WORKING IMMIGRANTS: AN OPPORTUNITY?

Abstract

Contemporary human migration becomes one of the most influent variables of the local labor market in terms of costs and social perception of the currently employed workers. Dealing with a heavily globalized context, implies the necessity of designing supply chains across several geographical areas beyond national lines. Direct labor cost represents the main decision driver in terms of location-allocation decision problem. Exceeding availability of workers entails a reduction of the labor cost, with deep consequences on political and social fields.

This phenomenon, analyzed from an industrial perspective, leads to a reduction of the in-house cost of labor, due to an offer which overcomes the current demand. This fact represents an opportunity to produce high quality products developing local skills at a lower cost, opting for shorter supply chains and avoiding huge scrap percentages – typical of low cost production performed in developing countries.

This paper presents a quantitative model to evaluate the theoretical optimal length of a supply chain as a function of the in-house and out-source cost of labor. Furthermore, a scenario analysis is performed: the model is fed with several demand-offer labor ratio to evaluate the logistic cost of each alternative and the corresponding maximum scrap percentage of a same-cost solution. An environmental impact analysis associated with the previous is performed pinpointing the carbon-dioxide emissions related with each of the previous alternatives.

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1. INTRODUCTION

Supply chain design became a crucial node of the process through which companies implement their strategy. Up to 10-15 years ago, the focus of supply chain design practices was centred on the performance of a single objective of the supply chain (vendor, buyer, stock levels, distance, mean of transportation, etc.) (Beamon, 1998). Nowadays, more attention is paid on the whole supply-distribution system, especially when a single company owns several stages of its supply chain following a strategy of vertical integration. Example of this kind can be found in JELS literature (Zanoni, Mazzoldi, Zavanella, & Jaber, 2014). But in this case, it rarely happens that, costs of transportation are taken into account: Ab Rahman et al (Ab Rahman et al., 2016) recently use this approach proposing an heuristic methodology limited to two transportation modes.

Several model has been proposed in literature (M., C.J., & K., 2002) in order to support decisions during the designing phase: the optimization approach is largely used in most of them: Cordeau and Pasin suggest a model where a huge number of industrial variables are taken into account in order to choose between different opportunity of supply chain (Cordeau, Pasin, & Solomon, 2006): they also stress on the concept that optimization approach may fail dealing with too many variables of this kind. Diabat et al. suggest a carbon emission constraint for a supply chain optimization problem (Link, Diabat, & Simchi-levi, 2015). Manzini et al. add a stochastic simulation approach near the classical simulation method, and implement a computerized tool to compare different scenarios with different strategical term (long, medium or short run strategy) (Manzini, Gamberi, Gebennini, & Regattieri, 2008).

In recent years, the theme of environmental impact has been largely analyzed from various perspective: both in long term planning (Hugo & Pistikopoulos, 2005) and in relation to operational activities (Hammami, Nouira, & Frein, 2015). Carbon emissions have been investigated in forward (Nouira, Hammami, Frein, & Temponi, 2016) or reverse flow design (Salema, Barbosa-Povoa, & Novais, 2010); adequate logistic structures environmental impact has been analyzed too (Aronsson & Huge Brodin, 2006). Another interesting contribute on this topic comes from Joana et al who analyze different optimal supply chain depending on the carbon policy applied (Marti, Tancrez, & Seifert, 2015).

Only few approaches consider the local cost of direct labor as a decision variable of the problem: Hammami et al. (Hammami, Frein, & Hadj-Alouane, 2009) follow this path, modeling a multinational supply chain. Nevertheless, they use an optimization approach with no references to the production quality ratio which represents the crucial point and the originality of this paper.

The aim of this paper is to present a simple model, inspired by recent literature contributes, able to accounting and comparing local manufacturing cost with huge distances to be covered, in order to deliver raw material and semifinished product to the following process. It will also be considered the quality aspects which heavily affect the percentage of product which can be effectively sold on the market. The remainder of this paper is organized as follows: Section 2 presents the method used to asses the cost of a supply chain, Section 3 presents a simple numerical application which results are discussed in Section 4.

2. METHOD

As stated in the introduction, this paper aims to design the optimal supply chain length based on three different factor:

The *cost of direct labor*. This cost is related with local aspects (social, cultural and political ones) and it has represented, in the past year, one of the major decision driver for de-localization strategy. The average cost per hour of direct labor in a specific country *i* will be represented by $C_{lab}^{i}\ \left[\frac{€}{hour}\right]$.

The *cost of logistics*. This cost is related with the connection between production and consuming point. In particular, it is a complex function which must tak into account not only the distance, but also the mean of transportation; it will be expressed as $C_{transp}^{i}(m)\left[\frac{€}{trip}\right]$ where *i* represents the country and *m* the chosen mix of transportation modes.

The *cost of quality*. This cost represents the amount the buyer must pay in order to replace defective bought parts. In particular, this cost is function of the technology chosen for production which is rarely considered in a make-or-buy decision. This parameter will be the objective of this paper and will be calculated as the maximum incoming scrape rate that a firm can afford without shorten its supply chain; it is assumed that longer supply chains allow cheaper labor cost $C_{lab}^{i}\ \left[\frac{€}{hour}\right]$. This parameter is expressed as a percentage which calculates the ratio between good parts and the total amounts of parts per trip (η_{tech}).

It is important to remark that this parameter must result relevant in relation with the kind of product a company wants to produce: as an example this model cannot be applied in the agri-food sector where the length of a supply chain is imposed by strict time constraints. On the other hand, it can be easily adapted to non-perishable product with some technological requirements where the expertise and the technology used in production phase have a relevant role.

If the logistic cost has already been presented as a typical parameter in this kind of analysis, the first and the third ones, result to be pretty novel and not always simple to estimate (with specific regard to the cost of quality). Nevertheless, all the parameters can be easily got from time series

Following this notation, it is possible to express the cost as a single function:

$$K(m)^i = (C_{lab}^i \times W \times Q) + C_{transp}^i(m) + \left(\frac{Q}{\eta_{tech}} \times P_i\right)$$

Where:

W represents the quantity (in terms of hours) of labor necessary to realize one single part of finished products.

Q is the quantity of finished product to realize to realize a logistics load (the TEU container is assumed as trip unit)

P_i is the price for a single unit of finished product realized in location i.

The function $K(m)^i$ expresses the expected total cost per trip (TEU) depending on the location where production is performed and on the mean of transportation used. Once one has defined the cost of a current supply chain $K(\overline{m})^{\overline{i}}$, it can be easily calculated the maximum quality scrap rate affordable as a decision driver for an alternative supplier:

$$\eta_{tech} \geq \frac{Q \times P_i}{K(\overline{m})^{\overline{i}} - (C_{lab}^i \times W \times Q) - C_{transp}^i(m)}$$

3. APPLICATION

In order to set a real scenario and to proof the functionality of this theoretical framework, data have been collected in order to feed the model. In particular, statistical data about annual earnings per person in manufacturing (OECD.Stat, s.d.) has been divided for the average worked hours for each specific country. This value is considered as an estimation of C_{lab}^i. On the other side it is necessary to give an estimation of the logistic cost, four different mean of transportation has been considered (United States, s.d.) with linear cost presented in Table 1.

Table 1: Cost per kilometer per transportation mode

TRANSPORTATION MODE	€/KM PER TON
TRUCK	0.4465
RAIL	0.03621
AIR	5.588
WATER	0.1207

In order to simulate a scenario, it has been supposed to produce 1000 unit of products per TEU (Q=10) each one realized with a work effort of 1 hour (W=1). The price P_i has been supposed to be equal to the cost of one hour of work plus a 35% (to cover plant costs and firm's edges). It has been possible to identify state with similar cost of supply for each different mean of transportation supposing shipment towards Italy.

Figure 1: color gradient of cost K for country (yellow for cheaper countries, red for more expensive countries)

As it is understandable from results, the distance influences the total cost slightly modifying the country ranking. The cheaper countries in the example considered are presented in Figure 1 with a gradient of red and compared in the following graphs. Figure 3 compares the cost of labor of the countries at the bottom of the list. Figure 4 compares the logistic cost of the same countries; total cost $K(m)^i$ are compared in Figure 2.

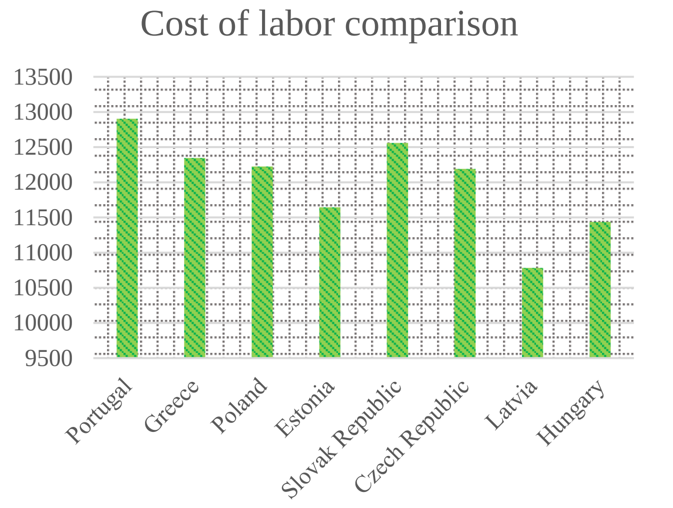

Figure 2: comparison between cost of labor of the countries at the bottom of the ranking (€ per TEU)

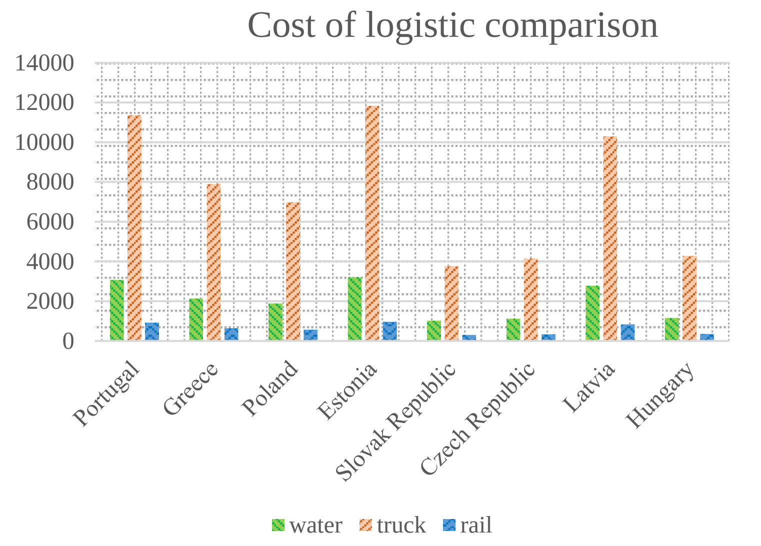

Figure 3: comparison between cost of logistic of the countries at the bottom of the ranking (€ per TEU)

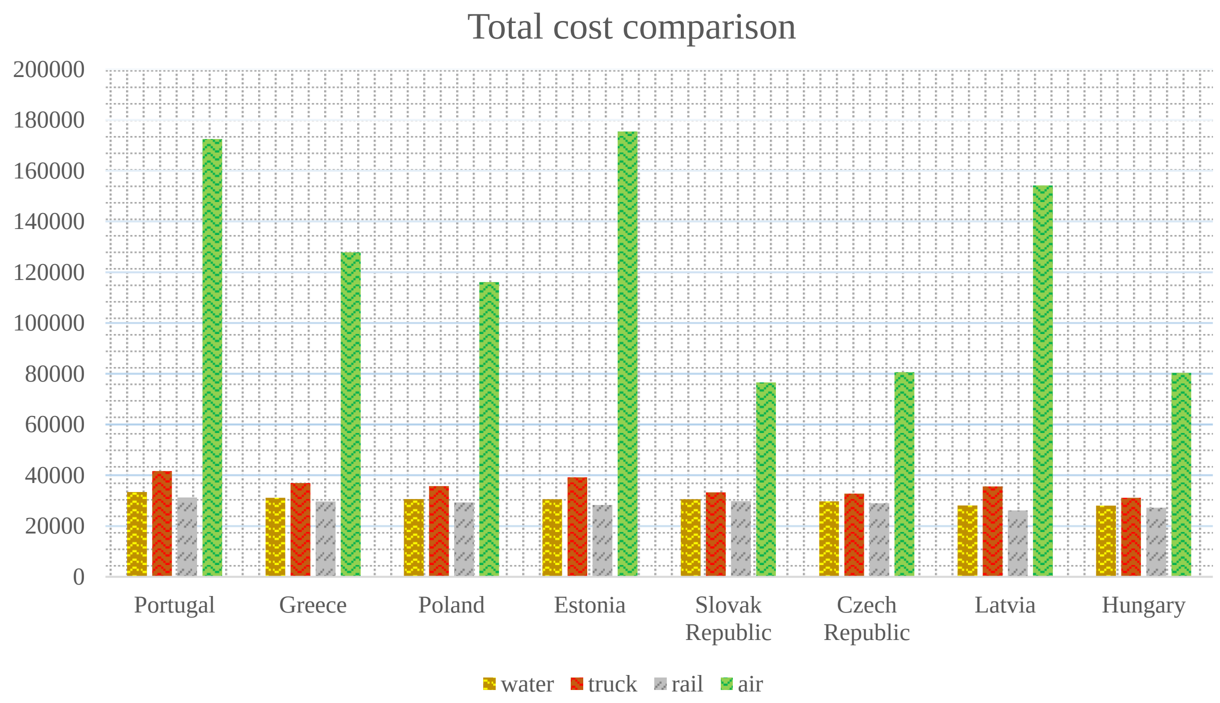

Figure 4: comparison between total cost of the countries at the bottom of the ranking (€ per TEU)

The scenario currently depicted is assumed a an AS-IS situation. It will, now, be considered the total cost $K(\overline{m})^{\overline{\iota}}$ calculated for each country as a basis for amelioremen ts supposing a reduction of the cost of labour indoor. It will, then, be calculated η_{tech}, the maximum quality rate affordable for outsourcing strategy. Data for the following application has been collected from the Italian statistical Office (ISTAT).

In order to estimate the reduction in cost of labour, it is considered the actual offer in terms of openings in the industrial sector:

$$D\%_i = \frac{openings}{total\ employeed}$$

In Italy, with regard to the industrial sector, the number of openings is estimated[1] at around 350000.

$$\begin{aligned} openings &= D\%_i \times (total\ employeed) \\ &= 0.06 \times 0.269 \times 22884000 \\ &= 3\ 693477 \end{aligned}$$

Let, now, consider this demand as a constant and check the offer quantity. It is represented by the actual unemployeed rate plus a coefficient to take into account the migration phenomenon in the measure it increases the number of people looking for a job.

$$\begin{aligned} Offer &= 2808000 \times 0.269 + 83245 \times 0.19 \times 0.269 \\ &= 759607 \end{aligned}$$

As it has been calculated, the estimated offer in Italy is double than the demand but the percentage linked with the presence of migrants is less than 1%. It is important to note that it has been taken into account the number of migrants who legally asked for staying in Italy (and who can hopefully have the possibility to apply for a regular job in Italy).

Considering the reduction of hourly earning per worker proportional to the demand-offer ratio, it has been possible to calculate the TO-BE $C_{lab}^{i} = 19.597 \left[\frac{€}{hour}\right]$.

Let, now, check, the η_{tech} value for the various countries in the Figure 5. Adiacent columns represent the same transport mode with and without the effect of migrants. As it is possible to understand, there is no significant gain to justify indoor techology and processing.

On a different side, it results interesting to investigate the CO_2 emission for each alternative considered. It has been considered an average amount of CO_2 emitted for each transportation mode (Table 2).

Table 2: emissions per kilometer per transportation mode

TRANSPORTATION MODE	CO_2/KM PER TON
TRUCK	0.150
RAIL	0.100
AIR	0.500
WATER	0.040

As it is possible to observe in Figure 6, reducing the length of the supply chain, maintaining work and competences in-house, even if not economically convenient, would result in a strong reduction of environmental impact due to transportation of good.

This environmental perspective is too often neglected but it should be considered as inspiration for companies's strategy and operational activities.

[1] The coefficient 0.296 has been adopted to estimate only the percentage of workers employed (or expected unemployed) in the industrial sector.

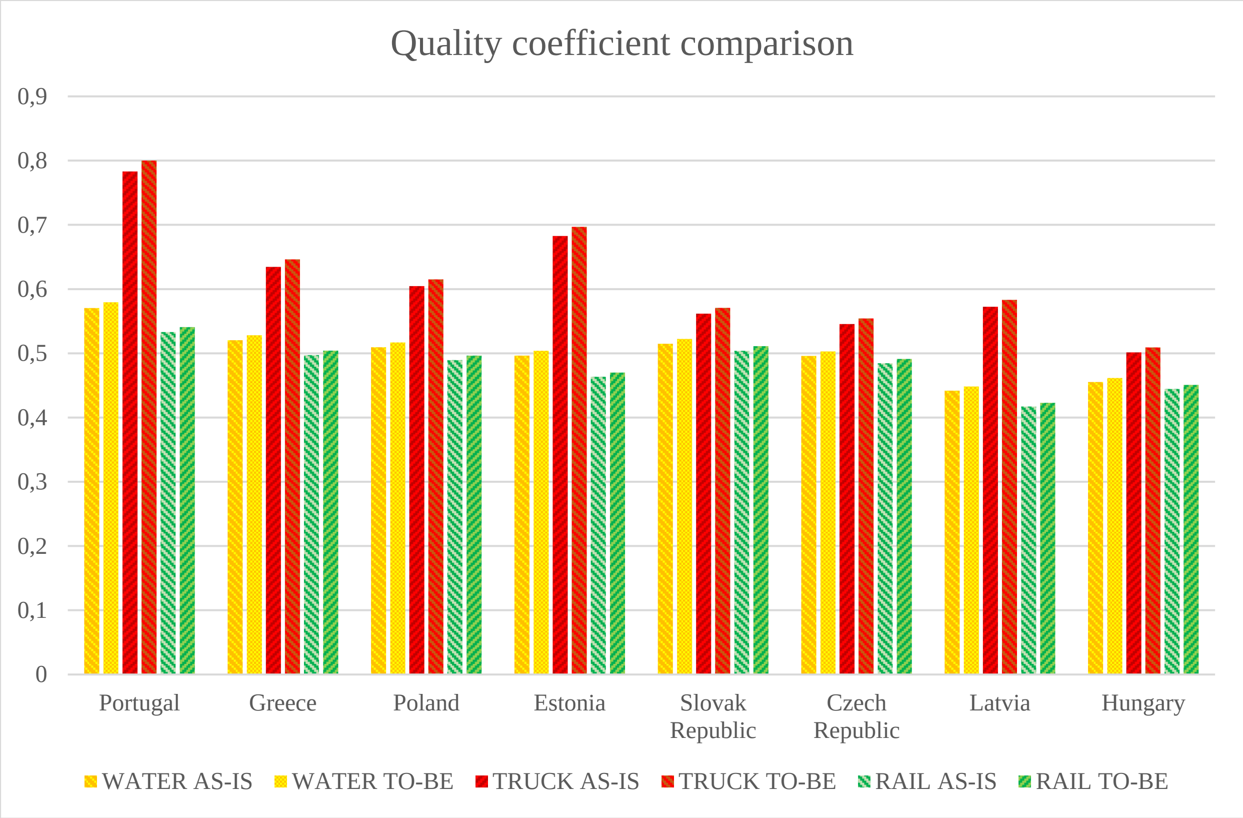

Figure 5: quality coefficient increase (AS-IS vs. TO-BE)

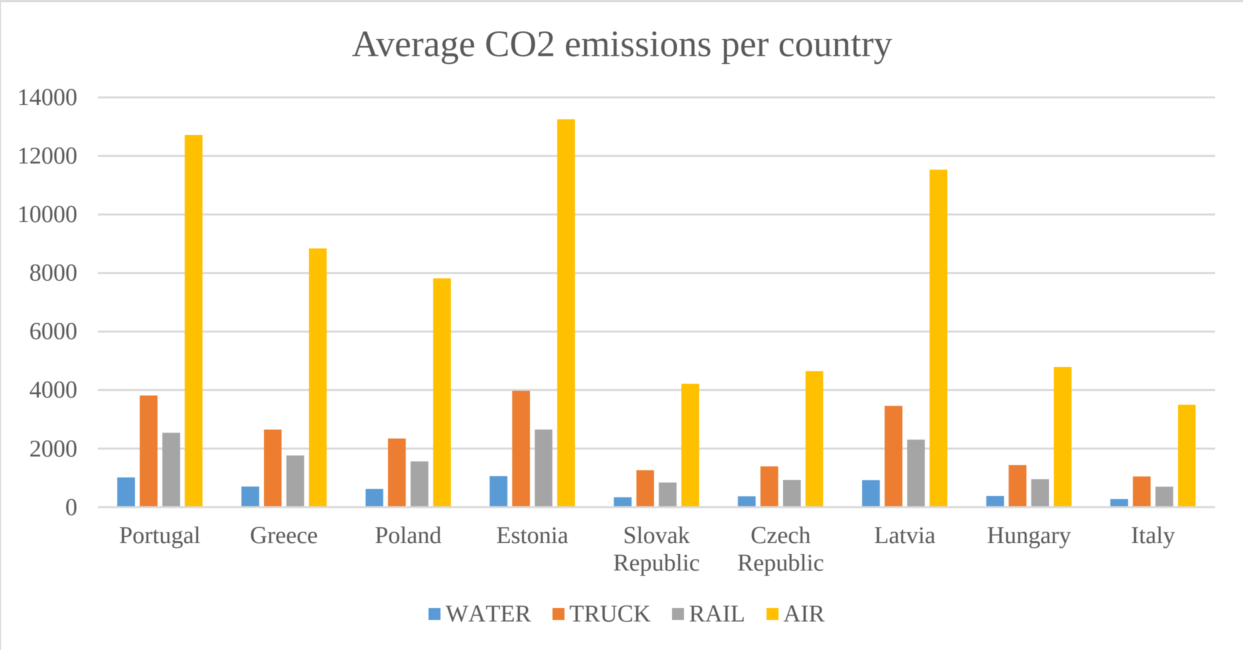

Figure 6: carbon dioxide average emissions (CO_2 Kg per TEU)

4. RESULTS AND CONCLUSION

From the previous application it is possible to observe that, in the case of Italy, the impact of migrants has a very slight effect on the cost of labour and on labour policies for a company. From here, it results that the main decision driver for outsourcing decision (the cost of labor) is not heavily modified such to justify shorter supply chains with evidences of reducted costs. This result may be affected by assumptions in the application but the author considers a major responsibility in Italian job policy and very high unemployment rate more than in numerical simplification. Further studies could focus on the socio-political factors in order to better depict the employing condition and compare the Italian situation to the ones of other countries. As a conclusion, from an industrial point of view, it results no economically convenient to decide to develop internal competences where an outsourced supply chain already exists.

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