Structural Estimation of Inflation Channel Heterogeneity: Imported Inputs vs. Final Goods

Abstract

This paper develops a New Keynesian DSGE model that distinguishes between imported intermediate inputs and imported final consumption goods to analyze the inflationary consequences of global supply chain disruptions. Motivated by empirical evidence from the COVID-19 period and structural shifts in trade patterns, the model incorporates endogenous wage bargaining with labor market frictions and nominal rigidities. Disruptions in imported intermediate inputs raise domestic marginal costs, propagate through hiring dynamics, and generate persistent inflation via wage-price feedback. In contrast, shocks to imported final goods alter the consumption basket composition with more transitory effects. The model features a modified Phillips curve in which foreign input cost shocks and labor market tightness jointly determine inflation dynamics.

1 Motivation

The COVID-19 pandemic generated unprecedented disruptions in global supply chains accompanied by significant inflationary pressures, reigniting debates about the persistence and nature of inflation dynamics. Initially interpreted by policymakers as transitory phenomena, inflationary pressures persisted longer than anticipated, prompting renewed analysis of the mechanisms underlying inflation transmission in highly interconnected economies. Much of the recent macroeconomic literature has characterized these global disturbances either as imported inflation, conceptualized as cost-push shocks arising from elevated prices of foreign goods, or as direct access constraints, emphasizing reduced availability of foreign-produced commodities.

However, this literature typically ignores a critical structural distinction: the difference between imported intermediate inputs and imported final consumption goods. Shocks to imported final goods primarily affect the consumer basket directly, altering consumer prices without necessarily influencing firms' production costs. Conversely, disruptions in imported intermediate inputs induce immediate increases in domestic marginal production costs, as firms substitute toward more costly domestic inputs or operate below optimal capacity.

Empirically, these channels manifest differently: imported intermediate input prices exhibit substantially greater volatility compared to domestic intermediate prices, indicating more pronounced and rapid transmission into domestic firms' marginal costs. For instance, during the COVID-19 period, import price indices for industrial supplies and materials experienced sharp fluctuations relative to the comparatively stable Producer Price Index for domestic industrial commodities, highlighting the distinct and volatile nature of imported intermediate cost shocks. Concurrently, the share of imported final goods within total domestic consumption, which had steadily risen prior to the global financial crisis, exhibited stabilization and notable declines post-2008, highlighting structural shifts in consumption patterns and import dependency. Recent empirical evidence underscores the necessity of explicitly separating these channels. Figure 1 illustrates this distinction by comparing year- over-year inflation rates of imported industrial supplies and materials (imported intermediate inputs) and the domestic Producer Price Index (PPI) for industrial commodities excluding fuels (domestic intermedi- ate prices). Notably, imported intermediate input prices exhibit markedly higher volatility compared to domestic intermediate prices, suggesting that foreign input shocks can propagate quickly and significantly into domestic production costs. This difference indicates that disruptions in imported intermediates—such as those experienced during COVID-19—may lead firms to reassess production decisions, marginal costs, hiring practices, and wage-setting behavior. By substituting domestically produced inputs or altering pro- duction structures, firms attempt to mitigate imported inflationary pressures, thereby generating shifts in labor demand and influencing broader labor market dynamics.

Furthermore, from Figure 2 data on the share of imported final consumption goods in domestic markets underline additional dimensions of macroeconomic vulnerability. Notably, while the share of imported consumption increased steadily before the 2008 global financial crisis, it subsequently plateaued and experienced notable declines. These fluctuations likely reflect periods of intensified supply-chain disruptions, policy-induced shifts (such as tariff adjustments), or altered consumer preferences, all of which underscore the importance of explicitly modeling the changing composition of imported goods. Such structural shifts in import reliance can substantially modify domestic inflation dynamics and consumption behavior, implications that standard single-channel treatments of imported inflation or access constraints typically overlook.

Motivated by these empirical patterns and theoretical gaps, this paper develops a dynamic stochastic general equilibrium (DSGE) model incorporating an explicit distinction between imported intermediate inputs and imported final consumption goods. Our model introduces endogenous wage bargaining within a New Keynesian framework featuring labor market frictions, enabling a rigorous analysis of how imported intermediate input shortages amplify domestic marginal cost fluctuations and propagate through the labor

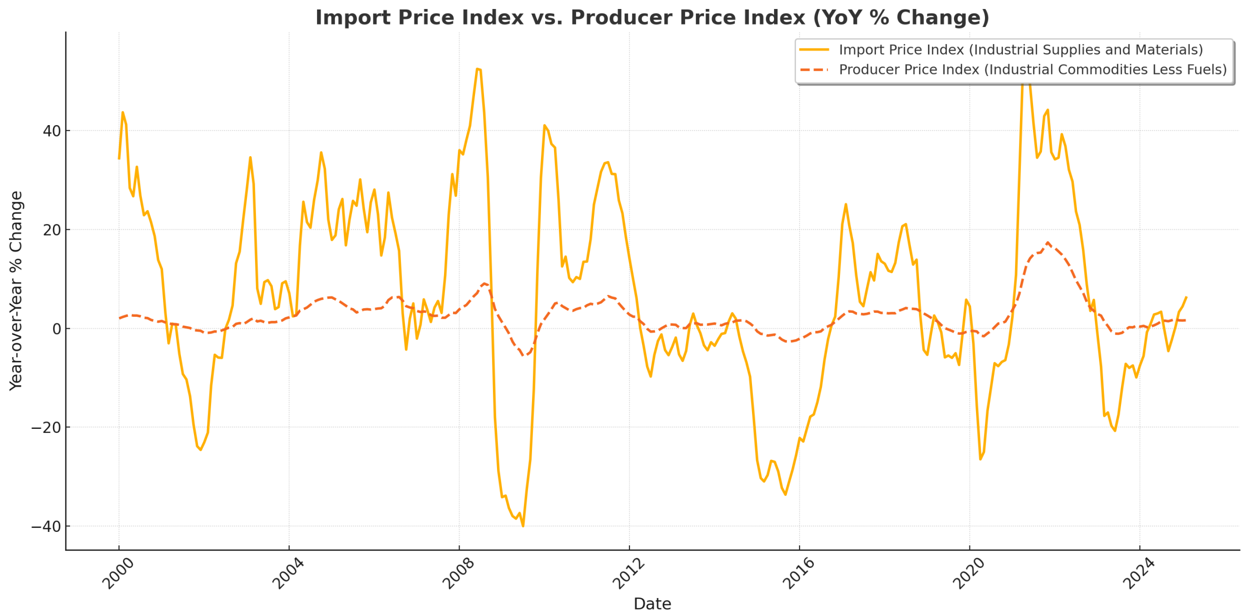

Figure 1: Year-over-year inflation rates of imported industrial supplies and materials (imported intermediate inputs) and the domestic Producer Price Index (PPI) for industrial commodities excluding fuels (domestic intermediate prices).

market to shape inflation persistence. Specifically, disruptions in imported intermediate inputs lead firms to reassess their production decisions, hiring practices, and wage-setting behavior, generating shifts in labor demand and fostering potentially persistent inflationary dynamics through wage-price feedback mechanisms. In contrast, shocks affecting imported final consumption goods directly influence the cost and composition of consumption baskets, with more immediate but potentially less persistent impacts on overall inflation.

By introducing these two separate channels into a unified theoretical framework, this paper addresses the following research questions:

- How do global supply chain disruptions affecting imported intermediate inputs differ from those affecting imported final goods in their impact on domestic inflation dynamics?
- To what extent does the scarcity of imported intermediate goods amplify inflation persistence through endogenous wage bargaining and labor market frictions compared to shocks affecting only imported final consumer goods?
- How does the volatility in the imported share of consumption, particularly evident during post-2008 episodes of tariff adjustments and supply-chain disruptions, influence the monetary transmission mechanism and policy trade-offs faced by central banks?

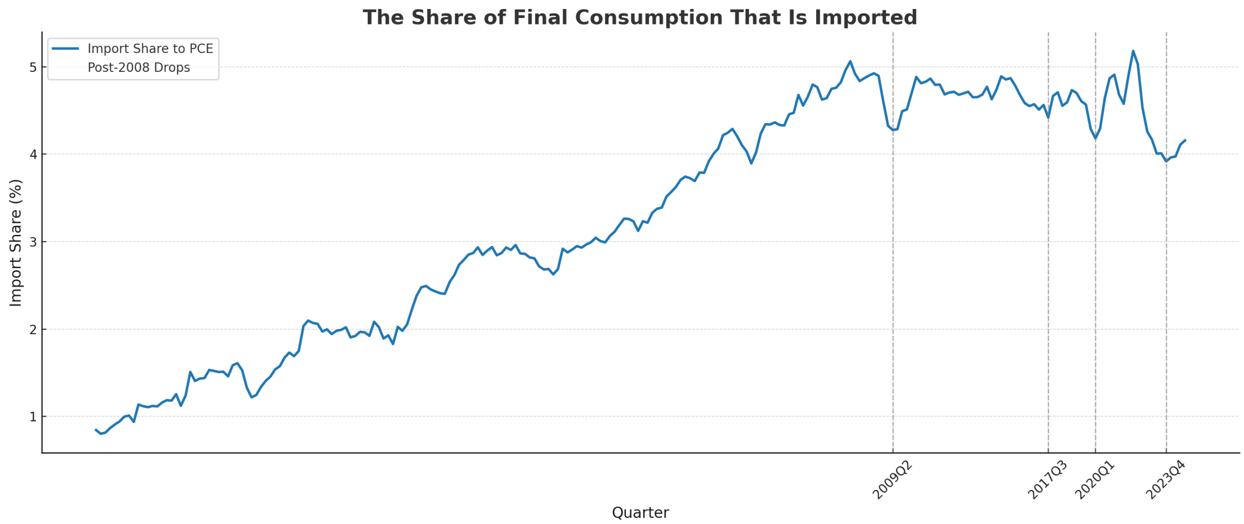

Figure 2: This figure plots the share of imported final consumption goods in total personal consumption. The data is sourced from the Federal Reserve Economic Data (FRED). Specifically, the series `A652RC1Q027SBEA` represents *Imports of goods: Consumer goods, except food and automotive* (billions of dollars, quarterly, seasonally adjusted annual rate), and `PCE` represents *Personal Consumption Expenditures* (billions of dollars, quarterly, SAAR). The share is calculated as the ratio: `A652RC1Q027SBEA / PCE`.

By distinguishing clearly between these channels, our theoretical framework contributes to current debates surrounding inflation persistence, cost-push shocks, and the optimal monetary policy response in an era characterized by deep global economic integration and recurrent supply chain disruptions.

2 Households

There is a representative household with a continuum of members of measure unity. The number of family members currently employed is n_t. Employment is determined through a search and matching process. The family provides perfect consumption insurance for its members, implying that consumption is the same for each person, regardless of whether he or she is currently employed.

Individuals not currently working are searching for jobs.

Accordingly, conditional on n_t, the household chooses consumption c_t, government bonds B_t, and investment i_t to maximize the utility function

$$E_t \sum_{s=0}^{\infty} \beta^s \epsilon_t^b \log(c_{t+s} - hc_{t+s-1}), \tag{1}$$

where h is the degree of habit persistence in consumption preferences and where ϵ_t^b is a preference shock with mean unity that obeys

$$\log \epsilon_t^b = \rho^b \log \epsilon_{t-1}^b + \zeta_t^b, \tag{2}$$

and where all primitive innovations, including ζ_t^b, are zero-mean i.i.d. random variables.

Let Π_t be lump sum profits, T_t be lump sum transfers, p_t be the nominal price level, and r_t be the one-period nominal interest rate (specifically, the central bank policy instrument). Then the household's budget constraint is

$$\begin{aligned} c_t + i_t + \frac{B_t}{p_t r_t} &= w_t n_t + (1 - n_t) b_t + r_t^k k_t \\ &\quad + \Pi_t + T_t + \frac{B_{t-1}}{p_t}. \end{aligned} \tag{3}$$

Here, households own capital and choose the optimal capital k_t be rented to the firms at the rate r_t^k. The capital accumulation equation is

$$k_t = (1 - \delta) k_{t-1} + i_t, \tag{4}$$

The first-order necessary conditions yield:

For c_t,

$$\lambda_t = \frac{\epsilon_t^b}{c_t - h c_{t-1}} - \beta h E_t \frac{\epsilon_{t+1}^b}{c_{t+1} - h c_t}, \tag{5}$$

For B_t,

$$\lambda_t = r_t B_t E_t \left(\frac{\lambda_{t+1} p_t}{p_{t+1}} \right). \tag{6}$$

For i_t,

$$1 = \beta E_t \frac{\lambda_{t+1}}{\lambda_t} \left[(1 - \delta) + r_{t+1}^k \right]. \tag{7}$$

where $\lambda_t = u'(c_t)$.

Again, except for the treatment of the labor supply decision, the household sector is conventional.

Aggregate consumption in our open economy model is defined as

$$c_t = c_t^d + c_t * \delta_t^f \tag{8}$$

where c_t^d denotes domestic final consumption goods and $c_t * \delta_t^f$ represents the imported final consumption goods, with δ_t^f being the share of total consumption that is imported. This parameter, δ_t^f, captures the proportion of consumption sourced from abroad and is subject to variations stemming from multiple factors. For instance, supply chain constraints can limit the effective availability of imports even if nominal import orders remain high; tariff hikes or other trade policy measures may elevate import costs and restrict supply; and shifts in consumer preferences or lifestyle trends can lead to a higher propensity for domestic consumption. We assume δ_t^f obeys the following exogenous stochastic process:

$$\log \delta_t^f = (1-\rho^f) \log \delta^f + \rho^f \log \delta_{t-1}^f + \zeta_t^f. \tag{9}$$

3 Unemployment, Vacancies, and Matching

At time t, each firm posts v_{it} vacancies in order to attract new workers and employs n_{it} workers.

The total number of vacancies and employed workers is given by:

$$v_t = \int_0^1 v_{it}\, di, \quad n_t = \int_0^1 n_{it}\, di. \tag{10}$$

All unemployed workers at t look for jobs. Our timing assumptions are such that unemployed workers who find a match go to work immediately within the period. Accordingly, the pool of unemployed workers searching for a job at t, u_t, is given by the difference between unity (the total population of workers) and the number of employed workers at the end of period $t-1$, n_{t-1}:

$$u_t = 1 - n_{t-1}. \tag{11}$$

The number of new hires or "matches," m_t, is a function of searching workers and vacancies, as follows:

$$m_t = \sigma_m u_t^\nu v_t^{1-\sigma}. \tag{12}$$

The probability a firm fills a vacancy in period t, q_t, is given by:

$$q_t = \frac{m_t}{v_t}. \tag{13}$$

Similarly, the probability a searching worker finds a job, s_t, is given by:

$$s_t = \frac{m_t}{u_t}. \tag{14}$$

Both firms and workers take q_t and s_t as given.

Finally, each period, firms exogenously separate from a fraction $1 - \rho$ of their existing workforce n_{it-1}. Workers losing their job at time t are not allowed to search until the next period. Accordingly, within our framework, fluctuations in unemployment are due to cyclical variation in hiring as opposed to separations. Both Hall (2005b, 2005c) and Shimer (2005, 2007) present evidence in support of this phenomenon.

4 Manufacturing Firms

Each period, Manufacturing firms produce output y_{it} using capital, k_{it}, and labor, n_{it}:

$$y_{it}^d = (k_{it})^\alpha (z_t n_{it})^{1-\alpha}, \tag{15}$$

where z_t is a common labor-augmenting productivity factor. We assume $\epsilon_t^z = z_t/z_{t-1}$ obeys the following exogenous stochastic process:

$$\log \epsilon_t^z = (1 - \rho^z) \log \epsilon^z + \rho^z \log \epsilon_{t-1}^z + \zeta_t^z. \tag{16}$$

Note that the steady-state value ϵ^z corresponds to the economy's growth rate Y_t. Thus, following PST, we are allowing technology to be nonstationary in levels, though stationary in growth rates.

For simplicity, we assume that capital is perfectly mobile across firms and that there is a competitive rental market in capital. These assumptions ensure constant returns to scale at the firm level, which greatly simplifies the wage bargaining problem.

It is useful to define the hiring rate x_{it} as the ratio of new hires $q_t v_{it}$ to the existing workforce n_{it-1}:

$$x_{it} = \frac{q_t v_{it}}{n_{it-1}}. \tag{17}$$

Observe that due to the law of large numbers, the firm knows x_{it} with certainty at time t since it knows the likelihood q_t that each vacancy it posts will be filled. The hiring rate is thus effectively the firm's control variable.

The total workforce, in turn, is the sum of the number of surviving workers ρn_{it-1} and new hires $x_{it} n_{it-1}$:

$$n_{it} = (\rho + x_{it}) n_{it-1}. \tag{18}$$

Equation (18) reflects the timing assumption that new hires go to work immediately.

Let p_t^w be the relative price of manufacturing firms goods, w_t^n be the nominal wage, r_t^k be the rental rate of capital, and $\beta E_t \Lambda_{t,t+1}$ be the firm's discount rate, where the parameter β is the household's subjective discount factor and where $\Lambda_{t,t+1} = \lambda_{t+1}/\lambda_t$. Then, the value of the firm, $F_t(w_{it}^n, n_{it-1})$, may be expressed as:

$$\begin{aligned} F_t(w_{it}^n, n_{it-1}) = p_t^w y_t^d - \frac{w_t^n n_{it}}{p_t} - \kappa_t x_{it} n_{it-1} - r_t^k k_{it} \\ + \beta E_t \Lambda_{t,t+1} F_{t+1}(w_{it+1}^n, n_{it}). \end{aligned} \tag{19}$$

with

$$\kappa_t = \kappa z_t. \tag{20}$$

We use the standard assumption of fixed costs of posting a vacancy and, we allow adjustment costs to drift proportionately with productivity in order to maintain a balanced steady-state growth path (otherwise adjustment costs become relatively less important as the economy grows).

At any time, the firm maximizes its value by choosing the hiring rate (by posting vacancies) and its capital stock, given its existing employment stock , the probability of filling a vacancy, the rental rate on capital, and the current and expected path of wages. If it is a firm that is able to renegotiate the wage, it bargains with its workforce over a new contract. If it is not renegotiating, it takes as given the wage at the previous period's level, as well as the likelihood that it will be renegotiating in the future.

We next consider the firm's hiring and capital rental decisions, and defer a bit the description of the wage bargain. The firm's first-order condition for capital is simply:

$$r_t^k = p_t^w \alpha \frac{y_{it}^d}{k_{it}} = p_t^w \alpha \frac{y_t^d}{k_t}. \tag{21}$$

Given Cobb–Douglas technology and perfect capital mobility, all firms choose the same capital–output ratio and, in turn, the same capital–labor and labor–output ratios.

Firms choose n_{it} by setting x_{it} or, equivalently, v_{it}. The firm's hiring decision yields:

$$\kappa_t = p_t^w a_{it} - \frac{w_{it}^n}{p_t} + \beta E_t \Lambda_{t,t+1} \frac{\partial F_{t+1}(w_{it+1}^n, n_{it})}{\partial n_{it}}, \tag{22}$$

with

$$a_{it} = (1-\alpha)\frac{y_{it^d}}{n_{it}} = (1-\alpha)\frac{y_t^d}{n_t} = a_t. \tag{23}$$

By making use of the envelope theorem to obtain $\frac{\partial F_t(w_{it}^n, n_{it-1})}{\partial n_{it-1}}$ and combining equations, we obtain

$$\kappa_t = p_t^w a_t - \frac{w_{it}^n}{p_t} + \rho\beta E_t \Lambda_{t,t+1} \kappa_{t+1}. \tag{24}$$

The hiring rate thus depends on the discounted stream of earnings and savings on adjustment costs.

Finally, for the purpose of the wage bargain, it is useful to define $J_t(w_{it}^n)$, the value to the firm of having another worker at time t after new workers have joined the firm, that is, after adjustment costs are sunk. Differentiating $F_t(w_{it}^n, n_{it-1})$ with respect to n_{it}, taking x_{it} as given, yields:

$$J_t(w_{it}^n) = p_t^w a_t - \frac{w_{it}^n}{p_t} + \beta E_t \Lambda_{t,t+1} \frac{\partial F_{t+1}(w_{it+1}^n, n_{it})}{\partial n_{it}}. \tag{25}$$

By making use of the hiring rate condition and the relation for the evolution of the workforce, $J_t(w_{it}^n)$ may be expressed as expected average profits per worker net of the first-period adjustment costs, with the discount factor accounting for future changes in workforce size:

$$J_t(w_{it}^n) = p_t^w a_t - \frac{w_{it}^n}{p_t} - \beta E_t \Lambda_{t,t+1} \kappa_{t+1} x_{it+1} + E_t(\rho + x_{it+1})\beta\Lambda_{t,t+1} J_{t+1}(w_{it+1}^n). \tag{26}$$

5 Workers

In this subsection, we develop an expression for a worker's surplus from employment, which is a critical determinant of the outcome of the wage bargain.

Let $V_{it}(w_{it}^n)$ be the value to a worker of employment at firm i and let U_t be the value of unemployment. These values are defined after hiring decisions at time t have been made and are in units of consumption goods. $V_t(w_{it}^n)$ is given by:

$$V_t(w_{it}^n) = \frac{w_{it}^n}{p_t} + \beta E_t \Lambda_{t,t+1}[\rho V_{t+1}(w_{it+1}^n) + (1-\rho)U_{t+1}]. \tag{27}$$

To construct the value of unemployment, we first define $V_{x,t}$ as the average value of employment conditional on being a new worker at t:

$$V_{x,t} = \int_0^1 V_t(w_{it}^n) \frac{x_{it} n_{it-1}}{x_t n_{t-1}} di. \tag{28}$$

where $x_{it} n_{it-1}$ is total new workers at firm i and $x_t n_{t-1}$ is total new workers at t.

Next, let b_t be the flow value from unemployment, including unemployment benefits, as well as other factors that can be measured in units of consumption goods. As before, let s_t be the probability of finding a job for the subsequent period. Then U_t may be expressed as:

$$U_t = b_t + \beta E_t \Lambda_{t,t+1}[s_{t+1} V_{x,t+1} + (1 - s_{t+1}) U_{t+1}]. \tag{29}$$

with

$$b_t = b z_t, \tag{30}$$

We assume that b_t grows proportionately to z_t in order to maintain a balanced growth; otherwise, b_t would become a smaller fraction of labor income as the economy grows. The value of unemployment thus depends on the current flow value b_t and the likelihood of being employed versus unemployed next period. Note that the value of finding a job next period for a worker that is currently unemployed is $V_{x,t+1}$, the average value of working next period conditional on being a new worker. That is, unemployed workers do not have *a priori* knowledge of which firms might be paying higher wages next period. They instead just randomly flock to firms posting vacancies.

To derive the wage equation, we define the worker's surplus from employment:

$$H_t(w_{it}^n) = V_t(w_{it}^n) - U_t, \tag{31}$$

Due to the law of large numbers and for convenience, we drop i and get:

$$H_{x,t} = V_{x,t} - U_t. \tag{32}$$

It follows that

$$H_t(w_t^n) = \frac{w_t^n}{p_t} - b_t + \beta E_t \Lambda_{t,t+1}[(\rho - s_{t+1})H_{t+1}]. \tag{33}$$

We could also get

$$J_t(w_t^n) = p_t^w a_t - \frac{w_t^n}{p_t} - \beta E_t \Lambda_{t,t+1}\kappa_{t+1}x_{t+1} + E_t(\rho + x_{t+1})\beta\Lambda_{t,t+1}J_{t+1}(w_{t+1}^n). \tag{34}$$

5.1 Nash Bargaining and Wage Dynamics

As we noted earlier, we introduce staggered Nash wage bargaining and allow for nominal wage contracting to past inflation because we have a monetary model. The firms can set their old contract as nominal wages w_{it}^n following the indexation rule:

$$w_{it}^n = \gamma_z w_{it-1}^n \pi_{t-1}^{\gamma}, \tag{35}$$

where $\pi_t = p_t/p_{t-1}$ and where γ is the degree of indexing to past inflation. We also estimate the parameter γ. The term γ_z in the indexing rule provides an adjustment for trend productivity.

Firms that enter a new wage agreement at t negotiate with the new hires. Let w_{it}^* denote the wage of a firm that renegotiates at t. Given constant returns, all sets of renegotiating firms and workers at time t face the same problem and thus set the same wage. As we noted earlier, the firm negotiates with the marginal worker over the surplus from the marginal match. We assume Nash bargaining, which implies that the contract wage w_t^* is chosen to solve:

$$\max H_t(w_t^n)^{\eta_t} J_t(w_t^n)^{1-\eta_t}, \tag{36}$$

where $J_t(w_t^n)$ and $H_t(w_t^n)$ are given by equations (31) and (32).

In the conventional search and matching framework, the bargaining power parameter is constant. Here, in order to allow for an error term in the wage equation, we allow this parameter to evolve exogenously according to:

$$\eta_t = \eta \epsilon_t^{\eta}, \tag{37}$$

where ϵ_t^{η} is a mean-unity bargaining power shock that follows the stochastic process:

$$\log \epsilon_t^{\eta} = \rho^{\eta} \log \epsilon_{t-1}^{\eta} + \zeta_t^{\eta}. \tag{38}$$

The first-order necessary condition for the Nash bargaining solution is given by:

$$\eta_t J_t(w_t^{*n}) = (1-\eta_t) H_t(w_t^{*n}). \tag{39}$$

Finally, the bargaining wage is given by:

$$\frac{w_t^{*n}}{p_t} = \eta_t p_t^w a_t + (1-\eta_t) b_t + \beta E_t \Lambda_{t,t+1} \left(\eta_t \rho \kappa_{t+1} + (1-\eta_t) \frac{\eta_{t+1}}{1-\eta_{t+1}} (s_{t+1} - \rho) \kappa_{t+1} \right) \tag{40}$$

In contrast to the standard model, the Nash wage here incorporates not only the standard bargaining wage but also the future potential bargaining power changes and the cost of new hire. This adds a dynamic element to the wage-setting process, accounting for future uncertainties and opportunities.

Finally, the aggregate wage dynamics can be expressed as:

$$\frac{w_t^n}{p_t} = \left(1 - \rho \frac{n_{t-1}}{n_t}\right) \frac{w_t^{*n}}{p_t} + \rho \frac{n_{t-1}}{n_t} \gamma_z \frac{w_{t-1}^n}{p_t} \pi_{t-1}^{\gamma}. \tag{41}$$

5.2 Domestic Intermediate goods firms

In this model, a continuum of monopolistically domestic intermediate goods firms, indexed by $j \in [0,1]$, purchase manufacturing goods from wholesale firms. They then transform the manufacturing goods into differentiated intermediate goods.

Domestic intermediate goods firms set their prices in a staggered manner, following a standard time-dependent Calvo pricing rule. Specifically, each firm has a probability $1-\lambda^p$ of being able to adjust its price in the current period, with this probability being independently and identically distributed across time and firms.

For firms that are unable to adjust their prices, they follow an indexation rule:

$$p_{i,t}^d = \pi p_{i,t-1}^d. \tag{42}$$

On the other hand, firms that can adjust their prices aim to maximize their expected discounted profits, subject to constraints on how frequently they can change prices. Given that all firms resetting their prices are identical ex ante, they all opt for the same price p_t^d*. Applying the law of large numbers, the aggregate price level p_t can be expressed as:

$$p_t^d = \left((1-\lambda^p)(p_t^d*)^{1-\epsilon_p} + \lambda^p(\pi p_{t-1}^d)^{1-\epsilon_p}\right)^{\frac{1}{1-\epsilon_p}}. \tag{43}$$

This formulation captures the dynamics of price-setting behavior among domestic intermediate firms, taking into account both the rigidity of prices and the opportunity to adjust them.

The final domestic intermediate good is a CES aggregate of a continuum of domestic manufacturing goods. The aggregate output is given by:

$$y_t^d = \left(\int_0^1 y_{jt}^{\frac{\epsilon_p - 1}{\epsilon_p}} dj\right)^{\frac{\epsilon_p}{\epsilon_p - 1}}. \tag{44}$$

Here $\epsilon_p > 1$ represents the elasticity of substitution across these intermediate goods. Through cost minimization, we can derive the household's demand for each retail good as an inverse function of its relative price:

$$y_{jt} = \left(\frac{p_{j,t}^d}{p_t}\right)^{-\epsilon_p^d} y_t^d. \tag{45}$$

Additionally, the aggregate price level p_t^d for final consumption goods can be expressed as:

$$p_t^d = \left(\int_0^1 {p_{j,t}^d}^{1-\epsilon_p} dj\right)^{\frac{1}{1-\epsilon_p}} \tag{46}$$

Reoptimizing retailers aim to maximize their expected discounted future profits by choosing a target price p_t^*. The objective function for this optimization is:

$$E_t \sum_{s=0}^{\infty} (\lambda^p \beta)^s \Lambda_{t,t+s} \left[\frac{p_t^d*}{p_{t+s}^d}\pi^s - p_{t+s}^w\right] y_{jt+s} \tag{47}$$

Solving this equation, we obtain an expression for the optimal target price p_t^*:

$$p_t^d* = \frac{\epsilon_p}{\epsilon_p - 1} \frac{\sum_{s=0}^{\infty}\left(\frac{\lambda^p\beta}{\pi\epsilon_p}\right)^s \Lambda_{t,t+s} y_{t+s}^d p_{t+s}^w (p_{t+s}^d)^{\epsilon_p}}{\sum_{s=0}^{\infty}\left(\frac{\lambda^p\beta}{\pi^{\epsilon_p - 1}}\right)^s \Lambda_{t,t+s} y_{t+s}^d (p_{t+s}^d)^{\epsilon_p - 1}} \tag{48}$$

Upon log-linearizing this equation, which can be found in the appendix, it becomes evident that the target price p_t^d* is determined by an expected discounted stream of the retailer's nominal marginal costs.

5.3 Domestic Final goods firms

Each period the domestic final goods firms provides a composite c_t^d that is the following CES aggregate of intermediate consumption goods y_t^d from domestic and y_t^f from foreign countries:

$$c_t^d = \left(\chi^{\frac{1}{\psi}} {y_t^d}^{\frac{\psi-1}{\psi}} + (1-\chi)^{\frac{1}{\psi}} {y_t^f}^{\frac{\psi-1}{\psi}} \right)^{\frac{\psi}{\psi-1}} \tag{49}$$

where $\psi > 0$ is the elasticity of substitution between the two goods. Finally, c_t^d is a composite of a continuum of differentiated retail consumption goods.From cost minimization, we obtain the demand functions for intermediate goods:

$$y_t^d = \chi \left(\frac{p_t^d *}{p_t} \right)^{-\psi} c_t^d \tag{50}$$

$$y_t^f = (1-\chi) \left(\frac{p_t^f}{p_t} \right)^{-\psi} c_t^d \tag{51}$$

Combining (50) and (51) with (52) yields a price index for p_t:

$$p_t = \left((1-\chi) {p_t^f}^{1-\psi} + \chi {p_t^d *}^{1-\psi} \right)^{\frac{1}{1-\psi}} \tag{52}$$

where p_t^f is the price of y_t^f. We assume $\epsilon_t^f = p_t^f / p_{t-1}^f$, as the inflation rate of foreign intermediate goods, obeys the following exogenous stochastic process:

$$\log \epsilon_t^f = (1-\rho^f) \log \epsilon^f + \rho^f \log \epsilon_{t-1}^f + \zeta_t^f. \tag{53}$$

5.4 Government and Resource Constraint

Certainly, the monetary policy in this model follows a simple Taylor rule, which can be expressed as:

$$\frac{r_t}{r} = \left(\frac{r_{t-1}}{r} \right)^{\rho_s} \left(\left(\frac{\pi_t}{\pi} \right)^{r_\pi} \left(\frac{y_t^d}{y_{n,t}^d} \right)^{r_y} \right)^{(1-\rho_s)} \tag{54}$$

The model's resource constraint allocates the total output y_t among various economic activities: domestic consumption, hiring costs, and investment in capital goods. The constraint is formulated as:

$$y_t = c_t^d + \kappa_t v_t + i_t \tag{55}$$

5.5 New Phillips curve

The divergence of our model from conventional monetary DSGE frameworks is noteworthy, particularly in the incorporation of foreign price inflation and hiring dynamics. These elements not only reshape the inflation dynamics but also offer a fresh perspective on the labor market's atypical responses to monetary policy. Utilizing the log-linearization technique around the inflation steady-state, we arrive at a Phillips curve relation for π_t:

$$\hat{\pi}_t^d = \frac{(1-\beta\lambda^p)(1-\lambda^p)}{\lambda^p} p_t^w + \beta E_t \pi_{t+1}^d. \tag{56}$$

Here, the term $\frac{(1-\beta\lambda^p)(1-\lambda^p)}{\lambda^p}$ acts as a coefficient for real marginal cost p_t^*, inversely related to the degree of price rigidity λ^p. This implies a dampened responsiveness of inflation to shifts in real marginal costs under higher price stickiness. The term $\beta E_t \pi_{t+1}$ underscores the forward-looking aspect of inflation, accentuating the role of future expectations.

Further disentangling the real marginal cost p_t^*, we identify three key components: the real wage w_t^n, the marginal hiring cost a_t, and the foreign supply chain shock e_t^f:

$$\hat{p_t}^w = -\hat{a}_t + p_1 E_t \hat{\Lambda}_{t,t+1} + p_2(\hat{w}_{t-1} - \hat{\pi}_t + \gamma\hat{\pi}_{t-1} - \hat{\epsilon}_t^z) + g(\hat{\eta}_t, \hat{\eta}_{t+1}). \tag{57}$$

Total inflation if we ignore the dynamic of old contract

$$\hat{\pi}_t = (1-\chi)\hat{\epsilon}_t^f + \chi(\zeta^p(\hat{n}_t - \hat{c}_t + \frac{\hat{\delta}_t^f}{1-\delta^f} + \zeta^r(-\hat{r}_t + \epsilon_{t+1}^z) + g(\hat{\eta}_t, \hat{\eta}_{t+1})) + \zeta^f E_t \hat{\epsilon}_{t+1}^f + \zeta^d E_t \pi_{t+1}^d). \tag{58}$$

Here, in our model, households consume a composite of domestic and foreign goods, implying that the aggregate inflation rate reflects both domestic cost pressures and imported price shocks. Expectations of future import inflation and domestic cost inflation further contribute to the forward-looking nature of price determination. $\hat{\epsilon}_t^f$ is the import cost-push inflation, and $(\zeta^p(\hat{n}_t - \hat{c}_t + \frac{\hat{\delta}_t^f}{1-\delta^f} + \zeta^r(-\hat{r}_t + \epsilon_{t+1}^z) + g(\hat{\eta}_t, \hat{\eta}_{t+1}))$ is the domestic intermediate part inflation, which will be affected by the labor supply with bargaining power , total consumption, imported consumption goods share and others.

Figure 3 shows a strong co-movement between the Proportion of imported goods in final consumption and the inflation rate, over the post-2000 period.

Standard DSGE reasoning would suggest that a decline in the import share δ_t^f increases domestic demand and, hence, domestic prices. However, as shown in Figure **??**, the data reveal a robust positive correlation between the import share and inflation rates in the post-2000 period. In other words, higher import shares are

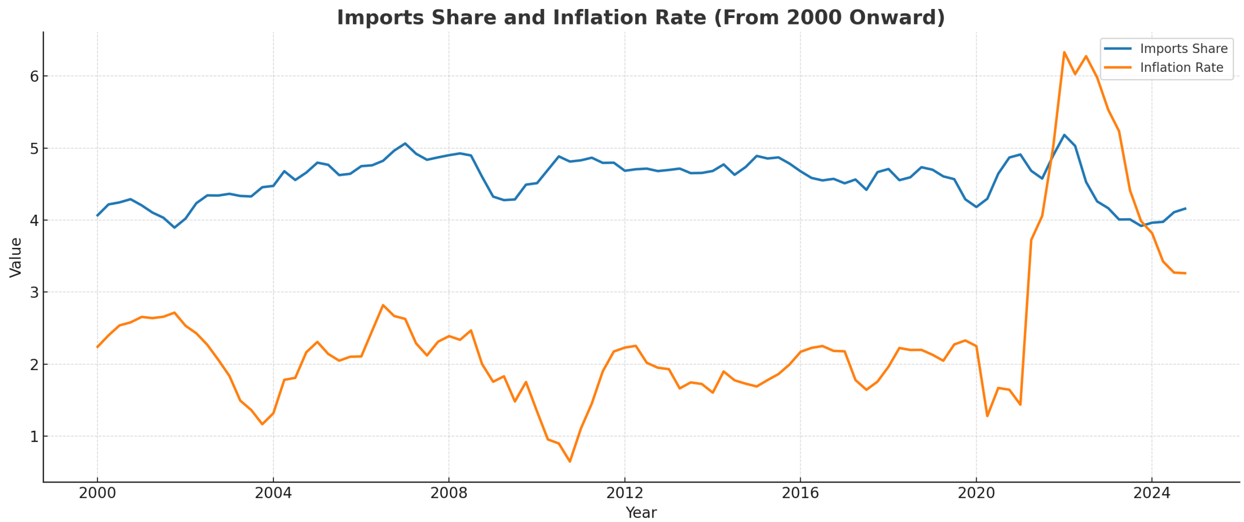

Figure 3: mports Share And Inflation Rate (From 2000 Onward)

associated with higher inflation. Our model reconciles this discrepancy by emphasizing the role of domestic production dynamics. Specifically, when households shift toward domestic goods, the resulting increase in the marginal product of labor reduces per-unit production costs, thereby dampening inflationary pressures.

These results underscore the necessity of distinguishing between imported final goods and intermediate inputs. Tariff policies, for example, yield heterogeneous effects on inflation: while tariffs on imported intermediate inputs directly elevate firms' marginal costs and propagate persistent cost-push inflation via wage-setting frictions, tariffs that primarily affect imported final goods induce reallocation effects that mitigate inflationary pressures. Thus, the transmission of trade shocks into aggregate inflation is highly contingent on the specific import composition affected by policy interventions. Consequently, this framework provides a refined perspective on inflation persistence and offers important implications for monetary policy.

APPENDIX

1 *The Complete Loglinear Model*

- **Physical capital dynamics**

$$\hat{k}_t = (1-\delta)(\hat{k}_{t-1} - \hat{\epsilon}^z_t) + \hat{i}_t \tag{4}$$

- **Marginal utility**

$$(1-\tilde{h})(1-\beta\tilde{h})\hat{\lambda}_t = \tilde{h}(\hat{c}_{t-1}-\hat{\varepsilon}^z_t) - (1+\beta\tilde{h}^2)\hat{c}_t + \beta\tilde{h}E_t(\hat{c}_{t+1}+\hat{\varepsilon}^z_{t+1}) + (1-\tilde{h})(\hat{\varepsilon}^b_t - \beta\tilde{h}E_t\hat{\varepsilon}^b_{t+1}). \tag{5}$$

where $\tilde{h} = h/\gamma_z$

- **Consumption saving**

$$0 = E_t\hat{\Lambda}_{t,t+1} + (\hat{r}_t - E_t\hat{\pi}_{t+1}) - E_t\hat{\epsilon}^z_{t+1} \tag{6}$$

- **Capital dynamic**

$$\hat{r}^k_{t+1} = \hat{r}_t + E_t\hat{\pi}_{t+1} \tag{7}$$

- **Imported final goods**

$$\hat{c}_t = \hat{c}^d_t + \frac{\hat{\delta}^f_t}{1-\delta^f} \tag{8}$$

- **Unemployment**

$$\hat{u}_t = -(n/u)\hat{n}_{t-1} \tag{11}$$

- **Matching**

$$\hat{m}_t = \sigma\hat{u}_t + (1-\sigma)\hat{\theta}_t. \tag{12}$$

- **Transition probabilities**

$$\hat{q}_t = \hat{m}_t - \hat{\theta}_t. \tag{13}$$

$$\hat{s}_t = \hat{m}_t - \hat{u}_t. \tag{14}$$

- **Technology**

$$\hat{y}_t^d = \alpha\hat{k}_t + (1-\alpha)\hat{n}_t. \tag{15}$$

- **Aggregate vacancies**

$$\hat{s}_t = \hat{q}_t + \hat{\theta}_t - \hat{n}_{t-1}. \tag{17}$$

- **Employment dynamics**

$$\hat{n}_t = \hat{n}_{t-1} + (1-\rho)\hat{m}_t. \tag{18}$$

- **Capital renting**

$$\hat{p}_t^w + \hat{y}_t^d - \hat{k}_t = \hat{r}_t^k. \tag{21}$$

- **Marginal product of labor**

$$\hat{a}_t = \hat{y}_t^d - \hat{n}_t. \tag{23}$$

- **Aggregate hiring rate**

$$\bar{p^w}\bar{a}(\hat{p_t^w} + \hat{a_t}) - \bar{w}\hat{w}_t + \rho\beta\kappa E_t\hat{\Lambda}_{t+1} = 0 \tag{24}$$

- **Nash bargaining wage**

$$\bar{w}_t\hat{w}_t^* = \eta\bar{p^w}\bar{a}(\hat{\eta}_t + \hat{p_t^w} + \hat{a_t}) - \eta b\hat{\eta}_t + \beta\eta s\kappa E_t\hat{\Lambda}_{t,t+1} + \beta\eta\kappa(2\rho - s)\hat{\eta}_t + \beta\eta\kappa(s-\rho)(\hat{s}_{t+1} + \frac{\eta}{1-\eta}\hat{\eta}_{t+1}) \tag{40}$$

- **Aggregate wage**

$$\hat{w}_t = (1-\rho)\hat{w}_t^* + \rho(\hat{w}_{t-1}^n - \hat{\pi}_t + \gamma\hat{\pi}_{t-1} - \hat{\epsilon}_t^z) \tag{41}$$

- **Inflation**

$$\hat{\pi}_t^d = \zeta^p \hat{p}_t^w + \beta E_t \hat{\pi}_{t+1}^d. \tag{43}$$

where

$$\zeta^p = (1 - \lambda^p)(1 - \lambda^p \beta)(\lambda^p)^{-1} \tag{59}$$

- **Intermediate goods**

$$\hat{y}_t^d = -\Psi(\hat{p}_t^d - \hat{p}_t) + \hat{c}_t^d \tag{50}$$

$$\hat{y}_t^f = -\Psi(\hat{p}_t^f - \hat{p}_t) + \hat{c}_t^d \tag{51}$$

- **Inflation**

$$\hat{p}_t = (1 - \chi)\hat{p}_t^f + \chi \hat{p}_t^d \tag{53}$$

- **Taylor rule**

$$\hat{r}_t = \rho_r \hat{r}_{t-1} + (1 - \rho_r)[\pi_x \pi_t + \gamma_y(\hat{y}_t^d - \hat{y}_{n,t}^d)] \tag{54}$$

- **Resource constraint**

$$\hat{y}_t = y_c \hat{c}_t + y_i \hat{\bar{i}}_t + y_v \hat{v}_t \tag{55}$$

where

$$y_c = \bar{c}/\bar{y}, \quad y_i = \bar{\bar{i}}/\bar{y}, \quad y_v = r^k \bar{k}/\bar{y},$$

- **Product cost**

$$\hat{p}_t^w = -\hat{a}_t + \zeta^r E_t \Lambda_{t,t+1} + p_2(\hat{w}_{t-1} - \hat{\pi}_t + \gamma \hat{\pi}_{t-1} - \hat{\epsilon}_t^z) + g(\hat{\eta}_t, \hat{\eta}_{t+1}) \tag{60}$$

where

$$p_0 = \bar{p}^w \bar{a}(1 - (1 - \rho)\eta)$$

$$\zeta^r = \frac{\beta\kappa(s - \rho)}{p_0}$$

$$p_2 = \frac{\bar{w}\rho}{p_0}$$