Shopping Time and Frictional Goods Markets: Implications for the New-Keynesian Model

Konstantin Gantert

Tilburg University
Department of Economics
Warandelaan 2, NL-5037 AB Tilburg

July 11, 2025

Abstract

This paper extends the canonical New-Keynesian (NK) model by incorporating costly household search effort and imperfect matching in goods markets, motivated by the observed procyclical behavior of shopping time and capacity underutilization. This structure endogenizes both the price elasticity of demand and capacity utilization. In steady state, search-and-matching (SaM) frictions lower long-run and potential output by increasing markups and generating idle productive capacity. In the dynamic model, search prices act as an additional inflationary term in the Euler equation, reducing its slope by up to 91 %, while capacity-driven productivity effects steepen the Phillips curve by 15 %. The resulting five-equation NK-SaM system nests the standard NK model and features endogenous real rigidities and cost-push forces. Simulations show that monetary policy becomes less effective, TFP shocks generate more RBC-like dynamics, and inflation and output responses are amplified or dampened depending on the relative convexity of search and labor effort. While the model can match a countercyclical labor wedge under certain calibrations, this comes with a trade-off against fitting procyclical efficiency dynamics.

Keywords: Goods Market Search Frictions, Endogenous Price Elasticity, Capacity Utilization, Flat Euler Equation, Search-Augmented Phillips Curve, Search-Driven Cost-Push Shocks

JEL: E21, E22, E31, E32, E52

Email address: k.gantert@tilburguniversity.edu (Konstantin Gantert)

1. Introduction

The New-Keynesian (NK) model is the cornerstone of modern monetary economics analyzing the relationship between price setting, monetary policy, and the business cycle. It builds heavily on the assumptions of sticky prices and monopolistic competition. However, households seem surprisingly passive following their consumption demand schedule effortlessly. While prices might be set inefficiently over the business cycle, trading on the goods market is seamless and efficient. This is contrary to the data.

According to the "American Time-Use Survey", time spent shopping - research, wait time, travel time, and the purchase process - on any given day takes up to 41 minutes, which is between 15% and 30% of time spent on home production. As Petrosky-Nadeau et al. (2016) show, shopping time increases both with individual and aggregate income. This procyclical pattern indicates that shopping for additional quantity dominates shopping for better prices as a motive of search. Shopping time varies significantly over the business cycle, both across individuals and in aggregate. The aggregate income elasticity of shopping time is estimated between 1.1 and 1.6 and can be as large as 4 for high income individuals.

While procyclical shopping time is a salient feature of the data, it is a-priori not clear whether it is a complement or substitute to supply side inputs in creating trades on the goods market. Data on different goods market variables hints at shopping time being at least a weak substitute. An income elasticity of shopping effort above one excludes perfect complements. Procyclical U.S. industry capacity utilization with a mean rate of 84% and a quarterly standard deviation of 1.54% further supports this pattern. Data on consumer durables with a 9% stockout rate (Khan and Thomas (2007)), procyclical advertising expenses up to 6% of U.S. GDP (Hall (2012)), and a countercyclical inventory-sales ratio (Den Haan and Sun (2024)) all point in the same direction: An increase of shopping effort over the business cycle leads to an increase in trades given a fixed supply.

Everyday examples foster intuition: a table at a restaurant may sit empty while diners queue, reflecting peak demand contrasts with underutilization during off-peak hours. A bakery might sell out of bread in the morning but face unsold inventory later. Car dealerships illustrate mismatches as buyers wait months for custom orders while used car prices soar due to shortages. Firms also sift through numerous supplier proposals before selecting one. In light of the procyclical patterns of shopping time and utilization in the data, I ask the following *research question*:

> *How does costly shopping effort and imperfect goods market matching influence time-allocation of households over the business cycle and thus the supply and demand channels of the New-Keynesian (NK) model?*

This paper builds on three strands of literature – NK-DSGE models, home production, and search-and-matching (SaM) on the goods market. First, the NK-DSGE literature focuses on explaining business cycle fluctuations in inflation and output through a dynamic IS equation and a NK Phillips curve (Yun (1996); Gali (2015)). Aggregate demand and supply are driven by inertia in price setting in a monopolistic competitive goods market environment. The framework is extended by sticky wages (Erceg et al. (2000)) and a notion of unemployment (Gali (2011)) to include unemployment in a tractable way. Medium-sized models (Christiano et al. (2005, 2010)) add bells and whistles to match the data and give a more realistic account of business cycle fluctuations.

Second, the home production literature models consumption as a combination of a good and time spent (Becker (1965)). These models feature an intratemporal trade-off between market and home work as time has an alternative productive use (Benhabib et al. (1991); Greenwood and Hercowitz (1991)). This channel relying on the substitutability of market and home consumption is shown to improve the likelihood of the model explaining U.S. data (McGrattan et al. (1997)). Combined with price setting inertia, the home production channel leads to a steeper dynamic IS curve and a flatter NK Phillips curve amplifying both inflation and output variation (Lester (2014); Safonova (2017); Gnocchi et al. (2016)).

And third, the goods market SaM literature focuses on the interaction of search costs and prices. Seminal work highlights how search costs influence price setting (Diamond (1971, 1982); Burdett and Judd (1983)) and how they interact with price adjustment costs (Benabou (1988, 1992)) in determining competition on the goods market. The price search literature is extended to recent DSGE models that incorporate costly search effort (e.g. Head et al. (2012); Kaplan and Menzio (2016)). More recent contributions focus on the search for additional goods based on the findings of Petrosky-Nadeau et al. (2016). Costly search is an input to a matching function resulting in additional trades of the same varieties or of trades in additional varieties. Goods market SaM is shown to impact labor market outcomes (Michaillat and Saez (2015); Petrosky-Nadeau and Wasmer (2015); Petrosky-Nadeau et al. (2021)), change the determinants of the business cycle (Bai et al. (2024)), create procyclical labor productivity following monetary policy shocks (Qiu and Rios-Rull (2022)), and drive the inventory-sales ratio in a reduced-form approach (Den Haan and Sun (2024)). The literature on customer capital (Gourio and Rudanko (2014); Paciello et al. (2019)) is related as trading arrangements have an asset value, but differs as it focusses on internal firm dynamics instead of household search. The recent literature on spatial Hotelling models (Schmitt-Grohé and Uribe (2025)) is close to this paper as it also introduces a second price margin of consumption but does not feature market feedback effects through capacity utilization.

I contribute to the literature by introducing goods market SaM to a small-scale NK model with home production. This framework is a natural starting point as shopping time is otherwise allocated to home production where it acts as a substitute for market goods. However, as shown by Petrosky-Nadeau et al. (2016), shopping time increases with income. In this framework, shopping time acts as an input to goods market matching but does not perfectly substitute for market production which plays a double role - matching input and goods supply. The impact of shopping time on output depends on goods market tightness and prices. I contribute to the literature by modeling the search effort and matching processes in detail separating search cost and productivity. Their variation depends on the interplay of sticky prices, search cost convexity, and the goods market structure. I analyze its impact on the dynamic IS and NK Phillips curves highlighting its role in explaining inflation and output fluctuations.

I find that the NK model with goods market SaM (NK-SaM) nests the benchmark NK model (see e.g. Erceg et al. (2000)), linking the *capacity utilization* and *price elasticity of demand channels* to inflation and the output gap. The model predicts a decrease in real

GDP in the long-run driven by idle capacity and a lower price elasticity of demand increasing price markups. Capacity utilization and the price elasticity are endogenous and influenced by firm market power and goods market frictions. The price elasticity of demand increases in search costs changing aggregate demand. It is amplified by variation in capacity utilization – a feedback channel of search effort to its costs. The NK Phillips curve slope depends on the endogenous variation in the price elasticity of demand. I find an increase in its slope by 15% making price setting more flexible compared to the benchmark model. The Euler equation slope is flatter by up to 91% as search prices act as an additional inflationary term working through the price elasticity of demand. Monetary policy affects aggregate demand less as search costs are only indirectly affected nominal interest rates.
Simulating the model for various business cycle shocks, I find that the output gap varies less in the NK-SaM model and monetary policy is less effective in steering aggregate demand. The NK-SaM model looks more like a RBC model while matching the empirical Phillips curve slope. Capacity utilization and the price elasticity of demand are endogenous objects and driven by the trade-off between flexible search prices and sticky purchase prices. Cost-push shocks arise naturally from the demand side as unobserved changes in search effort can create a recession with increasing prices. This result builds on the endogenous price elasticity of demand amplified by variation in capacity utilization.

The rest of the paper is organized as follows. Section 2 develops the model. Section 3 discusses the implications of goods market SaM on the long-run steady-state. Section 4 discusses the model dynamics through linearized first-order conditions and identifies two goods market SaM channels – *endogenous price elasticity of demand* and *endogenous capacity utilization*. Section 5 derives a reduced-form output gap version of the model to relate it to the benchmark NK model and quantify the impact of goods market SaM on the demand and supply equation slopes. Section 6 shows simulations of the model to exogenous shocks. Section 7 discusses the results in light of the literature and concludes.

2. Model Setup: Adding Search Effort and Goods Market Matching

The model is based on the canonical NK model à la Erceg et al. (2000) which also acts as the benchmark model. The main features include monopolistic competition à la Dixit and Stiglitz (1977) and price adjustment cost à la Rotemberg (1982). The novel feature of the paper is goods market search-and-matching (SaM) à la Michaillat and Saez (2015). In contrast to the literature, this paper builds on the sticky price assumption as a determinant of variable household search effort and capacity utilization over the business cycle. Household search effort on the goods market is an input in the goods market matching process. This feature follows the *dis-equilibrium optimizing framework* in an equilibrium model where goods markets can run excess demand or excess supply.

2.1. Goods Markets Setup

Households and firms meet on goods markets where costly household search effort and imperfect matching lead to excess demand or supply of goods, both in the steady-state and over the business cycle. Both states of the market are equlibrium processes, as marginal search cost are equalized to trade benefits. The goods market is segmented along a continuum $i \in (0, 1)$ of differentiated goods, $T_t(i)$, as search is directed following Moen (1997). Households exert costly search effort, $H_{S,t}(i)$, for each variety i and each firm i supplies its idle production capacity, $S_t(i)$, of its unique variety i. Each customer relationship trades one unit of one variety of the differentiated final good. Customer relationships for variety i are given by

$$T_t(i) \ = \psi_t \left[\gamma_S H_{S,t}(i)^{\Gamma_S} + (1-\gamma_S)\, S_t(i)^{\Gamma_S}\right]^{\frac{1}{\Gamma_S}} , \tag{1}$$

where $\psi_t > 0$ is the matching efficiency symmetric across all markets which fluctuates following an exogenous shock. $0 < \gamma_S \leq 1$ is a demand elasticity determining the impact of household search effort on goods market matching. $-\infty < \Gamma_S < 1$ is the matching input elasticity of substitution. Those three parameters determine the *search effort productivity* in the model. *Goods market tightness* for variety i is defined as demand relative to supply, $x_t(i) = \frac{H_{S,t}(i)}{S_t(i)}$. It is an indicator of excess demand in the economy. The probability of a household to find a final good i is given by $f_t(i) = \frac{T_t(i)}{H_{S,t}(i)}$. The probability of a firm i to sell a unit of its good is given by $q_t(i) = \frac{T_t(i)}{S_t(i)}$.

2.2. Households

There is a representative household with a continuum of members represented by the unit square and indexed by a pair $(j,k) \in [0,1] \times [0,1]$. j identifies the type of labor a household member is specialized in and k identifies the disutility of work for that household member given by $\mu_M k^{\nu_M}$ if the member is employed and zero otherwise. The representative household searches for market goods, supplies labor to market and home production, and consumes both market and home-produced goods. I follow Galí (2011) to aggregate labor disutility across employed and unemployed members of the household. The representative household maximizes their intertemporal utility

$$\mathbb{U}_t(j) \;=\; \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \Big[\frac{C_t(j)^{1-\sigma} - 1}{1-\sigma} - \frac{\mu_{S,t} H_{S,t}(j)^{1+\nu_S}}{1+\nu_S} - \frac{\mu_H H_{H,t}(j)^{1+\nu_H}}{1+\nu_H} - \frac{\mu_M H_{M,t}(j)^{1+\nu_M}}{1+\nu_M} \Big],$$

where $0 \leq \beta < 1$ and $\sigma > 0$. Each household allocates time to search effort, $H_{S,t}(j) = \int_0^1 H_{S,t}(i,j)di$, home production, $H_{H,t}(j)$, and market production participation, $H_{M,t}(j)$, where $\mu_{S,t}, \mu_H, \mu_M > 0$. $\mu_{S,t}$ varies following an exogenous shock. The inverses of their supply elasticities are given by $\nu_S, \nu_H, \nu_M \geq 0$. The disutility created by search effort constitutes a *search cost*. Households receive utility from consuming a composite good

$$C_t(j) \;=\; \left[\gamma_H C_{H,t}(j)^{\Gamma_H} + (1-\gamma_H)\, C_{M,t}(j)^{\Gamma_H}\right]^{\frac{1}{\Gamma_H}}, \tag{2}$$

where market goods, $C_{M,t}(j) = T_t(j)$, and home goods, $C_{H,t}(j) = H_{H,t}(j)$, are inputs to a CES aggregator with $0 \leq \gamma_H < 1$ and $-\infty < \Gamma_H \leq 1$. As there are infinitely many households, the variety i market goods finding probability, $f_t(i)$, is exogenous to each household. The aggreagte market composite good is determined by a Dixit and Stiglitz (1977) index

$$T_t(j) = \left(\int_0^1 T_t(i,j)^{\frac{\epsilon_t - 1}{\epsilon_t}} di \right)^{\frac{\epsilon_t}{\epsilon_t - 1}},$$

where $1 \leq \epsilon_t \leq \infty$ determines the elasticity of substitution between different varieties. It varies following an exogenous shock. The intertemporal budget constraint is given by

$$B_t(j) = (1 + r_{t-1}) B_{t-1}(j) + (1 - c_{W,t}(j)) W_t H_{M,t}(j) - \int_0^1 P_t(i) T_t(i,j) di + \Pi_{F,t}(j),$$

where $B_t(j)$ are one-period nominal bonds which pay the nominal interest rate, r_t. Labor income is given by $(1 - c_{W,t}(j)) W_t H_{M,t}(j) di$, where W_t is the nominal market wage and $c_{W,t}(j) = \frac{\kappa_W}{2} \left(\frac{W_t(j)}{W_{t-1}(j)} - \pi_W \right)^2$ are nominal wage adjustment costs with $\kappa_W \geq 0$ and steady-state nominal wage inflation, π_W. Final good expenses are given by $\int_0^1 P_t(i) T_t(i,j) di$, where $P_t(i)$ is the price for final good i. $\Pi_t(j)$ are firm dividends paid to the households by a mutual fund where each household owns an equal share.

2.3. Labor Unions

There is a labor union that aggregates specialized household labor and supplies it to each firm i. The labor union maximizes its profits according to

$$\Pi_{U,t} = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_{0,t} \left[W_t \int_0^1 H_{M,t}(i) di - W_t \int_0^1 H_{M,t}(j) dj \right],$$

where $H_{M,t}(i)$ is labor supplied to firm i, and $H_{M,t}$ is aggregate labor supplied to the labor union. It aggregates specialized household labor following Dixit and Stiglitz (1977)

$$H_{M,t} = \left(\int_0^1 H_{M,t}(j)^{\frac{\epsilon_W - 1}{\epsilon_W}} dj \right)^{\frac{\epsilon_W}{\epsilon_W - 1}},$$

where $1 \leq \epsilon_W \leq \infty$ determines the substitutability of specialized labor.

2.4. Firms

There are infinitely many firms on the unit interval. Each firm produces a unique variety of the final good and supplies its idle production capacity, $S_t(i)$, to the goods market. Each firm employs labor in a linear production capacity function, $\mathcal{Y}_{M,t}(i) = A_t H_{M,t}(i)$, where

$A_t > 0$ is an exogenous technology process. Each firm i maximizes its profits by

$$\Pi_{F,t} \;=\; \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_{0,t} \left[P_t(i) T_t(i) - W_t H_{M,t}(i) \right],$$

where $\beta_{0,t}$ is the period discount factor of the firm[1]. Idle production capacity is given by

$$\left(1 + c_{P,t}(i)\right) S_t(i) \;= \mathcal{Y}_{M,t}(i), \tag{3}$$

where $c_{P,t}(i) = \frac{\kappa_P}{2} \left(\frac{P_t(i)}{P_{t-1}(i)} - \pi \right)^2$ are proportional convex Rotemberg (1982) price adjustment costs with $\kappa_P \geq 0$ and steady-state price inflation, π. Each firm has a monopoly over its variety i of the final good. It jointly sets available production capacity (goods market tightness), $S_t(i)$ $(x_t(i))$, and the goods price, $P_t(i)$, to maximize its profits. This mechanism is similar to Sun (2024) where firms provide additional capacity to compete for buyers. Price setting is a combination of directed search by Moen (1997) and convex Rotemberg (1982) price adjustment costs. This mechanism implies managing the trade-off between its price and goods selling probability, $q_t(i)$. Additional search effort increaes *search costs* and thus decreases the price a household is willing to pay. However, additional search effort also increases the *goods selling probability* and thus decreases marginal costs. Optimal firm decisions depend on this nexus of search frictions and monopoly power.

2.5. General Equilibrium

The real gross domestic product is determined by aggregate trades of the final good, $Y_t = T_t$, which also acts as the numeraire. The central bank follows a Taylor (1993)-type rule and sets the nominal interest rate according to

$$\frac{1 + r_t}{1 + r} \;=\; \left(\frac{1 + r_{t-1}}{1 + r} \right)^{i_r} \left[\left(\frac{1 + \pi_t}{1 + \pi} \right)^{i_\pi} \left(\frac{Y_t}{Y_{N,t}} \right)^{i_{Gap}} \right]^{1 - i_r} M_t, \tag{4}$$

[1]The period discount factor of the firm is equal to the household stochastic discount factor as all firms are owned by the household mutual fund.

Table 1: Calibration Overview

Parameter	Value	Parameter	Value	Parameter	Value
β	0.99	ψ	$\bar{cu} = 0.86$	π	0
σ	1.5	γ_S	0.32	π_W	0
μ_M	$\bar{H}_M = 1$	Γ_S	0	σ_A	0.0064
μ_H	$\frac{\bar{H}_H}{\bar{H}_M} = 0.5393$	γ_H	0.55	σ_M	0.001
μ_S	$x = 1$	Γ_H	0.5	σ_P	0.1
ν_M	2	ϵ_W	$\bar{u} = 0.043$	σ_T	0.0064
ν_H	ν_M	κ_W	Slope $= -0.026$	ρ_A	0.9
ν_S	ν_M	i_R	0.8	ρ_M	0.5
ϵ	Markup $= 1.2$	i_π	1.7	ρ_P	0.8
κ_P	Slope $= 0.047$	i_{Gap}	0.12	ρ_T	0.8

NOTE: The full calibration with sources is given in Appendix C

where π is a central bank target, r is determined by the steady-state real interest rate, $Y_{N,t}$ is potential output given by the flexible price version of the model, $i_r \geq 0$ determines policy inertia, and $i_\pi, i_{Gap} \geq 0$ are policy coefficients. M_t is a monetary policy shock. All exogenous shocks follow an AR(1) process given by $X_t = X^{1-\rho_X} X_{t-1}^{\rho_X} \varepsilon_{X,t}, \quad \varepsilon_{X,t} \sim \mathcal{N}(0,\, \sigma_X^2)$ where $0 \leq \rho_X < 1$ is its autocorrelation, and $\varepsilon_{X,t}$ is a white noise random process around a normal distribution with zero mean and standard deviation σ_X.

2.6. Calibration

The model is calibrated to replicate the U.S. economy between 1984 and 2019. Time is in quarters. Common parameters follow the literature, i.e. Christiano et al. (2010) and Gnocchi et al. (2016). An overview is given in table 1.

Goods market matching efficiency, ψ, targets a steady-state capacity utilization rate of 86%, which is a weighted average of industry and service sector data. The search effort elasticity of goods market matching, γ_S, varies in the literature between 0.11 (Bai et al. (2024)) and 0.32 (Qiu and Rios-Rull (2022)). I set $\gamma_S = 0.32$ and $\Gamma_S = 0$[2] following Qiu and Rios-Rull (2022) and estimates of the companion paper Gantert (2025).

I set μ_M by normalizing the labor supply, $\bar{H}_M$, to one. μ_H is set by targeting the average time

[2]The matching function is Cobb-Douglas in most cases in the literature. Qiu and Rios-Rull (2022) explicitly estimate a CES matching function. They find a specification very close to Cobb-Douglas. For simplicity and ease of exposition, we thus assume a Cobb-Douglas goods market matching function.

use for home production relative to labor supply, $\frac{\bar{H}_H}{\bar{H}_M} = 0.5393$, as described by the American Time Use Survey (ATUS)[3]. The same approach for μ_S implies targeting $\frac{\bar{H}_S}{\bar{H}_M} = 0.1854$. However, as this implies $x = 0.1854$, goods markets would show a significant excess supply in steady-state. Alternatively, I calibrate $x = 1$[4], i.e. demand equal to supply. ν_M varies significantly in the literature, see e.g. Keane and Rogerson (2012); Chetty et al. (2013). I set $\nu_M = 2$ as an intermediate between micro and macro estimates. ν_S, varies significantly in the literature between 0 (e.g. Michaillat and Saez (2015)), close to 0 (e.g. Qiu and Rios-Rull (2022)), and approximately 5 (e.g. Bai et al. (2024)). A natural starting point[5] assumes the same supply elasticity as for labor supply, see i.e. Gnocchi et al. (2016); Huo and Rios-Rull (2020).

The steady-state unemployment rate, $\bar{u} = 4.3\%$, is targeted by choosing $\epsilon_W = \frac{(1+\bar{u})^{\nu_M}}{(1+\bar{u})^{\nu_M}-1}$. The NK wage Phillips curve (15) is determined by unemployment. $\kappa_W = (-1)\frac{(\epsilon_W-1)\nu_M}{slope_w}\frac{\bar{u}}{1+\bar{u}}$ is set by targeting an estimated slope of -0.026 (see e.g. Gali and Gambetti (2019)). The elasticity of substitution, ϵ, is set by targeting a steady-state price markup of 1.2. ϵ depends on γ_S - as shown in (6) in section 3 - as $x = 1$ in steady-state by assumption. I set the price adjustment cost parameter, κ_P, by targeting the slope of the linearized Phillips curve with the labor share as its determinant. I use a slope estimate of 0.047 following Gali and Gertler (1999).

3. Steady-State Implications of Goods Market Search-and-Matching

In the long-run equilibrium (steady-state), an increase in search prices leads to higher price markups, a lower labor allocation, and lower real GDP. This pattern results from two deviations from the benchmark model: The price elasticity of demand decreases in search

[3]Home production in a model without a separate goods market search margin also contains search time, which results in $\frac{\bar{H}_H}{\bar{H}_M} = 0.7247$ for the NK-Home Production model without goods market SaM.

[4]This calibration strategy is equivalent to using the ATUS values but setting an additional search effort technology parameter such that $x = 1$ in steady-state.

[5]Alternative values for $\frac{\nu_S}{\nu_M} \lesseqgtr 1$ will be considered throughout the paper. For instance, labor supply varies more in the extensive margin which shows lower supply elasticities, while search effort is thought of varying more in the intensive margin (see e.g. Chetty et al. (2013)). Such an economy is represented by $\nu_S < \nu_M$. Many papers in the literature follow this calibration strategy (i.e. Michaillat and Saez (2015); Qiu and Rios-Rull (2022)).

prices. And marginal productivity and capacity utilization decrease in the goods market matching efficiency. For the remainder of the paper, I assume that all firms share the same technology (and are summarized by a representative firm), and that demand is equal to supply in the steady-state, $x = 1$. The representative firm steady-state follows from optimal price setting (5), cost minimization (6), and goods market machting (7), given by

$$P_S = \frac{\phi_\epsilon}{1-\phi_\epsilon}, \tag{5}$$

$$mc = P_S \phi_\gamma^{-1} = \frac{\epsilon - 1}{\epsilon}\left(1 + \frac{\phi_\gamma}{\epsilon}\right)^{-1}, \tag{6}$$

$$q = \psi, \tag{7}$$

where $\phi_\gamma = \frac{\gamma_S}{1-\gamma_S} \geq 0$ is the search effort elasticity of available capacity. It describes the supply-side response to a 1% increase in search effort. $\phi_\epsilon = \frac{\epsilon-1}{\epsilon}\frac{\phi_\gamma}{1+\phi_\gamma} \leq 1$ is the search price elasticity of marginal costs. It describes the marginal costs response to a 1% increase in the search price – marginal search costs measured in units of the numeraire good.

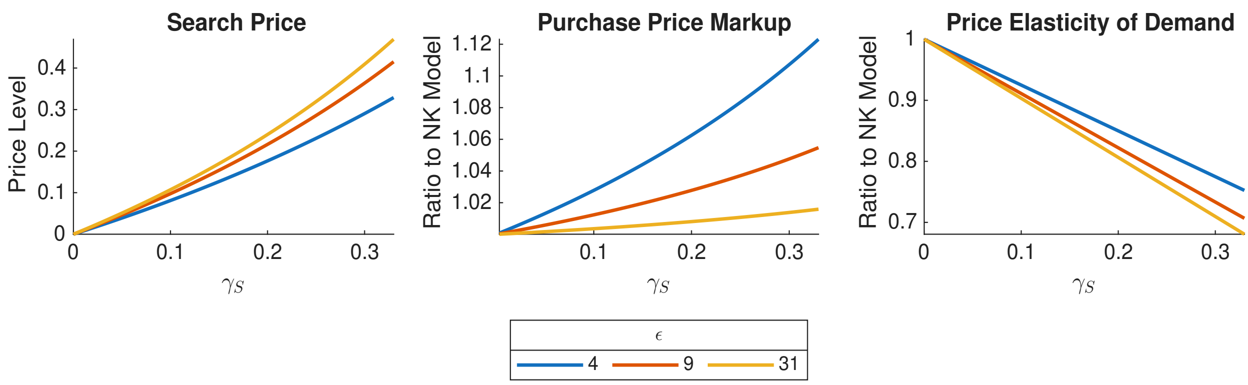
Capacity utilization, q, is set exogenously by the matching efficiency, ψ[6]. The search price, P_S, increases in ϕ_ϵ as price markups decrease in ϵ and marginal productivity of search effort increases in γ_S. Marginal costs increase in the search price but decrease in ϕ_γ. Higher search prices decrease a buyer's willingness to pay a high purchase price (markup). However, higher search effort productivity decreases the impact of the purchase price on the overall price and allows the firm to charge a higher price markup. Overall, marginal costs decrease in γ_S. This duality leads to a varying *price elasticity of demand* given by

$$\Xi = (-\epsilon)(1-\phi_\epsilon), \tag{8}$$

which increases in the elasticity of substitution of differentiated goods, ϵ, but decreases in ϕ_ϵ. Hence, given any ϵ, goods market SaM decreases the *price elasticity of demand* in γ_S as the

[6]The simple representation of steady-state capacity utilization follows from the assumption $x = 1$ in steady-state. Otherwise, goods market tightness and the structure of the goods market play a role as well. However, for Γ_S close to Cobb-Douglas, the quantitative impact is negligible.

Figure 1: Impact of γ_S and ψ on the steady-state conditional on ϵ



NOTE: The figure shows relative steady-state values of the NK-SaM model over the benchmark model for different calibrations. Search prices, P_S, are given as a real price level (consumption good as the numeraire) as they are zero in the benchmark model. Benchmark NK model and NK-SaM model are calibrated to different levels of relative home to market labor as shopping time is included in this measure for the benchmark model (see also section 2.6). This feature leads to a relative output steady-state not equal to one for $\gamma_S = 0$.

share of purchase prices in total prices decreases. This effect is greater for a higher elasticity of substitution of differentiated goods, ϵ.

Figure 1 shows how (5), (6), and (8) respond to different ϵ as we increase the search effort elasticity of matching, γ_S. Search prices increase in γ_S as search effort becomes more productive in creating matches and households shift their time to search. This effect is especially prevalent if consumption goods are easily substitutable (goods markets are highly competitive) and search is highly productive. We find search prices of 39% of the purchase price for the calibration in section 2.6. The *price elasticity of demand* relative to the benchmark model decreases in search price as γ_S increases, especially for high ϵ. It decreases up to 30%. The lower *price elasticity of demand* maps directly into higher price markups, especially if ϵ is low. Firms gain from high search effort as their capacity utilization and thus productivity increases. Having significant market power due to low ϵ, firms do not pass through a significant share of those productivity gains. This pattern leads to an increase of price markups of up to 12%. In the calibrated model, we set ϵ by targeting the price markup across models which implies an identical price elasticity of demand in steady-state across models. This approach implies a higher ϵ in the NK-SaM model, thus more competitive goods markets achieving the same level of price elasticity of demand.

The steady-state of the household is determined by marginal utility out of market consumption net of marginal search cost (9) given by

$$muc = \xi_{C_M} (1 - \phi_\epsilon) C^{-\sigma}, \tag{9}$$

where $\xi_{C_M} = \chi_{C_M} \frac{C}{C_M}$, and $\chi_{C_M} = (1 - \gamma_H) \left(\frac{C_M}{C}\right)^{\Gamma_H}$. Composite consumption, C, is given by (2) with $C_H = \left[\frac{\gamma_H}{\mu_H} C^{1-\Gamma_H}\right]^{\frac{1}{1+\nu_H - \Gamma_H}}$. Marginal utility of market consumption (9) increases in ξ_{CM} and $C^{-\sigma}$. Both elements describe the trade-off with home production. Adding goods market SaM decreases (9) in ϕ_ϵ as the search price increases. Quantitatively, (9) decreases with the *price elasticity of demand* as shown in fig. 1. However, ξ_{C_M} is higher in the NK-SaM model as shopping time is a separate margin described by ϕ_ϵ in the NK-SaM model but part of ξ_{C_M} in the benchmark model. Overall, marginal utility of market consumption is higher in the NK-SaM model with an increase of about 7% for the calibrated model.

The size of the market economy derives from *steady-state real GDP* - determined by production capacity and its utilization rate - and is given by

$$Y = C_M = q \cdot \underbrace{\left[\frac{muc}{\mu_M} \cdot \frac{\epsilon_W - 1}{\epsilon_W} \cdot q \cdot mc\right]^{\frac{1}{\nu_M}}}_{\text{Total labor allocation } (H_M)}, \tag{10}$$

where production capacity is determined by equilibrium labor supply, $\mathcal{Y}_M = H_M$. As in the benchmark model, equilibrium labor supply increases in muc as the opportunity cost of labor supply decrease, in ϵ_W as wage markup decrease, and in mc as price markups decrease. Adding goods market SaM increases labor supply as muc increases (shown in (9)) and decreases labor demand as productivity decreases in q and price markups increase in γ_S. Stedy-state output decreases as we increase the search effort elasticity of matching, γ_S, which implies lower muc as shown in (9) and lower mc as shown in (6). A lower elasticity of substitution, ϵ, implies a smaller impact on muc but a larger impact on mc. However, while a lower ϵ lowers steady-state output, its impact is symmetric across the benchmark and NK-SaM models as shown in fig. D.8. A matching efficiency, ψ, below one additionally reduces output both through lower labor productiivty and lower utilization of given production capacity. Overall, we find a decrease in real GDP of up to 33% and of 20% for the calibrated model.

Lemma 1. *Steady-state real GDP decreases in the NK-SaM model compared to the benchmark model as available production capacity decreases due to higher* ***search costs*** *(lower labor supply) and lower* ***labor productivity*** *(lower labor demand). This effect is amplified by* ***under-utilized*** *available production capacity.*

4. The Dynamics of the Trade-Off between Prices and Capacity Utilization

In the short-run, the model economy is driven by a trade-off between sticky purchase prices and flexible search prices. Firms maximize their profits by balancing prices and capacity utilization. This trade-off is determined by the behavior of the price elasticity of demand, capacity utilization, and alternative time-use in home production. In this section, we derive the (intertemporal) decision rules to highlight the impact of goods market SaM over the business cycle. The model is linearized around its deterministic steady-state. Variables with a hat indicate percentage (point) deviations[7] from steady-state, e.g. $\hat{x}_t$. Detailed derivations can be found in Appendix A.

4.1. Search and Utilization in Goods Markets

Search Prices. Firms target an optimal search price of households[8] – marginal search disutility of matching one good denominated in the numeraire good – by setting goods supply and purchase prices in a trade-off between marginal costs and capacity utilization to maximize their profits. The *search price* is given by

$$\boldsymbol{\hat{P}_{S,t}} = \epsilon \cdot \boldsymbol{\hat{mc}_t} + \frac{\Gamma_S}{1-\phi_\epsilon} \frac{1+\phi_\gamma}{\psi \phi_\gamma} \left(\boldsymbol{\hat{q}_t} - \boldsymbol{\hat{\psi}_t} \right) - (1+\phi_\gamma) \boldsymbol{\hat{\epsilon}_t}, \tag{11}$$

[7]Variables that are given in levels in the non-linear model are approximated by percentage deviations from steady-state and variables given in percent in the non-linear model are approximated by percentage point deviations from steady-state.

[8]Firms target a constrained optimal equilibrium on the goods market with fixed shares of search effort and goods supply due to the CES matching function and directed search following Moen (1997).

where $\hat{x}_t = \hat{q}_t - \hat{\psi}_t$. The search price increases in marginal costs as the price markup decreases. If demand is more price elastic – ϵ is high – households respond to lower price markups by increasing their search effort (thus the search price) more. If matching inputs are complements, $\Gamma_S < 0$, excess search effort is not (as) productive. Households respond by lowering search effort in tight goods markets to reduce unproductive search effort (thus search prices). An exogenous increase in the elasticity of substitution, $\boldsymbol{\hat{\epsilon}_t}$, decreases search price variation as marginal costs pass-through is higher and there is less scope for search prices to react to sticky purchase prices. The *price elasticity of demand* is given by

$$\boldsymbol{\hat{\Xi}_t} \; = \; -\, \phi_\epsilon \boldsymbol{\hat{P}_{S,t}} + \boldsymbol{\hat{\epsilon}_t}, \tag{12}$$

which increases in the elasticity of substitution, $\hat{\epsilon}_t$, and decreases in search prices as households respond less to purchase price changes if they make up a smaller share of the total price. Its slope is determined by the search price elasticity of marginal costs, ϕ_ϵ – it increases in γ_S and ϵ[9]. A change in marginal costs induces stronger variation in search prices if search effort is more productive or goods markets are more competitive (the pass-through to purchase prices is higher).

Capacity Utilization. Frictional goods markets require search effort and goods supply to form matches. It follows that *capacity utilization* is given by

$$\boldsymbol{\hat{q}_t} \; = \frac{\psi\phi_\gamma}{1+\nu_S} \underbrace{\left[(1-\phi_\epsilon)\,\boldsymbol{\hat{P}_{S,t}} - (\nu_S + \phi_C)\,\boldsymbol{\hat{Y}_t} - \boldsymbol{\hat{\mu}_{S,t}}\right]}_{\text{Search Effort}} + (1+\phi_\gamma)\,\boldsymbol{\hat{\psi}_t}, \tag{13}$$

which increases in search effort and matching efficiency, $\hat{\psi}_t$. A marginal increase in search prices implies a stronger increase in search effort if the search price elasticity of marginal costs, ϕ_ϵ, is low. Further, the implicit search effort in search prices decreases in ν_S as disutility of search convexity increases. Marginal search disutility increases as output expands. Both effects lead to a lower impact of search prices on capacity utilization. The trade-off in

[9] Variation in the *price elasticity of demand* does not vanish for perfectly substitutable goods, $\epsilon \to \infty$. In fact, its variation in $\hat{P}_{S,t}$ increases as ϕ_ϵ increases in ϵ.

time allocation creates a similar channel through home production and market consumption income effects summarized by $\phi_C = (1-\Gamma_H) - (1-\Gamma_H-\sigma)\left[1 - \frac{1-\Gamma_H}{1+\nu_H-\Gamma_H}(1-\chi_{C_M})\right]^{-1}\chi_{C_M}$. Capacity utilization increases less in light of home production as output increases. The overall impact of search effort on capacity utilization increases in ϕ_γ as the productivity of search effort increases.

Lemma 2. *Fluctuations in capacity utilization are driven by a trade-off between search prices and price markups summarized by the* ***price elasticity channel*** (12) *and the* ***capacity utilization channel*** (13). *High search prices imply high capacity utilization but require low price markups. Variation in capacity utilization is strictly increasing in the substitutability of matching inputs,* Γ_S, *as shown by* (11).

4.2. Price and Wage Setting in Light of Search Prices

Optimal Price Setting. The *centerpiece of the model* in the paper is the trade-off between flexible search prices and sticky purchase prices. It is summarized by the *NK Phillips curve* given by

$$\boldsymbol{\hat{\pi}_t} \;=\frac{1+\phi_\gamma}{\kappa_P}\left[\epsilon\left(1-\phi_\epsilon\right)\boldsymbol{\hat{mc}_t}+\frac{\Gamma_S}{\psi}\left(\boldsymbol{\hat{q}_t}-\boldsymbol{\hat{\psi}_t}\right)-\frac{\boldsymbol{\hat{\epsilon}_t}}{\epsilon-1}\right]+\beta\mathbb{E}_t\boldsymbol{\hat{\pi}_{t+1}}, \tag{14}$$

where inflation increases in marginal costs[10] - thus in search prices as shown by (11), decreases in goods market tightness if $\Gamma_S < 0$, and decreases in $\hat{\epsilon}_t$ as goods markets are more competitive. Price setting is sluggish due to price adjustment cost, κ_P, and forward-looking.

As in the benchmark model, the pass-through of marginal costs to purchase prices increase in the *price elasticity of demand.* Higher competition requires stronger price adjustments as demand for a single firm would otherwise explode leading to exploding marginal costs. Adding goods market SaM decreases the *price elasticity of demand* in ϕ_ϵ as shown by (8) which decreases the pass-through of marginal costs to purchase prices. In contrast, the pass-through

[10] Marginal costs determine the labor share, $\hat{ls}_t = \hat{mc}_t$, as in the benchmark model. We use this equivalence to match the slope of the labor share Phillips curve to estimates in the literature (i.e. Gali and Gertler (1999); Sbordone (2002)). The estimate is potentially biased by goods market tightness. However, as long as Γ_S is close to Cobb-Douglas, the bias is quantitatively small.

of marginal costs to purchase prices increases in the search effort elasticity of available capacity, ϕ_γ. As search effort becomes more productive, firms respond by increasing their available capacity which lowers search prices and amplifies demand for that firm. Therefore, firms increase their pass-through of marginal costs to purchase prices to balance an increase in demand. Tight goods markets lower purchase prices if goods market matching inputs are complements, $\Gamma_S < 0$. Firms try to attract additional demand in a goods market with otherwise high consumption costs. Combining the two goods market SaM effects on the pass-through of marginal costs leads to the combined effect of marginal costs on inflation given by $(\epsilon + \phi_\gamma)$. Hence, the ϕ_γ-channel is larger than the ϕ_ϵ-channel given ϵ[11], which implies a steepening of the marginal costs (labor share) slope of the Phillips curve in γ_S[12].

Lemma 3. *The trade-off between sticky purchase prices and flexible search prices has two components. First, the "flexible price component" describing the optimal time allocation between search effort, home production, and market production, given ϵ and γ_S. And second, its trade-off with price adjustment costs, as described by (14).*

Unemployment and Wage Inflation. The labor market features the extensive margin in a tractable way following Gali (2011). Unemployment is determined by sticky wage inflation. The *wage Phillips curve* is given by

$$\boldsymbol{\hat{\pi}_{W,t}} = (-1)\frac{\nu_M(\epsilon_W - 1)}{\kappa_W}\phi_u \boldsymbol{\hat{u}_t} + \beta \mathbb{E}_t \boldsymbol{\hat{\pi}_{W,t+1}}, \tag{15}$$

where $\epsilon_W \geq 1$, $\phi_u = \left(\frac{\epsilon_W - 1}{\epsilon_W}\right)^{\frac{1}{\nu_M}}$, and $\kappa_W \geq 0$. Real wages are given by $\hat{w}_t = \hat{\pi}_{W,t} - \hat{\pi}_t + w_{t-1}$ with $\hat{w}_t = \hat{mc}_t + \hat{lpr}_t$. Labor productivity is given by

$$\boldsymbol{\hat{lpr}_t} = \boldsymbol{\hat{A}_t} + \psi^{-1}\boldsymbol{\hat{q}_t}, \tag{16}$$

[11] As shown in (6), ϵ increases in γ_S when targeting a steady-state price markup. Hence, it further steepens the slope of the Phillips curve when one targets steady-state price markups instead of calibrating ϵ directly.

[12] If we target Phillips curve slope estimates, this finding implies higher price adjustment costs, κ_P, to balance the otherwise steeper slope.

which fluctuates in capacity utilization, $\hat{q}_t$, and productivity, $\hat{A}_t$. Adding goods market SaM adds a second real wage channel besides variation in marginal costs, $\hat{mc}_t$.

4.3. Intertemporal Consumption Allocation and Aggregate Demand

Consumption Euler Equation. Intertemporal consumption allocation of the representative household is determined by the response of output growth to changes in the real interest rate. The *consumption Euler equation* is given by

$$\hat{\boldsymbol{r}}_{\boldsymbol{t}} - \mathbb{E}_t \hat{\boldsymbol{\pi}}_{\boldsymbol{t+1}} = \phi_C \mathbb{E}_t \boldsymbol{\Delta} \hat{\boldsymbol{Y}}_{\boldsymbol{t+1}} + \phi_\epsilon \mathbb{E}_t \boldsymbol{\Delta} \hat{\boldsymbol{P}}_{\boldsymbol{S,t+1}}, \tag{17}$$

where Δ indicates growth rates. Adding goods market SaM features an "inflation-like" term given by variations in expected search price growth, $\mathbb{E}_t \Delta \hat{P}_{S,t+1}$. Future *price elasticity of demand* falls in expected search price growth. Following an increase in the real interest rate, households shift consumption less to the future if expected search price growth (implicit inflation) increases. This channel is more salient as ϕ_ϵ increases.

Corollary 1. *From* (17) *we can derive a* corrected price inflation measure *defined by*

$$\mathbb{E}_t \hat{\boldsymbol{\pi}}_{\boldsymbol{T,t+1}} = \mathbb{E}_t \hat{\boldsymbol{\pi}}_{\boldsymbol{t+1}} + \phi_\epsilon \mathbb{E}_t \boldsymbol{\Delta} \hat{\boldsymbol{P}}_{\boldsymbol{S,t+1}}, \tag{18}$$

which takes into account observed price inflation as well as unobserved search price inflation. Applying this inflation measure to the Euler equation results in the benchmark model Euler equation with inflation corrected for search price growth.

Lemma 4. *The growth in expected search prices is inflationary. Goods market SaM unambiguously reduces the variation of consumption (output) following a change in the real interest rate. Changes in goods market tightness affect intertemporal consumption allocation through the* ***price elasticity of demand channel****, even if purchase price inflation is constant.*

Real GDP. Labor is the only production factor in this economy determining production capacity given technology, $\hat{A}_t$. Goods market frictions lead to idle production capacity. It follows that *real GDP* is given by

$$\hat{\boldsymbol{Y}}_{\boldsymbol{t}} = \frac{1}{\nu_M + \phi_C}\left[\hat{\boldsymbol{mc}}_{\boldsymbol{t}} - \phi_\epsilon \hat{\boldsymbol{P}}_{\boldsymbol{S,t}} - \nu_M \phi_u \hat{\boldsymbol{u}}_{\boldsymbol{t}} + (1+\nu_M)\left(\psi^{-1}\hat{\boldsymbol{q}}_{\boldsymbol{t}} + \hat{\boldsymbol{A}}_{\boldsymbol{t}}\right)\right], \tag{19}$$

where the response to its right-hand side determinants increases in the labor supply elasticity, $\frac{1}{\nu_M}$, and decreases in the salience of home production and market consumption income effects, ϕ_C – symmetric to Lester (2014). As in the benchmark model, marginal costs *(sticky prices)* and unemployment *(sticky wages)* determine its endogenous variation. TFP shocks create exogenous variation. Goods market SaM adds the *price elasticity of demand* and *capacity utilization channels*. Real GDP (19) is a combination of *labor and efficiency wedges* by

$$\hat{\boldsymbol{Y}}_{\boldsymbol{t}} = \nu_M^{-1}\left[(1+\nu_M)\,\hat{\boldsymbol{\tau}}_{\boldsymbol{E,t}} - \hat{\boldsymbol{\tau}}_{\boldsymbol{L,t}}\right]$$

with the labor and efficiency wedges defined by

$$\hat{\boldsymbol{\tau}}_{\boldsymbol{L,t}} = \phi_C \hat{\boldsymbol{Y}}_{\boldsymbol{t}} + \nu_M \phi_u \hat{\boldsymbol{u}}_{\boldsymbol{t}} - \hat{\boldsymbol{mc}}_{\boldsymbol{t}} + \phi_\epsilon \hat{\boldsymbol{P}}_{\boldsymbol{S,t}}, \tag{20}$$

$$\hat{\boldsymbol{\tau}}_{\boldsymbol{E,t}} = \psi^{-1}\hat{\boldsymbol{q}}_{\boldsymbol{t}} + \hat{\boldsymbol{A}}_{\boldsymbol{t}}. \tag{21}$$

It follows that the *price elasticity of demand channel* affects real GDP through the (household side) labor wedge (20) and the *capacity utilization channel* affects real GDP through the efficiency wedge (21). As $\hat{P}_{S,t}$ increases in $\hat{mc}_t$ – as shown in (11) – the *price elasticity of demand channel* counteracts the benchmark model *labor demand channel* working through marginal costs. For $\Gamma_S \approx 0$, it follows that the impact of marginal costs on the labor wedge is defined by $(1 - \epsilon\phi_\epsilon) \lesseqqgtr 0$. If $\epsilon\phi_\epsilon > 1$, it follows that the *price elasticity of demand channel* dominates and the labor wedge increases in marginal costs. If $\epsilon\phi_\epsilon < 1$, it follows that the *labor demand channel* dominates and the labor wedge decreases in marginal costs as in the benchmark model. For $\Gamma_S < 0$, the labor wedge can be countercyclical with $\epsilon\phi_\epsilon > 1$ as the variation of search prices in marginal costs decreases. As shown in (13), the efficiency wedge always increases in marginal costs as search effort increases in marginal costs.

5. Quantifying the Impact of the Goods Market SaM on the Economy

Goods market SaM creates a countercyclical price elasticity of demand which is amplified by procyclical variation of the capacity utilization. Compared to the benchmark model, aggregate demand is less responsive to changes in the real interest rate while firm price setting is more flexible following feedback effects from capacity utilization on firm productivity. However, the model shows a trade-off between matching the procyclical efficiency wedge and the countercyclical labor wedge in the data. Adding home production alleviates the impact on the labor wedge as the time allocation trade-off dampens variation in capacity utilization and thus the price elasticity of demand. I determine the slopes of the reduced-form output gap model where gap variables are determined as the deviation from their flexible price counterpart, i.e. $\tilde{Y}_t = \hat{Y}_t - \hat{Y}_t^N$.

5.1. Goods Market SaM Channels in the Reduced-Form Model

Unobserved search effort paired with sticky purchase prices drives variation in the *price elasticity of demand gap*, the *capacity utilization gap* (efficiency wedge gap), and the *labor wedge gap* which creates a wedge between the output and unemployment gaps. They are described by reduced-form gap variable versions of (12), (19), and (20) given by

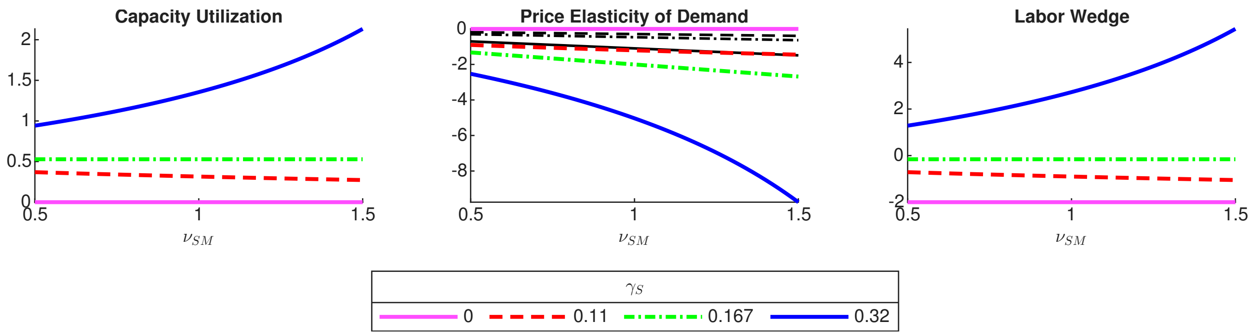
$$\tilde{\boldsymbol{\Xi}}_{\boldsymbol{t}} = (-1)\left[\theta_{\Xi,Y}\tilde{\boldsymbol{Y}}_{\boldsymbol{t}} + \theta_{\Xi,u}\tilde{\boldsymbol{u}}_{\boldsymbol{t}}\right], \tag{22}$$

$$\tilde{\boldsymbol{q}}_{\boldsymbol{t}} = \tilde{\boldsymbol{\tau}}_{\boldsymbol{E,t}} = \theta_{q,Y}\tilde{\boldsymbol{Y}}_{\boldsymbol{t}} + \theta_{q,u}\tilde{\boldsymbol{u}}_{\boldsymbol{t}}, \tag{23}$$

$$\tilde{\boldsymbol{\tau}}_{\boldsymbol{L,t}} = \theta_{\tau_L,Y}\tilde{\boldsymbol{Y}}_{\boldsymbol{t}} + \theta_{\tau_L,u}\tilde{\boldsymbol{u}}_{\boldsymbol{t}}, \tag{24}$$

where $\theta_{\Xi,Y} = \frac{\phi_\epsilon}{1-\phi_\epsilon}\left[\nu_S + \phi_C + \frac{1+\nu_S}{\phi_\gamma}\frac{\theta_{q,Y}}{\psi}\right]$ and $\theta_{\Xi,u} = \frac{\phi_\epsilon}{1-\phi_\epsilon}\frac{1+\nu_S}{\phi_\gamma}\frac{\theta_{q,u}}{\psi}$ are the slopes of (22), $\theta_{q,Y} = \theta_{q,q}^{-1}\left\{\epsilon\left(1-\phi_\epsilon\right)\left[\nu_M + \phi_C\right] - \left(1-\epsilon\phi_\epsilon\right)\left[\nu_S + \phi_C\right]\right\}$ and $\theta_{q,u} = \theta_{q,q}^{-1}\epsilon\left(1-\phi_\epsilon\right)\nu_M\phi_u$ with $\theta_{q,q} = \epsilon\left(1-\phi_\epsilon\right)\left[1+\nu_M - \frac{\Gamma_S}{1-\phi_\epsilon}\frac{\epsilon-1}{\epsilon}\right] + \frac{1-\epsilon\phi_\epsilon}{\psi\phi_\gamma}\left[1+\nu_S - \left(1+\phi_\gamma\right)\Gamma_S\right]$ are the slopes of (23), and $\theta_{\tau_L,Y} = \phi_C - \frac{1-\epsilon\phi_\epsilon}{\epsilon\phi_\epsilon}\theta_{\Xi,Y} + \frac{\Gamma_S}{1-\phi_\epsilon}\frac{1+\phi_\gamma}{\epsilon\phi_\gamma}\frac{\theta_{q,Y}}{\psi}$ and $\theta_{\tau_L,u} = \nu_M\phi_u - \frac{1-\epsilon\phi_\epsilon}{\epsilon\phi_\epsilon}\theta_{\Xi,u} + \frac{\Gamma_S}{1-\phi_\epsilon}\frac{1+\phi_\gamma}{\epsilon\phi_\gamma}\frac{\theta_{q,u}}{\psi}$ are the slopes of (24). Variations in the *price elasticity of demand gap* are determined by the search disutility convexity, ν_S, home production and income effects, ϕ_C, and variation in capacity utilization determined by $\theta_{q,Y}$ and $\theta_{q,u}$ (see (12)). Variations in the *capacity utilization*

Figure 2: Slopes of the goods market SaM channels



NOTE: The graphs show the impact of varying ν_S with a fixed ν_M on the slopes of the goods market SaM channels (inclduing home production). The benchmark model is shown by the full horizontal line ($\gamma_S = 0$). The NK-SaM model is shown in two variants for three different values of γ_S indicated by the dashed, dashed-dotted, and full lines. First, the bold-colored lines show $\Gamma_S \approx 0$. Second, the thin-black lines show $\Gamma_S = -\infty$ implying an substitution elasticity of ≈ 0 for the matching inputs.

gap are determined by search effort productivity, ϕ_γ, a labor demand channel, and a price elasticity channel (see (20) and (21)) – all three channels increase in marginal costs as shown by (11). Variations in the *labor wedge gap* are determined by the trade-off between the labor demand and price elasticity of demand channels as described for (20).

Figure 2 shows how goods market SaM affects the output gap elasticity of (22), (23), and (24). We apply Okun's law as found in Knotek (2007) to summarize the output and unemployment gap coefficients in one elasticity. Figures for the separate slopes can be found in Figure D.9a.

Capacity Utilization Gap. The output gap elasticity decreases as matching inputs become greater complements, $\Gamma_S \to -\infty$. For perfect complements, $\Gamma_S \to -\infty$, the elasticity coverges to zero. Its variation depends crucially on the substitutability of search effort and goods supply. As search effort becomes more productive – γ_S increases – pass-through of marginal costs to prices, $\epsilon(1 - \phi_\epsilon)$, decreases, but search effort productivity, ϕ_γ, increases. The second effect is larger as the output gap elasticity of capacity utilization increases in γ_S.

The impact of $\frac{\nu_S}{\nu_M}$ on the elasticity depends on the trade-off between the labor demand and the *price elasticity of demand* channels as described in (20). As ν_S increases, search price variations are increasingly convex as shown by (13), which implies convex marginal cost variations as shown by (11). If $(1 - \epsilon\phi_\epsilon) > 0$, the labor demand channel dominates and convex marginal costs lead to a stronger labor supply increase thus a lower capacity utilization increase. If $(1 - \epsilon\phi_\epsilon) < 0$, the *price elasticity of demand channel* dominates and convex marginal costs lead to a stronger decrease in the price elasticity of demand thus a higher capacity utilization increase. For $(1 - \epsilon\phi_\epsilon) = 0$, the two channels cancel out, leaving the capacity utilization gap independent of the impact of search disutility convexity.

Applying Okun's law to the calibrated model (see section 2.6), we find an overall output gap elasticity of the capacity utilization gap of 1.35[13]. The capacity utilization gap is procyclical.

Price Elasticity of Demand Gap. If matching inputs are perfect complements, $\Gamma_S \to -\infty$, variation in the price elasticity of demand is countercyclical but shows a small output gap slope. For $\Gamma_S \approx 0$, the slope of (22) is amplified by (23). Capacity utilization amplifies the countercyclical price elasticity of demand – especially if the *price elasticity of demand channel* dominates the labor demand channel. $\frac{\nu_S}{\nu_M}$ works through its impact on capacity utilization as described for (23).

Applying Okun's law to the calibrated model (see section 2.6), we find an overall output gap elasticity of the price elasticity of demand gap of -5.03[14]. For $\Gamma_S \to -\infty$, the overall elasticity reduces to -1.1 as capacity utilization is constant. Hence, the price elasticity of demand gap is strongly countercyclical as it is amplified by capacity utilization variation.

Labor Wedge Gap. For $\Gamma_S \approx 0$, the labor wedge gap is countercyclical as in the data (see e.g. Karabarbounis (2014)) if the *labor demand channel* of marginal costs dominates $((1 - \epsilon\phi_\epsilon) > 0)$. If the *price elasticity of demand channel* dominates $((1 - \epsilon\phi_\epsilon) < 0)$, the labor wedge is procyclical. As matching inputs become perfect complements, $\Gamma_S \to -\infty$, the output gap elasticity of the labor wedge is countercyclical for any $\epsilon\phi_\epsilon$ as it converges to its benchmark model value. Hence, there is a trade-off between matching a procyclical efficiency wedge and a counteryclical labor wedge in the NK-SaM model.

Applying Okun's law to the calibrated model (see section 2.6), we find an overall output gap elasticity of the labor wedge gap of 2.73[15]. The labor wedge gap is procyclical driven by the

[13]The individual elasticities of the capacity utilizaiton gap are given in Figure D.9a. For the calibrated model, they are 1.88 for the output gap and 1.06 for the unemployment gap.

[14]The individual elasticities of the price elasticity of demand gap are given in Figure D.9a. For the calibrated model, they are -6.57 for the output gap and -3.07 for the unemployment gap.

[15]The individual elasticities of the labor wedge gap are given in Figure D.9a. For the calibrated model, they are 4.57 for the output gap and 3.68 for the unemployment gap.

procyclical variation in the *capacity utilization channel.*

5.2. The Reduced-Form Five-Equation Model

The model presented in section 4 can be summarized by five equations - a consumption Euler equation (25), a NK price Phillips curve (26), a NK wage Phillips curve (27), a law of motion for real wages (28), and a Taylor (1993)-type rule (29). The five-equation reduced-form gap model including goods market SaM is given by

$$\hat{\boldsymbol{r}}_{\boldsymbol{t}} - \hat{\boldsymbol{r}}_t^N - \mathbb{E}_t \hat{\boldsymbol{\pi}}_{\boldsymbol{t+1}} = \Theta_{\mathbb{M},Y} \mathbb{E}_t \boldsymbol{\Delta} \tilde{\boldsymbol{Y}}_{\boldsymbol{t+1}} + \Theta_{\mathbb{M},u} \mathbb{E}_t \boldsymbol{\Delta} \tilde{\boldsymbol{u}}_{\boldsymbol{t+1}}, \tag{25}$$

$$\hat{\boldsymbol{\pi}}_{\boldsymbol{t}} = \Theta_{\pi,Y} \tilde{\boldsymbol{Y}}_{\boldsymbol{t}} + \Theta_{\pi,u} \tilde{\boldsymbol{u}}_{\boldsymbol{t}} + \beta \mathbb{E}_t \hat{\boldsymbol{\pi}}_{\boldsymbol{t+1}}, \tag{26}$$

$$\hat{\boldsymbol{\pi}}_{\boldsymbol{W,t}} = (-1) \frac{\epsilon_W - 1}{\kappa_W} \phi_u \tilde{\boldsymbol{u}}_{\boldsymbol{t}} + \beta \mathbb{E}_t \hat{\boldsymbol{\pi}}_{\boldsymbol{W,t+1}}, \tag{27}$$

$$\hat{\boldsymbol{\pi}}_{\boldsymbol{W,t}} - \hat{\boldsymbol{\pi}}_{\boldsymbol{t}} = \Theta_{w,Y} \boldsymbol{\Delta} \tilde{\boldsymbol{Y}}_{\boldsymbol{t}} + \Theta_{w,u} \boldsymbol{\Delta} \tilde{\boldsymbol{u}}_{\boldsymbol{t}}, \tag{28}$$

$$\hat{\boldsymbol{r}}_{\boldsymbol{t}} = i_r \hat{\boldsymbol{r}}_{\boldsymbol{t-1}} + (1 - i_r) \left[i_\pi \hat{\boldsymbol{\pi}}_{\boldsymbol{t}} + i_{Gap} \tilde{\boldsymbol{Y}}_{\boldsymbol{t}} \right] + \hat{\boldsymbol{M}}_{\boldsymbol{t}}, \tag{29}$$

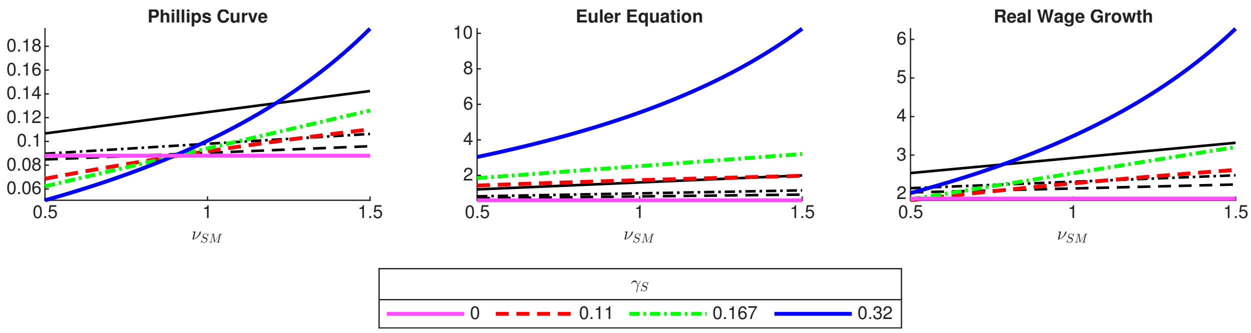
with the slopes for (25) given by $\Theta_{\mathbb{M},Y} = \phi_C + \theta_{\Xi,Y}$ and $\Theta_{\mathbb{M},u} = \theta_{\Xi,u}$; the slopes for (26) given by $\Theta_{\pi,Y} = \frac{1+\phi_\gamma}{\kappa_P} \left[\frac{1-\phi_\epsilon}{\phi_\epsilon} \theta_{\Xi,Y} - \frac{\Gamma_S}{\phi_\gamma} \frac{\theta_{q,Y}}{\psi} \right]$ and $\Theta_{\pi,u} = \frac{1+\phi_\gamma}{\kappa_P} \left[\frac{1-\phi_\epsilon}{\phi_\epsilon} \theta_{\Xi,u} - \frac{\Gamma_S}{\phi_\gamma} \frac{\theta_{q,u}}{\psi} \right]$; and the slopes for (28) given by $\Theta_{w,Y} = \frac{\theta_{\Xi,Y}}{\epsilon \phi_\epsilon} + \left(1 - \frac{\Gamma_S}{\epsilon(1-\phi_\epsilon)} \frac{1+\phi_\gamma}{\phi_\gamma} \right) \frac{\theta_{q,Y}}{\psi}$ and $\Theta_{w,u} = \frac{\theta_{\Xi,u}}{\epsilon \phi_\epsilon} + \left(1 - \frac{\Gamma_S}{\epsilon(1-\phi_\epsilon)} \frac{1+\phi_\gamma}{\phi_\gamma} \right) \frac{\theta_{q,u}}{\psi}$. The reduced-form gap model has the identical functional form as our benchmark model (see e.g. Erceg et al. (2000); Gali (2011)). By Proposition 1, the NK-SaM model nests the benchmark model. The wage Phillips curve and the Taylor rule are unaffected by goods market SaM.

Proposition 1. *The goods market search-and-matching model reduces to a benchmark NK model if $\gamma_S = 0$, $\mu_S = 0$, and $\psi = 1$. The goods market search-and-matching model nests the benchmark NK model as in Erceg et al. (2000).*

Proof. See Appendix B.3. □

Figure 3 shows how goods market SaM affects the slopes of the Euler equation (25), the NK price Phillips curve (26), and the real wage growth equation (28) compared to the

Figure 3: Slopes of the 5-Equation Model



NOTE: The graphs show the impact of varying ν_S with a fixed ν_M on the slopes of the reduced-form NK-SaM model (inclduing home production). The benchmark model is shown by the full horizontal line ($\gamma_S = 0$). The NK-SaM model is shown in two variants for three different values of γ_S indicated by the dashed, dashed-dotted, and full lines. First, the bold-colored lines show $\Gamma_S \approx 0$. Second, the thin-black lines show $\Gamma_S = -\infty$ implying an substitution elasticity of ≈ 0 for the matching inputs.

benchmark model as given by proposition 1. We apply Okun's law as found in Knotek (2007) to summarize the output and unemployment gap coefficients in one elasticity. Figures for the separate slopes can be found in Figure D.9b.

The Consumption Euler Equation. Applying Okun's law to the calibrated benchmark model (see section 2.6), we find an overall output gap elasticity of the consumption Euler equation of 0.6[16]. A 1% increase in the real interest rate gap leads to a 1.67% decrease in output gap growth. Adding goods market SaM increases the overall output gap elasticity through the *price elasticity of demand channel* to 5.54[17]. A 1% increase in the real interest rate gap leads to a 0.18% decrease in output gap growth - a response approximately eleven times smaller compared to the benchmark model. This result is much closer to the empirical literature (Ascari et al. (2021)). The results are qualitatively robust but vary quantitatively with the calibration of goods market SaM parameters. As shown in fig. 3, the overall output gap elasticity varies between 0.71 and 10.26. Following the discussion for (22), the elasticity increases especially in ν_S as $\Gamma_S \approx 0$ and γ_S is high.

Adding goods market SaM implies that monetary policy must adjust its interest rates (significantly) more to achieve the same impact on output as in benchmark model. A

[16] The individual elasticities of the consumption Euler equation are given in fig. D.9b. For the calibrated benchmark model, they are 0.6 for the output gap and 0 for the unemployment gap.

[17] The individual elasticities of the consumption Euler equation are given in fig. D.9b. For the calibrated NK-SaM model, they are 7.07 for the output gap and 3.07 for the unemployment gap.

countercyclical *price elasticity of demand* reduces the impact of real interest rate gap changes. The size of the impact depends on the *capacity utilization channel* as shown in (23). For $\Gamma_S \to -\infty$, the overall output gap elasticity is close to the benchmark model with 1.60.

Lemma 5. *The inverse of the output gap elasticity of the consumption Euler equation decreases in* $\frac{\nu_S}{\nu_M}$*,* γ_S*, and* Γ_S*. The countercyclical pattern of the* ***price elasticity of demand*** *increases in all three parameters making search costs a more salient feature of overall consumption costs. It follows that monetary policy has a lower impact on aggregate demand as goods market prices comprise a smaller share of the overall consumption costs.*

The Price Phillips Curve. Applying Okun's law to the calibrated benchmark model (see section 2.6), we find an overall output gap elasticity of the price Phillips curve of 0.088[18], with a price adjustment cost parameter[19] κ_P of 128. A 1% increase of the output gap leads to 0.088%-point increase of the inflation rate. Adding goods market SaM increases the overall output gap elasticity to 0.101[20] – a response approximately 15% stronger than in the benchmark model although the price adjustment cost parameter κ_P increases to 188. The countercyclical *price elasticity of demand* leads to a stronger pass-through of marginal costs to prices in the NK-SaM model.

The results vary both qualitatively and quantitatively when varying the goods market SaM calibration. As shown in fig. 3, the overall output gap slope of the NK-SaM model varies between 0.050 and 0.195. Whether prices are more or less flexible than in the benchmark model depends on $\frac{\nu_S}{\nu_M}$. If $\frac{\nu_S}{\nu_M}$ is low, firms adjust prices less than in the benchmark model. As search effort is less convex than labor supply, firms prefer to adjust supply through the capacity utilization margin rather than the price margin, vice-versa. This trade-off only matters if matching inputs are relatively substitutable. This pattern becomes more

[18]The individual elasticities of the price Phillips curve are given in fig. D.9b. For the calibrated benchmark model, they are 0.133 for the output gap and 0.090 for the unemployment gap.

[19]I recalibrate the price adjustment cost parameter, κ_P, under each parameter specification to match the slope of the labor share Phillips curve in the data. For the NK-SaM model, it is constant across all specifications if $\Gamma_S = 0$ and changes only very slightly across different calibrations for $\Gamma_S \neq 0$.

[20]The individual elasticities of the price Phillips curve are given in fig. D.9b. For the calibrated NK-SaM model, they are 0.131 for the output gap and 0.061 for the unemployment gap.

pronounced as search effort is more productive – γ_S increases.

Adding goods market SaM adds goods market tightness (capacity utilization) as a third dimension to any firm's price and quantity decision. A firm adjusts more along the less convex dimension. The impact depends on the variation of the *price elasticity of demand channel* as shown in (22). For the calibrated model, inflation varies more in response to variation in the output gap compared to the benchmark model. As the relationship between inflation and the labor share is fixed to its empirical value, it follows that the output gap varies less in the NK-SaM model. Goods market SaM changes the relationship between the labor share and the output and unemployment gaps.

Lemma 6. *Each firm sets prices to target an optimal share of matching inputs given the CES matching function. The slope of the output gap price Phillips curve increases in $\frac{\nu_S}{\nu_M}$, as firms adjust prices more aggressively to induce changes in search effort. The variation in prices increases for high γ_S and Γ_S as search effort is a more productive matching input and thus justifies larger price changes (thus higher price adjustment costs).*

Real Wage Growth. Applying Okun's law to the calibrated benchmark model (see section 2.6), we find an overall output gap elasticity of the real wage growth equation of 1.87[21]. Adding goods market SaM increases the overall output gap elasticity to 3.49[22] – a response approximately 87% stronger than in the benchmark model. A countercyclical *price elasticity of demand* leads to stronger variation in the marginal rate of substitution and procyclical *capacity utilization* leads to stronger variation in the marginal labor productivity. Both increase the responsiveness of real wage growth to output gap growth.

The results depend on the calibration of the goods market SaM parameters. The discussion of $\frac{\nu_S}{\nu_M}$ as for (26) applies as inflation affects real wage growth directly. As shown in fig. 3, the overall output gap slope of the NK-SaM model varies between 1.85 and 6.28. Hence, for the vast majority of calibrations, real wage growth is more responsive to output gap growth than

[21]The individual elasticities of the real wage growth equation are given in Figure D.9b. For the calibrated benchmark model, they are 2.83 for the output gap and 1.92 for the unemployment gap.

[22]The individual elasticities of the consumption real wage growth equation are given in Figure D.9b. For the calibrated NK-SaM model, they are 4.67 for the output gap and 2.36 for the unemployment gap.

in the benchmark model, especially if ν_S is high as $\Gamma_S \approx 0$ and γ_S is high.

Aggregate Impact. The overall impact of goods market SaM on the model economy depends on the interaction of the Phillips curves, the Euler equation, and real wage growth. The slopes of the Euler equation and real wage growth increase with goods market SaM in the analyzed parameter range, while the price Phillips curve shows ambiguous changes depending on $\frac{\nu_S}{\nu_M}$. Price inflation can be either less or more responsive to the business cycle. We simplify by assuming two cases: First, search effort supply is sufficiently more elastic than labor supply, i.e. $\frac{\nu_S}{\nu_M} = 0.5$. And second, search effort supply is sufficiently less elastic than labor supply, i.e. $\frac{\nu_S}{\nu_M} = 1.5$. The aggregate impact of those two cases is laid out in corollary 2. Simulations of the model provide a quantitative statement in the following section.

Corollary 2. *Case 1: For $\frac{\nu_S}{\nu_M} < \bar{\nu}_{SM}$, a flatter Phillips curve amplifies nominal effects while a flatter Euler equation dampens them. The two effects counteract each other.*
Case 2: For $\frac{\nu_S}{\nu_M} > \bar{\nu}_{SM}$, a steeper Phillips curve and a flatter Euler equation dampen nominal effects. The two effects amplify each other.

Robustness. The slopes and output gap elasticities presented in this section are qualitatively robust to different assumptions about preferences. Dropping home production in the time allocation of households leads to an increase of the *capacity utilization* and *price elasticity of demand channels* of roughly 25%. This pattern is quantitatively robust to changes in γ_S and $\frac{\nu_S}{\nu_M}$ as shown fig. D.10a. It translates to a change of the price Phillips curve and real wage growth slopes of approximately 25%. Only for the output gap elasticity of the Euler equation is the increase larger with approximately 35%. Using Greenwood et al. (1988) preferences instead of King et al. (1988) preferences shows a qualitatively and quantitatively similar impact on the slopes as the introduction of home production as shown in fig. D.10b.
Lastly, if we drop the sticky wages assumption, $\kappa_W = 0$, the impact of goods market SaM increases significantly as unemployment is constant across the business cycle[23]. For the calibrated, this implies stronger variation in *capacity utilization* and the *price elasticity of*

[23] We can derive the overall output gap elasticities of all margins for the 3-equation NK-SaM model (without sticky wages) by simply dropping the unemployment gap margin in (22)-(29).

demand. It follows that the response of the output gap to real interest gap changes is lower, price setting is more flexible, and real wage growth following output gap growth is stronger.

6. Simulation Analysis

The model features two channels summarizing the impact of goods market SaM: The *capacity utilization channel* and the *price elasticity of demand channel* which is amplified by variations in capacity utilization. In this section, I analyze the aggregate impact of goods market SaM on the model economy for business cycle shocks using impulse response (IRF) analysis. To highlight each goods market SaM channel, I construct different scenarios for (1) the benchmark model, and the NK-SaM model with (2) perfect matching complements[24], (3) a Cobb-Douglas matching function, and (4) a CES matching functions with weak complements. I use Dynare (Adjemian et al. (2024)) to solve and simulate the model economy.

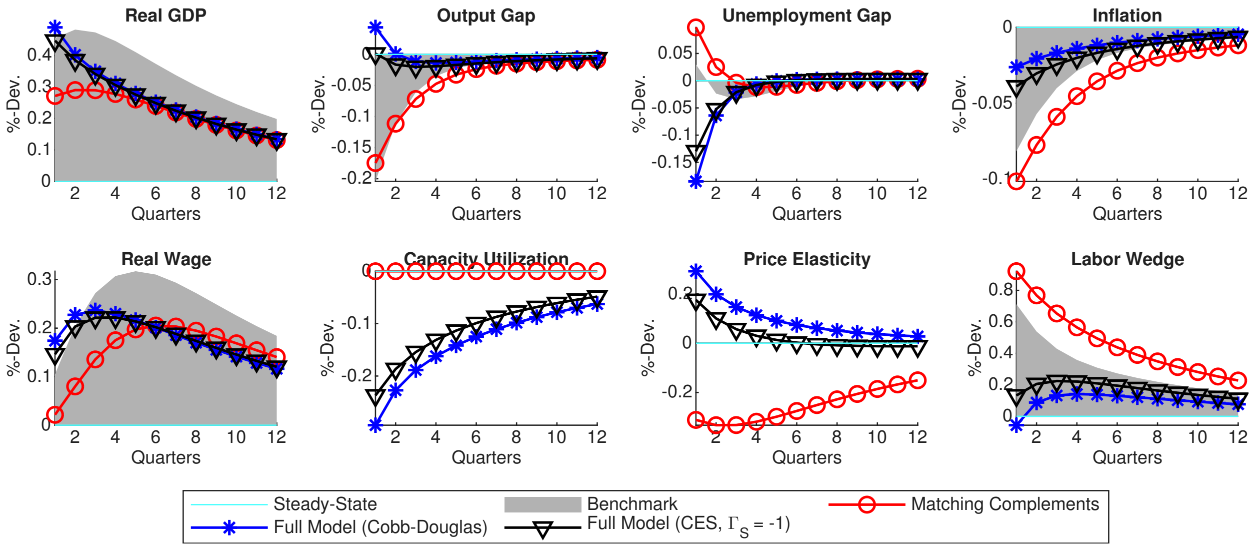
6.1. Supply and Demand Shocks with Goods Market SaM

TFP Shocks. Figure 4 shows IRFs to a one standard deviation expansionary TFP shock where the grey areas shows the benchmark model, the red curves the NK-SaM model with perfect matching complements, the black curves relax this assumption to weak complements, $\Gamma_S = -1$, and the blue curves relax it further to Cobb-Douglas, $\Gamma_S = 0$. Hence, we subsequently increase variation in the *capacity utilization channel* while the *price elasticity of demand channel* is present in all NK-SaM model versions.

The benchmark model IRFs to an expansionary TFP shock show a significant and persistent increase in real GDP. Real wages increase as labor productivity increases exogenously. Prices decrease slowly due to sticky prices, which leads to a countercyclical output gap and a procyclical labor wedge. Both capacity utilization and the price elasticity of demand are constant. Adding goods market SaM with perfect matching input complements shows the same qualitative behavior of the IRFs. As there is now a second cost to consumption, the

[24]This scenario studies the idea of search effort as a cyclical component creating disutility to the household and a trade-off in time allocation, however, not affecting capacity utilization. As there is no clear evidence on the search effort elasticity of matching, this scenario acts as a lower bound of the impact of goods market SaM on the NK model.

Figure 4: Impulse Responses to an Expansionary TFP Shock



NOTE: The figure shows IRFs to a one standard deviation expansionary TFP shock using the model presented in section 2 and section 4. The benchmark model follows proposition 1, the "matching complements" model sets $\Gamma_S = -\infty$, the CES model sets $\Gamma_S = -1$, the Cobb-Douglas model is calibrated as in table 1.

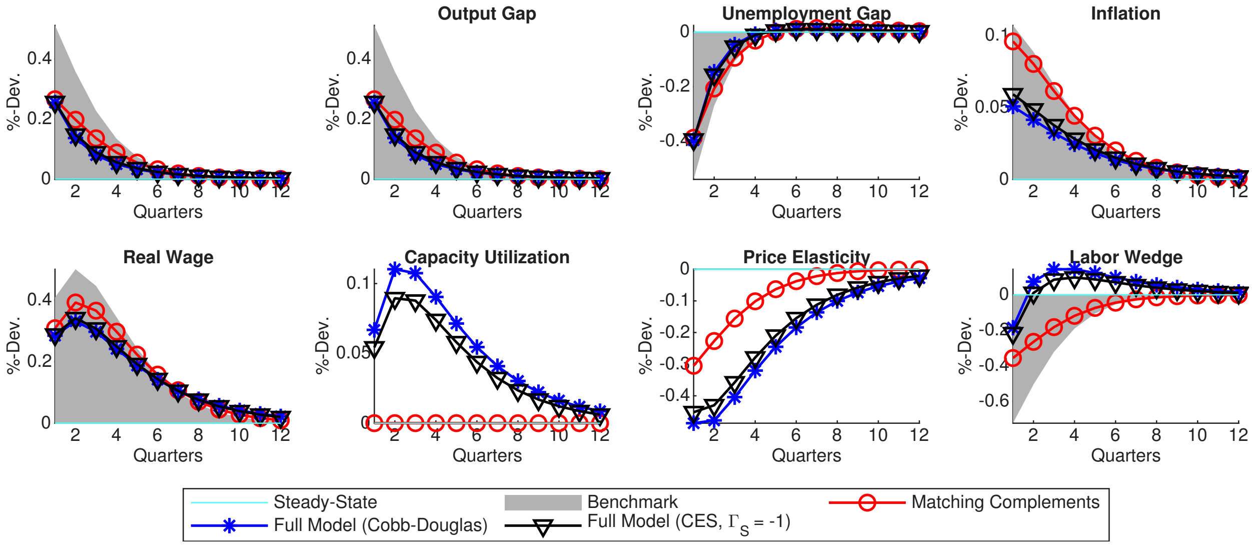
response of real GDP is smaller than in the benchmark model. The price elasticity of demand decreases in search prices which leads to stronger price cuts and a strongly procyclical labor wedge. Lower aggregate demand and the procyclical labor wedge lead to lower production, higher unemployment, and lower real wages.For a Cobb-Douglas matching function, real GDP initially shows a stronger response than the benchmark model, which leads to a brief positive deviation of the output gap. A significant drop in capacity utilization - in line with Basu et al. (2006) - lowers search prices and increases the price elasticity of demand. Hence, aggregate demand and thus production increase even as firms only slightly cut prices. This effect is strong enough to create a countercyclical unemployment response contrary to the NK literature (see e.g. Gali (1999)) but in line with Safonova (2017); Faccini and Yashiv (2022). Real wages increase initially more than in the benchmark model due to strong labor demand. However, as capacity utilization and thus labor productivity is low, real wage expansion is overall lower than in the benchmark model. Firms do not cut their prices further to attract additional demand as search effort is less effective as demand expands.

Overall, introducing goods market SaM with a Cobb-Douglas matching function makes the NK-SaM model in response to a TFP shock look more like an RBC model as output gap and inflation deviations are small while real GDP and employment are strongly procyclical. This feature follows from an endogeneized price elasticity of demand which turns procyclical as a countercyclical capacity utilization amplifies it. Lowering the substitutability of matching inputs leads the NK-SaM model to converge back to the benchmark model, as the CES model with $\Gamma_S = -1$ in fig. 4 shows.

Monetary Policy Shocks. Figure 5 shows IRFs to a one standard deviation expansionary monetary policy shock featuring the same models as in fig. 4. The IRFs of the benchmark model show a significant and persistent increase in real GDP. Households increase their consumption as the central bank cuts its nominal interest rate and prices are sticky. Production expands by attracting employment through higher real wages due to sticky prices. Hence, price markups decrease and the labor wedge decreases. Both capacity utilization and the price elasticity of demand are constant. Adding goods market SaM with perfect matching input complements shows the same qualitative behavior of the IRFs. As there is a second cost to consumption, the response of real GDP is smaller than in the benchmark model. The price elasticity of demand decreases in search prices which leads to a stronger price increase compared to the benchmark model. The real GDP response is about half as large as in the benchmark model, which is in line with the results from section 5.2. Lower aggregate demand leads to lower production thus higher unemployment in line with lower real wages and a countercyclical labor wedge.

Relaxing the matching inputs complementarity leads to small quantitative changes in the IRFs. For a Cobb-Douglas matching function, real GDP, the output gap, and real wages show a small increase in their IRFs. The unemployment gap shows a small decrease in their IRFs compared to the benchmark model. An increase in capacity utilization increases search prices and decreases the price elasticity of demand. Firms respond by cutting their price increases almost in half compared to the benchmark and perfect matching complements cases. The initial response of the labor wedge is negative as low price elasticity of demand and high aggregate demand decrease unemployment. As capacity utilization is more persistent than aggregate demand, it follows that the labor wedge deviates above its steady-state in transition. With strong substitutability of matching inputs, an expansionary monetary policy

Figure 5: Impulse Responses to an Expansionary Monetary Policy Shock



NOTE: The figure shows IRFs to a one standard deviation expansionary monetary policy shock using the model presented in section 2 and section 4. The benchmark model follows proposition 1, the "matching complements" model sets $\Gamma_S = -\infty$, the CES model sets $\Gamma_S = -1$, the Cobb-Douglas model is calibrated as in table 1.

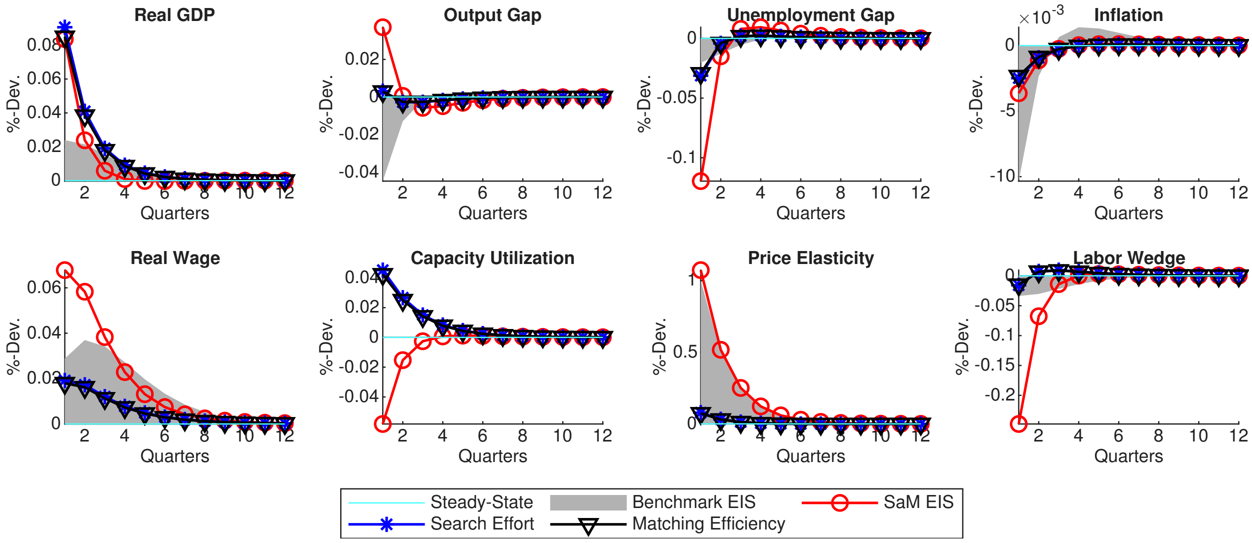
shock works mostly through higher utilization of existing production capacity instead of an expansion of it.

Overall, introducing goods market SaM with a Cobb-Douglas matching function makes the model in response to a monetary policy shock look more like the RBC model as output (gap), inflation, and labor deviations are smaller. Nominal shocks have a smaller impact on the economy. This pattern follows from a procyclical capacity utilization and countercyclical price elasticity of demand. Lowering the substitutability of matching inputs leads the NK-SaM model to converge back to the benchmark model, as the CES model with $\Gamma_S = -1$ in fig. 4 shows. This allows to partially reconcile the NK-SaM model with a countercyclical labor wedge but at the cost of lower capacity utilization variation.

6.2. Cost-Push Shocks in a Goods Market SaM Economy

The two goods market SaM shocks, $\hat{\psi}_t$ and $\hat{\mu}_{S,t}$ are natural candidates for cost-push shocks as they affect the non-pecuniary cost of the unobserved input factor search effort. They exogenously change search prices and thus the price elasticity of demand affecting the price setting power of firms. They are potential candidates for a micro-founded cost-push shock instead of the otherwise elusive markup shock modeled as exogenous variation to the

Figure 6: Impulse Responses to Different Cost-Push Shocks



NOTE: The figure shows IRFs to one standard deviation expansionary cost-push shocks using the model presented in section 2 and section 4. The benchmark model follows proposition 1, the Cobb-Douglas model is calibrated as in table 1. The shocks present exogenous variation in the elasticity of substitution (EIS), $\hat{\epsilon}_t$, in search effort, $\hat{\mu}_t$, and in matching efficiency, $\hat{\psi}_t$.

elasticity of intratemporal substitution (EIS) (Schmitt-Grohé and Uribe (2025) conduct a similar analysis with transportation costs).

Cost-Push Shocks in Comparison. Figure 6 shows IRFs to one standard deviation[25] expansionary shocks of the EIS, ϵ_t, search effort disutility, μ_t, and goods market matching efficiency, ψ_t. All three shocks qualify as cost-push shocks as they show negatively correlated real GDP and inflation deviations from steady-state while they do not affect the production process directly. In fig. 6, the grey areas show the IRFs to an EIS shock in the benchmark model as in Ireland (2004). The three curves show the three cost-push shocks present in the NK-SaM model as described above.The EIS shock shows in both the benchmark and the NK-SaM model a significant exogenous increase in the price elasticity of demand. In response, firms cuts price which leads to higher aggregate demand and output. Pass-through of marginal costs to prices is lower in the NK-SaM model as capacity utilization decreases – an unexpected feature following lower prices. Firms expand employment (lower labor wedge) and households increase search effort. As prices are sticky, it follows that production capacity increases faster than aggregate demand leading to an underutilization of capacity. The

[25]All three shocks are calibrated such that their initial expansionary real GDP response is roughly the same. With a shock persistence of 0.5, all three shocks converge back to steady-state in about 4 to 6 quarters.

incomplete pass-through of marginal costs to prices leads to a negative output gap in the benchmark model, while the search effort channel in the NK-SaM model leads to a positive output gap[26].

In the NK-SaM model, two additional shocks - search effort and matching efficiency - act as cost-push shocks. Targeting the same output response as for the EIS shock, we find similar deflation in the NK-SaM model. However, other variables show both qualitative and quantitative differences. The endogenous response of the price elasticity of demand while procyclical is significantly lower compared to the exogneous change of the EIS shock. Capacity utilization increases as search effort (efficiency) expands exogenously. As the increase in output works mainly through unobserved search effort, variation in labor market related-variables is significantly lower compared to the EIS shock. A low variation in the output gap shows that the exogenous shocks are not significantly amplified through the sticky price and wage assumptions in the NK-SaM model[27].

All three shocks show features of cost-push shocks. The NK-SaM model shows that such shocks can arise naturally from the demand side of the model. As there are clear interpretations of both demand side shocks, adding goods market SaM makes cost-push shocks in NK models less elusive.

Search Effort Shock. Both NK-SaM shocks show almost identical IRFs. In what follows, we focus on the search effort shock instead of the matching efficiency shock as it is in line with a procyclical search effort (see e.g. Petrosky-Nadeau et al. (2016)). While both shocks might explain part of the data, search effort shocks seem to be the more important shocks given shopping time data. Detailed IRFs for the matching efficiency shock can be found in Appendix F.

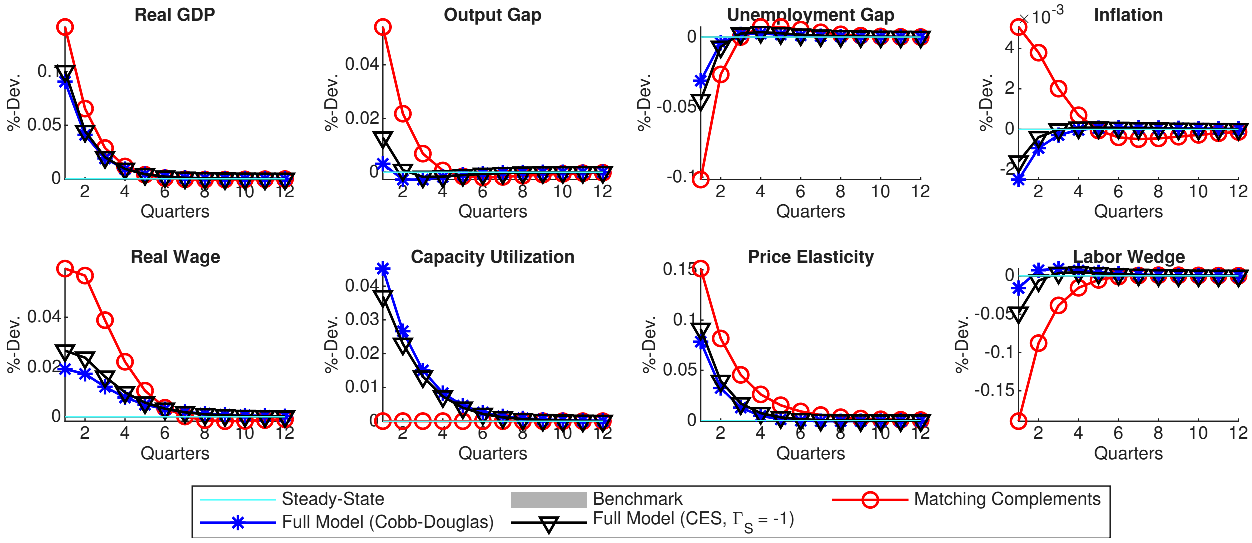
Figure 7 shows IRFs to a one standard deviation expansionary search effort shock featuring the same models as in Figure 4[28]. All three versions of the NK-SaM model show a significant

[26] We calculate the output gap to the flexible price model. For the output gap of the efficient model (with no monopolistic competition), the output gap is procyclical for both the benchmark and the NK-SaM model.

[27] We calculate the output gap to the flexible price model. If we assume no search friction and thus constant capacity utilization in the efficient model, then the output gap is procyclical for both shocks.

[28] There are no IRFs of the benchmark model as there is no search effort.

Figure 7: Impulse Responses to an Expansionary Search Effort Shock



NOTE: The figure shows IRFs to a one standard deviation expansionary search effort shock using the model presented in section 2 and section 4. The benchmark model follows proposition 1, the "matching complements" model sets $\Gamma_S = -\infty$, the CES model sets $\Gamma_S = -1$, the Cobb-Douglas model is calibrated as in table 1.

increase in real GDP. The Cobb-Douglas model is the same as in Figure 6. For perfect matching input complements, the output (gap) IRFs show significantly larger deviations from steady-state as search effort does not substitute for supply. The additional demand from households can only be satisfied if production increases. It follows that real wages increase significantly while unemployment and the labor wedge decrease significantly. The expansion in output drives up marginal costs which leads to higher inflation. The price elasticity of demand increases in search prices which are not balanced by an increase in capacity utilization. It follows that the search effort shock become an aggregate demand shock instead of a cost-push shock as matching inputs become perfect complements. The specific workings of the goods market and unobserved search effort are thus crucial for the classification of this shock.

For weak complements, $\Gamma_S = -1$, the IRFs are qualitatively identical to the Cobb-Douglas case as described for Figure 6 although quantitatively less pronounced. The search effort shock still identifies as a cost-push shock in this case[29]. Overall, goods market SaM allows for a natural implementation of (demand side) cost-push shocks. This section has shown how the interaction of the *price elasticity of demand* and *capacity utilization channels* is

[29]See fig. F.12a for the matching efficiency shock.

crucial for this interpretation. The search effort shock is a cost-push shock only if capacity utilization varies procyclically with variation in search effort. The procyclical search effort elasticity found in Petrosky-Nadeau et al. (2016) hints in that direction.

6.3. Robustness Analysis

The model in this paper is rather small and can be extended in several dimensions. Here, I present a few. Given space constraints and in light of brevity, I postpone model setup details (see Appendix A) and results (see Appendix F.3) to the appendix.

Alternative Calibration. Calibrating $\gamma_S = 0.11$ implies lower variation in the price elasticity of demand and capacity utilization. It follows that the labor demand channel dominates the price elasticity channel and the labor wedge is countercyclical. All other IRFs converge closer to the benchmark model. Calibrating $\frac{\nu_S}{\nu_M} = 0.5$ amplifies the variation in the price elasticity of demand and capacity utilization, thus amplifies the impact of goods market SaM on the IRFs along the lines of section 6. For $\frac{\nu_S}{\nu_M} = 1.5$, we find the opposite results. In both cases, the cyclicality of the labor wedge depends solely on γ_S even though $\frac{\nu_S}{\nu_M}$ affects the variation of the price elasticity of demand and of capacity utilization.

Alternative Preferences. Using Greenwood et al. (1988) preferences[30] leads to qualitatively similar but quantitatively larger results as income effects in the utility function drop out. Variation in capacity utilization and the price elasticity of demand increase with a countercyclical impact on the labor wedge as variation in search effort (labor) is higher. Comparing the IRFs to the slopes in fig. D.10b, we find that the output gap varies less following a smaller Phillips curve slope but aggregate demand effects are stronger following the larger Euler equation slope.

Frictional Labor Markets. Sticky wages alter the time allocation trade-off with the variation in search effort decreasing in wage adjustment costs, κ_W. As shown for the slopes of the reduced-form model (see section 5), sticky wages reduce the impact of goods market SaM.

[30] The main reason of chossing King et al. (1988) preferences in this paper is the unemployment modeling assumption following Galí (2011) which would otherwise not be possible.

Its quantitative impact on the IRFs is substantial (see fig. F.16), while there is no qualitative impact on the goods market SaM channels. Assuming flexible wages, the variation in capacity utilization and the price elasticity of demand dampens for TFP shocks as wages and thus labor and production capacity increase faster. For demand and search shocks we find the opposite impact as stronger wage growth cuts off labor demand. The dampening/amplifying impact on the two goods market SaM channels transmits to the rest of the economy as described in section 5 and section 6. Adding hours adjustment costs (see Lechthaler and Snower (2013)) as a proxy for labor market SaM (see e.g. Merz (1995); Blanchard and Gali (2010)) amplifies the IRFs symmetrically to sticky wages. Having both sums up their effects as the trade-off between market labor and search effort is further altered.

Capital in Production. Adding capital and capital utilization similar to Christiano et al. (2010) shows a small qualitative and quantitative impact on the IRFs (see **??**). The IRFs are more persistent as capital is a stock variable. Variation in capacity utilization decreases slightly for TFP and monetary policy shocks, while it increases slightly for search effort shocks. Variation in the price elasticity of demand is mostly unchanged with the exception of a lower persistence following a TFP shock. The labor wedge becomes mostly acyclical across shocks with capital as a substitute input factor. Compared to the benchmark model, adding capital has a smaller impact on the IRFs in the NK-SaM model as household time allocation has become more important through the additional dimension of search effort.

Long-Term Goods Market SaM. Adding firm inventories as in Den Haan and Sun (2024) shows a quantitatively small impact as inventory holdings are costly and available only for industry which comprises about one third of overall GDP (see fig. F.18). Adding long-term contracts on the goods market as in Michaillat and Saez (2015) shows a substantial impact on the economy if average contract length is high (e.g. one year). Search costs per unit traded decrease which implies lower variation in the price elasticity of demand and in capacity utilization. The IRFs of real GDP converge to the benchmark model which shows a slightly larger and hump-shaped response. For the search effort shock, real GDP shows a decreasing variation as the search friction that is alleviated by the shock decreases in the contract length.

The reduction in search frictions leads to a general increase in inflation variation. The impact of goods market SaM thus depends on a continuous and significant search cost on the goods market. Long-term contracts can alleviate those cost significantly in the model.

7. Discussion and Concluding Remarks

This paper extends the NK model to include procyclical shopping time via goods market search-and-matching, showing how search costs affect capacity utilization, inflation dynamics, and long-run GDP. Goods market search frictions reduce long-run GDP through idle capacity and price markups resulting from a lower price elasticity of demand, while also altering the slope of the Phillips curve and Euler equation.

The tension between flexible search prices and sticky purchase prices gives rise to endogenous capacity utilization and price elasticity of demand. It is amplified by the interaction between firm market power and goods market frictions. These features increase the NK Phillips curve slope by 15% and flatten the Euler equation by up to 91 % due to the inflationary role of search costs. Monetary policy affects aggregate demand less as search costs are only indirectly affected nominal interest rates.

Simulation results show muted output gap responses and weakened monetary policy transmission. The model aligns with RBC-like output dynamics yet preserves empirical inflation responsiveness. Cost-push shocks arise naturally from the demand side as unobserved search effort changes lead to an increase in prices while aggregate demand decreases. This result builds on the endogenous price elasticity of demand amplified by variation in capacity utilization. These changes in the volatility of policy targets and the effectiveness of policy transmission affect optimal monetary policy not only for monetary shocks, but also for TFP and search effort shocks — warranting further analysis in a medium-scale NK-DSGE setting with goods market SaM.

While long-term contracts might mitigate informational search costs (see section 6.3), data show such costs are minor (see Petrosky-Nadeau et al. (2016)). Instead, predominant frictions — travel and waiting — persist, rendering search effort a key macroeconomic margin. Further, in the NK-SaM model, consumption combines pecuniary and time costs, linking cyclical search effort to inflation. Given this structure, proxies for search cost enable adjusted inflation metrics (see corollary 1) and household-specific welfare analysis. However, non-pecuniary costs depend on time-use preferences, which require careful study. A drawback of the model is, that it underperforms in replicating the labor wedge, highlighting a trade-off with capacity utilization. Incorporating labor market frictions may resolve this and align both wedges more closely with data.

Overall, the framework highlights how pecuniary and non-pecuniary consumption costs shape inflation, output dynamics, and monetary policy over the business cycle. It invites further work on goods market structure within NK models. Extending it to include features such as an intensive trade margin, advertising, endogenous long-term contracts, or household heterogeneity could sharpen its policy relevance.

References

Adjemian, S., Juillard, M., Karamé, F., Mutschler, W., Pfeifer, J., Ratto, M., Rion, N., Villemot, S., 2024. Dynare: Reference manual, version 6. Technical Report 80. CEPREMAP. Series: Dynare working papers.

Ascari, G., Magnusson, L.M., Mavroeidis, S., 2021. Empirical evidence on the Euler equation for consumption in the US. Journal of Monetary Economics 117, 129–152. Publisher: Elsevier.

Bai, Y., Rios-Rull, J.V., Storesletten, K., 2024. Demand shocks as technology shocks. Technical Report.

Basu, S., Fernald, J.G., Kimball, M.S., 2006. Are technology improvements contractionary? American Economic Review 96, 1418–1448–1418–1448.

Becker, G.S., 1965. A theory of the allocation of time. The economic journal 75, 493–517.

Benabou, R., 1988. Search, price setting and inflation. The Review of Economic Studies 55, 353–376. Publisher: Wiley-Blackwell.

Benabou, R., 1992. Inflation and efficiency in search markets. The Review of Economic Studies 59, 299–329. Publisher: Wiley-Blackwell.

Benhabib, J., Rogerson, R., Wright, R., 1991. Homework in macroeconomics: Household production and aggregate fluctuations. Journal of Political Economy 99, 1166–1187–1166–1187.

Blanchard, O., Gali, J., 2010. Labor markets and monetary policy: A New Keynesian model with unemployment. American Economic Journal: Macroeconomics 2, 1–30–1–30.

Burdett, K., Judd, K.L., 1983. Equilibrium price dispersion. Econometrica: Journal of the Econometric Society , 955–969.

Chetty, R., Guren, A., Manoli, D., Weber, A., 2013. Does indivisible labor explain the difference between micro and macro elasticities? a meta-analysis of extensive margin elasticities. NBER macroeconomics Annual 27, 1–56.

Christiano, L.J., Eichenbaum, M., Evans, C.L., 2005. Nominal rigidities and the dynamic effects of a shock to monetary policy. Journal of Political Economy 113, 1–45–1–45.

Christiano, L.J., Trabandt, M., Walentin, K., 2010. DSGE models for monetary policy analysis, in: Handbook of Monetary Economics. Elsevier. volume 3, pp. 285–367–285–367.

Den Haan, W.J., Sun, T., 2024. The role of sell frictions for inventories and business cycles. London School of Economics and Political Science.

Diamond, P., 1971. A model of price adjustment. Journal of Economic Theory 3, 156–168.

Diamond, P.A., 1982. Aggregate demand management in search equilibrium. Journal of political Economy 90, 881–894. Publisher: The University of Chicago Press.

Dixit, A.K., Stiglitz, J.E., 1977. Monopolistic competition and optimum product diversity. American Economic Review 67, 297–308–297–308.

Erceg, C.J., Henderson, D.W., Levin, A.T., 2000. Optimal monetary policy with staggered wage and price contracts. Journal of Monetary Economics 46, 281–313.

Faccini, R., Yashiv, E., 2022. The importance of hiring frictions in business cycles. Quantitative Economics 13, 1101–1143.

Gali, J., 1999. Technology, employment, and the business cycle: do technology shocks explain aggregate fluctuations? American economic review 89, 249–271. Publisher: American Economic Association.

Gali, J., 2011. Unemployment fluctuations and stabilization policies: a new Keynesian perspective. MIT press.

Galí, J., 2011. Unemployment fluctuations and stabilization policies: a new Keynesian perspective. MIT press.

Gali, J., 2015. Monetary policy, inflation, and the business cycle: an introduction to the new Keynesian framework and its applications. Princeton University Press.

Gali, J., Gambetti, L., 2019. Has the US wage Phillips curve flattened? A semi-structural exploration. Technical Report.

Gali, J., Gertler, M., 1999. Inflation dynamics: A structural econometric analysis. Journal of Monetary Economics 44, 195–222–195–222.

Gantert, K., 2025. Revisiting TFP Dynamics: The Role of Goods Market Search and Capacity Utilization over the Business Cycle. Technical Report. Tilburg University.

Gnocchi, S., Hauser, D., Pappa, E., 2016. Housework and fiscal expansions. Journal of Monetary Economics 79, 94–108–94–108.

Gourio, F., Rudanko, L., 2014. Customer capital. Review of Economic Studies 81, 1102–1136. Publisher: Oxford University Press.

Greenwood, J., Hercowitz, Z., 1991. The allocation of capital and time over the business cycle. Journal of political Economy 99, 1188–1214–1188–1214.

Greenwood, J., Hercowitz, Z., Huffman, G.W., 1988. Investment, capacity utilization, and the real business cycle. American Economic Review , 402–417–402–417.

Hall, R.E., 2012. The cyclical response of advertising refutes counter-cyclical profit margins in favor of product-market frictions. Technical Report.

Harding, M., Lindé, J., Trabandt, M., 2023. Understanding post-covid inflation dynamics. Journal of Monetary Economics 140, S101–S118.

Harding, M., Lindé, J., Trabandt, M., 2022. Resolving the missing deflation puzzle. Journal of Monetary Economics 126, 15–34. Publisher: Elsevier.

Head, A., Liu, L.Q., Menzio, G., Wright, R., 2012. Sticky prices: A new monetarist approach. Journal of the European Economic Association 10, 939–973. Publisher: Oxford University Press.

Heathcote, J., Storesletten, K., Violante, G.L., 2010. The macroeconomic implications of rising wage inequality in the United States. Journal of political economy 118, 681–722–681–722.

Huo, Z., Rios-Rull, J.V., 2020. Demand induced fluctuations. Review of Economic Dynamics 37, S99–S117–S99–S117.

Ireland, P.N., 2004. Technology shocks in the new Keynesian model. Review of Economics and Statistics 86, 923–936–923–936.

Kaplan, G., Menzio, G., 2016. Shopping externalities and self-fulfilling unemployment fluctuations. Journal of Political Economy 124, 771–825–771–825.

Karabarbounis, L., 2014. The labor wedge: Mrs vs. mpn. Review of Economic Dynamics 17, 206–223.

Keane, M., Rogerson, R., 2012. Micro and macro labor supply elasticities: A reassessment of conventional wisdom. Journal of Economic Literature 50, 464–76–464–76.

Khan, A., Thomas, J.K., 2007. Inventories and the business cycle: An equilibrium analysis of (S, s) policies. American Economic Review 97, 1165–1188–1165–1188.

King, R.G., Plosser, C.I., Rebelo, S.T., 1988. Production, growth and business cycles: I. The basic neoclassical model. Journal of Monetary Economics 21, 195–232–195–232.

Knotek, E.S., 2007. How useful is okun's law? Economic Review-Federal Reserve Bank of Kansas City 92, 73.

Lechthaler, W., Snower, D.J., 2013. Quadratic labor adjustment costs, business cycle dynamics, and optimal monetary policy. Macroeconomic Dynamics 17, 464–475–464–475.

Lester, R., 2014. Home production and sticky price models: Implications for monetary policy. Journal of Macroeconomics 41, 107–121–107–121.

Mathä, T.Y., Pierrard, O., 2011. Search in the product market and the real business cycle. Journal of Economic Dynamics and Control 35, 1172–1191–1172–1191.

McGrattan, E.R., Rogerson, R., Wright, R., 1997. An equilibrium model of the business cycle with household production and fiscal policy. International Economic Review , 267–290.

Merz, M., 1995. Search in the labor market and the real business cycle. Journal of Monetary Economics 36, 269–300–269–300.

Michaillat, P., Saez, E., 2015. Aggregate demand, idle time, and unemployment. Quarterly Journal of Economics 130, 507–569–507–569.

Moen, E.R., 1997. Competitive search equilibrium. Journal of Political Economy 105, 385–411–385–411.

Paciello, L., Pozzi, A., Trachter, N., 2019. Price dynamics with customer markets. International Economic Review 60, 413–446. Publisher: Wiley Online Library.

Petrosky-Nadeau, N., Wasmer, E., 2015. Macroeconomic dynamics in a model of goods, labor, and credit market frictions. Journal of Monetary Economics 72, 97–113–97–113.

Petrosky-Nadeau, N., Wasmer, E., Weil, P., 2021. When hosios meets phillips: Connecting efficiency and stability to demand shocks .

Petrosky-Nadeau, N., Wasmer, E., Zeng, S., 2016. Shopping time. Economics Letters 143, 52–60–52–60.

Qiu, Z., Rios-Rull, J.V., 2022. Procyclical productivity in new keynesian models. Technical Report.

Rotemberg, J.J., 1982. Monopolistic price adjustment and aggregate output. Review of Economic Studies 49, 517–531–517–531.

Safonova, D., 2017. Home production, employment, and monetary policy. The Quarterly Review of Economics and Finance 64, 57–66.

Sbordone, A.M., 2002. Prices and unit labor costs: a new test of price stickiness. Journal of Monetary economics 49, 265–292–265–292.

Schmitt-Grohé, S., Uribe, M., 2025. Hotelling Meets Keynes: Aggregate Adjustment with Spatial Competition and Nominal Rigidity. Technical Report. National Bureau of Economic Research.

Smets, F., Wouters, R., 2007. Shocks and frictions in US business cycles: A Bayesian DSGE approach. American Economic Review 97, 586–606–586–606.

Sun, T., 2024. Excess capacity and demand-driven business cycles. Review of Economic Studies , rdae072.

Taylor, J.B., 1993. Discretion versus policy rules in practice, pp. 195–214–195–214.

Yun, T., 1996. Nominal price rigidity, money supply endogeneity, and business cycles. Journal of monetary Economics 37, 345–370.

APPENDIX

Appendix A. Complete Model Setup and Derivation of First-Order Conditions

Appendix A.1. Goods Market Setup

Goods market law of motion:

$$T_t(i,j) \;=\; (1-\delta_T)\, T_{t-1}(i,j) + m_t(i,j) \tag{A.1}$$

Goods market matching function:

$$m_t(i,j) \;= \psi_{S,t}\left[\gamma_S H_{S,t}(i,j)^{\Gamma_S} + (1-\gamma_S) S_t(i,j)^{\Gamma_S}\right]^{\frac{1}{\Gamma_S}} \tag{A.2}$$

Goods market tightness:

$$x_t(i,j) \;= \frac{H_{S,t}(i,j)}{S_t(i,j)} \;=\; \frac{q_t(i,j)}{f_t(i,j)} \tag{A.3}$$

Goods market matching probabilities:

$$f_t(i,j) \;= \frac{m_t(i,j)}{H_{S,t}(i,j)} \;=\; \psi_{S,t}\left[\gamma_S + (1-\gamma_S) x_t(i,j)^{-\Gamma_S}\right]^{\frac{1}{\Gamma_S}} \tag{A.4}$$

$$q_t(i,j) \;= \frac{m_t(i,j)}{S_t(i,j)} \;=\; \psi_{S,t}\left[\gamma_S x_t(i,j)^{\Gamma_S} + (1-\gamma_S)\right]^{\frac{1}{\Gamma_S}} \tag{A.5}$$

Appendix A.2. Labor Union: Aggregator and Quadratic Hours Adjustment Cost

Optimization Problem of the Labor Union.

$$\mathcal{L} = \max_{H_{M,t},H_{M,t}(i),H_{M,t}(j)} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_{0,t} \Bigg\{ \left[W_t \int_0^1 H_{M,t}(i)di - \int_0^1 W_t(j) H_{M,t}(j)dj - c_{HM,t} W_t H_{M,t} \right]$$
$$- \Omega_{1,t} \left[H_{M,t} - \left(\int_0^1 H_{M,t}(j)^{\frac{\epsilon_W - 1}{\epsilon_W}} dj \right)^{\frac{\epsilon_W}{\epsilon_W - 1}} \right]$$
$$- \Omega_{2,t} \left[H_{M,t} - \int_0^1 H_{M,t}(i)di \right] \Bigg\}$$

First-order condition.

$$W_t(j) \left(\frac{H_{M,t}(j)}{H_{M,t}} \right)^{\frac{1}{\epsilon_W}} = W_t \phi_{HM,t}, \tag{A.6}$$

where

$$\phi_{HM,t} = 1 - c_{HM,t} - c'_{HM,t} + \mathbb{E}_t \beta_{t,t+1} \frac{W_{t+1}}{W_t} \left(\frac{H_{M,t+1}}{H_{M,t}} \right) c'_{HM,t+1},$$

with

$$c_{HM,t} = \frac{\kappa_{HM}}{2} \left(\frac{H_{M,t}}{H_{M,t-1}} - 1 \right)^2,$$
$$c'_{HM,t} = \kappa_{HM} \left(\frac{H_{M,t}}{H_{M,t-1}} - 1 \right) \frac{H_{M,t}}{H_{M,t-1}}.$$

Appendix A.3. Optimization Problem: Household of Type j

Appendix A.3.1. Lagrange Maximization Problem (Households)

The utility maximization problem of each household is given by

$$
\begin{aligned}
\mathcal{L} = \max_{\substack{C_t(i,j),D_t(i,j),H_t(i,j),W_t(i,j),\\ B_t(i,j),K_t(i,j),I_t(i,j)}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \Bigg\{ & \mathbb{U}\Big(C_t(j), H_{S,t}(i,j), H_{H,t}(j), H_{M,t}(j) \Big) \\
& - \lambda_{1,t} \Bigg[B_t(j) - (1 + r_{t-1})\, B_{t-1}(j) + \int_0^1 P_t(i,j) T_t(i,j) di \\
& \qquad - \Big(1 - c_{W,t}(j)\Big) W_t(j) H_{M,t}(j) - P_t r_{K,t} e_{M,t}(j) K_{M,t-1}(j) - \Pi_t \Bigg] \\
& - \lambda_{2,t} \Bigg[C_t(j) - \Big(\gamma_H C_{H,t}(j)^{\Gamma_H} + (1 - \gamma_H)\, C_{M,t}(j)^{\Gamma_H} \Big)^{\frac{1}{\Gamma_H}} \Bigg] \\
& - \int_0^1 \lambda_{3,t}(i,j) \Bigg[T_t(i,j) - (1 - \delta_T)\, T_{t-1}(i,j) - f_t(i,j) H_{S,t}(i,j) \Bigg] di \\
& - \lambda_{4,t} \Bigg[H_{M,t}(j) - \left(\frac{W_t^*}{W_t(j)} \phi_{HM,t} \right)^{\epsilon_W} H_{M,t} \Bigg] \\
& - \lambda_{5,t} \Bigg[K_{M,t}(j) - \Big(1 - \delta_M\left(e_{M,t}(j)\right)\Big) K_{M,t-1}(j) - \Big(1 - c_{MI,t}(j)\Big) I_{M,t}(j) \Bigg] \\
& - \lambda_{6,t} \Bigg[K_{H,t}(j) - \Big(1 - \delta_H\left(e_{H,t}(j)\right)\Big) K_{H,t-1}(j) - \Big(1 - c_{HI,t}(j)\Big) I_{H,t}(j) \Bigg] \\
& - \lambda_{7,t} \Bigg[\left(\int_0^1 T_t(i,j)^{\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}} - C_{M,t}(j) - I_{M,t}(j) - I_{H,t}(j) \Bigg] \Bigg\},
\end{aligned}
$$

where

$$
C_{H,t}(j) \; = H_{H,t}(j)^{1-\alpha_H} \Big[e_{H,t}(j) K_{H,t-1}(j) \Big]^{\alpha_H},
$$

and it is assumed that the no-Ponzi scheme condition $\lim_{T\to\infty} \mathbb{E}_t B_T(j) \geq 0$ holds.

Appendix A.3.2. Functional Forms (Households)

Cost functions. Adjustment costs and capital depreciation are described by

$$\begin{aligned}
c_{W,t}(j) &= \frac{\kappa_W}{2}\left(\frac{W_t(j)}{W_{t-1}(j)}-1\right)^2, \\
\delta_{M,t}(j) &= \delta_{M1}+\frac{\delta_{M2}\delta_{M3}}{2}\Big(e_{M,t}(j)-1\Big)^2+\delta_{M3}\Big(e_{M,t}(j)-1\Big), \\
\delta_{H,t}(j) &= \delta_{H1}+\frac{\delta_{H2}\delta_{H3}}{2}\Big(e_{H,t}(j)-1\Big)^2+\delta_{H3}\Big(e_{H,t}(j)-1\Big), \\
c_{MI,t}(j) &= \frac{\kappa_{MI}}{2}\left(\frac{I_{M,t}(j)}{I_{M,t-1}(j)}-1\right)^2, \\
c_{HI,t}(j) &= \frac{\kappa_{HI}}{2}\left(\frac{I_{H,t}(j)}{I_{H,t-1}(j)}-1\right)^2.
\end{aligned}$$

Utility Function. Preferences either follow Greenwood et al. (1988) or King et al. (1988) and the convexity of search effort disutility can either apply to overall household search effort or firm-specific search effort.

GHH preferences (aggregate/firm-specific convexity in search disutility):

$$\mathbb{U}_t(i,j) = \frac{1}{1-\sigma}\left[C_t(j)-\mu_{S,t}\frac{\int_0^1 H_{S,t}(i,j)^{1+\nu_S}di}{1+\nu_S}-\mu_H\frac{H_{H,t}(j)^{1+\nu_H}}{1+\nu_H}-\mu_M\frac{H_{M,t}(j)^{1+\nu_M}}{1+\nu_M}\right]^{1-\sigma} \tag{A.7}$$

$$\mathbb{U}_t(i,j) = \frac{1}{1-\sigma}\left[C_t(j)-\mu_{S,t}\frac{\left(\int_0^1 H_{S,t}(i,j)di\right)^{1+\nu_S}}{1+\nu_S}-\mu_H\frac{H_{H,t}(j)^{1+\nu_H}}{1+\nu_H}-\mu_M\frac{H_{M,t}(j)^{1+\nu_M}}{1+\nu_M}\right]^{1-\sigma} \tag{A.8}$$

KPR preferences (aggregate/firm-specific convexity in search disutility):

$$\mathbb{U}_t(i,j) = \frac{C_t(j)^{1-\sigma}}{1-\sigma}-\mu_{S,t}\frac{\left(\int_0^1 H_{S,t}(i,j)di\right)^{1+\nu_S}}{1+\nu_S}-\mu_H\frac{H_{H,t}(j)^{1+\nu_H}}{1+\nu_H}-\mu_M\frac{H_{M,t}(j)^{1+\nu_M}}{1+\nu_M} \tag{A.9}$$

$$\mathbb{U}_t(i,j) = \frac{C_t(j)^{1-\sigma}}{1-\sigma}-\mu_{S,t}\frac{\int_0^1 H_{S,t}(i,j)^{1+\nu_S}di}{1+\nu_S}-\mu_H\frac{H_{H,t}(j)^{1+\nu_H}}{1+\nu_H}-\mu_M\frac{H_{M,t}(j)^{1+\nu_M}}{1+\nu_M} \tag{A.10}$$

FOC composite consumption (aggregate/firm-specific convexity in search disutility):

$$\frac{\partial\mathbb{U}_t(i,j)}{\partial C_t(j)} = \left[C_t(j)-ghh\left(\mu_{S,t}\frac{H_{S,t}(j)^{1+\nu_S}}{1+\nu_S}+\mu_H\frac{H_{H,t}(j)^{1+\nu_H}}{1+\nu_H}+\mu_M\frac{H_{M,t}(j)^{1+\nu_M}}{1+\nu_M}\right)\right]^{-\sigma} \tag{A.11}$$

$$\frac{\partial\mathbb{U}_t(i,j)}{\partial C_t(j)} = \left[C_t(j)-ghh\left(\mu_{S,t}\frac{\int_0^1 H_{S,t}(i,j)^{1+\nu_S}di}{1+\nu_S}+\mu_H\frac{H_{H,t}(j)^{1+\nu_H}}{1+\nu_H}+\mu_M\frac{H_{M,t}(j)^{1+\nu_M}}{1+\nu_M}\right)\right]^{-\sigma} \tag{A.12}$$

FOC search effort (aggregate/firm-specific convexity in search disutility):

$$\frac{\partial \mathbb{U}_t(i,j)}{\partial H_{S,t}(i,j)} = \left[ghh \frac{\partial \mathbb{U}_t(i,j)}{\partial C_t(j)} + (1-ghh)\right](-\mu_{S,t}) \left(\int_0^1 H_{S,t}(i,j)di\right)^{\nu_S} \tag{A.13}$$

$$\frac{\partial \mathbb{U}_t(i,j)}{\partial H_{S,t}(i,j)} = \left[ghh \frac{\partial \mathbb{U}_t(i,j)}{\partial C_t(j)} + (1-ghh)\right](-\mu_{S,t}) H_{S,t}(i,j)^{\nu_S} \tag{A.14}$$

FOCs home and market labor supply:

$$\frac{\partial \mathbb{U}_t(i,j)}{\partial H_{H,t}(j)} = \left[ghh \frac{\partial \mathbb{U}_t(i,j)}{\partial C_t(j)} + (1-ghh)\right](-\mu_H) H_{H,t}(j)^{\nu_H} \tag{A.15}$$

$$\frac{\partial \mathbb{U}_t(i,j)}{\partial H_{M,t}(j)} = \left[ghh \frac{\partial \mathbb{U}_t(i,j)}{\partial C_t(j)} + (1-ghh)\right](-\mu_M) H_{M,t}(j)^{\nu_M} \tag{A.16}$$

where ghh is an indicator variable for the GHH preferences.

Appendix A.3.3. First-Order Conditions (Households)

$$\left[\frac{\frac{\partial \mathbb{U}_t(i,j)}{\partial H_{M,t}(j)}}{muc_t(j)} + w_t(j)\Big(1 - c_{W,t}(j)\Big)\right] \epsilon_W \left(\frac{W_t^*}{W_t(j)}\phi_{HM,t}\right)^{\epsilon_W} = w_t(j)\Big[1 - c_{W,t}(j) - c'_{W,t}(j)\Big] + \mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t} w_{t+1}(j) \frac{H_{M,t+1}(j)}{H_{M,t}(j)} c'_{W,t+1}(j) \tag{A.17}$$

$$\mathbb{W}_{C,t}(j) = \frac{\partial \mathbb{U}_t(i,j)}{\partial C_t(j)} (1-\gamma_H) \left(\frac{C_{M,t}(j)}{C_t(j)}\right)^{\Gamma_H - 1} \tag{A.18}$$

$$(-1)\frac{\partial \mathbb{U}_t(i,j)}{\partial H_{H,t}(j)} = \frac{\partial \mathbb{U}_t(i,j)}{\partial C_t(j)} \gamma_H (1-\alpha_H) \left(\frac{C_{H,t}(j)}{C_t(j)}\right)^{\Gamma_H - 1} \frac{C_{H,t}}{H_{H,t}(j)} \tag{A.19}$$

$$\frac{P_t(i,j)}{P_t} = \frac{\mathbb{W}_{C,t}(j)}{muc_t(j)} \left(\frac{T_t(j)}{T_t(i,j)}\right)^{\frac{1}{\epsilon}} - P_{S,t}(i,j) + (1-\delta_T)\,\mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t} P_{S,t+1}(i,j) \tag{A.20}$$

$$muc_t(j) = \beta \mathbb{E}_t \frac{1+r_t}{1+\pi_{t+1}} muc_{t+1}(j) \tag{A.21}$$

$$Q_{M,t}(j) = \mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t}\Big[r_{K,t+1} e_{M,t+1} + \left(1 - \delta\left(e_{M,t+1}(j)\right)\right) Q_{M,t+1}(j)\Big] \tag{A.22}$$

$$\frac{\mathbb{W}_{C,t}(j)}{muc_t(j)} = Q_{M,t}(j)\left[1 - c_{MI,t}(j) - c'_{MI,t}(j)\right] + \mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t} Q_{M,t+1}(j) \frac{I_{M,t+1}(j)}{I_{M,t}(j)} c'_{MI,t+1}(j) \tag{A.23}$$

$$r_{K,t} = Q_{M,t}(j) \frac{\partial \delta\left(e_{M,t}(j)\right)}{\partial e_{M,t}(j)} \tag{A.24}$$

$$Q_{H,t}(j) = \mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t} \gamma_H \alpha_H \frac{\frac{\partial \mathbb{U}_{t+1}(i,j)}{\partial C_{t+1}(j)}}{muc_{t+1}(j)} \left(\frac{C_{H,t+1}(j)}{C_{t+1}(j)}\right)^{\Gamma_H - 1} \frac{C_{H,t+1}(j)}{K_{H,t}(j)} + \mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t}\left[1 - \delta\left(e_{H,t+1}(j)\right)\right] Q_{H,t+1}(j) \tag{A.25}$$

$$\frac{\mathbb{W}_{C,t}(j)}{muc_t(j)} = Q_{H,t}(j)\left[1 - c_{HI,t}(j) - c'_{HI,t}(j)\right] + \mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t} Q_{H,t+1}(j) \frac{I_{H,t+1}(j)}{I_{H,t}(j)} c'_{HI,t+1}(j) \tag{A.26}$$

$$\frac{\partial \delta\left(e_{H,t}(j)\right)}{\partial e_{H,t}(j)} = \gamma_H \alpha_H \left(\frac{C_{H,t}(j)}{C_t(j)}\right)^{\Gamma_H - 1} \frac{C_{H,t}(j)}{e_{H,t}(j)} \frac{\frac{\frac{\partial \mathbb{U}_t(i,j)}{\partial C_t(j)}}{muc_t(j)}}{Q_{H,t}(j) K_{H,t-1}(j)} \tag{A.27}$$

where

$$P_{S,t}(i,j) = \frac{c'_{S,t}(i,j)}{muc_t(j)} = (-1)\frac{\frac{\partial \mathbb{U}_t(i,j)}{\partial H_{S,t}(i,j)}}{f_t(i,j)} \frac{1}{muc_t(j)}. \tag{A.28}$$

Appendix A.3.4. Derivation of price elasticity of demand

Starting point – Inverse demand function derived from household FOCs:

$$\frac{P_t(i,j)}{P_t} = \frac{\mathbb{W}_{C,t}(j)}{muc_t(j)} \left(\frac{T_t(j)}{T_t(i,j)}\right)^{\frac{1}{\epsilon}} - P_{S,t}(i,j) + (1-\delta_T)\,\mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t} P_{S,t+1}(i,j)$$

First derivative:

$$\frac{\partial P_t(i,j)}{\partial T_t(i,j)} \frac{1}{P_t} = \frac{-1}{\epsilon} T_t(i,j)^{-1} \frac{\mathbb{W}_{C,t}}{muc_t(j)} \left(\frac{T_t(j)}{T_t(i,j)}\right)^{\frac{1}{\epsilon}} \tag{A.29}$$

Price elasticity of demand:

$$\Xi_t = \frac{P_t(i,j)}{T_t(i,j)} \cdot \frac{\partial T_t(i,j)}{\partial P_t(i,j)} \tag{A.30}$$

$$= (-\epsilon) \frac{P_t(i,j)}{P_t} \frac{muc_t(j)}{\mathbb{W}_{C,t}(j)} \left(\frac{T_t(i,j)}{T_t(j)}\right)^{\frac{1}{\epsilon}} \tag{A.31}$$

$$\overset{\text{Symmetry}}{\Rightarrow} \Xi_t = (-\epsilon) \frac{muc_t(j)}{\mathbb{W}_{C,t}(j)} \tag{A.32}$$

Benchmark case (setting $\gamma_S = 0 \Rightarrow P_{S,t} = 0$):

$$\Xi_t = (-\epsilon) \frac{P_t(i,j)}{P_t} \left(\frac{T_t(i,j)}{T_t(j)}\right)^{\frac{1}{\epsilon}} \tag{A.33}$$

$$\overset{\text{Symmetry}}{\Rightarrow} \Xi_t = (-\epsilon) \tag{A.34}$$

Appendix A.4. Optimization Problem: Goods Firms of Type i

Appendix A.4.1. Lagrange Maximization Problem (Firms)

The profit maximization of each firm is given by

$$
\begin{aligned}
\mathcal{L} \;=\; & \max_{\substack{T_t(i,j),S_t(i,j),x_t(i,j)\\ P_t(i,j),H_{M,t}(i),K_{Me,t}(i)}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_{0,t} \Bigg\{ \left[\int_0^1 P_t(i,j) T_t(i,j) dj - W_t(i) H_{M,t}(i) - P_t r_{K,t} K_{Me,t}(i) \right] \\
& - \phi_{1,t} \Bigg[\int_0^1 \Big(1 + c_{P,t}(i,j)\Big) S_t(i,j) dj - A_t H_{M,t}(i)^{1-\alpha_M} K_{Me,t}(i)^{\alpha_M} \\
& \qquad + (1-\delta_T) \int_0^1 T_{t-1}(i,j) dj - (1-\delta_I) \int_0^1 \Big(1 - q_{t-1}(i,j)\Big) S_{t-1}(i,j) dj \Bigg] \\
& - \int_0^1 \phi_{2,t}(i,j) \Big[T_t(i,j) - (1-\delta_T) T_{t-1}(i,j) - m_t(i,j) \Big] dj \\
& - \int_0^1 \phi_{3,t}(i,j) \Bigg[\frac{P_t(i,j)}{P_t} - \frac{\mathbb{W}_{C,t}(j)}{muc_t(j)} \left(\frac{T_t(j)}{T_t(i,j)} \right)^{\frac{1}{\epsilon}} + P_{S,t}(i,j) \\
& \qquad - (1-\delta_T) \mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t} P_{S,t+1}(i,j) \Bigg] dj \Bigg\},
\end{aligned}
$$

where $\mathcal{Y}_{M,t}(i) = A_t H_{M,t}(i)^{1-\alpha_M} K_{Me,t}(i)^{\alpha_M}$. The last constraint states the household consumption demand equation as derived in (A.20) and aggregated over all households. Price adjustment costs are given by

$$
c_{P,t}(i,j) \;= \frac{\kappa_P}{2} \left(\frac{P_t(i,j)}{P_{t-1}(i,j)} - 1 \right)^2 .
$$

Appendix A.4.2. First-Order Conditions (Firms)

$$w_t = (1-\alpha_M) A_t \left(\frac{K_{Me,t}(i)}{H_{M,t}(i)}\right)^{\alpha_M} mc_{Y,t}(i) \tag{A.35}$$

$$r_{K,t} = \alpha_M A_t \left(\frac{K_{Me,t}(i)}{H_{M,t}(i)}\right)^{\alpha_M - 1} mc_{Y,t}(i) \tag{A.36}$$

$$\begin{aligned} \frac{P_t(i,j)}{P_t} &= pr_t(i,j) + \varphi_t(i,j) \frac{\mathbb{W}_{C,t}(j)}{muc_t(j)} \frac{1}{\epsilon} \left(\frac{T_t(j)}{T_t(i,j)}\right)^{\frac{1}{\epsilon}} T_t(i,j)^{-1} \\ &+ \mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t} (1-\delta_T) \left[mc_{Y,t+1}(i) - pr_{t+1}(i,j) \right] \end{aligned} \tag{A.37}$$

$$\begin{aligned} mc_{Y,t}(i) &= \frac{1}{1+c_{P,t}(i,j)} \left[q_t(i,j) pr_t(i,j) - \mathbb{I}_{HS} \cdot \varphi_t(i,j) \nu_S \frac{P_{S,t}(i,j)}{S_t(i,j)} \right. \\ &\left. + \mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t} (1-\delta_I)(1-q_t(i,j)) mc_{Y,t+1}(i) \right] \end{aligned} \tag{A.38}$$

$$\varphi_t(i,j) = \frac{\gamma_S x_t(i,j)^{\Gamma_S} \frac{m_t(i,j)}{P_{S,t}(i,j)} \left[pr_t(i,j) - \mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t} (1-\delta_I) mc_{Y,t+1}(i) \right]}{(1-\gamma_S) - \mathbb{I}_{HS} \cdot \nu_S \left[\gamma_S x_t(i,j)^{\Gamma_S} + (1-\gamma_S) \right]} \tag{A.39}$$

$$c'_{P,t}(i,j) = \frac{\frac{P_t(i,j)}{P_t} \left[T_t(i,j) - \varphi_t(i,j) \right]}{mc_{Y,t}(i) S_t(i,j)} + \mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t} \frac{mc_{Y,t+1}(i) S_{t+1}(i,j)}{mc_{Y,t}(i) S_t(i,j)} c'_{P,t+1}(i,j) \tag{A.40}$$

where $\mathbb{I}_{HS}$ is an indicator variable for the alternative search effort disutility preferences, $H_{S,t}(j) = \left(\int_0^1 H_{S,t}(i,j)^{1+\nu_S} di\right)$. Marginal cost have to be corrected by capacity utilization to be comparable to the textbook NK model with

$$mc_t = \frac{mc_{Y,t}}{e_{S,t}}, \tag{A.41}$$

where $e_{S,t}(i) = \frac{T_t(i)}{\mathcal{Y}_{M,t}(i)}$ is the short-run capacity utilization of available firm capacity.

Appendix A.5. Symmetric Model

Appendix A.5.1. Representative Household

The FOCs and constraints of the symmetric model follow the assumption that all firms have the same technology and all households the same preferences. We can therefore drop the firm indexes i of differentiated goods and the household indexes j of differentiated labor, as both are given by representative good and labor supply. The system of representative household FOCs is given by

$$(-1)\frac{\frac{\partial \mathbb{U}_t}{\partial H_{M,t}}}{muc_t} = w_t\left(1-c_{W,t}\right)\left(1-\frac{1}{\epsilon_W c_{HM,t}^{\epsilon_W}}\right)+\frac{w_t c'_{W,t}}{\epsilon_W c_{HM,t}^{\epsilon_W}}-\mathbb{E}_t\frac{1+\pi_{t+1}}{1+r_t}\frac{H_{M,t+1}}{H_{M,t}}\frac{w_{t+1}c'_{W,t+1}}{\epsilon_W c_{HM,t}^{\epsilon_W}} \quad (A.42)$$

$$muc_t = \beta\mathbb{E}_t\frac{1+r_t}{1+\pi_{t+1}}muc_{t+1}, \quad (A.43)$$

$$\frac{\mathbb{W}_{C,t}}{muc_t} = 1-P_{S,t}+\left(1-\delta_T\right)\mathbb{E}_t\frac{1+\pi_{t+1}}{1+r_t}P_{S,t+1}, \quad (A.44)$$

$$\mathbb{W}_{C,t} = \frac{\partial \mathbb{U}_t}{\partial C_t}\left(1-\gamma_H\right)\left(\frac{C_{M,t}}{C_t}\right)^{\Gamma_H-1}, \quad (A.45)$$

$$(-1)\frac{\partial \mathbb{U}_t}{\partial H_{H,t}} = \frac{\partial \mathbb{U}_t}{\partial C_t}\gamma_H\left(1-\alpha_H\right)\left(\frac{C_{H,t}}{C_t}\right)^{\Gamma_H-1}\frac{C_{H,t}}{H_{H,t}}, \quad (A.46)$$

$$\begin{aligned} Q_{M,t} &= \mathbb{E}_t\frac{1+\pi_{t+1}}{1+r_t}e_{M,t+1}r_{K,t+1} \\ &+\mathbb{E}_t\frac{1+\pi_{t+1}}{1+r_t}Q_{M,t+1}\left[1-\delta_{M1}-\frac{\delta_{M2}\delta_{M3}}{2}\left(e_{M,t+1}-1\right)^2-\delta_{M3}\left(e_{M,t+1}-1\right)\right], \end{aligned} \quad (A.47)$$

$$\frac{\mathbb{W}_{C,t}}{muc_t} = Q_{M,t}\left[1-c_{MI,t}-c'_{MI,t}\right]+\mathbb{E}_t\frac{1+\pi_{t+1}}{1+r_t}Q_{M,t+1}c'_{I,t+1}\frac{I_{M,t+1}}{I_{M,t}}, \quad (A.48)$$

$$r_{K,t} = Q_{M,t}\left[\delta_{M2}\delta_{M3}\left(e_{M,t}-1\right)+\delta_{M3}\right], \quad (A.49)$$

$$\begin{aligned} Q_{H,t} &= \mathbb{E}_t\frac{1+\pi_{t+1}}{1+r_t}\frac{\frac{\partial \mathbb{U}_{t+1}}{\partial C_{t+1}}}{muc_{t+1}}\gamma_H\alpha_H\left(\frac{C_{H,t+1}}{C_{t+1}}\right)^{\Gamma_H-1}\frac{C_{H,t+1}}{K_{H,t}} \\ &+\mathbb{E}_t\frac{1+\pi_{t+1}}{1+r_t}Q_{H,t+1}\left[1-\delta_{H1}-\frac{\delta_{H2}\delta_{H3}}{2}\left(e_{H,t+1}-1\right)^2-\delta_{H3}\left(e_{H,t+1}-1\right)\right], \end{aligned} \quad (A.50)$$

$$\frac{\mathbb{W}_{C,t}}{muc_t} = Q_{H,t}\left[1-c_{HI,t}-c'_{HI,t}\right]+\mathbb{E}_t\frac{1+\pi_{t+1}}{1+r_t}Q_{H,t+1}\frac{I_{H,t+1}}{I_{H,t}}c'_{HI,t+1}, \quad (A.51)$$

$$Q_{H,t} = \frac{\gamma_H\alpha_H\left(\frac{C_{H,t}}{C_t}\right)^{\Gamma_H-1}\frac{C_{H,t}}{e_{H,t}}}{K_{H,t-1}\left(\delta_{H2}\delta_{H3}\left(e_{H,t}-1\right)+\delta_{H3}\right)}\frac{\frac{\partial \mathbb{U}_t}{\partial C_t}}{muc_t}, \quad (A.52)$$

where

$$c'_{W,t} = \kappa_W \left(\frac{W_t}{W_{t-1}} - 1 \right) \frac{W_t}{W_{t-1}} \tag{A.53}$$

$$c_{HM,t} = 1 - \frac{\phi_{HM}}{2} \left(\frac{H_{M,t}}{H_{M,t-1}} - 1 \right)^2 - \phi_{HM} \left(\frac{H_{M,t}}{H_{M,t-1}} - 1 \right) \frac{H_{M,t}}{H_{M,t-1}} \tag{A.54}$$

$$+ \mathbb{E}_t \frac{1 + \pi_{W,t+1}}{1 + r_t} \phi_{HM} \left(\frac{H_{M,t+1}}{H_{M,t}} - 1 \right) \left(\frac{H_{M,t+1}}{H_{M,t}} \right)^2 \tag{A.55}$$

$$\frac{\partial \mathbb{U}_t}{\partial C_t} = \left[C_t - ghh \left(\mu_{S,t} \frac{H_{S,t}^{1+\nu_S}}{1+\nu_S} + \mu_H \frac{H_{H,t}^{1+\nu_H}}{1+\nu_H} + \mu_M \frac{H_{M,t}^{1+\nu_H}}{1+\nu_H} \right) \right]^{-\sigma} \tag{A.56}$$

$$\frac{\partial \mathbb{U}_t}{\partial H_{S,t}} = \left(ghh \frac{\partial \mathbb{U}_t}{\partial C_t} + (1 - ghh) \right) (-\mu_{S,t}) H_{S,t}^{\nu_S} \tag{A.57}$$

$$\frac{\partial \mathbb{U}_t}{\partial H_{H,t}} = \left(ghh \frac{\partial \mathbb{U}_t}{\partial C_t} + (1 - ghh) \right) (-\mu_H) H_{H,t}^{\nu_H} \tag{A.58}$$

$$\frac{\partial \mathbb{U}_t}{\partial H_{M,t}} = \left(ghh \frac{\partial \mathbb{U}_t}{\partial C_t} + (1 - ghh) \right) (-\mu_M) H_{M,t}^{\nu_M} \tag{A.59}$$

Appendix A.5.2. Representative Firm

The system of representative goods firm FOCs is given by

$$w_t = (1 - \alpha_M) A_t \left(\frac{K_{Me,t}}{H_{M,t}} \right)^{\alpha_M} mc_{Y,t}, \tag{A.60}$$

$$r_{K,t} = \alpha_M A_t \left(\frac{K_{Me,t}}{H_{M,t}} \right)^{\alpha_M - 1} mc_{Y,t}, \tag{A.61}$$

$$pr_t = 1 - \varphi_t \frac{\mathbb{W}_{C,t}}{muc_t} \frac{1}{\epsilon} T_t^{-1} - (1 - \delta_T) \mathbb{E}_t \frac{1 + \pi_{t+1}}{1 + r_t} \Big[mc_{Y,t+1} - pr_{t+1} \Big], \tag{A.62}$$

$$mc_{Y,t} = \frac{1}{1 + c_{P,t}} \Big[q_t pr_t - \mathbb{I}_{HS} \cdot \varphi_t \nu_S \frac{P_{S,t}}{S_t} + \mathbb{E}_t \frac{1 + \pi_{t+1}}{1 + r_t} (1 - \delta_I)(1 - q_t) mc_{Y,t+1} \Big], \tag{A.63}$$

$$\varphi_t = \frac{\gamma_S x_t^{\Gamma_S} \frac{m_t}{P_{S,t}} \Big[pr_t - \mathbb{E}_t \frac{1+\pi_{t+1}}{1+r_t} (1 - \delta_I) mc_{Y,t+1} \Big]}{(1 - \gamma_S) - \mathbb{I}_{HS} \cdot \nu_S \Big[\gamma_S x_t^{\Gamma_S} + (1 - \gamma_S) \Big]}, \tag{A.64}$$

$$c'_{P,t} = \frac{T_t}{mc_{Y,t} S_t} \left[1 - \frac{\varphi_t}{T_t} \right] + \beta \mathbb{E}_t \frac{1 + \pi_{t+1}}{1 + r_t} \frac{mc_{Y,t+1} S_{t+1}}{mc_{Y,t} S_t} c'_{P,t+1}. \tag{A.65}$$

Appendix A.5.3. Constraints and General Equilibrium

The system of household, firm, and market constraints and policy rules is given by

$$T_t = (1-\delta_T)\, T_{t-1} + q_t S_t \tag{A.66}$$

$$x_t = \frac{q_t}{f_t} \tag{A.67}$$

$$C_t = \left(\gamma_H C_{H,t}^{\Gamma_H} + (1-\gamma_H)\, C_{M,t}^{\Gamma_H}\right)^{\frac{1}{\Gamma_H}} \tag{A.68}$$

$$C_{H,t} = H_{H,t}^{1-\alpha_H} \left[e_{H,t} K_{H,t-1}\right]^{\alpha_H} \tag{A.69}$$

$$K_{M,t} = (1-\delta\,(e_{M,t}))\, K_{M,t-1} - (1-c_{MI,t})\, I_{M,t} \tag{A.70}$$

$$K_{H,t} = (1-\delta\,(e_{H,t}))\, K_{H,t-1} - (1-c_{HI,t})\, I_{H,t} \tag{A.71}$$

$$T_t = C_{M,t} + I_{M,t} + I_{H,t} \tag{A.72}$$

$$(1+c_{P,t})\, S_t = \mathcal{Y}_{M,t} - (1-\delta_T)\, T_{t-1} + (1-\delta_I)\,(1-q_t)\, S_{t-1} \tag{A.73}$$

$$Y_{M,t} = cu_t \mathcal{Y}_{M,t} \tag{A.74}$$

$$\frac{1+r_t}{1+r} = \left(\frac{1+r_{t-1}}{1+r}\right)^{i_r} \left[\left(\frac{\pi_t}{\pi}\right)^{i_\pi} \left(\frac{Y_t}{Y_{N,t}}\right)^{i_{Gap}}\right]^{1-i_r} M_t \tag{A.75}$$

Appendix A.6. Definitions of Further Variables

$$u_t = \left[\frac{w_t}{\mu_M} \frac{muc_t}{ghh \frac{\partial \mathbb{U}_t}{\partial C_t} + (1 - ghh)} \right]^{\frac{1}{\nu_M}} \frac{1}{H_{M,t}} - 1 \tag{A.76}$$

$$cu_t = \frac{Y_t}{A_t H_{M,t}^{1-\alpha_M} K_{M,t-1}^{\alpha_M}} \tag{A.77}$$

$$ls_t = \frac{w_t H_{M,t}}{Y_t} \tag{A.78}$$

$$lpr_t = \frac{Y_t}{H_{M,t}} \tag{A.79}$$

$$lw_t = 1 - \varphi_{W,t} \frac{mc_{Y,t}}{e_{S,t}} e_{M,t}^{\alpha_M} \frac{muc_t}{ghh \frac{\partial \mathbb{U}_t}{\partial C_t} + (1 - ghh)} \tag{A.80}$$

$$\varphi_{W,t} = (1 - c_{W,t}) \frac{\epsilon_W \phi_{HM,t}^{\epsilon_W} - 1}{\epsilon_W \phi_{HM,t}^{\epsilon_W}} + \frac{c'_{W,t} - \mathbb{E}_t \frac{1+\pi_{W,t+1}}{1+r_t} \frac{H_{M,t+1}}{H_{M,t}} c'_{W,t+1}}{\epsilon_W \phi_{HM,t}^{\epsilon_W}} \tag{A.81}$$

Appendix B. Reduced-Form Model

Appendix B.1. Simplified System of Non-Linear Equation

Households.

$$\mu_M H_{M,t}^{\nu_M} = \frac{muc_t \frac{w_t}{\epsilon_W}\left[(\epsilon_W - 1)(1 - c_{W,t}) + c'_{W,t}\right] - \beta \mathbb{E}_t muc_{t+1} \frac{H_{M,t+1}}{H_{M,t}} \frac{w_{t+1}}{\epsilon_W} c'_{W,t+1}}{ghh \frac{\partial \mathbb{U}_t}{\partial C_t} + (1 - ghh)}$$

$$\mu_H H_{H,t}^{\nu_H} = \frac{\frac{\partial \mathbb{U}_t}{\partial C_t} \gamma_H (1 - \alpha_H)\left(\frac{C_{H,t}}{C_t}\right)^{\Gamma_H - 1} \frac{C_{H,t}}{H_{H,t}}}{ghh \frac{\partial \mathbb{U}_t}{\partial C_t} + (1 - ghh)}$$

$$1 = (1 - \gamma_H)\left(\frac{C_{M,t}}{C_t}\right)^{\Gamma_H - 1} \frac{\frac{\partial \mathbb{U}_t}{\partial C_t}}{muc_t} - P_{S,t}$$

$$muc_t = \beta \mathbb{E}_t \frac{1 + r_t}{1 + \pi_{t+1}} muc_{t+1}$$

$$\frac{\partial \mathbb{U}_t}{\partial C_t} = \left[C_t - ghh\left(\mu_{S,t} \frac{H_{S,t}^{1+\nu_S}}{1 + \nu_S} + \mu_H \frac{H_{H,t}^{1+\nu_H}}{1 + \nu_H} + \mu_M \frac{H_{M,t}^{1+\nu_M}}{1 + \nu_M}\right)\right]^{-\sigma}$$

Firms.

$$w_t = (1 - \alpha_M) A_t H_{M,t}^{-\alpha_M} q_t mc_t$$

$$pr_t = 1 - \varphi_t (1 - \gamma_H)\left(\frac{C_{M,t}}{C_t}\right)^{\Gamma_H - 1} \frac{1}{\epsilon} T_t^{-1} \frac{\frac{\partial \mathbb{U}_t}{\partial C_t}}{muc_t}$$

$$mc_t = \frac{1}{1 + c_{P,t}}\left[pr_t - \mathbb{I}_{HS} \cdot \varphi_t \nu_S \frac{P_{S,t}}{q_t S_t}\right]$$

$$\varphi_t = \frac{\gamma_S x_t^{\Gamma_S} \frac{m_t}{P_{S,t}} pr_t}{(1 - \gamma_S) - \mathbb{I}_{HS} \cdot \nu_S \left[\gamma_S x_t^{\Gamma_S} + (1 - \gamma_S)\right]}$$

$$c'_{P,t} = \frac{T_t}{mc_t q_t S_t}\left(1 - \frac{\varphi_t}{T_t}\right) + \mathbb{E}_t \frac{1 + \pi_{t+1}}{1 + r_t} \frac{mc_{t+1} q_{t+1} S_{t+1}}{mc_t q_t S_t} c'_{P,t+1}$$

Constraints, General Equilibrium, and Further Variables.

$$
\begin{aligned}
C_t &= \left[\gamma_H C_{H,t}^{\Gamma_H} + (1-\gamma_H)\, C_{M,t}^{\Gamma_H}\right]^{\frac{1}{\Gamma_H}} \\
C_{H,t} &= H_{H,t}^{1-\alpha_H} \\
C_{M,t} &= \frac{q_t}{1+c_{P,t}} A_t H_{M,t}^{1-\alpha_M} \\
C_{M,t} &= \psi\left[\gamma_S x_t^{\Gamma_S} + (1-\gamma_S)\right]^{\frac{1}{\Gamma_S}} S_t \\
S_t &= \frac{C_{M,t}}{q_t} \\
\frac{1+r_t}{1+r} &= \left(\frac{1+r_{t-1}}{1+r}\right)^{i_r}\left[\left(\frac{\pi_t}{\pi}\right)^{i_\pi}\left(\frac{Y_t}{Y_{N,t}}\right)^{i_{Gap}}\right]^{1-i_r} M_t \\
P_{S,t} &= \mu_{S,t}\frac{C_{M,t}^{\nu_S}}{f_t^{1+\nu_S}}\frac{ghh\frac{\partial \mathbb{U}}{\partial C_t} + (1-ghh)}{muc_t} \\
u_t &= \left[\frac{w_t}{\mu_M}\frac{muc_t}{ghh\frac{\partial \mathbb{U}}{\partial C_t} + (1-ghh)}\right]^{\frac{1}{\nu_M}}\frac{1}{H_{M,t}} - 1
\end{aligned}
$$

Appendix B.2. Linearized System of Equations

$$\hat{\pi}_{W,t} = (-1)\frac{\epsilon_W - 1}{\kappa_W}\phi_u \hat{u}_t + \beta \mathbb{E}_t \hat{\pi}_{W,t+1} \tag{B.1}$$

$$m\hat{u}c_t = \hat{r}_t - \mathbb{E}_t\hat{\pi}_{t+1} + \mathbb{E}_t m\hat{u}c_{t+1} \tag{B.2}$$

$$m\hat{u}c_t = u\hat{C}_t - \phi_\epsilon \hat{P}_{S,t} - (1-\Gamma_H)\left(\hat{C}_{M,t} - \hat{C}_t\right) \tag{B.3}$$

$$u\hat{C}_t = \tilde{\mathcal{U}}\left[\phi_{U,C_M}\hat{C}_{M,t} + \phi_{U,q}\hat{q}_t - \phi_{U,P_S}\hat{P}_{S,t} - \phi_{U,\psi}\hat{\psi}_t + \phi_{U,A}\hat{A}_t - \phi_{U,\mu}\hat{\mu}_{S,t}\right] \tag{B.4}$$

$$\nu_M\phi_u\hat{u}_t = \frac{1+\nu_M}{1-\alpha_M}\left[\psi^{-1}\hat{q}_t + \hat{A}_t\right] + \hat{m}c_t - \phi_\epsilon\hat{P}_{S,t} - \left[\frac{\alpha_M+\nu_M}{1-\alpha_M} + \phi_C\right]\hat{C}_{M,t} \tag{B.5}$$

$$\hat{P}_{S,t} = \frac{1}{1-\phi_\epsilon}\left[\hat{\mu}_{S,t} + (\nu_S+\phi_C)\,\hat{C}_{M,t} + \frac{1+\nu_S}{\psi\phi_\gamma}\hat{q}_t - (1+\phi_\gamma)\frac{1+\nu_S}{\psi\phi_\gamma}\hat{\psi}_t\right] \tag{B.6}$$

$$\hat{m}c_t = \frac{1+\phi_\gamma}{\epsilon}\left\{\left[1-\phi_\epsilon\left(1+\frac{1+\mathbb{I}_{H_S}\nu_S\epsilon}{\epsilon-1}\right)\right]\hat{P}_{S,t} - \left[1+\frac{\phi_\epsilon\,(1+\mathbb{I}_{H_S}\nu_S\epsilon)}{1-\phi_\epsilon}\right]\frac{\Gamma_S}{\psi\phi_\gamma}\left(\hat{q}_t - \hat{\psi}_t\right) + \hat{\epsilon}_t\right\} \tag{B.7}$$

$$\hat{\pi}_t = \frac{\phi_\gamma\,(1-\phi_\epsilon)}{\kappa_P\phi_\epsilon\,(1-\mathbb{I}_{H_S}\nu_S)}\frac{\epsilon-1}{\epsilon}\left[\hat{P}_{S,t} - \frac{1}{1-\phi_\epsilon}\frac{\Gamma_S}{\psi\phi_\gamma}\left(\hat{q}_t - \hat{\psi}_t\right) - \frac{1}{(\epsilon-1)\,(1-\phi_\epsilon)}\hat{\epsilon}_t\right] + \beta\mathbb{E}_t\hat{\pi}_{t+1} \tag{B.8}$$

$$\hat{\pi}_{W,t} = \hat{\pi}_t + \Delta\hat{m}c_t + \frac{1}{1-\alpha_M}\left[\Delta\hat{A}_t + \psi^{-1}\Delta\hat{q}_t\right] - \frac{\alpha_M}{1-\alpha_M}\Delta\hat{C}_{M,t} \tag{B.9}$$

where

$$
\begin{aligned}
\phi_\gamma &= \frac{\gamma_S x^{\Gamma_S}}{1-\gamma_S}\\
\phi_\epsilon &= \frac{\epsilon-1}{\epsilon}\frac{\phi_\gamma}{\left(1-\mathbb{I}_{HS}\nu_S\right)\left(1+\phi_\gamma\right)}\\
\phi_u &= \left(\frac{\epsilon_W-1}{\epsilon_W}\right)^{\frac{1}{\nu_M}}\\
\phi_{C_M} &= \frac{\left(1-\gamma_H\right)\left(\frac{C_M}{C}\right)^{\Gamma_H}}{1+\gamma_H\left(\frac{C_H}{C}\right)^{\Gamma_H}\frac{\left(1-\Gamma_H\right)+\left(1-ghh\right)\sigma}{\frac{1+\nu_H}{1-\alpha_H}-\Gamma_H}}\\
\phi_{C_H} &= \left(1-\Gamma_H\right)\left(1-\phi_{C_M}\right)\\
\phi_C &= \phi_{C_H}+\left(1-ghh\right)\sigma\phi_{C_M}\\
\tilde{\mathcal{U}} &= \left(-\sigma\right)\left[1-ghh\left\{\frac{\phi_\epsilon\chi_{C_M}}{1+\nu_S}+\frac{\left(1-\alpha_H\right)\left(1-\chi_{C_M}\right)}{1+\nu_H}+\frac{\left(1-\alpha_M\right)\chi_{C_M}}{1+\nu_M}\frac{\epsilon_W-1}{\epsilon_W}\left(1-\mathbb{I}_{HS}\nu_S\right)\phi_\gamma\phi_\epsilon\right\}\right]^{-1}\\
\phi_{U,C_M} &= \phi_{C_M}+ghh\left[\frac{\phi_\epsilon\phi_C}{\nu_S}\chi_{C_M}+\frac{1-\chi_{C_M}}{\frac{1+\nu_H}{1-\alpha_H}-\Gamma_H}\left(1-\Gamma_H+\left(1-ghh\right)\sigma\right)\phi_{C_M}-\frac{\epsilon_W-1}{\epsilon_W}\left(1-\mathbb{I}_{HS}\nu_S\right)\frac{\phi_\epsilon}{\phi_\gamma}\chi_{C_M}\right]\\
\phi_{U,q} &= ghh\left[\frac{1}{\nu_S}+\frac{\epsilon_W-1}{\epsilon_W}\left(1-\mathbb{I}_{HS}\nu_S\right)\right]\frac{\phi_\epsilon}{\psi\phi_\gamma}\chi_{C_M}\\
\phi_{U,P_S} &= ghh\frac{\phi_\epsilon}{\nu_S}\chi_{C_M}\left(1-\phi_\epsilon\right)\\
\phi_{U,\psi} &= ghh\frac{\phi_\epsilon}{\nu_S}\chi_{C_M}\frac{1+\phi_\gamma}{\psi\phi_\gamma}\\
\phi_{U,A} &= ghh\frac{\epsilon_W-1}{\epsilon_W}\left(1-\mathbb{I}_{HS}\nu_S\right)\frac{\phi_\epsilon}{\phi_\gamma}\chi_{C_M}\\
\phi_{U,\mu} &= ghh\phi_\epsilon\frac{\chi_{C_M}}{1+\nu_S}\left(1+\frac{1+\nu_S}{\nu_S}\right)
\end{aligned}
$$

Appendix B.3. Proof for Proposition 1

Setting $\gamma_S, \Gamma_S, \mu_S = 0$ and $\psi = 1$ leads to $\phi_\gamma = \phi_\epsilon = 0$. Further, setting $\hat{\psi}_t = \hat{\mu}_{S,t} = 0$.

$$\hat{\pi}_{W,t} = (-1)\frac{\epsilon_W - 1}{\kappa_W}\phi_u \hat{u}_t + \beta \mathbb{E}_t \hat{\pi}_{W,t+1} \tag{B.10}$$

$$\hat{r}_t - \mathbb{E}_t \hat{\pi}_{t+1} = m\hat{u}c_t - \mathbb{E}_t m\hat{u}c_{t+1} \tag{B.11}$$

$$m\hat{u}c_t = \tilde{\mathcal{U}}\left[\phi_{U,C_M}\hat{C}_{M,t} + \phi_{U,A}\hat{A}_t\right] - (1-\Gamma_H)\left(\hat{C}_{M,t} - \hat{C}_t\right) \tag{B.12}$$

$$\nu_M \phi_u \hat{u}_t = \frac{1+\nu_M}{1-\alpha_M}\hat{A}_t + \hat{mc}_t - \left[\frac{\alpha_M + \nu_M}{1-\alpha_M} + \phi_C\right]\hat{C}_{M,t} \tag{B.13}$$

$$\hat{q}_t = \hat{\psi}_t = 0 \tag{B.14}$$

$$\hat{mc}_t = \frac{1}{\epsilon}\left\{\hat{P}_{S,t} + \hat{\epsilon}_t\right\} \tag{B.15}$$

$$\hat{\pi}_t = \frac{1}{\kappa_P}\left[\hat{P}_{S,t} - \frac{1}{(\epsilon - 1)}\hat{\epsilon}_t\right] + \beta \mathbb{E}_t \hat{\pi}_{t+1} \tag{B.16}$$

$$\hat{\pi}_{W,t} = \hat{\pi}_t + \Delta \hat{mc}_t + \frac{1}{1-\alpha_M}\Delta \hat{A}_t - \frac{\alpha_M}{1-\alpha_M}\Delta \hat{C}_{M,t} \tag{B.17}$$

Summarizing the system:

$$\hat{\pi}_{W,t} = (-1)\frac{\epsilon_W - 1}{\kappa_W}\phi_u \hat{u}_t + \beta \mathbb{E}_t \hat{\pi}_{W,t+1} \tag{B.18}$$

$$m\hat{u}c_t = \hat{r}_t - \mathbb{E}_t \hat{\pi}_{t+1} + \mathbb{E}_t m\hat{u}c_{t+1} \tag{B.19}$$

$$m\hat{u}c_t = \tilde{\mathcal{U}}\left[\phi_{U,C_M}\hat{C}_{M,t} + \phi_{U,A}\hat{A}_t\right] - (1-\Gamma_H)\left(\hat{C}_{M,t} - \hat{C}_t\right) \tag{B.20}$$

$$\nu_M \phi_u \hat{u}_t = \frac{1+\nu_M}{1-\alpha_M}\hat{A}_t + \hat{mc}_t - \left[\frac{\alpha_M + \nu_M}{1-\alpha_M} + \phi_C\right]\hat{C}_{M,t} \tag{B.21}$$

$$\hat{\pi}_t = \frac{1}{\kappa_P}\left[\epsilon \cdot \hat{mc}_t - \frac{\epsilon}{\epsilon - 1}\hat{\epsilon}_t\right] + \beta \mathbb{E}_t \hat{\pi}_{t+1} \tag{B.22}$$

$$\hat{\pi}_{W,t} = \hat{\pi}_t + \Delta \hat{mc}_t + \frac{1}{1-\alpha_M}\Delta \hat{A}_t - \frac{\alpha_M}{1-\alpha_M}\Delta \hat{C}_{M,t} \tag{B.23}$$

Comparing this system with Erceg et al. (2000); Galí (2011) shows the same system of linearized equations. Hence, the NK-SaM model nests the benchmark NK model.

Appendix B.4. Linearized System of the Flexible Price Economy

The flexible price model acts as the reference point of the output gap model as it shows how the model economy fluctuates absent nominal frictions - $\kappa_P, \kappa_W = 0$. From Appendix

B.2 we derive the flexible price economy system of linearized equations given by

$$\hat{u}_t^N = 0, \tag{B.24}$$

$$\hat{r}_t^N = \hat{muc}_t^N - \mathbb{E}_t \hat{muc}_{t+1}^N, \tag{B.25}$$

$$\hat{muc}_t^N = \hat{uC}_t^N - \phi_\epsilon \hat{P}_{S,t}^N - (1-\Gamma_H)\left(\hat{C}_{M,t}^N - \hat{C}_t^N\right), \tag{B.26}$$

$$\hat{uC}_t^N = \tilde{\mathcal{U}}\left[\phi_{U,C_M}\hat{C}_{M,t}^N + \phi_{U,q}\hat{q}_t^N - \phi_{U,P_S}\hat{P}_{S,t}^N - \phi_{U,\psi}\hat{\psi}_t + \phi_{U,A}\hat{A}_t - \phi_{U,\mu}\hat{\mu}_{S,t}\right], \tag{B.27}$$

$$\hat{P}_{S,t}^N = \frac{1}{1-\phi_\epsilon}\frac{\Gamma_S}{\psi\phi_\gamma}\left(\hat{q}_t^N - \hat{\psi}_t\right) + \frac{1}{(\epsilon-1)(1-\phi_\epsilon)}\hat{\epsilon}_t, \tag{B.28}$$

$$\hat{q}_t^N = \frac{\psi\phi_\gamma}{1+\nu_S}(1-\phi_\epsilon)\hat{P}_{S,t}^N - \frac{\psi\phi_\gamma}{1+\nu_S}\hat{\mu}_{S,t} - \frac{\psi\phi_\gamma}{1+\nu_S}(\nu_S+\phi_C)\hat{C}_{M,t}^N + (1+\phi_\gamma)\hat{\psi}_t \tag{B.29}$$

$$\hat{mc}_t^N = \frac{1+\phi_\gamma}{\epsilon}\left\{\left[1-\phi_\epsilon\left(1+\frac{1+\mathbb{I}_{H_S}\nu_S\epsilon}{\epsilon-1}\right)\right]\hat{P}_{S,t}^N - \left[1+\frac{\phi_\epsilon(1+\mathbb{I}_{H_S}\nu_S\epsilon)}{1-\phi_\epsilon}\right]\frac{\Gamma_S}{\psi\phi_\gamma}\left(\hat{q}_t^N - \hat{\psi}_t\right) + \hat{\epsilon}_t\right\} \tag{B.30}$$

$$\hat{C}_{M,t}^N = \left[\frac{\alpha_M+\nu_M}{1-\alpha_M} + \phi_C\right]^{-1}\left\{\hat{mc}_t^N - \phi_\epsilon\hat{P}_{S,t}^N + \frac{1+\nu_M}{1-\alpha_M}\left[\psi^{-1}\hat{q}_t^N + \hat{A}_t\right]\right\}, \tag{B.31}$$

where search prices (price elasticity of demand) decrease endogenously in goods market tightness if $\Gamma_S < 0$ or increase exogenously in $\hat{\epsilon}_t$. This leads to lower variation in capacity utilization and a decrease in marginal costs (markups increase). Whether real GDP increases or decreases depends on which of the channels is quantitatively larger as search prices and capacity utilization increase real GDP while decreasing marginal costs decrease it.

If we instead assume $\Gamma_S = 0$, the flexible price system of equations shows search price variation only in exogenous shocks as shown by

$$\hat{P}_{S,t}^N = \frac{1}{(\epsilon-1)(1-\phi_\epsilon)}\hat{\epsilon}_t, \tag{B.32}$$

$$\hat{mc}_t^N = \frac{1+\phi_\gamma}{\epsilon}\left\{\left[1-\phi_\epsilon\left(1+\frac{1+\mathbb{I}_{H_S}\nu_S\epsilon}{\epsilon-1}\right)\right]\hat{P}_{S,t}^N + \hat{\epsilon}_t\right\}, \tag{B.33}$$

$$\hat{q}_t^N = \frac{\psi\phi_\gamma}{1+\nu_S}(1-\phi_\epsilon)\hat{P}_{S,t}^N - \frac{\psi\phi_\gamma}{1+\nu_S}\hat{\mu}_{S,t} - \frac{\psi\phi_\gamma}{1+\nu_S}(\nu_S+\phi_C)\hat{C}_{M,t}^N + (1+\phi_\gamma)\hat{\psi}_t, \tag{B.34}$$

$$\hat{C}_{M,t}^N = \left[\frac{\alpha_M+\nu_M}{1-\alpha_M} + \phi_C\right]^{-1}\left\{\hat{mc}_t^N - \phi_\epsilon\hat{P}_{S,t}^N + \frac{1+\nu_M}{1-\alpha_M}\left[\psi^{-1}\hat{q}_t^N + \hat{A}_t\right]\right\}. \tag{B.35}$$

Search prices increase as goods markets become more competitive. The adjustment follows instantaneously as both search and purchase prices are flexible. Higher search prices lead to higher marginal costs. Capacity utilization increases in higher search prices (as it implies higher search effort), but at a decreasing rate due to search cost convexity, ν_S, and a time allocation trade-off with home production, ϕ_C. Overall, real GDP increases in the flexible price economy as $\hat{\epsilon}_t$ increases. Assuming further that $\hat{\epsilon}_t = 0$, as is the case in the efficient (social planner) economy, the system of equations is given by

$$\hat{q}_t^N = (1+\phi_\gamma)\,\hat{\psi}_t - \frac{\psi\phi_\gamma}{1+\nu_S}\hat{\mu}_{S,t} - \frac{\psi\phi_\gamma}{1+\nu_S}(\nu_S+\phi_C)\,\hat{C}_{M,t}^N, \tag{B.36}$$

$$\hat{C}_{M,t}^N = \left[\frac{\alpha_M+\nu_M}{1-\alpha_M}+\phi_C\right]^{-1}\frac{1+\nu_M}{1-\alpha_M}\left[\psi^{-1}\hat{q}_t^N+\hat{A}_t\right], \tag{B.37}$$

With $\hat{\epsilon}_t = 0\forall t$ and $\Gamma_S = 0$, it follows that search prices are constant across time which implies constant marginal costs. Hence, capacity utilization increases in any of the two goods market SaM shocks, but decreases in real GDP due to search cost convexity, ν_S, and a time allocation trade-off with home production, ϕ_C. Overall, real GDP still increases in capacity utilization as well as exogenous TFP shocks.

Appendix C. Full Calibration of the Model

Appendix C.1. Calibration Overview and Sources

Table C.2: Calibration Sources

Parameter	Value/Target	Description	Source
Households			
β	0.99	Period discount rate	US data - FRED: (FEDFUNDS)
σ	1.5	Household risk aversion	Smets and Wouters (2007)
μ_H	$\frac{\bar{H}_H}{\bar{H}_M} = 0.5393$	Home production labor disutility level	US Bureau of Labor Statistics ATUS data
ν_H	ν_M	Elasticity of home production labor supply	Gnocchi et al. (2016)
γ_H	0.55	Share of home goods (consumption)	Gnocchi et al. (2016)
Γ_H	0.5	Elasticity of substitution (consumption)	Gnocchi et al. (2016)
Goods Market			
μ_S	$\bar{x} = 1$	Household search disutility level	Normalization
ν_S	ν_M	Household search supply elasticity	Huo and Rios-Rull (2020)
ψ	$\bar{cu} = 0.86$	Goods matching efficiency	US data - FRED: (TCU)
γ_S	0.32	Search effort elasticity of goods matching	Qiu and Rios-Rull (2022)
Γ_S	-0.0001	Matching input elasticity of substitution	Qiu and Rios-Rull (2022)
ϵ	$\bar{mc}^{-1} = 1.2$	Elasticity of substitution (diff. goods)	Christiano et al. (2010)
π	0	Steady-state inflation rate	Normalization
κ_P	Slope $= 0.047$	Price adjustment cost	Gali and Gertler (1999)
δ_T	0.25	Exogenous trade relationship separation	Mathä and Pierrard (2011)
δ_I	0.74	Goods inventory depreciation rate	Khan and Thomas (2007)
Labor Market			
μ_M	$\bar{H}_M = 1$	Labor disutility level	Normalization
ν_M	$\frac{1}{0.72}$	Frisch elasticity of labor supply	Heathcote et al. (2010)
ϵ_W	$\bar{u} = 0.043$	Elasticity of substitution (diff. labor)	US data - FRED: (UNRATE)
π_W	0	Steady-state wage inflation	Normalization
κ_W	$(-1)\frac{\epsilon_W - 1}{\kappa_W}\phi_u = -0.026$	Nominal wage adjustment cost	Gali and Gambetti (2019)
ϕ_{HM}	1.85	Market hours adjustment cost	Lechthaler and Snower (2013)
Capital Market			
α_M	$\bar{ls} = 0.64$	Capital elasticity of market production	US data - FRED: (LABSHPUSA156NRUG)
α_H	0.33	Capital elasticity of home production	Gnocchi et al. (2016)
δ_{M1}	0.025	Capital depreciation rate (market)	Christiano et al. (2010)
δ_{M2}	0.3	Capital utilization cost (market)	Christiano et al. (2010)
δ_{M3}	$\bar{e}_M = 1$	Capital utilization cost (market)	Normalization
δ_{H1}	δ_{M1}	Capital depreciation rate (home)	Gnocchi et al. (2016)
δ_{H2}	δ_{M2}	Capital utilization cost (home)	Gnocchi et al. (2016)
δ_{H3}	$\bar{e}_H = 1$	Capital utilization cost (home)	Normalization
κ_{MI}	4	Investment adjustment cost (market)	Christiano et al. (2010)
κ_{HI}	κ_{MI}	Investment adjustment cost (home)	Gnocchi et al. (2016)
Monetary Policy			
i_R	0.8	Interest rate persistence coefficient	Christiano et al. (2010)
i_π	1.7	Taylor coefficient wrt inflation	Christiano et al. (2010)
i_{Gap}	0.12	Taylor coefficient wrt output gap	Christiano et al. (2010)

NOTE: The table describes the calibration of the extended model setup as described in Appendix A. Steady-state targets are described in detail in Appendix C.2. For the calibration of the main model of this paper, see section 2.6. It is symmetric to this calibration for common parameters across model versions.

Table C.3: Calibration of the Shock Processes

Random Process		Autocorrelation	
Parameter	Value	Parameter	Value
σ_A	0.0064	ρ_A	0.9
σ_M	0.001	ρ_M	0.5
σ_P	0.01	ρ_P	0.5
σ_T	0.0008	ρ_T	0.5
σ_D	0.008	ρ_D	0.5

NOTE: The calibration of the exogenous processes is chosen alongside common values in the literature. The three cost-push shock processes are calibrated such that they are easy to compare. This calibration strategy does not represent any shock decomposition from the data.

Appendix C.2. Calibration Strategy

Capacity Utilization in the Steady-State. We set capacity utilization in the steady-state as defined in Appendix A.6. In order to be able to do so, we endogeneize the matching efficiency, ψ, in the steady-state. For $x \neq 1$, there is no closed-form solutions for this calibration strategy. Setting $x = 1$, as in the calibration in section 2.6, we can derive matching efficiency given by

$$\psi = q = cu \frac{\delta_T \delta_I}{1 - cu \left(\delta_T \left(1 - \delta_I\right) + \left(1 - \delta_T\right)\right)}, \tag{C.1}$$

which reduces to $\psi = q = cu$ for the model shown in section 2 and is lower than cu if either δ_T, δ_I, or both are below one.

Price Markups in the Steady-State. We target a steady-state markup of 20% across models (benchmark vs NK-SaM and the extended NK-SaM). This approach endogeneizes the elasticity of intratemporal substitution given by

$$\epsilon = \frac{\frac{\mathbb{W}_C}{muc} q}{1 - \beta \left(1 - \delta_T\right)} \left[q \frac{1 - \beta \left(1 - \delta_T\right) q \cdot mc}{1 - \beta \left(1 - \delta_T\right)} - \left[1 - \beta \left(1 - \delta_I\right) \left(1 - q\right)\right] q \cdot mc - \mathbb{I}_{HS} P_S \frac{q}{\delta_T} \nu_S \right]^{-1}, \tag{C.2}$$

which increases in δ_T and δ_I as search frictions become more salient and thus create higher steady-state price markups which requires a higher elasticity of substitution, ϵ, to match the 20% price markup target in steady-state.

Labor Share in the Steady-State. In the extended model with capital, we set the capital elasticity of production, α_M, to match a long-run average of US labor share data (see table C.2). In the extended model, it is defined by

$$\alpha_M \; = 1 - \frac{ls_{data}}{mc}, \tag{C.3}$$

which is set by the labor share data (ls_{data}) and the calibrated price markup steady-state. As we set mc to a fixed value across all models, it follows that α_M is symmetric across all models and equal to the benchmark model value.

Labor Frictions and the Wage Phillips Curve Slope. The elasticity of substitution of specialized labor can be derived from targeting the long-run US unemployment rate in the steady-state following the model definition of Galí (2011). The elasticity is given by

$$\epsilon_W \; = \frac{(1+u)^{\nu_M}}{(1+u)^{\nu_M} - 1}, \tag{C.4}$$

which is completely set given the data target and a calibrated ν_M. We use the calculated ϵ_W in calibrating the slope of the NK wage Phillips curve. In order to do so, we derive a linearized version of the NK wage Phillips curve of the model presented in section 2. This allows us to derive the slope of the NK wage Phillips curve determined by unemployment fluctuations only. We target empirical estimates of this NK wage Phillips curve ($NKWPC_{Slope}$) from Gali and Gambetti (2019) and solve for the wage adjustment costs parameter given by

$$\kappa_W \; = (-\nu_M)\frac{\epsilon_W - 1}{NKWPC_{Slope}}\frac{u}{1+u}, \tag{C.5}$$

which is defined given long-run US unemployment data and a calibrated value for ν_M (see table C.2). We use the value of κ_W derived from the model shown in section 2 also for the extended model as there is not in all cases a closed-form wage Phillips curve given.

Price Phillips Curve Slope. We set κ_P by matching the empirical estimate of the labor share slope in the NK price Phillips curve as given by Gali and Gertler (1999). In order to do so, we derive a linearized version of the NK price Phillips curve of the model presented in section 2. We set the empirical slope ($NKPC_{Slope}$) as a target and solve for κ_P given by

$$\kappa_P = NKPC_{Slope}^{-1} \frac{\phi_\gamma (1-\phi_\epsilon)}{\phi_\epsilon (1-\mathbb{I}_{HS}\nu_S)} \frac{\epsilon-1}{\epsilon} \left[\phi_{\pi,ls} + \phi_{\pi,q}\theta_{ls,q}\right], \tag{C.6}$$

where $\phi_{\pi,ls}$ is the marginal costs slope ($\hat{ls}_t = \hat{mc}_t$) and $\phi_{\pi,q}\frac{\phi_{ls,ls}}{\phi_{ls,q}}$ is the goods market tightness slope if $\Gamma_S \neq 0$ as shown in (14). The slope is defined by

$$\phi_{\pi,ls} = \frac{\epsilon}{1+\phi_\gamma}\left(1-\phi_\epsilon\left(1+\frac{1+\mathbb{I}_{HS}\nu_S\epsilon}{\epsilon-1}\right)\right)^{-1},$$

$$\phi_{\pi,q} = \frac{\Gamma_S}{\psi\phi_\gamma}\left(\frac{1+\frac{\phi_\epsilon}{1-\phi_\epsilon}(1+\mathbb{I}_{HS}\nu_S\epsilon)}{1-\phi_\epsilon\left(1+\frac{1+\mathbb{I}_{HS}\nu_S\epsilon}{\epsilon-1}\right)} - \frac{1}{1-\phi_\epsilon}\right),$$

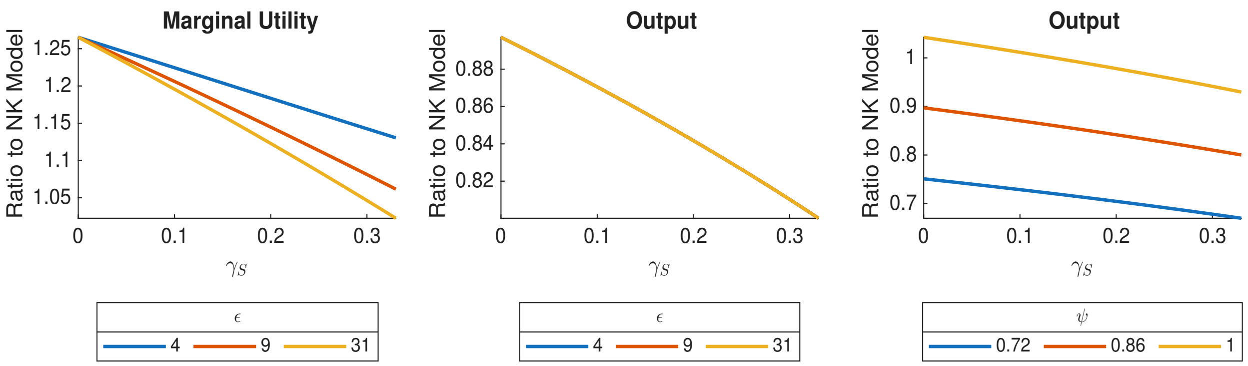
$$\theta_{ls,q} = \left(\frac{\frac{\alpha_M+\nu_M}{1-\alpha_M}+\phi_C}{1-\phi_\epsilon\frac{\epsilon}{1+\phi_\gamma}\left(1-\phi_\epsilon\left(1+\frac{1+\mathbb{I}_{HS}\nu_S\epsilon}{\epsilon-1}\right)\right)^{-1}}\frac{1}{\theta_{q,C_M}} - \frac{\phi_\epsilon\frac{\Gamma_S}{\psi\phi_\gamma}\frac{1+\frac{\phi_\epsilon}{1-\phi_\epsilon}(1+\mathbb{I}_{HS}\nu_S\epsilon)}{1-\phi_\epsilon\left(1+\frac{1+\mathbb{I}_{HS}\nu_S\epsilon}{\epsilon-1}\right)}}{1-\phi_\epsilon\frac{\epsilon}{1+\phi_\gamma}\left(1-\phi_\epsilon\left(1+\frac{1+\mathbb{I}_{HS}\nu_S\epsilon}{\epsilon-1}\right)\right)^{-1}}\right)^{-1}.$$

The slope of the independent variable $\hat{ls}_t$ is potentially confounded if $\Gamma_S \neq 0$ as goods market tightness drives the inflation rate in (14) independently of the labor share but also determines the labor share. It is also through goods market tightness, that all exogenous shocks except the monetary policy shock can drive goods market tightness and thus inflation independently from the labor share. Hence, the error term in the estimation equation summarizes various cost-push shocks (see also section 6). However, the quantitative impact of the goods market tightness term on inflation variation and the estimation of the labor share slope in (14) is likely small as $\hat{q}_t$ varies strongly if Γ_S is close to zero and shows little variation if Γ_S is sufficiently different from zero. Hence, we set the NK price Phillips curve slope by (C.6) without worrying too much about the potentially confounding factor in the model setup. We use the calculated price adjustment costs parameter κ_P also for the extended model as it does not have an equivalent closed-form solution of the Phillips curve slope.

Appendix D. Additional Results: and Robustness: Steady-States and Slopes of the Reduced-Form Model

Appendix D.1. Additional Results: Steady-State of the Reduced-Form Model

Figure D.8: Impact of γ_S and ψ on the steady-state conditional on ϵ

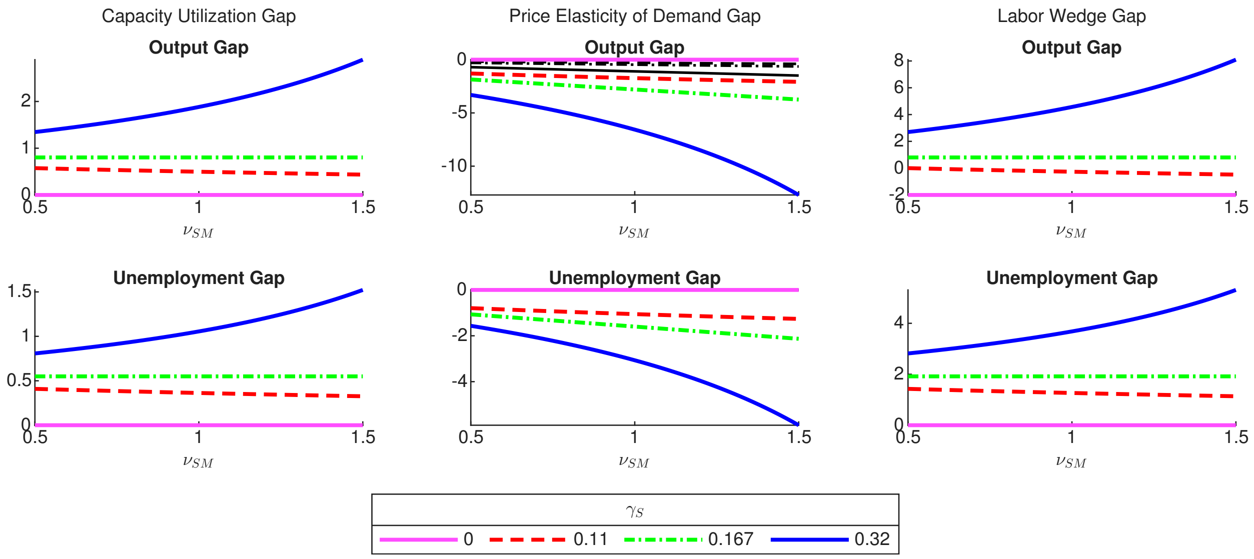


NOTE: The figure shows relative steady-state values of the NK-SaM model over the benchmark model for different calibrations. Search prices, P_S, are given as a real price level (consumption good as the numeraire) as they are zero in the benchmark model. Benchmark model and NK-SaM model are calibrated to different levels of relative home to market labor as shopping time is included in this measure for the benchmark model (see also section 2.6). This feature leads to a relative output steady-state not equal to one for $\gamma_S = 0$.

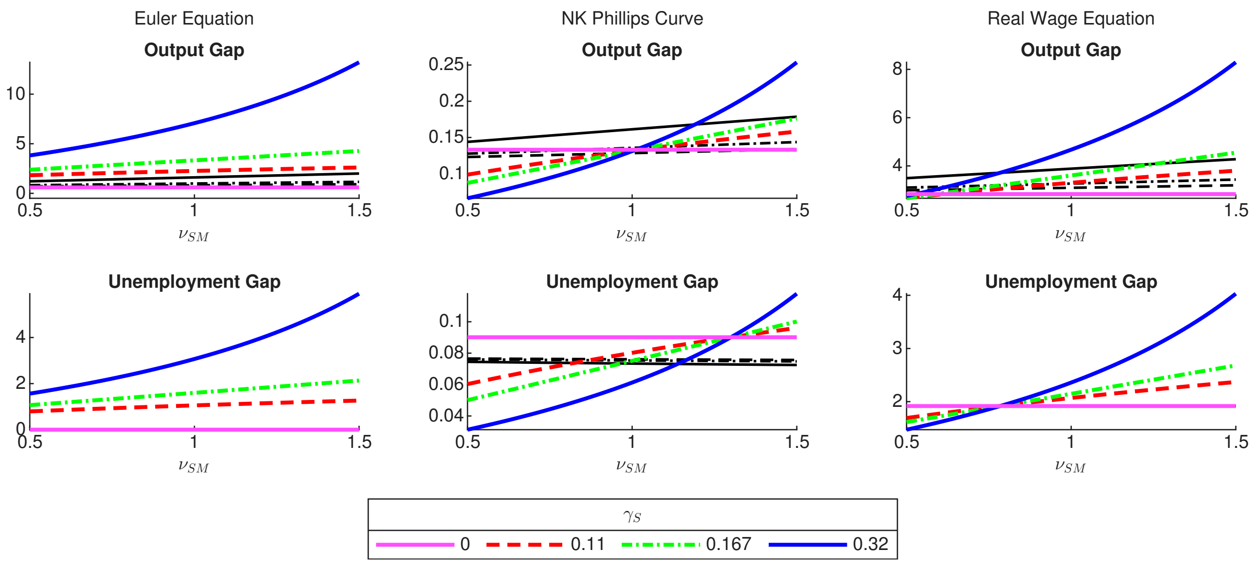
Appendix D.2. Additional Results: Slopes of the Reduced-Form Model

Figure D.9: Unemployment and Output Gap Slopes of the Reduced-Form NK-SaM Model

(a) Slopes of the Goods Market Channels



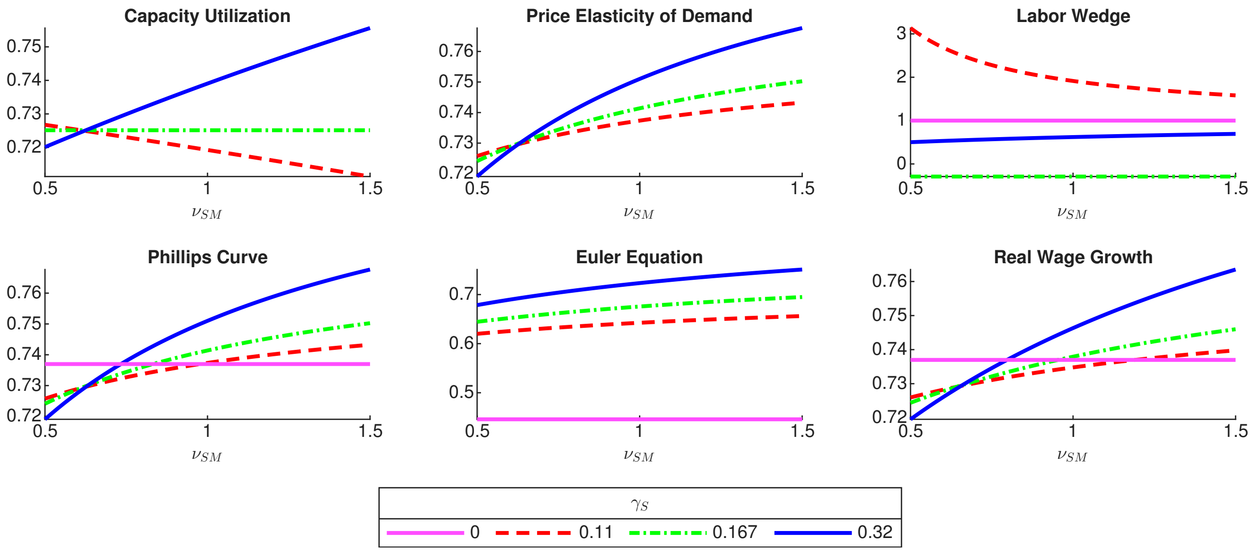
(b) Slopes of the Reduced-Form Model



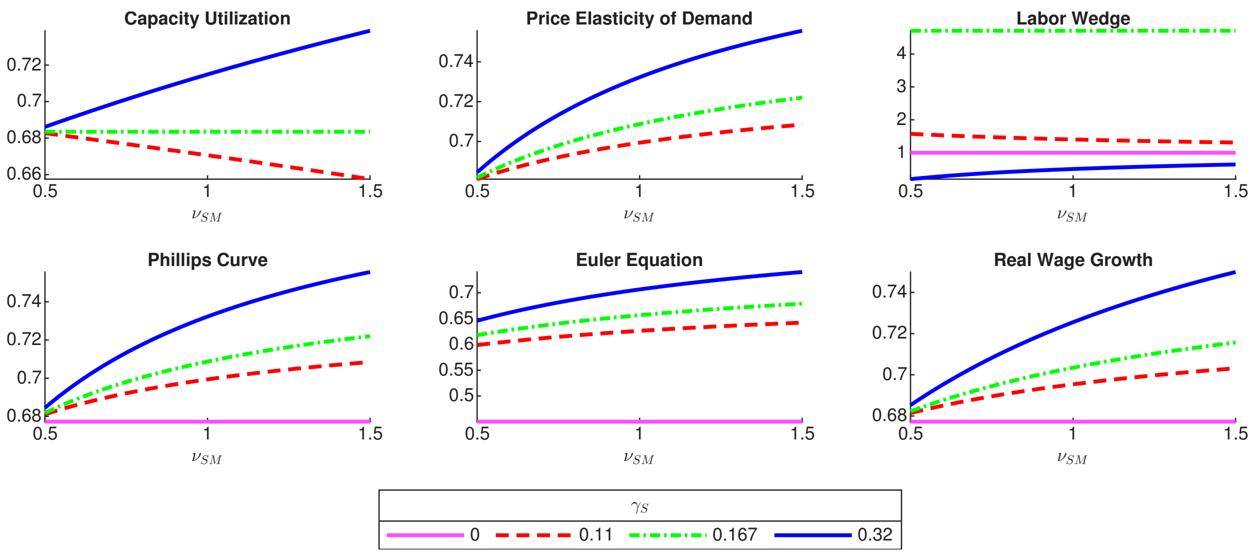
NOTE: The graphs show the impact of varying ν_S with a fixed ν_M on the slopes of the goods market SaM channels and the reduced-form NK-SaM model (inclduing home production). The benchmark model is shown by the full horizontal line ($\gamma_S = 0$). The NK-SaM model is shown in two variants for three different values of γ_S indicated by the dashed, dashed-dotted, and full lines. First, the bold-colored lines show $\Gamma_S \approx 0$. Second, the thin-black lines show $\Gamma_S = -\infty$ implying an substitution elasticity of ≈ 0 for the matching inputs.

Figure D.10: Robustness Analysis - Relative Slopes of the Reduced-Form Model

(a) Slopes of the model with home production relative to without home production



(b) Slopes of the model with GHH preferences relative to KPR preferences



NOTE: The graphs show the slopes of (a) the NK-SaM model with home production relative to without home production and (b) the NK-SaM model with GHH preferencs relative to KPR preferences. A value below one shows that the slope of a variable is smaller with home production (GHH preferences) compared to a model without home production (KPR preferences). The figure shows how this ratio changes for different combinations of γ_S and $\nu_{SM} = \frac{\nu_S}{\nu_M}$.

Appendix E. Back-of-the-Envelope Calculations: Goods Market Channels over the U.S. Business Cycle

Let's bring the reduced-form relationships (22) to (24) derived from the NK-SaM model to the data. Using output gap and unemployment gap data for the US[31], we perform back-of-the-envelope calculations[32] for all three variables. Figure E.11 shows the output gap and unemployment gap data as well as the calculated time series for the baseline NK model and the goods market SaM model with three different elasticities of substitution, $\Gamma_S = [-20,\ -5,\ 0]$.

For $\Gamma_S = 0$, the capacity utilization gap shows a strong standard deviation of up to 2.68 and is highly positively correlated with the output gap (see table E.4). It also highly correlates with the detrended capacity utilization measure as derived in Gantert (2025) and shows similar standard deviations.

The pattern of the capacity utilization gap translates - as in (22) - to the price elasticity of

Table E.4: Correlation and Standard Deviation of the Goods Market SaM Channels

	Data		NK		NK-SaM ($\Gamma_S \approx 0$)		NK-SaM ($\Gamma_S = -20$)	
	Std.	$Corr(X,Y)$	Std.	$Corr(X,Y)$	Std.	$Corr(X,Y)$	Std.	$Corr(X,Y)$
Utilization Gap	2.29	0.75	–	–	2.68	0.95	0.35	0.95
Price Elasticity Gap	–	–	–	–	11.46	−0.97	3.75	−0.99
Labor Wedge Gap	4.39	−0.49	4.29	−1.00	5.45	0.85	3.15	−0.99

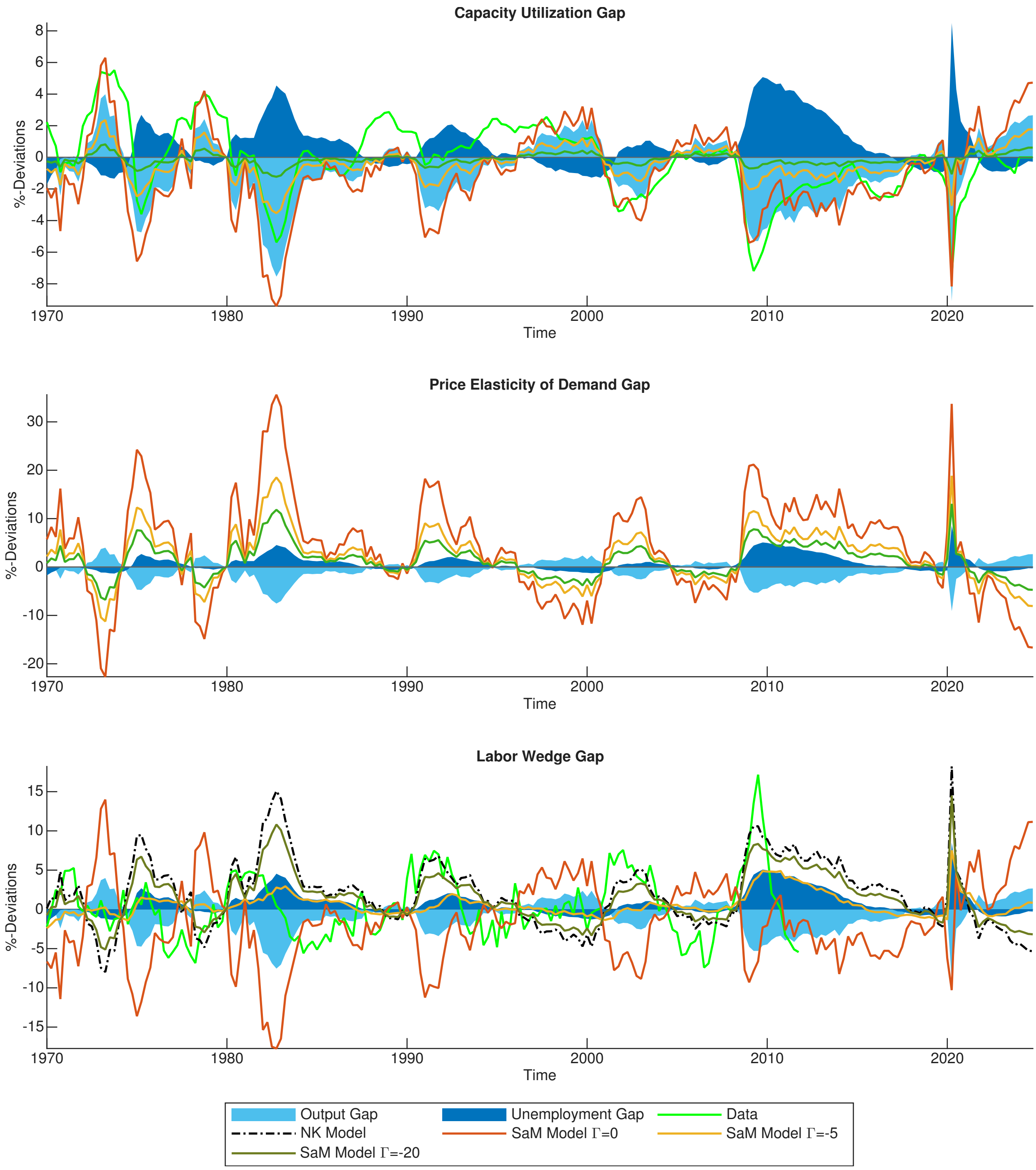
NOTE: X describes the variable on the left-hand side. Y describes output/real GDP.

demand gap. The data shows strong countercyclical variation with a standard deviation of up to 11.46, but especially in the 1970s to 1990s with peak increases above 30% and peak decrease below 20%. The correlation is significantly countercyclical with approximately −0.97. No direct empirical time series is available to compare the model simulations. During the Great Recession, the price elasticity of demand gap shows a stronger countercyclical pattern than the capacity utilization gap would indicate. Importantly, during the current increases in inflation following the COVID-pandemic, the model indicates a strong decrease

[31]Data is retrieved from FRED. (1) Output Gap → BEA Account Code: A191RX; (2) Unemployment Rate → FRED Code: UNRATE; (3) Noncyclical Rate of Unemployment → FRED Code: NROU; (4) Labor Wedge Data: see Karabarbounis (2014); (5) Capacity Utilization Data: see Gantert (2025).

[32]We take the relationship of output gap and unemployment gap data as given in the data. This relationship and their quantitative dimension are not necessarily replicated by the full model as presented in section 5.2.

Figure E.11: Back-of-the-envelope calculations for the goods market SaM channels



NOTE: The figure shows cyclical variation around a long-run trend (steady-state) for data, the benchmark model, and the NK-SaM model with alternative calibrations as given in the legend. It shows US data from 1970q1 to 2024q4. Data sources are described in the main text of Appendix E.

in the price elasticity of demand. This pattern follows Harding et al. (2022, 2023). However, variation in inflation and the NK Phillips curve are still linear in the model.

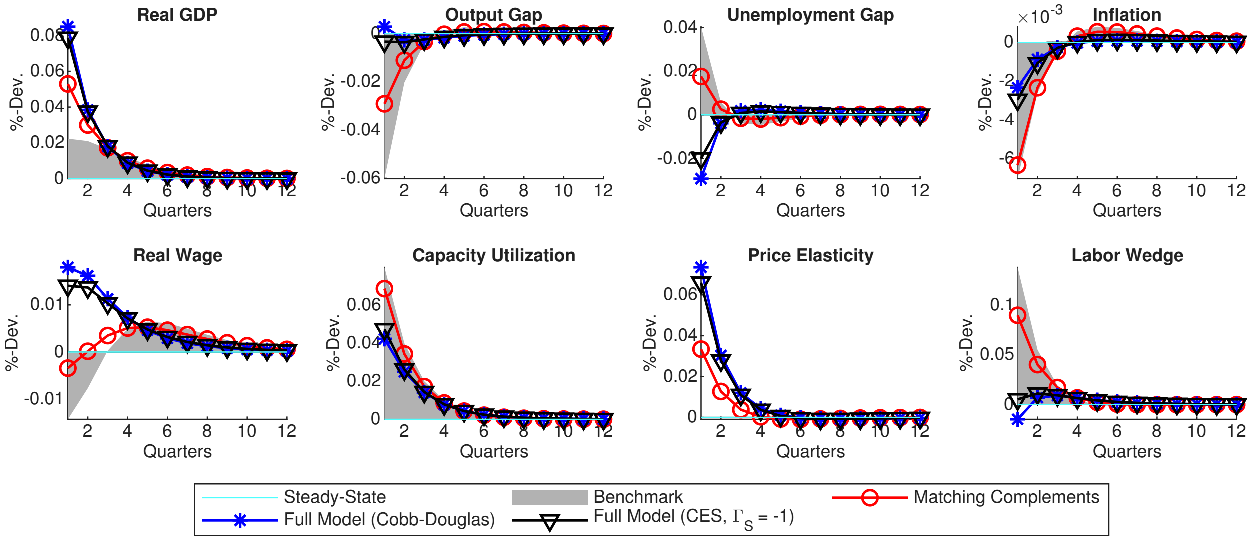
Lastly, fig. E.11 shows the calculated labor wedge gap. The baseline NK model shows a highly countercyclical labor wedge with a standard deviation of 4.29 which is roughly in line with the data (see e.g. Karabarbounis (2014)). For the NK-SaM model with $\Gamma_S = 0$, the price elasticity of demand channel dominates the labor demand channel of marginal costs and the labor wedge becomes procyclical. For $\Gamma_S = -20$, the NK-SaM model labor wedge is more in line with the data showing a countercyclical correlation with GDP. However, this comes at a cost of very little variation in capacity utilization, significantly below what the data shows. This is the trade-off between matching the efficiency and labor wedge data at the same time as described in section 5. However, even in a case with low capacity utilization variation we still find significant variation in the price elasticity of demand.

Appendix F. Additional Results and Robustness: Simulations

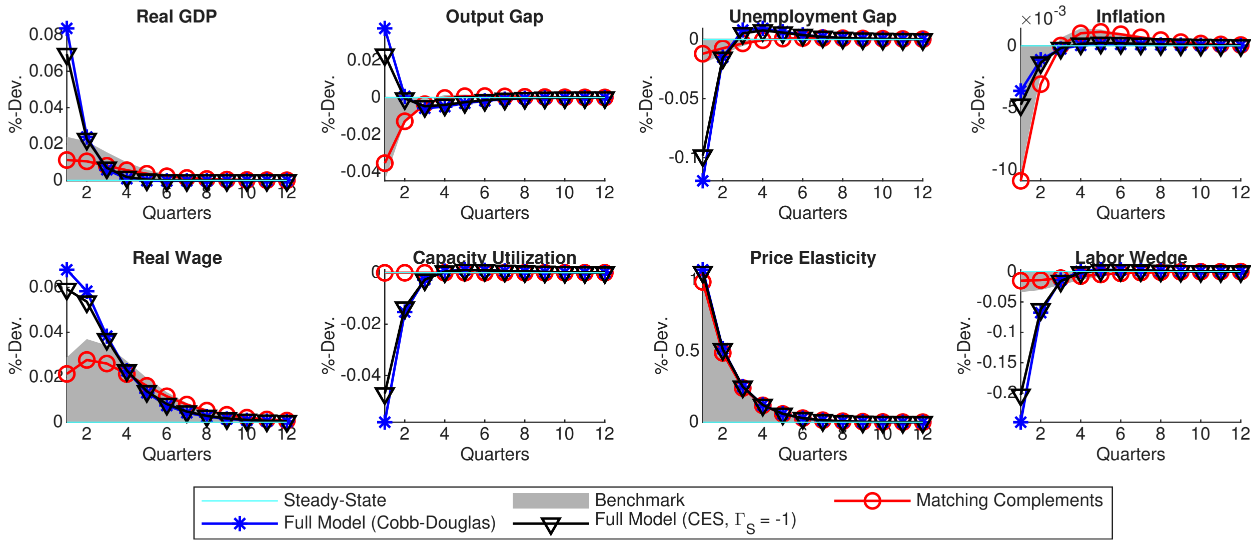
Appendix F.1. IRFs (Decomposition) to Further Cost-Push Shocks

Figure F.12

(a) IRFs to an Expansionary Matching Efficiency Shock



(b) IRFs to an Expansionary EIS Shock

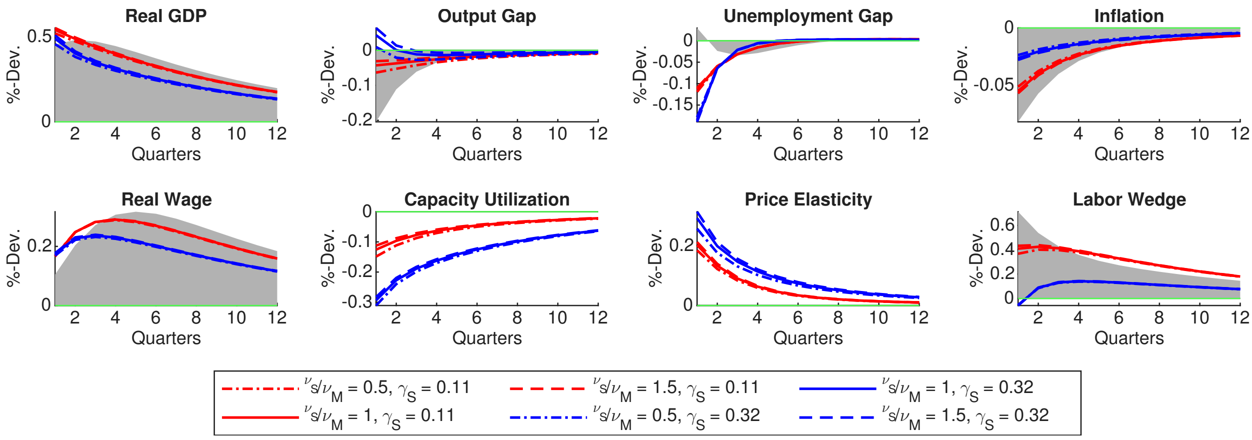


NOTE: The figure shows IRFs to a one standard deviation (a) expansionary matching efficiency and (b) expansionary elasticity of substitution (EIS) shock using the model presented in section 2 and section 4. The benchmark model follows proposition 1, the "matching complements" model sets $\Gamma_S = -\infty$, the CES model sets $\Gamma_S = -1$, the Cobb-Douglas model is calibrated as in table 1.

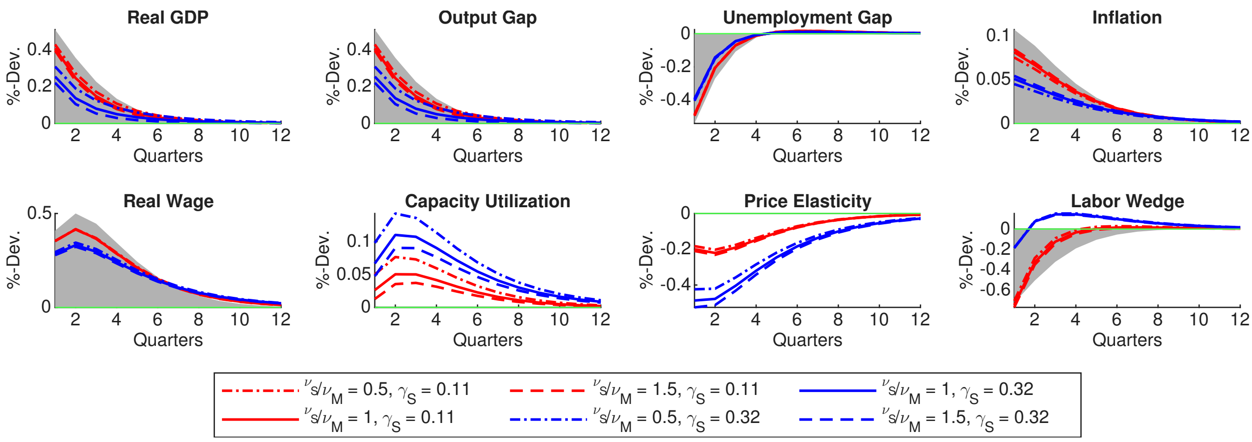
Appendix F.2. Alternative Calibration - Robustness of the Simulation Results

Figure F.13: Robustness to Calibration Changes in $\frac{\nu_S}{\nu_M}$ - IRFs to Expansionary Shocks

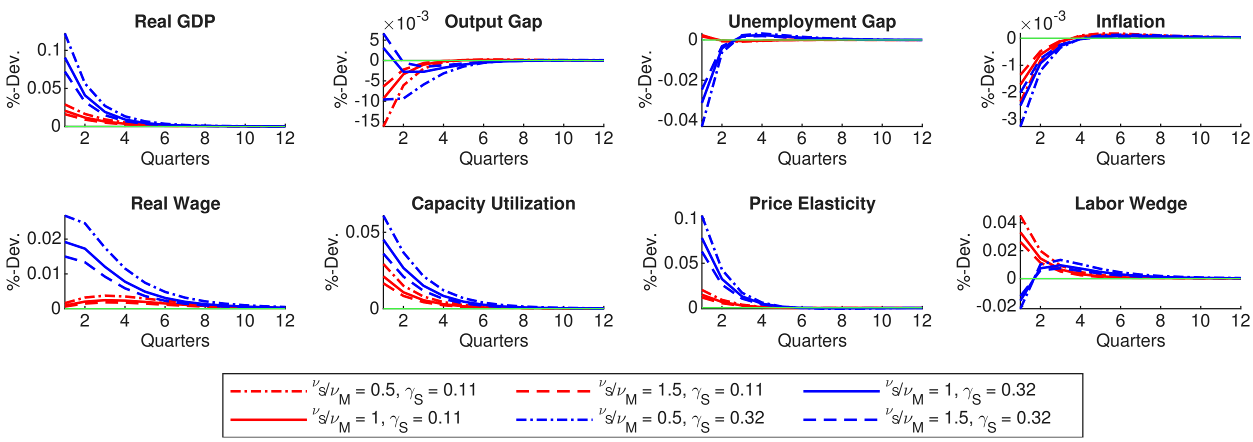
(a) IRFs to an Expansionary TFP Shock



(b) IRFs to an Expansionary Monetary Policy Shock



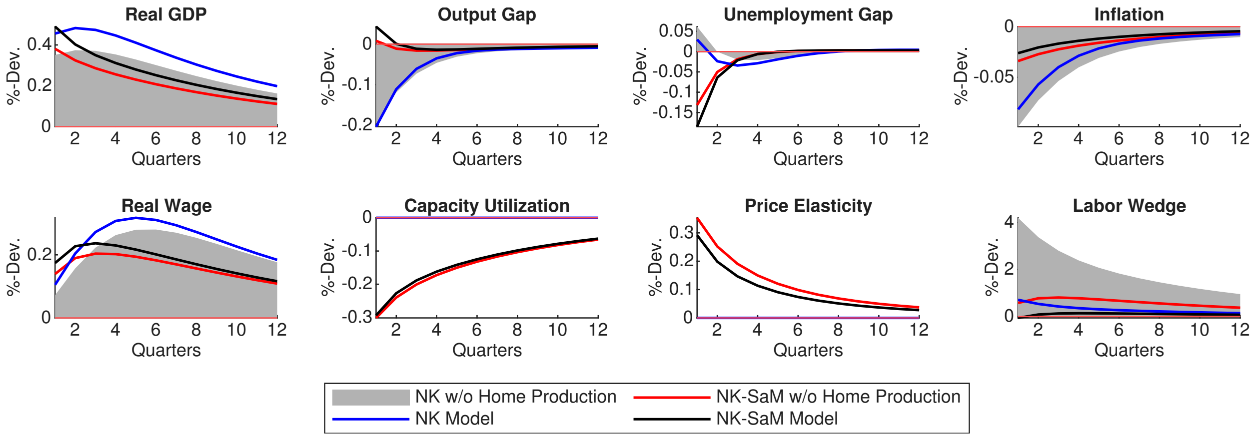
(c) IRFs to an Expansionary Search Effort Shock



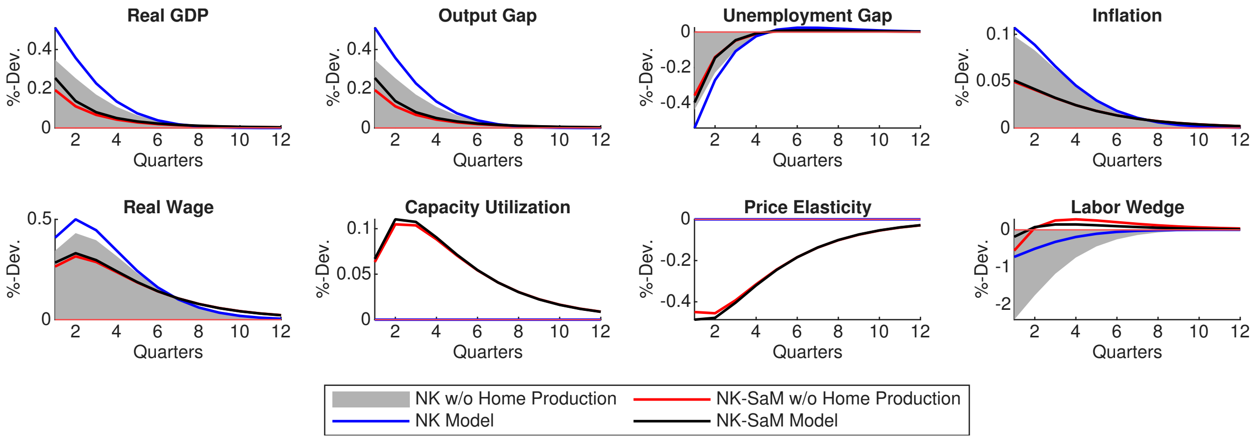
NOTE: The figure shows IRFs to one standard deviation expansionary shocks using the model presented in section 2 and section 4. The benchmark model (grey areas)follows proposition 1, the NK-SaM model is calibrated as given in the legend with varying values for γ_S and $\frac{\nu_S}{\nu_M}$.

Figure F.14: Robustness to Adding Home Production - IRFs to Expansionary Shocks

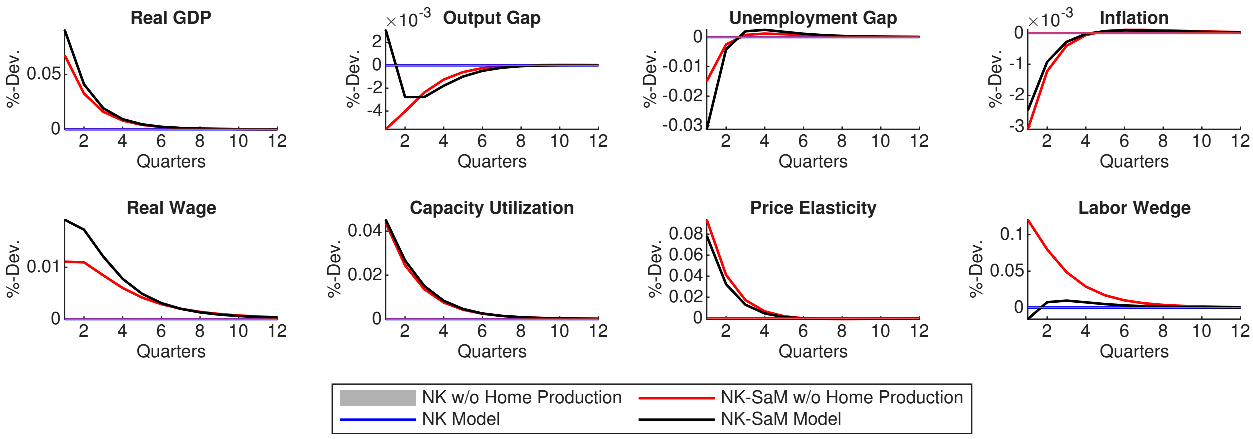
(a) IRFs to an Expansionary TFP Shock



(b) IRFs to an Expansionary Monetary Policy Shock



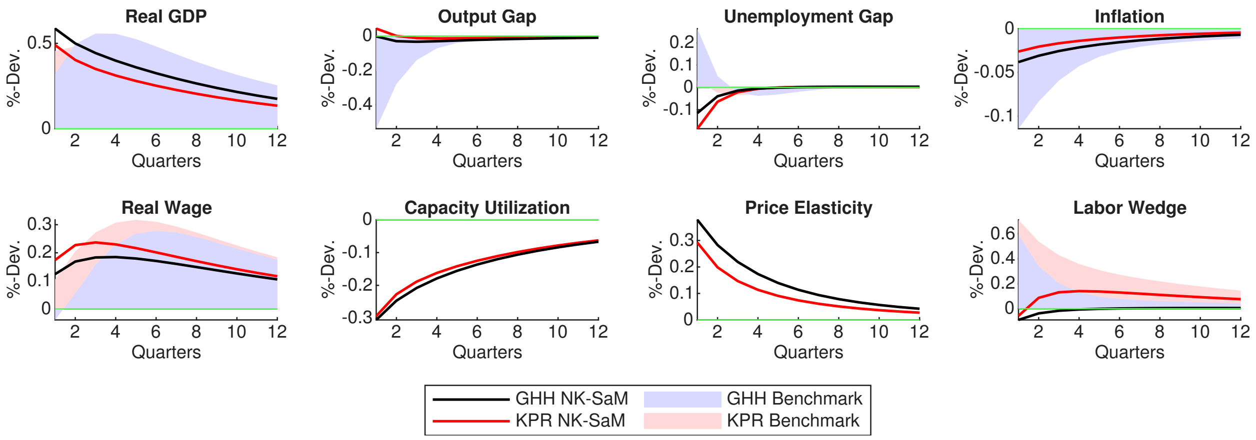
(c) IRFs to an Expansionary Search Effort Shock



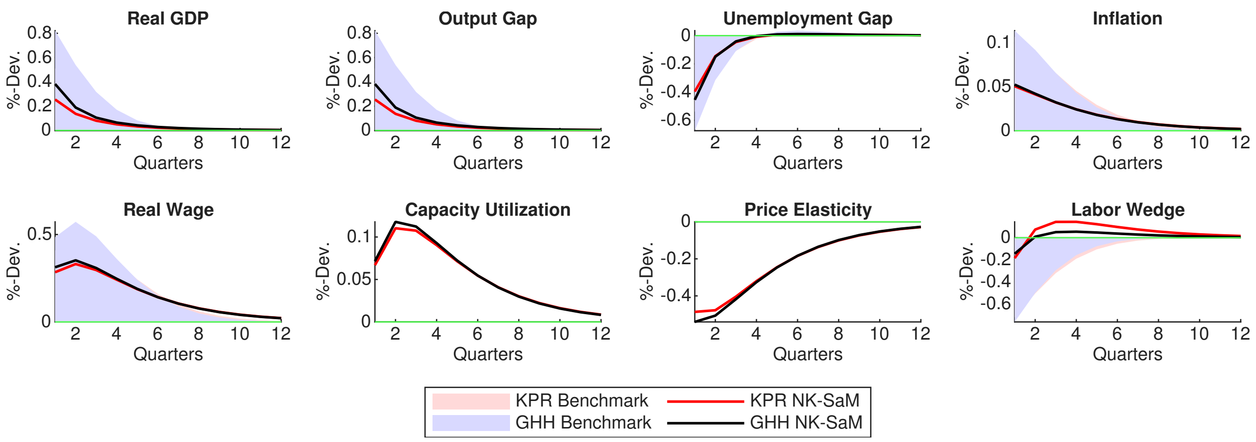
NOTE: The figure shows IRFs to one standard deviation expansionary shocks using the model presented in section 2 and section 4. The models are calibrated as given in the legend.

Figure F.15: Robustness to GHH Preferences - IRFs to Expansionary Shocks

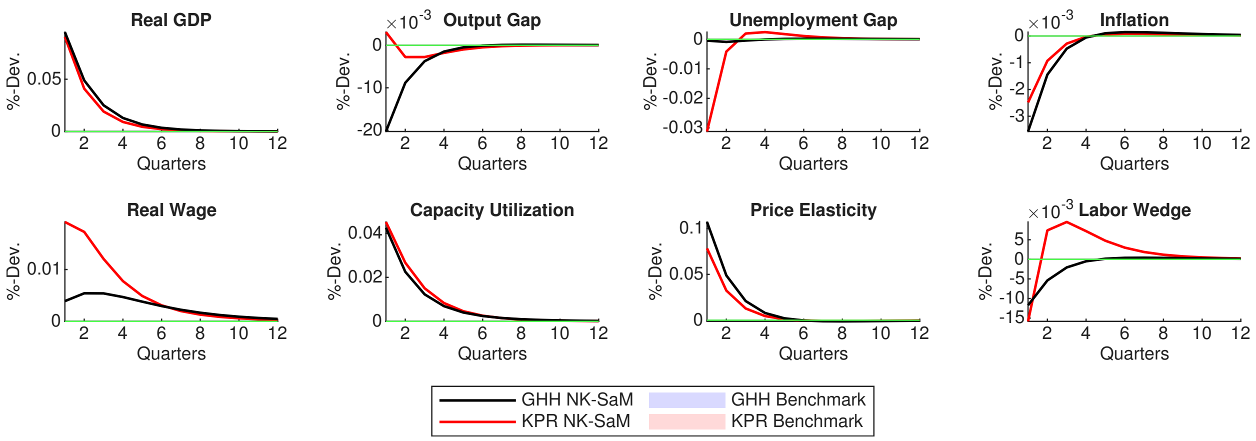
(a) IRFs to an Expansionary TFP Shock



(b) IRFs to an Expansionary Monetary Policy Shock



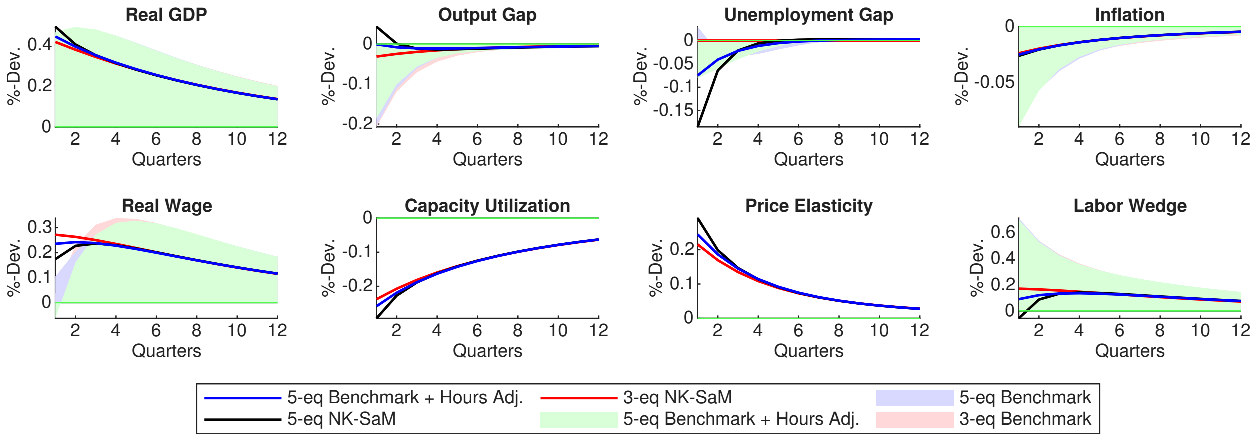
(c) IRFs to an Expansionary Search Effort Shock



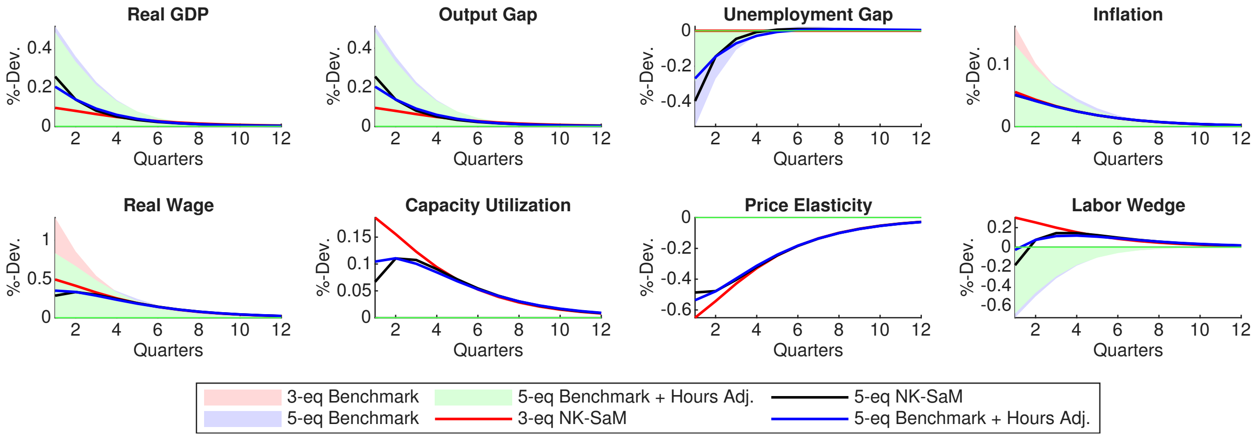
NOTE: The figure shows IRFs to one standard deviation expansionary shocks using the model presented in section 2 and section 4. The benchmark model follows proposition 1, the NK-SaM model is calibrated as in table 1. "KPR" are King et al. (1988) preferences. "GHH" are Greenwood et al. (1988) preferences. The model extension and its derivation is shown in Appendix A.

Figure F.16: Robustness to Calibration Changes in κ_W - IRFs to Expansionary Shocks

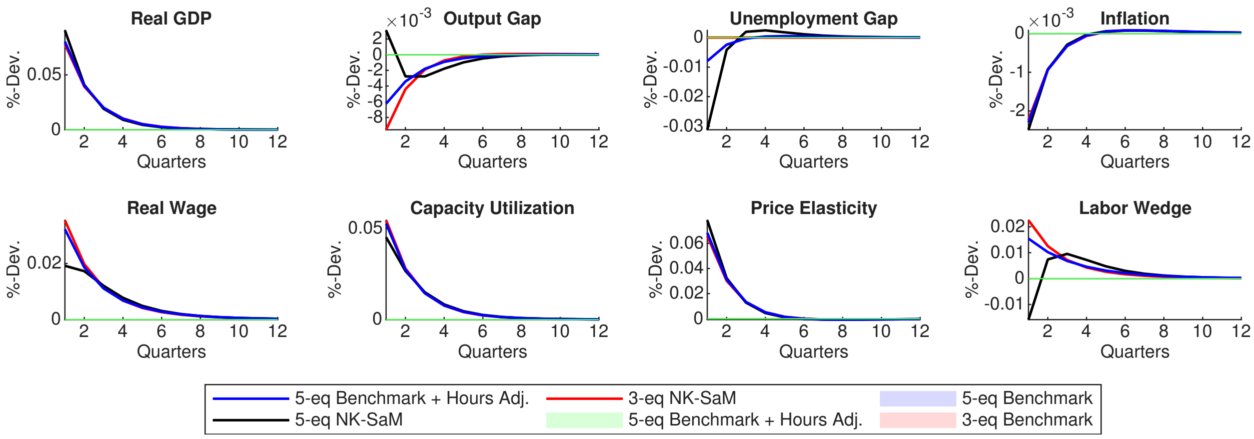
(a) IRFs to an Expansionary TFP Shock



(b) IRFs to an Expansionary Monetary Policy Shock



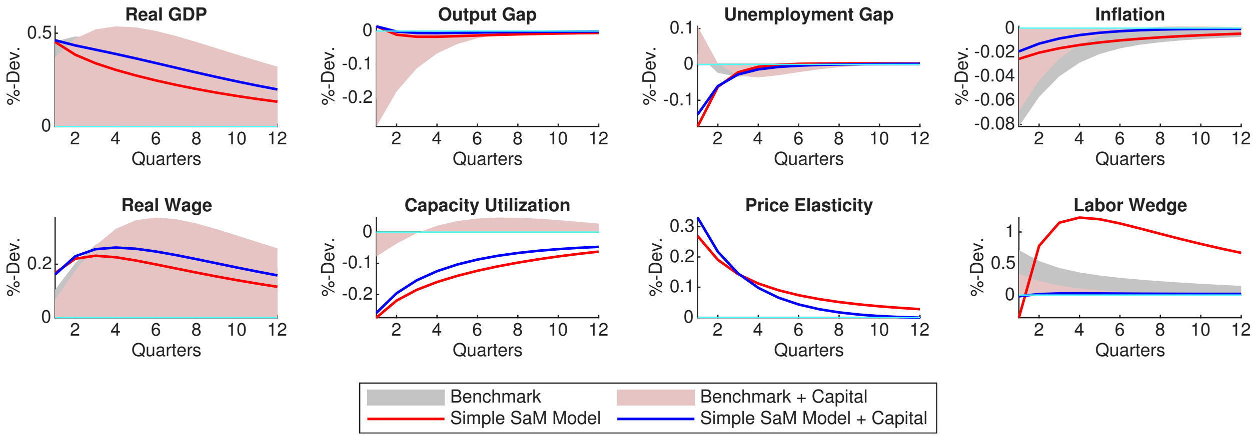
(c) IRFs to an Expansionary Search Effort Shock



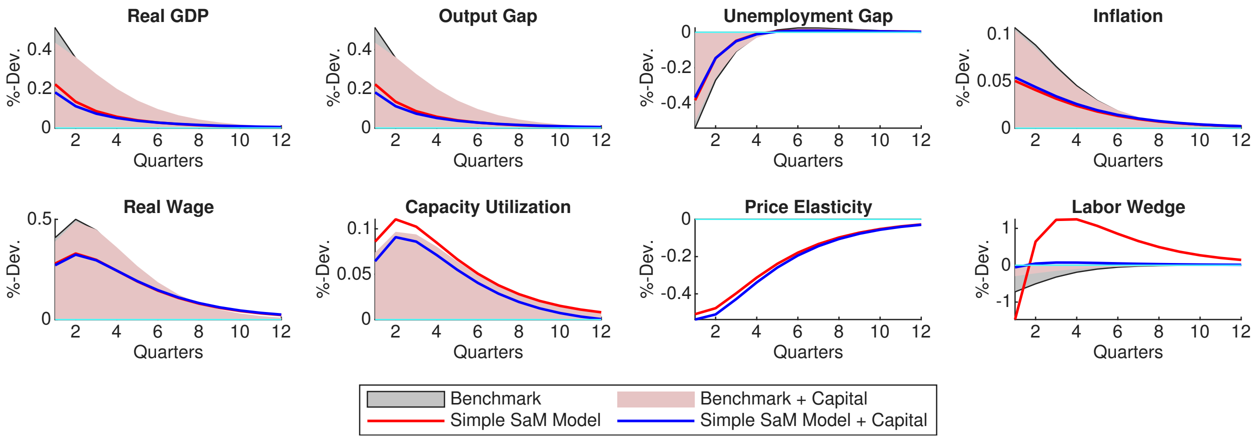
The figure shows IRFs to one standard deviation expansionary shocks using the model presented in section 2 and section 4. The benchmark model follows proposition 1, the 5-equation NK-SaM model is calibrated as in table 1. The 3-equation benchmark and NK-SaM models calibrate $\kappa_W = 0$. For the "hours adjustment costs" addition, we calibrate $\kappa_{HM} = 4$. The model extension and its derivation is shown in Appendix A.

Figure F.17: Robustness to Adding Capital Stock Channels - IRFs to Expansionary Shocks

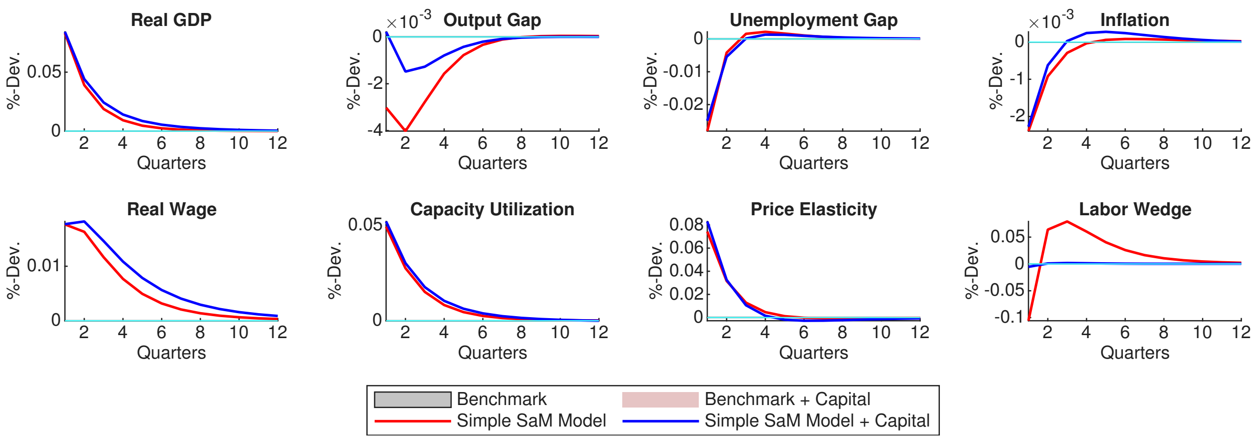
(a) IRFs to an Expansionary TFP Shock



(b) IRFs to an Expansionary Monetary Policy Shock



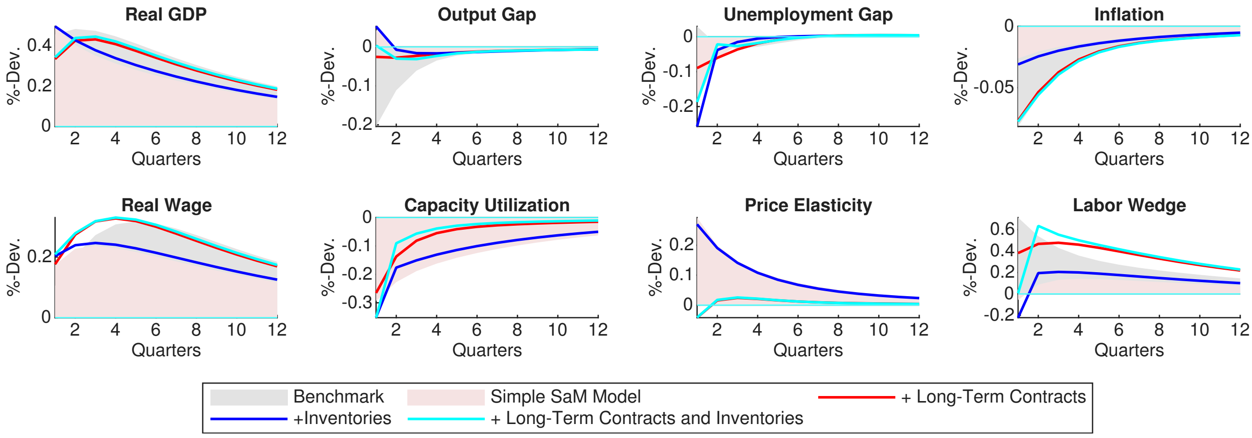
(c) IRFs to an Expansionary Search Effort Shock



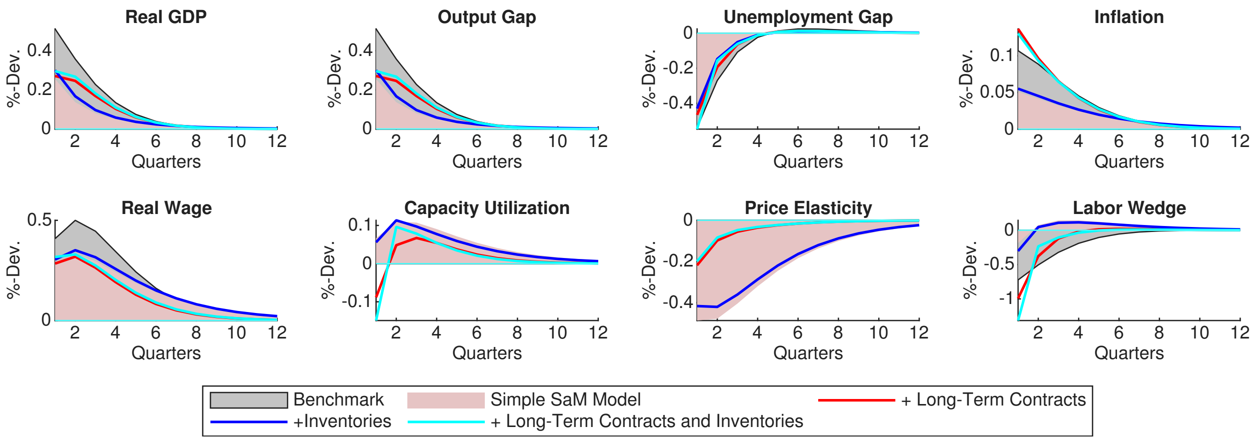
NOTE: The figure shows IRFs to one standard deviation expansionary shocks using the model presented in section 2 and section 4. The benchmark model follows proposition 1, the NK-SaM model is calibrated as in table 1. The capital stock and capital utilization channels are added as shown in Appendix A and calibrated as in Appendix C.

Figure F.18: Robustness to Adding Long-Term SaM Channels - IRFs to Expansionary Shocks

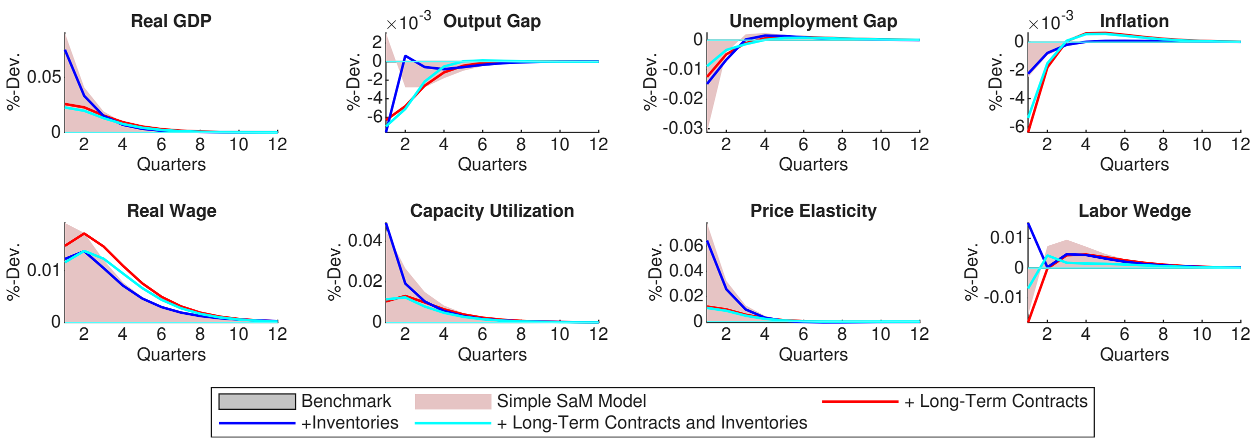
(a) IRFs to an Expansionary TFP Shock



(b) IRFs to an Expansionary Monetary Policy Shock



(c) IRFs to an Expansionary Search Effort Shock



NOTE: The figure shows IRFs to one standard deviation expansionary shocks using the model presented in section 2 and section 4. The benchmark model follows proposition 1, the NK-SaM model is calibrated as in table 1. The long-term contract and firm inventory channels are added as shown in Appendix A and calibrated as in Appendix C.