Sectoral Dynamics of Industrial Policy in a Two-sector Economy: the Case of Korea's Heavy and Chemical Industry (HCI) Promotion (1973-1979)

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Abstract

This study explores the impact of state's industrial policy on sectoral capacity utilization and growth in total output in the context of the Korea's Heavy and Chemical Industry (HCI) promotion (1973-1979). Using a Kalecki-Steindl framework within a two-sector open economy, the study first finds that primary industrial policy instruments – preferential interest rates and export promotion regime – have a positive effect on capacity utilization (aggregate demand) and economic growth, but unbalanced sectoral dependence undermines the effect of industrial policy. Second, the increased market power of firms in the targeted sector has a dual impact on the sectoral capacity, depending on the productivity growth characteristics of each sector. Third, the industrial policy regime is highly susceptible to adverse external price shocks. These findings are consistent with the Korean growth experience during the HCI promotion period in which *chaebols* (big business groups) flourished, and the economy suffered from stagflation and idle capacity in the final stage of HCI promotion.

Keywords — Industrial policy, Sectoral capacity utilization, Market power, Kalecki-Steindl framework, South Korea, Heavy and chemical industry promotion, External price shock

***JEL Classification*:** C62, E12, E22, E25, O25, O41

1 Introduction

The impact of the rampant COVID-19 pandemic since 2019, which has led to the recent supply chain shortage crisis and the prospect of imminent stagflation, has renewed interest in industrial policy among policymakers as well as the mainstream development economics community.[1] There is no consensus in the literature on the effectiveness of large-scale industrial interventions (Noland and Pack, 2003; Harrison and Rodríguez-Clare, 2010). From 1973 to 1979, South Korea's government initiated the Heavy and Chemical Industry (HCI) Promotion policy, the most extensive industrial policy in Korean history, aimed at fostering underpinning industries for economic growth.[2] Notably, the Korean experience is not an exception to the ongoing debate surrounding industrial policy, as highlighted by Auty (1992). Some critics, notably World Bank (1987), argue that the 1979-81 economic downturn can be largely attributed to the HCI promotion policy. In particular, the Korean HCI drive has been criticized at the micro level for misallocating subsidized credit, leading to an excess HCI capacity that yielded a low financial return (Kwack, 1984; Park, 1986; Rhee, 1987; Leipziger, 1988; Kim et al., 2021). However, despite concerns about market distortion and corruption, Korea's sectoral interventions may have had a positive impact on economic growth and successfully brought about a structural transformation of the economy (Amsden, 1992). More recent empirical literature (e.g., Lane, 2021; Choi and Levchenko, 2021) provides causal evidence supporting its efficacy.

Utilizing the Kalecki-Steindl distributional framework, this paper reevaluates industrial policy by examining how each component of the industrial policy impacts sectoral capacity utilization and overall economic growth. In addition, this study explores the nature of demand and growth regimes within the context of industrial policy. A group of two-sector models developed in the Kaleckian tradition offer a workable framework for various policy regimes that take into account the significance of income distribution and sectoral demand. For instance, Lavoie and Ramírez-Gastón (1997) and Kim and Lavoie (2017) present the Kaleckian traverse model with target rate of return pricing scheme to illustrate how the economy shifts from one steady growth path to another. Fujita (2018) investigates how sectoral capacity utilization interacts with the whole sectoral interdependence described in Sraffa (1975). Beqiraj et al. (2019) develop a two-sector model of the service and manufacturing sectors with differentiated markups and exogenous structural change arising from a shift in consumers' preferences. Nishi (2020) incorporates endogenous labour productivity into the baseline model, generating

[1] "Economists Reconsider Industrial Policy" *Project Syndicate*, Aug. 4^{th}, 2023. See also Juhász et al. (2023) for the review of the recent literature on industrial policy.

[2] The state designated several key strategic fields: electronics, automobiles, shipbuilding, machinery, petrochemicals, iron and steel, and nonferrous metals as a backbone of the economic development plan. This agenda was called 'The Five-Year Economic and Social Development Plan,' and the HCI promotion policy was enacted through the third implementation period of the plan (1972-76) and the fourth period (1977-1981).

a periodic solution path of the economy. In the context of an open economy, Blecker (1989, 1999) delve into the effects of intensified international competition on the relationship between distribution and economic growth, emphasizing export-oriented growth.

While the Kaleckian literature has a sizable collection of two-sector models enriched with open economy contexts, for instance Dutt (1995), there remains a need to incorporate additional elements to aptly capture the nuances of industrial policy regimes, particularly in East Asian emerging economies like Korea during the 1970s. This paper contributes to the existing literature by integrating the following additional features, offering a more comprehensive analytical framework for industrial policy. First, this study incorporates the cost of intermediate goods into the pricing equations alongside international trade, establishing a unique two-sector economy framework in which one sector is highly subordinate to another. The two sector economy framework differentiates between a primary, targeted sector (HCI or H sector) and a secondary, non-targeted sector (Light Industry or L sector). Such an asymmetric industrial structure is fueled by protectionist or import substitution policies in the sense that certain industries is supposed to rely on other industries for capital inputs. Second, this study offers fresh perspectives on the interplay between industrial policy and capital allocation efficiency by introducing a mechanism that identifies the strategic mobilization of capital via preferential interest rate regime. The finding questions the core principles of Washington Consensus, particularly concerning interest rate liberalization and efficient capital mobilization. Finally, this paper extends the Kalecki-Steindl framework to encompass an open economy, where the export promotion component is facilitated by a *de facto* pegged exchange rate system. This extension addresses the underconsumption concerns of Luxemburg (1913), particularly relevant to the post-World War II East Asian economies, including Japan and Korea, as highlighted in Mott and Ho (2020), which enabled rapid growth by generating sufficient foreign demand.

The paper presents the following major findings on the impact of industrial policy on the dynamics of sectoral capacity utilization. First, preferential interest rates and export promotion have a positive effect on capacity utilization rate in both H and L sectors. In particular, the lower interest rate regime combined with industry-specific preferential interest rates plays a central role in capital accumulation, thus boosting economic growth. This outcome sharply contrasts with the neoclassical view particularly the notion that relatively higher interest rates under liberalized financial regime is *growth-promoting* – a viewpoint that has been refuted by Dutt (1990), Burkett and Dutt (1991) and Grabel (1995). Second, the two-sector open economy model suggests the increasing market power of firms in the HCI (H) sector can have a dual effect on the aggregate demand and economic growth based on each sector's productivity growth regime. While a closed economy Kaleckian model shows that a higher firm profit share often leads to reduced capacity utilization, suggesting a *wage-led* demand regime, whereas open economy consideration can constrain this wage-led orientation as shown in Blecker (1989, 1999) and more recently in Nah and Lavoie (2017). This paper further posits that the nature of the demand and growth regime under industrial policy hinges on the productivity regimes of individual sectors and their interplay. The incorporation of productivity growth regime into the model provides a more nuanced analysis of the demand and growth regime, particularly throughout the HCI promotion period. This approach is advantageous as it fills up a gap in the existing literature, which often lacks the implications of productivity characteristics on economic expansion. Third, the study reveals that industrial policy regime is significantly vulnerable to external factors like commodity price shocks. This underscores the importance for policymakers to carefully plan and ensure macroeconomic stability while implementing industrial policies to prevent the unintended consequences highlighted in this study.

The rest of the paper is structured as follows. Section 2 provides a succinct context of the HCI promotion policy and highlights key observations from the HCI promotion period. Section 3 introduces the Kalecki-Steindl framework and derives the equilibrium conditions for the sectoral capacity utilization. Section 4 delves into comparative statics of the industrial policy and examines both short-run and long-run dynamics of sectoral capacity utilization with the system stability conditions. This section further offers a numerical analysis to delineate the characteristics of demand and growth regimes. Section 5 concludes the study.

2 HCI Promotion Overview

2.1 Contextualizing the HCI Promotion

Industrial policy is typically defined as the government's strategic and preferential assistance provided to particular firms or industries that are deemed essential for the country's economic growth and the welfare of its population. This definition implies that industrial policy is *selective* in nature (Chang, 1994, p.60). The fundamental objective of industrial policy within this framework pertains to effecting a shift from a conventional agricultural-based economy towards a more advanced and diversified industrial and service-oriented economy, a process commonly referred to as industrialization (Syrquin, 2008).

The HCI drive was officially announced in 1973 as a major project of the third Five-Year Economic and Social Development Plan (1972-1976). The state's initial economic revitalization initiatives in the 1960s focused more on export promotion than import substitution. This drive focused on the consumption goods industries or light industries and made the most of the low labour costs. However, this labour-intensive export promotion faced a number of external challenges, most notably increased price rivalry brought on by the growth of neighbour developing countries including China and Vietnam. Furthermore, the early 1970s' price surge, which began by the first Oil Price Shock in 1973, increased production costs, which prevented the businesses from being price competitive. The government officials viewed the capital-intensive HCI promotion as an alternative growth strategy to cope with the declining labour cost competitiveness with increasing protectionism as well as increasing national security concerns in the early 1970s (Woo, 1991; Amsden, 1992; Horikane, 2005).[3] In fact, HCI firms were expected to have a strong linkage effect – either positive spillover effects of an upstream firm's growth (e.g., automobile companies) on other downstream industries who produce inputs (e.g., tire and battery companies) for the upstream company or similar positive spillover effects from upstream companies but to the industry that enables the upstream industry to succeed (e.g., steel and rubber) (Hirschman, 1958; Liu, 2019). This input-output linkage may not only reduce transaction costs but also diversify potential risk (Haggard et al., 2000).

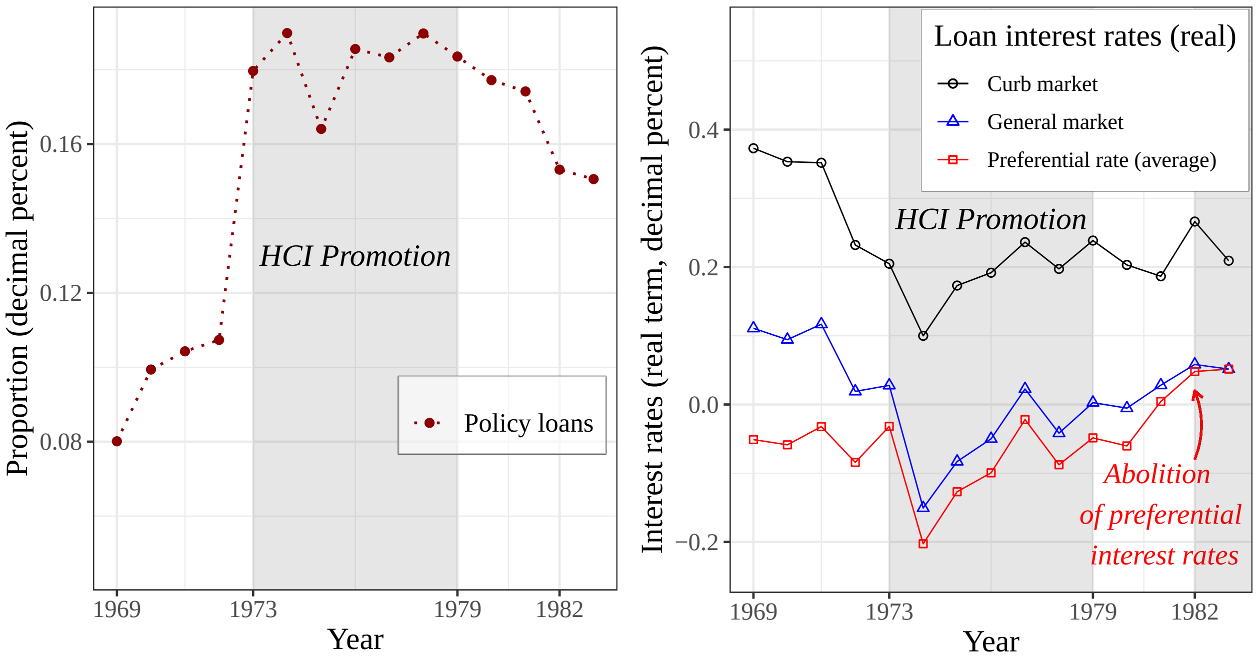
2.2 Observations from HCI Promotion

Here are notable observations from the Korean experience during the HCI promotion period.

1) Policy Loans and Interest Rate Regime (Preferential Treatments) Figure 1 (left) shows a sharp increase in the proportion of total preferential loans in the early 1970s, reaching over 15 percent by 1973 and persisting throughout the promotion period. Over 75 percent of total credit supplied to the entire manufacturing sector. Supported by capital subsidies and import tariff exemptions, the HCI sector nearly doubled its capital value during the promotion (Lane, 2021). This vast financial support not only catalyzed structural transformation but also boosted HCI exports, comprising over 50 percent of total exports (Cho et al., 1991). While the 1970s HCI promotion mirrored earlier (1960s) labour-intensive export promotion policies, it features more substantial loans and a more targeted industry-specific selection criterion.

Besides credit allocation control, the government regulated credit market interest rates, whose traces are shown in Figure 1 (right). The 1972 *8.3 Measure* or Presidential Emergency Decree facilitated distressed companies to roll over debts for three years at a favourable 1.35 percent monthly interest rate and imposed a moratorium on the curb market debt. By 1973,

[3]The literature also points out that from a geopolitical perspective, officials also needed to adopt a more proactive approach than the labour-intensive export promotion strategy used in the 1960s. The Nixon Doctrine, the first significant military withdrawal of 20,000 out of 61,000 US troops by June 1971 (see *Letter From President Nixon to Korean President Park* at National Archives, Nixon Presidential Materials, XIX, Part 1: https://history.state.gov/historicaldocuments/frus1969-76v19p1/d58), further fueled policymakers' interest in heavy and chemical industrialization. Horikane (2005) regarded the HCI promotion policy as politically rational, grounded in the prevailing geopolitical circumstances.



Source: Econ Stat Yearbook (various issues), BOK

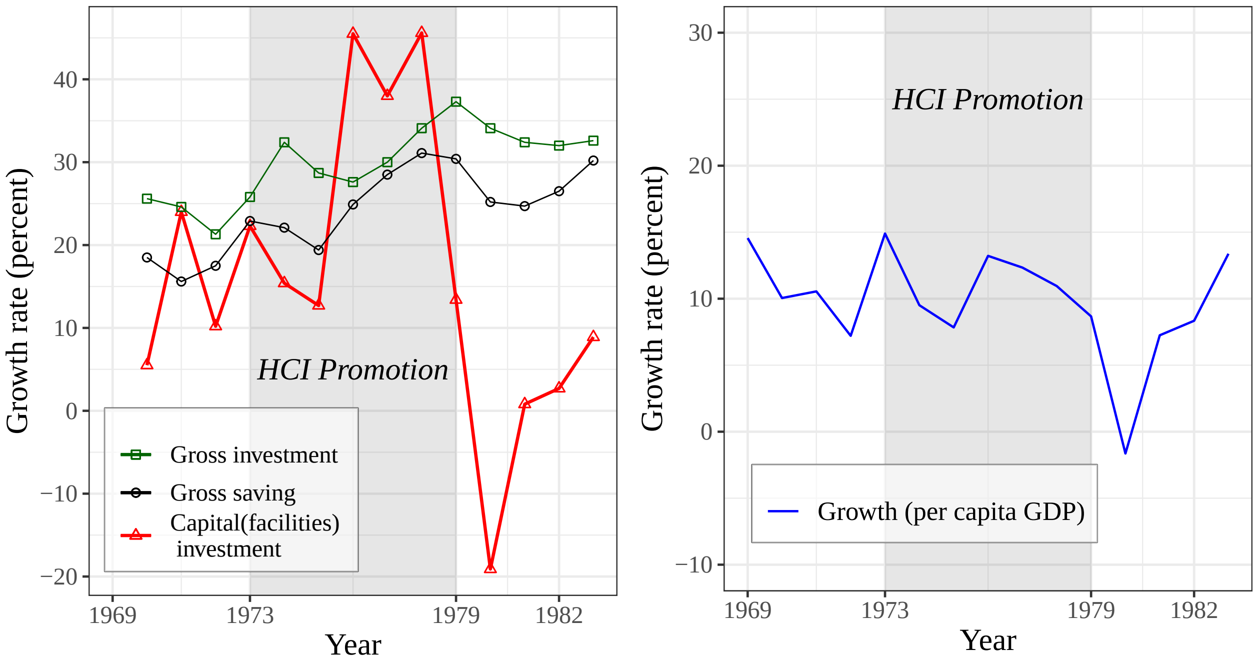
Source: BOK, Stat Bulletin (various issues)

Figure 1: Trends of Policy Loans for the HCI (Left) and Interest Rates (Right)

interest rates shifted from higher to a lower regime. While the gap between the general and curb market rates remained consistent, overall rates decreased substantially. Notably, the lower preferential rate remained below zero (average −8.8 percent). Until the 1980s deregulation, government-controlled bank loans dominated the credit market as a major source to finance the HCI promotion, leading to the curb market's rapid expansion.

2) Investment Hike and Economic Growth (Growth Impact) The growth rate of capital investment peaked around 45 percent in 1976 and 1978, and the rate dropped from 45 percent to around 10 percent in the final stage of HCI promotion (see Figure 2 (left)). During this period, the overall annual per-capita real GDP growth rate was relatively high, but was falling from 1976 to 1980 (see Figure 2 (right)).

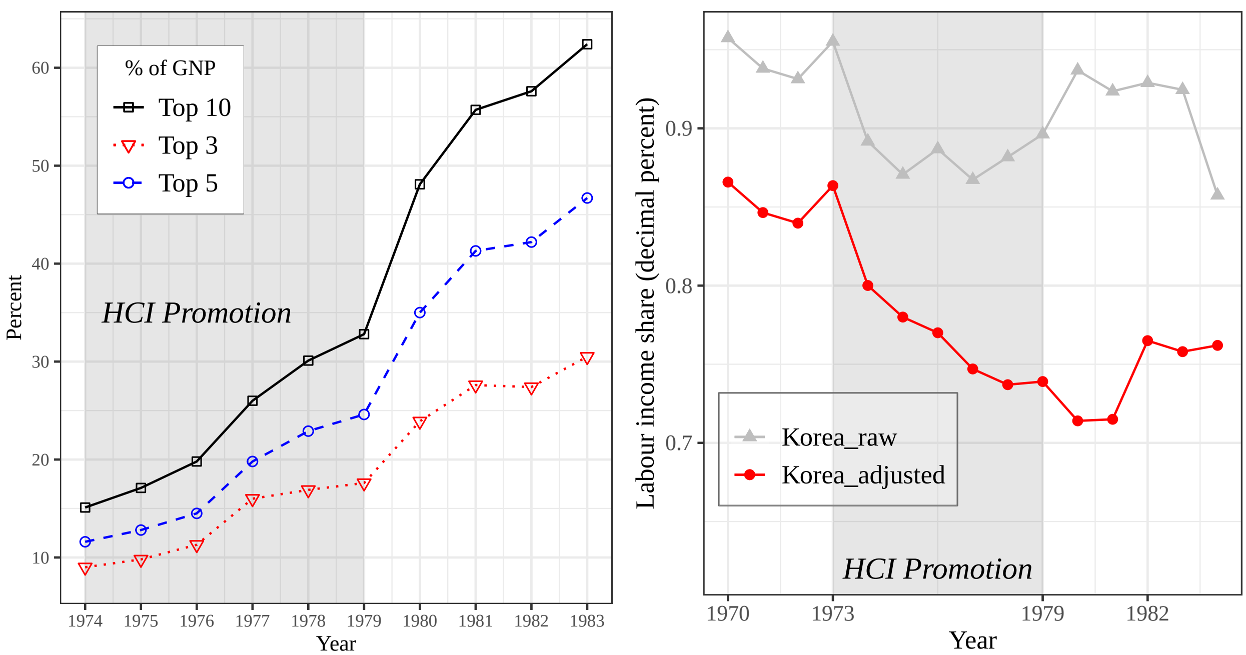
3) Growth of the *Chaebols* and Declining Wage Share (Distributional Impact) Throughout the HCI promotion period, the HCI sector dramatically expanded. In 1979, HCI industry took 54.7 percent of the entire industry (38.9 percent in 1970) while light industry took 45.3 percent (61.1 percent in 1970). As a result, its contribution to exports also increased, taking 41.9 percent of total exports in 1977. The remarkable growth of Korean big businesses did not occur until the early 1970s when the government's HCI promotion policy was implemented. In the middle of the HCI promotion period, the combined sales of top 10 *chaebols* reached 20 percent of total GNP and continued to rise during the 1980s as Figure 3 (left) shows. The expansion of the *chaebols* in the six targeted industries in 1979, the final year of the HCI promotion.



Source: Bank of Korea, ECOS

Source: Economic Statistics Yearbook, BOK

Figure 2: Growth Rates of Investment (Left) and Per Capita GDP (Right)

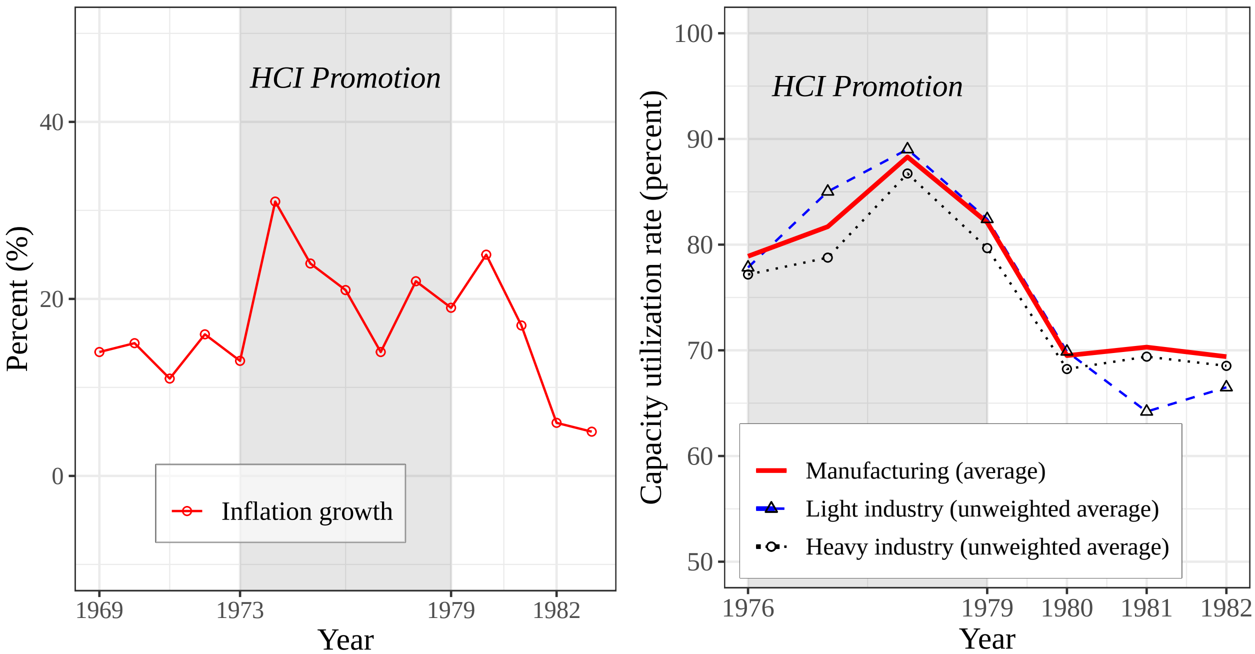


Source: Kim (1987)

Source: Lee et.al (2014) for Kor_adj, OECD, Kor_raw

Figure 3: Combined Sales of Top 10 Largest Chaebols (Left) and Labour Income Share Trends: International Comparison (Right)

In contrast, the HCI promotion was accompanied by a consistent decrease in the labour income share (Kim, 1990; Lee et al., 2014; Lee, 2015). This phenomenon is largely attributed to the rapid expansion of large business groups (*chaebols*) and their consequential leverage in wage bargaining negotiations, along with considerable extent of institutional wage suppression enforced by the authoritarian government (Kim and Topel, 1995).[4] Figure 3 (right) shows that the adjusted wage share[5] during the HCI promotion declined and rebounded as the promotion was terminated.



Source: Economic Statistics Yearbook, BOK

Source: Author's calculation based on Kim (1990)

Figure 4: Trends of Inflation and Growth Rate and Capacity Utilization Rates

4) Inflation and Idle Capacity (Macroeconomic Instability) Inflation, mainly driven by the 1973 and 1978 oil price shocks, was rampant throughout the industrial promotion period (see Figure 4 (left)). These shocks triggered a series of economic challenges. One of the most pressing issues was capital misallocation and underused capacity. This problem

[4] Kim and Topel (1995) points out that the lagged real-wage growth behind productivity indicates that government efforts to suppress wage growth for less skilled workers was effective at least until 1975.

[5] The estimation of labour share can differ depending on the treatment of self-employed income, particularly in countries like Korea with a high proportion of self-employed individuals. Gollin (2002) offers three methods: (i) treating self-employment income solely as labour income; (ii) aligning self-employment income with the labour income proportion of other sectors; (iii) equating self-employment income to the average wage of wage earners whose number is obtained from the data. The figure is based on the estimation of Lee et al. (2014) and Lee (2015) who adopts the second method, arguing that the third option overstates labour share since the real data (from 1975) indicates non-wage earners' per-capita surplus is consistently below employee compensation. The Bank of Korea (BOK) uses the first method, potentially overestimating the labour share by not accounting for capital owned by the self-employed.

was closely associated with the negative real cost of borrowing and thus excessive investment until 1982 when preferential interest rates were abolished. According to Jones and Sakong (1980), more than 30 or 40 percent of all investment made in the machinery sector were idled. Surprisingly, the government did not put any serious restraints on the *chaebols*, which were at the forefront of this overinvestment. Instead, the government remained committed to fostering economic growth through business promotion and concentration to reduce project gestation period rather reduce inequality (Jones and Sakong, 1980). Towards the end of the 1970s, the country's economy faced multiple challenges, including a persistent current account deficit, escalating foreign debt and slowed growth. Figure 4 (right) illustrates a significant decline in sectoral capacity utilization from 1978 to 1982 in both industry sectors. Firms burdened by overinvestment had to face subsequent financial insolvency. The compounded impact of the second Oil Price Shock in 1978 worsened the economy.

3 The Model

To characterize an economy under the industrial policy regime, a two-sector open economy model is presented. The HCI or H sector is the focus of the government's industrial policy. The model's primary characteristics reflect the industrial policy context that provides support to the H sector through the development of specific policy instruments, including (i) preferential interest rates for the H sector to promote capital investment; (ii) unilateral reliance of the L sector on the H sector due to import substitution for intermediate goods; and (iii) transition towards export promotion and the implementation of a *de facto* dollar peg regime. The model's emphasis on the H sector underscores the government's efforts to foster economic development and improve its balance of payments position, while also providing a framework for analyzing the intersectoral linkages and policy trade-offs that arise in an open economy context.

3.1 The Structure of the Economy

The economy is described as follows. There are two sectors operating in the economy: heavy and chemical industry (H sector) and light industry (L sector). I assume that Leontief production technology is used. This is a standard consideration in the Kaleckian literature in the sense that the Leontief function is able to capture a situation where idle capacity is generated. In reality, some level of fixed proportionality exists between inputs, which can result in idle capacity within firms. The Cobb-Douglas function, which assumes that inputs of capital and labour are substitutable at all levels of production, fails to capture the phenomenon of idle capacity. Hence, the the level of output production is given by

$$Q^x = \min\left[\frac{N^x}{a_N^x}, u^x\frac{K^x}{a_K^x}\right] = \min\left[\frac{N^x}{a_N^x}, u^x K^x\right], \quad x = \{H, L\} \tag{3.1}$$

where Q^x denotes output in real terms, N^x, required labour employment, and K^x, capital stock in real terms. a_K^x denotes the sectoral fixed amount of capital input stock per unit of potential output, which is assumed to be one so that a_N^x denotes the (relative) fixed amount of labour input per unit of potential output. Hence, the inverse of a_N^x is the sectoral capital-labour ratio or the relative productivity. $u^x \in (0, 1)$ is the key endogenous variable in the model, representing the industry-specific *actual* rate of capacity utilization given by

$$u^x := \frac{Q^x}{Q_F^x}, \quad x = \{H, L\}. \tag{3.2}$$

where Q_F^x denotes potential level of output. $u^x = 1$ when the capacity is fully utilized. It is important to note that, in addition to its definition, u^x is endogenously determined by a number of industrial policy instruments. As a result, the capacity utilization rates – the primary focus of this study – serves as a medium for industrial policy, which has a variety of macroeconomic effects.

I also assume that labour is always abundant so that the production is solely determined by capital in the sense that unlimited labour supply is typical in the late industrializing economies such as Japan and Korea. This assumption may not be readily applicable to the HCI sector, which requires a labour force with specific sector-specific skills or high-level expertise, the availability of which could be restricted. Nonetheless, this assumption gains credence from Korea's substantial investment in education since the 1960s. The prioritization of education aligns with the period of nationwide land reform which expanded educational opportunities among farming households (Amsden, 1992), validating the superfluity of skilled labour in the HCI sector during the 1970s. Under this assumption, the amount of labour required is pre-determined and fixed for a given level of output. Thus, with the condition of full capacity utilization, Q_F^x is given by

$$Q_F^x = K^x, \quad x = \{H, L\}, \tag{3.3}$$

and the actual production function is

$$Q^x = u^x K^x, \quad x = \{H, L\}. \tag{3.4}$$

The required labour employment for output production will be determined by production technology. Also by the property of the Leontief technology whose efficiency is achieved by equalizing the labour and capital inputs, the labour requirements at full capacity utilization should be: $N^x = a_N^x K^x, \;\; x = \{H, L\}$. Thus, the actual level of labour employment is given by

$$N^x = a_N^x u^x K^x, \;\; x = \{H, L\}. \tag{3.5}$$

Firms in both sectors mark up their prices over prime costs to adjust their production to meet consumption demand as follows. For firms in the heavy industry,

$$p^H = (1 + \mu^H)\Big[w^H a_N^H + \gamma \epsilon p_m^*\Big] \tag{3.6}$$

where μ^H is the markup rate, which is exogenously determined. γ denotes the fixed requirement of the imported intermediate good per unit of output for firms in HCI sector. Since output is simply the multiple of capacity utilization and capital, γ is in fact one (H sector is fully subordinate to foreign production sector). ϵ is exchange rate defined as KRW/USD, and p_m^* the fixed foreign-currency price of the imported intermediate good. In case of firms in the L sector, capital input K^L is in fact the output produced by firms in H sector. One potential attribute of the model representing a two-sector open economy is the equivalence between capital input and intermediate goods imported from the foreign sector. The firms operating in the H sector require intermediate goods for their production processes, which are commonly imported from foreign sectors due to the lower level of technology of most indigenous firms in developing countries. That is, the firms in H sector may have to require foreign intermediate products that necessitate top technology.

Another point I want to make in the present model is that firms mark up mainly on unit labour cost and intermediate goods price without considering capital cost such as rental cost of machinery. Here I assume that the markup is based on the perceived degree of market power that the firm possesses in its industry rather than on the actual total cost of production. In the current model, the markup is seen as a measure of the firms' market power and the level of concentration in the market based on Kalecki (1942, 1971). In this view, firms may absorb some of the costs of capital in order to prioritize maintaining stable levels of employment and output rather than maximizing profits through mere price change.[6]

For firms in the light industry,

$$p^L = (1 + \mu^L)\Big[w^L a_N^L + \phi p^H\Big] \tag{3.7}$$

[6]There are some Kaleckian literature that added unit interest costs to unit labour costs when applying the markup (e.g., Godley and Cripps, 1983; Godley and Lavoie, 2007). One issue, however, concerns what really determines the real normal profit rate: is it the nominal interest rate or the real interest rate that is relevant? (Lavoie, 1995). Kalecki himself did not think interest rates played much of a role, because he thought that interest rates did not significantly vary through the business cycle.

where ϕ is the fixed required rate of intermediate good per unit of output produced by firms in the heavy industry or HCI sector. This model postulates that the light industry highly depends on the production of heavy industry while the heavy industry highly depends on the production of foreign sector. Hence, the structure of this economy lies in somewhere between Kaleckian two-sector model which lacks the interdependence of industries and Sraffian economy which assumes a full interdependence of industries. We also need to note that under the Kaleckian-Steindl framework, the markup pricing has a strong distributional implication. That is, the sectoral profit share π^x is determined by markup rate and the ratio of materials to labour costs as follows:

$$\pi^H = \frac{\mu^H\left(1 + \frac{\gamma\epsilon p_m^*}{w^H a_N^H}\right)}{1 + \mu^H\left(1 + \frac{\gamma\epsilon p_m^*}{w^H a_N^H}\right)} \tag{3.8}$$

$$\pi^L = \frac{\mu^L\left(1 + \frac{\phi p^H}{w^L a_N^L}\right)}{1 + \mu^L\left(1 + \frac{\phi p^H}{w^L a_N^L}\right)} \tag{3.9}$$

where π^x is a monotonic increasing function of markups and the ratio of material to labour costs.[7] Here I assume that $w^H > w^L$, signifying a more pronounced institutional wage suppression on less-skilled workers, as expounded in the preceding chapter. At this point, we may think of the case in which labour mobility between the sectors is notably challenging.

Investment or capital accumulation is determined by two main components: net profit rate and capacity utilization rate. $I = g_K \cdot K$ where g_K is the rate of capital growth, in particular, which is given as

$$g_K^x = \frac{I^x}{K^x} = \alpha_0^x + \alpha_1^x(R^x - i^x) + \alpha_2^x u^x, \quad x = \{H, L\} \tag{3.10}$$

where α_0 is autonomous component, so called *animal spirit* from Keynes (1936) which may represent consumer confidence. It is assumed that sensitivity parameters are positive ($\alpha_1 > 0$ and $\alpha_2 > 0$). This investment function highlights the role of endogenous factors such as profits and capacity utilization in determining firm's investment decision. Here I distinguish each parameter by sector to take full advantage of sectoral variation facilitated by the two-sector model. i^x is the industry-specific interest rate in real term. So i^H denotes the preferential loan interest rate with the condition that $i^H < i^L$ in real term. R^x is the sectoral or industry-specific rate of return or profit given by

$$R^x := \frac{\pi^x Q^x}{K^x} = \pi^x u^x, \quad x = \{H, L\} \tag{3.11}$$

[7] See Appendix Section A for the algebraic notes for the profit ratio.

where π^x is the profit share of total income.

Equation (3.10) is the slightly revised version of the canonical Kaleckian investment function, $I/K = a + bR + c \cdot Q/K$, where R is profit rate and Q/K is capacity utilization, which is found in Rowthorn (1981), Dutt (1984), Blecker (1989), and Bhaduri and Marglin (1990). There are two main reasons for the revision: first, since equation (3.6) and equation (3.7) include the unit material costs from the use of intermediate goods, the investment reflects the net profit rate that nets out the borrowing costs; second, the investment decision is expected to be significantly affected by the credit interest rates under the HCI promotion regime. Hence, the capital stock in each of the two sectors grows according to the rates of investment in each sector, which is composed of the rate of autonomous investment, the rate of net profit and the rate of capacity utilization. In this model, depreciation of the capital is assumed away to reflect that the effect of depreciation is very small in the short run. This omission allows for a streamlined analysis without being encumbered by additional complexity.[8] Thus, the production cost is more closely related to investment rather than capital under the assumption that capital goods are not aging or that they are being replaced by newer capital goods at the same rate as they are depreciating. It refers to the expenses incurred when a firm acquires new capital goods, such as machinery or equipment to expand its productive capacity. That is, they are simply the prices of intermediate goods produced by either foreign firms or domestic firms.

With respect to international trade, the export performance of firms in the H sector depends on price competitiveness as measured by $\frac{\epsilon p^{H^*}}{p^H}$ where p^{H^*} denotes the foreign currency price of foreign manufactured goods. The export performance, represented by the ratio of export E relative to capital stock K, is given by

$$\frac{E^H}{K^H} = \zeta_0 + \zeta_1 \epsilon \overline{\Big(\frac{p^{H^*}}{p^H}\Big)}, \tag{3.12}$$

where $\zeta_i > 0$ are all constants. ϵ is the fixed nominal exchange rate as defined in equation (3.6). The expression $\overline{\left(\frac{p^{H^*}}{p^H}\right)}$ illustrates that within this economic context, large firms in the H sector exhibit rapid responsiveness to the fluctuations in foreign prices. This responsiveness allows them to continually adjust their export prices, ensuring the maintenance of price competitiveness, aided by favourable government-driven updates to the exchange rate. Thus, export is assumed to be largely determined by the exchange rate policy or ϵ in this model.

[8]While the assumption of zero depreciation is useful for short-run models, it is worth noting that it is a significant departure from the real-world phenomenon of physical capital wear and tear, and other factors that result in the depreciation of capital. Over longer time horizons, the effect of depreciation can become increasingly important, and accounting for it becomes necessary in more detailed models of investment and growth that aim to capture the long-run evolution of the capital stock and the level of output. However, the model does not take this depreciation factor into consideration for the sake of simplicity.

3.2 Deriving Short-run Equilibrium Paths of Sectoral Capacity Utilization

Now, we want to derive equations for the sectoral equilibrium conditions by setting the sectoral excess demand to be zero. Each sectoral equilibrium condition leads to the equation for the sectoral capacity utilization. Thus, the equation shows the equilibrium path of capacity utilization rate in each sector, which is affected by the changes in the key exogenous variables such as markups or profit shares, interest rates for the credit, etc. The demand for investment goods produced by the firms in the heavy industry sector is composed of the intermediate demand for investment goods in the light industry sector, $p^H \phi Q^L$, real investment in both sectors, $p^H I^H + p^H I^L$, and foreign demand for investment goods, $p^H E^H$. Then the excess demand for heavy industry is given by

$$ED^H = \underbrace{\phi Q^L + (I^H + I^L) + E^H}_{\text{Demand for investment goods}} - \underbrace{Q^H}_{\substack{\text{Supply of} \\ \text{investment goods}}} \tag{3.13}$$

Equivalently, we have

$$\begin{aligned}
\frac{ED^H}{K^H} &= \frac{\phi Q^L}{K^H} + \frac{I^H}{K^H} + \frac{I^L}{K^H}\frac{K^L}{K^L} + \frac{E^H}{K^H} - \frac{Q^H}{K^H} \\
&= \phi u^L k + \alpha_0^H + \alpha_1^H(\pi^H u^H - i^H) + \alpha_2^H u^H \\
&+ \left[\alpha_0^L + \alpha_1^L(\pi^L u^L - i^L) + \alpha_2^L u^L\right]k + \zeta_0 + \zeta_1 \epsilon\Big(\frac{p^{H^*}}{p^H}\Big) - u^H
\end{aligned} \tag{3.14}$$

where $k = \frac{K^L}{K^H}$.

Similarly, the excess demand for light industry is given by

$$\begin{aligned}
\frac{p^L ED^L}{p^L K^L} &= \frac{p^L(C^H + C^L - Q^L)}{p^L K^L} = \frac{\overbrace{w^H N^H + w^L N^L}^{\substack{\text{Total consumption} \\ \text{out of their wage bill} \\ \text{with zero saving propensity}}}}{p^L K^L} - \frac{p^L Q^L}{p^L K^L} \\
&= (1 - \pi^H)\frac{pu^H}{k} - \pi^L u^L
\end{aligned} \tag{3.15}$$

where $p = \frac{p^H}{p^L}$, and C^x indicates the consumption demand of workers in x sector. Here, aggregate consumption is solely composed of labour workers' consumption. This assumption is consistent with the Kaleckian literature that oftentimes posits that investment is assumed to be determined by the rate of profit and not affected by the level of saving.

Following Nishi (2020), the labour productivity growth rate in each sector is endogenously determined as a function of the profit share π^x and capacity utilization u^x as given:

$$\widehat{1/a_N^x} = q^x(\pi^x, u^x) = \beta_0^x + \beta_1^x \pi^x + \beta_2^x u^x, \text{ with } q_\pi^x \lesseqgtr 0 \text{ and } q_u^x > 0, \; x = \{H, L\} \tag{3.16}$$

where q_π^x and q_u^x are the first derivative with respect to profit share and the rate of capacity utilization, respectively. Thus, $\beta_1^x = q_\pi^x$ and $\beta_2^x = q_u^x$. The sign of q_π^x picks up whether productivity growth takes a profit-led or a wage-led regime. For the sake of analysis, we consider both wage-led and profit-led productivity growth regimes so that we may explore all possible cases of productivity growth regimes. The positive sign of q_u^x validates a common situation that greater utilization leads to higher productivity.

The labour productivity also leads to endogenous change in the growth of nominal wages (Nishi, 2020). As labour productivity gap between sectors widens, wage gap between sectors also increases. Thus, the growth rate of sectoral nominal wage is given by

$$\hat{w}^x = \eta^x \cdot \widehat{1/a_N^x} = \eta^x q^x(\pi^x, u^x), \; x = \{H, L\} \tag{3.17}$$

where $0 \leq \eta^x \leq 1$ denotes the strength of association between the productivity and the wage rate and is affected by the bargaining power of unions. That is, a rise in unions' bargaining power leads to an increase in η^x, thereby $\hat{w}^x$ increases. When $\eta^x = 1$, then wages grow at the same pace that labour productivity rises. In the model, η^x is exogenous. Also, it is believed in general $\eta^H > \eta^L$, implying that workers in the H firms usually have higher bargaining power than their counterparts in L sector, and thus their wage is higher than that of workers in L sector.

The short-run equilibrium condition that $ED^x = 0$ finally yields the equations for the sectoral capacity utilization. The equilibrium rates for two sectoral capacity utilization rates will solve the following system of two equations:

$$u^H = \Bigg[\underbrace{\frac{\phi + \alpha_2^L + \alpha_1^L \pi^L}{1 - \alpha_2^H - \alpha_1^H \pi^H}}_{\mathbf{A}}\Bigg] k u^L + \Bigg[\underbrace{\frac{\alpha_0^H - \alpha_1^H i^H + (\alpha_0^L - \alpha_1^L i^L)k + \zeta_0 + \zeta_1 \epsilon\left(\frac{p^{H^*}}{p^H}\right)}{1 - \alpha_2^H - \alpha_1^H \pi^H}}_{\mathbf{B}}\Bigg]. \tag{3.18}$$

$$u^H = \Bigg[\underbrace{\frac{\pi^L}{p(1 - \pi^H)}}_{\mathbf{C}}\Bigg] k u^L \tag{3.19}$$

where $k = \frac{K^L}{K^H}$ and $p = \frac{p^H}{p^L}$.

Hence the short-run equilibrium is defined as:

$$u^{H^*} = \frac{\mathbf{B}(\bar{k}) \cdot \mathbf{C}}{\mathbf{C} - \mathbf{A}} \tag{3.20}$$

$$u^{L^*} = \frac{\mathbf{B}(\bar{k})}{(\mathbf{C} - \mathbf{A})\bar{k}} \tag{3.21}$$

where relative capital stock between the two sectors k is fixed as $\bar{k}$. The derivation above ensures that the capacity utilization rates are endogenously determined by many factors. One of the primary reasons that the rate is below one is to maintain market power and avoid competition. Thus, as shown in equation (3.18) and equation (3.19), u^x is significantly influenced by the profit share, π^x, which is mainly determined by the degree of firms' market power or markups, μ^x. By producing less than the maximum possible output, in particular, firms in H sector can sustain their higher output prices than those produced at full capacity. In addition, they can quickly adjust its production to match sudden changes in market demand.

For the current model to be operational, appropriate parametric assumptions are necessary.

Assumption 1. $\mathbf{C} > \mathbf{A} > 0$ and $\mathbf{B} > 0$ where $\mathbf{A}$ and $\mathbf{C}$ refers to the positive slope of equation (3.18) and equation (3.19), respectively. $\mathbf{B}$ refers to the positive intercept of equation (3.18).

This assumption requires that α_0^x, α_1^x and α_2^x are sufficiently small for a unique equilibrium to exist in the system. This assumption states that the slope of capacity utilization equation for light industry (equation (3.19)) is steeper than that of capacity utilization equation for heavy industry (equation (3.18)) so that we have a unique equilibrium of the economy.

Assumption 2. The effect of profit share of H firms (π^H) on $\mathbf{C}$ is greater than that of price change, yielding $p > \frac{1-\pi^H}{\pi^L}$. It is because $\frac{\partial \mathbf{C}}{\partial \pi^H} > \frac{\partial \mathbf{C}}{\partial p}$ with $\frac{\partial \mathbf{C}}{\partial \pi^H} = \frac{p\pi^L}{\Delta^2}$ and $\frac{\partial \mathbf{C}}{\partial p} = \frac{\pi^H - 1}{\Delta^2}$.

This assumption ensures that the slope of equation (3.19) increases as firms in H sector gain more market power.

In terms of a linear relationship between capacity utilization of H industry and that of L industry (i.e., $\frac{\Delta u^H}{\Delta u^L}$), their different slopes show that u^H responds to the increase in u^L with higher sensitivity in L sector than in H sector. This difference partly explains the different degree of dependence between the two industries. Since firms in L industry is solely dependent upon the domestic H industry, the increase in the u^L has a greater effect on u^H in L industry, making the slope steeper. In addition, in equilibrium, u^H varies directly with u^L (direct variation). A simple proof is presented in Appendix Section B.

The following section shows how industrial policy generates the dynamics of sectoral capacity utilization under the HCI promotion regime are shown in the section that follows. By including the export function and industrial reliance in the model, it is possible to think more practically about how different industries react to market changes by utilizing different aspects of industrial strategy. Since their export is the inverse function of the price of their output, firms in the heavy industry sector, for instance, may not be able to fully exercise their market power by raising their markups μ^H. The present model helps one to see the result by considering the situation when the firms in the heavy industry sector charge different prices for the domestic and international markets. In this way, the model can not only differentiate the effects of the increase in the market power of domestic firms ($\mu^H \uparrow$) and external price shock (e.g., $p^{m*} \uparrow$) on the economy but also depicts the subordinate connection between the heavy and light industry sectors under the HCI promotion regime in a more realistic manner.

4 Sectoral Dynamics of Industrial Policy

4.1 Comparative Statics of Industrial Policy

1) Impacts of Preferential Interest Rate During the HCI promotion in Korea, the preferential/lower interest rate policy was implemented to induce selected firms to stimulate investment and promote economic expansion. This policy also coincided with the growth of large business conglomerates, or *chaebols*, which benefited from preferential rates to expand the scale of their business operations. The preferential interest rate policy can have a positive effect on the increase in the capacity utilization through the aggregate demand effect: preferential interest rates make it less expensive for firms to finance investments in capital goods. This in turn allows firms to increase their production capacity to meet the growing aggregate demand, as captured by equation (3.10).

Figure 5 (left) illustrates the positive effect of the preferential interest rates (i.e., $i^H \downarrow$), which is an exogenous variable. The decrease in the interest rates for the firms in the targeted H sector will shift up the intercept of equation (3.18). As a result, the utilization of both sectors will rise. The outcome is encouraging in the sense that providing cheap credit for the firms in H sector through preferential interest rates are one of the most representative instruments of HCI push. This growth implication sharply contrasts with the neoclassical view on development finance – notably the McKinnon-Shaw hypothesis (McKinnon, 1973; Shaw, 1973) and its extended studies including Kapur (1976); Mathieson (1980); Fry (1997) – that lower interest rates under the repressed financial regime may dampen economic growth through inefficient credit allocation. The major benefit of preferential interest rate policy during the 1970s Korea's HCI promotion was that it provided an incentive for large business

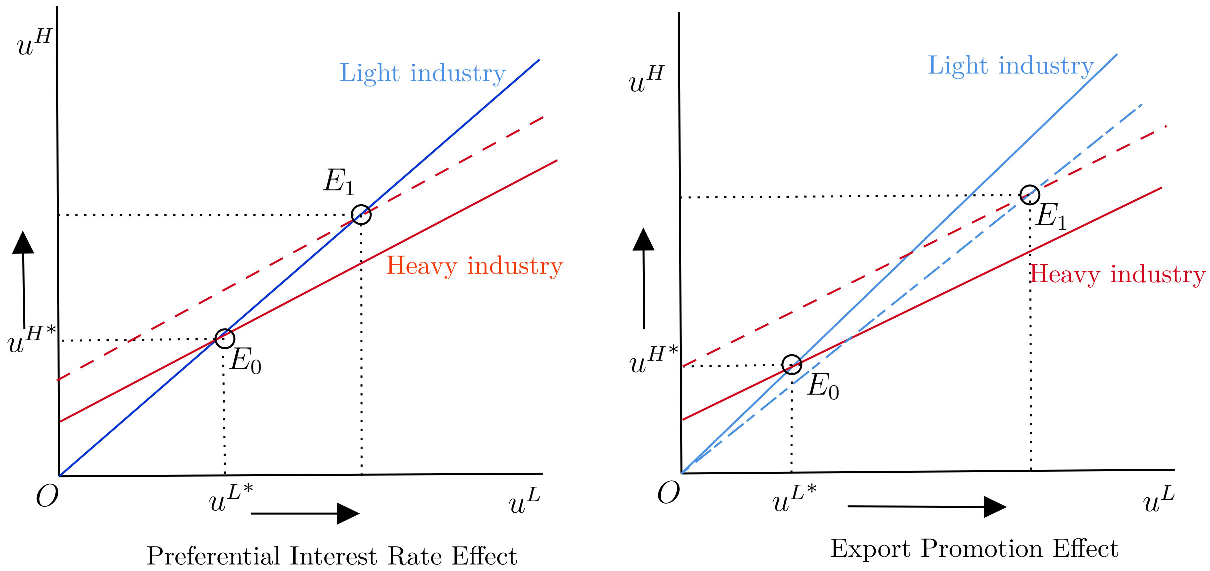


Figure 5: Short-run Equilibrium of Sectoral Capacity Utilization and the Impact of Preferential Interest Rates ($i^H \downarrow$) (left) and Export Promotion (ϵ = KRW/USD $\uparrow$) (right)

groups to invest in heavy and chemical industries. These industries required significant capital investments and were considered high-risk ventures, and so the preferential interest rates helped to offset some of the risks and incentivized the large business groups to invest in them. At the same time, the policy also helped the subordinate small and medium-sized firms grow in terms of capacity utilization. This was because the large business groups that invested in heavy and chemical industries often relied on these smaller firms as subcontractors. By investing in these industries, the large business groups created demand for the products and services provided by the smaller firms, which in turn helped to increase their capacity utilization.

Thus, the lower interest rate policy is generally expected to increase capacity utilization, as it reduces the cost of borrowing for firms and incentivizes investment in new projects or the expansion of existing ones. However, in the case of the HCI promotion in Korea, the lower interest rate policy was implemented selectively, only for firms in certain sectors. This policy, combined with other features of the HCI promotion, led to both an initial increase in capacity utilization, as well as a subsequent decrease in utilization and a rise in idle capacity.

The initial increase in capacity utilization was due to the fact that the lower interest rate policy allowed firms in the selected sectors to invest more in new projects or expand existing ones. This increased production and employment, which in turn led to a higher level of capacity utilization. However, the subsequent decrease in utilization was caused by several factors, including the overcapacity that resulted from the rapid expansion of heavy and chemical industries, as well as the stagnation of the Korean economy in the late 1970s. Therefore, while the lower interest rate policy generally has a positive effect on capacity utilization, its impact can be complex and depend on various factors such as the specific industries or sectors targeted by the policy, as well as broader macroeconomic conditions.

2) Export Promotion under a (*de facto*) Dollar Peg Regime The foreign exchange policy measure for export promotion under the HCI promotion policy was to devaluate the Korean won (KRW) by nearly 100 percent (Dornbusch and Park, 1987). Here I want to examine the effect of the government involvement in the foreign exchange rate. Korea's exchange rate system was classified by the IMF as a unified floating exchange rate system, but in fact the Korean won (KRW) was pegged to US dollar (USD) until the end of the 1970s (Nam and Kim, 1999). Whether it is intended by the government is not certain, but the initial exchange regime seems to significantly improve the competitiveness of exporting goods, facilitating the transition from import substitution to export promotion. In the model, the export is mainly determined by price competitiveness or terms of trade whose components are the exchange rate denoted by ϵ and the price ratio between the similar goods produced in foreign countries and those from the H sector, $\frac{p^{H^*}}{p^H}$. Figure 5 (right) illustrates the dynamics generated by export promotion via the exchange rate effect alone.

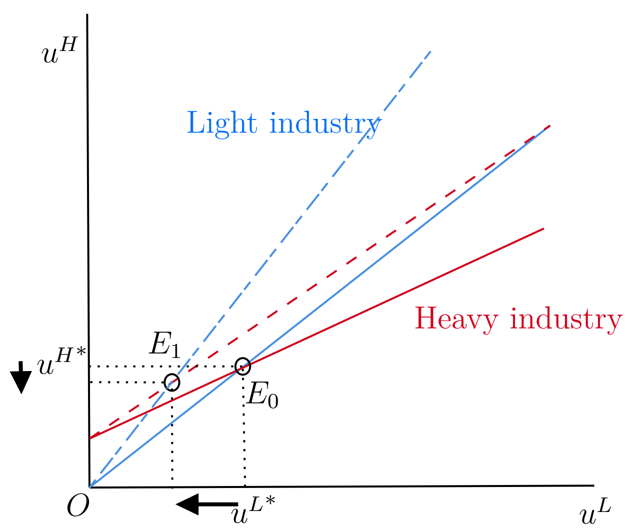


Figure 6: Short-run Equilibrium of Sectoral Capacity Utilization and the Impact of Higher Import Substitution (Sectoral Dependence) ($\phi \uparrow$)

3) Unilateral/Sectoral Dependence Effect In the early stages of industrial policy, sectoral dependence underscores the importance of import substitution as a primary protectionist policy. Notably, while Korea emphasized exports during the HCI promotion, steel largely remained an import-substitution industry (Amsden, 1992). Within this framework, firms in the L sector increasingly rely on the output (intermediate good) produced by the H sector. In the present model, we employ ϕ to represent the degree of sectoral dependence of the light industry on the heavy industry. Figure 6 illustrates the effect of higher degree of sectoral dependence on the sectoral utilization. As ϕ increases, both **A**

and **C**, the slopes of equation (3.18) and equation (3.19) respectively get steeper, causing utilization rates in both sectors to decrease. Notably, this impact is more substantial for L sector firms as sectoral dependence directly influences their pricing decisions in equation (3.7) according to the following mechanism: $\phi \uparrow \rightarrow\ p^L\ \rightarrow p \downarrow$. Conversely, the effects on the H sector may remain relatively marginal. Consequently, this feature of import substitution has notable distributional consequences, as the increasing production costs of L sector firms negatively affect their production and income. This sheds light on the remarkable transition from import substitution to export promotion observed in the developmental trajectories of Korea and neighbouring East Asian emerging economies, including Hong Kong, Singapore, and Taiwan (Rodrik et al., 1995; Irwin, 2021). This transformation underscores the primacy of the parameter ϵ in characterizing Korea's HCI promotion drive within this model, eclipsing the role of ϕ in its significance.

4) Effect of Market Power through Industrial Policy A rise in the markup ratio ($\mu^H \uparrow$) has an impact on the economy with two channels: the rise in the domestic relative price and the decrease in the export due to the reduced price competitiveness in the international market as shown in Figure 7. The markup rate plays a crucial role in determining income distribution within the traditional Kaleckian economy. However, in a two-sector open economy operating under a selective industrial policy regime, firms may refrain from fully exercising their market power due to concerns about maintaining price competitiveness in the global market. Thus, with the higher degree of market power and the price discrimination between domestic and foreign goods markets, firms in the HCI sector keep their export prices competitive in the global market to sustain their export performance. This is a highly feasible option for them under the HCI promotion regime due to the preferential interest rates, which can also serve as a subsidy for those who participate in the intense price competition in the international market.

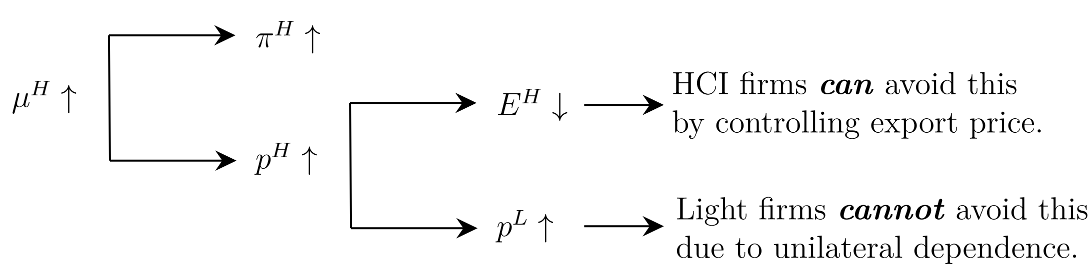
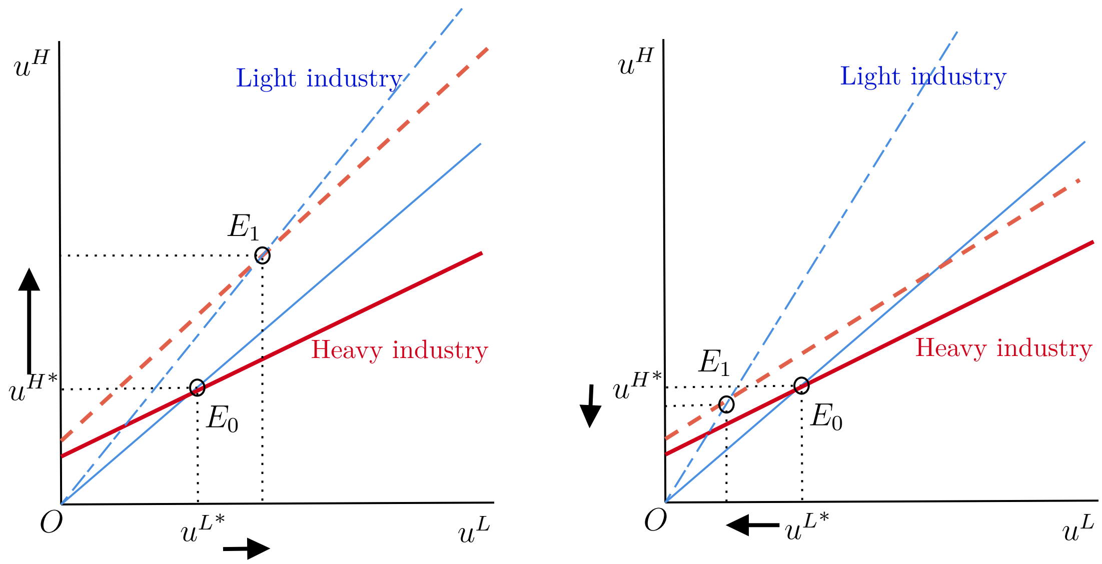


Figure 7: The Channel of the Markup Effects

Thus the increase in the profit share in the firms of H sector ($\pi^H \uparrow$) will make the slope of equation (3.18), **A**, steeper as the denominator of **A** decreases. The intercept of equation (3.18), **B**, will also increase when we assume that HCI firms manage to stay price



Impact of Increased Profit Share (Scenario 1) Impact of Increased Profit Share (Scenario 2)

Figure 8: Short-run Equilibrium of Sectoral Capacity Utilization and the Impact of Increased Market Power ($\mu^H \uparrow$) or Profit Share ($\pi^H \uparrow$)

competitive in the export market and thus the effect of the increase in the market power on the export market is trivial. Given assumption 2, the slope of equation (3.19), **C** will also increase as π^H rises,[9] implying that light industry responds to the change in the market power of firms in the heavy industry sector. Figure 8 shows the outcome hinges on the sensitivity of each sector. Scenario 1 shows the equilibrium rates of utilization increase in both sectors whereas scenario 2 shows the opposite. This also implies any mixed outcomes in which either the rate of H sector or the rate of L sector increases or decreases. As a result, the rate of utilization in H sector becomes more sensitive to the change in the rate of utilization in L sector. Later through numerical analysis, we will find that the demand regime of each sector – whether it is profit-led or wage-led – highly depends on the productivity growth regime of each sector.

5) Oil Price Shock Effect Finally, let us consider an external price shock or the increase in the resource price in the international commodity market. In equation (3.6), the oil shock can simply be incorporated in the model by identifying it as the increase in the cost of imported material ($p_m^* \uparrow$), which will increase p^H, the price of intermediate goods produced by firms in HCI sector. Figure 9 shows that the impact of the oil price shock is similar to that of the increase in the markups. Unlike the scenario of rising markup rates, the H sector firms have limited scope to mitigate the shock. This suggests that exports could substantially decline. However, according to equation (3.8), the profit share might still rise,

[9] Recall $\frac{\partial \mathbf{C}}{\partial p} = \frac{\pi^H - 1}{\Delta^2} < 0$.

especially when the exporting H sector firms suppress wages when they cannot refrain from transferring increased production costs to consumers. This will impact workers' consumption, further decreasing aggregate demand.

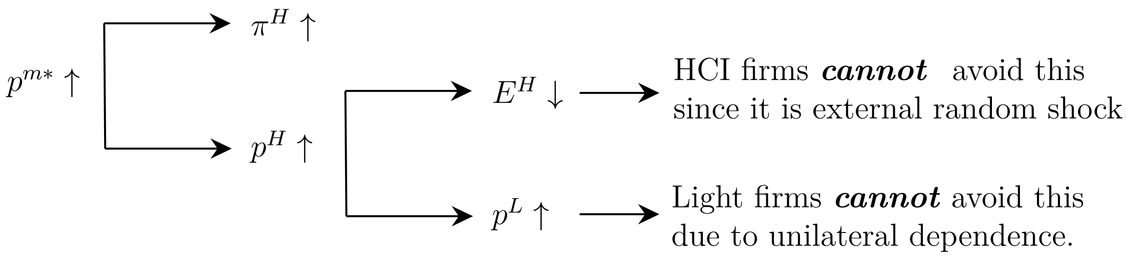


Figure 9: The Channel of the Oil Price Shock ($p^{m*} \uparrow$)

As a result, in equation (3.18), **A** will markedly increases, whereas **B** decreases significantly. Meanwhile, **C** in equation (3.19) also shows an increase. Figure 10 depicts the sectoral dynamics of an oil price shock, highlighting reduced capacity utilization across both sectors. This result emphasizes the severe repercussions of oil price shocks, making the HCI promotion or industrial policy regime vulnerable to external disturbances, especially significant commodity price shocks.

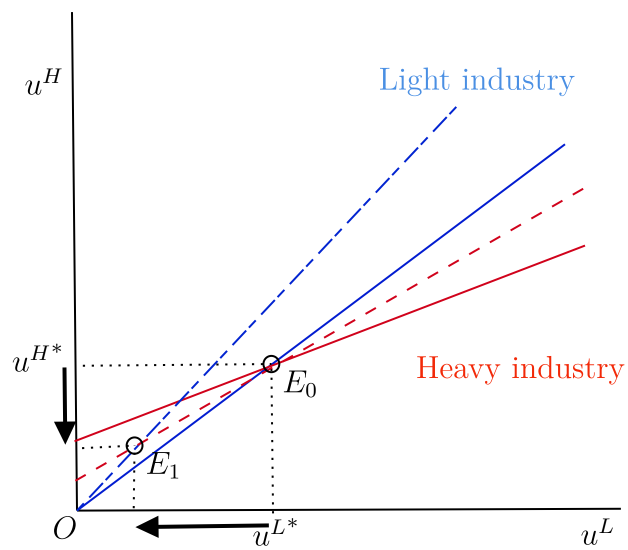


Figure 10: Short-run Equilibrium of Sectoral Capacity Utilization and the Impact of Oil Price Shock ($p_m^* \uparrow$) (right)

Now we may consider the macroeconomic implications of both increased profit share and the impact of price shock. We first need to note that capacity utilization and sectoral (or aggregate) demand are closely linked. That is, as the sectoral capacity is utilized at a full level, the economy is experiencing strong and sustained growth of sectoral demand. This unintended effect of industrial policy instrument or external shock lead to further engagement of the government, justifying the argument for the larger role of the state in the process of industrialization of many developing countries including Korea.

4.2 Short-run and Long-run Dynamics of Industrial Policy

This section proceeds to obtain the condition for the existence of steady state of key endogenous variables: sectoral capacity utilization rate, u^H, u^L and relative unit labour cost, z. More importantly, this section derives the local stability conditions for the steady states, substantiating the previous illustrative discussion of comparative statics of the equilibrium of two rates of sectoral capacity utilization. In other words, without considering the local stability of the steady state or if the steady state is locally unstable, the exercise does not make sense. The first part of the section will derive the equations for the steady states of the short-run dynamics system. The second part will figure out the conditions for the existence of unique solution to steady-state economy as well as its stability based on the Routh-Hurwitz condition, which proposes a necessary and sufficient condition for the local stability of the dynamic system. We will also state a couple of propositions based on the same condition.

1) Short-run Dynamics The dynamics of capacity utilization in each sector depends on the difference between excess demand and utilization: when excess demand exceeds utilization, a rise in the capacity utilization occurs in both sectors, and vice versa. The dynamics of each state variable is represented as its time-derivative:

$$\begin{aligned}\dot{u}^H &= \theta^H\left(\frac{ED^H}{K^H}\right)\\ &= \theta^H\biggl((\phi+\alpha_1^L\pi^L+\alpha_2^L)ku^{L^*}+(\alpha_1^H\pi^H+\alpha_2^H-1)u^{H^*}\\ &+\alpha_0^H-\alpha_1^H i^H+\alpha_0^L k-\alpha_1^L i^L k+\zeta_0+\zeta_1\epsilon\Bigl(\frac{p^{H^*}}{p^H}\Bigr)\biggr)\end{aligned} \tag{4.1}$$

$$\begin{aligned}\dot{u}^L &= \theta^L\left(\frac{ED^L}{K^L}\right)\\ &= \theta^L\left((1-\pi^H)\frac{pu^{H^*}}{k}-\pi^L u^{L^*}\right)\end{aligned} \tag{4.2}$$

where $\theta^x > 0$ denotes the parameters of the speed adjustment of the changes in the capacity utilization rate in response to the disequilibrating perturbation in each sector. For the sake of simplicity, I employ the proxy for the price ratio from Nishi (2020). This assumes that the relative price p is primarily influenced by the relative income distribution $\frac{1-\pi^L}{1-\pi^H}$ and relative unit labour cost z, defined as $\frac{w^H a_N^H}{w^L a_N^L} = \frac{\pi^L(1-\pi^H)\mu^H \gamma p_m^*}{\pi^H(1-\pi^L)\mu^L \phi p^H}$.[10] Furthermore, it posits that the impact of sectoral intermediate goods' prices, γp_m^* and ϕp^H, is negligible.

$$p = \frac{p^H}{p^L} = \frac{(1+\mu^H)(w^H a_N^L + \gamma p_m^*)}{(1+\mu^L)(w^L a_N^H + \phi p^H)} \approx \Big(\frac{1-\pi^L}{1-\pi^H}\Big) z \tag{4.3}$$

Thus, equation (4.2) can be rewritten as

$$\dot{u}^L = \theta^L \Bigg((1-\pi^L) z \frac{u^{H^*}}{k} - \pi^L u^{L^*} \Bigg) \tag{4.4}$$

Finally, taking the logarithm of relative unit labour cost z and its time derivative yields:

$$\begin{aligned} \dot{z} &= z\Big(\hat{w}^H - \widehat{1/a_N^H} - \hat{w}^L + \widehat{1/a_N^L}\Big) \\ &= -z\Big((1-\eta^H)\cdot \widehat{1/a_N^H} - (1-\eta^L)\cdot \widehat{1/a_N^L}\Big) \\ &= z\Big((1-\eta^L) q^L(\pi^L, u^L) - (1-\eta^H) q^H(\pi^H, u^H)\Big) \end{aligned} \tag{4.5}$$

where the second and third expressions are derived from equation (3.17).

The steady state of the short-run dynamics system is defined by $\dot{u}^H = \dot{u}^L = \dot{z} = 0$, which yields the following conditions:

$$(\phi + \alpha_1^L \pi^L + \alpha_2^L) k u^{L^*} + (\alpha_1^H \pi^H + \alpha_2^H - 1) u^{H^*} + \alpha_0^H - \alpha_1^H i^H + (\alpha_0^L - \alpha_1^L i^L) k + \zeta_0 + \zeta_1 \epsilon \Big(\frac{p^{H^*}}{p^H}\Big) = 0 \tag{4.6}$$

$$(1-\pi^L) z \frac{u^{H^*}}{k} - \pi^L u^{L^*} = 0 \tag{4.7}$$

$$(1-\eta^L) q^L(\pi^L, u^L) - (1-\eta^H) q^H(\pi^H, u^H) = 0 \tag{4.8}$$

The stability condition for steady-state economy is provided in Appendix Section B.

2) Long-run Dynamics The growth rate of the stock of capital is defined as the difference between the growth rate of the capital stock of each sector. All the capital goods or investment goods in HCI sector are either consumed by the domestic firms in the light industry or exported and consumed by the foreign firms. So using equation (3.10), the

[10]See Appendix Section A for the algebraic derivations of the relative unit labour cost ratio.

changes in the domestic capital stock is defined as

$$
\begin{aligned}
\dot{k} &= (g_I^L - g_I^H)k \\
&= \Big[\alpha_0^L + \alpha_1^L(R^L - i^L) + \alpha_2^L u^{L^*}(k) - \alpha_0^H - \alpha_1^H(R^H - i^H) - \alpha_2^H u^{H^*}(k)\Big]k \\
&= \Big[\alpha_0^L + \alpha_1^L(\pi^L u^{L^*}(k) - i^L) + \alpha_2^L u^{L^*}(k) - \alpha_0^H - \alpha_1^H(\pi^H u^{H^*}(k) - i^H) - \alpha_2^H u^{H^*}(k)\Big]k \\
&= \Big[\alpha_0^L - \alpha_1^L i^L + u^{L^*}(k)\Big(\alpha_1^L \pi^L + \alpha_2^L\Big) - \alpha_0^H + \alpha_1^H i^H - u^{H^*}(k)\Big(\alpha_1^H \pi^H + \alpha_2^H\Big)\Big]k
\end{aligned}
\tag{4.9}
$$

The long-run steady state condition further requires $\dot{k} = 0$ so that $g_I^L = g_I^H$ and the long-run steady-state is defined as a set of $(u_\ell^{*H}, u_\ell^{*L}, z_\ell^*, k_\ell^*)$ in which subscription ℓ refers to the long run values. The long-run steady state is described as:

$$
0 = (\phi + \alpha_1^L \pi^L + \alpha_2^L)k_\ell u_\ell^{L^*} + (\alpha_1^H \pi^H + \alpha_2^H - 1)u_\ell^{H^*} + \alpha_0^H - \alpha_1^H i^H + (\alpha_0^L - \alpha_1^L i^L)k_\ell + \zeta_0 + \zeta_1 \epsilon(\frac{p^{H^*}}{p^H}) \tag{4.10}
$$

$$
0 = (1 - \pi^L) z_\ell \frac{u_\ell^{H^*}}{k_\ell} - \pi^L u_\ell^{L^*} \tag{4.11}
$$

$$
0 = \eta^L q^L(\pi^L, u_\ell^L) - \eta^H q^H(\pi^H, u_\ell^H) \tag{4.12}
$$

$$
0 = \alpha_0^L - \alpha_1^L i^L + u_\ell^{L^*}(\alpha_1^L \pi^L + \alpha_2^L) - \alpha_0^H + \alpha_1^H i^H - u_\ell^{H^*}(\alpha_1^H \pi^H + \alpha_2^H) \tag{4.13}
$$

For the long-run steady state to be economically meaningful, the following condition must be satisfied.

$$
\begin{aligned}
\frac{du_\ell^{H*}}{dk_\ell} &< 0 \\
\frac{du_\ell^{L*}}{dk_\ell} &< 0 \\
\frac{d\dot{k}_\ell}{dk_\ell} &< 0
\end{aligned}
\tag{4.14}
$$

In order to understand the long-run trend of key variables from the model, it is essential to recognize that the economy can face stagnation due to three factors: higher degree of sectoral dependence, increasing market power of the firms in the targeted industries which is based on Steindl (1952)'s discovery that there is a trend toward stagnation in the markups, and finally adverse external price shocks. The first and the second factors stem from the selectivity of industrial policy – so they are endogenous – whereas the third factor is exogenous. Transitioning to export orientation might address this, but the latter two factors pose greater challenges. Thus, the model suggests that industrial policy require further redistribution measures for the stabilization of the economy against external price shock. The following section presents the numerical results for both short-run and long-run dynamics of industrial policy.

4.3 Numerical Analysis and Discussion

This section presents numerical simulations to illuminate the short-run and long-run dynamics of the economy under distinctive sectoral productivity growth regimes. We begin by summarizing the results from the comparative statics as depicted in graphical illustrations in Section 4.1. This is followed by a table to present the steady-state values for key endogenous variables to delineate differences across productivity regimes. Subsequently, we utilize another table to classify the emergent demand and growth regimes under the HCI promotion policy. For further reference, Appendix Section D provides the parameter values utilized in the simulation. In the latter part of this section, we delve into a brief discussion on the distributional implication of industrial policy and the connection with contemporary industrial policy challenges.

1) Short-run and Long-run Behaviours of Key Variables

Table 1: Impacts of Industrial Policy Measures (Model Prediction) under Wage-led Productivity Regime for Both Sectors)

		Endogenous variables				
Industrial policy regime		u^H	u^L	u^A	z	g^A
Policy instruments	$i^H \downarrow$	+	+	+	+	+
	$\phi \uparrow$	−	−	−	−	−
	$\epsilon \uparrow$	+	+	+	+	+
External shock (Oil shock)	$p_m^* \uparrow$	−	−	−	−	−
Market power	$\mu^H \uparrow$	?	?	?	?	?

Note: u^H: capacity utilization rate in H sector; u^L: capacity utilization rate in L sector; u^A: aggregate capacity utilization rate; z: relative labour input cost ratio; g^A: aggregate growth rate

Table 1 shows that various industrial policy instruments have distinctive effects on the sectoral economy. The preferential interest rate for H sector firms has led to aggregate demand expansion and long-run economic growth. Furthermore, the positive impact on the increase in relative labour input cost ratio (z) implies a shift towards more capital-intensive production in the H sector. The overall effect of higher dependence (ϕ) of the L sector firms on the H sector firms is negative. In particular, higher reliance can result in inefficiencies within the L sector firms. These inefficiencies may pose potential constraints on their expansion, especially if their inputs are heavily dependent on the H sector. This stands in stark contrast to the situation faced by the H sector firms. The third instrument (ϵ) represents the positive impact of export promotion by exchange rate manipulation. This industrial policy instrument is among the most important, especially given the limitations of the import substitution revealed in the current model. Within the context of industrial policy, the economy is facing the following unanticipated challenges: the oil shock and market power hike. It is apparent that the increase in oil prices has significantly harmed all of the endogenous factors. This widespread impact of the oil price shock highlights the economy's susceptibility to such external shocks and the significance of diversifying energy sources or enhancing resilience against such disruptions within the context of industrial policy. The effects of market power seem to be unclear: either positive or negative on capacity utilization. However, as we will explore in more detail later in Table 3, the effect of the increasing profit share of H sector companies hinges on the characteristics of sectoral productivity growth regimes and their interplay.

Table 2: Steady State Values of Key Variables with Productivity Growth Regimes

Productivity growth regimes:	WLP H sector +WLP L sector	PLP H sector +PLP L sector	WLP H sector +PLP L sector	PLP H sector +WLP L sector
Variables	Short-run steady state values			
$\mathbf{u^{H^*}}$	0.324	0.324	0.333	0.315
$\mathbf{u^{L^*}}$	0.612	0.612	0.635	0.588
$\mathbf{z^*}$	0.135	0.135	0.137	0.134
Variables	Long-run steady state values			
$\mathbf{u_\ell^{H^*}}$	0.259	0.259	0.265	0.253
$\mathbf{u_\ell^{L^*}}$	0.286	0.286	0.293	0.280
$\mathbf{z_\ell^*}$	0.121	0.121	0.123	0.120
$\mathbf{k_\ell^*}$	0.382	0.382	0.387	0.378

Note: WLP and PLP denote *wage-led* productivity regime and *profit-led* productivity regime, respectively.

Table 2 shows both short-run and long-run steady-state values of key variables for all possible combinations of productivity growth regimes. The findings of the simulation reveal that, regardless of the productivity regime adopted by each sector, the capacity utilization rate of the H sector is notably lower than that of the L sector in the short run. This shows that firms in the H sector typically have a higher potential for capacity utilization, easily leveraging their greater market power in the face of optimistic market prospects. In the long run, this relationship remains consistent, even though the disparity between the two sectors narrows considerably. This marked decrease in capacity utilization of H sector firms in the long run underscores the challenges faced by Korea's economy: substantial capital misallocation during the final phase of the HCI promotion, especially within the HCI sector.

Table 3: Demand and Growth Regimes for Different Productivity Growth Regimes

Productivity growth regime	Comparative statics in the short run and long run				
	Profit share shock	$\mathbf{u^H}$	$\mathbf{u^L}$	$\mathbf{u^A}$ (demand)	$\mathbf{k}$ (long-run growth)
WLP H sector and WLP L sector	$\pi^H \uparrow$	PLD	PLD	PLD	PLG
PLP L sector and PLP L sector	$\pi^H \uparrow$	WLD	WLD	WLD	WLG
WLP H sector and PLP L sector	$\pi^H \uparrow$	PLD	PLD	PLD	PLG
PLP H sector and WLP L sector	$\pi^H \uparrow$	WLD	WLD	WLD	WLG

Note: PLD and PLG denote *profit-led* demand regime and *profit-led* capital growth regime, respectively. WLD and WLG denote *wage-led* demand regime and *wage-led* capital growth regime, respectively. Numerical results are shown in Appendix Section C.

Table 3 displays the impact of a profit share shock on the demand and growth regimes, depending on the characteristics of productivity growth within each sector. The examination encompasses both short-term and long-term perspectives and spans four distinct productivity growth regimes. A key finding is that when the H sector operates within a wage-led productivity growth framework, the implementation of industrial policy leads to an economy that exhibits characteristics of a profit-led demand (PLD) and profit-led growth (PLG). This outcome appears to depart significantly from the empirical findings from Seguino (1999), Onaran and Stockhammer (2005) and Onaran and Galanis (2014), which suggest that higher wage share leads to higher demand and investment in Korea. However, we need to note that their analyses encompass data from the post-HCI period and do not account for the specific attributes of productivity growth regimes. Notably, the Marx-Webb effect (Storm and Naastepad, 2013; Lavoie, 2017), whereby real wage growth drives labour productivity growth, prevails in Korea, as evidenced by data available at the Office of Labor Affairs, Ministry of Labor and the Bank of Korea (Amsden, 1992, p.201). Given the strong wage-led productivity in Korean industries, the rising profit share of *chaebols* could have led to the expansion of aggregate demand and the long-run economic growth of the Korean economy during the 1970s. This aligns with the implication from open economy Kaleckian models that export-oriented economies tend to take on a profit-led growth regime. This finding underscores the significance of productivity orientation in shaping demand and growth regimes of an industrializing economy.

2) Efficiency vs. Equity The efficiency of capital allocation is a critical factor in determining the success of industrial policies aimed at promoting key industries or firms in those industries. Although industrial policy may successfully coordinate investment projects between firms, it generates a strong incentive for overinvestment due to the negative borrowing cost of the preferential credit. The inefficiency of capital allocation, a more direct cause of the increase in the idle capacity under the HCI promotion, is further supported by Auty (1992) who stresses the possibility of inadequate implementation capacity when the HCI promotion transformed from *Drive* stage to *Big Push* stage.[11] This transition triggers inflation and a real appreciation of the exchange rate, thereby causing higher import demands and lagged output from the long-gestation HCI projects to push the trade balance into deficit. In addition, the impact of market power of the firms in the heavy industry on macroeconomy should be noted based on Kim (1990) and Park (1986) who argue that the gap between the increasing domestic demand and the down-scaled support for the capacity of light industries was the main cause of inflation and that the concentration of investment on HCI triggered inflation, respectively.

Understanding how output is distributed between labour and capital in the different phases of the business cycle in the context of industrial policy, is more challenging. There are two conflicting views on the relationship between capacity utilization and labour share. The first view is established by the early Cambridge School scholars such as Robinson (1962, 1969); Harcourt (1972); Kaldor (1985), arguing that firms' markup pricing decreases wage share as capacity utilization increases beyond its normal level. In contrast, a notion adopted by Goodwin (1967); Davidson (1972); Shapiro and Stiglitz (1984); Bowles and Boyer (1988); Kurz (1994); Foley (2003); Taylor (2004); Barbosa-Filho and Taylor (2006) states that the real wages and the labour share increase with economic growth with which the level of capacity utilization increases and the economy gets closer to full employment. Nikiforos and Foley (2012) offer a strong case for a U-shaped distributive curve based on U.S. data, utilizing the Kaleckian theory that markup price is the major predictor of the income distribution. Their study considers the influence of overhead costs and negotiation processes on wage share.

The observation of a decline in the wage share during the period of HCI promotion suggests the dominance of the second connection. Specifically, in the advent of the Second Oil Price Shock, the bargaining power of workers might further weaken, allowing HCI firms to gain augmented market power. This, in turn, led to idle capital capacity, resulting in a reduction of wage share. It can be also suggested that the notable shift in the trend of utilization in 1978 was primarily due to external shocks, particularly the skyrocketing oil price. These factors are deemed to have exerted more pronounced impact on the macroeconomy than the industrial policy measures themselves.

The difference between labour productivity and capital productivity, particularly among

[11] According to Auty (1992), the HCI Drive seeks to accelerate the sequence of backward integration from light industry through capital-intensive intermediates into skill-intensive machinery and engineering. An HCI Big Push is even more ambitious since it seeks to capture the externalities arising from simultaneous entry into HCI sectors at different stages in the production chain.

firms in the H sector, is another factor for the drop in the wage share. The capital stock has grown dramatically, but the labour productivity does not appear to have increased. Positive externality, which was anticipated by the HCI-specific Big Push, may not materialize, but instead, labour productivity turns out to be falling behind capital accumulation and the expansion of large business groups. As a result, wage share decreased.

3) HCI Promotion and Contemporary Industrial Policy Challenges The landscape of industrial policy has undergone significant transformations since the 1970s. Governments are required to recalibrate each industrial policy measures to accurately address a spectrum of the pressing concerns: the post-pandemic inflationary shock, the escalating threat of climate change, issues associated with secular stagnation and declining wage shares. The recent geopolitical conflicts and wars have further intensified these challenges, leading to resource insecurities and macroeconomic instability.

Understanding the HCI promotion policy sheds light on these complexities. For instance, governments may take into account a green industrial policy, which aims to address both climate change and sustainable growth, as an alternative to conventional industrial policy. In light of this study, it is clear that policymakers need to take a comprehensive stance. That is, they should be aware of not only the context of industrial policies but also their macroeconomic ramifications such as market power concentration, inflationary pressure and widening income disparities.

5 Conclusion

The study evaluates the primary instruments of industrial policy, the primary sources of both intended and unintended consequences of the HCI promotion policy. The Korean industrial policy episode shows that, first, both preferential interest rate regime and export promotion through exchange rate intervention lead to aggregate demand expansion and economic growth. Second, the study provides more nuanced understanding on the impact of rising market power among H sector firms or *chaebols*, which can either spur or hinder aggregate demand and growth, depending on productivity growth regimes. Finally, the industrial policy regime is notably susceptible to external shocks like inflation or oil price hike. This study also underscores that industrial policy need not be bound by traditional growth paradigms such as the principle of manifest comparative advantage, fully liberalized financial regime or excessive competition (Chang, 1993). This strategic move is facilitated through targeted financial incentives among which preferential interest rate policy turns out to be crucial. Third, there is a pressing need for a regulatory framework that tackles market power dynamics given the enormous impact on sectoral capacity utilization and income distribution. Lastly, the 1970s' HCI promotion provides a lens to examine today's industrial policy challenges, as countries navigate a complex landscape of geopolitical shifts, technological revolutions, unprecedented health crises and climate change. Drawing from this past experience, Korean policymakers need not only recognize opportunities to shift their strategic emphasis on advanced sectors like secondary cell batteries and green technologies but also learn from the shortcomings of the HCI promotion policy including over-dependence on certain industries, unbalanced regional growth and socio-economic inequalities. By understanding these complex policy implications, countries can navigate industrial policy more effectively, fostering economic growth and resilience in an unpredictable global landscape. Future research could focus on devising optimal industrial policies for both developing and advanced economies, considering challenges like sectoral coordination and the risk of reinforcing firms' monopolistic or oligopolistic dominance.

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Appendices

A Algebraic Notes for Profit Share and Profit Rate

The sectoral profit share π^x is determined by μ^x (markup rate) and the ratio of materials to labour costs. Without considering the sectoral index, we have:

$$p = (1+\mu)(ULC + UMC)$$

where ULC denotes unit (average) labour cost and UMC denotes unit material cost.

Since the sectoral value added per output, $va^x := \dfrac{VA^x}{Q^x} = \underbrace{ULC^x}_{wage} + \underbrace{\mu^x(ULC^x + UMC^x)}_{profit}$

and the sectoral profit share, $\pi^x = \dfrac{profit^x}{total\ income^x}$

$$= \frac{\mu^x(ULC^x + UMC^x)}{ULC^x + \mu^x(ULC^x + UMC^x)} = \frac{\mu^x\left(1 + \boxed{\dfrac{UMC^x}{ULC^x}}\right)}{1 + \mu^x\left(1 + \boxed{\dfrac{UMC^x}{ULC^x}}\right)},$$

the profit ratio and the profit rate of firms in each sector are determined as follows:

$$va^H = w^H a^H + \mu^H(w^H a^H + \gamma\epsilon p^*_m)$$

$$va^L = w^L a^L + \mu^L(w^L a^L + \phi p^H)$$

and

$$\pi^H = \frac{\mu^H\left(1 + \frac{\gamma\epsilon p^*_m}{w^H a^H}\right)}{1 + \mu^H\left(1 + \frac{\gamma\epsilon p^*_m}{w^H a^H}\right)} \text{ and } \pi^L = \frac{\mu^L\left(1 + \frac{\phi p^H}{w^L a^L}\right)}{1 + \mu^L\left(1 + \frac{\phi p^H}{w^L a^L}\right)}.$$

Equivalently,

$$\mu^H = \frac{\pi^H}{1-\pi^H} \cdot \frac{1}{1 + \frac{\gamma p^*_m}{w^H a^H_N}} \text{ and } \mu^L = \frac{\pi^L}{1-\pi^L} \cdot \frac{1}{1 + \frac{\phi p^H}{w^L a^L_N}}.$$

The expressions above can be rewritten as

$$w^H a^H_N = \frac{1-\pi^H}{\pi^H} \cdot \mu^H \gamma p^*_m \text{ and } w^L a^L_N = \frac{1-\pi^L}{\pi^L} \cdot \mu^L \phi p^H.$$

Hence,

$$z = \frac{w^H a_N^H}{w^L a_N^L} = \frac{\frac{1-\pi^H}{\pi^H} \cdot \mu^H \gamma p_m^*}{\frac{1-\pi^L}{\pi^L} \cdot \mu^L \phi p^H} = \frac{\pi^L (1-\pi^H) \mu^H \gamma p_m^*}{\pi^H (1-\pi^L) \mu^L \phi p^H}$$

The sectoral profit rate R^x is given by

$$R^x = \frac{\pi^x u^x}{a_K^x} = \pi^x u^x, \quad x = \{H, L\}$$

where $a_K^x = 1$ is assumed.

B Conditions for the Local Stability of the Equilibrium

To obtain the condition for the local asymptotic stability of the steady state, the system needs a linearization around the sectoral steady state as follows:

$$\begin{bmatrix} \dot{u}^H \\ \dot{u}^L \\ \dot{z} \end{bmatrix} = \underbrace{\begin{bmatrix} j_{11} & j_{12} & 0 \\ j_{21} & j_{22} & j_{23} \\ j_{31} & j_{32} & 0 \end{bmatrix}}_{\mathbf{J}} \begin{bmatrix} u^H - u^{H^*} \\ u^L - u^{L^*} \\ z - z^* \end{bmatrix}$$

where $\mathbf{J}$ is the Jacobian matrix for the long-run dynamic system whose non-zero elements of $\mathbf{J}$ and their signs are determined as follows:

$$j_{11} = \frac{\partial \dot{u}^H}{\partial u^H} = \theta^H (\alpha_1^H \pi^H + \alpha_2^H - 1) < 0. \tag{A.1}$$

$$j_{12} = \frac{\partial \dot{u}^H}{\partial u^L} = \theta^H k (\phi + \alpha_1^L \pi^L + \alpha_2^L) > 0. \tag{A.2}$$

$$j_{13} = \frac{\partial \dot{u}^H}{\partial z} = 0. \tag{A.3}$$

$$j_{21} = \frac{\partial \dot{u}^L}{\partial u^H} = \theta^L (1-\pi^L) \frac{z}{k} > 0. \tag{A.4}$$

$$j_{22} = \frac{\partial \dot{u}^L}{\partial u^L} = -\theta^L \pi^L < 0. \tag{A.5}$$

$$j_{23} = \frac{\partial \dot{u}^L}{\partial z} = \theta^L \left((1-\pi^L) \frac{u^H}{k} \right) > 0. \tag{A.6}$$

$$j_{31} = \frac{\partial \dot{z}}{\partial u^H} = -z^* (1-\eta^H) q_{u^H}^H < 0. \tag{A.7}$$

$$j_{32} = \frac{\partial \dot{z}}{\partial u^L} = z^* (1-\eta^L) q_{u^L}^L > 0. \tag{A.8}$$

$$j_{33} = \frac{\partial \dot{z}}{\partial z} = 0. \tag{A.9}$$

The following is the characteristic equation based on the 3×3 Jacobian matrix $\mathbf{J}$.

$$p(\lambda) = \det(\lambda \mathbf{I} - \mathbf{J}) = \lambda^3 + c_1\lambda^2 + c_2\lambda + c_3 = 0 \tag{A.10}$$

where λ denotes a characteristic root, $c_1 = -\operatorname{Tr}\mathbf{J}$ (where Tr denotes the trace of the matrix $\mathbf{J}$), c_2 is the sum of the principal minors' determinants of $\mathbf{J}$, and $c_3 = -\det \mathbf{J}$ (where det denotes the determinant of matrix $\mathbf{J}$). Each coefficients are computed as follows:

$$c_1 = -\operatorname{Tr}\mathbf{J} = -j_{11} - j_{22} = \theta^H(1 - \alpha_1^H\pi^H - \alpha_2^H) + \theta^L\pi^L > 0$$

$$\begin{aligned} c_2 &= \begin{vmatrix} j_{22} & j_{23} \\ j_{32} & j_{33} \end{vmatrix} + \begin{vmatrix} j_{11} & j_{13} \\ j_{31} & j_{33} \end{vmatrix} + \begin{vmatrix} j_{11} & j_{12} \\ j_{21} & j_{22} \end{vmatrix} = -j_{23}j_{32} + j_{11}j_{22} - j_{12}j_{21} \\ &= -\theta^L \underbrace{(1-\pi^L)(u^H/k)zq_{u^L}^L\eta^L}_{\Omega_1} + \theta^H \underbrace{(1 - \alpha_1^H\pi^H - \alpha_2^H)\pi^L}_{\Omega_2} - \theta^H\theta^L \underbrace{(\phi + \alpha_1^L\pi^L + \alpha_2^L)(1-\pi^L)z}_{\Omega_3} \end{aligned}$$

and

$$\begin{aligned} c_3 &= -\det \mathbf{J} = j_{23}(j_{11}j_{32} - j_{12}j_{31}) \\ &= \theta^H\theta^L(\Omega_3 u^H q_{u^H}^H - \Omega_1\Omega_2) \end{aligned}$$

On the basis of Routh-Hurwitz criterion, the necessary and sufficient condition for the local stability of steady state of the system requires all eigenvalues have negative real part if and only if

$$c_1 > 0, c_2 > 0, c_3 > 0 \text{ and } c_1c_2 > c_3.$$

(i) $c_1 > 0$ is confirmed by equation (A.1), equation (A.5) and equation (A.9).
(ii) $c_2 > 0$ requires $\theta^H\Omega_2 > \theta^L\Omega_1 + \theta^H\theta^L\Omega_3$.
(iii) $c_3 > 0$ requires $\Omega_3 u^H q_u^H > \Omega_1\Omega_2$.
(iv) $c_1c_2 > c_3$ requires $[\theta^H(1 - \alpha_1^H\pi^H - \alpha_2^H) + \theta^L\pi^L](\theta^H\Omega_2 - \theta^L\Omega_1 - \theta^H\theta^L\Omega_3) > \theta^H\theta^L(\Omega_3 u^H q_{u^H}^H - \Omega_1\Omega_2)$. Condition (iv) is confirmed by the requirements of (i), (ii), (iii) and a specific value of θ^{H^*} for which a Hopf bifurcation occurs.

The condition generates the following propositions given that $\Omega_1 > 0, \Omega_2 > 0$ and $\Omega_3 > 0$.

Proposition 1. *After a certain threshold ($\theta^H = \frac{\Omega_2 - \Omega_1}{\Omega_3}$), the adjustment speed of the capacity utilization in HCI sector needs to be sufficiently faster than that of L sector for the local stability of the unique steady state in the short-run economy to exist. Equivalently, θ^L has an upper limit so that $\theta^H > \theta^L$ to hold for the stability.*

Proof. Given $\theta^x > 0$, $\theta^H\Omega_2 > \theta^L\Omega_1 + \theta^H\theta^L\Omega_3$ has an equivalent functional form of $\theta^L < \frac{\Omega_2\theta^H}{\Omega_3\theta^H + \Omega_1}$ with asymptotic lines $\theta^H = -\frac{\Omega_1}{\Omega_3}$ and $\theta^L = \frac{\Omega_2}{\Omega_3}$. The latter works as an upper limit for θ^L to hold the local stability condition for the steady state. For $\theta^H > \frac{\Omega_2 - \Omega_1}{\Omega_3}$, the adjustment speed for the HCI is always faster than that of L sector as the upper limit of θ^L is effective (see Figure 11). $\square$

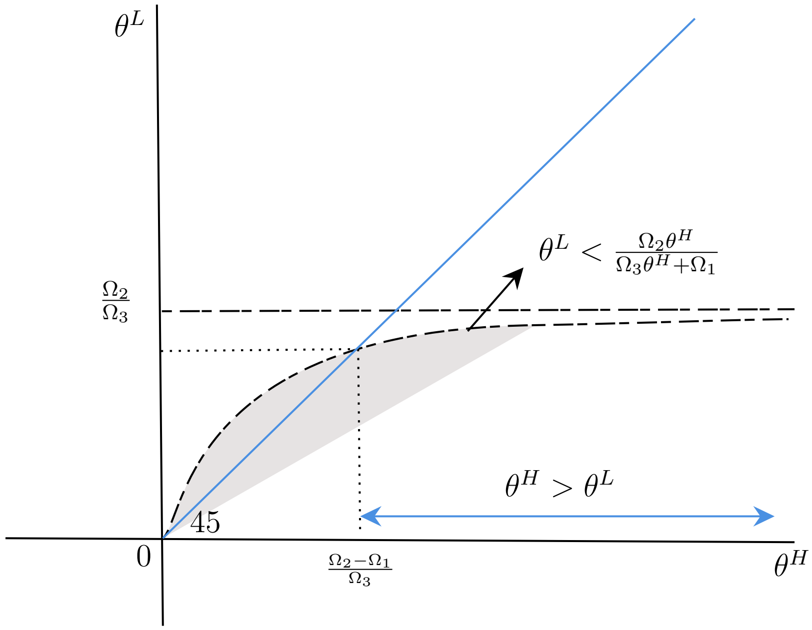

Figure 11: Existence of the Upper Bound for Adjustment Speeds of L Sector's Demand given $\theta^H > 0$ and $\theta^L > 0$

Proposition 2. *For the short-run economy's local stability, the growth rate of labour productivity in H sector has to increase as the capacity utilization rate in H sector grows given $\Omega_1 > 0$, $\Omega_2 > 0$ and $\Omega_3 > 0$.*

Proof. Since the local stability condition requires $\Omega_3 u^H q_u^H(u^H) > \Omega_1\Omega_2$, we have $u^H q_u^H(u^H) > \frac{\Omega_1\Omega_2}{\Omega_3} > 0$. Thus, $q_u^H(u^H) > 0$ with $u^H > 0$. $\square$

Proposition 3. *u^{H^*} varies directly with u^{L^*} in equilibrium.*

Proof. In equilibrium, equation (3.20) and equation (3.21) yield: $u^{H^*} = \bar{k} \cdot u^{L^*}\mathbf{C}$, and it is true that $\frac{du^{H^*}}{du^{L^*}} = \bar{k} \cdot \mathbf{C} > 0$. $\square$

C Matrix Representation of the System of Equations in the Short-Run and the Long-Run Dynamics and Computational Results

Short-Run System:

$$\begin{bmatrix} \alpha_1^H \pi^H + \alpha_2^H - 1 & k(\phi + \alpha_1^L \pi^L + \alpha_2^L) & 0 \\ (1-\pi^L)\frac{z}{k} & -\pi^L & (1-\pi^L)\frac{u^H}{k} \\ -(1-\eta^H)q_{u^H} & (1-\eta^L)q_{u^L} & 0 \end{bmatrix} \begin{bmatrix} du^H \\ du^L \\ dz \end{bmatrix} = \begin{bmatrix} \alpha_1^H u^H \\ 0 \\ (1-\eta^H)q_{\pi^H} \end{bmatrix} d\pi^H + \begin{bmatrix} -\alpha_1^L \\ \frac{z}{k}u^H + u^L \\ -(1-\eta^L)q_{\pi^L} \end{bmatrix} d\pi^L$$

Using Cramer's rule, we have the following solutions:

1) Wage-led productivity regime for both sectors

$$du^H = 0.0243649d\pi^H - 0.032362d\pi^L$$
$$du^L = 0.0716446d\pi^H - 0.111404d\pi^L$$

2) Profit-led productivity regime for both sectors

$$du^H = -0.0167433d\pi^H + 0.00884982d\pi^L$$
$$du^L = -0.033632d\pi^H - 0.00586179d\pi^L$$

3) Wage-led productivity regime for H sector and profit-led productivity regime for L sector

$$du^H = 0.024473d\pi^H + 0.00884982d\pi^L$$
$$du^L = 0.0721835d\pi^H - 0.00586179d\pi^L$$

4) Profit-led productivity regime for H sector and wage-led productivity regime for L sector

$$du^H = -0.0190963d\pi^H - 0.0366733d\pi^L$$
$$du^L = -0.0453675d\pi^H - 0.132907d\pi^L$$

Long-Run System:

$$\begin{bmatrix} \alpha_1^H\pi^H + \alpha_2^H - 1 & k(\phi + \alpha_1^L\pi^L + \alpha_2^L) & 0 & (\phi + \alpha_1^L\pi^L + \alpha_2^L)u^L + \alpha_0^L - \alpha_1^L i^L \\ (1-\pi^L)\frac{z}{k} & -\pi^L & (1-\pi^L)\frac{u^H}{k} & -\frac{1-\pi^L}{k^2}zu^H \\ -(1-\eta^H)q_{u^H} & (1-\eta^L)q_{u^L} & 0 & 0 \\ -(\alpha_1^H\pi^H + \alpha_2^H) & \alpha_1^L\pi^L + \alpha_2^L & 0 & 0 \end{bmatrix} \begin{bmatrix} du_\ell^H \\ du_\ell^L \\ dz_\ell \\ dk_\ell \end{bmatrix}$$
$$= \begin{bmatrix} \alpha_1^H u^H \\ 0 \\ (1-\eta^H)q_{\pi^H} \\ \alpha_1^H u^H \end{bmatrix} d\pi^H + \begin{bmatrix} -\alpha_1^L \\ \frac{z}{k}u^H + u^L \\ -(1-\eta^L)q_{\pi^L} \\ -\alpha_1^L u^L \end{bmatrix} d\pi^L$$

Using Cramer's rule, we have the following solutions:

1) Wage-led productivity regime for both sectors

$$\begin{aligned}du_\ell^H &= 0.0134934d\pi^H - 0.0135962d\pi^L \\ du_\ell^L &= 0.0174233d\pi^H - 0.0178105d\pi^L \\ dk_\ell &= 0.0127964d\pi^H - 0.0302163d\pi^L\end{aligned}$$

2) Profit-led productivity regime for both sectors

$$\begin{aligned}du_\ell^H &= -0.0121643d\pi^H + 0.012126d\pi^L \\ du_\ell^L &= -0.0107944d\pi^H + 0.010478d\pi^L \\ dk_\ell &= -0.00606968d\pi^H - 0.0113015d\pi^L\end{aligned}$$

3) Wage-led productivity regime for H sector and profit-led productivity regime for L sector

$$\begin{aligned}du_\ell^H &= 0.0135081d\pi^H + 0.0121098d\pi^L \\ du_\ell^L &= 0.0174967d\pi^H + 0.0103975d\pi^L \\ dk_\ell &= 0.0123677d\pi^H - 0.0111417d\pi^L\end{aligned}$$

4) Profit-led productivity regime for H sector and wage-led productivity regime for L sector

$$\begin{aligned}du_\ell^H &= -0.0118743d\pi^H - 0.0132402d\pi^L \\ du_\ell^L &= -0.00934784d\pi^H - 0.0160352d\pi^L \\ dk_\ell &= -0.0106319d\pi^H - 0.0358748d\pi^L\end{aligned}$$

D Parametric Setting

Table 4: Parametric Setting for the Short-run Dynamics

Symbol	Parameters Description	Values	Sources
a_K^H	Fixed amount of capital input per unit of potential output (H sector)	1.0	by assumption
a_K^L	Fixed amount of capital input per unit of potential output (L sector)	1.0	by assumption
i^H	Nominal preferential interest rate	0.117	BOK data (1973-1979)
i^L	Nominal market interest rate	0.167	BOK data (1973-1979)
π^H	Profit share in H sector	0.223	Averaged based on Lee (2015)
π^L	Profit share in L sector	0.223	Averaged based on Lee (2015)
ϵ	Nominal exchange rate	0.333	pre-determined by author
ϕ	Unilateral dependency rate of L sector on H sector	0.2	pre-determined by author
k	Relative short-run capital ratio ($= \frac{K^L}{K^H}$)	0.25	pre-determined by author
α_0^H	Autonomous investment in H sector	0.01	pre-determined by author
α_0^L	Autonomous investment in L sector	0.05	pre-determined by author
α_1^H	Coefficient of sensitivity on net profit in g_K^H	0.01	pre-determined by author
α_1^L	Coefficient of sensitivity on net profit in g_K^L	0.01	pre-determined by author
α_2^H	Coefficient of sensitivity on capacity utilization rate in g_K^H	0.55	Nishi (2020)
α_2^L	Coefficient of sensitivity on capacity utilization rate in g_K^L	0.5	Nishi (2020)
ζ_0	Coefficient in export function in H sector	0.02	pre-determined by author
ζ_1	Coefficient in export function in H sector	0.02	pre-determined by author
θ^H	Adjustment speed of H sector with profit-led L sector	0.02664	Author's calculation
θ^H	Adjustment speed of H sector with wage-led L sector	0.009	Author's calculation
θ^L	Adjustment speed of L sector	0.01	pre-determined by author
η^H	Proxy of worker's bargaining power in H sector	0.005	pre-determined by author
η^L	Proxy of worker's bargaining power in L sector	0.0025	pre-determined by author
q_π^H	Productivity growth rate by profit share in H sector (profit-led)	0.00025	pre-determined by author
q_π^H	Productivity growth rate by profit share in H sector (wage-led)	-0.00025	pre-determined by author
q_π^L	Productivity growth rate by profit share in L sector (profit-led)	0.00025	pre-determined by author
q_π^L	Productivity growth rate by profit share in L sector (wage-led)	-0.00025	pre-determined by author
q_u^H	Productivity growth rate by utilization in H sector	0.025	Nishi (2020)
q_u^L	Productivity growth rate by utilization in L sector	0.005	Nishi (2020)
p^{H^*}	Competing foreign goods price	1.01	pre-determined by author
	Endogenous variables description		
u^H	Rate of capacity utilization in H sector	Equation (3.2)	
u^L	Rate of capacity utilization in L sector	Equation (3.2)	
z	Relative labour input cost ratio	Equation (4.3)	
Q^H	Actual level of output in H sector	Equation (3.4)	
Q^L	Actual level of output in L sector	Equation (3.4)	
p^H	Price level of goods in H sector	Equation (3.6)	
p^L	Price level of goods in L sector	Equation (3.7)	
R^H	Rate of return of firms in H sector	Equation (3.11)	
R^L	Rate of return of firms in L sector	Equation (3.11)	
g^H	Growth rate of capital stock in H sector	Equation (3.10)	
g^L	Growth rate of capital stock in L sector	Equation (3.10)	
E^H	Export of firms in H sector	Equation (3.12)	

Note: The parameter values used in the simulation and numerical analysis are not necessarily calibrated to reflect the real economy but instead to illustrate the basic properties for the steady-state of the model and characterize a representative economy under the industrial policy regime.