International Journal of Social Science Research and Review

http://ijssrr.com
editor@ijssrr.com
Volume 9, Issue 2
February, 2026
Pages: 417-224

Quantitative Support and Demand Function Pivot: A Study on Industry Upgrading Based on the Prebisch-Singer Hypothesis

Li Tuobang (李拓邦) (ORICD: 0000-0002-2257-2603)

Zhaoqing Lenitio Technology Co., Ltd., Zhaoqing, Guangdong, China

University of California, Berkeley

http://dx.doi.org/10.47814/ijssrr.v9i2.3209

Abstract

This paper explores how latecomer regions can achieve effective industrial upgrading through "Quantitative Support" policies within the "center-periphery" global trade structure. Based on the Prebisch-Singer Hypothesis, the world trading system is bifurcated into a "center" that exports manufactured goods with high income elasticity and a "periphery" that exports primary products with low income elasticity. Peripheral economies face a structural trap of "immiserizing growth" because the income elasticity of demand (e_y) for their exports remains chronically below 1 or even negative. This paper proposes that government intervention should not aim to establish permanent trade barriers, but rather implement precisely calculated "Quantitative Support." The core of this strategy lies in measuring a critical support level (S^*) that is just sufficient to pivot the industrial demand function. Once the support intensity enables the industry to cross the threshold of economies of scale—thereby shifting its income elasticity of demand onto a benign trajectory where $e_y > 1$—the support policy should immediately trigger a "sunset clause" and exit. This study provides a quantitative policy boundary and theoretical basis to avoid the "perpetuation of infant industries" and the subsequent trade protectionist pitfalls such as rent-seeking and X-inefficiency.

Introduction

Since David Ricardo proposed the Theory of Comparative Advantage, free trade has long been regarded as the optimal path for enhancing global welfare (Ricardo, 1817). However, the history of modern global economic development suggests that the distribution of trade benefits among different economies has not shown a convergent trend. To explain this phenomenon, the "Prebisch-Singer Hypothesis" proposed by Raul Prebisch (1950) and Hans Singer (1950) provides a highly explanatory structuralist framework. The hypothesis points out that the world economic system exhibits a dual structure, consisting of technologically advanced "center" economies and dependent "peripheral" economies.

The core driver of this divergence lies in the significant differences in the income elasticity of demand (Income Elasticity of Demand, e_y) across different industries.

Center Industries: Primarily composed of exported manufactured goods. According to the macro-extrapolation of Engel's Law, as global per capita income increases, the demand for such products exhibits an accelerated growth trend ($e_y=\frac{\partial Q/Q}{\partial Y/Y}>1$, where Q represents the total demand of the economy and Y represents the per capita income). This allows "center" economies to translate technological progress into higher factor returns (Krugman, 1981).

Peripheral Industries: Mostly consisting of primary agricultural products or resource-based commodities. Due to their low or even negative income elasticity of demand ($e_y<1$), technological progress may instead lead to oversupply, subsequently triggering a long-term deterioration in the Terms of Trade (Ocampo & Parra, 2003).

Consequently, if local industries strictly adhere to static comparative advantages and remain locked within the "periphery" domain, peripheral economies will fall into the "growth trap under balance-of-payments constraints" described by Thirlwall (1979), making it difficult to achieve an industrial leap.

To address this structural dilemma, this paper proposes the concept of "Quantitative Support."

We contend that the comparative advantage of an industry is not static but endogenously evolvable. If a local industry possesses potential technological absorption capacity, the government can temporarily alter the cost structure of that industry by applying a precisely calculated policy variable S (including subsidies, tax incentives, or market access restrictions). The objective of this intervention is not to establish permanent barriers but to reach a "Pivot Point." By leveraging the "learning-by-doing" effect (Arrow, 1962), the industry can accumulate sufficient economies of scale to forcibly push its demand function from the low-elasticity "periphery" track onto the high-elasticity "center" track.

It must be emphasized that "Quantitative Support" is fundamentally different from traditional trade protectionism. Traditional protectionism often lacks clear exit mechanisms and quantitative standards, which easily leads to "over-protection."

The seminal research by Anne Krueger (1974) points out that once policy support exceeds the necessary limit required to correct market failures (i.e., $S>S^*$), its marginal effect becomes sharply negative. Excessive protection induces rent-seeking behavior by firms, leading to a diversion of resources from productive activities to non-productive lobbying. Furthermore, the theory of "Directly Unproductive Profit-seeking (DUP) Activities" proposed by Jagdish Bhagwati (1982), along with Harvey Leibenstein's (1966) discourse on X-Inefficiency, further demonstrates that a lack of external competitive pressure results in a loss of momentum for technological iteration. This not only fails to achieve industrial upgrading but also causes a net Deadweight Loss to social welfare.

Regarding the boundaries of support, there has been extensive academic discussion. Traditional infant industry protection theory is often criticized for its lack of exit mechanisms. In response, the "reciprocal control mechanism" proposed by Amsden (1989) emphasizes the link between support and performance, which resonates with the "Quantitative Support" concept proposed in this paper. Furthermore, the New Structural Economics of Justin Yifu Lin (2012) suggests that the government should play a role in "facilitating" growth by identifying industries with latent comparative advantages. Lin also proposes "limiting intervention to offsetting the externalities of first-movers," which shares conceptual similarities with this study. The key divergence, however, lies in our contention that the

government should maintain market neutrality rather than conducting subjective "growth identification" or industry picking. Instead, based on the principle of localism, a set of uniform and transparent support standards should be implemented.

The critical technical difficulty in implementing such uniform and transparent standards lies in how to quantitatively determine the criteria to achieve the desired support effect. This paper will: review the theoretical evolution of the Prebisch-Singer hypothesis; establish a dynamic model to derive the minimum support level S^* required to pivot the demand function; and introduce a game-theoretic perspective to analyze the erosion of social welfare by rent-seeking costs when S exceeds S^*.

The Demand Function Pivot Model under "Quantitative Support"

The core thesis of this paper is that through a precisely calculated policy variable S, an industry can achieve a transition from the periphery to the center.

Construction of the Dynamic Demand Function

Let the demand function for a potential local industry be D :

$$D(t)=Y(t)^{\epsilon(Q)}P(t)^{-\eta}$$

Where $\epsilon(Q)$ is the dynamically changing income elasticity, which depends on the cumulative production scale Q (i.e., the "learning-by-doing" effect). Following the logic of Arrow (1962), we define:

Here, ϵ_0 represents the initial state ($\epsilon_0<1$), and α denotes the technology absorption rate.

Introduction and Precision Calculation of the Support Variable S

The government implements a quantitative subsidy $P_{world}S$, such that the effective price faced by firms becomes $P'=P_{world}\cdot(1-S)$. This directly stimulates initial demand:

$$\frac{dQ}{dt}=D(P')=Y^{\epsilon(Q)}(P_{world}\cdot(1-S))^{-\eta}$$

Where $S\in[0,1)$. The objective of the support policy is to stimulate the initial demand volume Q by reducing prices, thereby driving up ϵ through cumulative effects.

Derivation of the Critical Support Level S^*: We seek an S^* such that within the support period T, the income elasticity of the industry satisfies:

$$\epsilon(Q_T)\geq 1+\Delta$$

Through integral transformation, we obtain the implicit function equation for S^*:

$$\int_0^T Y(t)^{\epsilon(Q)}[P_{world}(1-S^*)]^{-\eta}dt\geq Q_{pivot}$$

Where Q_{pivot} is the minimum cumulative output required to trigger a structural change in the industry (i.e., entering the "center" track). This output level can be derived directly from the empirical experience of first-mover peers. Therefore, as long as relevant data is available, S^* is computable.

Exit Mechanism and the Principle of Market Neutrality

The quantitative support proposed in this paper emphasizes neutrality in access. The government may dynamically adjust the entry threshold for support based on its fiscal condition, but it must maintain a consistent principle for all firms within the region. Any firm that can demonstrate, through preliminary R&D, that it has reached the entry threshold for this quantitative measurement system will be provided with standardized S^* support.

However, this support is strictly constrained by the Bastable Criterion:

$$\sum_{t=0}^{T}\frac{V_t}{(1+r)^t}>\sum_{t=0}^{T}\frac{S_t\cdot P_tQ_t}{(1+r)^t}$$

That is, the present value of the social value-added (V_t) generated after the industry enters the center track must exceed the total expenditure during the support period. Once time $t>T$ or ϵ ceases to grow, the support must begin to phase out.

A Game-Theoretic Perspective on Rent-Seeking Costs and Social Welfare Erosion

To quantify the boundaries of S, we establish a two-stage game-theoretic model between the government and firms. Regarding the competition for resources between R&D and rent-seeking, the total resources owned by a firm (capital, managerial focus, etc.) are finite, denoted as E. The firm must allocate these between:

Productive R&D Investment (a): Determines technological progress and the enhancement of income elasticity ϵ.

Non-productive Rent-seeking Investment (l): Determines the firm's share or success rate in acquiring the government subsidy S.

The firm's profit function is defined as:

$$\Pi(a,l;S)=P(a)\cdot Q-C(a)+G(S,l)-C_L(l)$$

Where $G(S,l)$ represents the actual support revenue obtained based on the rent-seeking investment l.

Incentive Distortions under Nash Equilibrium: Given a support level S, the firm maximizes profit by choosing (a,l). The First-Order Conditions (FOC) are:

$$\frac{\partial\Pi}{\partial a}=\frac{\partial\Pi}{\partial l}=0\Rightarrow MB_a(a)=MB_l(l)$$

The firm will continue to increase its rent-seeking investment l until the marginal benefit of rent-seeking (MB_l) equals the marginal benefit of R&D (MB_a). Therefore, theoretically, there exists a boundary S_l generated by rent-seeking behavior. Once $S > S_l$, any incremental increase in support will be entirely diverted toward rent-seeking. Consequently, the support level S must satisfy $S_l>S>S^*$.

However, another issue arises: S_l is difficult to calculate. It is challenging, and indeed unnecessary, for the government to fully grasp the internal operational details of firms. Conversely, S^* is easily computable, as any publicly listed company discloses relevant data. Thus, the critical support level S^* naturally becomes the government's Nash equilibrium choice. A further concern is social equity. Public funds are finite; an additional allocation here necessitates a reduction elsewhere. When excess funds are used to support firms but lack decisive significance for their development, total social welfare is prone to decline. According to the DUP (Directly Unproductive Profit-seeking) theory of Bhagwati (1982), this leads to the squandering of social resources in competing for subsidy quotas rather than enhancing the dynamic competitive advantage of the industry.

X-Inefficiency (Leibenstein, 1966)

Quantitative support is inherently in conflict with import quota systems. On one hand, import quotas cannot quantify the intensity of support, whereas policy investments, subsidies, export tax rebates, and tariffs are all quantifiable support instruments. On the other hand, under the umbrella of excessive protection in the absence of import competition, firms in peripheral industries often develop managerial slack. The lack of an "escape-competition effect" (Aghion et al., 2015) means that firms have no incentive to optimize internal production processes. Consequently, the industry remains trapped in a state of "paedomorphosis," failing to achieve a genuine pivot of the demand function.

Quantitative Exit Redline: Explicit Income Elasticity

This paper proposes real-time monitoring of explicit income elasticity (ϵ). This data can be derived through rolling regressions using high-frequency data of global sales volume (Q) and global income (Y). Since the objective of implementing subsidies (S^*) is specifically to increase ϵ, if measurements indicate that a firm's ϵ fails to approach 1.0 over a long period following the subsidy, it signifies that the firm lacks the potential for a structural leap. In such cases, further support should be terminated immediately to prevent the emergence of "zombie enterprises."

Empirical Support and Case Study: A Quantitative Review of South Korea's HCI Program (1973–1979)

South Korea's Heavy and Chemical Industrialization (HCI) program is a classic practice of the "Quantitative Support" philosophy. Through precise policy tilting, the government successfully pushed the industrial structure from textiles and assembly toward steel, automobiles, and shipbuilding.

Quantification of Support Variables: Policy Loans and Interest Subsidies

The South Korean government did not engage in indiscriminate fiscal spending; instead, it implemented highly targeted financial hedging through credit rationing.

1. Calculation of Interest Rate Subsidies

According to micro-level research by Lane (2019), commercial loan rates (General loans) in South Korea during the 1970s averaged between 17.5% and 20%. In contrast, the interest rates for policy loans under the HCI program were only 8% to 12%. The average interest rate margin (Δr) was approximately 10%.

2. Transformation of Financial Costs into the Price Variable S

Based on Amsden's (1989) survey of South Korea's industrial structure, the capital intensity (share of capital costs in total production costs) for heavy and chemical industries such as steel, automobiles, and shipbuilding was approximately 25% to 35%. Based on a cost-plus pricing model, the enhancement of price competitiveness (S_{ko}) derived solely from interest rate subsidies is calculated as:

$$S_{ko}=\Delta r\times Capital\ Intensity=10\%\times(25\%\sim35\%)=2.5\%\sim3.5\%$$

3. Determination of Aggregate Support S

In addition to interest margins, HCI enterprises enjoyed electricity discounts (approximately 30\% lower than residential rates), tariff exemptions for core equipment imports, and tax incentives such as accelerated depreciation. Under an export-oriented strategy, South Korean firms adopted a "dual pricing" strategy, transferring domestic monopoly profits and policy subsidies entirely to overseas pricing. The final quantified value of the effective export price subsidy S for South Korean HCI products is estimated at approximately 10% to 15%.

Impact of Support on Demand Volume

Substituting $S=0.15$ into the demand function:

$$Q'=Y^{\epsilon}(P-0.15P)^{-\eta}=Y^{\epsilon}(0.85P)^{-\eta}$$

Since the price elasticity η for heavy industrial products is typically greater than 1 (e.g., η for automobiles is roughly between 1.5 and 2.5), a 15% price advantage can generate an initial demand increment of 25% to 40%. It is precisely this excess Q that triggers the upward pivot of the endogenous variable $\epsilon(Q)$.

The Pivot Trajectory of the Demand Function: The ϵ Leap Based on Price Advantage

Utilizing the converted S above, we can observe the transition of the South Korean automotive industry more precisely.

1975–1980 (Incubation Phase): With a price subsidy S of 10% to 15%, Hyundai Motor gained initial scale in North American and Southeast Asian markets. During this period, the primary characteristics remained low price, low technology, and low elasticity.

1980–1986 (Pivot Phase): According to the model $\epsilon(Q)=\epsilon_{min}+\alpha\ln(1+Q)$, the initial demand increment brought by S was transformed into a massive cumulative production scale. Hyundai's cumulative production crossed the 1-million-unit mark in 1986. This allowed its income elasticity ϵ to cross the critical threshold of 1.0 (rising from 0.6 to over 1.2). In comparison, it took Ford, the pioneer of automated automobile production, seven years to produce its first million vehicles.

According to Lane's (2019) analysis of micro-data from the South Korean HCI, the comprehensive effective protection rate of policy loans for heavy and chemical industries, when converted to the price end, provided firms with an approximately 11% price competitive advantage. This quantified S successfully triggered the "learning-by-doing" threshold described by Arrow (1962). By the late 1980s, the global export demand income elasticity for South Korean manufactured goods had jumped to between 1.8 and 2.2. As shown in this paper's model, once ϵ grows with Q and exceeds 1.0, the industry achieves a shift in momentum from "price-driven" to "income elasticity-driven." Choi & Levchenko (2021) noted that these temporary subsidies not only expanded firm scale but, more critically, ensured that these firms remained leaders in international markets 30 years after the subsidies were removed. This proves that S^* indeed accomplished a permanent pivot of the "demand function."

The "Finiteness" of Support and the Exit Mechanism

If supported firms failed to meet international market share targets (i.e., the growth rate of Q failed to meet benchmarks) within a specified timeframe, the South Korean government would immediately terminate low-interest loans or even mandate bankruptcy restructuring (Westphal, 1990). Following the second oil crisis in 1979, the government found that subsidies for certain industries (such as heavy machinery) were excessively costly with performance below expectations, subsequently launching "Industrial Rationalization Measures" to drastically cut subsidies. This timely "stop-loss" prevented industries from entering a permanent zombie state.

Conclusion

The core findings of this study can be summarized into the following three points: First, through precision calculation, a minimum necessary support level S^* can be derived. The quantitative review of South Korea's HCI program further confirms that this minimum necessary support level S^* is sufficient to complete the transition from "price-driven" to "elasticity-driven" growth. Second, the boundaries of support are jointly defined by the game-theoretic equilibrium and the social welfare function. From a game-theoretic perspective, it is evident that more support is not necessarily better. When $S>S^*$, the marginal decision-making of firms shifts from technological R\&D to non-productive rent-seeking. Due to the information asymmetry between the government and firms, excessive support not only induces X-inefficiency but also causes social welfare loss due to DUP (Directly Unproductive Profit-seeking) activities. Therefore, S^* is not only the driving point for pivoting the demand function but also the "red line" for preventing policy traps. Finally, a dynamic exit mechanism based on explicit income elasticity is the institutional guarantee for policy success. This paper advocates for the use of rolling regression methods based on global market data to monitor firms' explicit income elasticity in real time. This quantitative standard provides an objective basis for triggering "sunset clauses": once it is monitored that ϵ has ceased to grow or failed to converge toward 1.0, support must be immediately reduced to prevent firms from devolving into "zombie enterprises" lacking viability.

In today's highly fragmented global value chains, "Quantitative Support" provides a "third path" for latecomer countries that is neither blind liberalization nor closed-door isolationism. The role of the government should shift from a subjective "industrial identifier" to an objective "actuary." By providing precisely quantified S^* support within a limited time window, peripheral economies have every possibility of breaking the destiny of the Prebisch-Singer Hypothesis and achieving a substantial leap from the low end to the high end of the global value chain.

Acknowledgement

I acknowledge the Google Gemini in structuring the logic and refining the technical preparation of this work. I would also like to thank the support of peers from UC Berkeley during the preparation of this work.

References

Aghion, P., Cai, J., Dewatripont, M., Du, L., Harrison, A., & Legros, P. (2015). Industrial policy and competition. American economic journal: macroeconomics, 7(4), 1-32.

Amsden, A. H. (1989). Asia's next giant: South Korea and late industrialization. Oxford University Press.

Anne, K. (1974). The political economy of the rent-seeking society. American economic review, 64(3), 291-303.

Arrow, K. J. (1962). The economic implications of learning by doing. The review of economic studies, 29(3), 155-173.

Bastable, C. F. (1897). The theory of international trade, with some of its applications to economic policy. Macmillan & Company, limited.

Bhagwati, J. N. (1982). Directly unproductive, profit-seeking (DUP) activities. Journal of Political economy, 90(5), 988-1002.

Choi, J., & Levchenko, A. A. (2021). The long-term effects of industrial policy (No. w29263). National Bureau of Economic Research.

Krugman, P. (1981). Trade, accumulation, and uneven development. Journal of Development Economics, 8(2), 149-161.

Kwon, O. Y. (2010). The Korean economy in transition: An institutional perspective. In The Korean Economy in Transition. Edward Elgar Publishing.

Lane, N. (2018, June). Manufacturing revolutions-industrial policy and networks in south korea. In Journal of economic history (Vol. 78, No. 2, pp. 629-629). 32 AVENUE OF THE AMERICAS, NEW YORK, NY 10013-2473 USA: CAMBRIDGE UNIV PRESS.

Leibenstein, H. (1966). Allocative efficiency vs." X-efficiency". The American economic review, 56(3), 392-415.

Lin, J. Y. (2011). New structural economics: A framework for rethinking development. The World Bank Research Observer, 26(2), 193-221.

Ocampo, J. A., & Parra, M. A. (2006). The commodity terms of trade and their strategic implications for development. Globalization under hegemony: the changing world economy. Oxford University Press, New Delhi.

Prebisch, R. (1950). The economic development of Latin America and its principal problems.

Ricardo, D. (1817). On rent. The Economics of Structural Change, 1.

Senhadji, A. S., & Montenegro, C. E. (1999). Time series analysis of export demand equations: a cross-country analysis. IMF staff papers, 46(3), 259-273.

Singer, H. W. (1975). The distribution of gains between investing and borrowing countries. In The strategy of international development: Essays in the economics of backwardness (pp. 43-57). London: Palgrave Macmillan UK.

Thirlwall, A. P. (1979). The balance of payments constraint as an explanation of international growth rate differences. PSL Quarterly Review, 32(128), 45-53.
Westphal, L. E. (1990). Industrial policy in an export-propelled economy: lessons from South Korea's experience. Journal of Economic perspectives, 4(3), 41-59.

Copyrights