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Endogeneous Distribution and the Political Economy of Trade Policy*

Satya P. Das

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Abstract

This paper examines the political economy of trade policy in the context of a small open economy, when factor ownerships are variable. The median voter hypothesis is used. In the long run, both trade protection and distribution of wealth and income are endogenous, and the paper investigates how these are affected by basic parameters like terms of trade and technology.

Journal of Economic Literature Classification: D31, F13

Key Words: Distribution, Median Voter, Politics, Tariff

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1 Introduction

The theory of the political economy of trade policy is rich and growing. There are two discernible approaches. One emphasizes pressure groups for or against some protection through their lobbying efforts (e.g. Rodrik (1986), Hillman and Ursprung (1988) and Grossman and Helpman (1994, 1995) among many others). The other characterizes trade policy that emerges as a result of direct voting (e.g. Mayer (1984) and Mayer and Riezman (1987) and Levy (1997)). The underlying scenario, common to both approaches, is that a country's population is heterogeneous in terms of factor ownership. Therefore, trade policy changes have asymmetric effects on individual welfare and hence generate, through lobbying or voting, asymmetric pressure on policy. An equilibrium trade policy in some sense is the outcome. An implicit assumption underlying both approaches is that factor ownerships are exogenous.

In reality however, they do change over time. For example, it is a well-known fact by now that many developed countries have experienced an increase in wealth and income inequality in recent years. It then makes sense that factor-distributional changes should be taken into account in understanding the political economy process of trade policy setting. In other words, trade policy as well as factor ownership distribution are endogenous and must be jointly dependent on other basic parameters of a market-oriented economy. The existing literature has emphasized and provided many insights into the causal link from factor distribution to trade policy. What is emphasized here is this causal link as well as that from trade policy to factor distribution in a simultaneous way.

The task is clearly difficult however. First, individual heterogeneity has to be recognized at a more primitive level, which would imply some distribution of factor ownership. Second, in order for ownership to change, some primary factors have to be treated as traded assets – as they really are. Thus changes in commodity as well as asset prices, due to change in trade policy or other basic parameters, need to be ascertained. Third, there is a built-in dynamics because of factor ownership changes. This paper sets out to make a beginning by presenting a very specific and simple version of the standard Heckscher-Ohlin economy in which there is distributional dynamics but no aggregate dynamics and in which policy is viewed as resulting from a majority voting process. (Thus, it does not deal with lobbying.) The model builds upon the important work of Mayer (1984).

One finding of the paper is that, as the international price of the labor-intensive good rises, trade protection falls and wealth-income inequality falls. Another finding is that an increase in the endowment of land (fixed capital) *lowers* the real wage, *raises* the land rent and may increase or decrease inequality. More than the specific results, the paper hopes to have demonstrated that it is possible to analyze endogenous protection through political economy and endogenous distribution of factor ownership in a tractable way.

The basic model is laid out in section 2. Section 3 examines transitional dynamics and the steady state. Comparative statics are considered in Section 4. Section 5 considers consumption and production interventions. Section 6 concludes the paper.

2 The Model

Consider the standard 2×2 small open economy. The goods are x and y , respectively imported and exported. To fix ideas, let the import sector be labor-intensive and let p^* denote the international price of good x in terms of good y , the numeraire good. Assume that an import tariff/subsidy or

an export tariff/subsidy is the policy instrument that is chosen through the political process.

The production function in each sector is Cobb-Douglas: $Q_j = A_j L_j^{\alpha_j} K_j^{1-\alpha_j}$, $j = x, y$, $0 < \alpha_j < 1$. The Q 's, L 's and K 's are the respective outputs, labor and land employed. Sector x being labor intensive, $\theta \equiv \alpha_x - \alpha_y > 0$. The K -input is nonreproducible and hence called land rather than capital. Let \bar{K} denote the total endowment of land. There are two perfectly substitutable assets: land and loans. Goods markets and trade policy relating to these markets being our focus, it is assumed that there is no international borrowing or lending.¹

Each individual in the economy possesses a unit of (nontradable) endowment of labor that is supplied inelastically to the market. The number of households and the total endowment of labor are normalized to one. Then \bar{K} is also the mean land holding. All markets are perfectly competitive.

Holding of land varies across individuals resulting from differences in preferences. This is where heterogeneity comes in. Following Das (1999 a,b), each individual lives for one period and obtains utility from own consumption and bequest passed on to the offspring (Aghion and Bolton (1997) and Piketty (1997)). From now on, the terms – individual, household and dynasty – will be used interchangeably. The dynasty h faces the utility function:

$$U_{ht} = \Gamma \left(C_{xht}^\gamma C_{yht}^{1-\gamma} \right)^{1-\beta} \left[K_{ht+1} - \frac{D_{ht}(1+i_t)}{r_{t+1} + p_{kt+1}} - h \right]^\beta, \quad \Gamma > 0, h \geq 0; 0 < \beta, \gamma < 1 \quad (1)$$

where C_{xht} and C_{yht} represent consumption of the respective good at time t , γ is the share of expenditure allocated to good x , K_{ht+1} is the land bequeathed, D_{ht} the debt bequeathed, i_t is the interest rate, r_t is the land rent, p_{kt} is the land price and h is the basic preference parameter that varies across the households. We can define $B_{ht+1} \equiv K_{ht+1} - D_{ht}(1+i_t)/(r_{t+1} + p_{kt+1})$ as the net value of the bequest in terms of land. Our specification implies that land and loans are perfect substitutes.

Higher h , greater is the marginal utility from bequests to be passed. Since it is nonnegative, it means that no one would pass zero or negative bequest: at the optimum $B_{ht+1} > 0$ for all h . h has continuous and finite support, say, from 0 to 1, with density function $\phi(h) \geq 0$. Apart from $\int_0^1 \phi(h)dh = 1$, no other restrictions are required, except that the median of h , h_m , be less than its mean, say \bar{h} , i.e.,

$$h_m < \bar{h}. \quad (R1)$$

This would ensure that in the steady state the distribution of land is skewed to the right, a feature observed in most market-oriented economies (see Mayer (1984)).

We would impose two more regularity conditions:

$$\bar{h} < \bar{K}. \quad (R2)$$

$$\omega^* > \bar{K}, \quad (R3)$$

where ω^* is the wage/rental ratio at the free trade price level. As will be seen later, (R2) will imply a finite positive price of land in equilibrium. Notice that (R3) is based on the primitives facing the small open economy. As will also be seen, it would imply that at the politically determined tariff level, $\omega > \bar{K}$, that is, the total wage bill in the economy exceeds the total earnings to land. (R3) will be needed as sufficient to ensure the second-order condition in determining the optimal

¹The complications that would arise if this were allowed will be discussed later.

tariff for the median voter as well as stability of the dynamic adjustment process. Also, it is valid from the empirical standpoint, as in most actual economies the wage bill exceeds 50% of the total income.

While h varies across the households, it is assumed the same for any given household. Thus a dynasty is identified with a particular h for all t . The price paid for this assumption is that the model is unable to capture mobility in the wealth-income ladder. But it preserves a property that considerably aids tractability, namely that the median dynasty's identity is unchanged while its wealth holding may vary.²

In addition to factor earnings, the households receive a part, ϕ_{ht} , of the tariff revenues, N_t . $N_t \geq 0$ as tariff may be positive, zero or negative. A household's budget constraint can now be written as

$$p_t C_{xht} + C_{yht} + p_{kt} K_{ht+1} - D_{ht} \leq w_t + (r_t + p_{kt}) K_{ht} - D_{ht-1} (1 + i_{t-1}) + \phi_{ht} N_t.$$

where $p_t = p^*(1 + \tau_t)$ is the tariff inclusive price, τ_t being the ad valorem rate of tariff at t . Each household maximizes U_{ht} subject to its budget constraint. The choice variables are C_{xht} , C_{yht} , K_{ht+1} and D_{ht} .

In terms of sequence of things, at the beginning of each period, the political process (median voting) determines the equilibrium tariff. Given this tariff, each household's choice variables are the ones indicated above.

The post-tariff optimization can be equivalently seen in two stages. In stage one the total expenditure, $E_{ht} = p_t C_{xht} + C_{yht}$, and savings are decided and in stage two, E_{ht} is allocated to buying x and y . The assumed form of the subutility function from bequest implies that the arbitrage condition $1 + i_t = (r_{t+1} + p_{kt+1})/p_{kt}$ holds, i.e., the returns from loan and land are equal. An individual cannot separately choose K_{ht+1} and D_{ht} but can choose B_{ht+1} , the net value of the asset. Using the arbitrage condition and the definition of E_{ht} , the budget constraint can be restated as:

$$E_{ht} + p_{kt} B_{ht+1} \leq w_t + (r_t + p_{kt}) B_{ht} + \phi_{ht} N_t. \quad (2)$$

Also, using the static indirect utility expression, we have

$$U_{ht} = p_t^{-\gamma(1-\beta)} E_{ht}^{1-\beta} (B_{ht+1} - h)^\beta, \quad (3)$$

where we have normalized $\Gamma[\gamma^\gamma(1-\gamma)^{1-\gamma}]^{1-\beta}$ to one. This is maximized subject to the preceding budget constraint. The first-order condition is:

$$E_{ht} = \frac{1-\beta}{\beta} p_{kt} (B_{ht+1} - h), \quad (4)$$

and substituting this into the budget constraint gives the individual asset demand function:

$$B_{ht+1} - h = \beta \left[\frac{w_t + r_t B_{ht} + \phi_{ht} N_t}{p_{kt}} + B_{ht} - h \right]. \quad (5)$$

²Note that preference heterogeneity in an additive form could have been alternatively introduced in the subutility from current consumption. This would have implied that the relative risk aversion from current consumption is not equal to one and moreover it varies across the households. Hence our specification keeps the role played by risk aversion neutral.

If we sum it up over all h and use that, for any t , $\sum_h B_{ht} = \bar{K}$ (since there is no international borrowing or lending), we get the land market clearing equation:

$$\frac{(1 - \beta)p_{kt}(\bar{K} - \bar{h})}{\beta} = w_t + r_t\bar{K} + N_t. \quad (6)$$

Note that our regularity assumption (R2) ensures a finite and positive price of land.

At this point, we follow Mayer and use the neutral assumption that tariff revenues are distributed in proportion to individual earnings in the total earnings in the economy. Thus $\phi_{ht} = (w_t + r_t B_{ht}) / (w_t + r_t \bar{K})$. Substituting this and the land market clearing equation into (5),

$$B_{ht+1} - h = (1 - \beta)(\bar{K} - \bar{h})\phi_{ht} + \beta(B_{ht} - h). \quad (7)$$

We begin to trace the economy from a steady state situation in which τ_t is given (e.g. tariff is non-political and $\tau_t = 0$) and wealth holding of any household is unchanged over time. Turning to (7), we then have

$$B_h - h = (\bar{K} - \bar{h})\phi_h; \quad \text{Or } (\omega + \bar{h})B_h = h(\omega + \bar{K}) + (\bar{K} - \bar{h})\omega, \quad (8)$$

where ω is the wage rental ratio. From these two expressions it follows that

Result 1: At the steady state, B_h and $B_h - h$ are increasing in h .

This holds even if tariff were political. Moreover, as is intuitive, the household having a higher propensity to leave bequest, ends up with more wealth.³

Result 1 sets the stage for dynamics off the steady state as well. In view of (7), we see that, starting from any initial steady state, $B_{ht+1} - h$ in the next period is increasing in h irrespective of the tariff rate chosen in period t . Hence it follows that

Result 2: At any t off or along the steady state, $B_{ht} - h$, and hence B_{ht} , increase with h .

In turn this implies that

Result 3: The median household is the same for all t and is identified with $h = h_m$.

Assuming for now that the median voter hypothesis holds, the distributional dynamics is governed by (7) with $h = h_m$, that is,

$$B_{mt+1} - h_m = (1 - \beta)(\bar{K} - \bar{h}) \frac{\omega(\tau_{mt}) + B_{mt}}{\omega(\tau_{mt}) + \bar{K}} + \beta(B_{mt} - h_m), \quad (9)$$

where τ_{mt} is the preferred tariff rate for the median household (and τ_{mt} would depend on B_{mt}).

In order to understand that the median voter hypothesis holds in the presence of changes in factor ownerships and how τ_{mt} is dependent on B_{mt} and other basic parameters of the economy, we need to characterize, for any given t , the tariff preference of each household type.

Tariff Preference for Household h

If we substitute (4) and (7) into U_{ht} , we get

$$U_{ht} = [\beta^\beta (1 - \beta)^{1-\beta}] p_t^{-\gamma(1-\beta)} p_{kt}^{1-\beta} \left[\frac{\phi_{ht}(1 - \beta)(\bar{K} - \bar{h})}{\beta} + B_{ht} - h \right] \quad (10)$$

$$= [\beta^\beta (1 - \beta)^{1-\beta}] p_t^{-\gamma(1-\beta)} p_{kt}^{-\beta} \left[p_{kt} \frac{\phi_{ht}(1 - \beta)(\bar{K} - \bar{h})}{\beta} + p_{kt}(B_{ht} - h) \right]. \quad (11)$$

³This is unlike the infinite horizon Ramsey model with utility from consumption of goods only wherein the most patient household ends up with all land (or capital).

The expression (10) will be used below but the expression (11) is straightforward to interpret. *Ceteris paribus*, an increase in p_t reduces static welfare. An increase in p_{kt} raises the cost of passing bequest and tends to lower utility. At the same time, an increase in p_{kt} increases the current value of wealth and has a positive effect on utility (captured by the term in the square bracket).

At any t , each household inherits B_{ht} and its most preferred tariff rate is the one that maximizes (10) at given B_{ht} . From (10) or (11), it is seen that each household's calculation of its own optimal tariff would take into account how a change in tariff would affect the land price. We analyze this next.

Notice that $N_t = p^* \tau_t (C_{xt} - Q_{xt})$, where C_{xt} and Q_{xt} are the aggregate consumption and output of good x . From Cobb-Douglas preferences, $C_{xt} = \gamma E_t / p_t$, where $E_t = \sum_h E_{ht}$ is the aggregate expenditure. However, aggregating the budget constraint of all households it (naturally) follows that $E_t = w_t + r_t \bar{K} + N_t$. Substituting this into the demand function of good x and substituting the resulting expression into the definition of N_t ,

$$N_t = \frac{\gamma \tau_t (w_t + r_t \bar{K}) - p^* \tau_t (1 + \tau_t) Q_{xt}}{1 + (1 - \gamma) \tau_t}.$$

Thus, by 'solving' tariff revenues, and using the identity $w_t + r_t \bar{K} = p_t Q_{xt} + Q_{yt}$,

$$E_t = w_t + r_t \bar{K} + N_t = \frac{1 + \tau_t}{1 + (1 - \gamma) \tau_t} [p^* Q_x(p_t) + Q_y(p_t)]. \quad (12)$$

Hence, in the presence of tariff, total expenditure exceeds the value of national output at international prices by a factor dependent on the magnitude of tariff. Substituting (12) into (6),

$$\frac{(1 - \beta) p_{kt} (\bar{K} - \bar{h})}{\beta} = \frac{1 + \tau_t}{1 + (1 - \gamma) \tau_t} [p^* Q_x(p_t) + Q_y(p_t)]. \quad (13)$$

Log-differentiating this expression and using $p^* (1 + \tau_t) dQ_{xt} + dQ_{yt} = 0$ along the production possibility frontier, one obtains

$$\hat{p}_{kt} = \left[\frac{\gamma}{1 + (1 - \gamma) \tau_t} - \mu_x \eta_x \tau_t \right] (\widehat{1 + \tau_t}), \quad (14)$$

where the 'hat' represents a proportional change and

$$\begin{aligned} \mu_x &\equiv \frac{p^* Q_{xt}}{p^* Q_{xt} + Q_{yt}} \equiv \text{share of the import sector in the national output at international prices} \\ \eta_x &\equiv \frac{p_t}{Q_{xt}} \frac{dQ_{xt}}{dp_t} \equiv \text{own price elasticity of the supply of the importable.} \end{aligned}$$

Intuitively, an increase in tariff, on one hand, tends to raise tariff revenues and disposable income and increases the demand for land as an asset through an income effect. This tends to increase the price of land. On the other hand, the increase in tariff results in less production efficiency (i.e. less earnings at world prices) and thereby lowers the demand for land. The price of land tends to decrease.

Turning now to the expression of U_{ht} and taking to account how p_{kt} is affected by p_t , the “price effects” in U_{ht} in (10) is given by

$$(1 - \beta)(\hat{p}_{kt} - \gamma\hat{p}_t) = -(1 - \beta) \left[\frac{\gamma(1 - \gamma)}{1 + (1 - \gamma)\tau_t} + \mu_x\eta_x \right] \tau_t(\widehat{1 + \tau_t}). \quad (15)$$

Furthermore, totally differentiating ϕ_{ht} ,

$$d\phi_{ht} = \frac{\omega_t(\bar{K} - B_{ht})}{(\omega_t + \bar{K})^2} \hat{\omega} = \frac{\omega_t(\bar{K} - B_{ht})}{\theta(\omega_t + \bar{K})^2} (\widehat{1 + \tau_t}),$$

where recall that $\theta = \alpha_x - \alpha_y$.

All ingredients are at hand now. Computing the change in individual utility with respect to an increase in tariff, the marginal gains and losses from an increase in tariff are given by

$$G = \frac{(1 - \beta)(\bar{K} - \bar{h})(\bar{K} - B_{ht})\omega_t}{\theta(\omega_t + \bar{K})^2[(1 - \beta)(\bar{K} - \bar{h})\phi_{ht} + \beta(B_{ht} - h)]} \quad (16)$$

$$L = (1 - \beta) \left[\frac{\gamma(1 - \gamma)}{1 + (1 - \gamma)\tau_t} + \mu_x\eta_x \right] \tau_t, \quad (17)$$

where $\hat{U}_{ht}/(\widehat{1 + \tau_t}) = G - L$. G is the factor income gain, which is positive or negative as $B_{ht} \leq \bar{K}$. L is the deadweight loss associated with tariff. Tariff preference would depend on how G and L change with τ_t .

To begin with, consider any household whose wealth holding is less than the average. As long as $\tau_t \leq 0$, $G > 0 > L$. Hence the household’s most preferred tariff is positive. Next, Appendix 1 shows that if the regularity condition (R3) is met and $\tau_t \geq 0$, G is a declining function of τ_t . This is shown as the downward sloping G function in panel (a) of Figure 1.

How L changes with τ_t is harder to characterize in general since $d(\eta_x\mu_x)/d\tau_t \gtrless 0$. But we shall argue that the effect of this change on the magnitude of L is likely to quite small, for the following reasons. First, from the definition of L , it follows that for small values of τ_t , the marginal effect of a change in $\eta_x\mu_x$ is small also. Second, when τ_t is sufficiently high, the output of good x will be close to its specialization level and hence $\eta_x \rightarrow 0$ (while $\mu_x \rightarrow 1$). Third, in general, as τ_t increases, Q_{xt} increases and the value of national output at international prices falls; thus μ_x rises unambiguously. On the other hand, Appendix 2 shows that, given Cobb- Douglas technology, as τ_t increases, η_x changes in the opposite way: it decreases. Hence, when τ_t is not very large or small, the product $\eta_x\mu_x$ is not likely to change significantly. Appendix 2 also shows that the changes in p^* and \bar{K} or a neutral technical progress in either sector – the parameters whose effect on tariff and distribution will be considered – have opposite effects on $\eta_x\mu_x$ too. Thus, henceforth, let $\eta_x\mu_x$ be treated as a constant. It follows then that L increases with τ_t .

Panel (a) of Figure 1 depicts the G and L functions for any household with $B_{ht} < \bar{K}$. Note that given (R1), the median household falls in this category. Clearly, the optimal tariff is positive. Moreover, as a comparative statics, we see that for higher- h household (and hence with higher B_{ht} and $B_{ht} - h$, the G function is at a lower level, implying that the optimal tariff is less, as one would expect.

Turn next to a household whose wealth holding is greater than the average. The L function is the same as when $B_{ht} < \bar{K}$. $G < 0$ whether $\tau_t \gtrless 0$. Thus, for any $\tau_t \geq 0$, $G < 0 \leq L$ and hence welfare is monotonically decreasing. In the range $\tau_t < 0$, the slope of the G function may be

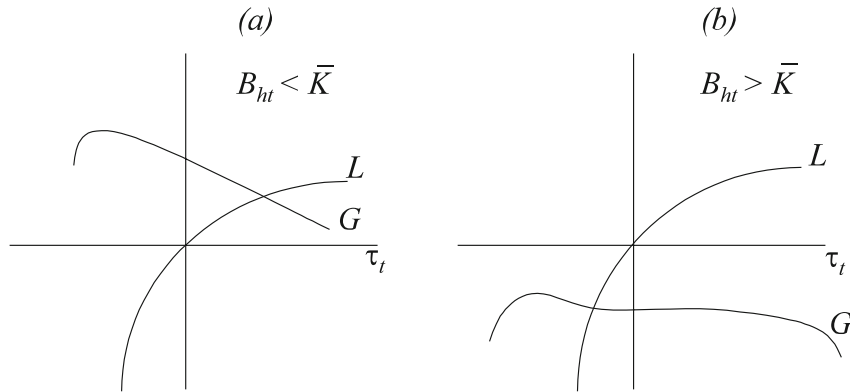


Figure 1: Individual Gains and Losses from a Change in Tariff

negative, zero, or even positive and exceeding that of the L function. Hence the G function may intersect the L function once or more, or may not intersect at all. But in any event, optimal tariff is negative since welfare is monotonically decreasing in the range $\tau_t \geq 0$. It may not be monotonic with respect to h however. Panel (b) of Figure 1 exhibits this case.

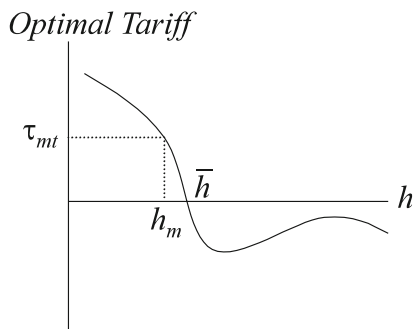


Figure 2: Individually Optimal Tariffs

Figure 2 shows the pattern of optimal tariff across all households. Given (R1), the median household's optimal tariff is positive. In general we have,

Proposition 1: The optimal tariff is positive, zero or negative as $h \lesseqgtr \bar{h}$.

This is quite intuitive. Households with better-than-average wealth holding would prefer a subsidy to labor intensive imports, or, equivalently, a subsidy to land intensive exports. Those with less-than-average wealth would prefer a tariff on the labor intensive imports.

In terms of Figure 2, it is now straightforward to check that the median voter hypothesis holds. Starting with any τ less than τ_{mt} , majority will prefer a marginal increase in tariff. At any $\tau > \tau_{mt}$, a marginal reduction will be preferred by households starting from some h below h_m to \bar{h} because the new tariff will be closer their optimal tariff and hence will be welfare improving. A marginal reduction will also be preferred by those with $h > \bar{h}$ but the reasoning is slightly different: it is because their utility is monotonically decreasing over $\tau_t \geq 0$, irrespective of whether their utility function is strictly concave with respect to τ . Thus

Proposition 2: The median voter hypothesis holds. At t , τ_{mt} is the politically chosen tariff.

Propositions 1 and 2 are same as Mayer's and serve as our point of departure for dynamic analysis with endogenous distribution.

3 Dynamics

Given the expressions of G and L , for the median household, the first order condition is:

$$\frac{(\bar{K} - \bar{h})(\bar{K} - B_{mt})\omega(\tau_{mt})}{\theta(\omega(\tau_{mt}) + \bar{K})^2[(1 - \beta)(\bar{K} - \bar{h})\phi_{mt} + \beta(B_{mt} - h_m)]} = \left[\frac{\gamma(1 - \gamma)}{1 + (1 - \gamma)\tau_{mt}} + \mu_x \eta_x \right] \tau_{mt}. \quad (18)$$

The l.h.s. and the r.h.s. are G_m and L_m respectively, where both are deflated by $1 - \beta$. This is illustrated in Figure 3, which is, essentially, a truncated part of panel (a) of Figure 1.

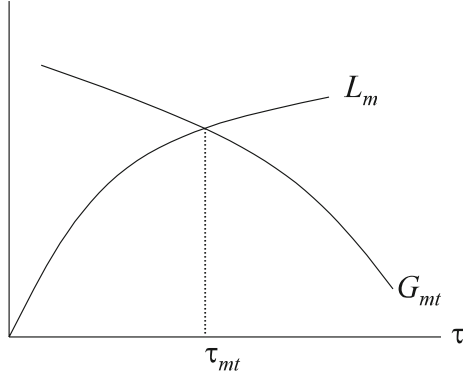


Figure 3: The Median Voter

An increase in B_{mt} (at $h = h_m$) shifts the G_{mt} curve down. Thus $\tau_{mt} = \tau(B_{mt}; \cdot)$ with $\partial\tau/\partial B_{mt} < 0$. Substituting this function into (9), we have

$$B_{mt+1} = (1 - \beta)h_m + (1 - \beta)(\bar{K} - \bar{h}) \frac{\omega(\tau(B_{mt})) + B_{mt}}{\omega(\tau(B_{mt})) + \bar{K}} + \beta B_{mt}. \quad (19)$$

This is the basic dynamic equation.

At given τ_{mt} , an increase in B_{mt} tends to increase B_{mt+1} by a positive income effect. Indirectly however, a higher wealth position implies a lower tariff (i.e. less demand for protection by the median household), a lower wage/rental ratio, a lower share of the median household in total earnings and less accumulation of wealth. Thus dB_{mt+1}/dB_{mt} is ambiguous in sign. Algebraically,

$$\frac{dB_{mt+1}}{dB_{mt}} = \beta + \frac{(1 - \beta)(\bar{K} - \bar{h})}{(\omega_t + \bar{K})^2} \left[\omega_t + \bar{K} + \frac{\omega_t(\bar{K} - B_{mt})}{\theta(1 + \tau_{mt})} \frac{d\tau_{mt}}{dB_{mt}} \right]. \quad (20)$$

Given (R2), (R3) and that $d\tau_{mt}/dB_{mt} < 0$, the derivative is less than one. But it can be negative and less than -1. Instability cannot be ruled out without further restriction. It is evident from (20) that the process is stable if β is not low enough. Appendix 3 proves a more general and precise result that stability is ensured if a condition stronger than (R3) holds irrespective of the magnitude of β or if β exceeds a threshold value:

Proposition 3: The dynamic adjustment path of the median household's wealth is (locally) stable if

$$\omega^* \geq \frac{3}{2}\bar{K} \quad \text{or if } \beta \geq \frac{3\bar{K} - 2\omega^*}{2\omega^* - \bar{K}}.$$

These are alternative and sufficient conditions.⁴ From now on, it will be implicit that ω^* sufficiently exceeds \bar{K} or β is above a lower bound such that the adjustment path is stable, and we will be concerned with steady state only.

Along the steady state, eqs. (19) and (18) respectively boil down to

$$B_m = B_m(\omega; \bar{K}) \equiv \frac{h_m \bar{K} + (\bar{K} + h_m - \bar{h})\omega}{\omega + \bar{h}} \quad (21)$$

$$\frac{(\bar{K} - \bar{h})(\bar{K} - B_m)\omega}{\theta(\omega + \bar{K})[(1 - \beta)(\bar{K} - \bar{h})(\omega + B_m) + \beta(B_m - h_m)(\omega + \bar{K})]} = \left[\frac{\gamma(1 - \gamma)}{1 + (1 - \gamma)\tau_m} + \mu_x \eta_x \right] \tau_m. \quad (22)$$

From (21),

$$B_m - h_m = \frac{(\bar{K} - \bar{h})(\omega + h_m)}{\omega + \bar{h}}; \quad \bar{K} - B_m = \frac{(\bar{h} - h_m)(\omega + \bar{K})}{\omega + \bar{h}}.$$

Using these, (22) is reduced to

$$\frac{(\bar{h} - h_m)\omega}{\theta[(1 - \beta)(\omega + B_m)(\omega + \bar{h}) + \beta(\omega + h_m)(\omega + \bar{K})]} = \left[\frac{\gamma(1 - \gamma)}{1 + (1 - \gamma)\tau_m} + \mu_x \eta_x \right] \tau_m. \quad (23)$$

Instead of (B_m, τ_m) , it would be convenient to analyze steady state in the (B_m, ω) space. Eq. (21) is already expressed in this space. In (23), the function $\omega(\tau_m)$ can be inverted and we can write $\tau_m = g(p^*, \omega, A'_x)$, where $g_p < 0$ and $g_\omega > 0$ (< 0 if the import sector were land intensive). A'_x is inversely proportional to A_x , the technology parameter of sector x (see Appendix 2). A decrease in A'_x would mean a Hicks-neutral technical progress in this sector. Thus $\partial g / \partial A'_x > 0$. The l.h.s. of (23) can be expressed as $f(B_m, \omega; \bar{K})$.⁵ Thus

$$f(B_m, \omega; \bar{K}) = g(p^*, \omega; A'_x). \quad (24)$$

Eqs. (21) and (24) solve the median household's wealth and the wage/rental ratio in the steady state. Graphically, this is shown in Figure 4(a); ignore panel (b) for now. The BB and MM curves graph eqs. (21) and (24) respectively.

⁴Eq. (20) also indicates that if β is large enough, $dB_{mt+1}/dB_{mt} > 0$ and so that the adjustment path is monotonic. Interestingly, when $-1 < dB_{mt+1}/dB_{mt} < 0$, the dynamics would exhibit an oscillatory pattern, implying a 'political cycle of tariff and distribution'. This kind of cycle is of different nature from a standard political cycle paradigms (e.g. Alesina, Roubini and Cohen (1997)). The latter means that decision making by politicians in pursuit of furthering their interests causes systematic changes in the path of a macro economy. Here it is meant that the political process may imply that, consequent to a shock, the adjustment path of a macro economy, otherwise monotonic, would be nonmonotonic. This would arise only when β is not too high and the wealth of the median household falls sufficiently short of the average.

⁵(R1) – (R3) are used in establishing below that $\partial f / \partial \omega < 0$.

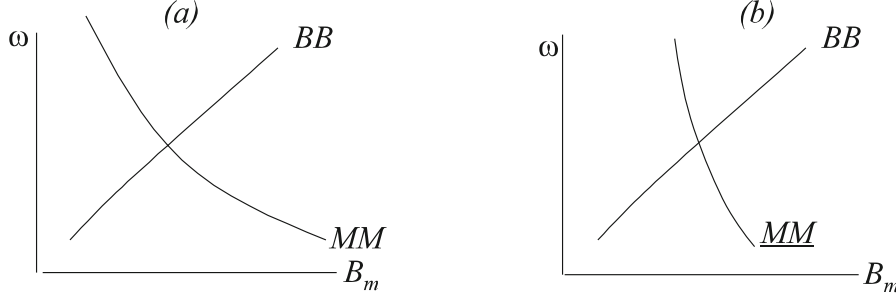


Figure 4: Steady State

4 Effects of Parametric Changes

In this model economy, distribution affects trade policy and vice versa, and both are endogenous, and, in the long run, stationary. The primitives of this economy are (a) the external terms of trade, (b) technologies, (c) the total endowment of land, (d) preference parameters including those of the distribution of h . Here we analyze how changes in some these primitives (namely (a), (b) and (c)) would affect long run trade policy and distribution.

In what follows we take the coefficient of variation as the measure of inequality (while all results also hold in terms of the proportional distance between mean and median (as in Alesina and Rodrik (1994))). Turning to wealth inequality first, in view of (21), observe that, along the steady state,

$$B_h = \frac{h(\omega + \bar{K}) + (\bar{K} - \bar{h})\omega}{\omega + \bar{h}}.$$

Thus the standard deviation of wealth holding is given by $\sigma_B = \sigma_h(\omega + \bar{K})/(\omega + \bar{h})$. For notational simplicity, let σ_h be normalized to one henceforth. The mean wealth is \bar{K} , given to this economy. Thus the coefficient of variation of wealth holding equals

$$\psi_B = \frac{\omega + \bar{K}}{\bar{K}(\omega + \bar{h})}. \quad (25)$$

Similarly, the coefficient of variation of income has the expression:

$$\psi_I = \frac{1}{\omega + \bar{h}}. \quad (26)$$

Inequality may also be thought of in terms of utilities and

$$\psi_U = \frac{(1 - \beta)(\bar{K} - \bar{h}) + \beta(2\omega + \bar{K} + \bar{h})}{(\bar{K} - \bar{h})(\omega + \bar{h})}. \quad (27)$$

The common element among all these indices is that the only endogenous variable that affects them is the wage rental ratio, and, moreover, for a given set of parametric values, a higher ω implies less inequality. This is because the wage income is same for all households while asset holding and income from assets vary. Hence an increase in the wage rate relative to the yield of asset income (land rent) implies in less inequality. How parametric changes affect the wage rental ratio is therefore critical in understanding how long run distribution is affected.

We are ready now to generate predictions on the effects of some parametric changes.

Terms of Trade and Technical Progress

Suppose the nation faces a decreasing terms of trade, i.e., p^* increases. As a result, the BB curve is unaffected, while, from (24), the MM curve shifts out. Both ω and B_m rise. By the Stolper-Samuelson implications, real wage rises and the land rent falls. Since ω increases, the effect of distribution is clear-cut: inequality in terms of wealth, income or individual welfare falls.

As ω increases, the domestic price of the imported good must have risen. Hence, the change in equilibrium tariff is not apparent. But a related graphical technique would prove that the tariff rate falls. Instead of (24), consider

$$f(\underline{B}_m, \underline{\omega}) = \underline{g}, \quad (28)$$

where \underline{g} is a constant, determining the MM curve in Figure 4(b). Let $\underline{g} = g_0$, the value of $g(\cdot)$ at the original value of p^* . Then the intersection of the (same) BB curve and the MM curve gives the original value of ω and B_m . Now consider an increase in p^* . We know that both ω and B_m increase and the BB curve does not shift. Hence the MM curve must shift out. This means that \underline{g} must have fallen as p^* increases. Recalling that, by definition, g is a monotonically increasing function of τ_m , it follows that τ_m must have fallen also.

It is straightforward to see that if imports were land intensive instead, the implications would be just the opposite. Hence

Proposition 4: An increase in the international price of the labor intensive good (a) increases real wage, (b) lowers land rent, (c) improves wealth of the median household, (d) reduces inequality and (e) leads to less trade protection.⁶

These effects are quite intuitive. Now consider a neutral technical progress in the labor intensive sector, i.e., the cost parameter A'_x falls. From the zero profit condition for this sector, it follows that it is equivalent to an increase in price. In view of (24), the MM curve shifts. Hence

Proposition 5: The effect of a neutral technical progress in the labor intensive sector are qualitatively same as those of an increase in the international price of the labor intensive good.

An Increase in Land Endowment

This is our last exercise. Relative to a given economy, consider another with a higher per capita land endowment. In some sense it captures the effect of ‘capital’ accumulation.

We see that this shifts the BB curve out and the MM curve in. Consequently, ω decreases and B_m may increase or decrease. The decline in ω means a decline in the real wage and an increase in the land rent. Note that (a) these are caused by an increase in the per capita endowment of land and (b) a decrease in ω means a lower tariff. The reason behind these changes is that an increase in the per capita land endowment tends to increase the median voter’s wealth and hence lower its (political) demand for protection. The international price remaining unchanged, the real wage falls and land rent increases. This explains the change in trade policy and factor rewards. The median household, thus, “accommodates” a cut in the wage rental ratio. It has a secondary effect also, which is negative: ceteris paribus, a decrease in the wage rental ratio lowers the wealth of the median household. The net effect on this household’s wealth is therefore uncertain. However, the equilibrium tariff declines unambiguously, as tariff is related one to one with the wage rental ratio and the latter falls.

⁶This also means less export subsidy, if imports were land intensive, when the international price of the (labor intensive) exports rises.

As for inequality, an increase in \bar{K} means that the average wealth rises. As ω falls, the variance of wealth rises too. Thus the effect of ψ_B is ambiguous. It is also checked that ψ_I increases, whereas ψ_U may increase or decrease. The overall effect of land (capital) accumulation on inequality is then unclear.

Proposition 6: An increase in \bar{K} leads to a decrease in the real wage and trade protection and an increase in the land rent. The effect on inequality is ambiguous.

Note that this result holds irrespective of which sector is labor or land intensive.

5 Consumption and Production Interventions

It is assumed thus far that direct trade intervention is the only policy instrument available. This is ad hoc. Mayer and Riezman (1987) have examined the political-economy implications of simultaneous choice of consumption and production interventions. Their central result is that the optimal consumption tax of all households is zero, irrespective of factor ownership, whereas the pattern of optimal production subsidy is same as in case an import tariff: households with above-average (below-average) wealth would prefer a production tax on (subsidy to) the labor-intensive good. In the process, this is a more efficient outcome compared to a trade tax or subsidy.

The same result holds here together with the similar implications of changes in terms of trade, technology or land accumulation on the type and degree of production intervention and distribution. In terms of our terminology, given production intervention (and thereby factor rewards), there is only a price effect associated with a consumption tax and thus the optimal consumption tax is zero for any household at each t , on or off the steady state. This leaves production intervention.

Let s_t denote production subsidy to sector x and let $S_t = p^* s_t Q_x(p_t)$ be the total cost of the subsidy program, where $p_t = p^*(1 + s_t)$ is the producer price. Analogous to (6), we have the following land market clearing condition:

$$\frac{(1 - \beta)p_{kt}(\bar{K} - \bar{h})}{\beta} = w_t + r_t \bar{K} - S_t = p^* Q_x(p_t) + Q_y(p_t) \equiv I^*(p^*, s_t), \quad (6')$$

where $I^*(\cdot)$ is the total income at world prices. An increase in s_t reduces I^* and lowers land price. Algebraically,

$$\hat{p}_{kt} = -\mu_x \eta_x s_t (\widehat{1 + s_t}), \quad (14')$$

which can be compared to (14).

The marginal gain function for a household is same as before. The marginal loss function constitutes only the second term of L in (17) (as there is no consumption loss). Given that $\mu_x \eta_x$ changes insignificantly when s_t , p^* or \bar{K} changes, the same qualitative conclusions as for tariff hold and for the same reasons.⁷

6 Conclusions

This paper extends the theory of political economy of trade protection by considering endogenous distribution of factor ownership in the standard 2×2 framework. Growth dynamics is totally

⁷Subsequent works by Mayer and Riezman (1989, 1990) identify situations in which tariffs may result as preferred instruments.

suppressed in attempting to focus on distributional dynamics. The ‘capital’ in the Heckscher-Ohlin model is more appropriately called ‘land’ here. In the long run, trade policy as well as the distribution of land ownership are endogenous and they are dependent on ‘more basic’ primitives such as technology and preferences. Land ownership changes through participation in the market for land. In terms of the political economy, the median voter approach is used. A terms of trade change and neutral technical progress have symmetric implication toward trade intervention and inequality in terms of wealth, income or welfare: they decrease or increase the price of labor or land intensive good rises. Interestingly, an increase in the endowment of land results in less real wage and higher land rent – via less demand for protection.

The economy under consideration is small and it has allowed trade in goods only, not in loans, so as to focus entirely on goods trade. Free mobility of loans is, in principle, straightforward to introduce but would add considerable complexity. The country’s average wealth would be another variable since it can deviate from the average land holding. Moreover, with land market clearing in every period, the price of land, in the absence of trade in loans, is determined period by period, not influenced by expectation of future land prices. If loans were to move free internationally, the dynamics of land price has to be considered on its own; bubbles may also rise. The dimension of the dynamics would jump from one to three: not just that of the median voter’s wealth but also that of aggregate wealth and the land price.

The paper has presented an elementary, specific model of distribution – an example so to speak. However, the existing literature – perhaps the entire literature – on the political economy of trade policy assumes that factor ownerships are exogenous. Needless to say, factor ownerships evolve over time. The paper wishes to make the point that analyzing endogenous distribution – along with endogenous trade policy through the political process – is very much possible and likely to yield new insights.

Appendix 1

It is shown here that for any household with $B_{ht} < \bar{K}$, G is a negative function of τ_t , as long as (R3) holds and $\tau_t \geq 0$.

Given that the import sector is labor intensive, it is sufficient to show that $dG/d\omega_t < 0$. In the text it is already shown that

$$d\phi_{ht}/d\omega_t > 0. \quad (\text{A1})$$

Next log-differentiating $\omega_t/(\omega_t + \bar{K})^2$, we find

$$\frac{\hat{\omega}_t - 2(\widehat{\omega_t + \bar{K}})}{d\omega_t} = -\frac{\omega_t - \bar{K}}{\omega_t(\omega_t + \bar{K})}, \quad (\text{A2})$$

The import sector being labor intensive, the regularity condition (R3) and $\tau_t \geq 0$ imply that $\omega_t > \omega^* > \bar{K}$. Thus (A2) is negative. In view of (A1) and (A2), $dG/d\omega_t < 0$.

Appendix 2

Cobb-Douglas technologies imply that the unit cost functions are of the form, $A'_j w^{\alpha_j} r^{1-\alpha_j}$, for $j = x, y$. Thus the zero profit conditions can be stated as:

$$A'_x w^{\alpha_x} r^{1-\alpha_x} = p; \quad B_y w^{\alpha_y} r^{1-\alpha_y} = 1.$$

In log we have

$$\alpha_x \ln w + (1 - \alpha_x) \ln r = \ln p - \ln A'_x; \quad \alpha_y \ln w + (1 - \alpha_y) \ln r = -\ln B_y.$$

In this paper we will be concerned with the effect of technical progress in a particular sector (along with that of other basic parameter). Thus, let us, for notational simplicity, normalize B_y to one so that $\ln B_y = 0$ but keep A'_x as it is. The last two equations solve ω , the wage rental ratio:

$$\omega = (p/A'_x)^{1/(\alpha_x - \alpha_y)}.$$

Let input coefficients be denoted as usual by a_{ij} 's. Next, applying Shephard's lemma, we have

$$a_{Lx} = A'_x \alpha_x \omega^{-(1-\alpha_x)} = A'_x \alpha_x (p/A'_x)^{-(1-\alpha_x)/(\alpha_x - \alpha_y)} = A'_x (1-\alpha_y)/(\alpha_x - \alpha_y) \alpha_x p^{-(1-\alpha_x)/(\alpha_x - \alpha_y)}.$$

Similarly,

$$\begin{aligned} a_{Kx} &= A'_x^{-\alpha_y/(\alpha_x - \alpha_y)} (1 - \alpha_x) p^{\alpha_x/(\alpha_x - \alpha_y)}; \quad a_{Ly} = A'_x (1-\alpha_y)/(\alpha_x - \alpha_y) \alpha_y p^{-(1-\alpha_y)/(\alpha_x - \alpha_y)} \\ a_{Ky} &= A'_x^{-\alpha_y/(\alpha_x - \alpha_y)} (1 - \alpha_y) p^{\alpha_y/(\alpha_x - \alpha_y)} \end{aligned}$$

Next we turn to the full employment equations:

$$a_{Lx} Q_x + a_{Ly} Q_y = 1; \quad a_{Kx} Q_x + a_{Ky} Q_y = \bar{K}.$$

Substituting the expressions of a_{ij} 's into these,

$$\alpha_x p^{-(1-\alpha_x)/(\alpha_x - \alpha_y)} Q_x + \alpha_y p^{-(1-\alpha_y)/(\alpha_x - \alpha_y)} Q_y = A'_x^{-(1-\alpha_y)/(\alpha_x - \alpha_y)}$$

$$(1 - \alpha_x)p^{\alpha_x/(\alpha_x - \alpha_y)}Q_x + (1 - \alpha_y)p^{\alpha_y/(\alpha_x - \alpha_y)}Q_y = \bar{K}A_x^{\alpha_y/(\alpha_x - \alpha_y)}.$$

Solving Q_x ,

$$\begin{aligned} Q_x &= \frac{(1 - \alpha_y)p^{1/(\alpha_x - \alpha_y)} - \bar{K}\alpha_y A_x^{1/(\alpha_x - \alpha_y)}}{(\alpha_x - \alpha_y)A_x^{(1 - \alpha_y)/(\alpha_x - \alpha_y)}p^{\alpha_x/(\alpha_x - \alpha_y)}} \\ \Rightarrow \frac{dQ_x}{dQ_p} &= \frac{(1 - \alpha_x)(1 - \alpha_y)p^{(1 + \alpha_y)/(\alpha_x - \alpha_y)} + \alpha_x\alpha_y A_x^{1/(\alpha_x - \alpha_y)}\bar{K}}{(\alpha_x - \alpha_y)^2 A_x^{(1 - \alpha_y)/(\alpha_x - \alpha_y)}p^{2\alpha_x/(\alpha_x - \alpha_y)}} \end{aligned}$$

Then

$$\eta_x = \frac{p}{Q_x} \frac{dQ_x}{dp} = \frac{(1 - \alpha_x)(1 - \alpha_y)p^{(1 + \alpha_y)/(\alpha_x - \alpha_y)} + \alpha_x\alpha_y A_x^{1/(\alpha_x - \alpha_y)}\bar{K}}{(\alpha_x - \alpha_y)p^{\alpha_y/(\alpha_x - \alpha_y)}[(1 - \alpha_y)p^{1/(\alpha_x - \alpha_y)} - \bar{K}\alpha_y A_x^{1/(\alpha_x - \alpha_y)}]}$$

It is easy to see that the signs of $\partial\eta_x/\partial p$, $\partial\eta_x/\partial\bar{K}$ and $\partial\eta_x/\partial A_x'$ are opposite to $\partial Q_x/\partial p$, $\partial Q_x/\partial\bar{K}$ and $\partial Q_x/\partial A_x'$, while the latter set of derivatives are of the same sign as $\partial\mu_x/\partial p$, $\partial\mu_x/\partial\bar{K}$ and $\partial\mu_x/\partial A_x'$. Hence μ_x and η_x change in opposite ways as p , \bar{K} or A_x' changes.

Appendix 3

Proposition 1 is proved here. Denote the r.h.s. of (18) as $g(\tau_{mt})$ and the denominator of the left hand side as D . Totally differentiating the first-order condition, we then have

$$\begin{aligned} -\frac{d\tau_{mt}}{dB_{mt}} &= \frac{(\omega + \bar{K})^2[(1 - \beta)(\bar{K} - \bar{h}) + \beta(\bar{K} - h_m)]}{\frac{D^2 g'(\tau_{mt})}{\theta\omega(\bar{K} - \bar{h})} + \frac{\bar{K} - B_m}{\theta(1 + \tau_m)} [(1 - \beta)(\bar{K} - \bar{h})(\omega^2 - \bar{K}B_m) + \beta(B_m - h_m)(\omega^2 - \bar{K}^2)]} \\ &< \frac{\theta(1 + \tau_m)(\omega + \bar{K})^2}{\bar{K} - B_m} \frac{(1 - \beta)(\bar{K} - \bar{h}) + \beta(\bar{K} - h_m)}{(1 - \beta)(\bar{K} - \bar{h})(\omega^2 - \bar{K}B_m) + \beta(B_m - h_m)(\omega^2 - \bar{K}^2)} \end{aligned}$$

where the subscript t ignored for notational convenience. Substituting the r.h.s. of this expression into (20), a sufficient condition for (local) stability is:

$$\begin{aligned} \frac{(1 + \beta)(\omega + \bar{K})^2}{(1 - \beta)(\bar{K} - \bar{h})} + \omega + \bar{K} &> A_1 \equiv \frac{\omega(\omega + \bar{K})^2[(1 - \beta)(\bar{K} - \bar{h}) + \beta(\bar{K} - h_m)]}{(1 - \beta)(\bar{K} - \bar{h})(\omega^2 - \bar{K}B_m) + \beta(B_m - h_m)(\omega^2 - \bar{K}^2)} \\ \Leftrightarrow \frac{2(\omega + \bar{K})}{1 - \beta} + \frac{1 + \beta}{1 - \beta} \frac{(\omega + \bar{K})(\omega + \bar{h})}{\bar{K} - \bar{h}} &> A_1. \end{aligned}$$

The term $\omega + \bar{K}$ cancels out from both sides. Then the above inequality is equivalent to

$$\begin{aligned} &\frac{2}{1 - \beta} [(1 - \beta)(\bar{K} - \bar{h})(\omega^2 - \bar{K}B_m) + \beta(B_m - h_m)(\omega^2 - \bar{K}^2)] \\ &+ \frac{1 + \beta}{1 - \beta} \frac{\omega + \bar{h}}{\bar{K} - \bar{h}} [(1 - \beta)(\bar{K} - \bar{h})(\omega^2 - \bar{K}B_m) + \beta(B_m - h_m)(\omega^2 - \bar{K}^2)] \\ &> \omega(\omega + \bar{K})[(1 - \beta)(\bar{K} - \bar{h}) + \beta(B_m - h_m)] + \beta\omega(\omega + \bar{K})(\bar{K} - B_m). \end{aligned} \tag{A3}$$

Let the last term in the r.h.s. be expressed as

$$\frac{\beta\omega(\omega + \bar{K})(\bar{K} - B_m)}{\bar{K} - \bar{h}} \cdot (\bar{K} - \bar{h})$$

and let the coefficients of $\bar{K} - \bar{h}$ and $B_m - h_m$ be collected at one side of the inequality. (A3) is then equivalent to

$$(\bar{K} - \bar{h})A_2 + \frac{\beta(B_m - h_m)}{1 - \beta}A_3 > 0, \quad \text{where} \quad (\text{A4})$$

$$\begin{aligned} A_2 &\equiv \omega^2 - 2\bar{K}B_m - \omega\bar{K} - \omega\bar{K} + \beta\omega^2 + \beta\omega\bar{K} \\ &\quad + \frac{(1 + \beta)(\omega + \bar{h})(\omega^2 - \bar{K}B_m)}{\bar{K} - \bar{h}} - \frac{\beta\omega(\omega + \bar{K})(\bar{K} - B_m)}{\bar{K} - \bar{h}} \\ A_3 &\equiv \omega^2 - 2\bar{K}^2 - \omega\bar{K} + \beta\omega^2 + \beta\omega\bar{K} + (1 + \beta)\frac{\omega + \bar{h}}{\bar{K} - \bar{h}}(\omega^2 - \bar{K}^2). \end{aligned}$$

Consider various terms in A_2 . The sixth term can be expressed as

$$\begin{aligned} &\frac{(1 + \beta)(\omega + \bar{h})(\omega^2 - \bar{K}B_m)}{\bar{K} - \bar{h}} \\ &= \frac{\omega + \bar{h}}{\bar{K} - \bar{h}}(\omega^2 - \bar{K}B_m) + \frac{\beta(\omega + \bar{h})}{\bar{K} - \bar{h}}[\omega(\bar{K} - B_m) + (\omega - \bar{K})(\omega + B_m)] \\ &= \frac{\omega + \bar{h}}{\bar{K} - \bar{h}}[\omega^2 - \bar{K}B_m + \beta(\omega - \bar{K})(\omega + B_m)] + \frac{\beta\omega(\omega + \bar{h})}{\bar{K} - \bar{h}}(\bar{K} - B_m). \end{aligned}$$

Substituting this into A_2 ,

$$\begin{aligned} A_2 &= \omega^2 - 2\bar{K}B_m - \omega\bar{K} + \beta\omega^2 + \beta\omega\bar{K} + \frac{\omega + \bar{h}}{\bar{K} - \bar{h}} \\ &\quad [\omega^2 - \bar{K}B_m + \beta(\omega - \bar{K})(\omega + B_m)] - \beta\omega(\bar{K} - B_m) \\ &> \omega^2 - 2\bar{K}B_m - \omega\bar{K} + \beta\omega^2 + \beta\omega B_m + [\omega^2 - \bar{K}B_m + \beta(\omega - \bar{K})(\omega + B_m)] \\ &\quad \text{using } \omega > \bar{K} \\ &= 2(\omega^2 - \bar{K}B_m) - \bar{K}(\omega + B_m) + \beta\omega(\omega + B_m) + \beta(\omega - \bar{K})(\omega + B_m) \\ &= 2(\omega^2 - \bar{K}B_m) + (\omega + B_m)[\beta(2\omega - \bar{K}) - \bar{K}] \\ &> 2(\omega - \bar{K})(\omega + B_m) + (\omega + B_m)[\beta(2\omega - \bar{K}) - \bar{K}] \\ &\quad \text{since } \omega^2 - \bar{K}B_m > (\omega - \bar{K})(\omega + B_m) \\ &= (\omega + B_m)[\beta(2\omega - \bar{K}) - (3\bar{K} - 2\omega)] \end{aligned} \quad (\text{A5})$$

Similarly, using $\omega > \bar{K}$, we have

$$\begin{aligned} A_3 &> \omega^2 - 2\bar{K}^2 - \omega\bar{K} + \beta\omega^2 + \beta\omega\bar{K} + (1 + \beta)(\omega^2 - \bar{K}^2) \\ &= (2 + \beta)(\omega^2 - \bar{K}^2) - \bar{K}(\omega + \bar{K}) + \beta\omega(\omega + \bar{K}) \\ &= (\omega + \bar{K})[\beta(2\omega - \bar{K}) - (3\bar{K} - 2\omega)]. \end{aligned} \quad (\text{A6})$$

Hence, as a sufficient condition, the inequality (A4) is met if the r.h.s. of (A5) and (A6) substitute A_2 and A_3 respectively in (A4) and the resulting expression is positive: that is,

$$\left[(\bar{K} - \bar{h})(\omega + B_m) + \frac{\beta(B_m - h_m)}{1 - \beta} \right] [\beta(2\omega - \bar{K}) - (3\bar{K} - 2\omega)] > 0, \text{ i.e.}$$

$$\beta(2\omega - \bar{K}) > 3\bar{K} - 2\omega \Leftrightarrow \beta > \frac{3\bar{K} - 2\omega}{2\omega - \bar{K}}. \quad (\text{A7})$$

But $\omega > \omega^*$, the wage/rental ratio at the free trade equilibrium. Thus (A7) is satisfied and the dynamic path is stable if

$$\beta > \frac{3\bar{K} - 2\omega^*}{2\omega^* - \bar{K}}.$$

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