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The impact of shifting elasticity of substitution on international firm location: global macroeconomic implications

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Abstract. *This study examines the impact of increased substitution elasticity between home and foreign tradable goods on firm location and macroeconomic variables. Using a two-country model, we show that deregulation in the tradable sector attracts producers to the home country and boosts local consumption and production, accompanied by currency appreciation. Although these consumption and production trends mirror those found in the non-tradable goods literature, our findings on firm relocation contrast sharply, revealing that tradable sector dynamics yield the opposite migratory effect.*

Keywords: elasticity of substitution, deregulation, tradable sector, production location, exchange rate.

JEL Classification: F31, F41, L51, L52.

1. Introduction

Since the 1990s, the globalization of economic activity—driven by deregulation aimed at removing barriers to trade and international capital flows—has accelerated the formation of global value chains (GVCs) in the manufacturing processes of firms headquartered in developed countries (Antràs, 2015; Tajoli and Felice, 2018; Kozul-Wright and Fortunato, 2019; Kano et al., 2020; Li et al., 2024). The expansion of GVCs has blurred the "nationality" of products and rendered the traditional, origin-based brand loyalty—the so-called Armington structure—obsolete. Domestically self-contained production systems are now the exception, and an international division of labor has become established, with developed countries handling Research and Development (R&D) and emerging and developing countries responsible for the processing and assembly of intermediate goods (Awate et al., 2015; Hertenstein and Williamson, 2018; Li, 2018). As a result, reverse imports—where products manufactured in emerging and developing countries flow back to developed countries as final consumption destinations—and cross-border imports and exports have become the standard forms of commodity circulation in the modern global economy. Furthermore, market liberalization and the convergence of product standards (Wang and Zhu, 2025), as well as the standardization of product specifications through compliance with global environmental regulations (Perkins and Neumayer, 2012), have reduced heterogeneity in the attributes of goods and increased the elasticity of substitution between domestic and foreign goods in consumers' utility functions, thereby contributing to this trend. Furthermore, the rise of digital platforms has dramatically reduced international search costs through cross-border e-commerce, which is another important aspect worth noting (Lendle et al., 2016; Kim et al., 2017). In particular, the spread of online reputation feedback systems and return guarantees has reduced the uncertainty stemming from information asymmetry and is effectively eliminating the risk of adverse selection regarding low-quality foreign goods (Hui et al., 2016; Tadelis, 2016; Liu and Tang, 2018; Saeedi, 2019). These changes in the market environment have expanded consumers' choice sets to a global scale, enabling them to compare prices and quality from a global perspective, and consequently leading to the establishment of consumer behavior that is sensitive to relative price differences. Furthermore, the advancement of transportation infrastructure, including maritime transport, has dramatically reduced trade costs—a factor that cannot be overlooked. This is because the reduction in trade costs, manifested as shorter lead times, has improved the effective geographical proximity between trading partners, further increased the substitutability of domestic and foreign goods, and served as a catalyst for market integration (Amador and Cabral, 2016).

The factors outlined above—including the deregulation of trade and international capital flows since 1990, the rise of digital platforms, the convergence of product standards, and the reduction in transportation costs—have dramatically increased consumers' sensitivity to relative prices. This structural shift suggests that deregulation of trade goods within a single country amplifies the impact on trade volumes through fluctuations in exchange rates. In other words, deregulation in a global economy exposes domestic producers to

fierce international competition while providing consumers with welfare benefits in the form of access to cheaper goods. From a macroeconomic perspective, these phenomena can be formulated as an "increase in the elasticity of substitution between domestic and foreign goods," thereby enabling an examination of their macroeconomic implications.

The purpose of this paper is to theoretically elucidate the impact on national macroeconomies of the "increased elasticity of substitution between domestic and foreign goods" against the backdrop of the structural changes in the global economy described above. For the analysis, we adopt the framework of the New Open Economy Macroeconomics (NOEM) which internalizes firms' international location. By using this framework, we can clarify not only the traditional effects of increased elasticity of substitution on consumption and exchange rates but also the ripple effects it has on "firm relocation," which progresses in parallel with economic globalization.

In terms of research related to this study, Cavelaars (2006) was one of the first researchers to analyze the effects of deregulation using the NOEM model. Cavelaars's study elucidated the macroeconomic effects of deregulation in the non-tradable goods sector. The results showed that deregulation increases output in each country. Johdo (2019) used Cavelaars's model to analyze the effects of deregulation in the non-tradable goods sector, taking into account the international location of firms. This analysis revealed that while deregulation increases output in the deregulated country, it also causes firms to relocate abroad due to currency appreciation. However, existing research has focused on the impact of deregulation as an increase in the elasticity of substitution between two goods in the non-tradable goods sector, and there has not yet been sufficient research on the impact of deregulation in the tradable goods sector corresponding to an increase in the elasticity of substitution between domestic and foreign goods.

In contrast to the two studies mentioned above, this study uses a NOEM framework that accounts for the cross-border location of producers to examine the macroeconomic effects of increased substitution elasticity between domestic and foreign goods in a given country—specifically, the effects of deregulation in the tradable goods sector. Our analysis shows that increased substitution elasticity between domestic and foreign goods leads to higher relative consumption and production in the deregulated country, as well as an appreciation of that country's currency. Furthermore, producers relocate from the foreign country to the deregulated country. The resulting effects on production and consumption are identical to those demonstrated by Johdo (2019) for the non-tradable goods sector; however, the results regarding the international movement of producers in the tradable goods sector are the opposite of those in Johdo (2019). The results of this study suggest the following: If the objective of deregulation policies aimed at increasing the elasticity of substitution between domestic and foreign goods is to promote production and consumption, deregulation should be implemented regardless of whether the target industry produces tradable or non-tradable goods. However, if the government also intends to prevent domestic producers from relocating abroad—thereby mitigating concerns over

intellectual property infringement and supply chain risks, particularly during emergencies or disasters—deregulation should be prioritized for industries that produce tradable goods.

This paper is organized as follows. Section 2 presents the model. Section 3 presents the values of the key variables in a symmetric steady state. Section 4 describes the methods for the logarithmic-linear approximation of the model in both the short run and the long run. Section 5 uses the log-linear approximation methods described in Section 4 to clarify the macroeconomic effects of an increase in the elasticity of substitution between domestic and foreign goods—that is, the effects of deregulation in the tradable goods sector. Section 6 presents the conclusions.

2. Model

The model structure in this paper is based on the model by Johdo (2019). In this model, there are two countries: a domestic country and a foreign country. The asterisk symbol is employed to indicate foreign variables. Firms can move internationally, but their owners cannot. The intertemporal objective of agent i is to maximize the following utility function:

$$U_0(i) = \sum_{t=0}^{\infty} \beta^t \left(\log C_t(i) + \chi \log\left(\frac{M_t(i)}{P_t}\right) - \left(\frac{\kappa}{2}\right)\left(L_t^s(i)\right)^2 \right), \tag{1}$$

where:

β ($0 < \beta < 1$) is a discount factor, $L_t^s(i)$ is the amount of labor effort, and the consumption index $C_t(i)$ is defined as $C_t(i) = \left(\int_0^1 C_t(i,j)^{(\sigma-1)/\sigma}\, dj \right)^{\sigma/(\sigma-1)}$, where $\sigma > 1$ and $C_t(i,j)$ is the good j's consumption. In addition, $M_t(i)$ denotes nominal money balances and $P_t = (\int_0^1 P_t(j)^{1-\sigma} dj)^{1/(1-\sigma)}$. When ε_t represents the exchange rate, purchasing power parity is defined as $P_t = \varepsilon_t P_t^*$. In this model, producers in the range $[0, n_t]$ are located in the domestic country during period t, while the remaining firms in the range $(n_t, 1]$ are located in the foreign country. The representative agent's budget constraint can be expressed as follows:

$$P_t B_{t+1}(i) - P_t(1+r_t)B_t(i) + M_t(i) - M_{t-1}(i) = \int_0^{n_t} \Pi_t(j)\, dj + \int_{n_t}^1 \varepsilon_t \Pi_t^*(j) dj + W_t(i) L_t^s(i) + P_t T_t(i) - P_t C_t(i), \tag{2}$$

where:

B_{t+1}^i denotes real bonds held by agent i, r_t denotes the real interest rate, W_t^i denotes the nominal wage rate, $\int_0^{n_t} \Pi_t(j)\, dj$ ($\int_{n_t}^1 \varepsilon_t \Pi_t^*(j) dj$) represents the total nominal profit flows of producers located in the domestic country (and abroad), and $T_t(i)$ denotes real lump-sum transfers.

In the domestic country, producer *j*, hires a continuum of differentiated labor inputs locally and produces a unique product according to $y_t(j) = \left(s^{-1/\phi} \int_0^s L_t^d(i,j)^{(\phi-1)/\phi} di\right)^{\phi/(\phi-1)}$, where $\phi > 1$.

The labor demand for agent *i*'s labor service, as determined by producer *j*, can be expressed as follows:

$$L_t^d(i,j) = s^{-1}(W_t(i)/W_t)^{-\phi}\, y_t(j), \text{ where } W_t \equiv \left(s^{-1} \int_0^s W_t(i)^{1-\phi} di\right)^{1/(1-\phi)}. \quad (3)$$

The product *j*'s market-clearing condition is as follows:

$$y_t(j) = \int_0^s C_t(i,j)\, di + \int_s^1 C_t^*(i,j)\, di = (P_t(j)/P_t)^{-\sigma} C_t^w, \quad (4)$$

where:

$C_t^w \equiv \left(\int_0^s C_t(i,j)\, di + \int_s^1 C_t^*(i,j)\, di\right)$. Similarly, we obtain $y_t^*(j) = (P_t^*(j)/P_t^*)^{-\sigma} C_t^w$. Agents seek to maximize (1) subject to (2).

The first-order conditions for this problem with respect to $B_{t+1}(i)$ and $M_t(i)$ can be written as $1/C_t(i) = \beta[(1 + r_{t+1})/C_{t+1}(i)]$ and $M_t(i)/P_t = \chi C_t(i)((1 + R_{t+1})/R_{t+1})$, respectively, where R_{t+1} is the nominal interest rate. In monopolistic competitive goods markets, domestic-located producer *j* faces the profit-maximization problem: $\max_{P_t(j)} \Pi_t(j) = (P_t(j) - W_t) y_t(j)$. By differentiating the profit with respect to $P_t(j)$, we obtain $P_t(j) = (\sigma/(\sigma - 1))W_t$.

Substituting (4) and the price mark-ups into $\Pi_t(j)/P_t$ and $\Pi_t^*(j)/P_t^*$, respectively, yields

$$\Pi_t(j)/P_t = (1/\theta)(P_t(j)/P_t)^{1-\theta} C_t^w,\ \Pi_t^*(j)/P_t^* = (1/\theta)(P_t^*(j)/P_t^*)^{1-\theta} C_t^w. \quad (5)$$

In accordance with the Johdo (2019) formulation, the adjustment process for relocation of producers is presented as follows:

$$n_t - n_{t-1} = \gamma[\Pi_t(j)/P_t - \Pi_t^*(j)/P_t^*]. \quad (6)$$

The parameter γ ($0 \le \gamma < \infty$) is the extent of producer mobility between two countries. In this study, the incorporation of monetary wage rigidities into the model is achieved through the implementation of single-period wage contracts. By substituting the equilibrium labor market conditions for the domestic country $L_t^s(i) = \int_0^{n_t} L_t^d(i,j) dj$ and equation (3) into (2), and maximizing (1) with respect to $W_t(i)$, the following first-order condition is obtained:

$$\phi(W_t(i)/P_t)^{-1} \left(\kappa\left(L_t^s(i)\right)^2\right) = (\phi - 1)(L_t^s(i)/C_t(i)). \quad (7)$$

3. Symmetric steady state

In the symmetric steady state, where $B_0 = 0$ and $s = s^* = 1/2$, the rate of real interest is given by $r_{ss} = (1 - \beta)/\beta \equiv \delta$. The allocation of producers is $n_{ss} = 1/2$. Hence, from (7), we obtain

$$L_{ss}^s = L_{ss}^{*s} = C_{ss} = C_{ss}^* = C_{ss}^w = y_{ss}(j) = y_{ss}^*(j) = \left(\frac{\phi-1}{\phi}\right)^{1/2} \left(\frac{\sigma-1}{\sigma}\right)^{1/2} \left(\frac{1}{\kappa}\right)^{1/2}. \tag{8}$$

Substituting C_{ss}^w from (8) into (5) yields the following levels of real profit:

$$\Pi_{ss}(j)/P_{ss} = \Pi_{ss}^*(j)/P_{ss}^* = \left(\frac{1}{\sigma}\right)\left(\frac{\phi-1}{\phi}\right)^{1/2} \left(\frac{\sigma-1}{\sigma}\right)^{1/2} \left(\frac{1}{\kappa}\right)^{1/2}. \tag{9}$$

4. Log-linear approximation

In order to examine the macroeconomic effects of a deregulation of the tradable goods sector in the domestic country, a log-linear approximation is solved around the zero-shock steady state. We use $\hat{Z}$ to denote the short-run percentage change of any variable Z that is consistent with the time span of monetary wage contracts. Furthermore, $\bar{Z}$ is employed to denote the long-run percentage change, a convention that aligns with the notion of flexible nominal wages.

5. Deregulation shocks of the tradable goods sector

We examine the effects of an unanticipated deregulation of the tradable goods sector on the exchange rate, producer relocation, and domestic consumption. In this model, the elasticity of substitution between two goods in the tradable goods industry (σ) is interpreted as a parameter that determines the degree of regulation of the tradable goods market in the domestic economy. Thus, a higher value of σ means that the tradable goods market is more deregulated. Therefore, a shock that increases σ can be considered as deregulation of the tradable goods market. Below, we examine the impact on the macroeconomy of an increase in σ ($\hat{\sigma} > 0$ and $\bar{\sigma} > 0$) in the first period. The log-linearization of equation (6) near the symmetric steady state yields the following short-run equation for the share of domestic producers:

$$\hat{n} = 2\gamma \left(\frac{\phi-1}{\phi}\right)^{1/2} \left(\frac{\sigma-1}{\sigma}\right)^{3/2} \left(\frac{1}{\kappa}\right)^{1/2} \left(\hat{\varepsilon} + \left(\frac{1}{\sigma-1}\right)\hat{\sigma}\right). \tag{10}$$

Equation (10) demonstrates how exchange rate depreciation affects producer behavior, specifically by shifting production locations toward domestic markets. This shift occurs because depreciation raises the relative cost of foreign production, thereby stimulating

domestic output through the expenditure-switching effect. This result is qualitatively the same as that in Johdo (2019). However, the second term in parentheses on the right-hand side of equation (10) does not exist in the corresponding equation in Johdo (2019), which focuses on deregulation of non-tradable goods industries. This term, $(1/(\sigma-1))\hat{\sigma}$, indicates that deregulation of tradable goods industries leads to producers moving from foreign countries to the domestic country through an increase in relative profits in the domestic country. Similarly, the long-run effect of an unexpected deregulation shock in the domestic country on the direction of international producer migration is as follows.

$$\bar{n} = 2\gamma\left(\frac{\varphi-1}{\varphi}\right)^{\frac{1}{2}}\left(\frac{\sigma-1}{\sigma}\right)^{\frac{3}{2}}\left(\frac{1}{\kappa}\right)^{\frac{1}{2}}\left[\bar{\varepsilon} - (\bar{W} - \bar{W}^*) + \left(\frac{1}{\sigma-1}\right)\bar{\sigma}\right]. \tag{11}$$

Similar to the result in (10), it is shown by (11) that producers are relocated from abroad to the domestic country by a depreciation of the domestic currency. Also, because nominal wages become more flexible in the long run, (11) is a decreasing function of the relative nominal wage differential in the domestic country. Similarly to the result in (10), this shows that an unexpected deregulation shock in the domestic country leads to a relocation of producers from abroad to the domestic country.

The macroeconomic effects of an unanticipated permanent deregulation of the tradable goods sector in the domestic country are now considered: $\hat{\sigma} = \bar{\sigma} > 0$. The following are the closed-form solutions for the three key variables:

$$\hat{C} - \hat{C}^* = \frac{2\delta\gamma_2\hat{\sigma}+\gamma_4\bar{\sigma}}{\delta\gamma_1+\delta+\gamma_3} > 0, \tag{12}$$

$$\hat{\varepsilon} = -\left(\frac{2\delta\gamma_2\hat{\sigma}+\gamma_4\bar{\sigma}}{\delta\gamma_1+\delta+\gamma_3}\right) < 0, \tag{13}$$

$$\hat{n} + \bar{n} = 2\gamma\left(\frac{\phi-1}{\phi}\right)^{1/2}\left(\frac{\sigma-1}{\sigma}\right)^{3/2}\left(\frac{1}{\kappa}\right)^{1/2}\left(\frac{2\delta\gamma_2\hat{\sigma}+\gamma_4\bar{\sigma}}{\delta\gamma_1+\delta+\gamma_3}\right)\gamma_5 > 0, \tag{14}$$

where

$$\gamma_1 = \left(\frac{\sigma-1}{\sigma}\right)^2\left[\frac{\sigma}{2} + 2\gamma\left(\frac{\phi-1}{\phi}\right)^{1/2}\left(\frac{\sigma-1}{\sigma}\right)^{1/2}\left(\frac{1}{\kappa}\right)^{1/2}\right] > 0,$$

$$\gamma_2 = \frac{1}{2}\left[1 + 4\gamma\left(\frac{1}{\sigma-1}\right)\left(\frac{\phi-1}{\phi}\right)^{1/2}\left(\frac{\sigma-1}{\sigma}\right)^{3/2}\left(\frac{1}{\kappa}\right)^{1/2}\right] > 0,$$

$$\gamma_3 = \left\{1 + \left(\frac{\sigma-1}{\sigma}\right)\left[\frac{\sigma-1+4\gamma\left(\frac{\phi-1}{\phi}\right)^{1/2}\left(\frac{\sigma-1}{\sigma}\right)^{3/2}\left(\frac{1}{\kappa}\right)^{1/2}}{\sigma+1+4\gamma\left(\frac{\phi-1}{\phi}\right)^{1/2}\left(\frac{\sigma-1}{\sigma}\right)^{3/2}\left(\frac{1}{\kappa}\right)^{1/2}}\right]\right\} > 0,$$

$$\gamma_4 = \frac{2}{\sigma}\left[\frac{\sigma+4\gamma\left(\frac{\phi-1}{\phi}\right)^{1/2}\left(\frac{\sigma-1}{\sigma}\right)^{3/2}\left(\frac{1}{\kappa}\right)^{1/2}}{\sigma+1+4\gamma\left(\frac{\phi-1}{\phi}\right)^{1/2}\left(\frac{\sigma-1}{\sigma}\right)^{3/2}\left(\frac{1}{\kappa}\right)^{1/2}}\right] > 0,$$

$$\gamma_5 = \left[\frac{\sigma+4\gamma\left(\frac{\phi-1}{\phi}\right)^{1/2}\left(\frac{\sigma-1}{\sigma}\right)^{3/2}\left(\frac{1}{\kappa}\right)^{1/2}}{\sigma+1+4\gamma\left(\frac{\phi-1}{\phi}\right)^{1/2}\left(\frac{\sigma-1}{\sigma}\right)^{3/2}\left(\frac{1}{\kappa}\right)^{1/2}}\right] > 0.$$

Equation (12) indicates that an unanticipated deregulation of the tradable goods sector in the domestic country results in a proportionate increase in the relative domestic consumption level. Regarding exchange rate changes, equation (13) shows that an unexpected deregulation of the tradable goods sector in the domestic country results in an appreciation of the exchange rate. The results of (14) demonstrate that when the domestic tradable goods industry is deregulated, producers will move from foreign countries to the domestic country. In particular, an intuitive explanation of equation (14) for international producer relocation is as follows: To begin, note that an unanticipated deregulation of the tradable goods sector in the domestic country has two opposing effects on the direction of the relocations of producers between countries. First, the unexpected deregulation of the tradable goods sector in the domestic country increases the global demand for that country's goods. This occurs through a decline in the price of those goods due to increased productivity. In turn, this increases production in the domestic country's tradable goods sector, ultimately leading to increased profits for producers in that sector. Hereafter, we shall call this the 'productivity effect'. Therefore, this productivity effect causes relocation of producers from the foreign country to the domestic country. Second, as shown in equation (13), an appreciation of the domestic currency shifts global demand from domestic products to foreign products. This shift in demand decreases the relative profits of firms located domestically, causing domestic producers to relocate to the foreign country. We refer to this as the 'exchange rate effect'. The direction of producer relocation between the two countries is determined by the relative strength of the productivity effect and the exchange rate effect. However, in our model, the productivity effect always outweighs the exchange rate effect, meaning that deregulation of tradable goods industries always leads to the movement of producers from foreign countries to the domestic market. This result is the exact opposite of that in Johdo (2019), whose analysis finds that deregulation of non-tradable goods industries results in the movement of producers from the domestic market to the foreign country.

6. Conclusion

This paper examined the impact of unexpected deregulation of a country's tradable goods sector on relative consumption, exchange rates, and producer mobility. The study compared the impact of unexpected deregulation of a country's tradable goods

sector with previous study predictions, particularly those concerning the international relocation of producers. Our results revealed that, unlike previous studies, when deregulation targets different industries, the impact on consumption and exchange rates remains consistent, while the direction of international producer mobility reverses.

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