

ENVIRONMENTAL FACTORS IN THE RELOCATION OF INDUSTRIAL PRODUCTION

Ervin LUMNITZER - Alexandra GOGA BODNÁROVÁ

Abstract

The following publication gives an introduction concerning the discussions concerning the relocation abroad of automotive industry.

This paper shall give the basic information explaining the way to find out about influences of different aspects.

Key Words

Politics, automotive industry, labour cost, emission regulations

1. Introduction

The relocation of industrial production facilities is based on the assumption that the relocation will result in lower costs for a given product. Not only is the wage differential between two production centres decisive in this respect, but also the varying environmental legislation in different regions and countries. In the final analysis, the actual decision to buy is highly dependent upon the purchase price. The customer is at pains to buy the supposedly cheapest product. Despite the availability of these cheap products and the social acceptability of buying them, wage increases are being demanded to increase purchasing power, e.g. by the United Services Union (VERDI) in Germany. Employers argue on the other hand, that raising wages could make a relocation of the production facilities to a foreign country unavoidable.

2. An Attempt at an Objective Assessment of the Determining Factors for Production Relocation

Considering the vehicle in its totality, from manufacture to recycling, it is the operation of the vehicle that is responsible for the greatest share of emissions. One may conclude from this that the greatest potential for the reduction of emissions is the optimisation of vehicles in terms of the consumption and clean burning of fuel. The fraction of emissions due to the production of the vehicle is so large that an easing of restrictions (e.g. by relocating to emergent economic regions) would have a significant impact on the material balance sheet. A relocation of the power unit production to countries with lower environmental constraints would only have a very slight effect on the overall product cost of a vehicle. As mentioned above, there are four variables in this sector, which affect the choice of production centre location and therefore also on the total emissions.

2.1 Differences in the Cost of Labour as a Determining Factor in the Selection of a Production Location

The first factor to be considered is represented by wage differences. The following overview of how the cost of labour can vary within the European Union will serve to put this in context.

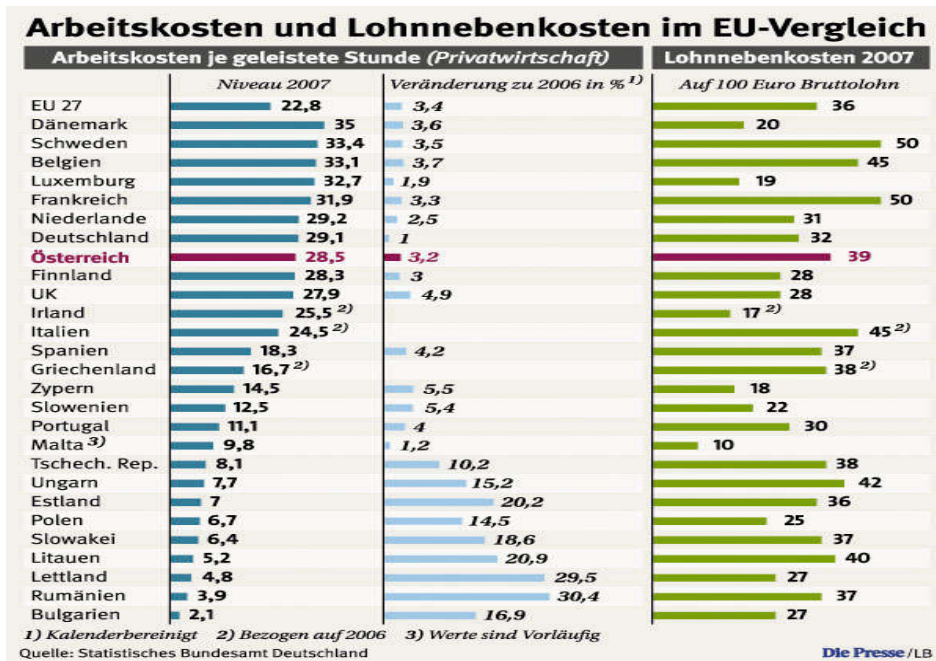
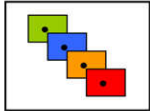


Figure 1 Source Euro per hour

The Fig. 1 shows significant wage differences even within Europe. What may be required in this context, at a later date, is an evaluation relative to the country specific environmental directives. But a decision on this will be postponed until after the international analysis.

Of more interest in this context are the fundamental differences per professional category. The Fig. 2 shows a comparison between Germany and China in terms of various level of qualification. This shows clearly that the wages differ in the unskilled labour category by a factor of 15 and by a factor of 3 in the high qualification bracket. It is understandable from this perspective that businesses view simple tasks falling within the domain of unskilled labour as attractive candidates for relocation to emergent economic regions.

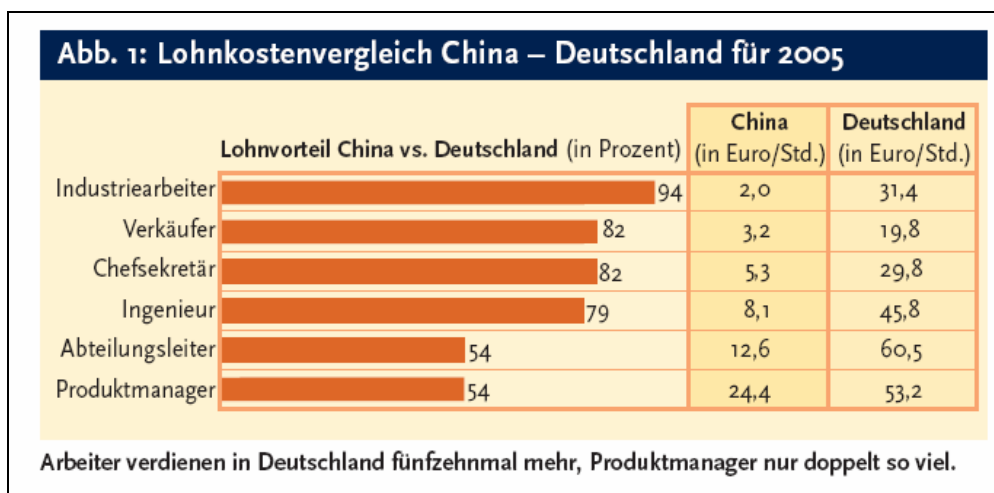


Figure 2 Source

The following fig. 3 further breaks down the industrial worker's wage differential and shows the cost of labour in China, Mexico, Russia, Thailand and India next to that of the industrialised countries.

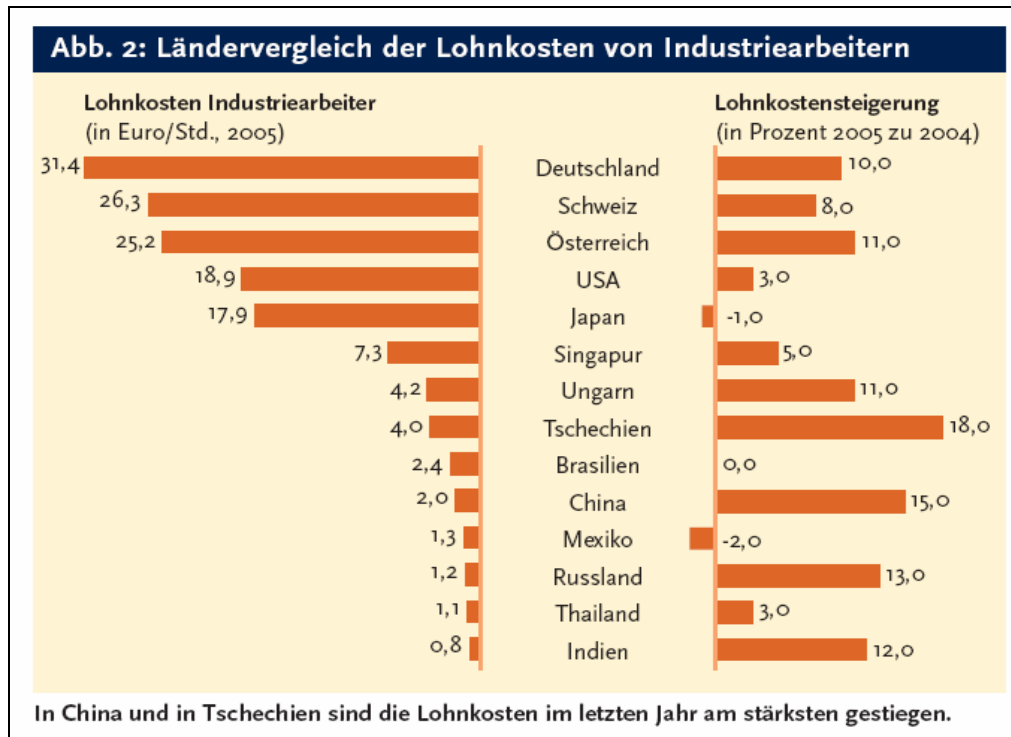
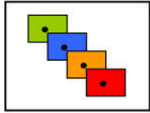


Figure 3 Source

Two aspects are worthy of note in this context. The cost of labour for industrial workers in Germany are almost forty times higher than in India, whilst in China, Russia and India wages have increased by 12 to 15 percent within a single year. But as wages in Germany increased by ten percent at the same time, there has been virtually no change in terms of percentages and none at all in real terms. Nevertheless, the high wage increases in the boom regions China and India indicate that further high rates of increase can be expected in the coming years. These increases could mean that the absolute difference decreases thereby making relocation less interesting. It requires a more in-depth analysis to determine exactly what difference in hourly wages is required to reduce the attractiveness of emergent economies.

2.2 Power and Logistics Costs as Determining Factors in the Selection of a Production Site Location

One consideration in terms of relocating production facilities to emergent economic regions is the cost of component transportation. This includes finished products, e.g. toys as well as ancillary components such as circuit boards or other plastic parts for automobile manufacture. Transport costs are taken into consideration when deciding whether or not to relocate a production centre.

Wage costs are one element of transport cost. Another element is transport infrastructure as well as the related energy costs. Even if the cost of energy for transportation only constitutes a small fraction of the overall cost of transport and the cost of transport itself is only one small part of the cost of production, a variation in the cost of energy is relevant to the consideration of the overall cost of production. These energy costs are also reflected within the overall scope of production and have been ignored in the current model, as energy costs are similar throughout the world. The only variable in this context is in the level of taxation. Only the cost of energy for transportation can work against a business trend towards relocating and therefore represents a key variable. The fig. 4 shows the historical development of the cost of crude oil.

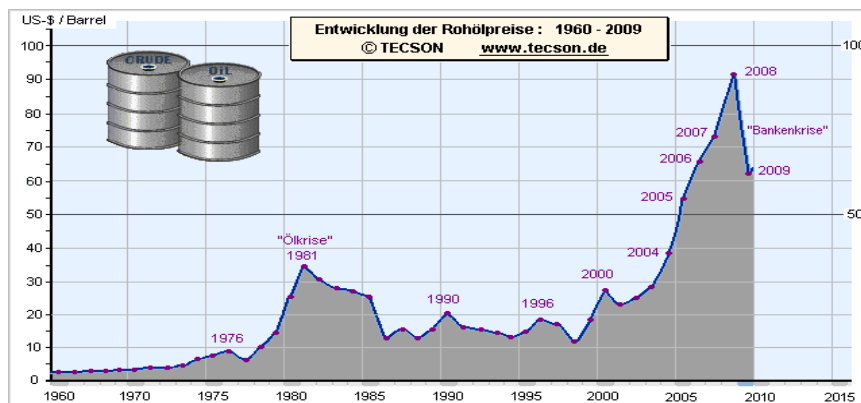
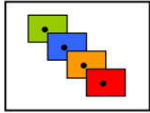


Figure 4 Source

The energy cost variations, as a variable, will be of relevance to the overall model from a historical perspective, as the intention is to verify the mathematical model to be developed on the basis of the history of the various determining factors.

2.3 Environment Protection Costs as a Determining Factor in the Selection of a Production Location

Environmental protection costs in this context means those costs that are necessary within a given country to meet the stipulations of the country in question. For example these can be environmental constraints on exhaust air, wastewater filtration and cleaning, noise restrictions, building regulations for production facilities including lighting, social institutions etc. The following fig. 5, designed to enable a comparison between countries, is the result of previous research. The basic data from this graph cannot be used in the mathematical model but does give an indication of the development of CO₂ on a per region basis and also of the changes over a 15 year period.

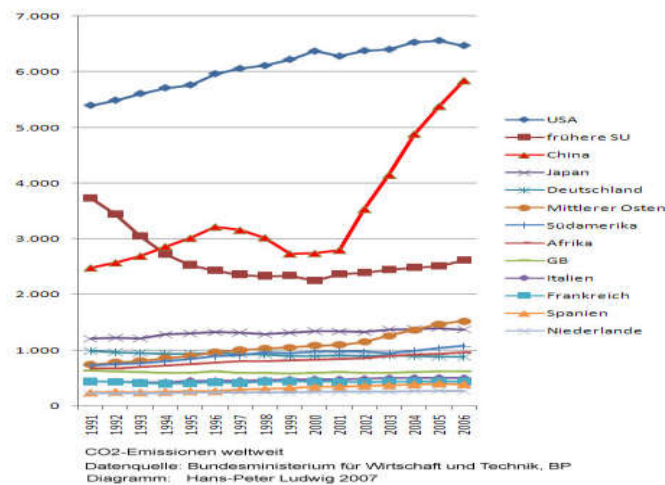
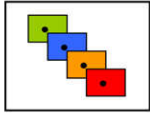


Figure 5 Source CO₂ in m. ton p.a.

To be able to integrate these elements into the mathematical model it is necessary to define a unit of measure for a given product to show the difference in the threshold values of pollutants. Conversely it is possible to derive the restrictions that have to be met from this data. And from these figures it is possible to calculate what investments will need to be made.

As the objective here is to discover what cost savings can be realised by lower environmental restrictions, research, perhaps in the form of a survey of companies that have already relocated, is a possibility. An additional study would show if comparative data are already available for costs arising from environmental restrictions; if not then these would have to be researched or the assumption would need to be substantiated. The assumption in terms of this point is that a change in emission restrictions, to match German restrictions for example, in the emergent economic regions or even in the USA, would lead to significant additional economic production costs, which in turn would make relocating less attractive. An initial estimate of these effects raises the suspicion that for example the reasons for not ratifying the Kyoto-protocol could have much more to do with the competitiveness of home-based industry than is currently assumed.



2.4 Environmental Costs as a Determining Factor in the Selection of a Production Location

'Environmental costs' means those costs necessary for repairing environmental damage. This refers to such things as, for example, the renaturation of land, land consumption per se and water purification. The precise nature of the correlation between the environment protection costs and environmental costs arising from environmental damage can only be ascertained through an in-depth study and analysis. It is to be hoped that a mathematically definable relationship exists through which the objectification can be expedited. Should it transpire that such a relationship does not exist and that a numerical model cannot be produced, it would be regrettable inasmuch as including the cost of environmental damage would create some political leverage.

The acceptability of buying products from distant regions whilst shutting ones eyes to the environmental consequences, is directly influenced by the cost differential between a product made in China and a European product. It may be assumed that two main variables exist in terms of countering the trend towards production site relocation. The other main element is the cost differential for production sites. Examples are modern filtering facilities for exhaust air or wastewater. Two factors apply within Europe in this context. A high investment is required in air cleansing and emission avoidance technology in Europe, as a matter of principle, due to the stringent requirements for environmental protection and the high standard of technology required to meet the target values. Further improvements in air or wastewater quality can only be achieved with yet higher expenditure for small improvements.

This situation contrasts with that in the Asian region for example. The wastewater cleansing or air filtration technologies employed there are of a very low standard, whereby significantly greater emission reductions are possible at a much lower cost than in Europe.

07062: Treibhauseffekte der Industrieverlagerung nach China und Indien

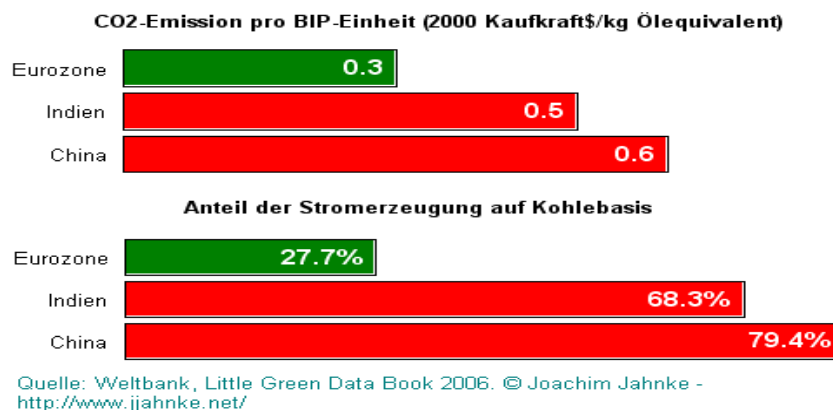


Figure 6 Source

The diagram on fig. 6 clarifies the issues relating to the different restrictions in the context of relocating to China and India.

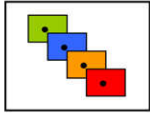
Conclusion

Reports about the renunciation of production sites in China are appearing in the press as well as in the publications of various institutes with increasing frequency. This rejection is happening because the cost of labour is increasing and the quality issues associated with Chinese manufacturing are no longer outweighed. These effects demonstrate that the market reacts sensitively to fluctuations in specific factors.

It can be assumed that relocation cycle times are influenced by wage developments on the one hand but also from the other prevailing conditions in the various countries on the other. Given the increasing cost of labour in the low-wage countries and increasing consumer sensitivity in terms of environmental compatibility in conjunction with increasing energy costs, the degree to which a return to local production may be economically viable should be investigated.

Acknowledgement

This paper was supported by the Slovak Research and Development Agency under the contract No. APVV-0432-12 and KEGA 3/7426/09.



References

- [1] Externe Kosten kennen – Umwelt besser schützen, Umweltbundesamt, April 2007
- [2] [on-line] Available on - URL: <http://www.tecson.de/poelhist.htm>
- [3] [on-line] Available on - URL:
http://diepresse.com/images/uploads/7/8/8/378760/23s26_Arbeitkosten_Lohnkosten_EU_Vergleich_2007_Kopie2008422205410.jpg
- [4] [on-line] Available on - URL:
http://www.econbiz.de/archiv/myk/whumyk/controlling/loehne_china.pdf, S. S. 48, io new management Nr. 11 | 2005
- [5] [on-line] Available on - URL:
http://www.econbiz.de/archiv/myk/whumyk/controlling/loehne_china.pdf S. 48, io new management Nr. 11 | 2005
- [6] [on-line] Available on - URL: http://www.personalvitality.com/artikel_sterne/ENNEAD_a1_co2_emission_diagram.jp
- [7] [on-line] Available on - URL: http://www.jjahnke.net/index_files/07062a.gif

CONTACT ADDRESS:

Authors: prof. Ing. **Ervin LUMNITZER**, PhD.
Workplace: Technical University of Košice, Faculty of Mechanical Engineering
Address: Park J.A. Komenského 5, 042 00 Košice, Slovak Republic
E-mail: ervin.lumnitzer@tuke.sk

Authors: Ing. **Alexandra GOGA BODNÁROVÁ**
Workplace: Technical University of Košice, Faculty of Mechanical Engineering
Address: Park J.A. Komenského 5, 042 00 Košice, Slovak Republic
E-mail: alexandra.bodnarova@tuke.sk