Trade, development, and poverty-induced comparative advantage
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This paper deals with the relation between trade and development when poverty affects individual decision making. We develop a two-sector model that links production and schooling decisions under poverty with standard neo-classical trade analyses. The decision to either work or acquire skills depends on households having reached subsistence levels of income, implying that the income level of a country becomes important in establishing comparative advantages and trade patterns. Trade liberalisation is always allocative efficient, but its timing is important for the speed by which countries industrialise. Our analysis supports the idea that there are instances that stalling trade liberalisation may serve industrial development.

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1. Introduction
Ever since Adam Smith wrote his groundbreaking The Wealth of Nations, economists have debated the desirability of international trade. In this discussion, opponents have continuously brought in numerous specific cases in which free trade might not be desirable. Many of these convincing cases notwithstanding, this focus on exceptions has, in a way, only served to confirm the general rule that free trade is beneficial under ‘normal’ circumstances. With ‘the case for free trade (thus being) settled’ in principle (Bhagwati et al. 1998), the economic debate has shifted towards specification of what circumstances could still count as normal.

A particularly persistent line of critique in this respect is that traditional trade theory has no attention for the specific problematic situation of developing societies. Being poor, lacking industrialisation and facing competition from economies in a much more advanced stage of development are not the normal circumstances for which the case for free trade has

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been settled. According to this argument, the poor need a special trade economics, as well as different policies from the liberal ones suggested by conventional trade theory. Such sentiments have fuelled protests at various WTO summits in recent years, and to some extent have contributed to the collapse of the current Doha-round. Theoretically, these dissenting voices have been propped up by economic historians and development economists claiming that late-comer development requires industrialization under government protection and support, before subjecting economic sectors to the discipline of the market (e.g. Amsden 1989; Wade 1990).

Regardless of whether one is willing to subscribe to this argumentation to abandon free trade policies for poor societies, the pervasiveness of the critique warrants economics to confront the argument and address the impact of poverty upon trade patterns. This paper aims at doing so. We develop a framework in which poverty co-determines comparative advantage, and use it to verify the desirability of trade in relation to issues such as allocative efficiency and development. In particular, we develop a two-sector model that links production and schooling decisions under poverty with standard neo-classical trade analysis. The decision either to work in agriculture or to acquire the skills needed for manufacturing is modelled to depend on households having reached a certain minimum, subsistence level of income. Apart from the influence of nature-given comparative advantages, the income level of countries is then important in establishing comparative advantage. Over time, reductions in poverty might shift trade patterns and the verdict on the desirability of trade becomes dependent on the timing of trade liberalisation as well as on the perspective taken. Our analysis suggests that whereas trade is always desirable, if one focuses on short-term allocative efficiency, temporary protection might be preferred because of the dynamic effects on industrialization and development.

The structure of our paper is as follows. Section 2 further motivates our set-up by discussing the potential impact of poverty on labour supply and production decisions on a micro-level, and trade and development on the macro-level. Section 3 subsequently constructs a formal model that takes these insights into account, which is used in Sections 4 and 5 to discuss the implications of including poverty over time for, respectively, the accumulation of training and comparative advantage. Section 6 discusses the desirability of trade in our poverty-ridden framework and Section 7 concludes.

2. Why poverty matters

Neo-classical trade theory has shown that trade is beneficial since it allows countries to exploit their comparative advantages. This conclusion is based on models in which individual behaviour is assumed the same all over the world, regardless of individuals' income or position. From development economics we learn that decision making might be different under poverty
than under relative affluence. Examples include the efficiency wages-literature (e.g. Dasgupta 1997), the literature about Giffen behaviour (Marrewijk and Bergeijk 1990; Jensen and Miller 2007, 2008), or, on a more fundamental level, Sen’s (1999) notion of development as an increase in freedoms and capacities. If such differences indeed are relevant, the question is how they affect the insights of trade theory. In order to answer this question, a micro-analysis of the circumstances under which the poor produce is warranted. A main characteristic of the situations of poverty is that individuals are directly confronted not with one budget constraint – as in usual neoclassical theory – but with two. First, it is impossible to consume more than one earns. Second, it is impossible to consume less than a certain minimum needed for survival. This simple fact has important consequences for the labour supply decisions of the individual.

Figure 1 depicts the decision of an individual confronted with the choice between work, resulting in income in the present, and training, resulting in higher wages in future. The U-curves represent iso-utility curves depicting all possible combinations of training and current income that yield the labourer the same level of utility. The slope of the curve in each point gives the marginal rate of substitution of current income and training in utility: the steeper the slope, the more the labourer values an additional unit of training. She weighs this against the opportunity cost of training, which is the wage to be earned on the labour market. In the figure, this is represented...
by the slope of the budget lines $w_zL_{\text{max}}$, for $z = A, B, C$. These budget lines give, for each level of training that is physically possible ($L \leq L_{\text{max}}$), the income level attainable at the prevailing wage rate. Normally, the optimising labourer will choose a ‘consumption’ basket of training and income such that the marginal costs of training equal the marginal benefits; that is, where the budget line is a tangent to the highest indifference curve possible. Points B and C indicate such points. Below the wage associated with point B, however, optimisation means working until income reaches the level of consumption minimally required to sustain the household (the horizontal line $E_{\text{min}}$), while spending the rest of time on training. For instance, for wage $w_A$, the desired choice would be $A'$, yet the labourer must choose $A$ to stay at a subsistence level of income. The resulting training expansion path is depicted by the bold solid line in the figure. Up until point B, it is the room for training that determines how much labourers train, causing any rise in the wage rate to reduce training levels. At wages above $w_B$, poverty no longer constrains, so that the level of training is determined by normal marginal cost-benefit analysis. Training falls with higher current wages, although at high enough wage levels it increases again, leading to the ‘bend’ in the training expansion path.

The analysis shows that individuals constrained by poverty limit labour supply once earnings go up. Although the incentive to train decreases when untrained labour wages rise, it is the growing opportunity to take time off to train that matters. Only when wages rise above subsistence levels do neoclassical trade-off decisions apply, securing a negative relation between current wages and training. On a macro-level, this has important implications. Let us assume that training is required for labour to engage in manufacturing, so that the amount of training a country’s labour force consumes sets the pace of its industrialisation. If training time is positively correlated with untrained labour wages, as our analysis of decision-making under poverty shows, it follows that countries that are more productive in the sector using untrained labour industrialise faster and may eventually gain a comparative advantage in manufacturing goods. Poverty may thus turn around comparative advantages, while it also matters for development.

3. A formal model of poverty and training

To formally verify the consequences on aggregate variables of poverty-based training decisions at the household level, we model a potentially poor country as producing two goods by means of land and labour. Land is homogeneous and in fixed supply. Labour supply is fixed as well, but consists of two qualities, trained and untrained labour, whose ratio may vary over time. Initially, all labour is of the untrained quality but over time individuals may become trained. Land and untrained labour are inputs to
the production of a homogeneous, agricultural product \( F \) (from Food). Trained labour is the only input for producing varieties of a manufactured good \( M \). Food entails decreasing returns to scale – over time the quantity of land is fixed while that of untrained labour is not – while in manufacturing we assume increasing returns to scale at the firm level.

To formalise training decisions, we assume that each period individuals have a certain amount of time available for working and/or training and normalise this to one. This time is devoted to working (for trained individuals) or to working and/or training (for untrained individuals). The decision how much to train is based on comparing current wages foregone and the net present value of the increase in wages that result from being trained. However, when the amount of training would yield a wage income below subsistence, the time devoted to training is such that it allows individuals to survive, leaving them a subsistence level of income. Consequently, above subsistence, the decision to become trained labour is based upon the desire for training; ‘at subsistence’ it is the room for training that determines training time. To aggregate individual training levels, we note that, in our analysis, being a trained or untrained individual is a dichotomous affair: one works either in the untrained agricultural sector or in the trained manufacturing sector. This would imply – given an initially homogeneous labour force – that all labourers would devote the same time to training, simultaneously becoming trained enough to enter the manufacturing sector. This is not a very plausible way of aggregating individual decisions. Therefore, we first aggregate individual training activities and use that to determine how many trained individuals arise. One motivation for doing so is that the possibility to enter the market as a trained labourer also depends on many other aspects than receiving training. Individuals may have different talents to undergo training, requiring some of them to train more than one period in order to be seen as trained labourer, but also other unforeseen reasons may preclude individuals entering the trained labour market. These aspects have in common that agents themselves are unaware of the effectivity of their training, adding randomness to who becomes trained labourer and who does not. Pooling individual training decisions is a convenient, non-restrictive way to mimic these random processes.\(^4\)

This set-up is made explicit by the following set of equations. The time individuals devote to training is governed by:

\[
T = \frac{r - w}{\rho w} \quad \text{(above subsistence)} \tag{1}
\]

\[
T^S = \frac{(w - E_{\text{min}})}{w} \quad \text{(at subsistence)} \tag{2}
\]

where \( T \) denotes the share of time per period devoted to training and \( w \) and \( r \) denote wage rates for untrained and trained labour, respectively.\(^5\) The
superscript ‘S’ is used to distinguish training levels at subsistence. The parameter $0 < \rho \leq 1$ denotes the individual’s time preference and $E_{\min}$ is the minimum subsistence level of expenditures. There are no tuition fees.

By choice of units, we set the total number of individuals in society equal to one. Denoting untrained individuals with $L$ and trained individuals with $H$, this implies that at any point of time:

$$H + L = 1$$  \hspace{1cm} (3)

The transformation of individual training activities into trained individuals is governed by:

$$\dot{H}_t = C \cdot T \cdot L \quad \text{(above subsistence)}$$

$$\dot{H}_t = C \cdot T^S \cdot L \quad \text{(at subsistence)}$$ \hspace{1cm} (4)

That is, the total amount of time trained in society $(T^S \cdot L)$ translates directly into trained individuals, taking into account an efficiency parameter $C \geq 0$. This parameter can be interpreted as the efficiency of the training system per se – a given input of hours trained yields a higher ‘output’ of trained individuals, but it can also be seen as an average measure of the untrained labourers’ talent for training – a higher $C$ implies that less training hours are required to become trained.

Essentially, equation (1) is the outcome of a cost-benefit calculation that the untrained labourer makes, weighing the net present value of a persistent difference in wages $(r - w)/\rho$ against the costs of current wage income foregone due to (also) being engaged in training, $wT$. It is relevant when individuals have a choice to optimally determine their training-work decision.\(^6\) By contrast, equation (2) determines training levels such that the remaining wage income just equals the minimum level of expenditures required to survive: $w(1 - T^S) = E_{\min}$. It is the room for training that determines how much individuals train. In terms of Figure 1, equation (1) applies to the curved part of the training expansion path and equation (2) to the flat part. Which of the two decision rules applies is determined by the model.

The amount of trained labour $H$ also denotes how many trained labourers are available for manufacturing production. Since part of untrained labourers’ time is devoted to training, the amount of labour available for food production is $L \equiv \zeta (T) \cdot L < L$, with $0 < \zeta (T) < 1$ and $\zeta'(T) < 0$. In our analysis we will typically apply $\zeta = 1 - T$ as a plausible benchmark.\(^7\)

Wages of untrained labour are determined in the food sector. Food is produced by land and untrained labour and since the pile of arable
land is fixed, its production entails decreasing returns. Specifically, we assume

\[ F = A \ell^\beta \]  

(5)

with \( 0 < \beta < 1 \) and \( A \) a positive constant that denotes fertility of land. Food is a homogeneous product and we choose it as numeraire, setting its price to one throughout the analysis \( (p_F = 1) \). The wage of untrained individuals is then equal to their marginal productivity:

\[ w = \beta A \ell^{\beta - 1}. \]  

(6)

Trained labour is the sole production factor of manufactures. The manufacturing sector is monopolistically competitive and faces increasing returns to scale. Specifically, the production of any variety of the manufactured good entails a fixed cost \( f \) and a marginal production cost of \( a_m \) units of trained labour. The total labour requirement of producing \( x \) units of a manufacturing variety thus equals \( H_x = f + a_m x \) and total costs are \( r(f + a_m x) \). Profit maximisation implies that price becomes a fixed mark-up over marginal cost:

\[ p = \frac{a_m r}{1 - 1/\sigma} \]  

(7)

while assuming free entry and exit of firms drives (excess) profits to zero, implying \( x = f(\sigma - 1)/a_m \) and \( H_x = \sigma f \). Since trained labour is only used in manufacturing, the total number of manufacturing varieties \( N \) is implicit in the full employment condition for trained labour:

\[ H = NH_x = N\sigma f \]  

(8)

Given their training decision and the wage income this implies, all individuals divide consumption over food and the composite manufactured good in a Cobb–Douglas way, while the demand for varieties entails standard Dixit–Stiglitz love of variety:

\[ U = C_M \mu C_F^{1-\mu} \]  

(9)

\[ C_M = \left( \sum_{i=0}^{N} c_i^{1-1/\sigma} \right)^{1/(1-1/\sigma)} \]  

(10)

where \( 0 < \mu < 1 \) denotes the expenditure share on manufactured goods and where \( \sigma > 1 \) is the constant elasticity of substitution between varieties as well as the price elasticity of demand. \( C_M \) and \( C_F \) denote, respectively,
consumption on the manufacturing composite and food. Utility maximisation implies that a share $\mu$ of the individual’s income is spent on manufactured goods and a share $1-\mu$ on food.

All individuals divide their income over food and manufactures in the same way, irrespective of training and income levels. Accordingly, we can depict consumption levels as a function of aggregate income $I$ as:

$$C_F = (1-\mu)I \quad \text{and} \quad C_M = \mu I \quad (11)$$

Total income in the economy consists of what is earned in manufacturing and food production. Recalling that there are zero profits in manufacturing and assuming that rents (due to the presence of decreasing returns to scale in agriculture) are redistributed to the entire population, we get:

$$I = rH + wE/\beta$$

All income is spent on food and manufactures. Wages foregone due to training are implicit in $E$, while there are also no tuition fees.

In autarky, the ratio of total earnings in manufacturing and agriculture must equal the ratio of expenditure shares. Hence, equilibrium requires:

$$\frac{r(f + a_m x)N}{Ae^\beta} = \frac{\mu}{1-\mu} \quad (12)$$

where we used equation (11) to determine $C_M/C_F$. Substituting the equilibrium firm size in this equation and rearranging gives the wage rate for trained labour as a function of $H$:

$$r = \frac{\mu}{(1-\mu)} \frac{Ae^\beta}{H} \quad (13)$$

We can now determine the amount of training when untrained labour’s incomes are above subsistence. Substituting equations (6) and (13) into equation (1) yields,

$$T = \frac{1}{\rho} \left[ \frac{\mu}{(1-\mu)} \frac{\zeta(T)(1-H)}{\beta H} - 1 \right] \quad (14)$$

**Proposition 1:** Above subsistence levels of income, the time an untrained labourer devotes to training decreases when the amount of trained labour in society increases, be it at a decreasing rate: $\partial T/\partial H < 0$; $\partial^2 T/\partial H^2 > 0$. Training levels are zero for $0 < H < H < H \leq 1$ where $H = \mu \zeta / [(1-\mu)\beta + \mu \zeta]$. 
A rise in the share of trained labour $H$ will cause a fall in the relative reward of trained labour. The relative abundance of trained labour increases, while wages of untrained labour rise due to decreasing returns to scale in agriculture. The desirability of undergoing training falls, becoming zero at $0 < H < 1$ where the wage premium of getting trained is just equal to the loss of wage income foregone. We note that $H$ is independent of the fertility of land $A$, since the exogenous boost to income of higher land fertility spreads over society according to fixed relative expenditure shares on goods.

At subsistence, it is the room for training that determines how much an individual trains, as given by equation (2). Applying the equilibrium wage rate for untrained labour, the amount of training is:

$$T^S = \frac{[\beta A \xi^{\beta-1} - E_{\text{min}}]}{\beta A \xi^{\beta-1}}$$

Proposition 2: At subsistence levels of income, the time an untrained labourer devotes to training increases when the amount of trained labour in society increases, at an increasing rate: $\partial T^S/\partial H > 0$; $\partial^2 T^S/\partial H^2 > 0$. Training levels are positive for all $0 < H < 1$ if and only if $(E_{\text{min}}/\beta A)^{1/(\beta-1)} > \zeta$.

At subsistence levels of income, transformation is based on the possibilities for training. Training increases when the income of untrained labour rises, which is the case as more unskilled labourers become trained labour. When $H \leq \overline{H} \equiv 1 - (1/\zeta) \cdot (E_{\text{min}}/\beta A)^{1/(\beta-1)}$, the wage rate is equal to the subsistence level of expenditures and the room for training is zero. To have a positive level of training in the initial situation, when $H = 0$, therefore requires $H < 0$ and hence $(E_{\text{min}}/\beta A)^{1/(\beta-1)} > \zeta$. For the remainder of the analysis we assume that this is the case.

Figure 2 shows both functions diagrammatically (the dashed curves). The exact positions of the curves depend on the particular parameter values, but, consistent with our propositions, the subsistence curve cuts the vertical axis at $[1-E_{\text{min}}/\beta A_{\xi}^{\beta-1}] > 0$, while the ‘above subsistence’ curve cuts the horizontal axis at $\overline{H} < 1$. The true function of $T$ of course depends on which decision rule applies, to which we turn now.

4. Training as time goes by

When the amount of trained labour in the economy increases, our model indicates that individual training levels increase when the economy is at subsistence, while training levels decrease when the economy is above subsistence. Which situation applies is determined by comparing the outcomes of training decisions under either regime. If $T^S \geq (\leq) T$, then untrained labour is above (at) subsistence as the room for training is equal
to or higher (lower) than the desired level of training. In terms of Figure 2, the true function of $T$ is indicated by the bold curve.

The regime switch may however not be so smooth as Figure 2 seems to imply. Individuals are myopic and do not realise that their individual training decisions have macro implications. This is not problematic as long as training levels increase when $H$ goes up, as at subsistence. Higher training levels and higher $H$ both increase marginal productivity in agriculture, increasing wages and the room for training. However, when income levels are above subsistence, training levels decrease in $H$ so that wages for untrained labour drop in spite of higher $H$. The decline in wages may be such that individuals fall back to subsistence again. This marks the beginning of an oscillative pattern of individual training levels and likewise regime switches. Wages at the end of subsistence periods increase when $H$ accumulates, lowering desired training levels in the subsequent ‘above subsistence’ period. At some point the desired training levels become zero – we do not allow for ‘distraining’ – so that wages also increase across ‘above subsistence’ periods until at some point the room for training remains above desired levels.

**Proposition 3:** There is a unique value $0 < \tilde{H} < 1$ for which the desire for training equals the room for training. Due to the macro implications of collective individual decision making, $\tilde{H}$ also marks the beginning of an oscillative pattern of individual training levels over time. Ultimately it is the desire for training that determines individual training levels.
The value of \( \tilde{H} \) is implicit in:

\[
(1 + \rho)(1 - \tilde{H})^{\beta - 1} = \frac{\rho E_{\text{min}}}{\beta A^\beta} \left( \frac{\zeta(\cdot)}{1 - \mu} \right) \left( 1 - \tilde{H} \right)^\beta
\]  

(16)

The left-hand-side of equation (16) is a positive function of \( H \), ranging from \((1 + \rho)\) at \( H = 0 \) to infinity at \( H = 1 \). The right-hand side is a negative function of \( H \) ranging from infinity at \( H = 0 \) to \( \frac{E_{\text{min}}}{A} \) at \( H = 1 \). Hence, both functions intersect once on the support of \( H \). By applying the implicit function theorem, \( \tilde{H} \) increases in \( E_{\text{min}} \) and \( z \) while it decreases in \( A \). If land is less fertile or when subsistence levels of expenditure are higher, there is less room for training and the economy reaches its above subsistence state later. Likewise, if \( \zeta \) goes up, the effective labour supply in food production goes up, implying a lower wage level for untrained individuals and less room for training.

We now discuss the accumulation of \( H \) over time, which is based on aggregating individual training levels. Using equation (4), we get

\[
\dot{H}_t = \begin{cases} 
C \cdot L_t \cdot T_t = \frac{C}{\rho} (1 - H_t) \left[ \frac{\mu}{(1 - \mu)} \left( \frac{\zeta(\cdot)}{1 - \mu} \right) - 1 \right] & \text{(above subsistence)} \\
C \cdot L_t \cdot T^S_t = \frac{C}{\rho} \left[ \frac{\beta A^\beta (\cdot)^{\beta - 1}}{\beta A^\beta (\cdot)^{\beta - 1}} \right] \left( 1 - H_t \right)^{\beta - 1} & \text{(at subsistence)}
\end{cases}
\]

where a dot denotes a time derivative. The subscript \( t \) is added to signify that training decisions depend on the amount of trained individuals at a particular moment in time. The derivatives of these functional forms are (omitting time subscripts):

\textbf{At subsistence}

\[
\frac{dH}{dH} = C \left[ (2 - \beta) E_{\text{min}} - w \right] / w \geq 0
\]

\[
\frac{d^2H}{dH^2} (2 - \beta) = CE_{\text{min}} (\beta - 1) / w (1 - H) < 0
\]

\textbf{Above subsistence}

\[
\frac{dH}{dH} = -C \left( T + \frac{T}{H} + \frac{1}{\rho} \right) < 0 \text{ if } T > 0
\]

\[
\frac{d^2H}{dH^2} = C \left[ T + \frac{1}{\rho} \left( 1 + \frac{\mu z(\cdot)}{\beta(1 - \mu)} \left( 1 + \frac{1}{H} \right) \right) \right] / H^2 > 0 \text{ if } T > 0
\]

\textbf{Proposition 4:} At subsistence, the accumulation of trained labour increases over time as long as \( w < (2 - \beta) E_{\text{min}} \). Above subsistence, the accumulation of trained labour decreases over time, but is positive as long as \( H < \tilde{H} \).
Whereas $T^S$ increases in $H$, aggregate training levels might decrease in $H$. This is a logical outcome of aggregation. While the room for training increases, the number of individuals it applies to reduces. The ‘above subsistence’ inference follows directly from Proposition 1.

Ultimately the accumulation of trained labour stops, which we will refer to as the economy’s steady state. By Proposition 3 the steady state level of $H$ is determined by $C \cdot (1 - H_t) \cdot T_t = 0$ in equation (17), hence:

$$H = \frac{\mu \zeta(T)}{(1 - \mu) \beta + \mu \zeta(T)}$$  

which is equal to the threshold level $\bar{H}$ beyond which individual training levels are zero.

**Proposition 5:** The economy reaches a steady state of zero trained labour accumulation at $< H < 1$. The steady state level of $H$ is independent of $A$, the fertility of land.

To illustrate the macro implications of individual training decisions, Figure 3 provides a numerical analysis of the true path of training as a function of $H$ (solid curve) and the $T^S$ and $T$ curves (dashed). The figure is based on the following parameter values: $A = 4$, $E_{min} = 1.75$, $\mu = \beta = 0.6$, $\rho = 0.9$, $C = 0.1$, $a_m = 0.5$ and $f = 1$, increasing $H$ from zero to one with steps of 0.01. Moreover, we set $\zeta(T)$ equal to $1 - T$. To operationalise myopic behaviour, we assume that training decisions depend on the previous period’s value of $H$. Since $H$ accumulates over time and we do not allow for distraining, lower values of $H$ indicate earlier moments in time. Hence, in Figure 3 $T_t = [(r/w)_{t-1} - 1]/\rho$ and $T^S = 1 - E_{min}/w_{t-1}$.

The figure clearly shows oscillations, which start at the switching point $\bar{H}$ and dampen when $H$ increases as explained. The rapid increase in training levels at the beginning of the subsistence curve is a ‘beginning of time’ effect. At time zero, training levels increase from zero to a positive but finite level, increasing wages considerably. After a while these changes normalise.

The oscillations could be easily avoided if individuals did not change training levels over time that lightly. For instance, oscillations disappear when the change in training levels depends on past wages as follows

$$T_t = T_{t-1} + \delta \left[ \left( \frac{f - w}{w} \right)_{t-1} - T_{t-1} \right]$$  

and setting $0 \leq \delta \leq 1$ low enough. The plausibility of this depends on how one interprets a time period. In our set-up, trained individuals arise as the result of pooled individual training decisions. In that case, it seems plausible
to see each period as a moment in time when a new generation of individuals decides how much to set aside for training. Training in each period then concerns different individuals and large swings in training levels across periods are not unlikely. We will pursue this interpretation henceforth.

The oscillations in individual training levels also influence the accumulation of trained labour. Figure 4 depicts the development of $H$ over time for the parameter constellation we used before, for alternative values of $b$ and $A$. For low values of $b$ the accumulation of $H$ increases at first, then decreases and ultimately it becomes zero. For higher values of $b$, the decline sets in much faster. Changes in the value of $A$ affect the position of the $H$-curve, but not its pattern. In addition, the time it takes before the oscillations end does not change. Higher fertility of land implies that the curves shift upwards, while rotating counterclockwise. Initial training levels are higher and subsistence levels of income are reached at an earlier stage. The oscillations would disappear once changes in $T$ are smoothened over time, as in equation (19) and with a low enough adjustment rate. We note however that even when the regime switches disappear, oscillations remain until steady state is reached. This is because we constrain the minimum level of training at zero. If training is zero, wages drop, increasing the desire for training to above zero. It takes until the calculated steady state level $H$ before this process comes to an end.

5. Poverty-induced comparative advantage and trade
In this section we use our model to verify the implications of poverty on comparative advantage and trade. We assume that the world consists of two
regions, North and South, that are initially exactly similar, except that North has more fertile land at its disposal than South. Using asterisks to denote southern variables, $A > A^*$ throughout the analysis.

In our model, comparative advantage is given by the relative price of manufactures over food. With food being numeraire, the relative price of manufactures over food.
manufactured goods is given by equation (7). Using equation (r autarky) to substitute for $r$, we get:

$$ p = \frac{a_m A^\mu \sigma}{(1 - \mu) \sigma - 1} \frac{\zeta(T)^\beta (1 - H)^\beta}{H} $$

(20)
as the relative price of manufactures in North. The relative price of manufactures increases when the share of manufacturing in total expenditures increases ($\mu$), when the marginal labour costs of manufacturing production goes up ($a_m$) and when the monopoly power of manufacturing producers increases (as implied by a lower price elasticity of demand $\sigma$). The relative price of manufactures also increases when the fertility of land $A$ goes up. Likewise, equation (20) implies that the relative price of manufactures goes down when $H$ increases ($dp/dH < 0$) and when the effective labour input into food production goes down ($\zeta(T)$ down).

For the South, an isomorphic equation applies for $p^*$. The comparative advantage of both countries is given by $p/p^*$. If $p/p^* > (<) 1$, we say that North has a comparative advantage in food (manufactures). If the two countries are completely identical, except for the fertility of land, we get:

$$ \frac{p}{p^*} = \frac{A H^*}{A^* H} \left[ \frac{\zeta(T^*) (1 - H^*)}{\zeta(T^*) (1 - H^*)} \right]^\beta $$

(21)

where we have implemented $\mu = \mu^*$, $\sigma = \sigma^*$ and $a_m = a_m^*$.

**Proposition 6:** South has a comparative advantage in manufacturing when training levels and trained labour stocks are equal, but, due to unequal possibilities for training, South’s comparative advantage switches to food. When both countries have reached steady state, South’s comparative advantage lies in manufacturing again.

The less fertile soil in the South puts it at a disadvantage in producing food compared with the North. However, differences in soil fertility also imply that South and North face different time paths for the accumulation of trained labour, see Figure 4. In fact, having more fertile land implies a comparative advantage for North in manufactures at the beginning of the first period after which training could occur. As both countries reach the same steady state, by Proposition 5, $H$ is independent of $A$, and eventually comparative advantage retains its initial ordering.

We illustrate the development of comparative advantage over time in Figure 5, for two different values of $\beta$. Using our benchmark parameter constellation, South immediately obtains a comparative advantage in food. Its initial comparative advantage in manufacturing has become a disadvantage, setting it behind in the transformation from a mainly
agriculture-based society to an industrialised society. North therefore also reaches the point where income gets above subsistence earlier, from which point onwards training levels start to fall. In the South, the room for training still increases, and \( p/p^* \) starts to increase. This continues once South surpasses subsistence levels of income – prices of manufactures will fall in both countries, but more rapidly in South than in the North – and South retains its initial comparative advantage in manufactures.

The overall picture is invariant to the value \( b \). A lower value of \( b \) shifts the curve downward and prolongs the time it takes for South to retain its nature given comparative advantage in manufactures. The reason is simple and in line with our earlier results. A lower value of \( b \) implies higher decreasing returns in food production, which amplifies the positive impact of training on wages. With training levels at subsistence higher in North, the wage difference between North and South increases and so does \( H \) accumulation over time (cf. Figure 4). This also explains the difference in amplitude of the oscillations that appear in the figure. With lower decreasing returns, the time paths of trained labour accumulation converge and oscillation periods overlap. The wage and price shocks that occur in both countries therefore either reinforce or counter each other, affecting the amplitude of the swings in comparative advantage accordingly.

The overall picture is also invariant to allowing for depreciation of trained labour. Arguably, skills acquired during training may wear out over
time, implying that trained labour may become unsuitable for producing manufactures after a while. However, allowing for this possibility in our framework, for instance by assuming that each period a certain percentage of the total trained labour force becomes untrained again, does not affect the analysis whatsoever. This is different when we allow for other increases in the untrained labour force, for instance exogenous population growth. Provided the (exogenous) untrained labour force growth exceeds the (endogenous) outflow into trained labour, a country may remain at subsistence forever. The reason is of course that since the number of people working in agriculture does not decline, wages for untrained labour are depressed, which mitigates the room for training and depresses wages even further. In our analysis it is more likely that the less fertile country remains at subsistence – the pressure on wages in agriculture is initially highest there. In that case, its comparative advantage will also remain in agricultural produce forever. In terms of Figure 5: the upward sloping part disappears.

The implications of these results for the desirability of trade depend on the criteria used. From a welfare point of view, nothing in the model disqualifies the standard result of trade theory that trade brings efficiency gains. In addition, trade in our model does not affect the eventual steady states, which are determined by internal factors only. If we are concerned with the pace of industrialisation, however, the switching of comparative advantage in our model offers some arguments against trade liberalization. Focusing on South, the immediate reversal of comparative advantage means that trade benefits untrained labour until comparative advantages switch back to the nature-given state again. As long as incomes in South are at subsistence, this income boost increases room for training and the pace of industrialisation. Once incomes rise above subsistence, by contrast, higher untrained labour wages depress the incentive to train, slowing down South’s catch up process. It is only when specialisation patterns shift back again that trade again starts to stimulate Southern industrial development. In that stage, South exports manufactured goods, increasing the gap between

Table 1. Effects of trade on welfare and the pace of industrial development.

<table>
<thead>
<tr>
<th></th>
<th>North</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Welfare</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All phases</td>
<td>positive</td>
<td>positive</td>
</tr>
<tr>
<td><strong>Industrial Development</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase 1: at subsistence; poverty induced comparative advantage</td>
<td>negative</td>
<td>positive</td>
</tr>
<tr>
<td>Phase 2: above subsistence; poverty induced comparative advantage</td>
<td>positive</td>
<td>negative</td>
</tr>
<tr>
<td>Phase 3: above subsistence; nature–given comparative advantage</td>
<td>negative</td>
<td>positive</td>
</tr>
</tbody>
</table>
trained labour and untrained labour and thereby augmenting the incentive to train. For North, the effects are always opposite.

The results are summarised in Table 1. Whereas from an efficiency point of view trade is always beneficial to both regions, it shows that if one's primary concern is industrialisation, North and South have conflicting interests. Whenever Northern development benefits from trade, Southern industrialisation does not and vice versa.

6. Conclusion

This paper has argued that poverty is a crucial factor in assessing the desirability of trade liberalisation for development. The basic argument we have put forward is that poverty limits people in their economic choices. Confronted with a wage that is hardly sufficient to survive, people are forced to supply all the labour time necessary for reaching a subsistence income. Deciding on one's labour inputs on the basis of their preferences about various alternative uses of available time is a luxury that poor people cannot afford.

The main effect of this observation is that, in the context of poverty, higher wages will tend to limit labour supply and boost alternative uses of time, such as schooling. It follows that countries whose population enjoys higher agricultural incomes will be able to invest more in training, and therefore develop faster. These aspects of poverty have been analysed in a formal set-up that takes heed of these non-standard decision processes. It has been shown that countries enjoying a nature-given comparative advantage in agriculture, for instance because of higher fertility of land, will develop a poverty-induced comparative advantage in manufacturing. Over time, however, as incomes rise and industrialisation takes hold in less advantaged regions as well, this pattern of comparative advantage will shift back again to its nature-given position.

Trade has no qualitative effect on these processes, but may either speed up or slow down industrialisation. Dependent on the specific phase of relative development of a country, it might be desirable to temporarily pass by on trade if one's goal is to industrialise as soon as possible. Our results indicate that this concerns not so much the least developed regions, but that it is more applicable to intermediately developed countries that have grown beyond constraining poverty already. For these, temporary protection may boost industrial development. As in standard trade theory, however, trade brings immediate efficiency gains that need to be weighed against such concerns with industrialisation. If a country puts a stronger emphasis on current income, trade is always optimal. If, by contrast, a country is willing to sacrifice current gains from trade to achieve higher levels of income in future sooner, stalling free trade could be better. In the end, this is a political decision.
Acknowledgement

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Notes

1. A different way to put this is to say that work is a Giffen good. Giffen behaviour can be a consequence of minimum consumption requirements (Marrewijk and van Bergeijk 1990). Indeed, the work/training decision meets the three conditions under which Giffen behaviour can be observed (Jensen and Miller 2008): households face subsistence concerns, they consume a basic (work) and a fancy good (training), and the basic good has no ready substitute.

2. That is, we implicitly assume that the wages just above subsistence are not high enough to lead to a situation in which higher wages lead to a lowering of the number of hours worked. The latter phenomenon is a well-known possibility in the literature on labour markets, where it leads to the backward bending part of the individual labour supply curve. Our assumption seems reasonable in light of the fact that backward bending supply curves are usually considered to occur in situations of relative affluence.

3. This pattern has clear historical antecedents. Industrial and commercial centres typically emerged either at locations where the soil was fertile enough to boost large populations not directly engaged in food production, or where particularly favorable water routes made it possible to import food from other regions, such as the cases of Venice, the Black Sea and Holland (Cipolla 1980, 75–6).

4. Non-restrictive, since it also leaves room for other interpretations than random choices. For instance, untrained individuals may see the importance of people becoming trained and are willing to sacrifice income in order for others to become trained. The amount of time devoted to training is thus actually what each individual decides to ‘chip in’ for the common good of getting a trained labour force.

5. The expression features nominal wage rates, where in equation (1) real wages would be due. However, the price index drops out.

6. The training decision above subsistence implies that individuals are myopic, perceiving current wage differentials to persist forever. It can be shown, however, that equation (1) is also consistent with static forward-looking expectations (see Baldwin et al. 2003, Section 2.B.4). Moreover, it is intuitively plausible: untrained labour bases its decision to become trained or not on the profitability of doing so.

7. We chose a general formulation because training-while-working may affect labour input disproportionally. Training could affect the efficacy of labour input positively, also when it does not directly apply to food production, but it may also require more effort and energy than the hours devoted to it. In any case, we assume that the individual takes the value of $\zeta$ as given.

8. In modelling the manufacturing sector and the demand side of the economy, we follow standard practice in international trade modelling and the new economic geography literature. See, for example, Brakman et al. (2001) and Baldwin et al. (2003).

9. We ignore subscripts to distinguish between varieties as each variety enters consumer demand symmetrically. Hence, equilibrium output, price and labour requirements will be the same across varieties.
10. Note therefore that the effect of subsistence levels of income on consumption choices works through the budget constraint. In our framework, utility maximisation can be seen as a three-tier process, where consumers first decide on their current and future income levels, and then divide the remaining income optimally over consumption possibilities.

11. That is, we assume identical and homothetic preferences. We apply it to maintain focus on the relation between poverty, training decisions and comparative advantage. Moreover, it keeps results tractable, for which reason homothetic preferences are also the standard assumption in trade theory. See, however, Matsuyama (2000) and Stibora and de Vaal (2007) for a treatment of non-homothetic preferences in a trade theoretic framework.

12. Land rents are equal to food production minus what is paid to untrained labour, hence $(1 - \beta)wE/\beta$. Our assumption that land rents are redistributed to the whole population implies that initially, when all individuals are untrained, each untrained labourer is also owner of land and that this does not change when individuals become trained.

13. By equation (3), $H$ is also the share of trained labour in society.

14. Though technically feasible, it makes no sense to allow for $w = E_{\text{min}}$ at positive levels of $H$ as then positive $H$ could never have been reached.

15. We note that a second steady state equilibrium exists, which occurs when even at $H = 0$ wages are at subsistence. Then $w - E_{\text{min}} = 0$ also implies a positive steady state level of $H$. It is, however, immediately clear that this is a theoretical possibility only, as supposedly any economy has started at some point in time without any amount of trained labour (hence positive $H$ could never have been reached). The limiting case when $w - E_{\text{min}} = 0$ at $H = 0$ is possible though, but highly unstable. Any rise in $H$ leads to an upward spiral until income is above subsistence level and, subsequently, the stable steady-state equilibrium is reached.

16. Extensive sensitivity analysis shows that the basic form of the figure is invariant to alterations in any of these parameters, provided of course that training levels are positive at $H = 0$.

17. In contrast to Figure 3, the horizontal axis exhibits constant increments in time and not in $H$. All values of $\dot{H}$ were calculated by using the actual amount of $H$ in the previous period.

18. The smoothness of $\dot{H}$ also disappears if the effectivity $C$ by which individual training transforms into trained labour approaches one. The reduction in untrained labour as well as the reduction in desirability of getting trained during the first period is so large that the economy immediately switches to the above subsistence state and remains there forever.

19. This does not imply that our definition of steady state should be that training levels are zero for two consecutive periods. In our numerical calculations, we made training levels depend on past period’s wages. Such lagged operationalisation of the simulateness of decision making of individual agents is not warranted when calculating the steady state mathematically.

20. During period 1 training levels are $[1 - E_{\text{min}}/\beta A]$ for North and $[1 - E_{\text{min}}/\beta A^*]$ for South, amounting to $H = C[1 - E_{\text{min}}/\beta A]$ and $H^* = C[1 - E_{\text{min}}/\beta A^*]$ at the beginning of period 2. Using this in equation (21) and assuming $\zeta(T) = 1 - T$ and $\zeta(T^*) = 1 - T^*$, shows that the relative price of manufactures in period 2 is smaller than $A/A^*$ (which was the initial relative price). Taking the derivative of the relative price with respect to $A$ and evaluating it for $A = A^*$, yields $d(p/p^*)/dA < 0$. Hence, during period 1, $p/p^*$ falls and becomes lower than one.
21. Strictly speaking, we cannot speak of initial comparative advantages, since there is no manufacturing sector initially. Were we to assume starting points with epsilon small, equal shares of trained labour, South’s initial comparative advantage would be in manufacturing however.

22. This clearly contrasts to standard treatments of comparative advantage, where comparative advantage is typically taken as given. In comparison to the dynamic comparative advantage literature, the mechanism we offer is completely different. The literature on endogenous comparative advantage explains how comparative advantages evolve when there are no inherent differences between agents, see Yang and Ng (1998) for an overview. In addition, the relation between exogenous comparative advantage and endogenous comparative advantage has received attention, for instance by establishing conditions under which initial exogenous comparative advantages may change. An early and seminal contribution is Yang (1994). As of yet, comparative advantage has not been linked to decision making under poverty at all.

23. In the end, this must imply that the room for training becomes negative, so that untrained labour gets under subsistence. This opens the door to endogenous population growth – some people will starve to death – but we will not consider this option.

24. This holds when the population growth rates in both countries are not too far apart. Only when the more fertile North also reaches steady state at subsistence levels of income, while having a population growth rate exceeding that of South considerably, will the upward sloping part reappear.

25. Specifically, the relative consumption shares of agricultural and manufactures products and the degree of economies of scale in the agricultural sector.

References


