Industrialization “without” tariffs – Friedrich List as a forerunner of modern Development Economics

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Abstract:

In this paper, we analyse Friedrich List's contribution to the modern theory of economic development. We argue that Friedrich List saw economic development as a combination of a sectorial division of labour (following Adam Smith, 1776) and a geographical division of labour across regions and countries. In this sense, the passage from a traditional economy to an industrial one consists of balanced growth at both the sectorial and geographical level, as we see in modern development economics (see Rosentein-Rodan, 1943; and Murphy et al., 1989). In addition, List highlights the role of transport costs in the industrialization process not only in terms of the costs incurred by firms, but also how industrialization affects these costs, since modern technology produces goods that are “lighter” to transport than goods produced with traditional technology. In this sense, contrary to what is usually attributed to List, tariffs are not the central part of his argument for industrialization. He puts more emphasis on the creation of a larger internal market via for instance a customs union and the complementarities between resources and sectors in a country. We illustrate these arguments with a model.

Keywords: Friedrich List; Economic Development; Sectorial Division of Labor, Geographical Division of Labor, Customs Union, Transport Costs.

JEL Classification: O14, R11, R30

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1. Introduction

The first formal approach to economic development can be found in the first chapter of ADAM SMITH's (1776) *Wealth of Nations* dedicated to the concept of division of labor. Suppose that a set of *n* workers produces a good (for instance, "pins"), performing different complementary tasks for that purpose. If the workers switch from a situation of occupational homogeneity, where each one achieves all productive tasks to specialization, each worker doing a specific task, labor productivity can assumed to rise drastically. According to SMITH (1776) this rise in productivity stems from a capitalization of the productive process in terms both of human and physical capital. As the task performed by each worker becomes simpler and more narrowly defined, his skill and mastery of the process also increase. Furthermore, as the task becomes simpler, it can be more likely mechanized through the construction of a dedicated machine. According to SMITH (1776), this rise in labor productivity due to occupational specialization lies in the core of the mechanism of economic development.

Let us assume now that an economy is, from the spatial point view, formed by two homogeneous countries, *Home* and *Foreign*, each one being endowed with *n* workers that are also consumers. The two countries are connected by a road along which goods can be carried with the cost of f per unit of weight dispatched.

ADAM SMITH (1776) said that the degree of occupational specialization and, consequently, the pace of economic develop is "limited by the extent of the market". BECKER and MURPHY (1992) interpreted correctly this assertion as meaning that the degree of division of labor is directly related with the number of workers that can be engaged in a specialization process. This number is bounded from above by the ability to coordinate the workers within the same productive process.

According to ADAM SMITH (1776), the "extent of the market" is seen to depend on two broad factors, each one of them including more than one determinant.

1. The density of population, which can be either uniform in space or asymmetric. In the latter case, the density around the factory is most important. Moreover, a "wealthy" worker endowed with human or physical capital who receives higher dividends or wage, is equivalent to two or more "poor" workers for the purpose of assessing the "extent of the market".
2. The transport cost of the unit of output which is exported between countries *Home* and *Foreign.* This can be decomposed into two components. The first is the size of f, the transport cost of the unit of weight of output exported which is inversely related with the quality of the transport system. Before the arising of railways, water transportation was much faster than carrying goods by land. For a given value, a product can be "lighter" and precious or "heavier" and raw. Former products are easier to move than the latter.

Let us assume that the spatial economy is underdeveloped at the start, so that each worker is a generalist who performs all productive tasks, and the unit transport cost f is prohibitively high thus excluding trade in parts or in the finished good.

If the transport system remains unchanged, a direct path of economic development consists in shifting a share of population of country *Home* to country *Foreign*, thus enabling the latter country to achieve a deeper and thinner occupational specialization and benefit from an increase in labor productivity (STIGLER, 1951). By contrast, the remaining workers in the *Home* country become more generalists and their productivity falls significantly.

This strategy of economic growth leads to an increasing spatial imbalance. By contrast, modern Development Economics (ROSENSTEIN-RODAN, 1943; MURPHY et Al., 1989) designs a strategy of growth that is *balanced* both in sectorial and geographical terms. This strategy consists in a proportional capitalization of each worker, both in “human” (skills and mastery of task) and “physical” (substitution of a mechanized process of doing a task for a manual one). Since “capital” is a fixed input, the investment in each task amounts to the substitution of an increasing returns for a constant returns productive technology. Since each worker is now “wealthier”, this amounts to a rise in the number of workers in each region and, through the above outlined process, to a net gain in labor productivity. The increased supply of output in each country is exactly matched by a jump in individual consumption expenditure related with expanding incomes (wages and dividends).

FRIEDRICH LIST (1841) can be viewed as a forerunner of modern Development Economics as he aims to design a development strategy, which should be balanced both at the sectorial and geographical levels. If we compare his work with ROSENSTEIN-RODAN (1943) and MURPHY et AL. (1989), his worth follows from two circumstances. Firstly, he stands as a forerunner, since his main work, *The National System of Political Economy* was published as early as 1841. Secondly, his analysis is more complete than the modern Development Economics’ since its does not limit itself to a consideration of coordinated investments that switch technology from constant to increasing returns in each sector, but includes also a fully examination of the role of transport costs in keeping the economy balanced across the countries.

FRIEDRICH LIST’s (1841) perception of transports covers two main insights. The first one is the idea that transport costs are usually underestimated because there is a part associated with the international political situation (e.g. trade wars, embargos and so on), which is disregarded because it happens randomly. The second one is the insight that the rate of industrial transformation of a raw material decreases its transport cost because it is weight-losing thus making the finished product “lighter” and more easy to carry than the intermediate good.

2 Assumptions of the model

The model that LIST (1841) puts forward features a spatial economy made up by two symmetric countries, *Home* (H) and *Foreign* (F). Each country has n immobile inhabitants, who are both workers and consumers. There are two productive sectors, namely "agriculture" and manufacturing".

Each country has a fixed endowment of fertile land with n units of extent. For start, we assume that each consumer owns a farm with one unit of extent. Agriculture works under constant returns, according to a Cobb-Douglas production function:

$$Q = \beta L^{\alpha} S^{1-\alpha} \tag{2.1}$$

Here the symbols in (2.1) stand for:

$Q \equiv$ (raw) agricultural output
$L \equiv$ Labor input
$S \equiv$ Land input
$\alpha \in (0,1) \equiv$ Distribution parameter
$\beta > 0 \equiv$ constant productivity term

By choosing adequate unit measures for the agricultural output, β can be set equal to 1. Dividing both sides of **Error! Reference source not found.** by S, we obtain an intensive production function for the agricultural good:

$$\frac{Q}{S} = \left(\frac{L}{S}\right)^{\alpha} \Leftrightarrow q = l^{\alpha} \tag{2.2}$$

In expression (2.2), the symbols have the following meaning:

$q \equiv$ agricultural output per unit of land
$l \equiv$ intensity of land cultivation

Besides "agriculture", the cultivation of land in order to obtain a raw material, the economy comprehends a second productive task, namely "manufacture", which consists in processing and "refining" the raw material reducing its weight in order to get a "lighter" and more transportable consumer good. The final consumer good has also a specific value (per unit of weight) higher than the intermediate good.

Following SMITH (1776) and BECKER and MURPHY (1992), the two productive tasks will be assumed to be strictly complementary, so that one unit of raw material will be used to produce one unit of manufactured good.

There are two possible production regimes. In the more primitive one, according to SMITH (1776), there will be no division of labor, i.e., no occupational specialization of workers. In this production system, each farmer raises corn and then he grinds it into flour it in his cottage. No capital (either human or physical is used in production), only raw labor. If the productivity in the milling task is given by θ, and the joint labor input is l, the Leontief production function in this "cottage economy" is:

$$q = \underset{l}{Min}\left\{ l^{\alpha}, \theta l \right\} \tag{2.3}$$

We will assume that the farmer is able to refine all the raw material that he produces, i.e.:

$$q = \underset{l}{Min}\left\{ l^{\alpha}, \theta l \right\} = l^{\alpha} \tag{2.4}$$

And this amounts to setting a lower bound to productivity in milling work:

$$\theta > l^{\alpha-1} \tag{2.5}$$

In this unspecialized production regime, two conditions ensure that the market for consumer goods works in perfect competition, namely:

- the number of producers n is high enough,
- the consumer goods produced in the cottages are completely homogenous

Let p_c be the competitive price of the manufactured good, which is taken by all the farmers. Then, the profit function of the "cottage" is:

$$\pi = p_c l^{\alpha} - \left(w + \theta \right) l - R \tag{2.6}$$

Symbol R stands for the land rent. The farmer receives two rewards, namely the wage of cultivating land, w, and the reward of processing the raw material, θ, which is equivalent to the labor productivity in this task.

Since the market of the consumer good is competitive, in equilibrium, profits will be zero and equation (2.6) becomes:

$$R = p_c l^{\alpha} - \left(w + \theta \right) l \tag{2.7}$$

Henceforth, we will assume that land rent, following from the fixed endowment of fertile land in each country, will be each farmer's payoff in the non -cooperative game, which will be presented ahead.

Economic development means the specialization of famers in land cultivation, manufacturing being left to a monopolist that substitutes an increasing returns system for the "primitive" constant returns technology shown in expression (2.7). This new specialized processing technology uses a fixed input – a "machine – to refine unlimited quantities of the agricultural intermediate good into a final consumer good. For simplicity, we will assume that labor, as a variable productive factor is no longer required for industrial transformation.

Hence, economic growth entails always "occupational specialization", with different tasks being assigned to different groups of workers, while it may require (or not) "geographical specialization". If the industrial firm concentrates all manufacturing activity in a single plant in single country, geographical specialization of production will arise. By contrast, if the industrialist sets up two plants, one located in each country, specialization of workers will not be matched by country specialization.

Friedrich LIST (1841) judges the kinds of labor division very differently. While he finds that "occupational" specialization is socially positive, since it increases labor productivity, the geographical concentration of manufacture harms the country that is restrained to agriculture. A short reason behind LIST's (1841) point of view is that manufacture is far more "capitalized" (both in "physical" and "human" terms) that agriculture and a capitalist economy tends to reward much more "capital" than raw labor. Nevertheless, since LIST's (1841) argument is more complex than this, a long quotation of him becomes useful now.

> ***Compare, on the one hand, the value of landed property and renting of a district where a mill is not within reach of the agriculturist, with their value in those districts where this industry is carried on their very midst, and we shall find that already this single industry has a considerable effect on the value of land and rent; that there under similar conditions of similar fertility, the total value of the land has not merely increased to double, but to ten or twenty times more than the cost of erecting the mill amounted to; and that the land proprietors would have obtained considerable advantage by the erection of the mill, even if they have built it at their common expense and presented it to the miller … (page 141)***

In order to understand why the installation of a mill in a cornfield increases the land rent and value, it is necessary to realize that LIST (1841) ranks economic goods in the following way:

$$\text{Real Estate} \prec \text{Agricultural goods} \prec \text{Manufactured goods} \prec \text{Precious metals}$$

The order "$\prec$" means "less easy to transport from one place to another", because it is 'lighter' for a given value".

Consequently, when a mill is installed in a cornfield, the refined product (typically "flour") is "lighter" and easier to export. The increase of demand of flour by consumers in the foreign country leads to an increase of the output of corn at home. Consequently, the intensity of cultivation and the land rent rise in the domestic country and LIST (1841) estimates that the rise in land value covers the fixed cost of installing the mill.

3 The “*Listian*” economy as a non-cooperative sequential game

The workings of the spatial economy can be modelled through the following purely sequential game in extensive form (see next page).

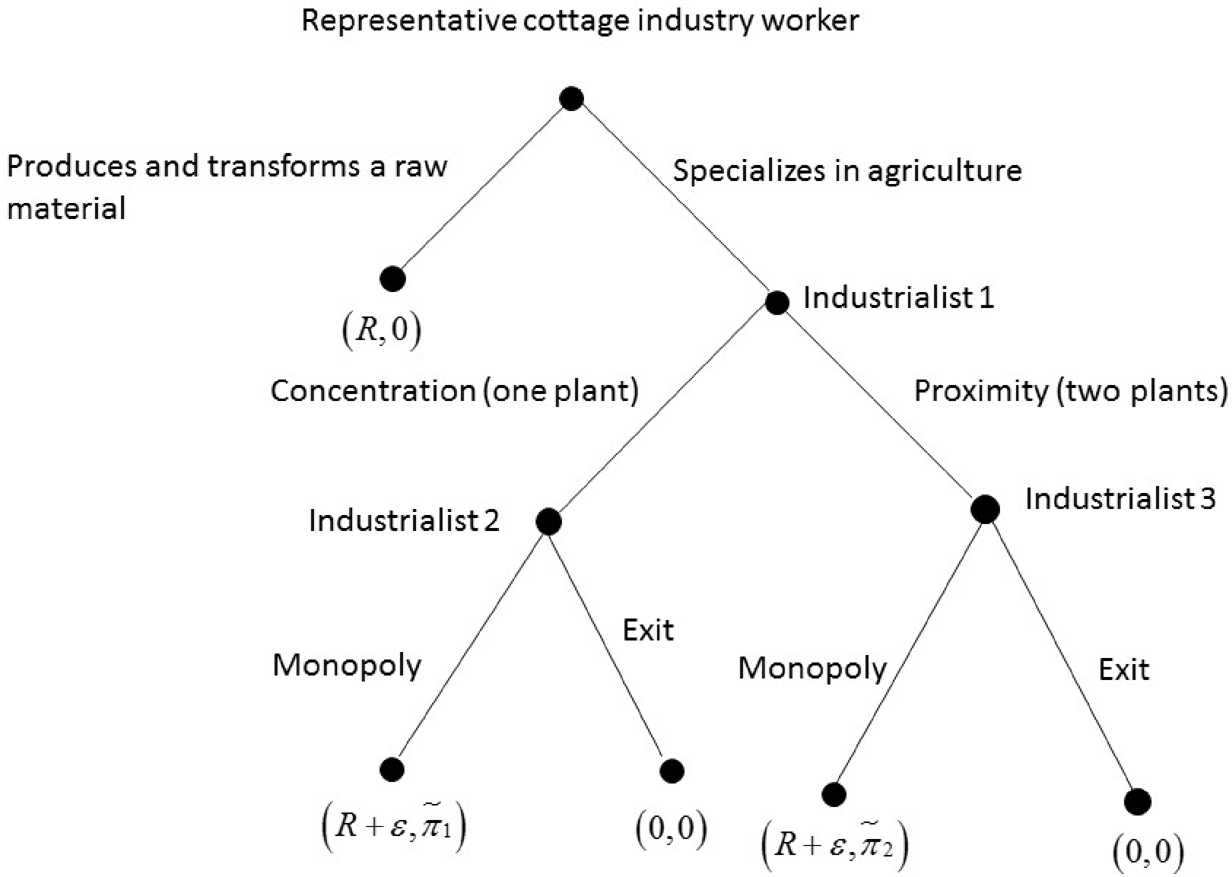

Figure 1: The *Listian* economy as a sequential game

This game has two players: a competitive fringe of symmetric cottage industry workers and an industrial monopolist.

The game starts with a symmetric decision by each cottage industry worker of either specializing in raising an agricultural product or accumulating agriculture with the industrial transformation of the raw material. This processing is done exclusively with labor as a variable input. If the cottage worker also transforms the input, it gets a rent with size (2.7) and the game ends with the cottage industry supplying all the needs in consumer goods.

Instead, the cottage workers may decide to specialize in agriculture, thus opening the field for the entry of a manufacturing monopoly, which specializes in the industrial processing of the farmers' output. If this happens, the technology for refining the intermediate good changes. Instead of labor as a variable cost, the monopolist uses labor embodied in a fixed input (a "refining mill" or "machine" in more general terms), besides the raw material itself. An increasing returns technology substitutes for a constant returns one.

The manufacturing firm takes two successive decisions. Firstly, it chooses either to concentrate industrial input refining in a single plant, in a single country (this action being labeled *Concentration*) or setting up two plants, one in each country, i.e. achieving *Proximity* between the supply and the customers of the final manufactured good. This choice determines the trade relations between the two countries. If industrial production concentrates in *Foreign* country, this country will engage in inter-industry trade with the other country. It will import the intermediate good produced by farmers in the *Home* country and it will export back the finished product. By contrast, if the monopolist achieves *Proximity* to customers, autarky will prevail in the international economy.

The second decision concerns pricing by the monopolist. Following STIGLER (1951), we assume that the industrial firm sets monopoly prices, but it faces an elastic demand related with the possibility that the farmers refrain from labor division and enter the market of the manufactured good. Hence, its price is a "limit price" which fulfills the role of entry deterrence as in DIXIT (1979, 1980). If while charging this "limit price" the monopolist makes a loss, it exits the market.

The perfect information game depicted in Figure 1 can be solved through backward induction in order to assess a subgame perfect equilibrium (SGPE) as it is usual.

We tackle first the pricing decision by the industrial firm. Let us consider firm the information set "Industrialist 2", where the firm sets up a single plant in a single country in the context of a spatial concentration strategy. The firms profit function π_1 is:

$$\pi_1 = \left(p_m - k\right)Q + \left(p_m - k - f\right)Q - G \tag{3.1}$$

Here the symbols stand for:

$p_m \equiv$ fob mill price of the finished good
$k \equiv$ fob mill price of the raw material
$Q \equiv$ number of units of both used input and sold output in each country
$f \equiv$ unit transport cost of the intermediate good
$G \equiv$ Fixed cost of a machine (e.g., a "mill")

The symbol Q can stand for the number units of both input and output because the proportions between them are fixed. Then, the units of measure of each one can be set such that the proportion is exactly "one to one".

Another crucial definition is:

$$p_m \equiv p_c - (1-\gamma) f \tag{3.2}$$

Here p_c is the competitive price of the consumer good whenever it is supplied by a cottage industry. Furthermore, γ is the "refining rate" implicit in the manufacturing process. It is given by the ratio:

$$\gamma \equiv \frac{\text{Total weight of the output}}{\text{Total weight of the input}} \in (0,1) \tag{3.3}$$

Symbol γ stands for the percentage of weight of the raw material that is "lost" during its industrial transformation. A low value for symbol γ, i.e., a value close to 0, means that the global production process is close to primary production. By contrast, a value for γ smaller than but close to 1 reveals a highly industrialized economy. Fob mill price (3.2) implies that highly industrialized products are "lighter" and easier to move between countries than goods that are closer to primary production.

The expression of p_m in (3.2) means that each consumer is not willing to pay a full price higher than p_c for the consumer good. Since p_m is a fob mill price, each consumer bears the transport cost. Hence, the maximum fob mill price that the distant consumers accept to pay is $p_m = p_c - (1-\gamma) f$.

Inserting (3.2) into (3.1), allows us to write the monopolist's profit function under spatial concentration as:

$$\pi_1 = Q\left[2(p_c - k) - f(1+2\gamma)\right] - G \tag{3.4}$$

Proposition 1: If the monopolist decides to concentrate spatially its production, the price k that he pays for the intermediate good equalizes the land rent under vertical integration of primary and secondary production, $R\left(p_c\right)$, and land rent under farmer's specialization in agriculture, $R\left(k\right)$. This price is approximately:

$$k \approx p_c e^{-\alpha\left(\frac{\theta}{w}\right)} \tag{3.5}$$

Proof: In Appendix A.

With a known value for symbol k , it is easy to find the production scale Q in the profit function π_1 shown in (3.4). This scale is determined by the farmer's aggregate output when they receive a price k for the agricultural raw material. The land rent of the individual farmer is:

$$R\left(l\right) = kl^{\alpha} - wl \tag{3.6}$$

Maximization of the rent leads to the optimal intensity of land cultivation:

$$l^{*} = \left(\frac{k\alpha}{w}\right)^{1/1-\alpha} \tag{3.7}$$

The optimal output of each farmer is then:

$$q^{*} = \left(l^{*}\right)^{\alpha} = \left(\frac{k\alpha}{w}\right)^{\alpha/1-\alpha} \tag{3.8}$$

It is clear that the current scale of production of the industrial monopolist is determined by its aggregate volume of input, i.e.:

$$Q = nq^{*} = n\left(\frac{k\alpha}{w}\right)^{\alpha/1-\alpha} \tag{3.9}$$

Inserting k from (3.5) and Q from (3.9) in profit function π_1 in (3.4), we obtain the industrialist's profit when it sets up one plant only:

$$\pi_1 = n\left[\frac{\alpha p_c}{we^{\alpha\left(\theta/w\right)}}\right]^{\frac{\alpha}{1-\alpha}} \cdot \left[2p_c\left(1-e^{-\alpha\left(\theta/w\right)}\right) - f\left(3-2\gamma\right)\right] - G$$

As the industrial firm serves $2n$ consumers, the *per capita* profit of the single plant single country firm becomes:

$$\hat{\pi}_1 = \frac{\pi_1}{2n} = \frac{1}{2}\left[\frac{\alpha p_c}{we^{\alpha\frac{\theta}{w}}}\right]^{\frac{\alpha}{1-\alpha}}\left[2p_c\left(1-e^{-\alpha\frac{\theta}{w}}\right)-f\left(3-2\gamma\right)\right]-\frac{G}{2n} \tag{3.10}$$

In this expression, $\frac{G}{2n}$ expresses the influence of manufacturing scale economies in the economy.

If the industrialist opts for a strategy of *Proximity* between supply points and consumers, he sets up a plant in each country. His profit function becomes

$$\pi_2 = 2\left[Q\left(p_m - k\right) - G\right] \tag{3.11}$$

In (3.11), as with *Proximity* between production and consumers there is no transport of goods, p_m equals p_c. Furthermore, k and Q are given again approximately by (3.5) and (3.9), respectively. Performing these substitutions, the monopolist profits if he sets up a plant in each country close to its customers is:

$$\pi_2 = 2\left\{np_c\left[\frac{\alpha p_c}{we^{\alpha\left(\theta/w\right)}}\right]^{\frac{\alpha}{1-\alpha}}\cdot\left[1-e^{-\alpha\left(\theta/w\right)}\right]-G\right\}$$

The *per capita* profit, which gives the importance of industrial scale economies in the economy, is:

$$\hat{\pi}_2 = \frac{\pi_2}{2n} = \frac{1}{n}\left\{np_c\left[\frac{\alpha p_c}{we^{\alpha\left(\theta/w\right)}}\right]^{\frac{\alpha}{1-\alpha}}\cdot\left[1-e^{-\alpha\left(\theta/w\right)}\right]-G\right\} \tag{3.12}$$

$\hat{\pi}_2$ can be simplified to:

$$\hat{\pi}_2 = p_c \left[\frac{\alpha p_c}{we^{\alpha \frac{\theta}{w}}} \right]^{\frac{\alpha}{1-\alpha}} \left(1 - e^{-\alpha \frac{\theta}{w}} \right) - \frac{G}{n} \tag{3.13}$$

In profit function (3.13), the ratio fixed costs over population in each country expresses the importance of scale economies in manufacturing when the monopolist sets up two plants. It is clear that that, in this case, industrial fixed costs become a higher burden for the workings of the economy than if the firm concentrates production in a single country.

The extensive form depicted in Figure 1, together with the following payoffs:

- R , the land rent under vertical integration, defined in (3.6), (3.5) and (3.7).
- $\hat{\pi}_1$, the *per capita* profit under the strategy of geographic concentration of production, given in (3.10).
- And $\hat{\pi}_2$, the *per capita* profit if the firm locates a plant in the proximity of customers in each country, given in (3.13).

all define a whole multidimensional class of games, given the fact that no numeric values are assigned to the parameters, rather than a single game.

In order to keep this class of games within a complexity level that allows us to understand it, we will concentrate on three parameters which will be left in general form, the remaining ones being assigned numerical values. The parameters that define this simplified class of games are:

- f , the unit transport cost of the agricultural intermediate good.
- $\gamma \in (0,1)$, the "refining rate" in manufacturing, equivalent to the ratio given by $\frac{\text{weight of the output}}{\text{weight of the input}}$.
- $\hat{G} = \frac{G}{n}$, the relative importance of economies of scale in manufacturing for the workings of overall economy.

The following parameters will have assigned numerical values:

- $p_c = 1$
- $\alpha = \frac{1}{2}$
- $w = \theta = 1$

With these simplifications, the normalized profit functions in (3.10) and (3.13) become, respectively

$$\hat{\pi}_1 = \frac{1}{4\sqrt{e}}\left[2\left(1-\frac{1}{\sqrt{e}}\right)-f\left(3-2\gamma\right)\right]-\frac{\hat{G}}{2} \tag{3.14}$$

and

$$\hat{\pi}_2 = \frac{1}{2\sqrt{e}}\left(1-\frac{1}{\sqrt{e}}\right)-\hat{G} \tag{3.15}$$

Since we have three parameters, we will consider two fixed values for transport costs. According to COMBES and LAFOURCADE (2005), in the empirical literature it is usual to estimate trade costs as about 20% share of total exports or imports value. Hence, the base value $f = 0.2$ will be assumed. The alternative scenario will entail a value for the transport cost that is double than this. We will assume then that $f = 0.4$.

According to LIST (1841), the change between low and high transport costs has a double dimension. On the one hand, there is a long run trend of fall of transport costs on account of the improvement of transportation. This long run trend explains the expanding size of economic spaces which can play an important role in the world economy. Hence, the world economy started with groups of trading cities (the Italian and Hanseatic cities). Then from the seventh century on, it became an arena for wide nation-states (such as France and England). At last, the world economy became the playground for countries or federations with a continental width (the BRICS, US and the EU).

But LIST (1841) remarked that transport costs suffer sharp variations following from changes in the political international situation, which namely leads to embargos or tariffs rise. According to the German economist, these variations are usually underestimated because they are **random**.

Hence, for each value of $f\left(\text{either} f = 0.2 \text{ or} f = 0.4\right)$, we plot in space $(\gamma, \hat{G})$ the following conditions:

$$\hat{\pi}_1 = 0$$

$$\hat{\pi}_2 = 0$$

$$\hat{\pi}_1 = \hat{\pi}_2 = 0$$

These lines define boundaries for the regions concerning the production regime in $(\gamma, \hat{G})$ space, namely:

No division of labor iff $\hat{\pi}_1 < 0$ and $\hat{\pi}_2 < 0$

Specialization with “Concentration” iff $\hat{\pi}_1 > 0$ and $\hat{\pi}_1 > \hat{\pi}_2$

Specialization with “proximity” iff $\hat{\pi}_2 > 0$ and $\hat{\pi}_1 < \hat{\pi}_2$

These regions are depicted in Figure 2, for $f = 0.2$, and in Figure 3, for $f = 0.4$.

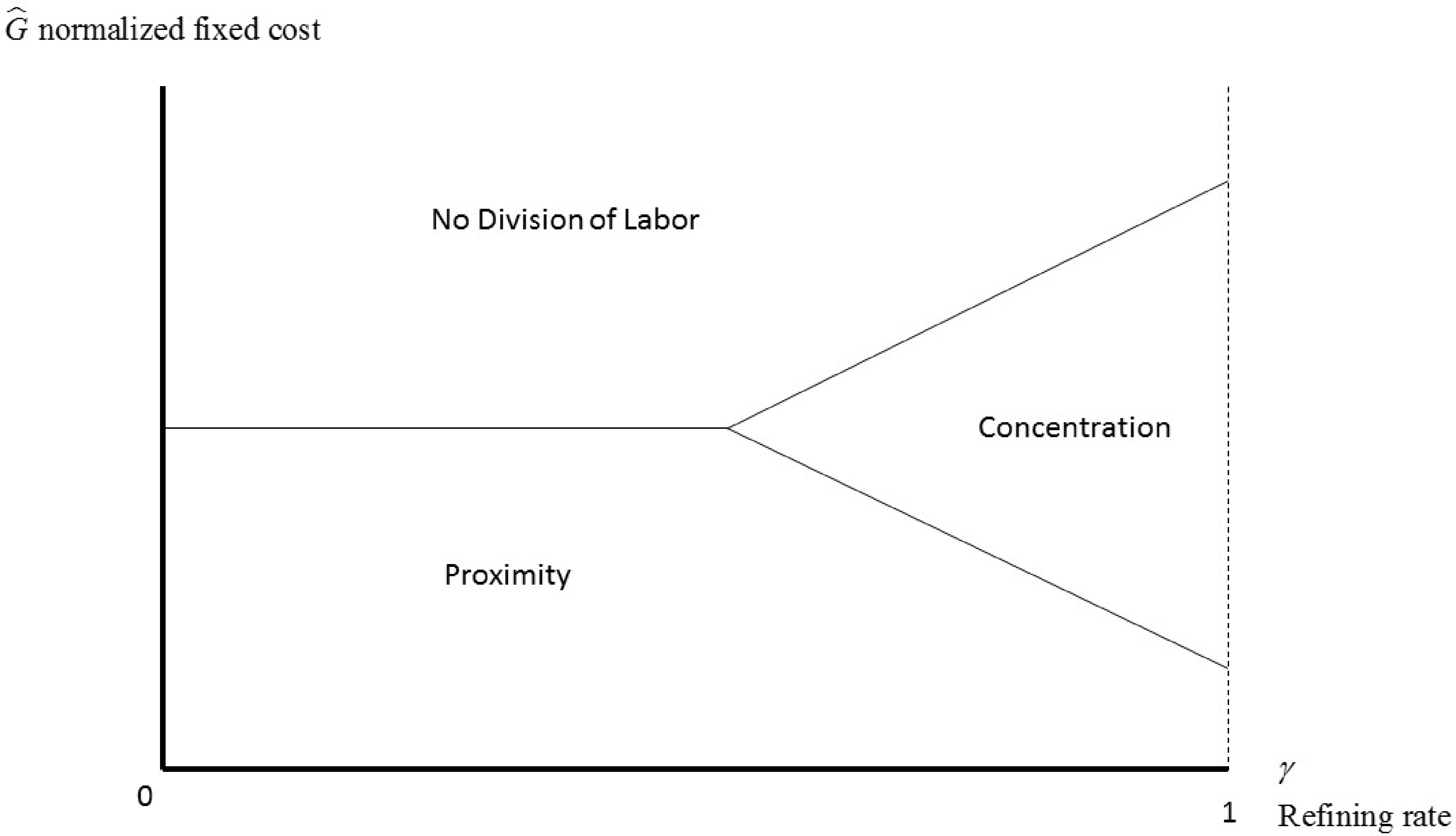

Figure 2: Production regimes for $f = 0.2$ in space $\left(\gamma, \widehat{G}\right)$

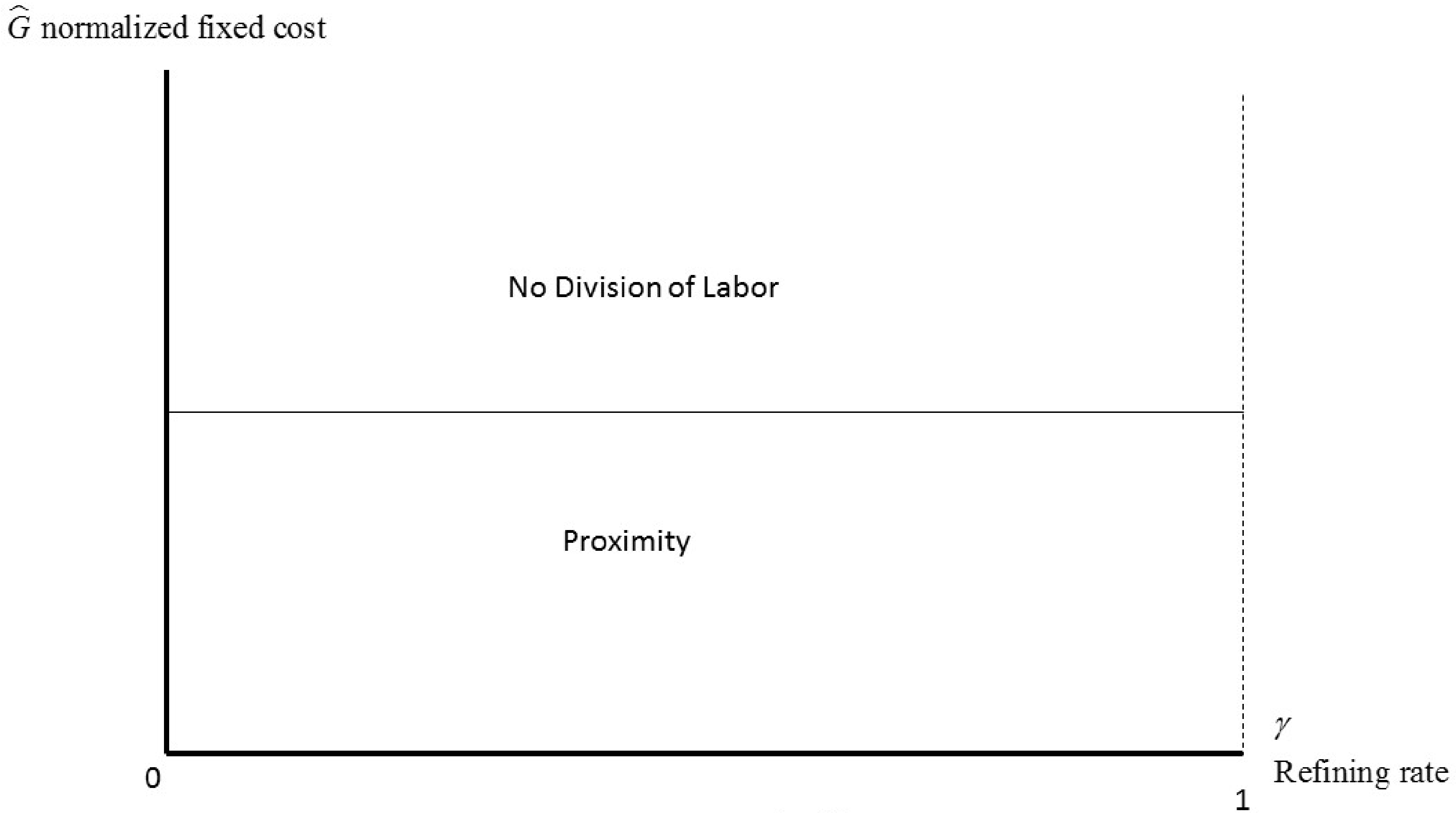

Figure 3: Production regimes in space $\left(\gamma, \widehat{G}\right)$ for $f = 0.4$

4 Discussion of the model results

The first thing to note is that with a slight change of assumptions, the choice of *Proximity* can lead to intra-industry trade instead of autarky. It is sufficient that instead of a multi-plant monopolist we have two independent firms, which charge uniform delivered prices instead of fob mill prices. It is also required that transport costs are moderate and the firms' products' are horizontally differentiated. This theme is dealt with ahead in the Appendix B. Note however that our results do not change qualitatively with the introduction of intra-industry trade.

The second thing to note is that when examining Figures 2 and 3, one should bear in mind that the location of the boundary between regions "No Division of Labor" and "Proximity" is the same, as it does not depend upon the level of transport costs, f .

Let us consider the case with normal/low transport cases, as depicted in Figure 2, the reference case. Assume that, both countries are in a primitive state of no productive specialization for the start. Then, the two countries can develop by means of two types of movement in Figure 2:

- A "horizontal East-West" shift, which leads the countries from "no division of labor" to a situation of **both** occupational and geographic specialization. Country *H* specializes in agriculture thus exporting raw materials to country *F*, which this country pays through exports of the manufactured good. This good is manufactured under a technology of increasing returns. This movement can be regarded as following from an increase in the degree of industrial processing, making the finished good "lighter" and easier to carry between countries. Hence, it allows a geographical differentiation of productive activity to emerge.
- A "vertical North-South" shift, which leads the countries from no division labor to a geographically even industrialization. Friedrich LIST (1841) led the experience of expanding the domestic market of Germany through a Customs Union (*Zollverein*) among the then independent Prussia and other smaller German states. LIST was the first secretary of *Zollverein,* starting in 1834 and leading at last to the political unification of Germany in 1871.

The use of a Customs Union to expand the internal market of a set of countries was theorized later by Jacob VINER (1950). In order to gain insight of it, it is necessary to introduce a third country standing for the rest of the world. Hence, the third country will be labeled as *RoW*. Up to now, we have implicitly assumed that the barriers to trade between *RoW* and either *Home* or *Foreign,* are prohibitive, so that no trade actually takes place.
Let us assume instead that, the transport cost of goods between each pair of countries within the set $\{\text{Home, Foreign, Rest of World}\}$ is constant and equal to $f = 0.2$ Then, assume that $\{\text{Home, Foreign}\}$ form a Customs Union and consequently their industrial producers refine further their manufactured products, whose transport costs fall to $f(1-\gamma)$, where $0 < \gamma < 1$ standing for the "refining rate".

Provided that the *RoW* producers do not refine further their products, a "trade diversion" will take place, with domestic production in either *Home* or *Foreign* countries substituting for the previous imports from *RoW*. This effect, is equivalent to a rise of the number of consumers in both countries and can be plotted in Figures 2 and 3 by means of a decline of the normalized fixed cost $\hat{G}$.

Let us assume now that the starting point is a situation where *Home* specializes in agriculture and *Foreign* in manufacturing. How can the agricultural country achieve industrialization? In order to differentiate this problem from the preceding one, we will assume that the starting point is located in the region of *Concentration* but **below** the boundary dividing "no division of labor" and "proximity". Hence, the agricultural country will have three strategies to industrialize, namely:

1. Increase the tariffs between the two countries, thus switching from $f = 0.2$ in Figure 3 to $f = 0.4$. This is the "bad" protectionist strategy that is likely to provoke a deterioration of the political situation between the two countries.
2. Set up a Customs Union between the two countries, with Viner (1950)'s effect of "trade diversion", determining a movement North-South in Figure 3 and a shift from *Concentration* to *Proximity*.
3. Diminish the degree γ of industrial processing, thus making industrial products heavier and stimulating their production closer to the customers. This strategy means a more "resource-based" industrialization, closer to natural comparative advantages of each country.

Hence, "protectionism" and high tariffs are not the LIST (1841)'s core policy for economic development and industrialization of an agricultural backward country. The main instruments are regional economic integration and an industrial growth based on the specific natural resources of the country.
With these policy instruments and under low transport costs, "Proximity" between industrial production and customers means the expansion of inter-industry trade, rather than national autarchy (see Appendix B).

5 Conclusions

In this paper, we have argued that Friedrich LIST (1841) can be viewed as a forerunner of modern Development Economics, because according to him development is founded on the implicit complementarities yielded by the joint location of different sectors which simultaneous substitute modern increasing returns for traditional constant returns. His idea is clearly that different productive sectors support each other reciprocally along an industrialization process as in ROSENSTEIN-RODAN (1943) and MURPHY et Al. (1989).

Furthermore, LIST (1841)'s analysis seems more complete than ROSENSTEIN-RODAN (1943)'s as it assigns an important role to agriculture and natural resources in the industrialization process.

The sources of income growth that sustain industrial investment are more conspicuously land rent and value, rather than dividends or wages, in spite of the fact that these latter kinds of income may also increase.

Last but not least, LIST's (1841) contains a fine geographical economics analysis, focused on the determinants of transport (and trade) costs, which is much absent from the modern Development Economics. Friedrich LIST (1841) is more than a forerunner. We can assign him one of the most important roles in the history and theory of economic development within the history of economic ideas.

Appendix A: Proof of Proposition 1

Note first that from the maximization of the land rent in (2.7), we obtain the optimal intensity of cultivation:

$$l^* = \left(\frac{p_c \alpha}{w + \theta} \right)^{\frac{1}{1-\alpha}} \tag{A.1}$$

The land rent is then given by:

$$R(p_c) = p_c^{\frac{1}{1-\alpha}} \left(\frac{\alpha}{w + \theta} \right)^{\frac{\alpha}{1-\alpha}} (1-\alpha) \tag{A.2}$$

Moreover the land rent of a farmer that only cultivates the land and receives a price k for the primary product can be shown to equal:

$$R(k) = k^{\frac{1}{1-\alpha}} \left(\frac{\alpha}{w} \right)^{\frac{\alpha}{1-\alpha}} (1-\alpha) \tag{A.3}$$

Equating equations (A.2) and (A.3), we have:

$$R(p_c) = R(k) \tag{A.4}$$

We solve this equality for price of the input according to the following steps:

1. Substitute equations (A.2) and (A.3) into equation (A.4), and cut the common term (1-α), yielding:

$$(p_c)^{\frac{1}{1-\alpha}} \left(\frac{\alpha}{w + \theta} \right)^{\frac{\alpha}{1-\alpha}} = (k)^{\frac{1}{1-\alpha}} \left(\frac{\alpha}{w} \right)^{\frac{\alpha}{1-\alpha}}$$

2. Taking logs and simplifying gives:

$$\ln k = \ln p_c - \alpha \ln \left(1 + \frac{\theta}{w} \right)$$

3. We assume that the productivity of the transformation task is not much higher than the reward of the land cultivation task, so that, (θ/w) is small. Then, we can use the MacLaurin approximation, i.e. $ln(1+x)$, for a small x and obtain:

$$\ln k \approx \ln p_c - \alpha \frac{\theta}{w}$$

4. Taking exponentials, simplifying and solving for k, we obtain the input price shown in the main text.

■

Appendix B: Transport Costs, Product Differentiation and Intra-industry Trade

We now consider a case where intra-industry trade can arise in equilibrium. In order to achieve this, we need to introduce product differentiation in the manufacturing good. We do the following assumptions.

1. Two symmetric countries, H and F, with the same number of consumers. W.l.g, the number consumers in each country is normalized to 1.

2. Two industrial firms that produce and sell a heterogeneous good. Unit production costs are constant and set to zero w.l.g.. Each firm has a fixed location in a different country.

3. Each consumer buys a unit of consumer good per unit of time (individual rigid demand).

4. Each firm's price is bounded from above by the price p_c, which is set by a fringe made up by many small firms.

5. Each firm sets a uniform delivered price wherever it sells the product. However, a firm can refrain from selling the product in a country simply because firm revenues do not cover the delivery costs.

6. Product differentiation is modelled through the so called "logit model", as in DE PALMA et AL. (1985, 1987). A consumer patronizes seller i rather than seller j, if the random utility of buying from firm i exceeds the random utility of purchase from firm j:

$$-p_i + \eta_i > -p_j + \eta_j \tag{B.1}$$

where η stands for a random term which accounts for non-price factors that determine the consumer's decision.

7. The parameter η is i.i.d. distributed across firms according to a Weibull distribution. A standard result of the literature is that the probability of a consumer buying from firm i is given by:

$$x = \frac{e^{-\frac{p_i}{\mu}}}{e^{-\frac{p_i}{\mu}} + e^{-\frac{p_j}{\mu}}} = \frac{1}{1 + e^{\frac{p_i - p_j}{\mu}}} \tag{B.2}$$

We will prove the following proposition.

Proposition B1: In this economy, intra-industry trade, i.e. the overlapping of the market areas of the firms is connected with low transport costs.

Proof: Only price cuts are feasible. Price rises above p_c lead to zero sales and profits. Let Firm 1 be the deviating firm. We have to consider two cases:

1. Transport costs are relatively low:

$p_c > p_1' > t$ where p_1' is the deviating price by firm 1. Then, p_c is a Nash equilibrium price for both firms only if:

$$\pi_1\left(p_c, p_c\right) = \frac{p_c + \left(p_c - t\right)}{2} \geqq \pi_1\left(p_1', p_c\right) = \left[p_1' + \left(p_1' - t\right)\right]x \tag{B.3}$$

where x is given by equation (B.2). It is clear that $x \in (\frac{1}{2}, 1)$. More precisely, we have:

$$\lim_{\mu \to 0} x = 1$$
$$\lim_{\mu \to \infty} x = \frac{1}{2} \tag{B.4}$$

Furthermore, from equation (B.2) it can easily be checked that x is a strictly decreasing function of μ.

If $\mu \to +\infty$, it can be checked that inequality (B.3) is met for any $p_1' < p_c$. By contrast, if $\mu \to 0$, inequality (B.3) can be written as, taking into account equation (B.4):

$$\frac{p_c + \left(p_c - t\right)}{2} \geqq \left[p_1' + \left(p_1' - t\right)\right] \tag{B.5}$$

This inequality will not be met if the price deviation is limited. If $p_1' < \frac{2}{3} p_c$, we have:

$$\frac{p_c + (p_c - t)}{2} < \left[p_1^{'} + \left(p_1^{'} - t \right) \right] \tag{B.6}$$

Assume that p_1' is such that equation (B.5) holds. Since the right hand side of equation (B.3) is a continuous and strictly decreasing function of μ, there will be a unique critical level μ^* of the degree of product differentiation so that $\mu < \mu^*$ implies that p_c is not a Nash price equilibrium for the firms. In this case, p_c will be a Nash price equilibrium only if product heterogeneity is high enough, i.e. if there is enough overlapping of sales areas, or, which is equivalent, if there is enough intra-industry trade.

2) Transport costs are relatively high:

$t > p_c > p_1'$, in this case, by definition, there is no overlapping of market areas as each firm can only profitably deliver its output in the country where it is located. The degree of product heterogeneity does not condition this result.

■

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