\Theta_{hou,t}}\, diii\right)^{\frac{1}{\Theta_{hou,t}}} \tag{A36}$$

The parameter $\Theta_{hou,t}$ is a time-varying elasticity of substitution between the differentiated housing producers and gauges the monopoly power an intermediate firm has in selling its housing produced iii. The first order condition of the housing producers profit maximization problem leads to the following demand for housing $y_{hou,t}(iii)$:

$$y_{hou,t}(iii) = \left(\frac{P_{hou,t}(iii)}{P_{hou,t}}\right)^{-\Theta_{hou,t}} y_{hou,t} \tag{A37}$$

where $P_{hou,t}$ is the housing price level. Housing price cost-push shocks $e_{serv,t}$ are centered around the markup of final housing prices over marginal cost in the home region, denoted as θ_{hou}. $(\theta_{hou} = \Theta_{hou}/(\Theta_{hou} - 1))$

Intermediate housing producers are the first stage of housing production. Intermediate firms use labor packaged by the employment agencies and endowed land to produce differentiated intermediate housing that they sell to the final housing producers. A continuum of these firms indexed by iii exist and use the following CES technology production process:

$$y_{hou,t}(iii) = e_{a,hou,t}\left[(1-\alpha_{land})^{\frac{1}{\tau_{hou}}} L_{hou,t}^{\frac{\tau_{hou}-1}{\tau_{hou}}} + \alpha_{land}^{\frac{1}{\tau_{hou}}} Land^{\frac{\tau_{hou}-1}{\tau_{hou}}}\right]^{\frac{\tau_{hou}}{\tau_{hou}-1}} \tag{A38}$$

where $Land$ is the land factor of production used by the housing sector and $e_{a,hou,t}$ is a stationary stochastic productivity shock that alters the production process. τ_{hou} denotes the elasticity of substitution between the factor inputs in the housing sector.

The intermediate firms' profit in the housing sector at time t is given by:

$$\begin{aligned}\frac{\Pi_{hou,t}(iii)}{P_t} = \frac{P_{hou,t}(iii)}{P_t} y_{hou,t}(iii) - \frac{W_{hou,t}}{P_t} L_{hou,t}(iii) - \\ \frac{R_{l,t}}{P_t} Land(iii) - \frac{\kappa_{hou}}{2}\left(\frac{P_{hou,t}(iii)/P_{hou,t-1}(iii)}{\pi_{hou,t-1}^{\iota_{hou}} \pi^{1-\iota_{hou}}} - 1\right)^2 \frac{P_{hou,t}}{P_t} y_{hou,t}\end{aligned} \tag{A39}$$

where price stickiness is introduced via quadratic adjustment costs with level parameter κ_{hou}, and ι_{hou} captures the extent to which price adjustments are indexed to past inflation in the domestic housing sector. A domestic firm's objective is to choose the quantity of labor, land and the price of its output each period, to maximize the present value of profits subject to the demand function it is facing with respect to its individual output. The first-order conditions of the firm with respect to labor and land can be combined and linearized to relate housing labor and land.

$$\tau_{hou}\hat{r}_{l,t} = \tau_{hou}\hat{w}_{hou,t} + \hat{L}_{hou,t} \tag{A40}$$

The first-order condition with respect to price yields the linearized New Keynesian Phillips curve for domestic housing prices as:

$$\hat{\pi}_{hou,t} - \iota_{hou}\hat{\pi}_{hou,t-1} = \beta E_t[\hat{\pi}_{hou,t+1} - \iota_{hou}\hat{\pi}_{hou,t}] - \frac{\Theta_{hou} - 1}{\kappa_{hou}}\left(\hat{p}_{hou,t} - \hat{MC}_{hou,t}\right) + \hat{e}_{hou,t} \tag{A41}$$

where $p_{hou,t}$ is the relative price of housing, ($p_{hou,t} = \frac{P_{hou,t}}{P_t}$), and $MC_{hou,t}$ is the marginal cost of housing production defined as

$$\hat{MC}_{hou,t} = (1 - \alpha_{land})\hat{w}_{serv,t} + \alpha_{land}\hat{r}_{l,t} - \hat{e}_{a,hou,t} \tag{A42}$$

A1.6 Importers

A unit measure of importers indexed by m, import foreign goods from abroad, differentiate them and markup their price, and then sell these heterogeneous goods to perfectly competitive import aggregators, who aggregate these imported goods using a CES aggregator. The demand curve facing each importer is given by:

$$y_{F,t}(m) = \left(\frac{P_{F,t}(m)}{P_{F,t}}\right)^{-\Theta_{F,t}} y_{F,t} \tag{A43}$$

where $y_{F,t}$ is the aggregate level of imports and $\Theta_{F,t}$ is a time-varying elasticity of substitution between the differentiated import goods. Import cost-push shocks $e_{F,t}$ are centered around the markup of import good prices over its import price, θ_F. ($\theta_F = \Theta_F/(\Theta_F - 1)$)

Importers maximize the present value of profits subject to the demand function they are facing from the aggregators. The importer's profits at time t are given by

$$\frac{\Pi_{F,t}(i)}{P_t} = \frac{P_{F,t}(i)}{P_t}y_{F,t}(m) - \frac{e_t P^*_{H,t}}{P_t}y_{F,t}(m) - \frac{\kappa_F}{2}\left(\frac{P_{F,t}(m)/P_{F,t-1}(m)}{\pi_{F,t-1}^{\iota_F}\pi^{1-\iota_F}} - 1\right)^2 \frac{P_{F,t}}{P_t}y_{F,t} \tag{A44}$$

where κ_F and ι_F are the price adjustment cost and indexation parameters. Import price frictions ensure there is not perfect import price/exchange rate pass through.

The first-order condition of importers with respect to price yields the following linearized import-price New Keynesian Phillips curve:

$$\hat{\pi}_{F,t} - \iota_F \hat{\pi}_{F,t-1} = \beta E_t[\hat{\pi}_{F,t+1} - \iota_F \hat{\pi}_{F,t}] - \frac{\Theta_F - 1}{\kappa_F} \left(\hat{p}_{F,t} - r\hat{e}r_t - \hat{p}^*_{H,t} \right) + \hat{e}_{F,t} \tag{A45}$$

where $p_{F,t}$ is the relative price of import goods, ($p_{F,t} = \frac{P_{F,t}}{P_t}$) and rer_t is the real exchange rate. Import price cost-push shocks $\epsilon_{F,t}$ are centered around the markup of import good prices over its import price, denoted as θ_F. ($\theta_F = \Theta_F/(\Theta_F - 1)$)

A1.7 Capital Producers

Capital goods are produced in a perfectly competitive sector of the economy by purchasing aggregated business investment from the goods producers and transforming it into new capital. In addition to producing new capital, capital producers also buy and sell capital from entrepreneurs at price Q_t. At the end of time t capital producers purchase non-depreciated $t-1$ physical capital from entrepreneurs and investment goods from the aggregated good producers and convert them to the time t capital stock. The time t physical capital stock is then purchased by entrepreneurs and used in time $t+1$ production. The physical capital stock evolves according to:

$$\bar{K}_t = (1-\tau)\bar{K}_{t-1} + e_{I,t} \left(1 - S\left(\frac{I_t}{I_{t-1}} \right) \right) I_t \tag{A46}$$

where τ is the depreciation rate and I_t is the investment good purchased.

Capital producers face a stochastic exogenous AR(1) process $e_{I,t}$ that alters the ability of producers to turn investment purchases into physical capital. In addition, capital producers face investment adjustment costs represented by the function S. Where $S(1) = S'(1) = 0$, $S'() > 0$ and $S''() > 0$.

Capital producers profit is defined as:

$$\Pi^k_t = Q_t(\bar{K}_t - (1-\tau)\bar{K}_{t-1}) - P_{I,t} I_t \tag{A47}$$

where $P_{I,t}$ is the price of investment. The capital producers maximize future profits by choosing an Investment level subject to the households' discount factor and the capital accumulation equation. The first-order condition with respect to investment yields the following linearized investment demand equation:

$$\hat{I}_t - \hat{I}_{t-1} = \beta E_t[\hat{I}_{t+1} - \hat{I}_t] + \frac{1}{S''}(\hat{Q}_t - \hat{p}_{I,t}) + \hat{e}_{I,t} \tag{A48}$$

where $p_{I,t}$ is the relative price of investment goods, ($p_{I,t} = \frac{P_{I,t}}{P_t}$).

A1.8 Entrepreneurs and Financial Intermediaries

There exists a continuum of finite lived entrepreneurs indexed by e who are able to borrow from the perfectly competitive financial intermediary sector who obtain deposits from the households.[2] At the end of period $t-1$, entrepreneurs buy physical capital $Q_{t-1}\bar{K}_{t-1}$ using their own nominal net worth NW_{t-1} and a loan from the financial intermediary, $Loan_{t-1}$.

$$Q_{t-1}\bar{K}_{t-1}(e) = Loan_{t-1}(e) + NW_{t-1}(e) \tag{A49}$$

In period t the entrepreneur is then subject to a stochastic productivity shock $w_t(e)$ that increases or decreases the entrepreneur's physical capital stock. The productivity shock is drawn from the lognormal cumulative distribution $F(w)$ with mean $m_{w,t-1}$ and variance $\sigma^2_{w,t-1}$. The distribution is assumed to be known at $t-1$ and $m_{w,t-1}$ is such that $E[w_t(e)] = 1$. The standard deviation σ_w will follow an exogenous process and can be considered as a financing shock as it will either increase or decrease the riskiness of loans. Entrepreneurs then choose the optimal utilization rate u_t that maximizes their time t profit.

$$\max_{u_t(e)} \quad \left[R^k_t u_t(e) - P_t a(u_t(e))\right] w_t(e)\bar{K}_{t-1}(e) \tag{A50}$$

where R^k_t is the rental rate of utilized capital paid by the intermediate goods firms and $a()$ is the cost of capital utilization payed in final good output, with $a(u) = 0$, $a'() > 0$ and $a''() > 0$.

Entrepreneurs at the end of period t sell the non-depreciated physical capital to the

[2]All interactions between entrepreneurs, intermediate firms and the financial intermediary are assumed to take placed in the closed-economy.

capital producers resulting in the following period t revenue for entrepreneur e:

$$w_t(e)\tilde{R}_t^k(e)Q_{t-1}\bar{K}_{t-1}(e) \tag{A51}$$

where

$$\tilde{R}_t^k(e) = \frac{R_t^k u_t(e) + (1-\tau)Q_t - P_t a(u_t(e))}{Q_{t-1}} \tag{A52}$$

Entrepreneurs and the financial intermediary agree upon a loan contract that consists of the size of the loan $Loan_t$, the interest rate of the loan R_t^c and the default threshold of the loan $\bar{w}_t$ below which entrepreneurs cannot pay back the loan and are obligated to turn over their time t revenues to the financial intermediary. However, the financial intermediary is only able to recover a $(1-\mu)$ fraction of the defaulted revenue due to bankruptcy costs.

$$\bar{w}_t(e)\tilde{R}_t^k Q_{t-1}\bar{K}_{t-1}(e) = R_t^c(e)Loan_{t-1}(e) \tag{A53}$$

The financial intermediary only pays deposit holders an interest payment if the deposits are given in the form of a loan. The interest payment paid on deposits lent out is equal to the domestic risk free interest rate R_t. As a result the interest rate paid on deposits, R_t^D, is equal to:

$$R_t^D = ldr_t R_t + (1 - ldr_t) \tag{A54}$$

where ldr_t is equal to the loans to deposit ratio ($Loans_t/Dep_t$). This creates a wedge between R_t and R_t^D dependent upon loan demand and deposit supply, both of which are impacted by conventional and unconventional monetary policy intervention.

The financial intermediary abides by a zero profit condition since they operate in a perfectly competitive environment given by:

$$\begin{aligned}
&[1 - F_{t-1}(\bar{w}_t(e))]R_t^c(e)Loan_{t-1}(e) + (1-\mu)\int_0^{\bar{w}_t(e)} w dF_{t-1}(w)\tilde{R}_t^k Q_{t-1}\bar{K}_{t-1}(e) \\
&\quad = R_{t-1}Loans_{t-1}(e)
\end{aligned} \tag{A55}$$

where the first term on the left equals the expected revenue payed back to the financial intermediary, the second term equals the expected revenue the financial intermediary receives when a entrepreneur defaults and the term right of the equality is the associated cost of deposits lent out by the financial intermediary. The optimal contract maximizes expected entrepreneur profits subject to the banks' zero profit condition.

The aggregate equity, V_t, of entrepreneurs operating in the economy evolves according to

$$V_t = \tilde{R}_t^k Q_{t-1}\bar{K}_{t-1} - \left(R_{t-1} + \mu G_{t-1}(\bar{w}_t)\tilde{R}_t^k \frac{Q_{t-1}\bar{K}_{t-1}}{Q_{t-1}\bar{K}_{t-1}-N_{t-1}}\right)(Q_{t-1}\bar{K}_{t-1} - NW_{t-1}) \quad \text{(A56)}$$

where the first term on the right is the time t revenue of entrepreneurs minus the interest and principle payments entrepreneurs borrowed from the banking sector. Notice that the agreed upon contract interest rate of the loan will be higher than the risk less rate, R_{t-1}. This external finance premium will be a function of bankruptcy costs and exogenous entrepreneur risk. At the end of each period a fraction $1-\gamma$ of entrepreneurs exit the economy and are replaced by new entrepreneurs. Exiting entrepreneurs transfer some fraction of their net worth to households and the remaining net worth is transferred to newly born entrepreneurs symbolized as Tr_t. Aggregate net worth, NW_t, is subject to net worth shocks and evolves in accordance to:

$$NW_t = \gamma V_t + Tr_t + e_{NW,t} \quad \text{(A57)}$$

The sector is characterized by two key log-linearized equations, the first being the spread of the return on capital over the risk free rate:

$$\hat{S}_t \equiv E_t\left[\hat{\tilde{R}}_{t+1}^k - \hat{R}_t\right] = \chi\left(\hat{Q}_t + \hat{\bar{K}}_t - N\hat{W}_t\right) + \hat{e}_{Fin,t} \quad \text{(A58)}$$

where χ is the elasticity of the spread with respect to the capital to net worth ratio and $\hat{e}_{Fin,t}$ is a finance shock that effects the riskiness of entrepreneurs and thus the riskiness of banks being paid back in full.

The second key equation contains the evolutional behavior of entrepreneur net worth:

$$N\hat{W}_t = \delta_{\tilde{R}^k}(\hat{\tilde{R}}^k_t - \hat{\pi}_t) - \delta_R(\hat{R}_{t-1} - \hat{\pi}_t) + \delta_{qK}(\hat{Q}_{t-1} + \hat{\bar{K}}_{t-1}) + \delta_n N\hat{W}_{t-1} - \delta_\sigma \hat{e}^{Fin}_{t-1} + \hat{e}^{NW}_t \tag{A59}$$

where the δ coefficients are functions of the steady state values of the loan default rate, entrepreneur survival rate, the steady state variance of the entrepreneurial risk shocks, the steady state level of revenue lost in bankruptcy, and the steady state ratio of capital to net worth. The value of χ, which will be estimated, will determine the steady state level of the variance of the exogenous risk shock, the steady state value of the percentage of revenue lost in bankruptcy and the steady state level of leverage. Therefore, the value of χ will determine the values of the δ coefficients.[3]

A1.9 Dominant Oil Producing Economy

The household in the dominant oil producer chooses an optimal consumption level $c_{dom,t}$, labor supply $L_{dom,t}$, oil prices $P_{oil,dom,t}$, imported oil machinery $X_{dom,t}$, bond holdings $B_{dom,t}$ and US deposits dep_t, so to maximize

$$E_t \sum_{s=0}^{\infty} \beta^s_{dom} \left[log(c_{dom,t+s}) - \frac{L^{1+\nu_{l,dom}}_{dom,t+s}}{1+\nu_{l,dom}} \right] \tag{A60}$$

given oil production and oil market clearing:

$$Oil_{supply,dom,t} = e_{a,oil,dom,t} L^{\alpha_{L,oil,dom}}_{oil,dom,t} X^{\alpha_{x,dom}}_{oil,dom,t} \tag{A61}$$

$$Oil_{demand,t} + Oil_{inv,t} - Oil_{inv,t-1} = Oil_{supply,dom,t} + Oil_{supply,fringe,t} \tag{A62}$$

[3] For a comprehensive look at the functional forms of all the δ coefficients used in coding the model, one must look at the working appendix of Del Negro and Schorfheide available at http://economics.sas.upenn.edu/ schorf/research.htm.

and the following budget constraint

$$c_{dom,t} + \frac{e_{dom,t}Dep_t}{P_{dom,t}} + \frac{B_{dom,t}}{P_{dom,t}} + X_{oil,dom,t} \leq \frac{W_{dom,t}}{P_{dom,t}}L_{dom,t} + \frac{e_{dom,,t}R^D_{t-1}Dep_{t-1}}{P_{dom,t}} + \frac{R_{dom,t-1}B_{dom,t-1}}{P_{dom,t}} + \frac{\Pi_{dom,serv,t}}{P_{dom,t}} + \frac{P_{oil,dom,t}Oil_{supply,dom,t}}{P_{dom,t}} \tag{A63}$$

The dominant oil producing households can hold DOP issued short-term bonds or US based deposits that pay R^D_t. In addition, $e_{dom,t}$ is the pice of a US dollar in DOP currency that is needed to buy US deposits. As in the US and ROW, prices in the DOP service sector are subject to nominal rigidity and only DOP labor is needed to produce them. DOP consumption is given by

$$c_{dom,t} = \left[(1-\gamma_{dom})^{\frac{1}{\lambda_{type,dom}}} c_{dom,goods,t}^{\frac{\lambda_{type,dom}-1}{\lambda_{type,dom}}} + \gamma_{dom}^{\frac{1}{\lambda_{type,dom}}} c_{dom,serv,t}^{\frac{\lambda_{type,dom}-1}{\lambda_{type,dom}}}\right]^{\frac{\lambda_{type,dom}}{\lambda_{type,dom}-1}} \tag{A64}$$

$$c_{dom,goods,t} = \left[n^{\frac{1}{\lambda_{c,dom}}} c_{goods,US,t}^{\frac{\lambda_{c,dom}-1}{\lambda_{c,dom}}} + (1-n)^{\frac{1}{\lambda_{c,dom}}} c_{goods,ROW,t}^{\frac{\lambda_{c,dom}-1}{\lambda_{c,dom}}}\right]^{\frac{\lambda_{c,dom}}{\lambda_{c,dom}-1}} \tag{A65}$$

where the steady state shares of $c_{dom,goods,t}$ from the US and ROW imports are given by the relative size of the two regions.

The DOP *monetary authority* follows the following linearized Taylor rule to set the short-term nominal interest rate that adjusts due to deviations of DOP inflation and DOP output from their steady state levels.

$$\hat{R}_{dom,t} = \rho_{dom}\hat{R}_{dom,t-1} + (1-\rho_{dom})\Big[r_{\pi,dom}\hat{\pi}_{dom,t} + r_{y,dom}(\gamma_{dom}\hat{c}_{dom,serv,t} + (1-\gamma_{dom})\hat{Oil}_{supply,dom,t}) - r_{d,dom}\hat{app}_{dom,t}\Big] \tag{A66}$$

where $\hat{app}_{dom,t}$ is appreciation of the DOP currency against the US dollar and $\hat{\pi}_{dom,t}$ is defined as:

$$\hat{\pi}_{dom,t} = \gamma_{dom}\hat{\pi}_{serv,dom,t} + (1-\gamma_{dom})[n(\hat{\pi}_{H,t} - (1+\chi_d)\hat{app}_{dom,t}) + (1-n)(\hat{\pi}^*_{H,t} - (1+\chi_d)(\hat{app}_{dom,t} - \hat{d}_t))]$$

$$ \tag{A67} $$

The parameter χ_d determines the amount of exchange rate pass through on DOP import pricing.

A1.10 Global Oil Inventories

Crude oil is assumed to be storable in inventories in a perfectly competitive oil storing market as in Unalmis et al. (2012) in which a storer buys oil at market value and stores it for future selling while facing a quadratic oil storing cost. The storer choses the optimal amount of storage $Oil_{inv,t}$ to maximize profits given by

$$ \frac{E_t p_{oil,t+1}}{R_t} - p_{oil,t} Oil_{inv,t} - p_{oil,t} \Gamma(Oil_{inv,t}) \tag{A68} $$

where $\Gamma(Oil_{inv,t})$ is a cost that increases with the amount of oil storage. Oil storage demand is subject to exogenous oil speculation shocks assumed to follow an AR(1) process.

A1.11 Exogenous Processes

The model is complete with 23 exogenous shocks to each region, three oil shocks and one global trade shock. There are seven region specific i.i.d. pricing shocks to sectoral wages, sectoral domestic prices, and import prices, three AR(1) bond demand shocks, four AR(1) demand shocks to business investment, housing, final consumption and goods consumption, four policy shocks to government purchases, taxes, monetary policy rate and a LSAP (bond supply available to the public ratio) shock. Further, two finance AR(1) shocks that are assumed to be correlated across regions, one to net worth and a financial risk shock that directly affects the loan spread. There are also three stationary AR(1) technology shocks to each of the three sectors of the economy. In addition, the domestic region (US) is subject to five anticipated monetary policy shocks in the monetary policy interest rate setting rule that are identified off of Federal Funds Rate market expectations as in Del Negro et al. (2013). All shocks are listed in Table A1.

Table A1: Exogenous Processes

Description	Type	US	ROW
Price and Wage Shocks			
Price Mark-up shock to domestic Goods Prices	iid	$\hat{e}_{H,t}$	$\hat{e}_{H^*,t}$
Price Mark-up shock to domestic Service Prices	iid	$\hat{e}_{serv,t}$	$\hat{e}_{serv^*,t}$
Price Mark-up shock to domestic Housing Prices	iid	$\hat{e}_{hou,t}$	$\hat{e}_{hou^*,t}$
Price Mark-up shock to Import Prices	iid	$\hat{e}_{F,t}$	$\hat{e}_{F^*,t}$
Wage shock in Goods sector	iid	$\hat{e}_{w,goods,t}$	$\hat{e}_{w,goods^*,t}$
Wage shock in Service sector	iid	$\hat{e}_{w,serv,t}$	$\hat{e}_{w,serv^*,t}$
Wage shock in Housing sector	iid	$\hat{e}_{w,hou,t}$	$\hat{e}_{w,hou^*,t}$
Productivity Shocks			
Productivity shock in Goods sector	AR(1)	$\hat{e}_{a,goods,t}$	$\hat{e}_{a,goods^*,t}$
Productivity shock in Service sector	AR(1)	$\hat{e}_{a,serv,t}$	$\hat{e}_{a,serv^*,t}$
Productivity shock in Housing sector	AR(1)	$\hat{e}_{a,hou,t}$	$\hat{e}_{a,hou^*,t}$
Demand Shocks			
Consumption shock	AR(1)	$\hat{e}_{b,t}$	$\hat{e}_{b^*,t}$
Consumption Goods shock	AR(1)	$\hat{e}_{goods_d,t}$	$\hat{e}_{goods^*_d,t}$
Business Investment shock	AR(1)	$\hat{e}_{I,t}$	$\hat{e}_{I^*,t}$
Import Demand shock	AR(1)	$\hat{e}_{trade,t}$	-
Housing Demand shock	AR(1)	$\hat{e}_{hou_d,t}$	$\hat{e}_{hou^*_d,t}$
Finance Shocks			
Bond Duration Preference shock	AR(1)	$\hat{\gamma}_{a,t}$	$\hat{\gamma}_{a^*,t}$
Home Short Bond Preference shock	AR(1)	$\hat{\gamma}_{S,t}$	$\hat{\gamma}_{S^*,t}$
Home Long Bond Preference shock	AR(1)	$\hat{\gamma}_{L,t}$	$\hat{\gamma}_{L^*,t}$
Net Worth shock	AR(1) & Corr	$\hat{e}_{NW,t}$	$\hat{e}_{NW^*,t}$
Financial Spread shock	AR(1) & Corr	$\hat{e}_{Fin,t}$	$\hat{e}_{Fin^*,t}$
Policy Shocks			
Monetary Policy shock	iid	$\hat{\epsilon}_{r,t}$	$\hat{\epsilon}_{r^*,t}$
LSAP shock	AR(1)	$\hat{\gamma}_{b,t}$	$\hat{\gamma}_{b^*,t}$
Govt Purchase shock	AR(1)	$\hat{g}_t$	$\hat{g}^*_t$
Govt Tax shock	AR(1)	$\hat{e}_{tax,t}$	$\hat{e}_{tax^*,t}$
Anticipated Monetary shocks for $k = 1, 2, 3, 4, 5$	iid	$\hat{e}^r_{k,t-k}$	-
Oil Shocks			
Fringe Oil Supply shock	AR(1)	$\hat{e}_{oil_{fringes},t}$	
OPEC+ Oil Supply shock	AR(1)	$\hat{e}_{a,oil,dom,t}$	
Oil Inventory shock	AR(1)	$\hat{e}_{oil_{inv},t}$	

A1.12 Linearized Equations - Home Region

- Household FOC's

$$\hat{\lambda}_t = -\frac{1}{1-h}(\hat{c}_t - h\hat{c}_{t-1}) + \hat{e}_{b,t} \tag{A69}$$

$$\hat{R}_{L,t} = \frac{\kappa}{R_L}E_t[\hat{R}_{L,t+1}] + \left(1 - \frac{\kappa}{R_L}\right)\left(\hat{R}_t + \left(\frac{\pi}{\beta R} - 1\right)\hat{T}_t\right) \tag{A70}$$

$$\hat{T}_t = \frac{1}{\lambda_a}\left(\hat{a}_{L,t} - \hat{a}_{S,t} + \frac{1}{1-\gamma_a}\hat{\gamma}_{a,t}\right) - \frac{1}{\lambda_L}\left(\hat{a}_{L,t} - (\hat{q}_{L,t} + \hat{b}_{H,L,t}) + \hat{\gamma}_{L,t}\right) + \frac{1}{\lambda_s}\left(\hat{a}_{S,t} - \hat{b}_{H,S,t} + \hat{\gamma}_{S,t}\right) \tag{A71}$$

$$\begin{aligned}\hat{\lambda}_t = \frac{\beta R}{\pi}\left(E_t[\hat{\lambda}_{t+1}] + \hat{R}_t - E_t[\hat{\pi}_{t+1}]\right) + \left(1 - \frac{\beta R}{\pi}\right)\Bigg[\frac{1-\gamma_a}{\lambda_a}\left(\hat{a}_{L,t} - \hat{a}_{S,t} + \frac{1}{1-\gamma_a}\hat{\gamma}_{a,t}\right) \\ + \frac{1-\gamma_S}{\lambda_S}\left(r\hat{e}r_t + \hat{b}_{F,S,t} - \hat{b}_{H,S,t} + \frac{1}{1-\gamma_S}\hat{\gamma}_{S,t}\right) - \hat{a}_t\Bigg]\end{aligned} \tag{A72}$$

$$\hat{\lambda}_t = \frac{\beta R^D}{\pi}\left(E_t[\hat{\lambda}_{t+1}] + \hat{R}^D_t - E_t[\hat{\pi}_{t+1}]\right) - \left(1 - \frac{\beta R^D}{\pi}\right)d\hat{e}p_t \tag{A73}$$

$$\frac{-1}{1-h_{hou}}(h\hat{o}u_t - h_{hou}h\hat{o}u_{t-1}) + \hat{e}_{hou_d,t} = \frac{1}{1-\beta(1-\tau_h)}\left[\hat{p}_{hou,t} + \hat{\lambda}_t - \beta(1-\tau_h)E_t(\hat{p}_{hou,t+1} + \hat{\lambda}_{t+1})\right] \tag{A74}$$

$$\hat{w}_{Household,goods,t} = (\nu_l - \eta_l)\,\hat{L}_t + \eta_l\hat{L}_{goods,t} - \hat{\lambda}_t \tag{A75}$$

$$\hat{w}_{Household,serv,t} = (\nu_l - \eta_l)\,\hat{L}_t + \eta_l\hat{L}_{serv,t} - \hat{\lambda}_t \tag{A76}$$

$$\hat{w}_{Household,hou,t} = (\nu_l - \eta_l)\,\hat{L}_t + \eta_l\hat{L}_{hou,t} - \hat{\lambda}_t \tag{A77}$$

- Aggregate Definitions

$$\hat{a}_t = \gamma_a\hat{a}_{S,t} + (1-\gamma_a)\hat{a}_{L,t} \tag{A78}$$

$$\hat{a}_{S,t} = \gamma_S\hat{b}_{H,S,t} + (1-\gamma_S)(r\hat{e}r_t + \hat{b}_{F,S,t}) \tag{A79}$$

$$\hat{a}_{L,t} = \gamma_L\hat{b}_{H,L,t} + (1-\gamma_L)(r\hat{e}r_t + \hat{q}^*_{L,t} + \hat{b}_{F,L,t}) \tag{A80}$$

$$\hat{c}_t = \gamma_{serv,c}\hat{c}_{serv,t} + (1-\gamma_{serv,c})\hat{c}_{goods,t} \tag{A81}$$

$$\hat{c}_{goods,t} = \gamma_c \hat{c}_{H,t} + (1-\gamma_c)\hat{c}_{F,t} \tag{A82}$$

$$\hat{Int}_{total,t} = \gamma_{int} \hat{Int}_{H,t} + (1-\gamma_{int})\hat{Int}_{F,t} \tag{A83}$$

$$\hat{Int}_{total,t} = \gamma_{int,goods} \hat{Int}_{goods,t} + (1-\gamma_{int,goods})\hat{Int}_{goods,serv,t} \tag{A84}$$

$$\hat{I}_t = \gamma_I \hat{I}_{H,t} + (1-\gamma_I)\hat{I}_{F,t} \tag{A85}$$

$$\hat{L}_t = (1-\gamma_{serv}-\Delta_{hou})\hat{L}_{goods,t} + \gamma_{serv}\hat{L}_{serv,t} + \Delta_{hou}\hat{L}_{hou,t} \tag{A86}$$

- UIP Equations

$$\hat{R}_t - \hat{R}^*_t = E_t \hat{d}_{t+1} + \left(\tfrac{\pi}{\beta R} - 1\right)\tfrac{1}{\lambda_s}\left[\hat{b}_{H,S,t} - (\hat{rer}_t + \hat{b}_{F,S,t}) - \tfrac{1}{1-\gamma_S}\hat{\gamma}_{S,t}\right] \tag{A87}$$

$$\begin{aligned} \hat{R}_{L,t} - \hat{R}^*_{L,t} = {} & \frac{\kappa}{R_L}\left(E_t[\hat{R}_{L,t+1}] - E_t[\hat{R}^*_{L,t+1}]\right) + \left(1 - \frac{\kappa}{R_L}\right)\Big\{E_t\hat{d}_{t+1} \\ & + \left(\frac{\pi}{\beta R} - 1\right)\frac{1}{\lambda_L}\left[\hat{q}_{L,t} + \hat{b}_{H,L,t} - (\hat{rer}_t + \hat{q}^*_{L,t} + \hat{b}_{F,L,t}) - \frac{1}{1-\gamma_L}\hat{\gamma}_{L,t}\right]\Big\} \end{aligned} \tag{A88}$$

- Policy Equations

$$\hat{R}_t = \rho \hat{R}_{t-1} + (1-\rho)\left[r_\pi \hat{\pi}_t + r_y \hat{y}_t + r_d \hat{d}_t\right] + \hat{\varepsilon}_{r,t} + \sum_{k=1}^{5} \hat{e}^r_{k,t-k} \tag{A89}$$

$$\begin{aligned} & \frac{g}{y}(\hat{g}_t) + \frac{R}{\pi}\frac{b_S}{y}\left(\hat{R}_{t-1} - \hat{\pi}_t + \hat{b}_{S,t-1}\right) + \frac{R_L}{\pi}\frac{q_L b_L}{y}\left(\hat{R}_{L,t} - \hat{\pi}_t + \hat{q}_{L,t} + \hat{b}_{L,t-1}\right) \\ & \quad = \frac{tax}{y}\hat{tax}_t + \frac{b_S}{y}\hat{b}_{S,t} + \frac{q_L b_L}{y}\left(\hat{q}_{L,t} + \hat{b}_{L,t}\right) \end{aligned} \tag{A90}$$

$$\hat{tax}_t = \tau_Y \hat{y}_t + \tau_b \frac{\frac{b_S}{y}}{\frac{b_S}{y} + \frac{q_L b_L}{y}}\hat{b}_{S,t-1} + \tau_b \frac{\frac{q_L b_L}{y}}{\frac{b_S}{y} + \frac{q_L b_L}{y}}\left(\hat{q}_{L,t-1} + \hat{b}_{L,t-1}\right) + \hat{e}_{tax,t} \tag{A91}$$

$$\frac{b_S}{y}\hat{b}_{S,t} = \frac{b_{H,S}}{y}\hat{b}_{H,S,t} + \left(\frac{b_s}{y} - \frac{b_{H,S}}{y}\right)\hat{b}^*_{F,S,t} \tag{A92}$$

$$\frac{q_L b_L}{y}\hat{b}_{L,t} = \frac{q_L b_{H,L}}{y}\hat{b}_{H,L,t} + \left(\frac{q_L b_L}{y} - \frac{q_L b_{H,L}}{y}\right)\hat{b}^*_{F,L,t} \tag{A93}$$

$$\hat{\gamma}_{b,t} = \hat{q}_{L,t} + \hat{b}_{L,t} - \hat{b}_{S,t} \tag{A94}$$

- Capital

$$\hat{\bar{K}}_t = (1-\tau)\hat{\bar{K}}_{t-1} + \tau \hat{I}_t + S'' \tau \hat{e}_{I,t} \tag{A95}$$

$$\hat{I}_t - \hat{I}_{t-1} = \beta E_t[\hat{I}_{t+1} - \hat{I}_t] + \frac{1}{S''}(\hat{Q}_t - \hat{p}_{I,t}) + \hat{e}_{I,t} \tag{A96}$$

$$\hat{K}_t = \hat{u}_t + \hat{\bar{K}}_{t-1} \tag{A97}$$

$$\hat{u}_t = \frac{r_k}{a''(u)} \hat{r}^k_t \tag{A98}$$

- New Keynesian Phillip's Curves

$$\hat{\pi}_{H,t} - \iota_H \hat{\pi}_{H,t-1} = \beta E_t[\hat{\pi}_{H,t+1} - \iota_H \hat{\pi}_{H,t}] - \frac{\Theta_H - 1}{\kappa_H}\left(\hat{p}_{H,t} - \hat{MC}_{goods,t}\right) + \hat{e}_{H,t} \tag{A99}$$

$$\hat{\pi}_{serv,t} - \iota_{serv} \hat{\pi}_{serv,t-1} = \beta E_t[\hat{\pi}_{serv,t+1} - \iota_{serv} \hat{\pi}_{serv,t}] - \frac{\Theta_{serv} - 1}{\kappa_{serv}}\left(\hat{p}_{serv,t} - \hat{MC}_{serv,t}\right) + \hat{e}_{serv,t} \tag{A100}$$

$$\hat{\pi}_{hou,t} - \iota_{hou} \hat{\pi}_{hou,t-1} = \beta E_t[\hat{\pi}_{hou,t+1} - \iota_{hou} \hat{\pi}_{hou,t}] - \frac{\Theta_{hou} - 1}{\kappa_{hou}}\left(\hat{p}_{hou,t} - \hat{MC}_{hou,t}\right) + \hat{e}_{hou,t} \tag{A101}$$

$$\hat{\pi}_{F,t} - \iota_F \hat{\pi}_{F,t-1} = \beta E_t[\hat{\pi}_{F,t+1} - \iota_F \hat{\pi}_{F,t}] - \frac{\Theta_F - 1}{\kappa_F}\left(\hat{p}_{F,t} - r\hat{e}r_t - \hat{p}^*_{H,t}\right) + \hat{e}_{F,t} \tag{A102}$$

$$\hat{\pi}_{Int,F,t} - \iota_F \hat{\pi}_{Int,F,t-1} = \beta E_t[\hat{\pi}_{Int,F,t+1} - \iota_F \hat{\pi}_{Int,F,t}] - \frac{\Theta_F - 1}{\kappa_F}\left(\hat{p}_{Int,F,t} - r\hat{e}r_t - \hat{p}^*_{H,t}\right) + \hat{e}_{F,t} \tag{A103}$$

- New Keynesian Wage Phillip's Curves

$$\begin{aligned}\hat{\pi}_{w,goods,t} - \iota_{w,goods} \hat{\pi}_{w,goods,t-1} = \beta E_t[\hat{\pi}_{w,goods,t+1} - \iota_{w,goods} \hat{\pi}_{w,goods,t}] - \\ \frac{\Theta_{w,goods} - 1}{\kappa_{w,goods}}\left(\hat{w}_{goods,t} - \hat{w}_{Household,goods,t}\right) + \hat{e}_{w,goods,t}\end{aligned} \tag{A104}$$

$$\begin{aligned}\hat{\pi}_{w,serv,t} - \iota_{w,serv} \hat{\pi}_{w,serv,t-1} = \beta E_t[\hat{\pi}_{w,serv,t+1} - \iota_{w,serv} \hat{\pi}_{w,serv,t}] - \\ \frac{\Theta_{w,serv} - 1}{\kappa_{w,serv}}\left(\hat{w}_{serv,t} - \hat{w}_{Household,serv,t}\right) + \hat{e}_{w,serv,t}\end{aligned} \tag{A105}$$

$$\hat{\pi}_{w,hou,t} - \iota_{w,hou}\hat{\pi}_{w,hou,t-1} = \beta E_t[\hat{\pi}_{w,hou,t+1} - \iota_{w,hou}\hat{\pi}_{w,hou,t}] - \frac{\Theta_{w,hou} - 1}{\kappa_{w,hou}}(\hat{w}_{hou,t} - \hat{w}_{Household,hou,t}) + \hat{e}_{w,hou,t} \tag{A106}$$

- Goods Producers

$$\hat{y}_{goods,t} = \hat{e}_{a,goods,t} + (1 - \alpha_k - \alpha_{O,goods} - \alpha_{M,goods})\hat{L}_{goods,t} + \alpha_k\hat{K}_t + \alpha_{M,goods}\hat{Int}_{goods,t} + \alpha_{O,goods}\hat{Oil}_{goods,t} \tag{A107}$$

$$\hat{K}_t = \tau_{goods}\hat{w}_{goods,t} + \hat{L}_{goods,t} - \tau_{goods}\hat{r}_{k,t} \tag{A108}$$

$$\hat{Oil}_{goods,t} = \tau_{goods}\hat{w}_{goods,t} + \hat{L}_{goods,t} - \tau_{goods}\hat{p}_{oil,t} \tag{A109}$$

$$\hat{Int}_{goods,t} = \tau_{goods}\hat{w}_{goods,t} + \hat{L}_{goods,t} - \tau_{goods}\hat{p}_{M,t} \tag{A110}$$

$$\hat{MC}_{goods,t} = (1 - \alpha_K - \alpha_{O,goods} - \alpha_{M,goods})\hat{w}_{goods,t} + \alpha_K\hat{r}_t^k + \alpha_{O,goods}\hat{p}_{oil,t} + \alpha_{M,goods}\hat{p}_{M,t} - \hat{e}_{a,goods,t} \tag{A111}$$

- Service Producers

$$\hat{y}_{serv,t} = \hat{e}_{a,serv,t} + (1 - \alpha_{O,serv} - \alpha_{M,serv} - \alpha_{M,goods,serv})\hat{L}_{serv,t} + \alpha_{M,serv}\hat{Int}_{serv,t} + \alpha_{M,goods,serv}\hat{Int}_{serv,t}\hat{Int}_{goods,serv,t} + \alpha_{O,serv}\hat{Oil}_{serv,t} \tag{A112}$$

$$\hat{Oil}_{serv,t} = \tau_{serv}\hat{w}_{serv,t} + \hat{L}_{serv,t} - \tau_{serv}\hat{p}_{oil,t} \tag{A113}$$

$$\hat{Int}_{serv,t} = \tau_{serv}\hat{w}_{serv,t} + \hat{L}_{serv,t} - \tau_{serv}\hat{p}_{serv,t} \tag{A114}$$

$$\hat{Int}_{goods,serv,t} = \tau_{serv}\hat{w}_{serv,t} + \hat{L}_{serv,t} - \tau_{serv}\hat{p}_{M,t} \tag{A115}$$

$$\hat{MC}_{serv,t} = (1 - \alpha_{O,serv} - \alpha_{M,serv} - \alpha_{M,goods,serv})\hat{w}_{serv,t} + \alpha_{O,serv}\hat{p}_{oil,t} + \alpha_{M,serv}\hat{p}_{serv,t} + \alpha_{M,goods,serv}\hat{p}_{M,t} - \hat{e}_{a,serv,t} \tag{A116}$$

- Housing Producers

$$\hat{y}_{hou,t} = \hat{e}_{hou,serv,t} + (1 - \alpha_{land})\hat{L}_{hou,t} \tag{A117}$$

$$\hat{MC}_{goods,t} = (1 - \alpha_{land})\hat{w}_{hou,t} + \alpha_{land}\hat{r}_{l,t} - \hat{e}_{a,hou,t} \tag{A118}$$

$$\tau_{hou}\hat{r}_{l,t} = \tau_{hou}\hat{w}_{hou,t} + \hat{L}_{hou,t} \tag{A119}$$

$$\hat{y}_{hou,t} = \hat{HI}_t \tag{A120}$$

$$\hat{hou}_t = \tau_h \hat{HI}_t, (1 - \tau_h)\hat{hou}_{t-1} \tag{A121}$$

- Entrepreneurs and Financial Sector

$$E_t\left[\hat{\tilde{R}}^k_{t+1} - \hat{R}_t\right] = \chi\left(\hat{Q}_t + \hat{\bar{K}}_t - \hat{NW}_t\right) + \hat{e}_{Fin,t} \tag{A122}$$

$$\hat{S}_t = E_t\left[\hat{\tilde{R}}^k_{t+1} - \hat{R}_t\right] \tag{A123}$$

$$\begin{aligned}\hat{NW}_t = \delta_{\tilde{R}^k}(\hat{\tilde{R}}^k_t - \hat{\pi}_t) - \delta_R(\hat{R}_{t-1} - \hat{\pi}_t) + \delta_{qK}(\hat{Q}_{t-1} + \hat{\bar{K}}_{t-1}) +\\ \delta_n \hat{NW}_{t-1} - \delta_\sigma \hat{e}_{Fin,t-1} + \hat{e}_{NW,t}\end{aligned} \tag{A124}$$

$$\hat{\tilde{R}}^k_t - \hat{\pi}_t = \frac{1-\tau}{1-\tau+r^k}\hat{Q}_t + \frac{r^k}{1-\tau+r^k}\hat{r}^k_t - \hat{Q}_{t-1} \tag{A125}$$

$$\frac{R^D}{ldr}\hat{R}^D_t = R\left(\hat{R}_t + \hat{ldr}_t\right) - \hat{ldr}_t \tag{A126}$$

$$\left(\frac{\bar{K}}{NW} - 1\right)\hat{loans}_t = \frac{\bar{K}}{NW}\left(\hat{Q}_t + \hat{\bar{K}}_t\right) - \hat{NW}_t \tag{A127}$$

- Balance of Payments US/ROW

$$\begin{aligned}
&\frac{b_{F,S}}{y}\left[\left(r\hat{e}r+\hat{b}_{F,S,t}\right)-\frac{R^*}{\pi^*}\left(r\hat{e}r_t+\hat{R}^*_{t-1}+\hat{b}_{F,S,t-1}-\hat{\pi}^*_t\right)\right]...\\
&\quad+\frac{q^*_L b_{F,L}}{y}\left[\left(r\hat{e}r+\hat{q}^*_{L,t}+\hat{b}_{F,L,t}\right)-\frac{R^*_L}{\pi^*}\left(r\hat{e}r_t+\hat{R}^*_{L,t}+\hat{q}^*_{L,t}+\hat{b}_{F,L,t-1}-\hat{\pi}^*_t\right)\right]...\\
&\quad-\frac{b^*_{F,S}}{y}\left[\hat{b}^*_{F,S,t}-\frac{R}{\pi}\left(\hat{R}_{t-1}+\hat{b}^*_{F,S,t-1}-\hat{\pi}_t\right)\right]...\\
&\quad-\frac{q_L b^*_{F,L}}{y}\left[\left(\hat{q}_{L,t}+\hat{b}^*_{F,L,t}\right)-\frac{R_L}{\pi}\left(\hat{R}_{L,t}+\hat{q}_{L,t}+\hat{b}^*_{F,L,t-1}-\hat{\pi}_t\right)\right]...\\
&\quad=\frac{y^*_F}{y}\left(\hat{p}_{H,t}+y^*_{F,t}\right)-\frac{y_F}{y}\left(r\hat{e}r_t+\hat{p}^*_{H,t}+y_{F,t}\right)
\end{aligned} \tag{A128}$$

- Oil Market

$$\hat{Oil}_{demand,t}=\frac{Oil_{goods}}{Oil_d}\hat{Oil}_{goods,t}+\frac{Oil_{serv}}{Oil_d}\hat{Oil}_{serv,t}+\frac{Oil^*_{goods}}{Oil_d}\hat{Oil^*}_{goods,t}+\frac{Oil^*_{serv}}{Oil_d}\hat{Oil^*}_{serv,t} \tag{A129}$$

$$\hat{Oil}_{demand,t}=\hat{Oil}_{supply,t}+\frac{Oil_{inv}}{Oil_s}\hat{Oil}_{inv,t-1}-\frac{Oil_{inv}}{Oil_s}\hat{Oil}_{inv,t} \tag{A130}$$

$$\hat{Oil}_{supply,t}=\frac{Oil_{s,fringe}}{Oil_s}\hat{Oil}_{supply,fringe,t}+\frac{Oil_{s,dom}}{Oil_s}\hat{Oil}_{supply,dom,t} \tag{A131}$$

$$\hat{Oil}_{inv,t}=\frac{\beta}{\beta-1-\kappa_{oil}}(E_t\hat{p}_{oil,t+1}-\hat{p}_{oil,t}-(\hat{R}_t-E_t\hat{\pi}_{t+1}))+\hat{e}_{oil_{inv},t} \tag{A132}$$

- Price and Inflation Definitions

$$\hat{p}_{goods,t}=\gamma_c\hat{p}_{H,t}+(1-\gamma_c)\hat{p}_{F,t} \tag{A133}$$

$$\hat{p}_{m,t}=\gamma_{int}\hat{p}_{H,t}+(1-\gamma_{int})\hat{p}_{Int,F,t} \tag{A134}$$

$$0=(1-\gamma_{serv}-\Delta_{hou})\hat{p}_{goods,t}+\gamma_{sev}\hat{p}_{serv,t}+\Delta_{hou}\hat{p}_{hou,t} \tag{A135}$$

$$\hat{p}_{oil,t}=\hat{p}^*_{oil,t}+r\hat{e}r_t \tag{A136}$$

$$\hat{p}_{I,t}=\gamma_I\hat{p}_{H,t}+(1-\gamma_I)\hat{p}_{F,t} \tag{A137}$$

$$\hat{\pi}_{goods,t}-\hat{\pi}_t=\hat{p}_{goods,t}-\hat{p}_{goods,t-1} \tag{A138}$$

$$\hat{\pi}_{serv,t} - \hat{\pi}_t = \hat{p}_{serv,t} - \hat{p}_{serv,t-1} \tag{A139}$$

$$\hat{\pi}_{hou,t} - \hat{\pi}_t = \hat{p}_{hou,t} - \hat{p}_{hou,t-1} \tag{A140}$$

$$\hat{\pi}_{H,t} - \hat{\pi}_t = \hat{p}_{H,t} - \hat{p}_{H,t-1} \tag{A141}$$

$$\hat{\pi}_{F,t} - \hat{\pi}_t = \hat{p}_{F,t} - \hat{p}_{F,t-1} \tag{A142}$$

$$\hat{\pi}_{Int,F,t} - \hat{\pi}_t = \hat{p}_{Int,F,t} - \hat{p}_{Int,F,t-1} \tag{A143}$$

$$\hat{\pi}_{oil,t} - \hat{\pi}_t = \hat{p}_{oil,t} - \hat{p}_{oil,t-1} \tag{A144}$$

$$\hat{\pi}_{w,goods,t} - \hat{\pi}_t = \hat{w}_{goods,t} - \hat{w}_{goods,t-1} \tag{A145}$$

$$\hat{\pi}_{w,serv,t} - \hat{\pi}_t = \hat{w}_{serv,t} - \hat{w}_{serv,t-1} \tag{A146}$$

$$\hat{\pi}_{w,hou,t} - \hat{\pi}_t = \hat{w}_{hou,t} - \hat{w}_{hou,t-1} \tag{A147}$$

- Output Definitions

$$\hat{y}_{goods,t} = \frac{y}{y_{goods}}\left[\frac{c}{y}\gamma_c\hat{c}_{H,t} + \frac{I}{y}\gamma_I\hat{I}_{H,t} + \frac{g}{y}g_{goods}\hat{g}_t + \frac{y_F^*}{y}\hat{y}_{F,t}^* + r_k\frac{\bar{K}}{y}\hat{u}_t + \frac{dom}{y}\hat{y}_{F,dom,t}\right] + \gamma_{int}\alpha_{M,goods}\hat{Int}_{H,t} \tag{A148}$$

$$\hat{y}_{F,t} = \frac{c}{y}\frac{y}{y_F}(1-\gamma_c)\hat{c}_{F,t} + \frac{I}{y}\frac{y}{y_F}(1-\gamma_I)\hat{I}_{F,t} + \frac{y}{y_F}(1-\gamma_{int})\alpha_{M,goods}(1-\gamma_{serv}-\Delta_{hou})\hat{Int}_{F,t} \tag{A149}$$

$$\hat{y}_{F,dom,t} = \alpha_{x,dom}\hat{X}_{oil,US,t} + (1-\alpha_{x,dom})\hat{c}_{goods,US,t} \tag{A150}$$

$$\hat{y}_{serv,t} = \frac{1}{\gamma_{serv}}\left(\frac{c_{serv}}{y}\hat{c}_{serv,t} + \frac{g}{y}(1-g_{goods})\hat{g}_t\right) + \alpha_{M,serv}\hat{Int}_{serv,t} \tag{A151}$$

$$\hat{y}_t = (1-\gamma_{serv}-\Delta_{hou})(\hat{p}_{goods,t}+\hat{y}_{goods,t}) + \gamma_{serv}(\hat{p}_{serv,t}+\hat{y}_{serv,t}) + \Delta_{hou}(\hat{p}_{hou,t}+\hat{y}_{hou,t}) \tag{A152}$$

- Other Definitions

$$\hat{R}_{L,t} = -\left(1 - \frac{\kappa}{R_L}\right)\hat{q}_{L,t} \tag{A153}$$

$$r\hat{e}r_t - r\hat{e}r_{t-1} = \hat{d}_t + \hat{\pi}^*_t - \hat{\pi}_t \tag{A154}$$

$$\hat{c}_{H,t} - \hat{c}_{F,t} = \lambda_c\left(\hat{p}_{F,t} - \hat{p}_{H,t}\right) - \hat{e}_{trade,t} \tag{A155}$$

$$\hat{c}_{goods,t} - \hat{c}_{serv,t} = \lambda_{type}\left(\hat{p}_{serv,t} - \hat{p}_{goods,t}\right) + \hat{e}_{goods_d,t} \tag{A156}$$

$$\hat{I}_{H,t} - \hat{I}_{F,t} = \lambda_I\left(\hat{p}_{F,t} - \hat{p}_{H,t}\right) \tag{A157}$$

$$I\hat{n}t_{H,t} - I\hat{n}t_{F,t} = \lambda_{Int}\left(\hat{p}_{Int,F,t} - \hat{p}_{H,t}\right) \tag{A158}$$

$$l\hat{d}r_t = lo\hat{a}ns_t - d\hat{e}p_t \tag{A159}$$

- Dominant Oil Producer

$$E_t\hat{c}_{dom,t+1} - \hat{c}_{dom,t} = \hat{R}_{dom,t} - E_t\hat{\pi}_{dom,t+1} \tag{A160}$$

$$(1-\mu_{dom})\hat{\lambda}_{dom,t} + \mu_{dom}\hat{p}_{oil,dom,t} = \hat{c}_{dom,t} + \nu_{l,dom}\hat{L}_{dom,t} + \hat{L}_{oil,dom,t} - \hat{Oil}_{supply,dom,t} \tag{A161}$$

$$(1-\mu_{dom})\hat{\lambda}_{dom,t} + \mu_{dom}\hat{p}_{oil,dom,t} = \hat{p}_{x,t} + \hat{X}_{oil,dom,t} - \hat{Oil}_{supply,dom,t} \tag{A162}$$

$$\mu_{dom} \equiv \frac{1}{1+\Lambda_{dom}} \tag{A163}$$

$$\Lambda_{dom} \equiv \frac{\frac{Oil_{supply,dom}}{Oil_s}}{\tau_{dem} + 2\left(\frac{\beta_{dom}}{\beta dom - 1 - \kappa_{oil}}\right)\frac{Oil_{inv}}{Oil_d}} \tag{A164}$$

$$\tau_{dem} \equiv n\left(\frac{1-\gamma_{serv}-\Delta_{hou}}{1-\Delta_{hou}}\tau_{goods} + \frac{\gamma_{serv}}{1-\Delta_{hou}}\tau_{serv}\right) + (1-n)\left(\frac{1-\gamma^*_{serv}-\Delta^*_{hou}}{1-\Delta^*_{hou}}\tau^*_{goods} + \frac{\gamma^*_{serv}}{1-\Delta^*_{hou}}\tau^*_{serv}\right) \tag{A165}$$

$$\hat{p}_{x,t} = n\hat{t}_{H,t} + (1-n)\hat{t}_{H^*,t} + \hat{t}_{T,dom,t} \tag{A166}$$

$$\hat{t}_{H,t} = (1-n)(rel\,\hat{price}_t) \tag{A167}$$

$$\hat{t}_{H^*,t} = -n(rel\,\hat{price}_t) \tag{A168}$$

$$(rel\,\hat{price}_t)-(rel\,\hat{price}_{t-1}) = (\hat{\pi}_{H,t}-(1+\chi_d)a\hat{p}p_{dom,t})-(\hat{\pi}^*_{H,t}-(1+\chi_d)(a\hat{p}p_{dom,t}-\hat{d}_t)) \tag{A169}$$

$$\hat{t}_{T,dom,t} = \frac{-\gamma_{dom}}{1-\gamma_{dom}}\hat{p}_{dom,serv,t} \tag{A170}$$

$$\hat{w}_{dom,t} = \nu_{l,dom}\hat{L}_{dom,t} + \hat{c}_{dom,t} \tag{A171}$$

$$\hat{Oil}_{supply,dom,t} = \hat{e}_{a,oil,dom,t} + \alpha_{L,oil,dom}\hat{L}_{oil,dom,t} + \alpha_{x,dom}\hat{X}_{oil,dom,t} \tag{A172}$$

$$\hat{\lambda}_{dom,t} = \hat{p}_{oil,dom,t}+\hat{Oil}_{supply,dom,t}+\frac{(1-\mu_{dom})Oil}{\mu_{dom}Oil_{s,dom}}\left[\tau_{dem}\hat{Oil}_{demand,t}\frac{Oil_{inv}}{Oil_s}\left(\hat{Oil}_{inv,t}+\hat{Oil}_{inv,t-1}\right)\right] \tag{A173}$$

$$\begin{aligned}\hat{\pi}_{serv,dom,t} - \iota_{serv,dom}\hat{\pi}_{serv,dom,t-1} = \beta_{dom}E_t[\hat{\pi}_{serv,dom,t+1} - \iota_{serv,dom}\hat{\pi}_{serv,dom,t}]- \\ \frac{\Theta_{serv,dom}-1}{\kappa_{serv,dom}}\left(\hat{p}_{serv,dom,t} - \hat{w}_{dom,t}\right)\end{aligned} \tag{A174}$$

$$\hat{\pi}_{serv,dom,t} - \hat{\pi}_{dom,t} = \hat{p}_{serv,dom,t} - \hat{p}_{serv,dom,t-1} \tag{A175}$$

$$\begin{aligned}\hat{R}_{dom,t} = \rho_{dom}\hat{R}_{dom,t-1} + (1-\rho_{dom})\Big[r_{\pi,dom}\hat{\pi}_{dom,t} + r_{y,dom}(\gamma_{dom}\hat{c}_{dom,serv,t} + \\ (1-\gamma_{dom})\hat{Oil}_{supply,dom,t}) - r_{d,dom}a\hat{p}p_{dom,t}\Big]\end{aligned} \tag{A176}$$

- Dominant Oil Producer Aggregates

$$\hat{c}_{dom,t} = (1-\gamma_{dom})\hat{c}_{dom,goods,t} + \gamma_{dom}\hat{c}_{dom,serv,t} \tag{A177}$$

$$\hat{c}_{dom,goods,t} = n\hat{c}_{goods,US,t} + (1-n)\hat{c}_{goods,ROW,t} \tag{A178}$$

$$\hat{X}_{oil,dom,t} = n\hat{X}_{oil,US,t} + (1-n)\hat{X}_{oil,ROW,t} \tag{A179}$$

$$\hat{L}_{dom,t} = (1-\gamma_{dom})\hat{L}_{oil,dom,t} + \gamma_{dom}\hat{L}_{serv,dom,t} \tag{A180}$$

$$\hat{c}_{dom,serv,t} = \hat{L}_{serv,dom,t} \tag{A181}$$

$$\begin{aligned}\hat{\pi}_{dom,t} = \gamma_{dom}\hat{\pi}_{serv,dom,t} + (1-\gamma_{dom})[n(\hat{\pi}_{H,t} - (1+\chi_d)a\hat{p}p_{dom,t})+ \\ (1-n)(\hat{\pi}^*_{H,t} - (1+\chi_d)(a\hat{p}p_{dom,t} - \hat{d}_t))]\end{aligned} \tag{A182}$$

- Dominant Oil Producer Demand

$$\hat{c}_{goods,US,t} - \hat{c}_{goods,ROW,t} = \lambda_{c,dom}(\hat{t}_{H^*,t} - \hat{t}_{H,t}) \tag{A183}$$

$$\hat{X}_{goods,US,t} - \hat{X}_{goods,ROW,t} = \lambda_{X,dom}(\hat{t}_{H^*,t} - \hat{t}_{H,t}) \tag{A184}$$

$$\hat{c}_{dom,goods,t} - \hat{c}_{dom,serv,t} = \lambda_{type,dom}(\hat{p}_{dom,serv,t} - \hat{t}_{T,dom,t}) \tag{A185}$$

- Dominant Oil Producer Trade

$$\hat{p}_{oil,dom,t} = \hat{p}_{oil,t} - r\hat{e}r_{dom,t} \tag{A186}$$

$$\hat{p}_{oil,dom,t} = \hat{p}^*_{oil,t} - r\hat{e}r^*_{dom,t} \tag{A187}$$

$$r\hat{e}r_{dom,t} - r\hat{e}r_{dom,t-1} = a\hat{p}p_{dom} + \hat{\pi}_{dom,t} - \hat{\pi}_t \tag{A188}$$

$$\hat{R}^D_t - E_t(\hat{\pi}_{t+1}) - (\hat{R}_{dom,t} - E_t(\hat{\pi}_{dom,t+1})) = E_t(r\hat{e}r_{dom,t+1}) - r\hat{e}r_{dom,t} + \chi_d\hat{b}_{dom,t} \tag{A189}$$

$$n\hat{x}_{dom,t} = \beta_{dom}\hat{b}_{dom,t} - \hat{b}_{dom,t-1} \tag{A190}$$

$$\begin{aligned} n\hat{x}_{dom,t} = \frac{1-\gamma_{dom}}{1-\gamma_{dom}\alpha_{x,dom}}\Bigg[&\hat{p}_{oil,dom,t} + \frac{Oil_{s,dom}}{Oil_s}\hat{Oil}_{demand,t} - (n\hat{t}_{H,t} + (1-n)\hat{t}_{H^*,t}) \\ &- (1-\beta_{dom})\hat{c}_{dom,goods,t} - \beta_{dom}\hat{X}_{oil,dom,t}\Bigg] \end{aligned} \tag{A191}$$

A2 Data, Calibrated and Estimated Parameters

Table A2 presents the weight placed on each country in order to produce the ROW series while Figure A1 plots the series of data used to estimate the model for both the US and the ROW.

There are 26 US data series, 22 ROW data series, four International bond holding data series, four oil market data series and five anticipated monetary policy series. The individual measurement equations that relate to the model variables are listed below. All e^{obs} are iid

Table A2: Country Weights for ROW Data

Country	Economic Variables	Financial Variables
European Union (EU)	0.424	0.560
China (CHN)	0.242	-
Japan (JPN)	0.161	0.212
United Kingdom (UK)	0.089	0.117
Canada (CAN)	0.046	0.061
Australia (AUS)	0.038	0.050

measurement error shocks calibrated to 10% of the data series sample standard error.

$$\text{US GDP Growth} = 100(\hat{y}_t - \hat{y}_{t-1}) + e_t^{gdp} \tag{A192}$$

$$\text{US Consumption Goods Growth} = 100(\hat{c}_{goods,t} - \hat{c}_{goods,t-1}) + e_t^{c_{good}} \tag{A193}$$

$$\text{US Consumption Services Growth} = 100(\hat{c}_{serv,t} - \hat{c}_{serv,t-1}) + e_t^{c_{serv}} \tag{A194}$$

$$\text{US Business Investment Growth} = 100(\hat{I}_t - \hat{I}_{t-1}) + e_t^{Inv} \tag{A195}$$

$$\text{US Residential Investment Growth} = 100(\hat{HI}_t - \hat{HI}_{t-1}) + e_t^{ResInv} \tag{A196}$$

$$\text{US Government Growth} = 100(\hat{g}_t - \hat{g}_{t-1}) + e_t^{gov} \tag{A197}$$

$$\text{US Wage Inflation in Goods Sector} = 400(\pi_{w,goods} + \hat{\pi}_{w,goods,t}) + e_t^{w,goods} \tag{A198}$$

$$\text{US Wage Inflation in Service Sector} = 400(\pi_{w,serv} + \hat{\pi}_{w,serv,t}) + e_t^{w,serv} \tag{A199}$$

$$\text{US Wage Inflation in Housing Sector} = 400(\pi_{w,hou} + \hat{\pi}_{w,hou,t}) + e_t^{w,hou} \tag{A200}$$

$$\text{US Hours Growth in Goods Sector} = 100(\hat{L}_{goods,t} - \hat{L}_{goods,t-1}) + e_t^{L_{good}} \tag{A201}$$

$$\text{US Hours Growth in Services Sector} = 100(\hat{L}_{serv,t} - \hat{L}_{serv,t-1}) + e_t^{L_{serv}} \tag{A202}$$

$$\text{US Hours Growth in Housing Sector} = 100(\hat{L}_{hou,t} - \hat{L}_{hou,t-1}) + e_t^{L_{hou}} \tag{A203}$$

$$\text{US GDP Deflator Inflation} = 400(\pi + \hat{\pi}_t) \tag{A204}$$

$$\text{US Consumption services Inflation} = 400(\pi + \hat{\pi}_{serv,t}) + e_t^{\pi_{serv}} \tag{A205}$$

$$\text{US Housing Inflation} = 400(\pi_{hou}^{obs} + \pi + \hat{\pi}_{hou,t}) + e_t^{\pi_{hou}} \tag{A206}$$

$$\text{US Import Inflation} = 400(\pi + \hat{\pi}_{F,t}) + e_t^{\pi_F} \tag{A207}$$

$$\text{US Policy Rate} = 400(R + \hat{R}_t) \tag{A208}$$

$$\text{US Ten Year Rate} = 400(R_L + \hat{R}_{L,t}) \tag{A209}$$

$$\text{US Spread} = 400(S + \hat{S}_t) \tag{A210}$$

$$\text{US Net Worth Growth} = 100(\hat{NW}_t - \hat{NW}_{t-1} + \hat{\pi}_t) + e_t^{NW} \tag{A211}$$

$$\text{US Short Public Debt to GDP} = 100\left(\frac{b_S}{y} + \hat{b}_{S,t} - \hat{y}_t\right) \tag{A212}$$

$$\text{US Long Public Debt to GDP} = 100\left(\frac{q_L b_L}{y} + \hat{q}_{L,t} + \hat{b}_{L,t} - \hat{y}_t\right) \tag{A213}$$

$$\text{ROW GDP Growth} = 100(\hat{y}_t^* - \hat{y}_{t-1}^*) + e_t^{gdp^*} \tag{A218}$$

$$\text{ROW Consumption Goods Growth} = 100(\hat{c}_{goods,t}^* - \hat{c}_{goods,t-1}^*) + e_t^{c_{good}^*} \tag{A219}$$

$$\text{ROW Consumption Services Growth} = 100(\hat{c}_{serv,t}^* - \hat{c}_{serv,t-1}^*) + e_t^{c_{serv}^*} \tag{A220}$$

$$\text{ROW Business Investment Growth} = 100(\hat{I}_t^* - \hat{I}_{t-1}^*) + e_t^{Inv^*} \tag{A221}$$

$$\text{ROW Residential Investment Growth} = 100(\hat{HI}_t^* - \hat{HI}_{t-1}^*) + e_t^{ResInv^*} \tag{A222}$$

$$\text{ROW Government Growth} = 100(\hat{g}_t^* - \hat{g}_{t-1}^*) + e_t^{gov^*} \tag{A223}$$

$$\text{ROW Wage Inflation in Goods Sector} = 400(\pi_{w,goods}^* + \hat{\pi}_{w,goods,t}^*) + e_t^{w^*,goods} \tag{A224}$$

$$\text{ROW Wage Inflation in Service Sector} = 400(\pi_{w,serv}^* + \hat{\pi}_{w,serv,t}^*) + e_t^{w^*,serv} \tag{A225}$$

$$\text{ROW Wage Inflation in Housing Sector} = 400(\pi_{w,hou}^* + \hat{\pi}_{w,hou,t}^*) + e_t^{w^*,hou} \tag{A226}$$

$$\text{ROW Hours Growth in Goods Sector} = 100(\hat{L}_{goods,t}^* - \hat{L}_{goods,t-1}^*) + e_t^{L_{good}^*} \tag{A227}$$

$$\text{ROW Hours Growth in Services Sector} = 100(\hat{L}_{serv,t}^* - \hat{L}_{serv,t-1}^*) + e_t^{L_{serv}^*} \tag{A228}$$

$$\text{ROW Hours Growth in Housing Sector} = 100(\hat{L}_{hou,t}^* - \hat{L}_{hou,t-1}^*) + e_t^{L_{hou}^*} \tag{A229}$$

$$\text{ROW GDP Deflator Inflation} = 400(\pi^* + \hat{\pi}_t^*) \tag{A230}$$

$$\text{ROW Consumption services Inflation} = 400(\pi^* + \hat{\pi}_{serv,t}^*) + e_t^{\pi_{serv}^*} \tag{A231}$$

$$\text{ROW Housing Inflation} = 400(\pi_{hou}^{obs} + \pi^* + \hat{\pi}_{hou,t}^*) + e_t^{\pi_{hou}^*} \tag{A232}$$

$$\text{ROW Import Inflation} = 400(\pi^* + \hat{\pi}_{F,t}^*) + e_t^{\pi_F^*} \tag{A233}$$

$$\text{ROW Policy Rate} = 400(R^* + \hat{R}_t^*) \tag{A234}$$

$$\text{ROW Ten Year Rate} = 400(R_L^* + \hat{R}_{L,t}^*) \tag{A235}$$

$$\text{ROW Spread} = 400(S^* + \hat{S}_t^*) \tag{A236}$$

$$\text{ROW Net Worth Growth} = 100(\hat{NW}_t^* - \hat{NW}_{t-1}^* + \hat{\pi}_t^*) + e_t^{NW^*} \tag{A237}$$

$$\text{ROW Short Public Debt to GDP} = 100\left(\frac{b_S^*}{y^*} + \hat{b}_{S,t}^* - \hat{y}_t^*\right) \tag{A238}$$

$$\text{ROW Long Public Debt to GDP} = 100\left(\frac{q_L^* b_L^*}{y^*} + \hat{q}_{L,t}^* + \hat{b}_{L,t}^* - \hat{y}_t^*\right) \tag{A239}$$

$$\tag{A240}$$

$$\text{US Short Public Debt to ROW GDP in ROW} = 100\left(\frac{b^*_{F,S}}{y^*} + \hat{b}^*_{F,S,t} - \hat{y}^*_t\right) + e_t^{Bond_1} \tag{A241}$$

$$\text{US Long Public Debt to ROW GDP in ROW} = 100\left(\frac{q_L b^*_{F,L}}{y^*} + \hat{q}_{L,t} + \hat{b}^*_{F,L,t} - \hat{y}^*_t\right) + e_t^{Bond_2} \tag{A242}$$

$$\text{ROW Short Public Debt to US GDP in US} = 100\left(\frac{b_{F,S}}{y} + \hat{b}_{F,S,t} - \hat{y}_t\right) + e_t^{Bond_3} \tag{A243}$$

$$\text{ROW Long Public Debt to US GDP in US} = 100\left(\frac{q^*_L b_{F,L}}{y} + \hat{q}^*_{L,t} + \hat{b}_{F,L,t} - \hat{y}_t\right) + e_t^{Bond_4} \tag{A244}$$

$$\text{Oil Price Inflation} = 100(\pi_{oil} + \hat{\pi}_{oil,t}) \tag{A245}$$

$$\text{Oil Inventory Trend} = 100(\hat{Oil}_{inv}) + e_t^{oil_{inv}} \tag{A246}$$

$$\text{OPEC+ Oil Supply Trend} = 100(\hat{Oil}_{supply,dom}) + e_t^{oil_{dom}} \tag{A247}$$

$$\text{Non-OPEC+ Oil Supply Trend} = 100(\hat{Oil}_{supply,fringe}) + e_t^{oil_{fringe}} \tag{A248}$$

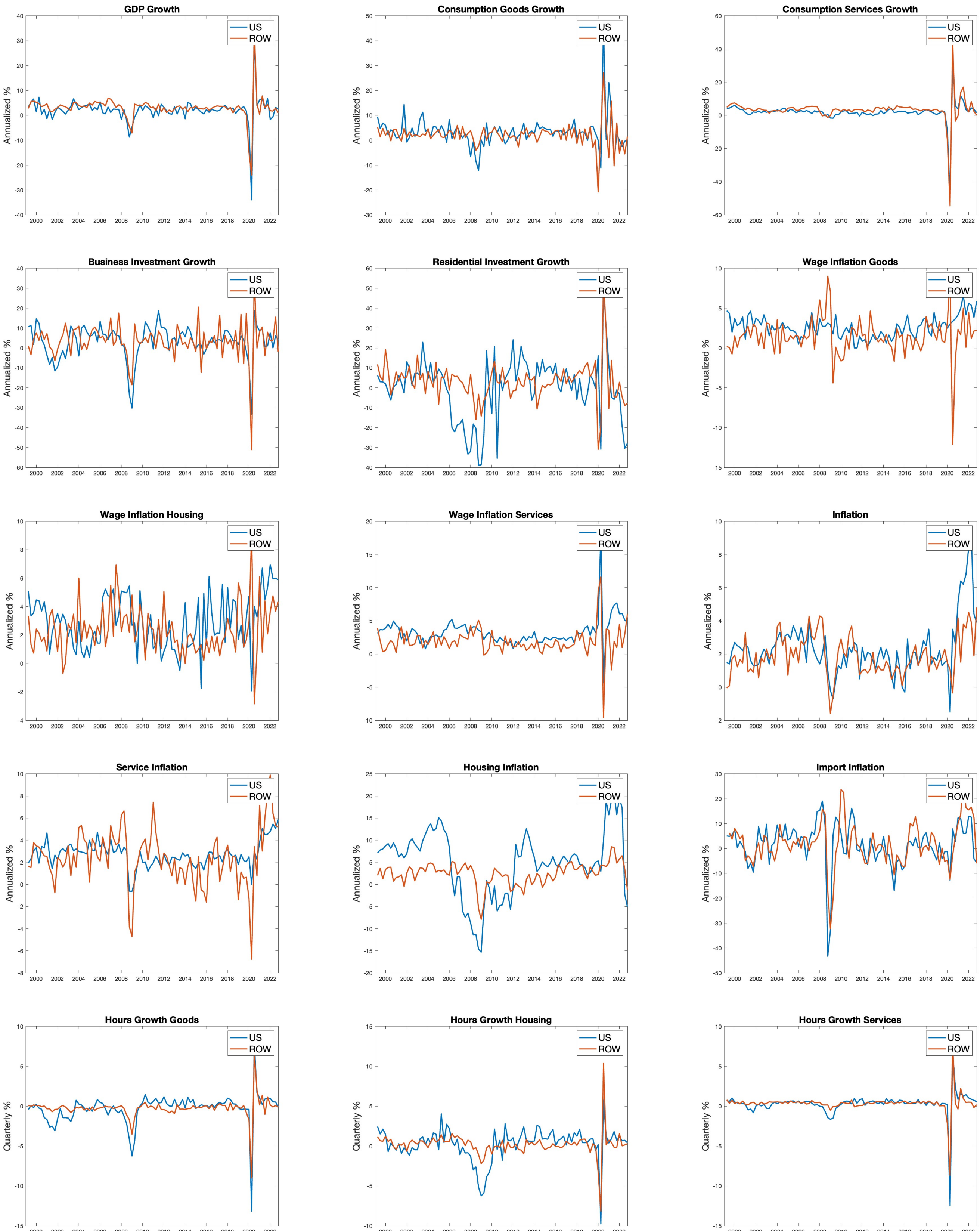
$$\text{US Policy Rate}^{Exp}_{t,t+1} = 400R + \Lambda_R G(\theta)^1 S_t \tag{A249}$$

$$\vdots \tag{A250}$$

$$\text{US Policy Rate}^{Exp}_{t,t+5} = 400R + \Lambda_R G(\theta)^5 S_t \tag{A251}$$

where US Policy $\text{Rate}^{Exp}_{t,t+k}$ is the market's time t expectations for the policy rate k quarters ahead and Λ_R is the row of Λ corresponding to the policy rate, $G(\theta)$ is the transitional matrix of the DSGE model and S_t is the state vector of the state-space model.

Figure A1: Data Series



Policy Rate
Annualized %
US
ROW
Long-term Rate
Annualized %
US
ROW
Risk Spread
Annualized %
US
ROW
Networth Growth
Quarterly %
US
ROW
Short-term Bond Supply
% of GDP (annual)
US
ROW
Long-term Bond Supply
% of GDP (annual)
US
ROW
US Currency Depreciation ($)
Quarterly Growth
Govt Growth
Annualized %
US
ROW
International Bond Holdings
% of GDP (annual)
$b_{F,S}/y$
$b^*_{F,S}/y^*$
$q^*_L b_{F,L}/y$
$q_L b^*_{F,L}/y^*$
Oil Supply Trend
% Deviation
OPEC+
Fringe
Oil Price
% Change
Oil Inventory Trend
% Deviation
US Cons and Labor Trend
% Deviation
Cons
Labor
US Import Growth
Y-o-Y %

A2.1 Additional Calibrated Parameters

In addition to the calibrated parameters discussed in Section 3.2, I also calibrate certain parameters around the financial accelerator, portfolio share and DOP economy. Following Chen et al. (2012), the parameter for the coupon payments of long-term bonds, (κ), is calibrated to imply a duration of 30 quarters for both regions, similar to the average duration in the secondary market for 10-year US Treasury bonds. The model's steady state default rate (F) is set to 0.0075 which corresponds to Bernanke, Gertler, Gilchrist (1999) annualized default rate of 3%. The quarterly survival rate of entrepreneurs is fixed at 0.985 which corresponds to an average entrepreneur life of roughly 12 years and the steady state loan to deposit ratio is set to 0.9 for both regions.

To calibrate the portfolio share parameters for the US and the ROW, I combine the supply of short and long-term bonds in each economy, as well as data on foreign bond holdings provided by the Treasury International Capital (TIC) database of the US Treasury. For the US the short and long-term government bonds outstanding[4] relative to annual GDP are 0.202 and 0.366, respectively, over the 1999-2019 period. The corresponding government short and long-term bond supply-to-GDP ratios for the ROW economy are given by 0.254 and 0.529, when the sample of countries used to construct the ROW measure for our estimation is calculated. For bond holdings, TIC data indicates that the foreign private holdings of short and long-term US Treasuries, as a ratio to world GDP excluding the US, are given by 0.02 and 0.068, respectively, for the 1999-2019 period. TIC data also shows that US residents' holdings of short and long-term foreign government bonds, as a ratio to US GDP, are given by 0.005 and 0.030. These represent our targets for the foreign holdings of each bond.

The differences in the bond supplies and international bond holdings can then be used to construct data targets for domestic holdings of these bonds. The bond holding ratios can then be used to calibrate the portfolio share parameters in the CES aggregates. As a result, the implied share of short-term bonds in the US portfolio, (γ_a), is 0.386, while the implied shares of domestic bonds in the US short and long-term portfolios, (γ_S) and (γ_L), are 0.97 and 0.888. For the ROW portfolio, the share of short-term bonds, (γ_a^*), is calculated to equal

[4]Short and long-term bonds held by the Federal Reserve are subtracted and the monetary base is added to the short-term bond supply amount.

0.318, while the implied shares of domestic bonds in their short and long-term portfolios, (γ_S^*) and (γ_L^*), are 0.926 and 0.883.

Table A3: Calibrated Parameters and Steady-states

Description	Symbols	US	ROW
Discount rate	β, β^*	0.9857	0.9857
Depreciation rate of Business Capital	τ, τ^*	0.025	0.025
Depreciation rate of Housing stock	τ_h, τ_h^*	0.01	0.01
Coupon rate for long-term bonds	κ, κ^*	0.9773	0.9773
Central bank policy-FX response	r_d, r_d^*	0	est
Anticipated monetary policy shock variance	$\sigma_{ant,k}$	$\sigma_r/5$	-
Capital share of goods production	α_K, α_K^*	0.35	0.35
Factor share of Intermed Goods in Goods sector	$\alpha_{M,goods}$, $\alpha_{M,goods}^*$	0.25	0.25
Factor share of Oil in Goods sector	$\alpha_{O,goods}$, $\alpha_{O,goods}^*$	0.06	0.06
Factor share of Oil in Services sector	$\alpha_{O,serv}$, $\alpha_{O,serv}^*$	0.014	0.014
Factor share of Intermed Services in Services sector	$\alpha_{M,serv}$, $\alpha_{M,serv}^*$	0.1	0.1
Factor share of Intermed Goods in Services sector	$\alpha_{M,goods,serv}$, $\alpha_{M,goods,serv}^*$	0.1	0.1
Factor Share of Land in Housing sector	α_{land}, α_{land}^*	0.4	0.4
Elasticity of substitution in Goods factor inputs	τ_{goods}, τ_{goods}^*	.225	.492
Elasticity of substitution in Services factor inputs	τ_{serv}, τ_{serv}^*	.225	.492
Elasticity of substitution in Housing factor inputs	τ_{hou}, τ_{hou}^*	1	1
Degree of markup in sector	$\theta_{\{w,H,F\}}$	1.25	1.25
Loan to deposit steady-state ratio	ldr, ldr^*	0.9	0.9
Survival rate of entrepreneur	γ, γ^*	0.985	0.985
Loan default rate	F, F^*	0.0075	0.0075
Portfolio share-Short vs Long	γ_a, γ_a^*	0.386	0.318
Portfolio share-Short-Domestic vs Foreign	γ_S, γ_S^*	0.970	0.926
Portfolio share-Long-Domestic vs Foreign	γ_L, γ_L^*	0.888	0.883
Home Goods share-Consumption	γ_c, γ_c^*	0.837	0.91
Home Goods share-Investment	γ_I, γ_I^*	0.837	0.91
Home Goods share-intermediate	γ_{int}, γ_{int}^*	0.837	0.91
Intermediate share-Goods vs Services	$\gamma_{int,goods}$, $\gamma_{int,goods}^*$	0.9	0.9
Steady-state inflation	π, π^*	1.005	1.005
Steady-state nominal interest rate	R, R^*	1.011	1.011
Steady-state long-term nominal interest rate	R_L, R_L^*	1.011	1.011
Steady-state interest rate spread	S, S^*	1.00575	1.00575

Table A4: Steady-state Ratios

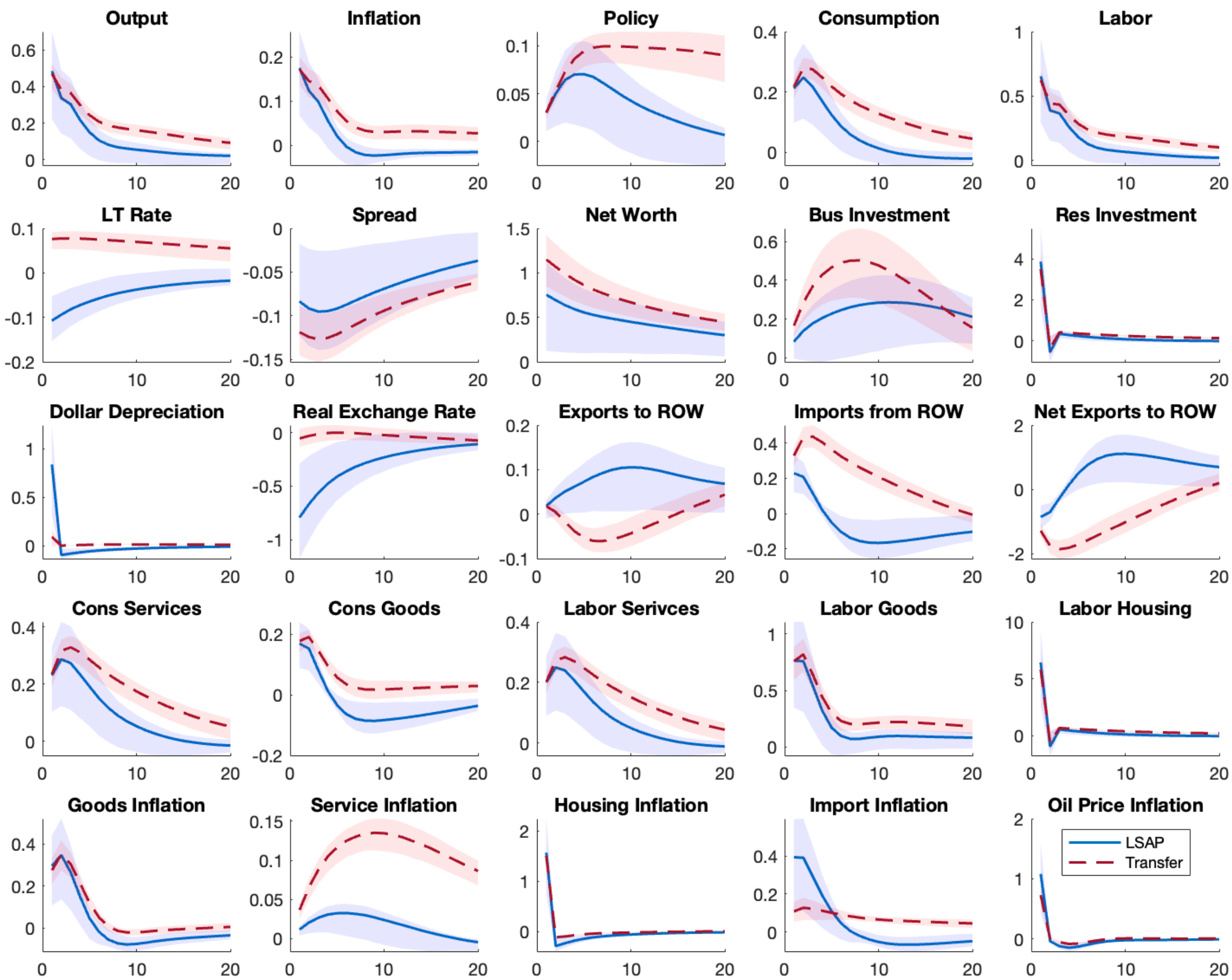
Description	Symbols	US	ROW
Relative size	$y/y^{*}, y^{*}/y$	0.54	1.85
Relative size ratio	n, $(1-n)$	0.35	0.65
Consumption to output	c/y, c^{*}/y^{*}	0.633	0.500
Consumption Services to output	c_{serv}/y, c^{*}_{serv}/y^{*}	0.45	0.294
Share of total Services to output	γ_{serv}, γ^{*}_{serv}	0.59	0.46
Consumption Services to consumption	$\gamma_{serv,c}$, $\gamma^{*}_{serv,c}$	0.709	0.588
Business Investment to output	I/y, I^{*}/y^{*}	0.127	0.207
Residential Investment to output	Δ_{hou}, Δ^{*}_{hou}	0.039	0.058
Government Expenditures to output	g/y, g^{*}/y^{*}	0.20	0.235
Government Goods Expenditure share	g_{goods}, g^{*}_{goods}	0.3	0.3
Tax to output	tax/y, tax^{*}/y^{*}	0.216	0.254
Exports to output	y^{*}_{F}/y, y_{F}/y^{*}	0.119	0.067
Imports to output	y_{F}/y, y^{*}_{F}/y^{*}	0.124	0.064
DOP Exports to output	dom/y, dom/y^{*}	.01	.005
Short-bond supply to GDP (annual)	b_{S}/y, b^{*}_{S}/y^{*}	0.202	0.254
Long-bond supply to GDP (annual)	b_{L}/y, b^{*}_{L}/y^{*}	0.366	0.523
Short-Home bond holdings to GDP (annual)	$b_{H,S}/y$, $b^{*}_{H,S}/y^{*}$	0.165	0.251
Long-Home bond holdings to GDP (annual)	$b_{H,L}/y$, $b^{*}_{H,L}/y^{*}$	0.240	0.513
Short-Foreign bond holdings to GDP (annual)	$b_{F,S}/y$, $b^{*}_{F,S}/y^{*}$	0.005	0.020
Long-Foreign bond holdings to GDP (annual)	$b_{F,L}/y$, $b^{*}_{F,L}/y^{*}$	0.030	0.068
Oil to output	$\frac{Oil_{goods}+Oil_{serv}}{y}$, $\frac{Oil^{*}_{goods}+Oil^{*}_{serv}}{y*}$	0.031	0.035
Goods oil ratio	$\frac{Oil_{goods}}{Oil_{d}}$, $\frac{Oil^{*}_{goods}}{Oil_{d}}$	0.232	0.557
Services oil ratio	$\frac{Oil_{serv}}{Oil_{d}}$, $\frac{Oil^{*}_{serv}}{Oil_{d}}$	0.086	0.124
Oil Inventory to oil demand	$\frac{Oil_{inv}}{Oil_{d}}$	0.33	-

Table A5: DOP Calibrated Parameters

Description	Symbol	DOP
Discount rate	β_{dom}	0.9857
CRRA Labor	$\nu_{l,dom}$	1.5
Oil Machines of oil production	$\alpha_{X,dom}$	0.115
Labor share of oil production	$\alpha_{L,Oil,dom}$	0.115
Share of total Services to output	γ_{dom}	0.5
Elasticity: DOP-Foreign Consumption	$\lambda_{c,dom}$	0.8
Elasticity: DOP-Foreign Oil Machines	$\lambda_{X,dom}$	0.8
Elasticity: DOP Goods-DOP Services	$\lambda_{type,dom}$	0.44
Service price indexation	$\iota_{serv,dom}$	0.3
DOP Services price Adj Cost	$\kappa^{est}_{serv,dom}$	0.8
Taylor rule: Persistence	ρ_{dom}	0.85
Taylor rule: Inflation	$\rho_{\pi,dom}$	1.5
Taylor rule: Output Gap	$\rho_{y,dom}$	0.2
Taylor rule: NER	$\rho_{d,dom}$	0.02
Exchange Rate Pass through to DOP	χ_d	0.015
Oil Supply share	$\frac{Oil_{supply,dom}}{Oil_s}$	0.516

A3 Additional Figures

Figure A2: LSAP and Tax/Transfer Shocks



Notes: The dashed blue line plots the response of an LSAP shock equivalent to a long-term asset purchase of 1.5% of steady state GDP by the central bank The dashed red line plots the response of a negative Tax shock that is calibrated to match the same output respone generated by the LSAP shock. All responses plot the % deviation away from each variable's respected steady state value on the y-axis. All interest rate and inflation rates are annualized.

The impulse responses of LSAP and transfer shocks that can be seen in Figure A2 reveal both shared and distinct macroeconomic effects. While both shocks stimulate output, inflation, and labor demand their transmission mechanisms differ notably in the trade sector. The LSAP shock, by altering the composition of domestic and international bond holdings, triggers a rebalancing of global portfolios, which in turn has a pronounced effect on the exchange rate, evident in the stronger dollar depreciation and real exchange rate movements.

This reflects the role of LSAPs in influencing term spreads and uncovered interest parity (UIP) conditions both long and short. In contrast, the transfer shock operates primarily as a domestic demand stimulus, boosting consumption and labor without significantly disturbing international bond flows. As a result, its impact on the exchange rate is comparatively muted. We see that the financial market channels are more present in LSAP transmission, especially in open economies, while transfer shocks remain more contained within domestic demand dynamics.