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Trade, Envy and Growth: International Status Seeking in a Two-Country World*

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Abstract

This paper analyzes international status seeking in a two-country model of endogenous growth: utility of agents in developing countries is affected by consumption gaps with the average consumer in advanced economies. By distorting terms of trade, status seeking: (i) may compensate for structural gaps in physical productivity, inducing convergence; (ii) may revert the link between trade and growth; and (iii) induces divergence when interacting with technological catching-up. In particular, envy in conjunction with catching-up predicts switchovers of growth leadership: when the advanced economy is both status- and technology-leader in the short run, convergence in interest rates - e.g. due to R&D spillovers - implies that the initially lagging economy becomes growth-leader in the long run, due to permanent price distortions induced by envy.

JEL Codes O33, F12, D91.

Keywords Endogenous Growth, International Trade, Consumption Externalities, Productivity Differences, Status Seeking, Technology Diffusion.

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1 Introduction

Capital sin or spirit of capitalism? Despite many censorious definitions, envy is a powerful economic incentive. Economists have long understood that human behaviour is crucially driven by the subjective perception of social status (Veblen, 1899), and there is strong empirical evidence that individuals form such perceptions on the basis of interpersonal comparisons (Frank, 1997). In particular, status-seeking behavior has been regarded as a major ingredient of the spirit of capitalism, as it represents an additional motive for acquiring goods, beyond the 'purely physical' benefit that consumption actually provides (Cole et al. 1992; Bakshi and Chen, 1996). These considerations inspired early consumption theories in arguing that consumption choices are affected by the willingness to catch up on the social scale (Duesenberry, 1949). More recently, the theory of comparison utility gave explicit microfoundations to aggregate models where saving rates depend on relative, rather than absolute consumption levels. The growing body of literature on 'outward-looking preferences' (Carrol et al. 1997) shows that when intertemporal choices embody some degree of status desire the long-run growth rate of the economy is modified (Alvarez-Cuadrado et al. 2004), and the economy may display dynamic inefficiency due to overaccumulation of capital (Alonso-Carrera et al. 2004). In this literature, social status phenomena are essentially consumption externalities that drive the economy away from the socially optimal equilibrium: as shown by Dupor and Liu (2003), the laissez-faire equilibrium in the presence of 'jealousy' implies that agents overconsume with respect to the Pareto-optimal equilibrium. Further distorsions induced by envy arise in the economy when utility is also affected by leisure, as in the optimal growth models with endogenous labor supply employed by Liu and Turnovsky (2005) and Alvarez-Cuadrado (2006).

It can be stressed that all contributions mentioned above assume *within*-country spillovers - that is, agents evaluate their status on the basis of the average consumption level of the economy in which they live. It is however plausible that, nowadays, status seeking phenomena also operate at the international level. One may recognize this as an aspect of globalization, i.e. a large-scale integration process which reshapes individual behavior by giving consumers new 'neighbors' to look at, and to compare with. There is substantial evidence that information delivered by global mass media and marketing activities of multinational firms, as well as tourism and migration, affect consumption patterns of developing countries by creating a *foreign benchmark* that fuels consumers' expectations and desires - see James (2000). As pointed out by Sklair (1991), the status-leader role played by western economies appears strenghtened by the fact that consumers in developing countries perceive commodities produced in advanced economies as positional goods - that is, status-signalling devices. Developments in Central and Eastern Europe countries after the end of the Cold War, or in China and India in recent years, provide a wealth of anedoctal evidence confirming this desire to 'have what they have' (e.g. Friedman, 2000). Moreover, taking into account unequal distribution of income within countries, the importance of status consumption is not confined to high-income classes of emerging economies - i.e. those who can afford a living standard comparable to the average consumer in advanced economies - since status desire directed towards positional goods is typically observed in low-income classes as well (Caplovitz, 1967; Belk, 1988). In other words, international consumption externalities exist, influence consumption behavior at the economy level, and likely have macroeconomic consequences.

From a general equilibrium perspective, transboundary envy - or equivalently, *international status seeking* - may have relevant implications for the development path followed by open economies, since growth rates are affected by consumption dynamics through the relative prices of traded goods. However, as noted above, a formal treatment of international status seeking is absent in the existing literature, where preferences are assumed to be interdependent among compatriots.[1] This paper analyzes 'Catching-Up With The Joneses' phenomena occurring between trading economies, and investigates its consequences for terms of trade and growth differentials. The world consists of two countries, the status leader and the status seeker, that produce heterogeneous goods. Consumption in the status-leader country represents the benchmark 'standard of living' for agents living in the less advanced (but developing) economy. Growth differentials depend on terms of trade effects, which are in turn modified by envy: as shown in section 2, consumption expenditure in the status-seeking economy grows, *ceteris paribus*, at higher rates. The dynamic increase in the relative foreign demand for the good produced by the status leader, in turn, inflates its relative price on the world market.

This general result is exploited to address a central topic in trade theory: the existence of structural gaps between trading economies, and the possible mechanisms leading to international convergence in growth rates. Sections 3 and 4 analyze two models of endogenous growth where standard convergence results are crucially modified by the presence of envy. In the literature on trade between asymmetric countries, structural gaps - i.e. international differences in the rates of physical productivity growth - are considered a major source of cross-country income differences (Rebelo, 1991) and international divergence (Feenstra, 1996). Section 3 develops a simple learning-by-doing model with status seeking, and shows that terms-of-trade effects generated by envy (i) may compensate for structural gaps and induce convergence, or even (ii) revert the link between trade and growth if the degree of status desire is sufficiently high. On the one hand, the possibility of envy-induced convergence is interesting in itself, since we ob-

[1] In addition to the literature on 'Catching-Up With Joneses' quoted above, a number of contributions formalized social status in terms of *relative wealth* (Corneo and Jeanne, 1997; Futagami and Shibata, 1998). Fisher (2005) and Fisher and Hof (2005) apply the relative wealth approach to open-economy models, but again assume *intra*-national status seeking: both papers consider a small-open economy where the benchmark level of wealth is the average level that agents observe in their own country.

tain constant market shares in the absence of the technological links that are typically required to obtain convergence - i.e. knowledge spillovers (Grossman and Helpman, 1991), flows of ideas (Rivera-Batiz and Romer, 1991), technology diffusion (Barro and Sala-i-Martin, 1997), trade in intermediate inputs (Acemoglu and Ventura, 2002). On the other hand, the relevance of envy for long-run dynamics raises the question of the interaction between status seeking and technological catching-up. The issue is tackled in section 4 by integrating status desire and catching-up in R&D productivity in the two-country model of horizontal innovations (Grossman and Helpman, 1991; Barro and Sala-i-Martin, 1997). The status leader is also technological leader, by virtue of a comparative advantage in R&D sectors, whereas the status seeker is also technological follower. First, it is shown that, for any positive degree of status desire, the two countries *diverge*: technological catching-up implies interest rate equalization, but status desire still distorts terms-of-trade dynamics, driving market shares away from stationary equilibria. Second, if the status-and-technology leader is also growth leader in the short run, the model predicts a switchover of growth leadership in finite time: due to the interaction between R&D spillovers and status desire, the initially lagging economy becomes growth leader in the medium run, and exhibits ever-increasing market shares from that point onwards. The implications of these results are discussed with the main conclusions in section 5.

2 International status seeking

A central element of Veblen's theory of conspicuous consumption is the observation that individual behavior is driven by the perception of social status: beyond the material benefit that commodities provide, consumption demand is influenced by "the stimulus of an invidious comparison which prompts us to outdo those with whom we are in the habit of classing ourselves" (Veblen, 1899, p.103). A similar reasoning underlies the modern theory of comparison utility, according to which individuals display outward-looking preferences: personal satisfaction depends on the observed gap between agents' consumption and the *social benchmark*, usually represented by the average consumption level of the economy (Carrol et al. 1997; Dupor and Liu, 2003). In a closed-economy context, intertemporal choices are affected by 'Catching-Up With The Joneses': wealth accumulation depends on relative consumption levels, and agents tend to overconsume with respect to the standard optimal growth model with status-independent preferences (Alonso-Carrera et al. 2004; Alvarez-Cuadrado et al. 2004). This literature assumes that preferences are interdependent among agents living in the same economy. Building on the idea that psychological benchmarks can be provided by consumption levels in foreign countries, this section formalizes the 'Catching-Up With The Joneses' phenomenon as an international externality between trading economies. In order to provide a general framework for studying the consequences of international status seeking, we begin by describing consumer's behavior in a two-country world, abstracting from technological specifications.

2.1 Intertemporal choices in a two-country world

Time is continuous and indexed by $t \in [0, \infty)$. The instantaneous variation of variable x is denoted by $\dot{x} = dx/dt$, and its growth rate by $\hat{x} = \dot{x}/x$. The world comprises two countries - or economic areas - indexed by $i = a, b$, specialized in producing heterogeneous goods.[2] A first country, the 'status-leader', produces good a, and a second country, labelled as the 'status-seeker', produces good b. Trade allows consumers in each country to enjoy both goods. Population N_i is constant in both economies, and agents are homogeneous within each country. The consumption index is denoted by γ_i, and is represented by a composite good which combines the two commodities available in the world. Denoting by c_i^j the quantity of good j consumed by agents in country i, per capita imports in country i are represented by c_i^j with $j \neq i$. Assuming a constant elasticity of substitution between traded goods, $\sigma > 0$, the consumption index reads

$$\gamma_i = \left[(1/2) \left(c_i^a \right)^{\frac{\sigma-1}{\sigma}} + (1/2) \left(c_i^b \right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \quad \sigma \neq 1. \tag{1}$$

When $\sigma < 1$, traded goods are perceived as complements, whereas $\sigma > 1$ implies that agents treat goods as substitutes. Individual consumption expenditure, expressed in terms of output produced in country i, is denoted by c_i. Denoting by p_a and p_b the relative prices of the respective goods, the expenditure constraint reads

$$p_i c_i = p_a c_i^a + p_b c_i^b. \tag{2}$$

The instantaneous utility functions are specified as

$$u_a \left(\gamma_a \right) = \frac{\gamma_a^{1-\nu} - 1}{1 - \nu}, \tag{3}$$

$$u_b \left(\gamma_b, \bar{\gamma} \right) = \frac{\left(\gamma_b / \bar{\gamma}^{\theta} \right)^{1-\nu} - 1}{1 - \nu}, \tag{4}$$

where $-\nu < 0$ is the elasticity of marginal utility. Preferences (3) are standard, and postulate that satisfaction of consumers in country a only depends on own consumption, γ_a. Preferences (4), instead, comply with the specifications adopted in the literature on 'comparison utility' (Carrol et al. 1997). In general, $\bar{\gamma}$ is a psychological benchmark level by which consumers evaluate their status: utility depends on a weighted ratio between own consumption, γ_b, and the reference level $\bar{\gamma}$, and the importance of status

[2] Originally, two-country models were considered the natural environment for analyzing the effects of trade in the Heckscher-Ohlin framework (for a recent result, see Fujiwara and Shimomura, 2005). A different perspective is taken by the literature on trade and endogenous growth, which focuses on cross-country differences in income levels and convergence in growth rates - see section 2.2.

in individual satisfaction is parametrized by θ, which is the *degree of status desire*: if $\theta \to 0$, benchmark levels are no longer important for consumer's utility, and (4) reduces to the standard form as in preferences (3). In the closed-economy setting, similar benchmark preferences have been used to describe two related phenomena, habit formation and 'Catching-Up with the Joneses' (Carrol et al. 1997; Alonso-Carrera et al. 2004; Alvarez-Cuadrado et al. 2004). In the former case, $\bar{\gamma}$ is the weighted average of past consumption indices of the same agent. In the latter case, $\bar{\gamma}$ is the average level of consumption within the economy in which the representative agent operates.

This paper considers relative consumption in a different context by formalizing asymmetric preferences between trading countries. In particular, consumers' behavior in economy b is driven by *international status seeking*. The underlying logic is that agents in emerging economies aim at achieving the living standards exhibited by consumers of more advanced economies. Formally, we assume $\bar{\gamma} = \gamma_a$, with $0 \leq \theta < 1$ and $\nu > 1$. Setting $\bar{\gamma} = \gamma_a$, utility in country b is affected by consumption gaps with the status leader: instantaneous satisfaction reads $u_b(\gamma_b, \bar{\gamma}) = u_b(\gamma_b, \gamma_a)$, where foreign consumption γ_a is taken as given. Envy arises when $\theta > 0$, which implies $\partial u_b / \partial \gamma_a < 0$: an increase in the benchmark level decreases utility. Another important restriction is that the elasticity parameter ν is assumed to exceed unity. Setting $\nu > 1$ implies that the cross derivative $\partial^2 u_b / (\partial \gamma_b \partial \gamma_a)$ be strictly positive: a marginal increase in consumption of country a increases the marginal utility (from own consumption) of agents in country b. This guarantees that agents in country b display 'Catching-Up with the Joneses' behavior (Dupor and Liu, 2003). In the present context, an increase in the benchmark level stimulates the willingness of country b's residents to consume more in order to cath-up with the status leader.[3]

Following a standard procedure (e.g. Frenkel and Razin, 1985; Gardner and Kimbrough, 1990), the consumer problem is solved in two steps. First, each agent chooses how to allocate consumption expenditures between the two goods by maximizing u_i subject to (2), using c_i^a and c_i^b as control variables and taking expenditure c_i as given. Defining the terms-of-trade index as $p \equiv p_b/p_a$, first-step optimality conditions imply

$$c_i^a = c_i^b p^\sigma \tag{5}$$

in both countries. Substituting (5) in (1)-(2), equilibrium consumption indices are

$$\gamma_a^*(c_a, p) = (c_a/p)\,\tau(p) \text{ and } \gamma_b^*(c_b, p) = c_b \tau(p), \tag{6}$$

where we have defined

$$\tau(p) \equiv (1/2)^{\frac{\sigma}{\sigma-1}} \left(1 + p^{\sigma-1}\right)^{\frac{1}{\sigma-1}}. \tag{7}$$

[3] As pointed out by Alonso-Carrera et al. (2004), the restriction $\nu > 1$ is relevant because it guarantees an interior solution to the intertemporal maximization problem in the presence of consumption externalities.

Substituting (6) in (3)-(4) gives the indirect utility functions

$$u_a^*(c_a;p) = u_a(\gamma_a^*(c_a,p)) \text{ and } u_b^*(c_b;p,\bar{\gamma}) = u_b(\gamma_b^*(c_b,p),\bar{\gamma})$$

where the price index is taken as given by each consumer, and benchmark levels $\bar{\gamma} = \gamma_a^*(c_a,p)$ are taken as given by agents in country b. In the second step, agents choose the sequence of consumption expenditures $\{c_i(t)\}_0^\infty$ that maximizes the objective function

$$\int_0^\infty u_i^*(c_i(t))\, e^{-\rho t} dt, \tag{8}$$

where $\rho > 0$ is the utility discount rate. Objective (8) is maximized subject to the dynamic wealth constraint

$$\dot{q}_i(t) = r_i(t)\, q_i(t) + w_i(t)\, \ell_i(t) - c_i(t), \tag{9}$$

where all variables are expressed in terms of output produced in country i. Private wealth per capita q_i is held in the form of assets yielding a rate of return equal to r_i, and labor income equals the wage rate w_i times units of labor efficiency supplied, ℓ_i. Denoting by μ_a and μ_b the dynamic multipliers associated with constraint (9), optimality conditions of the second-step problem imply

$$\hat{\mu}_a = \rho - r_a \text{ and } \mu_a = c_a^{-\nu}\tau^{1-\nu}p^{\nu-1}, \tag{10}$$

$$\hat{\mu}_b = \rho - r_b \text{ and } \mu_b = c_b^{-\nu}\tau^{(1-\nu)(1-\theta)}p^{\theta(1-\nu)}c_a^{\theta(\nu-1)}. \tag{11}$$

Time-differentiating μ_a and μ_b and substituting in the respective co-state equations gives

$$\hat{c}_a = \nu^{-1}\left[R_a + (\nu-1)(1-\tau_p)\hat{p}\right], \tag{12}$$

$$\hat{c}_b = \nu^{-1}\left[R_b + (1-\nu)(1-\theta)\tau_p\hat{p} + \theta(1-\nu)\hat{p} - \theta(1-\nu)\hat{c}_a\right], \tag{13}$$

where we have defined *net interest rates* as $R_i \equiv r_i - \rho$, and $\tau_p \equiv \partial\tau/\partial p$. From (12)-(13), consumption dynamics in both countries are influenced by terms of trade effects, through τ_p and $\hat{p}$.[4] In particular, expression (13) shows that, for any positive degree of status desire θ, the growth rate of consumption expenditure in country b is *directly* affected by consumption expenditure in country a, by virtue of transboundary envy.

Ruling out international mobility of assets, balanced trade in each point in time requires that $\hat{p}$ be proportional to the differential in expenditure growth rates,[5]

$$\hat{p} = \sigma^{-1}(\hat{c}_a - \hat{c}_b). \tag{14}$$

[4] Terms-of-trade effects in (12)-(13) vanish as $\nu \to 1$. In this case, utility becomes logarithmic and the growth rates of consumption expenditures in both countries obey the standard Keynes-Ramsey rule, $\hat{c}_i = R_i$. The logarithmic case, however, is not interesting for the aim of the present analysis, since $\nu \to 1$ would imply that consumers in country b do not display 'Catching-Up with the Joneses' behavior.

[5] Trade balance requires that the value of aggregate imports in country a match that of aggregate imports in country b - that is, $p_b c_a^b N_a = p_a c_b^a N_b$. Substituting this condition in (5) and (2) gives $p^\sigma = (c_a N_a)/(c_b N_b)$, which yields (14) after straightforward time-differentiation.

Substituting (12)-(13) in (14), the growth rate of the price index along the equilibrium path reads

$$\hat{p} = \frac{R_a - R_b - (\theta/\nu)(\nu - 1) R_a}{\nu\sigma - (\nu - 1)[1 + (\theta/\nu)(1 - \tau_p)]}. \tag{15}$$

Note that setting $\theta = 0$, we obtain the growth rate of the price index without envy,

$$\hat{p}^f \equiv \frac{R_a - R_b}{\nu\sigma - (\nu - 1)}, \tag{16}$$

where superscript f is used to denote results obtained in the 'status-free' model. Comparing (15) with (16), the effect of envy on the dynamics of terms of trade is twofold. On the one hand, envy imposes a wedge between terms-of-trade effects and the interest rate differential, $R_a - R_b$: this *interest-rate effect*, represented by the last term in the numerator of (15), is the source of the main results of our analysis. On the other hand, status desire induces an *elasticity effect* represented by the square brackets in the denominator of (15): θ modifies the elasticity of intertemporal substitution and, hence, the magnitude of $\hat{p}$ in response to a given interest rate differential. In this regard, the price elasticity can be denoted as

$$\epsilon(t) \equiv \frac{1}{\nu\sigma - (\nu - 1)[1 + (\theta/\nu)(1 - \tau_p(t))]}. \tag{17}$$

A sufficient condition to rule out the degenerate case of a negative price elasticity is

$$\frac{\nu}{\nu - 1}[1 + \nu(\sigma - 1)] > \theta, \tag{18}$$

which ensures case $\epsilon(t) > 0$ at each point in time. Since $\nu > 1$ and $\theta < 1$, condition (18) is easily met for a wide range of parameters (in particular, it is necessarily satisfied when traded goods are substitutes, $\sigma > 1$) and is assumed to hold throughout the rest of the paper.[6]

Expression (15) provides the basis for the main results of the present analysis: for given interest rates, status desire determines both the magnitude and the direction of terms-of-trade effects, by influencing the absolute value and the sign of $\hat{p}$. In particular, the price distorsion represented by the term $(\theta/\nu)(\nu - 1) R_a$ may be high enough to revert the sign of $\hat{p}$ with respect to the status-free case - see (16). The possibility that $\hat{p} < 0$ due to status seeking has an intuitive interpretation: ceteris paribus, status seeking boosts consumption expenditures in country b, implying a dynamic increase in the relative demand for good a. This process inflates the relative price of the good produced in the status-leader economy, driving down the price ratio, $p = p_b/p_a$, over

[6] Related literature ignores similar restrictions since the vast majority of two-country models assumes logarithmic intertemporal utility, $\nu = 1$. In this case, the price elasticity $\epsilon = 1/\sigma$ is, by construction, constant and strictly positive. See e.g. Frenkel and Razin (1985) and Feenstra (1996).

time. Obviously, the consequences of status seeking for growth differentials can be assessed only by making further assumptions regarding technologies and accumulation processes. Sections 3 and 4 apply this framework to standard models of endogenous growth. Below, we give formal definitions of growth differentials and a brief summary of established results in the literature on growth and international convergence.

2.2 Structural gaps and international convergence

In the early Nineties, the vast empirical evidence documenting cross-country differences in income levels stimulated a huge literature on international trade and economic growth. Two widely accepted empirical findings are: (i) cross-country gaps in productivity and income per capita are huge and persistent, and (ii) the rate of convergence between countries is limited, with estimated value around two per cent (Temple, 1999; Acemoglu and Ventura, 2002; Barro and Sala-i-Martin, 2004). Cross-country differences in income levels have been primarily explained in terms of asymmetric technologies that, in an endogenous-growth framework, may generate income gaps even if economies converge in growth rates. In this regard, a central result of this literature is that convergence in growth rates obtains when backward countries share some of the technological improvements of advanced economies - e.g. through knowledge spillovers (Grossman and Helpman, 1991), flows of ideas (Rivera-Batiz and Romer, 1991), technology diffusion (Barro and Sala-i-Martin, 1997), or trade in intermediate inputs (Acemoglu and Ventura, 2002). If none of these opportunities for technical improvement is accessible to lagging countries, structural differences in physical-productivity growth rates - *structural gaps*, henceforth - translate into persistent differences in growth rates (Rebelo, 1991), and market shares diverge despite free trade in final goods (Feenstra, 1996).

The situation in which the production possibility frontier of lagging countries is not improved by external factors can be labelled as *technological independence* - a broad definition including the absence of trade in intermediate inputs. The link between technological independence and diverging market shares is formally described as follows: denote by Y_i aggregate physical output in country i, and define the *growth differential* between economies a and b as $\Delta \equiv \hat{p}_a + \hat{Y}_a - \hat{p}_b - \hat{Y}_b$. The dynamics of the shares of the two countries in the world market are exclusively determined by the sign of the growth differential, since $\Delta > 0$ ($\Delta < 0$) implies that the value of output of country a increases (decreases) relative to world output. The degree of divergence, in turn, can be indexed by the absolute value of the growth differential, $|\Delta|$. Denoting aggregate consumption expenditure by $C_i = N_i c_i$, we can substitute (14) to rewrite the growth differential as

$$\Delta = \Delta^y - \hat{p} = \Delta^y - \sigma^{-1}\Delta^c, \tag{19}$$

where $\Delta^y \equiv \hat{Y}_a - \hat{Y}_b$ represents the *physical-output effect*, and the terms-of-trade effect, $\hat{p}$, is proportional to the differential in consumption growth rates, $\Delta^c \equiv \hat{C}_a - \hat{C}_b$. It follows from (19) that, if each country converges to a balanced growth equilibrium at least in the long run, $\hat{Y}_i \to \hat{C}_i$ implies

$$\lim_{t\to\infty} \Delta(t) = \lim_{t\to\infty} (\sigma - 1)\,\sigma^{-1}\Delta^y = \lim_{t\to\infty} (\sigma - 1)\,\hat{p}. \tag{20}$$

In the presence of structural gaps, $\hat{Y}_a \neq \hat{Y}_b$ also in the long run and the growth differential (20) differs from zero: the physical-output effect dominates if traded goods are perceived as substitutes ($\sigma > 1$), whereas terms-of-trade effects dominate when traded goods are perceived as complements ($\sigma < 1$).

3 Trade, Envy and Structural Gaps

The logic behind models with structural gaps is that barriers to knoweldge and technology diffusion prevent trading economies from achieving uniform growth rates. The effects of status seeking in this context can be analyzed in a simple manner by assuming linear returns to aggregate capital. The model presented in section 3.1 features learning-by-doing, and can be considered a two-country version of Romer (1989) - see also Rebelo (1991) and Young (1991) - extended to include heterogeneous goods and international status seeking.

3.1 Status seeking and learning-by-doing

In each country there are J identical firms, indexed by j, that produce $y_{i,j}$ units of final good i by employing $k_{i,j}$ units of capital and $\ell_{i,j}$ units of labor efficiency. Each firm's technology is represented by $y_{i,j} = F^i(k_{i,j}, \ell_{i,j})$, with $F^i : \Re^2 \to \Re$ homogeneous of degree one, twice continuously differentiable, strictly increasing, strictly concave and satisfying Inada conditions. Labor is supplied inelastically and is immobile at the international level. Normalizing work time to unity, efficient labor individually supplied, ℓ_i, is proportional to human knowledge, h_i, according to the relation $\ell_i = \eta_i h_i$, where η_i is a constant country-specific proportionality factor. The engine of growth is knowledge accumulation due to learning-by-doing: workers' knowledge is affected by an aggregated externality, which is taken as given by firms. In the competitive equilibrium, factor prices equal marginal productivities defined at given externalities:

$$r_i = F_1^i(k_{ij}, \ell_{ij}) \text{ and } w_i = F_2^i(k_{ij}, \ell_{ij}), \tag{21}$$

where F_1^i and F_2^i are partial derivatives with respect to the first and second argument, respectively. Since firms are of identical size, they employ identical amounts of inputs and produce the same output level $y_{ij} = y_i$. Aggregate output $Y_i = Jy_i$ thus equals $Y_i = F^i(K_i, L_i)$, where $K_i = Jk_i$ is aggregate capital and $L_i = J\ell_i = \eta_i h_i N_i$ is aggregate efficient labor. Following Romer (1989), we assume that h_i is positvely related with the aggregate capital stock K_i: assuming $h_i(t) = B_i K_i(t)$, constant $B_i > 0$ represents the intensity of learning-by-doing. Substituting this relation in the aggregate production function we obtain

$$Y_i = A_i K_i, \tag{22}$$

where the marginal social return from capital, $A_i \equiv F^i(1, \eta_i B_i N_i)$, is constant over time. The marginal private return from capital, instead, equals the equilibrium interest rate

$$r_i^* = A_i - w_i^* \eta_i B_i N_i < A_i, \tag{23}$$

where $w_i^* = F_2^i(1, \eta_i B_i N_i)$ is constant as well.[7] In order to have positive net interest rates, parameters must be such that $A_i - \eta_i B_i N_i > \rho$. Using (23), it derives that the numerator in (15) is constant. As shown in the Appendix, this implies that the growth rate of the price index is constant (at least) in the long run:

Proposition 1 *If $\sigma = 2$, then $\tau_p = 0.25$ at each instant, the price elasticity $\epsilon = \tilde{\epsilon}$ is constant, and*

$$\hat{p}(t) = \tilde{\epsilon}\left[R_a - R_b - (\theta/\nu)(\nu - 1) R_a\right] \text{ for all } t \in [0, \infty), \tag{24}$$

where $\tilde{\epsilon} = 2\nu - (\nu - 1)[1 + (\theta/\nu)(0.75)] > 0$. If $\sigma \neq 2$, then τ_p and ϵ converge to finite steady-state values τ_p^* and ϵ^*, and

$$\lim_{t \to \infty} \hat{p}(t) = \epsilon^* \left[R_a - R_b - (\theta/\nu)(\nu - 1) R_a\right]. \tag{25}$$

Proposition 1 shows that distortions induced by status seeking persist in the long run. The consequences for growth differentials and market shares are as follows. Since individual wealth equals domestic capital per capita, $q_i = K_i/N_i$, the dynamic law (9) implies the standard aggregate constraint $\dot{K}_i = Y_i - C_i$, from which

$$\hat{Y}_i = \hat{K}_i = A_i - (C_i/K_i) \tag{26}$$

at each point in time. Recalling that $\hat{p}$ and τ_p are both constant at least in the long run, optimality conditions (12)-(13) imply that $\hat{C}_a$ and $\hat{C}_b$ are asymptotically constant as well: the unique equilibrium compatible with (26) and intertemporal optimality conditions features balanced growth,

$$\lim_{t \to \infty} \hat{Y}_i = \lim_{t \to \infty} \hat{K}_i = \lim_{t \to \infty} \hat{C}_i \qquad (i = a, b),$$

[7] Substituting $h_i = B_i K_i$ in profit-maximizing conditions (21) we have constant interest and wage rates, $r_i^* = F_1^i(1, \eta_i B_i N_i)$ and $w_i^* = F_2^i(1, \eta_i B_i N_i)$. By Euler's Theorem, output is distributed according to $Y_i = r_i K_i + w_i L_i$, which can be rewritten as $A_i K_i = r_i K_i + w_i^* \eta_i B_i N_i K_i$ and solved for r_i to obtain (23).

which implies $\Delta^y = \Delta^c$ asymptotically. Using (19), (24) and (25), we obtain

$$\begin{aligned} \Delta(t) &= \tilde{\epsilon}(\sigma-1)\left[R_a - R_b - (\theta/\nu)(\nu-1)R_a\right] \qquad \text{if } \sigma = 2, &(27)\\ \lim_{t\to\infty}\Delta(t) &= \epsilon^*(\sigma-1)\left[R_a - R_b - (\theta/\nu)(\nu-1)R_a\right] \qquad \text{if } \sigma \neq 2, &(28)\end{aligned}$$

where (27) is valid at each point in time. The comparison between (27)-(28) and the status-free case,

$$\Delta^f = \epsilon^f(\sigma-1)(R_a - R_b), \tag{29}$$

is now straightforward.[8] Consider the assumption $R_a > R_b$ as the benchmark case. In the pure model without envy, this structural gap implies that physical productivity growth is higher in country a, which increases (decreases) its market share at the expense (in favor) of country b's share if the two goods are perceived as substitutes (complements). In view of this premise, the implications of envy are substantial:

Proposition 2 *When $R_a > R_b$, there exists a critical level of status desire*

$$\bar{\theta} = \frac{R_a - R_b}{R_a}\left(\frac{\nu}{\nu-1}\right) \tag{30}$$

such that: (i) if $\theta = \bar{\theta}$ then $\lim_{t\to\infty}\Delta(t) = 0$; (ii) if $\theta > \bar{\theta}$, the sign of the long-run growth differential is overturned by envy.

Proposition 2 asserts that status seeking influences the link between trade and growth, and reverts the growth differential between the two economies if the degree of status desire is sufficiently high. Result (i) shows that growth rates converge in the long run if θ equals the critical level (30), despite the fact that the two economies are technologically independent: knowledge spillovers are absent, no trade in inputs occurs, and technology diffusion is ruled out by assumption. Situation (i) thus describes *convergence induced by envy*, where constant market shares are exclusively due to international status-seeking. Result (ii) is to some extent stronger: if $\theta > \bar{\theta}$, envy overturns the sign of the growth differential. In particular, when traded goods are perceived as substitutes, $\sigma > 1$, status seeking reverts the growth differential in favor of economy b, against the status leader.

3.2 Other environments with structural gaps

The previous results can be generalized to a wider class of endogenous growth models. Propositions 1 and 2 are robust to alternative specifications of the supply-side of the economy as long as the long run equilibrium features balanced growth and the time-path of net interest rates complies with minimal conditions of regularity. Denoting by R_x the numerator in the right hand side of (15), the following result holds:

[8] From (17), in the status-free case $\theta = 0$ the price elasticity does not depend on τ_p and is therefore constant, $\epsilon^f = [1 + \nu(\sigma-1)]^{-1}$. As a consequence, the growth differential in the learning-by-doing model with structural gaps is constant and equal to (29) at each point in time.

Lemma 3 *Suppose that, for all* $\bar{t} \in [t_0, \infty)$ *with* $t_0 \geq 0$*, we have either* $R_x(\bar{t}) > 0$ *or* $R_x(\bar{t}) < 0$*. Then,* τ_p *eventually converges to a finite steady-state* τ_p^* *- which is either zero or* $(1/2)^{\frac{\sigma}{\sigma-1}}$*, depending on parameters - and the price elasticity* ϵ *is asymptotically constant. Hence, if both economies achieve balanced growth in the long run, Proposition 2 holds true.*

Lemma 3 is proved in the Appendix without making any assumption about technology and accumulation processes of knowledge and individual wealth. The only hypotheses are convergence to balanced growth within each country, and no cyclical switchovers in the sign of R_x from some point in time onwards. As a consequence, the same results derived in Proposition 2 can be obtained in more sophisticated models where economies have a multi-sectoral structure and the engine of growth is different - e.g. human capital formation, gains from specialization, R&D sectors, or vertical innovations. An immediate example is the expanding-varieties model presented in the section 4.1, which is extended to include the interaction between status seeking and technological catching-up.

4 Envy and Technological Catching-Up

If the lagging country exhibits technological catching-up induced by knowledge spillovers (Grossman and Helpman, 1991), trade in intermediate inputs (Acemoglu and Ventura, 2002), imitation (Barro and Sala-i-Martin, 1997) or flows of ideas (Rivera-Batiz and Romer, 1991), structural gaps may disappear in the long run. Without status-seeking, technological catching-up implies convergence in growth rates. This section shows that, as long as technological catching-up implies interest rate equalization, the presence of status seeking distorts terms of trade and makes the two economies *diverge* in the long run. This result is derived using the expanding-varieties model, employed in a two-country setting by Grossman and Helpman (1990), Feenstra (1996) and Barro and Sala-i-Martin (1997).

4.1 The expanding-varieties model

The structure of the supply side of the economy follows Barro and Sala-i-Martin (1997). Human knowledge is normalized to unity ($\ell_i = \eta_i$), and aggregate labor is in fixed proportion with population, $L_i = \eta_i N_i = \ell_i N_i$. A competitive final sector produces Y_i by means of labor and a continuum of differentiated intermediate goods, $x_i(s)$ with mass g_i. The aggregate production function is

$$Y_i = L_i^{1-\alpha_i} \int_0^{g_i} x_i(s)^{\alpha_i} \, ds. \tag{31}$$

Each variety of intermediates, $x_i(s)$, is produced with unit production cost by a monopolist who holds the relevant patent ans sells it to final firms at price $p_i^x(s)$. The demand schedule of final producers is taken as given by monopolists, who maximize instantaneous profits $\pi_i(s) = (p_i^x(s) - 1)\, x_i(s)$ by setting a constant mark-up over marginal cost. Equilibrium prices and quantities are invariant across different types of intermediates, with $p_i^x(s) = 1/\alpha$ and

$$x_i(s) = \alpha_i^{\frac{2}{1-\alpha_i}} L_i \text{ for any } s \in (0, g_i]\,. \tag{32}$$

From (32), equilibrium output equals

$$Y_i = \alpha_i^{-2} g_i x_i = \alpha_i^{\frac{2\alpha_i}{1-\alpha_i}} L_i g_i. \tag{33}$$

The source of growth in this model is the expansion in the set of intermediates: from (33), physical output is linear in the number of intermediates, implying $\hat{Y}_i = \hat{g}_i$. The set of varieties is expanded by means of R&D activity pursued by competitive firms. The innovation technology is

$$\dot{g}_i = D_i/\varsigma_i, \tag{34}$$

where D_i is R&D expenditure and ς_i is the R&D cost, i.e. an inverse index of the productivity of R&D investment. Free-entry conditions in the R&D business imply that the value of an innovation equals the R&D cost, $V_i = \varsigma_i$. The value of an innovation is in turn equal to the value of the corresponding patent, which is sold to the monopolist who will produce the new intermediate. In equilibrium, V_i equals the present-discounted value of future monopoly profits, implying the standard no-arbitrage equation

$$r_i = \hat{V}_i + (\pi_i/V_i) = \hat{\varsigma}_i + (\pi_i/\varsigma_i)\,, \tag{35}$$

where instantaneous profits $\pi_i = (1-\alpha_i)(x_i/\alpha_i)$ are constant from (32). The model is closed by the aggregate constraint of the economy, which is derived by the individual wealth constraint. Individual wealth is now represented by assets of domestic firms, and aggregate wealth reads $q_i N_i = g_i V_i = g_i \varsigma_i$. Substituting this relation in (9), and using (34)-(35), it follows that aggregate output must equal the sum of aggregate consumption, total expenditure in producing intermediates, and R&D investment,

$$Y_i = C_i + g_i x_i + D_i, \tag{36}$$

and the rate of varieties' expansion can be written as

$$\varsigma_i \hat{g}_i = \left(1 - \alpha_i^2\right) \alpha_i^{\frac{2\alpha_i}{1-\alpha_i}} L_i - (C_i/g_i)\,. \tag{37}$$

For the sake of exposition, the model is analyzed in two logical steps, beginning with structural productivity gaps, and then implementing technological catching-up using the technology absorption principle (Nelson and Phelps, 1966).

Structural gaps. Assume that the R&D cost is constant in both countries, $\varsigma_i(t) = \varsigma_i$. From (35), interest rates are constant over time,

$$r_i = \pi_i/\varsigma_i = (1-\alpha_i)\,\alpha_i^{\frac{1+\alpha_i}{1-\alpha_i}}\,(L_i/\varsigma_i)\,, \tag{38}$$

and the model produces exactly the same results derived in section 3.1. Propositions 1 and 2 hold true,[9] with structural gaps being now determined by differences in R&D costs, rather than differences in the intensity of learning by-doing. In particular, if country a exhibits a comparative advantage in R&D - that is, $\varsigma_a < \varsigma_b$ all other things being equal - it derives from (38) that the interest rate will be permanently lower in country b.

Technological Catching-Up. In a one-good version of the present model, Barro and Sala-i-Martin (1997) describe the convergence process between a technological leader - which produces 'original innovations' and displays a comparative advantage in R&D - and a technological follower, which readapts the blueprints developed abroad and catches-up with the leader by imitation. Barro and Sala-i-Martin (1997) assume that the cost of imitation is a function of the observed gap in the number of existing intermediates, and show that economy b achieves the same growth rate of country a in the long run, which implies *interest rate equalization* provided that input elasticities are equal, $\alpha_a = \alpha_b$. Interest rate equalization is a general feature of catching-up models. The 'cost of imitation' function is a possible way to obtain this outcome, and is used by Barro and Sala-i-Martin (1997) to describe transitional dynamics in detail, and to address a number of related topics. With respect to the issue of convergence, however, results are essentially the same if we assume spillovers in R&D that directly affect the productivity of firms in the lagging country (Feenstra, 1996: sect.6.3), since this mechanism makes the respective rates of return converge in the long run - see Bretschger and Steger (2004) and Smulders (2004). This is particularly relevant for the problem at hand, since consumption dynamics are affected by terms of trade and status desire, and convergence must be modelled in a tractable way. In this regard, we formalize spillovers in R&D according to the *technology absorption function* $\dot{\kappa}_i = \psi(\kappa^* - \kappa_i)$, where κ_i indicates a generic country-specific technological parameter and κ^* is the best practice technology available at the world level. The absorption function, originally used by Nelson and Phelps (1966), formalizes catching-up as an adjustment process whereby technology in country i converges to the leading technology with a speed of adjustment equal to $\psi > 0$ - also called 'absorptive capability' (Abramovitz, 1986). Empirical estimations of absorptive capability are presented in Hansson and Henrekson (1994), and applications to international technology diffusion are discussed in Rogers

[9] Since R_a and R_b are constant, Lemma 3 applies and τ_p converges to a finite steady-state τ_p^*. The growth rate of the price index is constant in the long run, and Proposition 1 holds. From (12)-(13), $\hat{C}_a$ and $\hat{C}_b$ are also constant in the long run, which implies balanced growth in both countries in the long run since constraint (37) is compatible with intertemporal optimality conditions only if $\hat{g}_i = \hat{C}_i$. Having obtained $\hat{C}_i = \hat{Y}_i = \hat{g}_i$ in the long run, expressions (14), (15) and (20) imply (27)-(28).

(2003). In the present model, the absorption function is associated with the relevant parameter of comparative advantage, the cost of R&D. Assume

$$\dot{\varsigma}_b(t) = \psi(\varsigma_a - \varsigma_b(t)), \qquad \varsigma_b(0) > \varsigma_a, \tag{39}$$

where ς_a is constant. Recalling that ς_i is an inverse index of the marginal productivity of R&D firms in country i, expression (39) means that the R&D sector in the lagging country increases its productive efficiency over time ($\dot{\varsigma}_b < 0$) by learning from the technological leader. A concrete example of this process may be that of R&D sectors that de-ingeneer components of final goods produced abroad, readapting the resulting know-how to develop components for domestic production. Alternatively, all the results presented below can be obtained in the model of section 3.1, applying the absorption principle to human knowledge h_i - as originally suggested by Nelson and Phelps (1966).

Assuming that all other things be equal between the two countries, equation (39) generates the basic result of catching-up models - that is, interest rate equalization: from the no-arbitrage equation (35), r_a is constant and given by (38), whereas the interest rate in country b equals

$$r_b(t) = \varsigma_b(t)^{-1}\left[(1-\alpha_b)\,\alpha_b^{\frac{1+\alpha_b}{1-\alpha_b}} L_b + \psi(\varsigma_a - \varsigma_b(t))\right], \tag{40}$$

where, by direct integration of (39), the time-path of R&D costs is

$$\varsigma_b(t) = \varsigma_a + (\varsigma_b(0) - \varsigma_a)\, e^{-\psi t}. \tag{41}$$

Since ς_b approaches ς_a in the long run, technological catching-up absorbes the initial comparative advantage for the status leader, and expressions (38) and (40) imply

$$\lim_{t\to\infty} r_b = (1-\alpha)\,\alpha^{\frac{1+\alpha}{1-\alpha}}(L/\varsigma_a) = r_a, \tag{42}$$

where $\alpha = \alpha_a = \alpha_b$ and $L = L_a = L_b$. With respect to the assumption of identical parameters, three remarks can be made. First, $L_a = L_b$ is required in view of the inherent features of the model under study, which displays scale effects in production.[10] Second, assuming uniform input shares is not necessarily inconsistent with trade specialization, as long as the degree of differentiation between produced goods lies within a given range: empirical evidence suggests that, while national economies exhibit various degrees of specialization, input shares do not exhibit great heterogeneity if compared to observed differences in policies and institutions.[11] Third, identical parameters consititute the relevant benchmark for the present analysis, since it allows

[10] In general, scale effects can be circumvented by assuming that the engine of growth is given by firm-specific spillovers (Peretto and Smulders, 2004) and modelling convergence through international R&D spillovers, as in Smulders (2004).

[11] See Acemoglu and Ventura (2002) and references quoted therein.

us to investigate the consequences of status seeking in isolation from deviations merely induced by asymmetric input shares.

From (42), technological absorption implies $R_a(t) > R_b(t)$ during the transition, which allows us to prove the following

Proposition 4 *In the long run, interest-rate equalization implies divergence: τ_p and ϵ converge to steady-state values τ_p^* and ϵ^* in the long run, terms-of-trade effects are strictly negative,*

$$\lim_{t\to\infty} \hat{p}(t) = -\epsilon^* (\theta/\nu)(\nu - 1) R_a < 0, \tag{43}$$

and each country achieves a balanced growth path, implying the long-run growth differential

$$\lim_{t\to\infty} \Delta(t) = -\epsilon^* (\theta/\nu)(\nu - 1) R_a (\sigma - 1) \neq 0. \tag{44}$$

Proposition 4 shows that, in the presence of technological catching-up, any positive degree of status desire generates a negative growth rate in the price index: all other things being equal, consumption expenditures grow at higher rate in country b as a consequence of status seeking, thereby inflating the relative price of the good produced by the status-leader. Expression (43) clarifies that price distortions persist even if the two countries converge towards the same technological base. The implications for growth differentials are summarized in expression (44): for any positive degree of status desire, the two economies *diverge*. This result is in stark contrast with the status-free case, $\theta = 0$, where interest rate equalization implies the well-known convergence result, $\lim_{t\to\infty} \Delta = 0$.

4.2 The convergence paradox and switchover of growth leadership

Comparing Propositions 2 and 4, a 'convergence paradox' emerges: in the presence of status-seeking, technological catching-up implies divergence, whereas technological independence admits convergence. This conclusion, nearly opposite to conventional results, originates in the distortions induced by envy in terms of trade: on the one hand, this effect may compensate for structural gaps, yielding envy-induced convergence. On the other hand, if structural gaps disappear, distorsions remain and envy drives market shares away from stationary equilibria. This second case is particularly interesting from the perspective of emerging economies. As noted in the Introduction, the present analysis builds on the idea that agents living in emerging economies aim at achieving consumption levels of more advanced countries. Hence, the scenario in which status-seeking phenomena plausibly arise is one in which country a exhibits comparative advantage in R&D at time zero, and is both status- and growth-leader in the short run. This section shows that, under these assumptions, the model of section 4.1 generates a switchover of growth leadership in favor of the initially lagging economy.

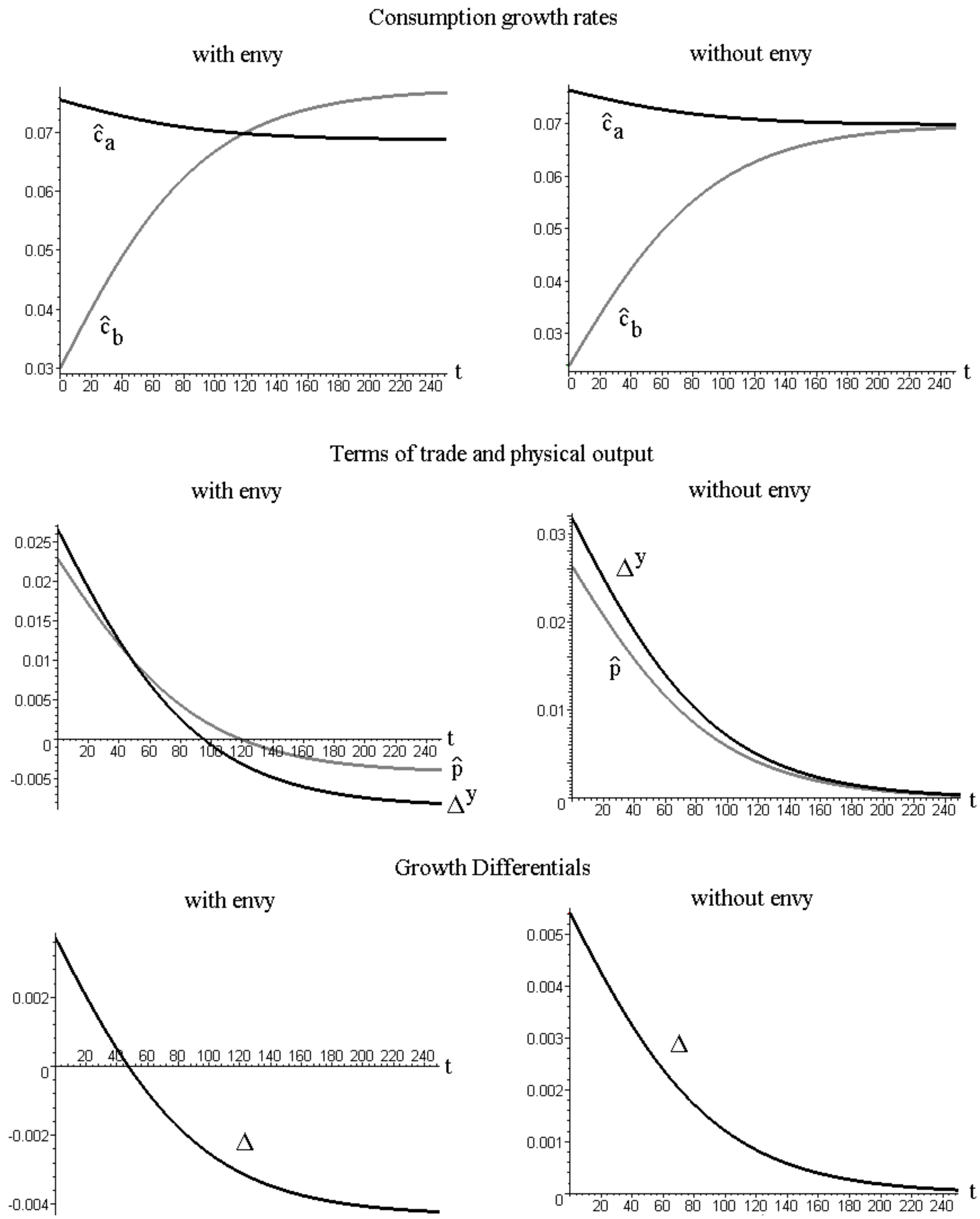

Figure 1: Status-seeking interacts with technological catching-up determining a switchover in growth leadership (left-side graphs). Ruling out envy, the two countries converge (right-side graphs).

Formally, the 'plausible scenario' is obtained by means of two simple assumptions: first, there is a huge productivity gap at time zero, $R_a \gg R_b(0)$, resulting from the comparative advantage in R&D of the status leader ($\varsigma_a \ll \varsigma_b(0)$); second, traded goods are substitutes, $\sigma > 1$, so that the status-free growth differential is in favor of the economy displaying higher growth in physical productivity. For simplicity, further assume $\sigma = 2$: this is not necessary for the switchover to occur, but it greatly simplifies the analysis. In fact, $\sigma = 2$ implies that $\tau_p = 0.25$ at each instant (see Appendix), and we can derive an explicit time path for terms-of-trade effects at each point in time: from (15) and (40), the only time-varying argument in $\hat{p}$ is the cost of R&D in country b, which evolves according to (41). Hence, it is possible to re-write (15) as a function of ς_b,

$$\hat{p}(t) = \phi_0(\varsigma_b(t)) = \tilde{\epsilon}\left[r_a - r_b(\varsigma_b(t)) - (\theta/\nu)(\nu - 1)(r_a - \rho)\right], \tag{45}$$

where $\tilde{\epsilon} = 2\nu - (\nu - 1)[1 + (\theta/\nu)(0.75)] > 0$ as in equation (24), and $r_b(\varsigma_b(t))$ is the function implicitly defined by (40). From (45), if the initial difference in R&D productivity is sufficiently high, the term in square brackets is initially positive: at $t = 0$, a large gap $\varsigma_b(0) - \varsigma_a$ implies $\hat{p}(0) > 0$ because the resulting differential in interest rates more than compensates for the effects of envy (the last term in square brackets). However, as time passes, the first term declines monotonously, and there exists a finite time at which the growth rate of the price index is zero (see Appendix):

$$t_* = \ln\left[\frac{(\psi + \Upsilon)(\varsigma_b(0) - \varsigma_a)}{(1 - \alpha)\alpha^{\frac{1+\alpha}{1-\alpha}}L - \Upsilon\varsigma_a}\right]^{\frac{1}{\psi}}, \tag{46}$$

where $\Upsilon \equiv r_a - (\theta/\nu)(\nu - 1)(r_a - \rho)$. At instant t_* the effects of status seeking exactly compensate for the existing gap in the rates of return from R&D. After time t_* technology absorption continues, the interest rate gap vanishes and the growth rate of $\hat{p}$ is strictly negative, approaching the long-run value derived in (43). A similar time-path is followed by the differential in physical-output growth rates, which obeys the rule

$$\Delta^y = \hat{g}_a - \hat{g}_b = \bar{L}\left(\varsigma_a^{-1} - \varsigma_b^{-1}\right) - \left[(z_a/\varsigma_a) - (z_b/\varsigma_b)\right], \tag{47}$$

where $\bar{L} \equiv (1 - \alpha^2)\alpha^{\frac{2\alpha}{1-\alpha}}L$ and $z_i \equiv c_i/g_i$. As before, the right-hand side of this expression can be positive in the short run as long as $\varsigma_b - \varsigma_a$ is large enough at time zero, but it converges to a negative value in the long run: as shown in the Appendix,

$$\lim_{t\to\infty}\Delta^y(t) = -\varsigma_a^{-1}\left(z_a^{ss} - z_b^{ss}\right) < 0. \tag{48}$$

With $\sigma > 1$, expression (48) implies that country b is growth leader in the long run: due to balanced growth, we have $\Delta < 0$ from (44). This implies that, if country a is initially growth leader by virtue of initial conditions, a switchover in growth leadership must occur during the transition.

Since the transitional dynamics of Δ are jointly determined by (45) and (47), the behavior of growth differentials in the short-medium run must be checked numerically. An example is given in Figure 1, which reports the time-paths of consumption growth rates, terms-of-trade effects and differentials in output growth based on equations (45) and (47). Parameter values are: $\alpha = 0.3$, $\nu = 1.5$, $\rho = 0.02$, $\theta = 0.3$, $L = 1$, $\varsigma_a = 0.6$ and $\varsigma_b(0) = 1.1$. The model predicts $\Delta^y = \Delta^c \simeq -0.9\%$ asymptotically - that is, even a relatively low status desire, $\theta = 0.3$, is capable of generating a one-per-cent gap in physical output growth rates in favor of the status-seeking country. The initial gap in R&D costs is filled over time at rate of absorption $\psi = 0.02$. The switchover in terms-of-trade effects occurs at time $t_* \simeq 120$, whereas the switchover in physical output growth gaps occurs around $t = 95$. Transitional effects produce a switchover in the overall growth differential around $t = 50$, after which Δ approaches its long-run equilibrium value, $(\sigma - 1)\hat{p} \simeq -0.45\%$. Clearly, higher degrees of status desire would produce more drastic growth differentials - see (44).

The general effects of envy can be easily assessed by comparing the time-paths of the relevant varibales with those obtained without status-seeking, also reported in Figure 1. Without envy, country a is growth leader during the whole transition, and countries converge in growth rates by virtue of technological catching-up, in line with established results. In the presence of status seeking, instead, country a remains status- and growth-leader only for a finite interval: the interaction between envy and technology absorption produces growth equalization in finite time; subsequently, country b overshoots the convergence goal, and long-run growth differentials turn in favor of the initially lagging economy, by virtue of the terms-of-trade effects generated by envy.

4.3 Remarks and connections with the literature

Nowadays, preferences are likely to be interdependent among trading countries. Undoubtedly, one aspect of modern globalization is that information, advertising, tourism, and migration, have contributed to creating a foreign benchmark, on the basis of which individuals in many countries evaluate their relative position (Sklair, 1991; James, 2000). While the view that status seeking has already crossed the borders is discussed in development studies, and advocated by sociologists, a formal treatment of international status seeking in a general equilibrium perspective is, to my knowledge, absent in the literature.[12] In particular, the macroeconomic implications of transboundary

[12] The idea that preferences are interdependent at the international level was considered by Nurkse (1957), who argued that knowledge of new consumption patterns widens the horizon of desires, thereby giving rise to an 'international demonstration effect'. Our analysis does not represent, however, a formalization of the demonstration effect: in Nurkse (1957), preference interdependence means that foreign goods open consumers' eyes to previously unrecognized possibilities, thereby leading to endogenous imitation on the production side. In this paper, instead, we follow the Veblenian approach in postulating that preference interdependence derives from envy, and therefore generates 'Catching-Up With The Joneses' phenomena operating at the international level. Envy was explicitly ruled

envy have not been investigated at the theoretical level, and our results may be related to those found in the literature on *intra*-national status seeking and 'inter-personal jealousy'. In a closed and static economy, Dupor and Liu (2003) show that the symmetric equilibrium among jealous private agents implies over-consumption; similarly, but in a dynamic setting, Alvarez-Cuadrado et al. (2004) find positive growth effects of outward-looking preferences in the Ramsey model, and Alonso-Carrera et al. (2004) show that 'Catching-Up with the Joneses' implies overaccumulation in the AK model. The tendency to overconsume is also present in our model, but it has quite different implications. In a two-country world, higher consumption expenditures in country b translate into increased relative prices for goods produced abroad. The distortion in price dynamics introduces a wedge between terms-of-trade effects and interest rate differentials, generating the 'convergence paradox' and possible switchovers in growth leadership. Similar connections and conceptual differences may be traced with respect to the literature where status seeking is modelled according to the *relative wealth approach* (Corneo and Jeanne, 1997; Futagami and Shibata, 1998; Fisher, 2005; Fisher and Hof, 2005). In this framework, the benchmark term depends on the gap between individual and average per capita asset holdings (instead of consumption levels), and this type of preferences may also induce equilibria with overconsumption. Fisher (2005) and Fisher and Hof (2005) apply the relative wealth approach to open-economy models, but again assume *intra*-national status seeking: both papers consider a small-open economy where the benchmark level is determined within the country, and address different issues with respect to those tackled here.[13]

With respect to the literature on trade and growth, the peculiarity of the model is obviously the introduction of transboundary envy. From a broader perspective, the analysis emphasizes the role of terms of trade, which is sometimes neglected in growth models. Empirical evidence suggests that terms-of-trade effects actually matter for growth and are "quantitatively important in understanding the observed patterns of cross-country income differences" (Acemoglu and Ventura, 2002: p.681). In this regard, the convergence paradox clarifies that interest rate equalization is not sufficient to ensure convergence once that terms-of-trade effects play an active role: as long as consumption externalities affect price dynamics, market shares will necessarily reflect existing distortions. This point also adds to the conclusions of the literature on outward-looking preferences in closed-economies: according to Alvarez-Cuadrado et al.

out by Nurkse as part of the mechanism giving rise to preference interdependence and demonstration effects (*ibid.* p. 61).

[13] Fisher (2005) and Fisher and Hof (2005) study the effects of relative-wealth spillovers in a small open economy with international capital mobility and a single homogeneous final good. Fisher and Hof (2005) focus on the role of such preferences in driving accumulation rates when the interest rate differs from the utility discount rate, and show that relative-wealth preferences magnify the effects of improvements in productivity on long-run consumption. Fisher (2005) shows that relative-wealth preferences may imply non-monotonic dynamics for the current account, due to the interplay between wealth spillovers and installation costs.

(2004), the 'Catching-Up with the Jones' phenomenon may account for non-linearities observed in the development paths of real-world economies. The present analysis suggests that similar consumption externalities affect the development path via terms-of-trade effects, and through this channel, the link between trade and growth. The idea that status spillovers may overboost consumption rates appears plausible with special regard to big countries, such as India and China, that are rapidly catching-up in the stages of economic development. Tackling this issue at the empirical level seems an interesting topic for applied research.

A final remark relates to the interpretation of the model. The status-seeking country in the present analysis should not be interpreted as an under-developed economy, for three main reasons. First, the assumption of similar technologies - i.e. comparable production functions - would become critical in this regard. Second, a reasonable social benchmark for consumers in poor countries is represented by owning specific material foreign goods. In this context, status-signalling commodities generate the "discrimination in favor of visible consumption" (Veblen, 1899: p.112), which can be formalized at the microeconomic level along the lines of the theory of positional goods - see Van Kempen (2003). In this context, the role of international envy in the growth process may be quite different, and itself part of the explanations for poverty persistence: since acquiring purely positional goods results in waste and is collectively self-defeating (Hirsch, 1976), conspicuous consumption in countries lacking infrastructures may confine the economy in poverty traps by crowding-out resources from technology-developing sectors. For all these reasons, tackling the issue of trade between affluent societies and under-developed countries would require a different model, not only as regards technological assumptions, but also with respect to preference specifications.

5 Conclusion

A central element of Veblen's theory of conspicuous consumption is the observation that individual behavior is driven by the subjective perception of social status. One aspect of modern globalization is that information, advertising, tourism, and migration, have contributed to creating a *foreign benchmark* on the basis of which individuals in many countries evaluate their relative position. While it is plausible that consumers in emerging economies aim at achieving consumption levels of more advanced countries, this type of 'Catching-Up With The Joneses' behavior has not been analyzed as far as international externalities are concerned. This paper analyzed the consequences of international status seeking in a two-country model of trade and endogenous growth, with asymmetric technologies and full specialization. In this framework, envy distorts terms of trade because faster growth of consumption expenditures in the status-seeking economy inflates the relative price of the good produced by the status-leader country. The main results are as follows. First, the effects of status seeking may compensate for structural gaps in physical productivity growth, leading to convergence induced by preferences, or even revert the sign of the growth differential between the two economies. Second, in the presence of technological catching-up, which implies interest-rate equalization, the two countries diverge since the distortions generated by envy induce a permanent wedge between the respective growth rates. In particular, the interaction between envy and technological catching-up produces a switchover of growth leadership: when the advanced economy is both status- and technology-leader in the short run, convergence in interest rates - e.g. due to R&D spillovers - does not eliminate distortions induced by envy, and the initially lagging economy becomes growth leader in the long run for any positive degree of status desire.

The literature on intra-national status seeking suggests that consumption externalities affect long-run capital accumulation (Carrol et al. 1997; Alonso-Carrera et al. 2004; Liu and Turnovsky, 2005) and provide a reasonable explanation for the observed non-linearities that characterize the development path of many economies (Alvarez-Cuadrado et al. 2004). Our results imply that international consumption externalities may affect the development path of big open economies via terms-of-trade effects and, through this channel, modify the link between trade and growth. A question that naturally arises is whether these theoretical results can be confirmed by empirical evidence. In particular, the idea that international status seeking may overboost consumption growth rates appears plausible with special regard to big countries that are rapidly catching-up in the stages of economic development, such as India and China. Addressing this issue at the empirical level seems an interesting topic for future research, and would shed more light on the scope and relevance of consumption externalities in today's globalized world.

Appendix

Proof of Propositions 1 and 2. See Proof of Lemma 3 below.

Proof of Lemma 3. The first part of Lemma 3 can be restated as follows. *Define*

$$R_x \equiv R_a - R_b - (\theta/\nu)(\nu-1) R_a, \tag{A1}$$

and suppose that, for all $\bar{t} \in [t_0, \infty)$ *with* $t_0 \geq 0$, *we have either* $R_x(\bar{t}) > 0$ *or* $R_x(\bar{t}) < 0$. *Then,* τ_p *eventually converges to*

$$\tau_p^* = \lim_{t\to\infty} \tau_p(t) = \begin{cases} 0 & \text{if} \quad (\sigma > 1, R_x(\bar{t}) < 0) \quad \text{or} \quad (\sigma < 1, R_x(\bar{t}) > 0) \\ (1/2)^{\frac{\sigma}{\sigma-1}} & \text{if} \quad (\sigma > 1, R_x(\bar{t}) > 0) \quad \text{or} \quad (\sigma < 1, R_x(\bar{t}) < 0) \end{cases}. \tag{A2}$$

Expression (A2) is proved as follows. Differentiating τ with respect to p from (7) yields

$$\tau_p = (1/2)^{\frac{\sigma}{\sigma-1}} \left(1 + p^{1-\sigma}\right)^{\frac{2-\sigma}{\sigma-1}} > 0 \tag{A3}$$

which implies that τ_p is constant and equal to 0.25 when $\sigma = 2$. When $\sigma \neq 2$, expression (A3) implies

$$\frac{\tau_p}{(1/2)^{\frac{\sigma}{\sigma-1}}} = \left[\left(1+\frac{1}{p^{\sigma-1}}\right)^{\frac{\sigma-2}{\sigma-1}}\right]^{-1} = \left(1+\frac{1}{p^{\sigma-1}}\right)^{\frac{2-\sigma}{\sigma-1}} = \left[\left(1+p^{1-\sigma}\right)^{\frac{2-\sigma}{1-\sigma}}\right]^{-1}. \tag{A4}$$

First, suppose $R_x(\bar{t}) < 0$, which implies $\hat{p}(\bar{t}) < 0$ and therefore $p(t) \to 0$ as $t \to \infty$. In this case: if $\sigma > 2$, the second term in (A4) implies $\tau_p^* = 0$; if $1 < \sigma < 2$, the third term in (A4) implies $\tau_p^* = 0$; if $\sigma < 1$, the fourth term in (A4) implies $\tau_p^* = (1/2)^{\frac{\sigma}{\sigma-1}}$. Second, suppose $R_x(\bar{t}) > 0$, which implies $\hat{p}(\bar{t}) > 0$ and therefore $p(t) \to \infty$ as $t \to \infty$. In this case: if $\sigma > 2$, the second term in (A4) implies $\tau_p^* = (1/2)^{\frac{\sigma}{\sigma-1}}$; if $1 < \sigma < 2$, the third term in (A4) implies $\tau_p^* = (1/2)^{\frac{\sigma}{\sigma-1}}$; if $\sigma < 1$, the fourth term in (A4) implies $\tau_p^* = 0$. All these results are gathered in expression (A2). In view of the fact that τ_p converges to a finite steady-state in the long run, expression (15) implies that:

$$\hat{p}(t) = \frac{R_x(t)}{2\nu - (\nu-1)\left[1+(\theta/\nu)(0.75)\right]} \text{ for all } t \in [0,\infty) \text{ if } \sigma = 2, \tag{A5}$$

$$\lim_{t\to\infty} \hat{p}(t) = \frac{\lim_{t\to\infty} R_x(t)}{\nu\sigma - (\nu-1)\left[1+(\theta/\nu)\left(1-\tau_p^*\right)\right]} \text{ if } \sigma \neq 2 \tag{A6}$$

in any model where, for all $\bar{t} \in [t_0, \infty)$ with $t_0 \geq 0$, we have either $R_x(\bar{t}) > 0$ or $R_x(\bar{t}) < 0$. In addition, if both countries converge to balanced growth, R_a and R_b are constant in the long run, implying that $\hat{p}$ and $\Delta^c = \Delta^y$ are constant at least asymptotically. From (20), this implies

$$\lim_{t\to\infty} \Delta(t) = (\sigma-1)\frac{\lim R_x(t)}{\nu\sigma - (\nu-1)\left[1+(\theta/\nu)\left(1-\tau_p^*\right)\right]}. \tag{A7}$$

Hence, from (A1), we can define the critical level of status desire as

$$\bar{\theta} = \left(\frac{\nu}{\nu-1}\right)\lim_{t\to\infty}\left(\frac{R_a(t)-R_b(t)}{R_a(t)}\right), \tag{A8}$$

¨and obtain a 'generalized Proposition 2': if $\lim_{t\to\infty} R_a(t)$ is strictly greater than $\lim_{t\to\infty} R_b(t)$, there exists a critical level of status desire (A8) such that: (i) if $\theta = \bar{\theta}$ then $\lim_{t\to\infty} \Delta(t) = 0$; (ii) if $\theta > \bar{\theta}$, the sign of the long-run growth differential is overturned by envy.

In the model with learning-by-doing of section 3.1, R_a and R_b are constant over the whole time-horizon, so that expressions (A5)-(A6) reduce to (24)-(25), which proves Proposition 1. Similarly, constant interest rates allow us to rewrite (A7) as (28), and obtain Proposition 2 by rewriting (A8) as (30).

Derivation of (47). Dividing both sides of (37) by ς_i

yields

$$\hat{g}_i = \left(\bar{L} - z_i\right) \varsigma_i^{-1}. \tag{A9}$$

where we have defined $\bar{L} \equiv (1-\alpha^2)\, \alpha^{\frac{2\alpha}{1-\alpha}} L$ and $z_i \equiv C_i/g_i$. Taking the difference between $\hat{g}_a$ and $\hat{g}_b$, and recalling that $\hat{g}_i = \hat{Y}_i$, we obtain (47). By definition, the growth rate of z_i equals $\hat{c}_i - \hat{g}_i$. Using (A9) we can write

$$\hat{z}_i = \hat{c}_i - \varsigma_i^{-1} \left(\bar{L} - z_a\right), \tag{A10}$$

Asymptotic balanced growth implies that z_a and z_b converge to steady-state levels in the long run: from (A10),

$$\lim_{t\to\infty} z_a(t) = z_a^{ss} = \bar{L} - \varsigma_a \hat{c}_a^{ss} \text{ and } \lim_{t\to\infty} z_b(t) = z_b^{ss} = \bar{L} - \varsigma_a \hat{c}_b^{ss}, \tag{A11}$$

where we have used $\lim_{t\to\infty} \varsigma_b(t) = \varsigma_a$ from (41). From (43), consumption expenditure grows at higher rate in country b in the long run, and $\hat{c}_b^{ss} > \hat{c}_a^{ss}$ implies $z_a^{ss} > z_b^{ss}$. As a consequence, the limit of expression (47) as time goes to infinity is strictly negative and equals (48).

Proof of Proposition 4. From (42), technological absorption implies $R_a(t) > R_b(t)$ during the whole transition, with $R_a(t) - R_b(t)$ decreasing monotonically towards zero. As a consequence, the sign of R_x - as defined in (A1) - falls in one of the following cases: first, R_x is negative from $t = 0$ onwards; second, R_x is initially positive but, due to the progressive reduction in the interest rate gap, it turns negative in finite time and remains negative thereafter. In either case, there exists an instant $t_0 \geq 0$ such that, for all $\bar{t} \in [t_0, \infty)$, we have either $R_x(\bar{t}) > 0$ or $R_x(\bar{t}) < 0$ (when $R_x(0) < 0$, then $t_0 = 0$; when $R_x(0) > 0$, then $t_0 = t_* > 0$ where t_* is finite and is given by expression (46) - see below). Hence, Lemma 3 applies and τ_p converges to a finite steady-state given by (A2). Setting $\lim_{t\to\infty} R_b(t) = R_a$ and $\lim_{t\to\infty} \tau_p(t) = \tau_p^*$ in (15) gives expression (43). Moreover, with $R_a = R_b$ and $\hat{p}$ and τ_p asymptotically stationary, equations (12)-(13) imply a constant growth rate in consumption expenditures in both countries. In order to satisfy constraints (37), long-run equilibria feature balanced growth in both economies, and hence $\hat{C}_i = \hat{Y}_i = \hat{g}_i$. As a consequence, the long-run growth differential is given by (20), and reduces to (44) due to interest rate equalization.

Derivation of (46). The term in square brackets in (45) is zero when

$$r_b(\varsigma_b(t)) = r_a - (\theta/\nu)(\nu - 1)(r_a - \rho). \tag{A12}$$

From (40) and (41), the interest rate in country b equals

$$r_b(t) = \frac{(1-\alpha_b)\, \alpha_b^{\frac{1+\alpha_b}{1-\alpha_b}} L_b - \psi\left(\varsigma_b(0) - \varsigma_a\right) e^{-\psi t}}{\varsigma_a + \left(\varsigma_b(0) - \varsigma_a\right) e^{-\psi t}}. \tag{A13}$$

Plugging (A13) in (A12), and defining $\Upsilon \equiv r_a - (\theta/\nu)(\nu-1)(r_a - \rho)$ we can solve the resulting expression for the time index by taking logarithms, obtaining (46). As intuitive, the logarithm is well-defined if $\varsigma_b(0) - \varsigma_a$ is large enough, since $t_* > 0$ exists only if $\hat{p}$ is strictly positive at time zero by virtue of a huge gap in the rates of return from R&D.

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