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Relative Quantities and Prices in Small and Open Developing Economies

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Abstract

This paper employs variants of a simple framework to discuss the determination of sectoral output and relative prices in a stylized small open developing economy which consists of a traditional sector that produces non-tradables and a modern sector that produces internationally traded goods. The baseline model has the flavor of the traditional two-good *dependent economy* framework with surplus labor. I then introduce a series of modifications in the structure of the framework to (briefly) explore aspects such as distributional conflict, external balance constraints, capital account considerations, natural resource discoveries, and supply-side bottlenecks. The analysis demonstrates that the basic structure of the framework provides a flexible tool for investigating important aspects of the development process in a small open economy.

JEL Classification: F41, F43, O11, O14.

Keywords: industrialization, income distribution, real exchange rate, surplus labor.

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Cantidades y precios relativos en economías en desarrollo pequeñas y abiertas

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Resumen

Este documento emplea variantes de un marco simple para discutir la determinación de la producción sectorial y los precios relativos en una economía en desarrollo pequeña y abierta, con un sector tradicional que produce bienes no transables y un sector moderno que produce bienes comercializados internacionalmente. El modelo base se inspira en el marco tradicional de una economía dependiente con dos bienes y con mano de obra excedente. Luego se realizan una serie de modificaciones en la estructura del modelo para explorar (brevemente) aspectos como el conflicto distributivo, las restricciones de equilibrio externo, la cuenta de capital, los descubrimientos de recursos naturales y los cuellos de botella del lado de la oferta. El análisis demuestra que la estructura básica del modelo proporciona una herramienta flexible para investigar aspectos importantes del proceso de desarrollo en una economía pequeña y abierta.

Clasificación JEL: F41, F43, O11, O14.

Palabras clave: distribución del ingreso, excedente de mano de obra, industrialización, tipo de cambio real.

1. Introduction and background

Developing and emerging economies now constitute a significantly larger share of the global economy than a few decades ago. This is true in terms of economic activity, output, and international transactions of assets, goods, and services. In line with this development, the focus of macroeconomics in a developing country context too continues to evolve. While mainstream open economy macroeconomics has mirrored developments in closed economy macroeconomic theory and focused on incorporating welfare considerations in a representative agent/intertemporal optimization context, the so-called neo-structuralists too have broadened their analysis to incorporate structural features that characterize developing economies as they modernize and interact with the rest of the world. The present contribution seeks to discuss some development-related open economy issues with the help of a simple set-up designed to analyze the interactions of quantities and prices over time.

In the next section I discuss the broad contours of the framework I employ in the rest of the paper. I then briefly discuss the justification for treating the stylized tradable sector in a developing economy as a price-taker, at least for the medium- and long-runs. I then develop the analysis by first building a simple framework in the tradition of the dependent economy model modified to incorporate structural features of developing economies such as dual labor markets and surplus labor/underemployment. After exploring some of the properties of this framework, I then incorporate complications such as external balance constraints (section 4.3), the possibility of capital ow reversals (section 4.4), terms of trade shocks (section 4.5), and finally supply-side bottlenecks (section 4.6). The emphasis throughout is on the big picture intuition rather than the details of macroeconomic and microeconomic behavior, and at various points, therefore, I sacrifice depth for breadth of vision.

2. A generic two-sector framework

I organize the analysis around a stylized small open developing economy with two sectors; a modern industrial sector and a traditional one. Developing economies are often characterized by stark structural differences between sectors. I limit my attention to two such differences. One that is also applicable to advanced economies, but typically much less so, is the distinction in the nature of production between the tradable sector and the non-tradable one. My analysis assumes that the tradable good is produced using modern production methods while the output of the traditional sector is non-tradable. Only the former uses capital and, owing to the underdeveloped nature of the industrial sector, all capital goods are imported. Second, unlike developed economies, least developed countries (LDCs) typically have large amounts of (hidden) unemployment and the development process involves the mobilization of these unemployed resources. An example often cited is that of China where record growth rates over the last four decades have involved moving millions of workers from the rural hinterland to the industrialized urban areas, mainly in the coastal provinces in the south and south east. The rural areas have low productivity and significant under- and informal employment, and the goods produced in these informal sectors tend to be relatively non-traded in nature.[1] An important implication is that, in the early stages of development, the development process involves shifting labor from low to higher productivity sectors that produce standardized, less sophisticated goods, before the focus can shift to imitation, reverse engineering, and learning from producing more sophisticated products.

I will utilize the classic Arthur Lewis conception of underemployment in the traditional sector with an elastic supply of (surplus) labor at any given point in time in order to capture the dual nature of the labor market. Growth under such circumstances becomes endogenous, although constraints other than diminishing returns to factors of production may hinder growth over time. Such factors, analyzed in subsequent sections, include but are not limited to distributional conflict and balance of payment constraints.

As I argue in the next section, it is plausible to assume for most developing countries that tradable goods producers are price-takers in international markets (although there are likely to be deviations from this in the short run). The incorporation of the classic Lewis duality and the presence of a non-tradable sector, where prices are determined internally, allows me to consider Keynesian/Kaleckian demand-side considerations. Like this latter family of models, the analysis here focuses on the mobilization of unemployed resources, but there are crucial differences. Output and growth in the modern sector are constrained from the supply side and the real exchange rate (the price of tradables relative to that of non-tradables) is a key variable that affects growth, the balance of payments, and income distribution.

Unlike the direction that much mainstream macroeconomic theory has taken over recent decades, I eschew basing consumption and investment behavior around intertemporal optimization by an optimizing representative agent. In such a framework, the real exchange rate, for example, naturally emerges as an endogenous variable whose value is determined in a general equilibrium set-up by deeper parameters such as preferences, factor endowments, and productivity. While such assumptions may or may not be useful in a long-run advanced economy context, their utility for developing economies is rather limited, given the presence of surplus labor, structural change, and rapidly evolving economic policy frameworks. The specifications for consumption behavior here, however, can be derived from microfoundations if we do away with perfect foresight and forward-looking expectations.

Finally, parts of the analysis below assume that policy makers have significant control over the real exchange rate. A body of literature going back to Mussa (1986) shows that the real exchange rate tracks the nominal exchange rate quite closely over time which suggests that targeting the latter

[1] A significant body of empirical literature now supports the relevance of sectoral productivity differences and duality in developing economies. Temple (2005) document that, in 1996, labor productivity in manufacturing relative to agriculture was almost 6 times higher in Sub-Saharan Africa while the corresponding number for OECD countries was 1.7. These estimates may be somewhat biased due to the fact that the agricultural sector is less well documented. Moreover, as they recognize, differences in average productivity are not the same as differences in marginal productivity. The direction of the bias, however, is not clear. Temple and Woessmann (2006) find that labor reallocation has a significant effect on country growth rates. Vollrath (2009), among others, finds that inefficiencies originating from duality could explain over half of the country-level variation in total factor productivity. See Temple (2005) for a comprehensive overview of dual economy growth models.

may effectively target the former as well, at least in the short- and medium-run (see Disyatat and Galati, 2005; for a more detailed discussion). Governments have a variety of policy options including monetary and fiscal policy, saving incentives, capital controls, and reserve management, and the evidence suggests that governments do indeed use these instruments to influence exchange rates.[2] One must recognize, however, that this assumption becomes less plausible over longer periods of time, especially in the presence of liberalized capital accounts.

3. Relative price determination in a small and open developing economy

Typically developing countries are not large or specialized enough in most sectors to influence the world price of their exports (and especially) imports. To what extent can the typical country be treated as a price taker in international markets? The answer mainly depends on: (1) the degree of substitutability between its products and those of its trading partners, and (2) the market power that it has in different sectors. To illustrate this, it would help to consider the matter more formally.[3]

Let's start with a closed economy which has a large number of firms producing *differentiated* products. Each firm produces a variety and faces a downward sloping demand curve. The typical $MR = MC$ condition for a monopolistically competitive firm, indexed by i, implies that:

$$P_i\left(1 - \frac{1}{\delta}\right) = Wa \tag{1}$$

where P_i denotes the price of variety i, W and a are the nominal wage and unit labor coefficient, and δ is the elasticity of demand which, if the number of product varieties is large enough, also approximates the elasticity of consumer substitution between varieties. I have assumed to help avoid aggregation issues that the elasticity of demand and technology are identical across firms.

Now suppose that these products are traded with the rest of the world. What determines the mark-up factor? One issue that is likely to be important is the extent of close substitutes available domestically and abroad. To see this, consider the following simple specification:

$$\delta_i = \delta = \frac{1}{1 - \Lambda\left(\frac{P_i}{P}\right)^{\lambda_1}\left(\frac{P_i}{EP^*}\right)^{\lambda_2}} \tag{2}$$

where P and P^* denote the domestic and foreign aggregate price levels. Notice that, (1) the higher the individual firm price relative to the aggregate domestic or foreign prices, the greater the elasticity of demand, and (2) the higher the parameters λ_i are, the greater the elasticity of demand. The presence of close (domestic and foreign) substitutes tend to make the latter parameters high. Plugging equation (2) into (1), and recalling that, from equation (1), $P_i = P$:

[2] A detailed discussion of these policy issues is beyond the scope of this paper but see, for example, the fear of floating literature emanating from Calvo and Reinhart (2002), who show that, in the aftermath of the Asian crises, developing countries have systematically intervened in the foreign exchange market to manage the behavior of exchange rates. Levy-Yeyati *et al.* (2013) find evidence that in the 2000s such interventions have aimed to maintain competitive exchange rates or to avoid overvaluations.

[3] The discussion here borrows from Rødseth (2000).

$$P = \left(\frac{1}{\Lambda}Wa\right)^{\frac{1}{1+\lambda_2}} (EP^*)^{\frac{\lambda_2}{1+\lambda_2}}$$

If most of the substitutes for domestic tradables are produced in the rest of the world, then λ_2 will be high. In the limit, when it approaches infinity, we get:

$$P = EP^* \qquad (3)$$

In the opposite case, on the other hand, where an economy specializes in a narrow range of differentiated varieties whose substitutes are also mostly produced domestically, λ_2 will be low, and in the extreme, approach zero.

$$P = \frac{1}{\Lambda}Wa \qquad (4)$$

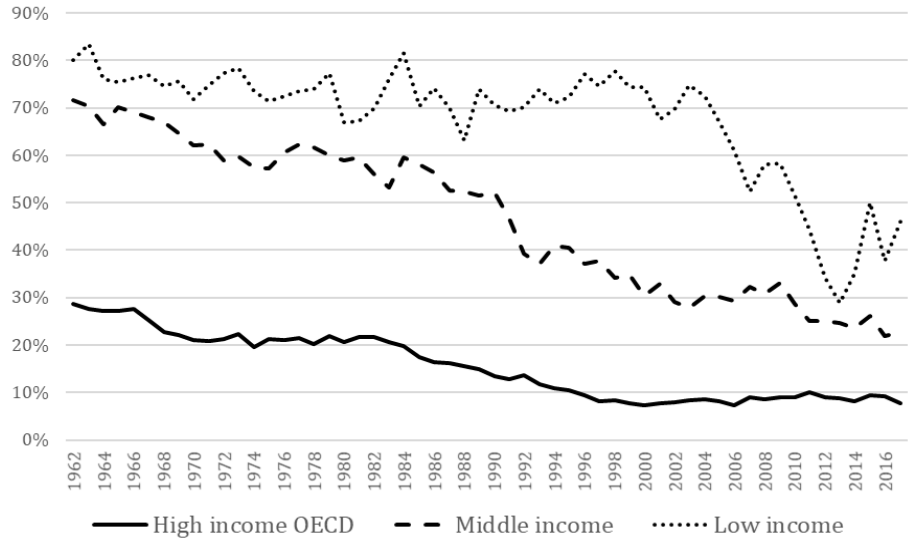
Needless to add it is hard to think of cases which would satisfy the latter criteria in a small open developing economy.

Empirical studies generally find that the price elasticities of export and import demand in developed countries are sufficiently high for the Marshall-Lerner condition to be satisfied (Bussiére *et al*., 2020). However estimated magnitudes vary and, for reasons identified originally by Orcutt (1950), aggregate estimates of trade elasticities are likely to be biased downwards and misleading. Moreover, given the underlying assumptions, crucially that the supply elasticities of exports and imports are infinite, the Marshall-Lerner condition is not the most relevant for developing economies with capacity constraints. This issue is much better explored at the sectoral level. For example, in general one would expect the degree of market power to be greater for economically large countries and the degree of substitutability to be greater for homogeneous goods than for differentiated goods. The latter observation suggests a closer look at the relative composition of developing and developed country exports. Fortunately, wider availability of data makes it a less daunting task to collect disaggregated information.

Figure 1 plots the share of primary goods in total exports for different categories of countries as reported by Lall (2000). Lall distinguishes between the technology and skill intensity of exports and classifies them into five product categories: high-skill intensive manufactures (High-skill), medium-skill intensive manufactures (Medium-skill), low-skill intensive manufactures (Low-skill), natural-resource-intensive manufactures (Resource), and primary products (Primary). The figure shows that, not surprisingly, this share is much higher for developing countries. A higher percentage of developing country exports are homogeneous primary goods.

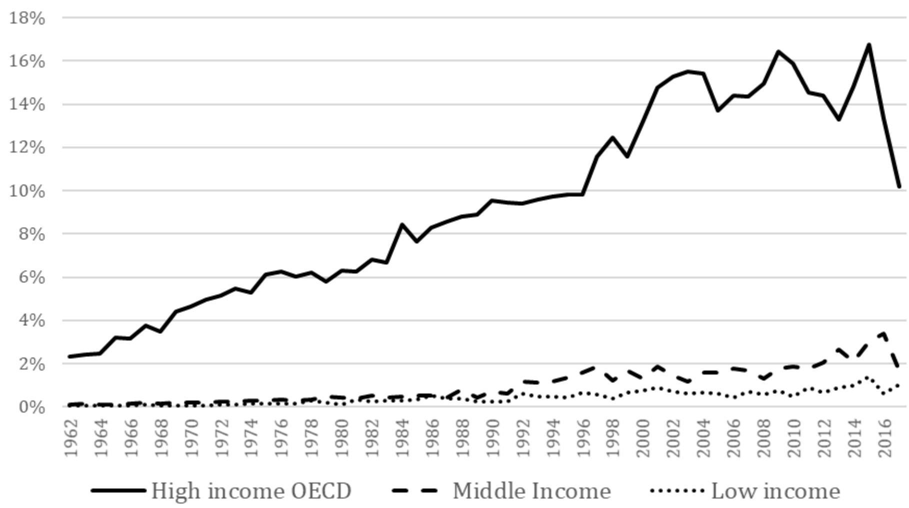
To illustrate this point further, Figure 2, shows the distribution of the median share of high skill-intensive goods. This share was only 1% for low income, 2% for middle income and 10% for high income OECD countries in 2017.

Figure 1 | The median share of primary good exports in total exports of a given country within each group



Note: Primary good classification is based on Lall (2000) and income classifications are from World Bank (2020).

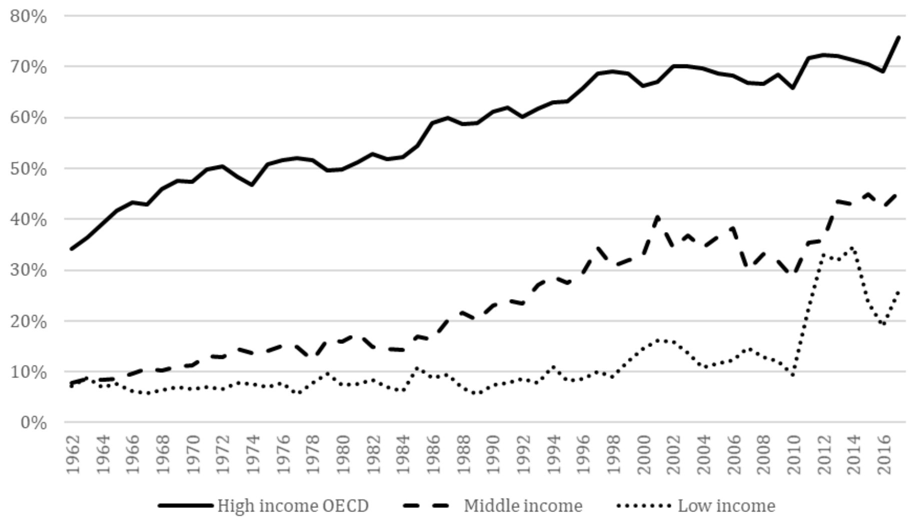
Figure 2 | The median share of high-skill exports in total exports of a given country within each group



Note: High-skill good classification is based on Lall (2000) and income classifications are from World Bank (2020).

In order to further explore how closely substitutable a country's exports are for exports from other countries, we can use the Rauch classification. By definition, differentiated products tend to have fewer substitutes than homogeneous goods. Figure 3 shows the median export shares of differentiated products (using the Rauch, 1999 *conservative* definition). In 2017, the median share of differentiated goods in high income OECD countries' export baskets was 76% while the numbers for middle-income and low-income countries were 45% and 26%, respectively.

Figure 3 | The median share of differentiated goods in total exports of a given country within each country group



Note: The classification for differentiated goods is based on Rauch (1999)'s conservative definition and income classifications are from the World Bank (2020).

Employing the Rauch (1999) classification, Broda and Weinstein (2006) and Soderbery (2018) find that the average elasticities of substitution are much higher for commodities than for reference-priced goods, which in turn are higher than those for differentiated goods. Likewise, Fontagne *et al.* (2019) shows that trade volume responses to bilateral tariffs are larger for homogeneous than for differentiated products. Finally, turning to market power, Soderbery (2018) derives inverse export supply elasticities for disaggregated trade flows and finds that importing countries that are larger in terms of GDP tend to have greater market power. Moreover, their estimates show that supply elasticities for differentiated goods are around three times larger than for homogeneous goods.

Taken together, the existing body of evidence provides good reason to treat the typical developing economy as a small open economy at the aggregate level, at least for long-run analysis. This is consistent with the earlier finding of Goldstein and Khan (1985) who showed that smaller open economies tend to experience greater effects on price setting of competitor prices than of domestic costs. Equation (3), in other words, is a more plausible assumption for traded sector output than equation (4).

4. Interactions between relative prices and quantities

4.1. A simple two-sector framework with surplus labor and infinitely elastic labor supply

Let's now turn to more general equilibrium considerations. The broader framework here is largely based on Razmi *et al.* (2012) and Razmi (2015), modified to allow for a closer analysis of key issues. It has the flavor of the dependent economy model with a traded goods sector (or T-sector) and a non-traded goods one (or N-sector).[4] Table 1 provides a summarized description of the variables employed.

Table 1 | Definitions of key variables

Variable	Definition
C_i, Y_i	Consumption and output of good i, respectively $(i = N, T)$
R	Total rents in the non-tradable sector
$\Pi, r, \bar{r}, r^*$	Profit share of output and the domestic, benchmark, and world profit rates
ω_i	Real wage in terms of non-tradables in sector i, $(i = N, T)$
υ	Worker share of marginal product in N-sector
$\breve{\omega}_N$	Shared wage in the N-sector (also the fallback position)
I	Investment
K	Stock of capital
L_i	Employment in sector i, $(i = N, T)$
TB	Trade balance
s_π	Worker and capitalist saving rates
e, q	Nominal and real exchange rates
p	Price of exported primary commodity in terms of non-tradables $(\equiv P_X/P_N)$
P_i	Price of good i, $(i = N, T)$
λ	Share of domestic consumption expenditure devoted to non-tradables

The benchmark stylized economy under consideration is characterized by sizable underemployment in the rural/traditional/non-tradable sector (in a later section, I'll consider how things change if we introduce supply-side bottlenecks and labor supply elasticity considerations). Various barriers such as quality standards, transaction barriers, transportation costs, and lack of infrastructure prevent exchange of the non-tradable good across international borders. Production requires a fixed factor (land) and labor (L_N), which earns an "effective" real wage (ω_N) determined by the productivity of labor at the margin. Specifically, labor gets a constant proportion (υ) of its marginal contribution that is determined by norms, institutions, etc. The rents are captured by the owners of the fixed factor (*i.e.*, the landlords), whose share in output is denoted by R. To summarize:

$$Y_N = AL_N^{\gamma};\ \gamma \leq 1 \tag{5}$$

$$\omega_N = \upsilon\gamma AL_N^{\gamma-1} \tag{6}$$

$$R = 1 - \upsilon\gamma \tag{7}$$

where A is a technological constant and the parameter $\gamma \in (0,1)$ captures the presence of diminishing returns in this sector.[5]

[4] See Swan (1960) for an early exposition.
[5] One should note here that none of the later results regarding steady state accumulation and growth depend on this assumption of diminishing returns, although modifying it will affect the real wage and distribution in the non-tradable sector. The product must be less than one to ensure a positive share of rents.

Developing economies with underemployment are characterized often by work sharing in the absence of public unemployment insurance coverage. The rural/informal/traditional sector acts as a fallback provider of employment. It is, therefore, practical at the aggregate level, for workers employed in the formal/modern/industrial sector, where wages are generally higher, to see income in the traditional sector as their fallback position. A useful measure of nontraded sector worker income, therefore, takes the empirically measured wage in the traditional sector as an average remuneration, that is, total labor income divided by the number of workers not employed in the modern sector. This "shared wage" ($\breve{\omega}_N$) is given by:

$$\breve{\omega}_N = \frac{\omega_N L_N}{L - L_T} \leq \omega_N \tag{8}$$

where L_T is employment in the tradable sector, while L is the total size of the labor force.[6] Depending on institutional and social characteristics, the measured wage in the non-tradable sector may fall anywhere between the shared wage $\breve{\omega}_N$ and the effective wage ω_N.

The modern sector of the economy, the tradable sector or T-sector, produces internationally tradable output using labor (L_T) and an accumulable factor of production, capital, (K), in fixed proportions. In line with traditional structuralist models for the South, the output of the sector is capital constrained.

$$Y_T = \min\left(K, \frac{L_T}{a}\right) \tag{9}$$

In line with our discussion in section 3, the price of the tradable good, P_T, measured in foreign currency terms, is internationally given. Workers have some bargaining power in the T-sector, and the real wage ω_T is assumed to be proportional to a benchmark level of worker purchasing power in terms of non-tradables, $\overline{\omega}_T$.[7] This benchmark level captures labor market institutions and one would expect it to be high enough so as to cover the transaction costs for workers to move from the traditional sector to the urban modern sector, so that $\overline{\omega}_T \geq \breve{\omega}_N$. One would also expect a premium over this benchmark in the modern sector that depends on the extent of principal-agent problems (efficiency wages) and bargaining in the presence of costly search and relationship-specific investment.

$$\omega_T = \phi \overline{\omega}_T; \phi \geq 1 \tag{10}$$

Given labor mobility between sectors, there are likely to be forces of convergence between wages in the two sectors. Moreover, given skill differentials and labor market frictions, and contrary to the assumption made in standard trade models of the Heckscher-Ohlin and Ricardian variety, one

[6] The total labor force includes the sum of employment in the two sectors as well as the unemployed. It is widely recognized that the terms unemployment and/or underemployment are much less well-defined in a low-income economy context. Many workers who are unable to find a job in the modern sector may either remain unemployed, or work in the non-tradable sector, often sharing work with family members. Some of these features were highlighted in the seminal contribution of Lewis (1954).

[7] It may be more accurate to think of the real wage as being negotiated in terms of both goods in the expenditure basket, but since the price of tradables is given, this is a qualitatively innocuous simplification.

would expect this adjustment to be gradual. The factor of proportionality ϕ is an assumed here to be a pre-determined variable that evolves over time depending on the actual real wage relative to the T-sector workers' fallback position. The partial lagged adjustment mechanism can be specified as follows:

$$\dot{\phi} = f(\breve{\omega}_N - \theta\phi\varpi_T);\ \theta \in (0, 1] \qquad (11)$$

Equation (11) indicates that distributional dynamics will play a key role in the later analysis. Denoting the real exchange rate (the relative price of tradables in terms of non-tradables) by q, and utilizing equations (9) and (10), the profit share of tradable output π is given by:

$$\pi = \frac{eP_T Y_T - W_T L_T}{eP_T Y_T} = 1 - \frac{\omega_T}{q} = 1 - \frac{a\phi\varpi_T}{q} \qquad (12)$$

Given full capacity utilization, the expression above also defines the profit rate, r. In line with standard structuralist and neo-Kaleckian literature, capitalists and landlords are assumed to save a constant proportion s_π of their income. For simplicity, assume no saving out of wages, government spending or taxation.[8]

Consumer preferences reflect substitutability between tradables and non-tradables, with the consumption of non-tradables, C_N, equaling a proportion λ of total capitalist, landlord, and worker consumption:

$$C_N = \lambda\left[(\omega_N L_N + \omega_T L_T) + (1 - s_\pi)\left(RAL_N^\gamma + q\Pi K\right)\right]$$

and,[9]

$$\lambda = \lambda(q);\quad \lambda' > 0 \qquad (13)$$

The first half of the expression in the square brackets on the right-hand side captures consumption by workers, while the second half represents consumption by landlords and owners of capital. Employing eqs. (5), (6), (7), (9), (10), and (12) allows us to consolidate the above expression, so that:

$$C_N = \lambda\left\{[1 - s_\pi(1 - \upsilon\gamma)]AL_N^\gamma + [(1 - s_\pi)q + s_\pi a\phi\varpi_T]K\right\} \qquad (14)$$

A similar expression can be derived for domestic consumption of the tradable good:

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[8] These assumptions about saving rates can be relaxed without affecting the qualitative nature of the analysis, as long as $s_\pi > s_\omega$, *i.e.*, a greater proportion of income out of profits is saved than that out of wages.

[9] The sign of the partial below indicates that the two goods are substitutes in consumption, with an elasticity of substitution greater than unity. This is likely at the aggregate level. Ostry and Reinhart (1992), for example, find the intra-temporal elasticity of substitution between tradables and non-tradables to range within 1.22-1.27 for developing countries.

$$qC_T = (1-\lambda)\{[1-s_\pi(1-\upsilon\gamma)]AL_N^\gamma + [(1-s_\pi)q + s_\pi a\phi\overline{\omega}_T]K\} \tag{15}$$

Let's next turn to investment behavior. As mentioned in Section 1, the typical developing country imports a high proportion of its capital goods so that structuralist literature often simplifies by assuming that *all* capital goods are imported. This means that periods of accelerated investment can generate pressure on the external account. Also, for reasons mentioned earlier, the typical developing economy is likely to be a price-taker in the international market for capital goods. Let's suppose that all capital goods are tradable and imported. A plausible specification of investment behavior would make it depend on expected and actual profitability which, if we assume static expectations and a baseline minimum profit rate, would take the form:

$$\frac{I}{K} = g(r-\bar{r}) = g\left(1-\phi\frac{a\overline{\omega}_T}{q}-\bar{r}\right);\ g' > 0 \tag{16}$$

where r captures the baseline profit rate which places a floor on positive investment.[10] The tradable good can, of course, be exported or consumed domestically, with the trade balance (TB), expressed in terms of tradables, soaking up any differences between income and expenditure.

$$\frac{TB}{K} = \frac{Y_T}{K} - \frac{C_T}{K} - \frac{I}{K} \tag{17}$$

where the trade balance is normalized by the capital stock for convenience.

Equations (5)-(17) contain 14 endogenous variables (Y_N, L_N, ω_N, $\breve{\omega}_N$, ω_T, C_N, C_T, R, Y_T, π, λ, ϕ, TB, I/K). The N-sector clearing condition completes the framework for our short-run analysis.

$$Y_N = C_N \tag{18}$$

The real exchange rate q and the level of capital stock K are pre-determined in the short run. We are now in a position to explore the short-run reduced form solutions for the endogenous variables of interest.

Substituting from eqs. (5) and (14), yields, after some manipulation:

$$L_N = \left\{\frac{\lambda[(1-s_\pi)q + s_\pi a\phi\overline{\omega}_T]}{1-\lambda[1-s_\pi(1-\upsilon\gamma)]}\frac{K}{A}\right\}^{\frac{1}{\gamma}} \tag{19}$$

[10] Or alternatively, the returns to investing abroad, which can be taken as exogenously determined for a small financially open economy. I return to this aspect later. Alternatively, one could treat these this as the user cost of capital that is kept stable by the central bank.
One issue that the formulation above ignores is that of capacity utilization and demand-side influences on investment. While undoubtedly there are periods of time when such factors dominate, it is hard to think of demand, as opposed to capacity, being the typical binding constraint for rms producing labor-intensive manufactures in an *open* developing economy.

Non-tradable output at any instant is determined by the amount of effective employment which is in turn ultimately determined by demand from the tradable sector. An expansion of the tradable sector (a rise in K), a shift in demand towards non-tradables (a rise in λ) or a decline in the saving rate expands employment in the non-tradable sector. Redistribution of income towards workers in either sector -that is, a rise in ω_T or υ- too expands non-tradable employment, as long as $s_\pi > s_\omega$ $(= 0)$. In brief, short-run equilibrium in the non-tradable sector presents a picture consistent with demand-led output growth.

Once L_N has been pinned down, N-sector output and wages can be determined using eqs. (5), (6), (8), and (19).

$$C_N = Y_N = \frac{\lambda[(1-s_\pi)q + s_\pi a\phi\bar{\omega}_T]}{1-\lambda[1-s_\pi(1-\upsilon\gamma)]}K \tag{20}$$

$$\omega_N = \upsilon\gamma A\left\{\frac{\lambda[(1-s_\pi)q + s_\pi a\phi\bar{\omega}_T]}{1-\lambda[1-s_\pi(1-\upsilon\gamma)]}\frac{K}{A}\right\}^{\frac{\gamma-1}{\gamma}} \tag{21}$$

$$\breve{\omega}_N = \frac{1}{L-aK}\upsilon\gamma\left\{\frac{(1-s_\pi)q + s_\pi a\phi\bar{\omega}_T}{1-\lambda[1-s_\pi(1-\upsilon\gamma)]}K\right\} \tag{22}$$

Non-tradable output and the sharing wage are increasing in K, q, and λ and declining in s_π (eqs. 20 and 22). Changes in these variables have the opposite impact on the effective N-sector real wage in the presence of diminishing returns (*i.e.*, as long as $\gamma < 1$ in equation 21). Intuitively, a real depreciation (a rise in q) causes increased spending on non-tradables, due to both income and substitution effects. Since output and employment in the N-sector are demand-led, these move upward, as does the sharing wage. Lower saving by either group has the same impact, as does, a higher tradable sector real wage. Due to diminishing returns, however, higher employment corresponds to a lower real effective wage. Increased employment in the modern tradable sector raises the shared wage but leaves the effective real wage unaffected. The former effect follows from the fact that more income is being distributed among fewer people outside the T-sector.

Domestic consumption of the tradable good can be derived from eqs. (15) and (19).

$$C_T = \frac{(1-\lambda)}{q}\frac{(1-s_\pi)q + s_\pi a\phi\bar{\omega}_T}{1-\lambda[1-s_\pi(1-\upsilon\gamma)]}K \tag{23}$$

Thus, substituting from equations (9), (16), (17) and (23), yields the following expression for the trade balance:

$$\frac{TB}{K} = 1-(1-\lambda)\frac{(1-s_\pi)q + s_\pi a\theta\phi\bar{\omega}_T}{1-\lambda[1-s_\pi(1-\upsilon\gamma)]} - g\left(1-\phi\frac{a\bar{\omega}_T}{q} - \bar{r}\right) \tag{24}$$

A higher saving rate generates a trade surplus. A rise in the labor share of output in the N-sector has the opposite effect. A real appreciation (*i.e.*, a decline in q) or an increased real wage in the T-sector have ambiguous effects on the trade balance. Consumption of tradables rises on the one hand while investment declines on the other. Intuitively, a real appreciation makes nontradables relatively expensive, switching expenditure towards tradables. This would negatively affect the trade balance. Tradable sector profitability declines, however, and the resulting decline in profitability would tend to generate a trade surplus. Stability of the long-run system requires the satisfaction of the famous Marshall-Lerner-Bickerdike-Robinson (MLRB) condition so that the spending effect dominates the investment effect and $\partial TB/\partial q > 0$. As mentioned earlier in section 3, a significant body of literature finds that this condition is satisfied.[11]

4.2. Dilemmas of real exchange rate policy

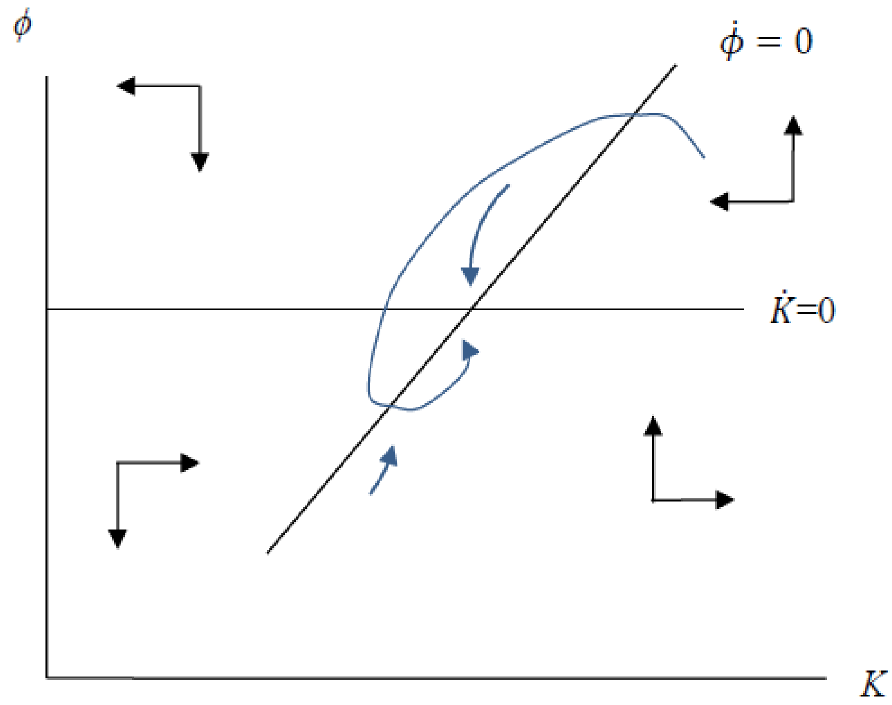
Equations (11) and (16) define the evolution of the state variables (K and ϕ) over time. A first glance at the latter equation may suggest that policy makers, who have sufficiently effective tools to manage the real exchange rate (*i.e.*, the main relative price) are able to pursue any accumulation and growth target. Interactions with the labor market, however, generate dynamics that complicate policy, ensure convergence to a steady state rate of growth over time, and impede the achievement of a higher steady state level of output. To see why, let's discuss the graphical representation of the dynamic system as captured by Figure 4.

Consider first the slopes of the isoclines starting with the $\dot{\phi} = 0$ one. A higher level of the capital stock is associated with a higher shared wage in the non-tradable sector (see equation 22), improving the fallback position of tradable sector workers. A higher T-sector real wage, specifically a higher ϕ, is now consistent with $\dot{\phi} = 0$. To the left of the $\dot{\phi} = 0$ isocline, the shared real wage ($\breve{\omega}_N$), and hence the fallback position of the T-sector workers is below their real wage, putting downward pressure on the latter. The $\dot{K} = 0$ isocline, on the other hand, is horizontal since, as we know from equation (16), the change in capital stock at any instant is independent of the level of capital stock at that instant. At any point below this isocline, the real wage is low and profit rate is higher than the benchmark level, leading to positive investment.

As shown mathematically in the Appendix, the system is locally stable (the trace of the Jacobian matrix of endogenous variables is negative while the determinant is positive). The underlying intuition is simple. Consider, for example, a shock that improves the fallback position of T-sector workers. The resulting rise in their real wage reduces investment, which then has the effect of dampening the initial improvement in the fallback position through a decline in employment and demand for non-tradables.

[11] Note that the MLRB condition is less stringent than the ML condition since it does not assume infinite export and import supply elasticities.

Figure 4 | The baseline dynamic system



The equilibrium could be a stable *node* or *focus*. It can be seen from the expression for the discriminant in the appendix that the lower the initial gap between the benchmark real wage ($\overline{\omega}_T$) and the fallback position ($\breve{\omega}_N$) of the workers, the more likely the system is to be a stable node with monotonic, acyclical adjustment.

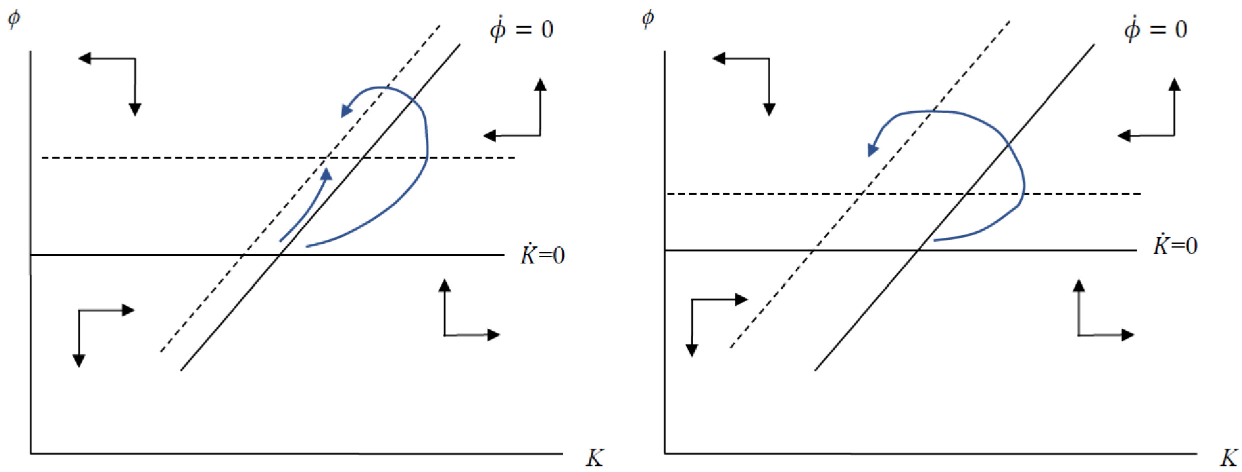
As can be seen from the slope of the $\dot{K} = 0$ isocline, and unlike the case of the traditional neoclassical constant returns to scale production function with factor substitution, there are no diminishing returns to capital accumulation. Interactions with the labor market nevertheless pose constraints on sustained capital accumulation, making policy management of relative prices challenging in practical terms. To see why, let's consider the comparative dynamics of a real devaluation aimed at facilitating expansion of the tradable sector.

Distributional conflict and wage inflation

The rise in profitability caused by an increase in q leads to an immediate rise in investment. Simultaneously, the shift in demand towards non-tradables improves the fallback position of tradable sector workers so that their real wage starts rising. As explained earlier, these two developments tend to dampen each other.

Whether or not the economy ends up at a higher level of capital stock in the new steady state depends partly in this simple set-up on how sensitive the shares of consumption are to relative price changes (*i.e.*, the magnitude of λ'). The left-hand panel in Figure 5, shows the case where this elasticity is sufficiently low so that, by the time rising wages have neutralized the initial impact on profitability, both the real wage and the level of capital stock are higher in the new steady state. But the system could easily end up in a new steady state where the steady state capital stock is lower and in spite of the initial impulse, the modern tradable sector has shrunk. Why? If consumers are sensitive to relative price changes, or if the T-sector is large enough, the resulting immediate increase in demand for non-tradables and the accompanying improvement in the shared wage in the N-sector could be adequately large so that T-sector workers are able to gain a significantly higher real wage in the new steady state. In terms of Figure 5, the relative vertical shift of the $\dot{\phi} = 0$ is greater. The wage inflation resulting from distributional conflict generated by real devaluation can undermine the initial impetus behind that policy action.

Figure 5 | Comparative dynamics of a real devaluation



Note: The left- and right-hand side panels illustrate the cases where λ′ is low and high, respectively.

This sub-section has underlined the potential role of distributional conflict in complicating policy. The next sub-section turns to another source of complications.

4.3. Applying an external account constraint

The previous section specified a steady state rate of capital accumulation and growth but did not impose any restrictions on the current account. Countries do not typically run expanding trade surpluses or deficits for long periods of time. This is particularly true for developing economies that often issue debt in foreign currency and rely on other economies for sophisticated imports. Let's now consider the implications of a trade balance constraint. Also, since the focus here is on distribution and the trade balance, I ignore the international exchange of financial assets.[12] Also, the steady state growth rate will now be treated as endogenous.

The system of equations (5)-(18) continues to apply, as do the short-run solutions (19)-(24). The new element is an equation for the evolution of the real exchange rate, which is specified so that q adjusts to maintain a constant trade balance (as a proportion of the capital stock) over time. There is a target for the trade balance ($\overline{TB}$), which could (but doesn't have to) be zero, and real exchange

[12] See the next section, however, for a rather crude treatment of financial flows.

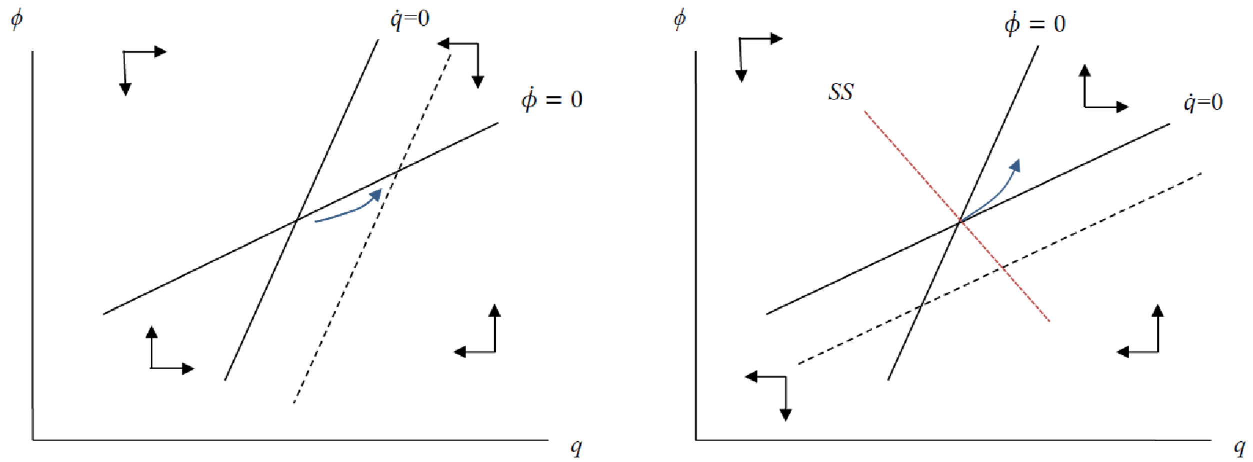
rate policy responds to deviations from the target (specifically, a trade deficit (surplus) is countered with a devaluation (revaluation)).

$$\dot{q} = h\left(\frac{\overline{TB}}{K} - \frac{TB}{K}\right) \tag{25}$$

Equations (11) and (25) constitute the new system of simultaneous differential equations. The $\dot{q}$ =0 isocline in Figure 6 represents the locus of points along which the trade balance is at its target level. To understand the intuition underlying the positive slope, recall that an increase in the T-sector real wage (through a rise in ϕ) generates a trade deficit relative to the target, thanks to higher consumption. The corresponding level of q that maintains the trade balance at the target level has to be higher (because a higher q diverts domestic consumption towards non-tradables).

As shown in the Appendix, the equilibrium could be a stable focus (or node), or it could be a saddle point. The former case occurs when the trade balance is relatively more sensitive to changes in the real exchange rate while the evolution of the tradable sector real wage is relatively more sensitive to distributional changes in that sector (*i.e.*, the $\dot{q}$ =0 isocline is steeper than the $\dot{\phi}$ =0 isocline).

Figure 6 | A change in the targeted trade balance due to a capital flow reversal



Let's consider the stable case, as illustrated by the left panel in Figure 6 and brie y explore how a change in the trade balance target plays out. Perhaps there has been an international turnaround of capital flows making it necessary to run smaller trade deficits (or greater trade surpluses). The $\dot{q}$ =0 isocline shifts to the right in Figure 6. Not surprisingly, the steady state is now associated with the higher real exchange rate.

Is investment higher or lower in the new steady state? A look at equation (16) should convince the reader that the answer depends on the new steady state ratio of ϕ to q. Furthermore, one can see by looking at the left-hand panel in Figure 6 that this ratio, in turn, depends on the slope of the $\dot{\phi}$ =0 isocline. The steeper this isocline, the higher the new steady state product wage in the T-sector, and the greater the likelihood that investment is lower.

Formally, as shown in the Appendix, the slope of the $\dot{\phi}$ =0 isocline is given by:

$$\left.\frac{\partial\phi}{\partial q}\right|_{\dot{\phi}=0} = \frac{\lambda(1-s_\pi)\{1-\lambda[1-s_\pi(1-\upsilon\gamma)]\} + \lambda'[(1-s_\pi)q + s_\pi a\phi\bar{\omega}_T]}{\lambda(1-s_\pi)q\{1-\lambda[1-s_\pi(1-\upsilon\gamma)]\}}\frac{\breve{\omega}_N}{\bar{\omega}_T}$$

In the event that the $\dot{\phi} = 0$ isocline is steeper than the other one, we get saddle path instability. This path is captured by the right panel in the figure. The stable arm (represented by SS) is negatively sloped. The intuition behind the instability is interesting. The key is to recall that the T-sector real wage is highly sensitive to the wage gap. A higher trade balance target means that the real exchange rate has to start rising. But since the labor market in this case highly sensitive to the resulting improvement in the worker fallback position, this leads to a rapid increase in the real T-sector wage, which means that the trade balance is moving further away from the new target level, which requires further real depreciation. Of course, the presence of forward-looking rational expectations or an omniscient social planner could generate solutions where the real exchange rate jumps to the new saddle path (which has moved to the left), and following this step appreciation that hurts the fallback position of tradable sector workers allow for gradual depreciation accompanied by falling *T*-sector wages to guide the economy to its steady state. Such an induced recession in the non-tradable sector (see equation 19) comes with its own problems, needless to add.

In sum, a highly responsive formal sector labor market can generate instability in the face of trade balance problems, as we know from the macroeconomic history of Latin American economies.

4.4. Capital account considerations

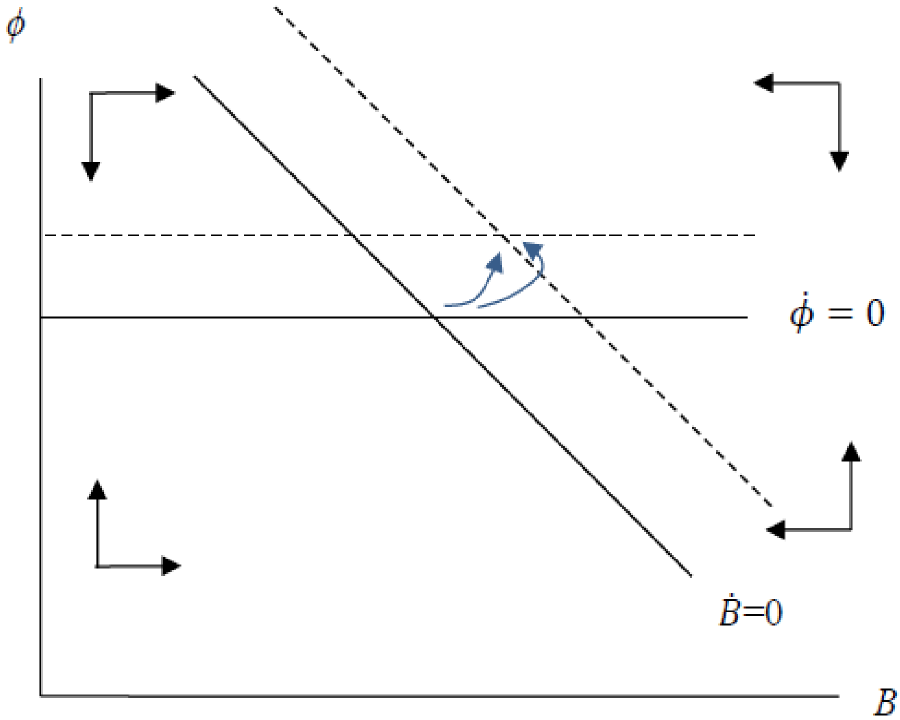
Incorporating international trade in financial assets significantly complicates the analysis and is beyond the scope of this paper. One could, however, introduce capital account-related *flow* considerations in a simple manner by borrowing from the traditional Mundell-Fleming treatment. Suppose that claims on capital are imperfect substitutes for bonds, so that capital inflows are a positive function of the gap between the domestic profit rate and the international interest rate (r^*). Let's use B to denote the *net* stock of international assets and ignore the interactions over time between asset accumulation and the current account. Developing country asset returns often incorporate a risk premium in international markets. Let's use x to represent this risk premium and plausibly assume that it is a positive function of the country's international indebtedness, so that $x = x(B)$ and $x' < 0$.

$$\dot{B} = k(r - x(B) - r^*) = g\left(1 - \phi\frac{a\bar{\omega}_T}{q} - x(B) - r^*\right) \tag{26}$$

Equations (11) and (26) define the new dynamic system. The equilibrium has the nature of a stable node or focus. How does a change in relative prices now affect the labor market, capital accumulation, and the external account?

Let's consider the effect of a real devaluation (see Figure 7). By increasing the domestic profit rate (and through arbitrage between domestic financial assets, the domestic interest rate), this development initially leads to greater investment and capital inflows. Without going into too much detail, both isoclines shift up, the real wage in the tradable sector is higher, and the new steady state rate of capital accumulation could be higher or lower depending on the relative vertical shift of the isoclines. The more muted the consumer response to relative price changes, the less the initial improvement in the fallback position due to expenditure-switching, and therefore, the higher the likelihood that ϕ/q is lower in the new steady state, and that the steady state investment is higher.

Figure 7 | The effects of a real devaluation



4.5. Terms of trade shocks and the Dutch disease

A significant number of developing economies remain dependent on the export of a narrow range of primary commodities such as oil and natural gas. A careful treatment of this issue would require a three-good framework (exportables, importables, and non-tradables). Here I take a simpler route by considering a natural resource that appears in the form of manna and is then exported. This bounty is not consumed directly at home although proceeds from it do of course influence domestic income and consumption of the other tradable and non-tradable goods. For simplicity, let's suppose that all proceeds from the export of the natural resource X, extraction of which grows proportionately with the size of the economy, are consumed.[13]

[13] The results discussed below do not qualitatively depend on this assumption and would pass through if we assume instead that a constant proportion is saved. In a representative agent interporal optimization framework, the trajectory of consumption will rise in light of the increased discounted value of lifetime income. The rise will, of course, depend on whether the shock is expected to be transitory or permanent.

How does our basic setup in Section 4.1 change? Equations (5)-(13) and the investment equation (16) are unaffected while eqs. (14) and (15) now need to be slightly modified:

$$C_N = \lambda\{[1 - s_\pi(1 - \upsilon\gamma)]AL_N^\gamma + [(1 - s_\pi)q + s_\pi a\phi\bar{\omega}_T]K + pXK\} \tag{27}$$

$$qC_T = (1 - \lambda)\{[1 - s_\pi(1 - \upsilon\gamma)]AL_N^\gamma + [(1 - s_\pi)q + s_\pi a\phi\bar{\omega}_T]K + pXK\} \tag{28}$$

where p is the (internationally determined) export price of the natural resource per unit relative to that of non-tradables. The trade balance equation becomes:

$$\frac{TB}{K} = \frac{Y_T}{K} - \frac{C_T}{K} - \frac{I}{K} + X \tag{29}$$

Again, the non-tradable sector clearing condition closes the model. The modified reduced form solutions are as follows:

$$L_N = \left\{\frac{\lambda[(1 - s_\pi)q + s_\pi a\phi\bar{\omega}_T] + pX}{1 - \lambda[1 - s_\pi(1 - \upsilon\gamma)]}\frac{K}{A}\right\}^{\frac{1}{\gamma}} \tag{30}$$

$$C_N = Y_N = \frac{\lambda[(1 - s_\pi)q + s_\pi a\phi\bar{\omega}_T + pX]}{1 - \lambda[1 - s_\pi(1 - \upsilon\gamma)]}K \tag{31}$$

$$\omega_N = \upsilon\gamma A\left\{\frac{\lambda[(1 - s_\pi)q + s_\pi a\phi\bar{\omega}_T] + pX}{1 - \lambda[1 - s_\pi(1 - \upsilon\gamma)]}\frac{K}{A}\right\}^{\frac{\gamma-1}{\gamma}} \tag{32}$$

$$\breve{\omega}_N = \frac{1}{L - K}\upsilon\gamma\left\{\frac{(1 - s_\pi)q + s_\pi a\phi\bar{\omega}_T + pX}{1 - \lambda[1 - s_\pi(1 - \upsilon\gamma)]}K\right\} \tag{33}$$

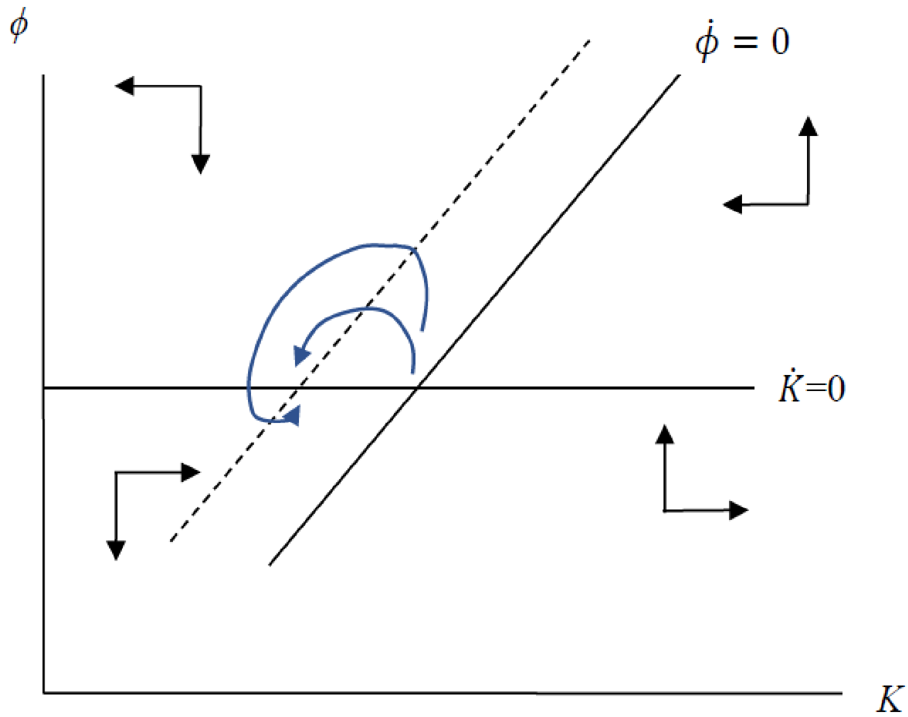
$$C_T = \frac{(1 - \lambda)}{q}\frac{(1 - s_\pi)q + s_\pi a\phi\bar{\omega}_T + pX}{1 - \lambda[1 - s_\pi(1 - \upsilon\gamma)]}K \tag{34}$$

$$\frac{TB}{K} = 1 - (1 - \lambda)\frac{(1 - s_\pi)q + s_\pi a\phi\bar{\omega}_T + pX}{1 - \lambda[1 - s_\pi(1 - \upsilon\gamma)]} - g\left(1 - \phi\frac{a\bar{\omega}_T}{q} - r^*\right) \tag{35}$$

We can now analyze the dynamic effects of a terms of trade shock (change in p) or, symmetrically, that of an increase in the manna available as a proportion of the capital stock (a rise in X) using the baseline system from section 4.2. Recall that the system consists of eqs. (11) and (16), with the level of the capital stock and the real wage in the tradable sector (or more precisely, ϕ) as the predetermined variables.

Once again, the mathematical solutions are provided in the Appendix. Here I will discuss the effects of the above-mentioned shock with the help of Figure 8. Given the specification of the system, *i.e.*, the incorporation of an exogenous bounty, the stability properties are unchanged from section 4.2. A positive terms of trade (*i.e.*, a rise in P_x or p) shock shifts the $\dot{\phi} = 0$ up and to the left. The discovery of a natural resource means that consumption of non-tradables is initially higher, which improves the fallback position of T-sector workers. The resulting wage inflation affects investment in the modern tradable sector negatively. As employment declines in the tradable sector, so does demand for non-tradables, and eventually the T-sector wage catches up with the fallback position, but the capital stock continues to shrink. Beyond this point, the falling level of K means an accompanying decline in the fallback position, putting downward pressure on the T-sector wage. In the most direct approach to the new steady state both w_T and K are declining, although cycles are possible. The steady state level of the capital stock is lower while the real T-sector wage is unchanged. Initial wage inflation has been followed by deflation in the face of declining T-sector employment. Consistent with the Dutch disease phenomenon, the composition of the economy has moved away from the nonprimary tradable sector. If the relative resource cost of extraction of the natural resource remains low, other more labor- or capital-intensive tradable sectors are the ones likely to shrink. Thinking in terms of the Dornbusch *et al.* (1977) framework, it is the sectors that the country has the strongest static comparative advantage in that will thrive.

Figure 8 | A terms of trade shock



A factor that could relieve the negative effects of real appreciation in the face of the initial rise in demand for non-tradables is the possibility of productivity improvements or movement down average cost curves as a consequence of increased output. Such a development is precluded by assumption in this simple set-up. Considering that we are analyzing a small developing economy, this does not seem to be a major limitation.

4.6. Production bottlenecks

I have ignored potential supply-side constraints in the nontradable sector so far. This was reasonable, I think, considering that I was focusing on an economy with large amounts of surplus labor and where the policy makers have sufficient tools to manage the real exchange rate. It is not uncommon, however, for low and middle-income economies to run into supply-side bottlenecks and experience real appreciation following episodes of excess demand. Let's, therefore, relax these two strong assumptions, and introduce supply-side considerations more explicitly in the non-tradable sector.

To accommodate the possibility of supply-side constraints, let's modify the basic framework in section 4.2 so that N-sector output responds to relative price changes. To frame things in simple, albeit stylized terms, let's specify non-tradable output behavior as follows:

$$Y_N = DL_N(q);\ L_N' < 0 \tag{36}$$

$$\omega_N = D \tag{37}$$

$$\breve{\omega}_N = \frac{DL_N}{L - L_T}$$

Labor is the only factor utilized in the non-tradable sector and production is subject to constant returns to scale. Non-tradable output is a function of labor employed in that sector, which declines in response to a relative price shift in favor of tradables. Moreover, the real wage in this sector equals the average product of labor. Again, there is surplus labor that shares the non-tradable sector income and could be utilized in the tradable sector without affecting non-tradable output.

The production and factor income specifications for the tradable sector roll over from the previous section, as do the trade balance and investment specifications. The consumption expressions for the two goods need to be slightly modified and become:[14]

$$C_N = \lambda\{DL_N + [(1 - s_\pi)q + s_\pi a\phi\overline{\omega}_T + qX]K\} \tag{38}$$

$$qC_T = (1 - \lambda)\{DL_N + [(1 - s_\pi)q + s_\pi a\phi\overline{\omega}_T + qX]K\} \tag{39}$$

[14] Notice that one difference from the previous section is that I have consolidated the price of all tradables (including the natural resource) into one price, the real exchange rate *q*. In this section, I do not explore terms of trade shocks, so the distinction is no longer important.

Once again, the N-sector clearing condition closes the model. Using (36) and (38), we get:

$$DL_N(q) = \lambda(q)\{DL_N + [(1 - s_\pi)q + s_\pi a\phi\bar{\omega}_T + qX]K\}$$

so that,

$$L_N(q) = \lambda \frac{(1 - s_\pi)q + s_\pi a\phi\bar{\omega}_T + qX}{1 - \lambda}\frac{K}{D} \tag{40}$$

Since the real exchange rate now is endogenous, the equation above is not a reduced form solution for L_N. We can, however, utilize the implicit function theorem to derive partial solutions for q.

$$q = q(K, \phi, X, \bar{\omega}_T);\ q_K, q_\phi, q_X, q_{\bar{\omega}_T} < 0 \tag{41}$$

Where:

$$q_K = \frac{\partial q}{\partial K} = \frac{\lambda}{1 - \lambda}\frac{(1 - s_\pi)q + s_\pi a\phi\bar{\omega}_T + X}{\Lambda D} < 0,$$

$$q_\phi = \frac{\partial q}{\partial \phi} = \frac{\lambda}{1 - \lambda} s_\pi a\bar{\omega}_T \frac{K}{\Lambda D} < 0,$$

$$q_X = \frac{\partial q}{\partial X} = \frac{\lambda}{1 - \lambda}\frac{K}{\Lambda D} < 0,$$

$$q_{\bar{\omega}_T} = \frac{\partial q}{\partial \bar{\omega}_T} = \frac{\lambda}{1 - \lambda} s_\pi a\phi \frac{K}{\Lambda D} < 0,$$

and:

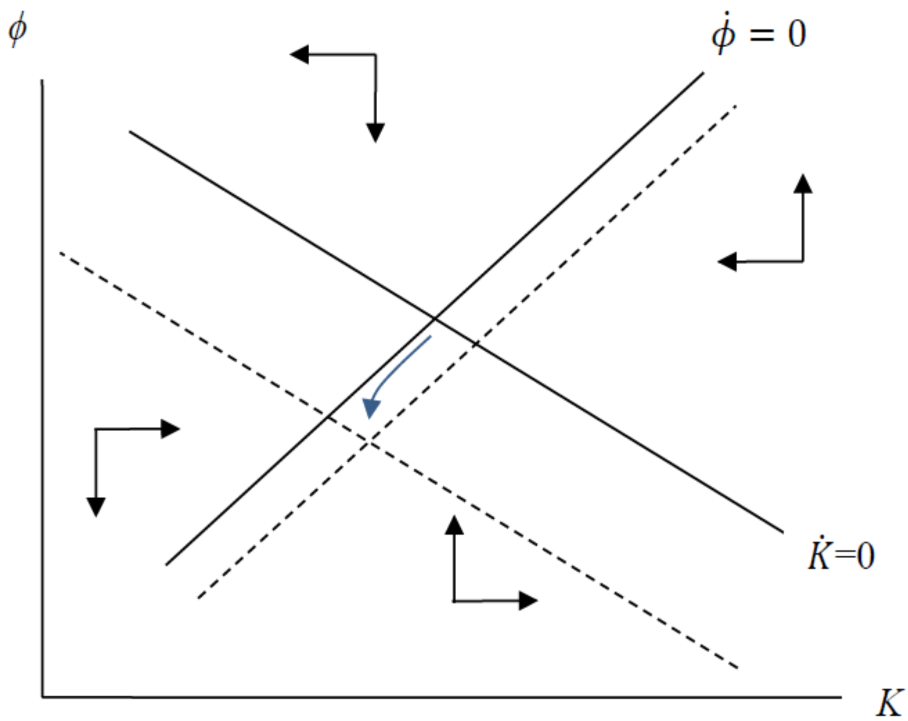
$$\Lambda \equiv L_N' - \frac{\lambda'[(1 - s_\pi)q + s_\pi a\phi\bar{\omega}_T + X] + \lambda(1 - \lambda)(1 - s_\pi)}{(1 - \lambda)^2}\frac{K}{D} < 0$$

To understand the intuition underlying the signs above, notice that a rise in q affects output and consumption of non-tradables in opposite directions, therefore generating excess demand for this good. This means that, if K rises, for example, the excess demand for non-tradables must be eliminated by real appreciation. This (partial) positive correlation between q and K is consistent with the Balassa-Samuelson effect.

We can also employ (38), (39), and (41) to solve for consumption of the two goods as a function of the pre-determined and exogenous variables. From the perspective of this section, a key result that carries over from previous sections is that the domestic consumption of both goods rises with the level of the capital stock, improving the fallback position of T-sector workers.

Let's turn once more to the dynamic system as captured by eqs. (16) and (11). Figure 9, which illustrates the system, shows the effect of a new natural resource discovery. The change shifts both isoclines downwards. As formally shown in the Appendix, the $K = 0$ isocline shifts more than the other one in the horizontal direction so that the steady level of both the capital stock and the T-sector real wage drop to lower values. Recall from the previous section that, with no supply-side constraints in the non-tradable sector, it was only the size of, but not the real wage in, the tradable sector that declined. Why the difference? Unlike the case without a supply bottleneck, the newly arrived bounty leads to real appreciation. A look at equation (16) will convince the reader that this means that the real wage must be lower for investment to be non-negative in the new steady state. Intuitively, the initial appreciation raises the real product wage in the T-sector while simultaneously putting downward pressure on the fallback position. Investment and the real wage decline as a result.

Figure 9 | Natural resource discovery in the presence of supply-side bottlenecks



In sum, the presence of supply-side bottlenecks exacerbates the negative effect of a natural resource discovery on real wages in the tradable sector.

5. Concluding thoughts

Development economics as a distinct academic field has been in existence for more than half a century now but some of the original insights of the pioneers remain relevant. Indeed, one could go further back in time and draw on Ricardo and the classical economists to understand some of the features and constraints that appear much more prominently in developing economies such as the dual structure of labor markets, the presence of a traditional sector alongside a modern one, balance of payments issues, and distributional conflict over scarce resources.

I have attempted to present a series of stylized models built around a baseline framework that incorporate some of these issues in a parsimonious manner. This allowed me to carry out a series of thought exercises focused on issues that lie at the intersection of development and international economics, and that have been considered important over the years, both among academics and policy makers. As always, some of the different broad mechanisms may be more or less important over different time horizons and for different types of countries. For example, populous countries such as India with scarce land may have more surplus labor than sparsely populated land-abundant countries such as Argentina. Some countries may be heavily abundant in natural resources while others may not. Real wage flexibility will be higher in some countries compared to others. Static comparative advantage, either due to Ricardian technological differences or due to relative factor endowments, as in the Heckscher-Ohlin or specific factors frameworks, may well make it easier to influence industrialization and structural change in some cases compared to others. The main thrust of analysis should be to identify the salient structural features in each context in order to explore them in a formal and insightful manner.

The tradable sector that I have analyzed in this paper is special in the sense that it's the part of the economy where production takes place and capital is utilized under modern conditions. The goal here was simplicity and clarity. A less barebones structure would incorporate the possibility of economies of scale (Ros and Skott, 1998; Rapetti, 2012), dynamically evolving comparative advantage (Krugman, 1987), market imperfections (Rodrik, 2008), structural diversification (Razmi, 2013), and learning-by-exporting (Guzman et al., 2018), among other important aspects. Obviously monetary considerations are important too, especially on the balance of payments front.

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Appendix

This section provides the formal algebraic expressions underlying the discussion in each section.

Section 4.1

Consider the dynamic system based on equations (11) and (16). The elements of the endogenous variable Jacobian are:

$$\mathbf{J} = \begin{vmatrix} \dot{K}_K & \dot{K}_\phi \\ \dot{\phi}_K & \dot{\phi}_\phi \end{vmatrix}$$

Where:

$$\dot{K}_K = -g' \frac{a\overline{\omega}_T}{q} K < 0,$$

$$\dot{K}_\phi = 0,$$

$$\dot{\phi}_K = f' \frac{L}{(L-aK)K} \breve{\omega}_N > 0,$$

$$\dot{\phi}_\phi = -f' \frac{(1-\lambda)(L-aK) + \lambda s_\pi (1-\upsilon\gamma)L}{(L-aK)\{1-\lambda[1-s_\pi(1-\upsilon\gamma)]\}} \overline{\omega}_T < 0$$

$Trace = -f'\overline{\omega}_T < 0$, $|\mathbf{J}| = f'g' \frac{a\overline{\omega}_T}{q} \frac{L}{(L-aK)K} \breve{\omega}_N > 0$

Denoting the discriminant by Δ:

$$\Delta = f'\overline{\omega}_T \left[\overline{\omega}_T - 4g' \frac{a}{q} \frac{L}{(L-aK)K} \breve{\omega}_N \right] <> 0$$

Section 4.2

Using "~" to denote steady state values of variables:

$$\frac{d\tilde{K}}{dq} = -\frac{\upsilon\gamma}{\breve{\omega}_N} \frac{\lambda(1-s_\pi)\{1-\lambda[1-s_\pi(1-\upsilon\gamma)]\} + \lambda'[(1-s_\pi)q + s_\pi a\phi\overline{\omega}_T]}{\{1-\lambda[1-s_\pi(1-\upsilon\gamma)]\}^2} + \frac{\phi}{q} \frac{L-aK}{K} \frac{1}{\breve{\omega}_N} <> 0$$

$$\frac{d\tilde{\phi}}{dq} = \frac{\phi}{q} > 0$$

Notice that a high value of λ' and limited availability of workers from outside the T-sector (*i.e.*, low $L - aK$) tend to make $\frac{d\tilde{K}}{dq}$ negative.

Section 4.3

Consider the dynamic system based on equations (11) and (25). The elements of the endogenous variable Jacobian are:

$$\mathbf{J} = \begin{vmatrix} \dot{q}_q & \dot{q}_\phi \\ \dot{\phi}_q & \dot{\phi}_\phi \end{vmatrix}$$

Where:

$$\dot{q}_q = -h' \left\{ \frac{\{1-\lambda[1-s_\pi(1-\upsilon\gamma)]\}(1-\lambda)\frac{a\bar{\omega}_T}{q^2} + \lambda\prime[(1-s_\pi)q + s_\pi a\phi\bar{\omega}_T](1-\upsilon\gamma)}{\{1-\lambda[1-s_\pi(1-\upsilon\gamma)]\}^2} s_\pi - g' \frac{a\phi\bar{\omega}_T}{q^2} \right\} < 0,$$

$$\dot{q}_\phi = -h' \left\{ -\frac{1-\lambda}{1-\lambda[1-s_\pi(1-\upsilon\gamma)]} s_\pi + g' \right\} \frac{a\bar{\omega}_T}{q} > 0,$$

$$\dot{\phi}_q = f' \frac{\lambda(1-s_\pi)\{1-\lambda[1-s_\pi(1-\upsilon\gamma)]\} + \lambda\prime[(1-s_\pi)q + s_\pi a\phi\bar{\omega}_T]}{1-\lambda[1-s_\pi(1-\upsilon\gamma)]} \frac{\breve{\omega}_N}{\lambda[(1-s_\pi)q + s_\pi a\phi\bar{\omega}_T]} > 0,$$

$\dot{\phi}_\phi = -f' \frac{(1-s_\pi)q}{[(1-s_\pi)q + s_\pi a\phi\bar{\omega}_T]} \bar{\omega}_T < 0$, (given that $\breve{\omega}_N - \phi\bar{\omega}_T \approx 0$ around the steady state).

Trace = $\dot{q}_q + \dot{\phi}_\phi < 0$, $|\mathbf{J}| <> 0$

$|\mathbf{J}| > 0$ if $-\frac{\dot{q}_q}{\dot{q}_\phi} > -\frac{\dot{\phi}_q}{\dot{\phi}_\phi}$, *i.e.* if the $\dot{q} = 0$ isocline is the steeper one.

The slopes of the two isoclines are:

$$\left.\frac{\partial\phi}{\partial q}\right|_{\dot{\phi}=0} = \frac{\lambda(1-s_\pi)\{1-\lambda[1-s_\pi(1-\upsilon\gamma)]\} + \lambda'[(1-s_\pi)q + s_\pi a\phi\bar{\omega}_T]}{(1-s_\pi)q\{1-\lambda[1-s_\pi(1-\upsilon\gamma)]\}} \frac{\breve{\omega}_N}{\bar{\omega}_T}$$

$$\left.\frac{\partial\phi}{\partial q}\right|_{\dot{q}=0} = \frac{\dfrac{\{1-\lambda[1-s_\pi(1-\upsilon\gamma)]\}(1-\lambda)\dfrac{a\bar{\omega}_T}{q^2} + \lambda'[(1-s_\pi)q + s_\pi a\phi\bar{\omega}_T](1-\upsilon\gamma)}{\{1-\lambda[1-s_\pi(1-\upsilon\gamma)]\}^2} s_\pi \dfrac{q}{a\bar{\omega}_T} - g'\dfrac{\phi}{q}}{\dfrac{1-\lambda}{1-\lambda[1-s_\pi(1-\upsilon\gamma)]} s_\pi - g'}$$

Section 4.4

The vertical shifts of the two isoclines are given by:

$$\left.\frac{\partial\phi}{\partial q}\right|_{\dot{B}=0}=\frac{\phi}{q}>0$$

$$\left.\frac{\partial\phi}{\partial q}\right|_{\dot{q}=0}=\frac{\frac{1-s_\pi}{(1-s_\pi)q+s_\pi a\phi\overline{\omega}_T}+\frac{\lambda'}{\lambda}\frac{1}{1-\lambda[1-s_\pi(1-\upsilon\gamma)]}\frac{\breve{\omega}_N}{\overline{\omega}_T}K}{\frac{1}{1-\lambda[1-s_\pi(1-\upsilon\gamma)]}\left[(1-\lambda)+\frac{\lambda s_\pi(1-\upsilon\gamma)L}{(L-aK)}\right]}>0$$

Notice that the higher λ' is, the greater the vertical shift of the $\dot{q}=0$ isocline.

Section 4.5

The comparative dynamic outcomes as a result of an increase in X are as follows:

$$\frac{d\widetilde{K}}{dX}=-\frac{p}{\frac{L}{L-aK}[(1-s_\pi)q+s_\pi a\phi\overline{\omega}_T+pX]}K<0$$

$$\frac{d\tilde{\phi}}{dX}=0$$

Section 4.6

The slopes of the two isoclines are as follows:

$$\left.\frac{\partial\phi}{\partial K}\right|_{\dot{K}=0}=\frac{1}{q}\frac{\lambda}{1-\lambda}\frac{(1-s_\pi)q+s_\pi a\phi\overline{\omega}_T+pX}{\Lambda D}>0$$

$$\left.\frac{\partial\phi}{\partial K}\right|_{\dot{\phi}=0}=\left[\frac{DL_N}{L-K}+L'_N q_K\right]\frac{D}{(L-K)\overline{\omega}_T}>0$$

The horizontal shifts of the 2 isoclines are given by:

$$\left.\frac{\partial K}{\partial X}\right|_{\dot{K}=0}=-\frac{K}{(1-s_\pi)q+s_\pi a\phi\overline{\omega}_T+pX}<0$$

$$\left.\frac{\partial K}{\partial X}\right|_{\dot{\phi}=0}=-\frac{\frac{L'_N}{L-K}\frac{\lambda}{1-\lambda}\frac{K}{\Lambda}}{\frac{DL_N}{(L-K)^2}+\frac{L'_N}{L-K}\frac{\lambda}{1-\lambda}\frac{[(1-s_\pi)q+s_\pi a\phi\overline{\omega}_T+pX]}{\Lambda}}>0$$

Notice that, if $\frac{DL_N}{(L-K)^2}=0$ in the denominator of the second line, then the shift of the two curves is identical in magnitude. Since $\frac{DL_N}{(L-K)^2}>0$, this proves that $\dot{\phi}=0$ isocline will shift by less.