

ECONOMICS COMPARISON OF TRACTOR AND TRACK CONTAINERS TRANSPORT

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Summary: At resolution if buy tractor or truck for containers transport there act the role economics costs for acquisition and operation all vehicles too. This article considers by economics comparison of tractor with tractor's trailer chosen trucks vehicles.

Key words: Economics comparison, container transport

1. INTRODUCTION

There can be more possibilities at acquisition of new techniques to the company. Tractor with trailer or truck can be offered as a purchase option especially in agriculture. At the decision whether buy tractor or truck, the main argument will be purpose of usage. Tractor is the best option if the main target of usage is work on the fields, snow cleaning etc. and transfer material or raw materials occasionally. Truck is chosen if transportation and raw material is required. Containers usage increases utilization of both vehicles. It could happen that company owner has to make decision if he buys tractor or truck. E.g. it is needed to take off harvest from the yard which is not closed to stock. The advantage of truck purchase is its higher speed and possibility to use it for transportation in bigger distances. Advantage of tractor is universality and possibility to use it for another activity than transfer.

Final decision has to be done by top management which wants to buy new vehicle after all advantages; disadvantages and usage of chosen vehicle are considered. One of the arguments is economics comparison of buying and operation of tractor and truck.

Trucks with implemented single-arm container truss and tractor with semi-trailer where single arm container truss is situated will be compared.

2. EXPERIMENTAL PART

2.1. Chosen vehicles for comparison

Vehicles which belong to the most often purchased for fitting JNK of different brands were chosen for comparison. Tractor Forterra 10641 represents the tractor part and it will be used for translocation with tractor container trailer TNK 11. Renault Premium 420.26, Avia D 120 and Tatra 815 represent trucks.

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Source: [1]

Fig. 1 - Traktor Zetor Forterra 10641



Source: [2]

Fig - 2 Renault Premium



Source: [3]

Fig. 3 - Avia D 120



Source: Author

Fig. 4 - Tatra 815



Source: [4]

Fig. 5 - Tractor trailer

2.1.1. Technical parameters of chosen vehicles

Tractor and its trailer

Tab. 1 - Technical parameters of traktor and traktor trailer

Tractor		
Type		Zetor FORTERRA 10641
Technical parameter [1]	max. speed	40 km/h
	fuel consumption	57,1 l/100 km
	drive	4x4
Engine	type	Zetor 1305

	power	74 kW
	turning moment	440 Nm
	engine capacity	4 156 cm ³
Weight	vehicle dry weight	5 050 kg
	trailer weight	12 625 kg
Costs	purchase price	1 303 645 Kč
	damage liability	1 347 Kč/rok [4]
	vehicle excise duty	not a subject [6]
Tractor trailer [6]		
Type		TNK 11
Weight	vehicle dry weight	2 180 kg
	total weight	11 380 kg
Cost	purchase price	498 000 Kč
	damage liability	480 Kč
	vehicle excise duty	not a subject [6]
Effective weight of combination of vehicles		9 200 kg

Source: Author

Spreading rate at tractors is at $\left[\frac{\text{g}}{\text{kW} \cdot \text{h}} \right]$. It is needed to have petrol consumption in same units

for comparison tractors with trucks.

Tractor Research Institute in Brno (Výzkumný ústav traktorů v Brně) shows orientation values of consumption in l/h for different charges of motors. In the case when we will consider that tractor goes in average speed 30 km/h, that means that tractor goes 100 km in 3,3 hours, consumption for Tractor Forterra 10641 is following:

Tab. 2 - Orientation values in dependence on engine load

ENGINE LOAD	100 %	80 %	50 %
Consumption per [l/h]	21,86	17,49	12,24
Consumption per [l/3,3h; l/100km]	72,14	57,72	40,39

Source: [8]

It is supposed that if tractor has trailer with immediate weight which is coming to maximum of allowed connecting weight that charge of engine will be neither 50 % nor 100 %. Tractor is constructed for work on the field and in the heavy environment and directly there maximum charge of engine is assumed. If we consider that charge of tractor engine is about 80% then value of consumption is coming to 57,72 l/100 km

Trucks

Tab. 3 - Technical parametr sof trucks

Type		Renault Premium 450.26 [2]	Avia D 120 [3]	TATRA 815 [9]
Technical parameter	max. speed	100 km/h	118 km/h	90 km/h
	fuel consumption	30 l/100 km	22 l/100 km	32 l/100 km
	drive	6x2	4x4	4x4
Engine	type	Dxi 11	Cummins ISB 160	T 3-928
	power	331 kW	117 kW	230 kW
	turning moment	2 140 Nm	602 Nm	1 300 Nm
	engine capacity	7 2200 cm ³	4 500 cm ³	12 670 cm ³
Weight	vehicle dry weight	8 015 kg	3 950 kg	9 900 kg
	effective weight	17 985 kg	8 040 kg	9 100 kg
	total weight	26 000 kg	11 990 kg	19 000 kg
Costs	purchase price	2 629 750 Kč	1 646 100 Kč	2 980 000 Kč
	damage liability [6]	20 003 Kč	13 983 Kč	20 003 Kč
	vehicle excise duty [7]	27 300 Kč	10 800 Kč	29 100 Kč

Source: Author

2.2 Economics comparison

The subject of economics comparison is purchase price, taxes depreciation, Vehicle Excise Duty, damage liability and fuel costs. Salary costs for driver and company operating costs are not included because it could be estimated that these costs are approximately same. Repairs costs will not be also included because more and more accurately datas of particular vehicles are needed.

2.2.1. Conditions of economics comparison

It is necessary to set up certain conditions of operation to compare tractors and trucks. Tractor with trailer where mechanism for fetching containers is situated will be compared with trucks which have also mechanism for fetching containers.

We will use the case in which the vehicle was bought and entered to usage during the whole year since 1.1.2008.

General information

Number of working days in year 2008	253 days
Average passed kilometres per a workday	60 km/day
Passed kilometres in year L	15 180 km/year
Unit price for diesel oil	26 Kč

Conditions are made up; they try to create imaginary case with real figures.

2.2.2 Depreciation

Ethical and technical datedness of property are taken into consideration thanks to taxes depreciations. All tangible assets above 40 thousands crores have to be amortised.

Agricultural and forestry tractors belong to 2nd depreciative group according to new law modification 586/1992 Sb. O daních z příjmu (Income taxes). The change at motor vehicles was since 2008. Before 2008 they belonged to 1st A depreciative group.

2nd depreciative group is amortised in 5 years. Depreciation rate in the first year is 11 % of purchase cost and in next years it is 22,25 % of purchase cost. Depreciative amount is rounded to the whole higher number. Residual value is written off in the last year.

Tab. 4 - Depreciation of chosen vehicles in 1st and 5th year

Name of vehicle	Purchase price [Kč]	Amortization amount per 1 st year [Kč]	Amortization amount per 5 th year [Kč]
Zetor FORTERRA 10641	1 303 645	143 401	290 058
Traktorový přívěs TNK 11	498 000	54 780	110 805
Renault PREMIUM 450.26	2 629 750	288 613	583 752
Avia D 120	1 646 100	181 071	366 255
TATRA 815	2 980 000	327 800	663 050

Source: Author

2.2.3. Economic comparison

Acquisition costs and 1st year of operation of chosen automotive vehicles in fictitious conditions are shown in table 5. Comparison is considered only with vehicle purchasing and operating that's why driver's salary and company operating costs are not taken to total costs. These costs would be almost same or with minimum differences in real case.

Maintenance costs are not considered too. We have to know more details about car safety or vehicle's maintenance costs in some company to involve these costs to economic comparison. This information would be found with difficulty. What's more, chosen vehicles would be used in more companies, different conditions and different environment. Then indications about servicing would be incomparable.

The purpose of this comparison is economic comparison of tractors and trucks in case you are not sure which mode to choose.

Tab. 5 - Economic comparison of chosen vehicles

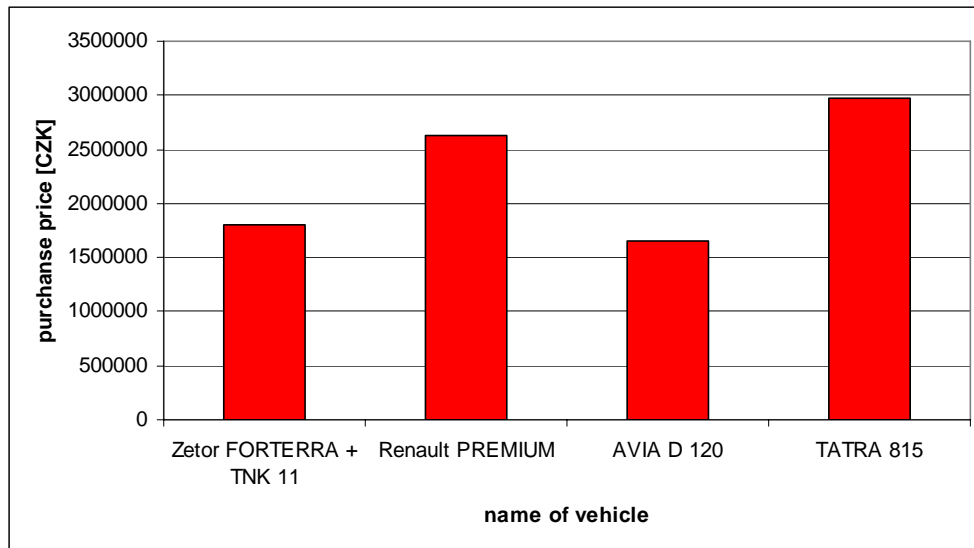
		FIXED COSTS		OPERATING COSTS				
		Purchase price [CZK]	Depreciation per 1 st year [CZK]	Damage liability [CZK]	Vehicle excise duty [CZK]	Fuel costs [CZK]	Operating costs total [CZK]	TOTAL [CZK]
Zetor FORTERRA + TNK 11	Zetor Forterra	1 303 645	143 401	1 347	není	225 362	226 709	1 673 755
	TNK 11	498 000	54 780	480	není	-	480	553 260
	Total costs of combination of vehicles	1 801 645	198 181	1 827	není	225 362	227 189	2 227 015
Renault PREMIUM		2 629 750	288 613	20 003	27 300	118 404	165 707	3 084 070
AVIA D 120		1 646 100	181 071	13 983	10 800	86 830	111 613	1 938 784
TATRA 815		2 980 000	327 800	20 003	29 100	126 298	175 401	3 483 201

Source: Author

Final prices are mainly influenced by operating costs and consumption. It is huge difference between tractor and truck consumption. Truck consumption was found at company's catalogues, newsletters etc., where the consumption is introduced in 1/100 km and methodology of the finding is now seen in or at which load is named consumption. Tractor consumption is brought in operation unit of measure $\frac{g}{kW \cdot h}$.

Tractor is not used only for shipment on freeways but also for transmission of different devices.

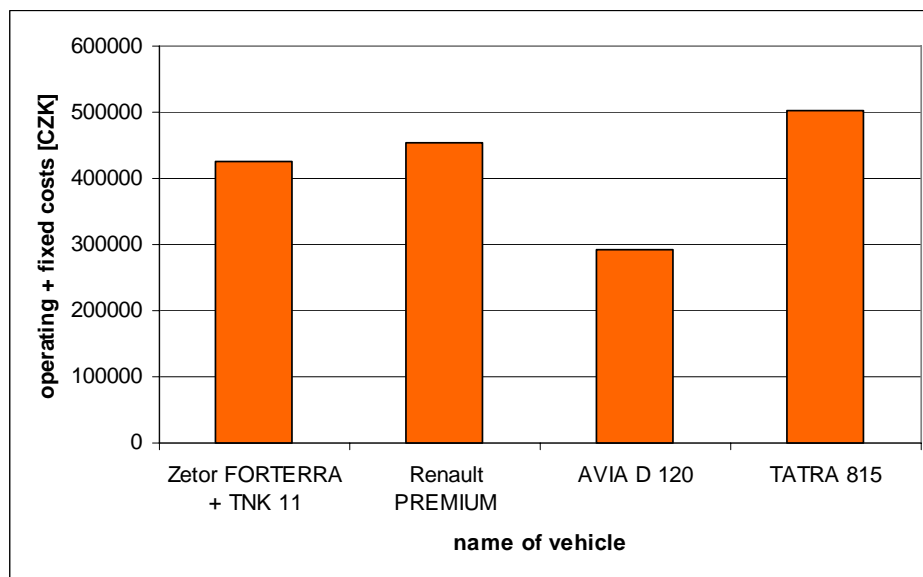
Conditions have to be set up at ratio from spreading rate in 1/100 km (they are not needed to correspond to operation on freeways exactly) and so consumption could be higher calculated. Verifying of consumption at chosen vehicles or get more exact datas are necessary for more accurate comparison. Shown worth are enough for our purposes.



Source: Author

Fig. 6 - Comparison of purchase price at chosen vehicles

It is evident from picture 6 that purchasing of tractors with tractor trailer is cheaper than trucks purchasing. Only vehicle AVIA is price comparable to more high performance tractor FORTERRA from the list. AVIA has about 1,96 tons smaller payload than tractor FORTERRA with tractor trailer TNK 11 is able to transport.

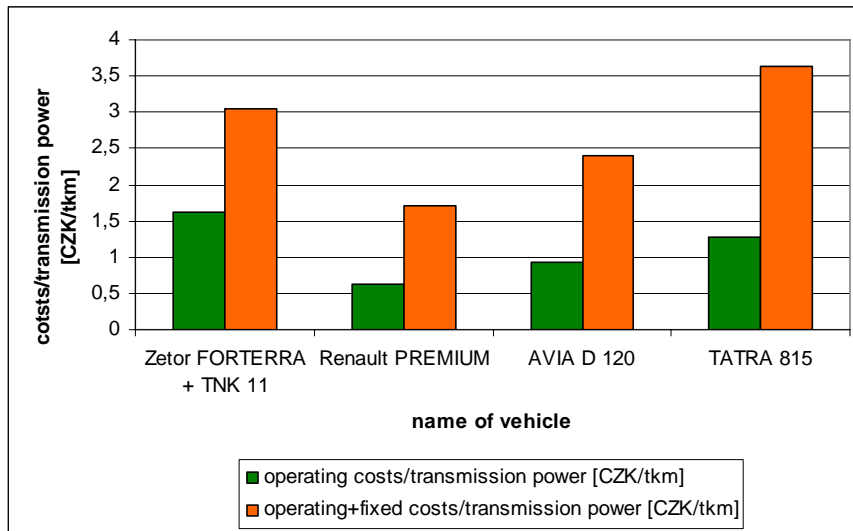


Source: Author

Fig. 7 - Comparison of operating and fixed costs

If fixed costs are calculated to operating costs (depreciation in our case) then tractors have smaller costs to trucks.

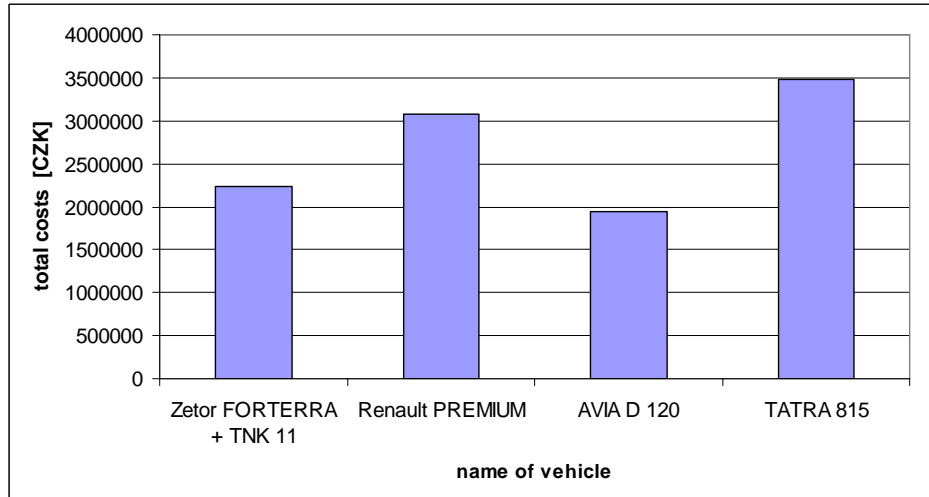
For now only datas without regard to transferred quantity or performance were compared. Therefore AVIA D 120 seems to be the best economic vehicle. But it has the smallest capacity weight in chosen vehicles. Comparison of costs in rate to possible transferred performance in tkm is shown at picture 8.



Source: Author

Fig. 8 - Transport costs compared to the handling performance of selected vehicles

You can find at comparison at both columns at picture 8 that with adding fixed costs to operating costs the range of vehicles is not changed in comparison of expenses in 1 tkm. Only TATRA 815 is moved because of high purchase price. Higher consumption plays a big role at tractor and truck Renault PREMIUM it's higher payload. This comparison would be purposeful only if we have values of real company and compare vehicles in which the company choose.



Source: Author

Fig. 9 - Compared the total cost of selected vehicles

Total costs were compared at picture 9, it means purchase costs, fixed costs and operate costs in the 1st operating year. When total costs of tractors and trucks are compared we can say that tractor acquisition with tractor trailer is cheaper than truck acquisition, except AVIA D 120 where total costs are about 300 000 CZK lower.

3. CONCLUSION

Big advantage of my suggestion is lower purchase price and lower depreciation at tractor acquisition. Further big advantage is low damage liability. The rule no. 16/199 Sb., O silniční dani (Vehicle Excise Duty) doesn't relate to tractors and its tractor trailers is other advantage for tractor.

Economic impact and technical properties of vehicle are also considerate. Decision whether tractor or truck is more complicated in this criteria. Higher speed is plus for trucks. Universality is plus for tractor. Regarding capacity weight, tractors and trucks are comparable.

Purchase of tractor seems to be better in comparison of trucks and tractors. Tractor acquisition is profitable mainly from longer point of view due to low purchase price, low damage liability against trucks and the fact that Vehicle Excise Duty is not taken to tractor's trailers. It is beneficial to use tractor to non traffic purposes.

REFERENCES

- [1] *Zetor group* [online]. [2005] [cit. 2009-01-15]. Dostupný z [www: <http://zetor.com/cz/index.php?obsah=forterra_parametry&dir=produkty>](http://zetor.com/cz/index.php?obsah=forterra_parametry&dir=produkty).
- [2] LANCAR spol. s.r.o. Popůvky u Brna. *Renault Premium 450 – 26 6x2*. 2007. 4 s
- [3] AVIA Ashok Leyland. Praha. *AVIA D 120 - 4x4*. 2007. 3 s.
- [4] *Autorepair Ostrava spol. s.r.o.* [online]. [2006] , 5.1.2007 [cit. 2009-01-15]. Dostupný z [www: <http://www.autorepair.cz/novinky.html>](http://www.autorepair.cz/novinky.html).
- [5] *Povinné ručení* [online]. 2000-2009 [cit. 2009-01-15]. Dostupný z [www: <www.povinnेरuceni.com>](http://www.povinnेरuceni.com).
- [6] Zákon č. 16/1993 Sb., O silniční dani
- [7] Autorepair spol. s r.o. Ostrava. *Technická dokumentace*. 2004
- [8] ŠEDAJ, Miloš. Osobní sdělení. VUTR a.s., Výzkumný ústav traktorů Brno, Brno. [cit. 28. dubna 2008]
- [9] TATRA Kopřivnice a.s. Kopřivnice. *TATRA Terno 1*. 2007. 10 s.
- [10] LINDOVSKÝ, Martin. *Traktorová kontejnerová doprava*. [s.l.], 2008. 83 s. VŠB-Technická univerzita Ostrava. Fakulta strojní. Diplomová práce.

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