Expert Systems with Applications 42 (2015) 113–124

Contents lists available at ScienceDirect

Expert Systems with Applications

journal homepage: www.elsevier.com/locate/eswa

Shareholder value creation on deregulated transportation sector: Focus on North American railway freight

Olli-Pekka Hilmola [a,*], Milla Laisi [b]

[a] Lappeenranta University of Technology, Kouvola Research Unit, Prikaatintie 9, FIN-45100 Kouvola, Finland
[b] Lahti University of Applied Sciences, Niemenkatu 73, 15140 Lahti, Finland

ARTICLE INFO

Article history:
Available online 7 August 2014

Keywords:
Transportation
Freight
Shareholder value
Simulation
Deregulation

ABSTRACT

In transportation sector implemented deregulation processes as well as increased free competition in the global scale have been key change drivers in recent decades. This research work analyzes in retrospective shareholder value creation in North American railway freight and peer group of four transportation companies from Europe and one from Asia. Research shows that North American, and particularly Canadian, railway freight companies own exceptional ability to increase shareholder value over time. From peer group companies Ryanair and Copenhagen airports have shown similar performance. In comparison all analyzed companies beat Dow Jones index as its starting year is 2000. However, index performs better, if it is enlarged to take into account decades long time period. As a caveat for analyzed well performing companies are occasionally occurred economic crisis times, which challenge ownership advances as declines have been rapid and significant.

© 2014 Elsevier Ltd. All rights reserved.

1. Introduction

Although the United States has a long history in industry-specific regulation, it was the first country to start the deregulation process in the 1970s. The first steps were taken in 1978, when the Airline Deregulation Act was launched. The Act withdrew price and entry restrictions, which had dominated the airline industry since 1938. (Lehn, 2002; Winston, 1993) Peltzman, Levine, and Noll (1989) noted that in the railway industry, the change of political direction towards deregulation was due to a large amount of railway undertaking bankruptcies in the early 1970s. This was taken as a sign that a settlement, which had been created in 1920 to support the system, was no longer available. Only two choices were available: Further nationalization or deregulation of freight rates. The railway industry chose deregulation, which came into legal force in 1980. (Peltzman et al., 1989) Deregulation was realized via two acts, the Railroad Revitalization and Regulatory Reform Act in 1976, and the Staggers Rail Act in 1980. These facilitated the limitations on mergers and acquisitions, and gave companies some degree of independence in services, pricing, and mergers and acquisitions. The Staggers Rail Act also provided the railway undertakings with more freedom to reject unprofitable routes and expanded the range of companies' legitimate business strategies. The net effect was to allow more space for railways in order to be able to compete with road and barge transport. (Cramer, 2007; Eakin, Bozzo, Meitzen, & Schoech, 2010; Jahanshahi, 1998; Peltzman et al., 1989; Shi, Lim, & Chi, 2011; Smith & Grimm, 1987) Nonetheless, the Staggers Rail Act only partially deregulated the railway market. The Interstate Commerce Commission (ICC) preserved the right to set maximum rates or act, if a railway undertaking was noticed to misuse the market power or participate in anticompetitive behavior (Pettus, 2009). Once the transport industry had led the way in 1970s, a range of industries (for example banking, telecommunications and energy) were deregulated between the 1980s and 1990s. (Gong, 2006; Mahon & Murray, 1981; Winston, 1993) Although deregulation did cause some problems for the United States, generally the net benefits were better than expected (Niskanen, 1989). Therefore, the success of the United States deregulation experiments in several industries (banking, telecommunications and transportation) gained worldwide attention, and is noted as a driving force behind the deregulation waves in Japan and the European Union (Jansson, 2010; Winston, 1998).

North American railway freight undertakings are often seen as one group, homogeneous one, which is due to the fact that the deregulation and privatization taken place in 1980s and 1990s is noted to be the occasion for the results gained. This might have been the case in the first decade, but since dissimilarities between undertakings have become apparent. For example, Shi et al. (2011)

* Corresponding author. Fax: +358 5 344 4009.
E-mail addresses: olli-pekka.hilmola@lut.fi (O.-P. Hilmola), milla.laisi@lamk.fi (M. Laisi).

http://dx.doi.org/10.1016/j.eswa.2014.07.048
0957-4174/© 2014 Elsevier Ltd. All rights reserved.

highlighted that Burlington Northern Santa Fe (BNSF) was significantly better in efficiency and productivity development in 2002–2007 together with Grand Truck Corporation (subsidiary of Canadian National Railways) and CSX, if compared to the rest of Class 1 railway undertakings (especially Norfolk). However, it should be highlighted that railway freight sector in USA is success in deregulation and investment yield sense as compared to that of airlines – numerous bankruptcies have taken place in airline industry after deregulation year 1978 (Baik, Kwak, & Lee, 2011; Goetz & Vowles, 2009) and business model change to greatly favour low cost carriers (Homsombat, Zheng, & Fu, 2014; Pearce, 2012) have benefitted only few airlines in long-term such as Southwest. Investments in airlines within USA in general have therefore been extremely low yielding, or even complete disasters.

This research work concentrates on North American railway freight undertakings, which have been active in deregulated and privatized market environment for longer period of time. Therefore, undertakings are expected to gain higher sales, profitability and shareholder value. In general, studies confirm that deregulation in railway sector increases the demand for transportation (e.g. Hilmola, Ujvari, & Szekely, 2007). Furthermore, earlier researches have noted that cost structure and prices have declining development for a longer period of time (Boardman, Laurin, Moore, & Vining, 2012; Jensen & Stelling, 2007; Vogt, 2008). These circumstances should encourage demand in the sector, and make it profitable if compared to other transport modes, such as road and inland waterway. Naturally in North American case this good development has been fostered with the resolution that railway freight undertakings also own the infrastructure (Gomez-Ibanez & de Rus, 2006; Hilmola et al., 2007). This ownership structure has enabled mergers and acquisitions (M&A), which have modified and strengthened the demand for production with lower prices and costs even further (Cramer, 2007; Eakin et al., 2010; Miljkovic, 2001; Spychalski & Swan, 2004). Such a sector which used to be highly regulated, infrastructure and investments (for example rail network) were large-scale and excessive, wherefore rationalization brings benefits for decades. Nonetheless, the market has drawn opinions (Mu & Dessouky, 2011) that rail network is too highly utilized, and change in management methods, or more investments, is needed. It also should be highlighted that based on macro-economic studies, US transportation sector is typically going to downturn earlier than other sectors and recovers from it later (Lahiri & Yao, 2006). So, economical and business challenges due to cycle lengths are greater, and should lead to less attractive environment for making profitable business and build shareholder value.

As a peer group for North American railway freight we use four European companies from deregulated transportation sector, and one railway passenger and freight transporter having well established operations in Asia. It would have been difficult or simply impossible to find stock market listed companies from railway freight sub-sector other than North America with long history as peer group benchmark. Deregulation processes have been much slower moving in elsewhere. In Europe air transportation was released for free competition in the late 90s (Starkie, 2012), but process with airports has been much slower paced and have proceeded hand in hand with low cost carrier volumes (basically Ryanair and EasyJet; Pitt, 2001; Starkie, 2012). Same applies to European railway sector, but main actions with free competition have actually happened after year 2000, with very few publicly listed companies.

This research is structured as follows: In the following Section 2 we analyze railway sector from the angle of deregulation process. We also illustrate revenue and profit development of selected ten companies of empirical part within period of eleven years. Despite several major economic crises taken place in this period (dot.com crisis and 2008–2009 housing credit crunch), some companies, and particularly railway companies, seem to produce consistently profits. In turn air transports related companies are most sensitive to the crisis times. Section 3 illustrates used simulation method, simulation model and second hand data sources further. Empirical part follows in Section 4, where we analyze two main investment strategies, timing of share paybacks and risk (variation of yields). These analyzes are all accomplished for five large railway freight company shares and peer group of other transportation sector companies from recently deregulated sub-sectors. In Section 5 we discuss over the results of this study, and observations made during the simulation runs. It is illustrated, even with most robust railway stocks that increased daily variation (in both positive and negative directions) is the trigger of considerable downside risk, and valuations decline significantly over the several hundred days following this. Therefore, we speculate whether pure buy and never sell strategy combined with dividend invest back should be followed strictly. For the sake of strategy it would be wise to sell entire position or at least halt dividend investment back – investment back should be applied when situation settles (daily yield variation decreases). We conclude our work in Section 6, and provide further avenues for future studies in this area.

2. From efficiency to profitability in railway freight

Traditionally, railway transport sector has been evaluated from efficiency perspective. Especially assessments have concentrated on multidimensional approaches, including for example Data Envelopment Analysis (DEA). Such studies have mainly scrutinized European countries (e.g. Cantos, Pastor, & Serrano, 1999; De Jorge & Suarez, 2003; De Jorge-Moreno & Garcia-Cebrian, 1999; Hilmola, 2007; Yu & Lin, 2008), while in limited number of studies scope has been expanded to include e.g. Japanese companies among the European ones (e.g. Oum & Yu, 1994). Some research works have been studied in empirical analyzes, including for example India (George & Rangaraj, 2008), Switzerland (Cowie, 1999), and USA (Chapin & Schmidt, 1999). However, only few studies (Hilmola, 2009, 2009b; Yu, 2008) have conducted research works, which compare the position of African, Asian and American countries together with European counterparts. Yu (2008) stated in his research work, that the most efficient countries in railway transport (including both passenger and freight) come from Western Europe, following by Asian, East European and African countries. Hilmola (2009a) concentrated on efficiency in freight transport sector, and highlighted that only some countries dominate it globally, including such countries as Russia, China, USA and Canada (in ton–kilometers based efficiency models). When the railway freight sector is considered worldwide, it is rather hard to construe whether efficiency has improved. Some countries evolve and govern the sample, while countries like Africa and part of East Asia are lagging behind, which makes it hard to evaluate the improvement of entire sample. Globally, the situation in passenger transport sector is better, but sample is also dominated by few countries, like South Korea and Japan (Hilmola, 2009b). However, even privatized Japanese railway passenger transport system is net recipient of governmental support to ensure daily connectivity to different cities and regions (Jitsuzumi & Nakamura, 2010).

In general, market regulation has been criticized for misallocating resources. Backman (1981) noted that a connection exists between lower productivity and regulation. As a solution to poorly performing markets has been offered deregulation, because it can boost intensive competition by promoting new companies to the markets (Andersen, 1992). Competition is often noted to result in effective resource allocation, wherefore deregulation is regarded to decrease prices (Backman, 1981; Banister, 1990; Kay &

Vickers, 1988). In conjunction with other policies (for example, those eliminating tariffs and allowing foreign investments to enter the market), deregulation is often noted as a vital force of economic growth through promoting the private sector (Goetz, 2002; Gong, 2006). Pettus (2009) and Smith and Grimm (1987) noted, that deregulation revise market environment, which forces companies to utilize their resource base in a dissimilar way (Mahon & Murray, 1981). Several studies (see for example Bereskin, 1996; Bitzan & Keeler, 2003; Gu & Lafrance, 2010; Wilson, 1997) have highlighted that deregulation has a positive influence on productivity, cost savings and growth, due to reduced barriers of entry, increased level of competition and increased stimuli for innovations and adaption of advanced technologies. This is also noted in the transportation sector, where the correlation between developed and efficient transportation infrastructure and economic growth has been among the main reasons for development of deregulation (Andersson & Strömquist, 1998). Deregulation is also noted to have effect in competitive forces: Prices have decreased, and services have expanded and become better adapted to users' needs (see for example Joskow & Rose, 1989; Quinet & Vickerman, 2004; Rose, 1985; Rose, 1987; Winston, Corsi, Grimm, & Evans, 1990; Ying & Keeler, 1991). Based on Shi et al. (2011), in the U.S. railway market, the best productivity growth was attained with the technological progress.

During the last decades railway freight sector has attracted research on the effects of deregulation and privatization. USA started the process in 1980 (Hilmola et al., 2007; Reid & Jennings, 2003), while Canada followed in the mid 90s (Boardman et al., 2012). In both cases, deregulation commenced by producing efficiency growth during the first decade, which was followed by higher revenues, profits and employment. In USA and Canada railway freight transport concentrated on cost efficiency, which had a positive impact on freight rates (considerably decrease noted, see for example Boardman et al., 2012; Hilmola et al., 2007). At the same time, road transport freights increased due to increase in oil price and while sea transport rates were too high because of Panama Canal (usage fees and route length), rail transport attracted more volume to rails. If local transport markets are considered, for example Great Lakes, railway transport is challenging inland water transport due to lower emissions (United Nations, 2012: 27; McIntosh, 2013). Only during the recent years' the railway freight rates in North America have increased, which together with high volumes have provided steady market environment for profits and profitability (Huneke, Brennan, Boyles, & Smith, 2009). As described earlier, railway transport market is known for high barriers to entry. In USA among the main ones is the fact, that most of infrastructure was given to Class 1 railway freight undertakings, while others were able to lease the network from them (Gomez-Ibanez, 2004; Gomez-Ibanez & de Rus, 2006). When railway freight market is considered business and volume wise, North America together with Russia and China is holding forefront. The European Union's share is estimated to be around five percent from world's overall railway freight transport (Amos & Thompson, 2007).

Based on previous studies it is known, that American railway freight undertakings have undergone through significant wave of mergers and acquisitions (M&A) during the last two decades (Cramer, 2007; Eakin et al., 2010; Miljkovic, 2001; Spychalski & Swan, 2004). The undertakings are gaining high profits, good dividend yield and returns on invested capital (in a longer term). Alike companies in the USA, Canadian counterparts have enlarged the presence in USA railway market with M&A activity (for example, Canadian National Railway, acquisition of Elgin, Joliet and Eastern Railway Company in 2008 and eventually integrating company totally during 2012–2013, together with Canadian Pacific acquiring Dakota, Minnesota and Eastern Railroad in 2007; see Canadian Pacific, 2013; PR Newswire, 2013). Some American undertakings, such as for example Kansas City Southern made brave moves to take forefront in Mexican-USA railway freight transports (the company is included in Class 1 railway undertakings, although it is more than five times smaller than e.g. CSX and Norfolk).

For example, Siegel (2005) stated the U.S. railways are among the best investments in the longer period of time; even the well recognized investment fund Berkshire Hathaway has invested in the largest operators billions of USDs (BH, 2008). The increased ownership of Berkshire on Burlington Northern Santa Fe ended in

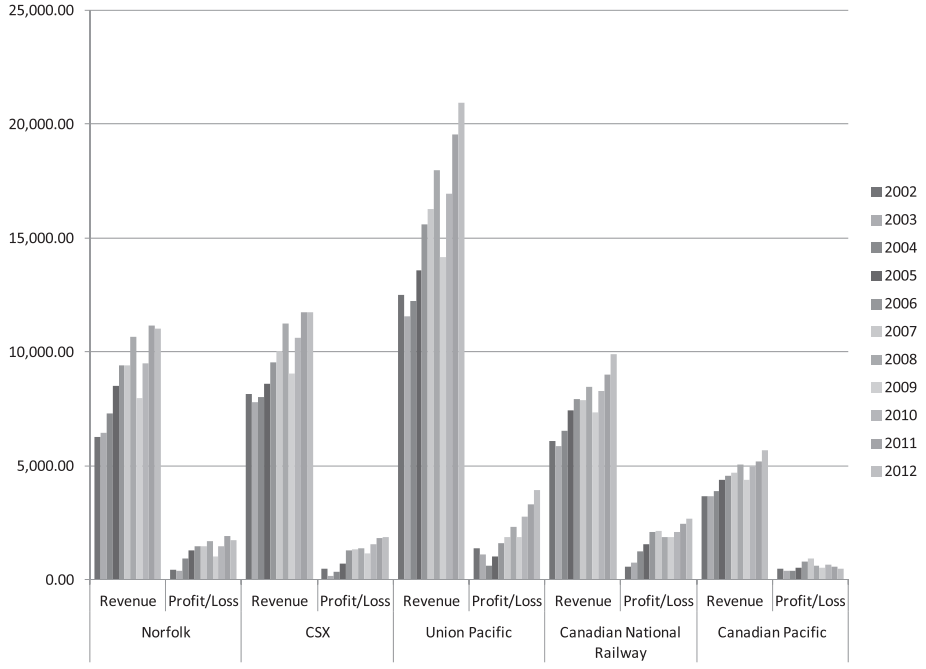

Fig. 1. Revenues and profits of selected three US Class 1 railways and two major Canadian railway companies during period of 2002–2012 (all in million USD or million CAD). Source: Thomson One Banker (2013) and Annual Reports.

2009, when the entire listed company was purchased by it with 26.3 billion USD out of stock exchange (Patterson & Blackmon, 2009). Similar, but somewhat smaller scale investment (valuation of it in the end of 2013 was around 5 billion USD) has been made by Bill Gates to Canadian National Railways as he started to accumulate position during year 2006, and was in the end of year 2012 the largest shareholder (Deveau, 2012). Although the largest railway freight undertakings in the USA have been concentrated on few companies, the sector is increasing the number of acting companies. This is due to the fact that number of Class 3 railway undertakings has increased with more than 200 in two decades (Johnson, McClure, Schneider, & Wood, 2004). Same trend is noted in Europe; for example in Germany the freight transport sector is controlled by few companies, even though the amount of all undertakings is approximately 370 (ERADIS, 2013; Holvad & Godward, 2012).

As a peer group for North American railway freight companies (Fig. 1), five well-known transportation sector companies were selected for investment yield analysis. These peers are represented in Fig. 2 concerning revenue and profit development. Some of these have recorded much more significant revenue growths than North American railway freight companies. As an example could be taken Ryanair, which is in revenue terms seven times higher (>600% growth) than in base period. Even if this performance is exceptional, growth of Guangshen Railway (>500%; reason for nearly tripling revenues in 2007 was business acquisition of Guangzhou–Pingshi Railway, see GSRC, 2013) and AP Moeller-Maersk (>100%) is also much brisker than that of North American railway companies. Actually only two airports of this study, Fraport (35.4%) and Copenhagen airport (63.9%) are much closer match.

On other side of the token, shown profit performance is different from revenue growth, even if it could be assumed that absolute profits would develop hand in hand with business scale. It is somewhat interesting to observe that highest profit improvement over observation period as well as the most stabile performance over time, is accounted for Copenhagen airport, which showed well above four times higher absolute profit in the end of the period. Ryanair is approaching this level, but still its absolute profits are slightly below four times higher in year 2012 as compared to base. Not all analyzed companies in Fig. 2 are showing rosy profit development – actually Maersk has constantly remained below the level of year 2002. Situation in Fig. 2 is not good either, if global credit crisis year of 2009 is analyzed – as all North American railway companies were able to show profits even in this critical time, Ryanair and Maersk were falling into losses. Please note that this was not the only difficult year for transportation sector companies in the observation period. Also year 2002 was extremely difficult for airline sector (economic downturn coupled together with security issues of air transports) – this could be seen in the Fraport losses in that particular year.

3. Research method and simulation model used

All of the calculations following in the empirical part could have been accomplished with the aid of spreadsheet and financial data information providers. However, this would have required a lot of customization and tailor made solutions as different issues were taken into account (sensitivity analysis) and daily returns were needed to be incorporated in the yield/risk analysis. Therefore, simulation approach and system dynamics program use was selected for this study. Simulation model is also handy in a way that all flows are somewhere stored in it, e.g. in the pipeline waiting dividends to be invested are inside of one element, and they could be incorporated in the total market values of made investments. Used simulation program was well-known system dynamics simulation package called Vensim (Professional Version, 6.2). This program has recently been used in numerous studies such as coal mining safety evaluation in China (Lei & Yuanyuan, 2014), disease spread in the community of UK (Viana, Brailsford, Harindra, & Harper, 2014) and competitiveness of airports in China (Cui, Kuang, Wu, & Li, 2013). Weakness of system dynamics in general (e.g. Viana et al., 2014) is its focus on macro-level and one product or few products at a time (or in this research case, shares and dividends). This weakness was avoided by using same simulation model for each company share and its dividend streams, but evaluation was made for each company in isolation (to avoid

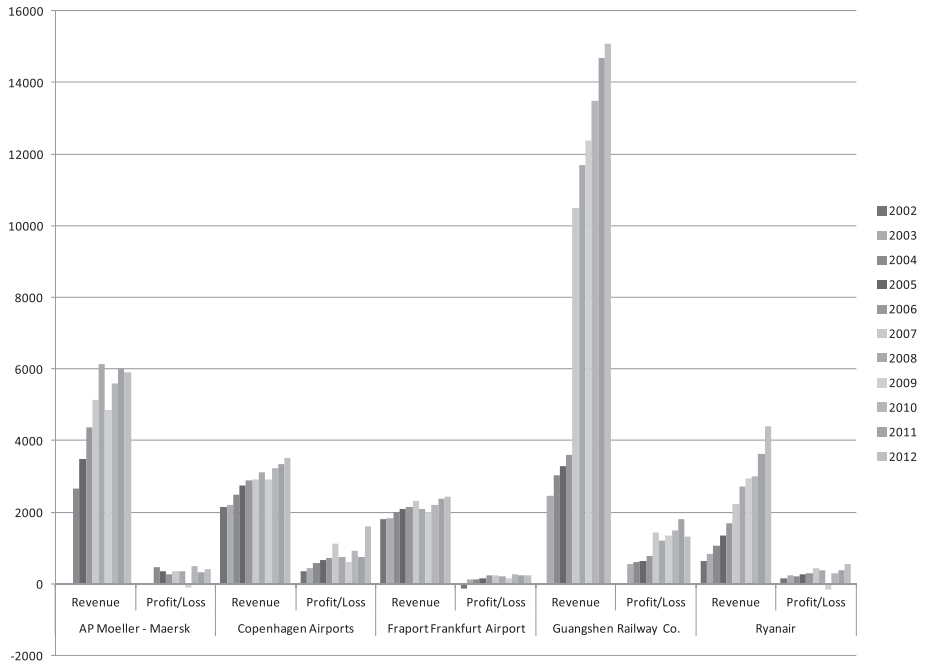

Fig. 2. Revenues and profits of selected five other transportation sector companies during period of 2002–2012 (Currencies: Maersk, USD; Copenhagen airports, DKK; Fraport, EUR; Guangshen, RMB; Ryanair, EUR). Source: Annual Reports.

complexity of simulation model, and possible invalid results). System dynamics holds considerable strength as models can be complex and contain numerous links, feedbacks and feed forwards between used variables. This complexity issue was really useful for the modeling and analysis of dividend investment back strategy scenario.

As this study concerns only one end product (equities of ten companies selected) and its daily stock price development and dividends, then we decided to use system dynamics simulation for the model building. Stock price and dividends are modeled in the top of Figs. 3 and 4, and they are exogenous information taken from spreadsheets. Initial investment is in all models set to be 1000 currency units (typically USD or EUR) and it means that with this amount simulation model purchases stocks in the very beginning of the simulation period. Simulation has two strategies incorporated in it: (1) conventional investment strategy, where dividends are raised and not invested back (share amount remains as the same what it was in the beginning of the simulation run; this simulation model is shown in Fig. 3), and alternatively (2) investment strategy, where dividends are invested back to shares of the target company (shown in Fig. 4). Latter strategy remains to be a bit more complex, since in this research work we were having aim to alter, when this repurchase should be made (right after receiving dividend or with some days or weeks delay). As model itself creates through its elements delay in the process, delayed stock price element was needed to be incorporated that repurchase price would correspond market price of this exact repurchase day in practice. To get daily yields from the simulation model, we were forced to take investment valuation of previous period in the model as separate element (in both applied investment strategies). To make simulation runs realistic, it was assumed that dividends are under tax rate of 25%, which is paid every time dividends are being received. Please note that in both Figs. 3 and 4 main variable is 'Total Shareholder Value', which is calculated in each moment with number of shares held times respective moment share price plus in the top of this dividends received (in Fig. 3, while in Fig. 4 dividends are only included, if they are yet to be invested to gain more shares).

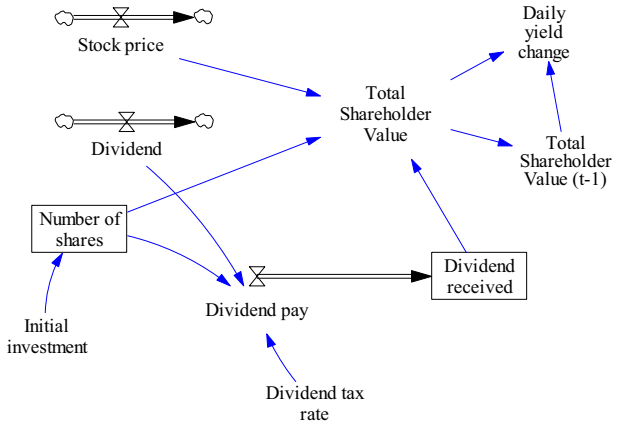

Fig. 3. Simulation model used in the study, where dividends are not reinvested back.

Data used in this study was taken from two different sources. Daily stock prices are available in the service of Google Finance (2013) and these have only been modified to take into account stock splits (or reverse splits). Google Finance (2013) validness of data was checked by visiting investor sections of analyzed companies and taking some far and close (in time sense) values from particular selected companies. Based on our experience, Google Finance (2013) data is valid. This is important for the purposes of this study as some other information providers do also provide long time series data freely, but stock prices are adjusted for both dividends and stock splits. As our intention is to examine dividend use as investment strategy approach, using dividend adjusted data would have resulted in too rosy (and invalid) valuations for investments. As Google Finance does not provide any dividend data, this was taken from Yahoo Finance (2013). Again the validity of this data was made by comparing Yahoo Finance (2013) data with the historical data taken from investor relations section of respective companies. Data was found to be reliable, but availability of dividend series was limited, and therefore some of the series were started from the period, when Yahoo Finance (2013) had availability for the data.

Initial intention in this study was to have as long as possible time series from all ten companies. This was, however, limited to

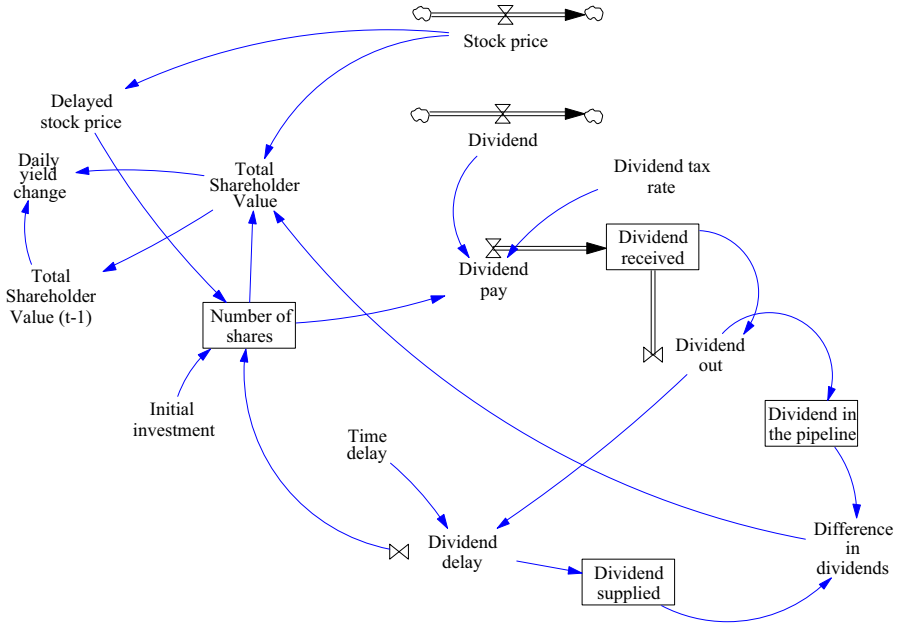

Fig. 4. Simulation model used in the study, where dividends are invested back to gain more shares.

some extent. In best cases time series started from the early or late 1980s, and continued until 29th of April 2013. Exceptions were Canadian railway companies, Canadian National Railway and Canadian Pacific. First mentioned could not have any data available from 1980s, as Canadian government privatized and listed company in stock exchange during the mid of 1990s. For some unknown reason Google Finance (2013) had Canadian Pacific data available only from 21st of August 2001 onwards. These data limitations could have made following analyzes a bit biased and favoring these two Canadian companies (especially Canadian Pacific). However, it should be noted that in these shorter time periods world has going through very disturbing periods in economic progression, and therefore Canadian investments should reflect this in their valuations. Actually it is so that investments in 1980s with historic yardsticks have been one of the bests as progression of stock market indexes since then has been extremely bullish (e.g. Dow index was in year 1985 trading at 1300–1500 as it was in the end of April.2013 approximately 14,700). This could favour somewhat railway freight companies of USA. Comparison group companies from transportation sector (five in latter part of Table 1) are having similar time-scale and observation period with two Canadians. So, from one angle Canadian railway freight and five peer companies from transportation sector are having similar time period and comparison is having needed validity.

As Table 1 illustrates, series used in this research work are extensive and having typically share trading days of at least 2500. Some railway freight companies of USA are having observation period up to more than 8000 days.

As in USA and Canada it is accustomed to give numerous dividends per year (in a good year four or even five dividends), the number of dividend pay days in the sample companies is also relatively high. However, absolute amounts as compared to share price of first trading day of Canadian companies (more or less same observation periods with the peer group), are not significantly different (see Table 2). Of course freight railway companies of USA are in class of their own with dividend provided, roughly four times the amount of price of share in the beginning of observation period. However, please do note that share trading days are twice or three times higher than what is the case of others.

In rest of the world it is typical to give dividends out once in a year, which is the case in all peer group transportation sector companies. Of course it is greatly dependent on company strategy, whether dividends are paid at all or is cash inflow invested back to future growth of business. For example, Ryanair has been applying this principle and only two times in sixteen year time period dividends have been paid out. However, if total dividend amount of Ryanair is compared to its low valuation in the mid of 1997, it is not abnormally low compared to rest of the analyzed companies (Table 2). Actually Maersk and Fraport have both paid much lower amounts as compared to starting price of the share (do note that observation period length is smaller in these).

As dividends were so numerous in North American part of the sample data, most recent ones were just recently been given (in some of the companies during early 2013). As in the following we even alter investing back these received funds, we were forced to add in the simulation model detection elements from received dividends (by comparing with parameter "difference in dividends" shown in Fig. 4), which were in the pipeline (to be invested). In the model we have valued these as the cash amount received.

For index comparison purposes it was selected two Dow Jones Industrial Average data series, one starting from the early 1980 (good comparison base to US railway freight companies) and another one from early 2000 (as comparison index for other later comers in the markets). As Dow Jones Industrial Average is used as yardstick, in the following research outcome and yields are evaluated thoroughly with general market development during the same time period. However, it should be noted that indexes do not contain, or will not receive dividends, which makes them

Table 1
Evaluated companies in this study and data set characteristics.

Company ticker	Name	Last date	First date	Share trading days	Dividend days
CNI	Canadian National Railway	29-Apr-13	2-Jan-97	4122	65
CP	Canadian Pacific	29-Apr-13	21-Aug-01	2953	47
CSX	CSX Corporation	29-Apr-13	2-Jan-81	8169	130
NSC	Norfolk Southern Corporation	29-Apr-13	2-Jun-82	7812	123
UNP	Union Pacific Corporation	29-Apr-13	2-Jan-80	8422	133
MAERSK-A	AP Moeller-Maersk	29-Apr-13	2-Jan-03	2586	11
KBHL	Copenhagen airports	29-Apr-13	16-Oct-00	3021	7
FRA	Fraport, Frankfurt Airport	29-Apr-13	11-Jun-01	3010	10
GSH	Guangshen Railway Co.	30-Apr-13	13-May-96	4285	16
RYAAY	Ryanair	30-Apr-13	26-Jun-97	4000	2

Table 2
Evaluated ten companies in this study and provided dividends in each observation period (share price and dividend values in different currencies) and reference index of Dow Jones Industrial Average (starting years 1980 and 2000).

Company ticker	Name	First date	Share price (first date)	Dividends received (total)
CNI	Canadian National Railway	2-Jan-97	6.29	9.88
CP	Canadian Pacific	21-Aug-01	19.10	9.39
CSX	CSX Corporation	2-Jan-81	1.33	5.27
NSC	Norfolk Southern Corporation	2-Jun-82	4.76	21.76
UNP	Union Pacific Corporation	2-Jan-80	8.97	36.19
MAERSK-A	AP Moeller-Maersk	2-Jan-03	22600.00	5979.00
KBHL	Copenhagen Airports	16-Oct-00	675.00	439.10
FRA	Fraport, Frankfurt Airport	11-Jun-01	34.80	9.59
GSH	Guangshen Railway Co.	13-May-96	20.25	9.75
RYAAY	Ryanair	26-Jun-97	3.39	4.33
DJI	Dow Jones Industrial Average	2-Jan-80	824.57	N/A
DJI-2000	Dow Jones Industrial Average	3-Jan-00	11357.51	N/A

significantly different as dividend invest back strategy cannot be applied (only buy and hold).

4. Market valuation of railway freight companies vs. selected non-US transportation companies

4.1. Yield analysis of ten selected shares and two strategies applied

As examining yields of investing 1000 currency units with (Table 3) or without (Table 4) dividend strategy, railway companies and in particular Canadian ones have clearly best returns. This high level is only reached in one other company of Tables 3 and 4, Ryanair. Investing dividends back to these companies will result in some additional yield, but not significant. As comparison, Dow Jones index (Table 3) nearly reaches the level of US railway freight companies (as dividends are not invested back) as examination period is long (from year 1980 onwards). However, Dow Jones shows lowest possible performance as starting year is 2000. This just further illustrates, how good investment deregulated transportation sector, and North American railway freight in particular, has been.

It is interesting that top three companies are followed with distance by popular dividend paying railway stocks, like CSX, Norfolk and Union Pacific. However, yields of these three railway companies are not poor, particularly in the case as dividend invested back strategy is followed (Table 4). From other companies only Copenhagen airport reaches the same yield level.

Even if railway freight sector in North America has been good investment, this sort of sector based thinking could be abandoned in peer group companies. For example, as Copenhagen airports' has shown exceptionally good yield performance, this is not the case with Fraport, Frankfurt Airport. Also rather interesting is to find out that Chinese economic growth has not resulted in abnormally high yields for Guangshen Railways. Situation is the same with Maersk, which has mainly served container transports between continents (mostly Europe and Asia). However, Maersk yield performance is not poor, and it falls between lower performing ones and North American railway companies and Copenhagen airports.

So, based on this analysis we may conclude that successfulness of this "dividend invest back" strategy is quite much case dependent, and works best in North American companies and in those, which have shown exceptional value creation in stock prices (like Copenhagen airports). In general all analyzed companies have provided some additional yield for dividend back investor (even if in Maersk case this is really marginal). Interestingly very low performing Guangshen Railways is showing more than 70% higher yield (4.8% p.a. vs. 2.8%), if dividends are invested back. So, North American railway investment model could and should be applied for this Asian company too, but yields have remained still very conservative.

4.2. Reinvesting dividends: when ought to purchase more shares?

As dividend investment back to shares appears to be so lucrative strategy, it was analyzed with simulation program, how timing of repurchases affects on overall yield. In earlier sub-section all yields were calculated with assumption that repurchases are made in the very same day as dividends arrive into bank account. Based on efficient market theory, timing should not play that major role, but in a case of large dividends (significant with respect of valuation of share) tend to lead into huge drops in share prices in the day of payment.

Simulation results suggest that repurchases should be made as soon as possible, when dividends are being received (Table 5). In all ten analyzed stocks day 0 and day 1 result in similar yields. However, after this made purchases show typically lower gains. This

Table 3
Five North American railway freight companies and five other transportation sector alternatives analyzed as one unit of currency is invested in the beginning of the period (first date) and dividends are not invested back. Comparison also made to Dow Jones Industrial Average in the same period (starting years 1980 and 2000). All currency amounts in '000 currency units.

Company ticker	Name	End amount	Start amount	Yield (p.a.) (%)	Last date	First date
CNI	Canadian National Railway	$ 16.57	$ 1.00	18.8	29-Apr-13	2-Jan-97
CP	Canadian Pacific	$ 6.89	$ 1.00	18.0	29-Apr-13	21-Aug-01
CSX	CSX Corporation	$ 21.48	$ 1.00	10.0	29-Apr-13	2-Jan-81
NSC	Norfolk Southern Corporation	$ 19.52	$ 1.00	10.1	29-Apr-13	2-Jun-82
UNP	Union Pacific Corporation	$ 19.46	$ 1.00	9.3	29-Apr-13	2-Jan-80
MAERSK-A	AP Moeller-Maersk	kr. 1.99	kr. 1.00	6.9	29-Apr-13	2-Jan-03
KBHL	Copenhagen Airports	kr. 4.01	kr. 1.00	11.7	29-Apr-13	16-Oct-00
FRA	Fraport, Frankfurt Airport	€ 1.51	€ 1.00	3.5	29-Apr-13	11-Jun-01
GSH	Guangshen Railway Co.	$ 1.60	$ 1.00	2.8	30-Apr-13	13-May-96
RYAAY	Ryanair	$ 13.74	$ 1.00	18.0	30-Apr-13	26-Jun-97
DJI	Dow Jones Industrial Average	14818.75	824.57	9.1	29-Apr-13	2-Jan-80
DJI-2000	Dow Jones Industrial Average	14818.75	11357.51	2.0	29-Apr-13	3-Jan-00

Table 4
Five North American railway freight companies and five other transportation sector alternatives analyzed as one unit of currency is invested in the beginning of the period and all dividends invested back to acquire more shares. All currency amounts in '000 currency units.

Company ticker	Name	End amount	Start amount	Yield (p.a.) (%)	Last date	First date
CNI	Canadian National Railway	$ 19.26	$ 1.00	19.9%	29-Apr-13	2-Jan-97
CP	Canadian Pacific	$ 7.71	$ 1.00	19.1%	29-Apr-13	21-Aug-01
CSX	CSX Corporation	$ 36.98	$ 1.00	11.8	29-Apr-13	2-Jan-81
NSC	Norfolk Southern Corporation	$ 32.38	$ 1.00	11.9	29-Apr-13	2-Jun-82
UNP	Union Pacific Corporation	$ 41.95	$ 1.00	11.9	29-Apr-13	2-Jan-80
MAERSK-A	AP Moeller-Maersk	kr. 1.99	kr. 1.00	6.9	29-Apr-13	2-Jan-03
KBHL	Copenhagen Airports	kr. 4.22	kr. 1.00	12.2	29-Apr-13	16-Oct-00
FRA	Fraport, Frankfurt Airport	€ 1.57	€ 1.00	3.8	29-Apr-13	11-Jun-01
GSH	Guangshen Railway Co.	$ 2.23	$ 1.00	4.8	30-Apr-13	13-May-96
RYAAY	Ryanair	$ 14.15	$ 1.00	18.2	30-Apr-13	26-Jun-97

Table 5
As dividends are invested back and sensitivity analysis of this strategy to shareholder value creation in the entire observation period as the date of purchase after dividend payout date has been altered.

Company ticker	0 day (%)	1 day (%)	2 days (%)	3 days (%)	4 days (%)	5 days (%)	10 days (%)	15 days (%)	20 days (%)	25 days (%)	30 days (%)
CNI	100.00	100.00	100.03	99.98	100.01	100.05	100.06	100.12	99.98	99.85	99.54
CP	100.00	100.00	99.85	99.85	99.90	99.89	99.82	99.76	99.75	99.64	99.27
CSX	100.00	100.00	99.96	100.06	100.21	100.28	99.77	100.16	100.20	99.97	99.44
NSC	100.00	100.00	99.75	99.57	99.26	99.46	99.36	99.80	99.84	99.34	99.09
UNP	100.00	100.00	98.88	98.15	97.62	97.08	97.99	97.25	96.97	97.01	96.09
MAERSK-A	100.00	100.00	99.90	99.80	99.85	99.90	99.95	99.70	99.80	99.80	99.90
KBHL	100.00	100.00	100.14	100.15	100.42	100.48	100.66	100.48	100.46	100.24	100.18
FRA	100.00	100.00	100.02	100.05	99.95	99.95	100.06	99.91	100.27	99.77	99.74
GSH	100.00	100.00	99.76	102.14	103.72	103.95	103.89	103.81	106.24	103.27	103.11
RYAAY	100.00	100.00	100.01	99.99	99.90	99.73	99.42	99.29	99.32	99.19	99.53

Table 6
Average daily yield, its standard deviation and Sharpe's ratio of analyzed ten companies and two strategies applied (arranged in descending Sharpe ratio order) as well as Dow Jones Industrial Average without dividends.

Ticker	Yield (%)	Stdev	Sharpe
CNI divi	0.09	0.018	0.049
CNI	0.08	0.017	0.049
CP divi	0.09	0.021	0.044
CP	0.08	0.019	0.043
RYAAY divi	0.10	0.027	0.038
RYAAY	0.10	0.027	0.038
DJI	0.04	0.011	0.036
KBHL divi	0.07	0.021	0.033
NSC divi	0.06	0.019	0.033
KBHL	0.07	0.021	0.033
NSC	0.05	0.015	0.032
CSX divi	0.06	0.020	0.032
CSX	0.05	0.017	0.031
UNP divi	0.07	0.022	0.030
UNP	0.05	0.017	0.029
MAERSK-A	0.04	0.019	0.024
MAERSK-A divi	0.05	0.020	0.023
GSH divi	0.06	0.028	0.021
FRA divi	0.04	0.021	0.018
FRA	0.03	0.020	0.017
GSH	0.04	0.024	0.016
DJI-2000	0.02	0.013	0.013

could be explained with dividend slump in share price, which seems to start recovery in several days after dividend has been paid. Differences in general are not wide, but one or two percents lower gains in monetary terms are end result in the entire simulation period. However, opposite case is also present in Table 4 – Union Pacific illustrates that nearly 4% of overall gains are lost, if investor waits dividend back investment for 30 trading days.

4.3. Yield and risk – Sharpe's ratio analysis

Looking only end valuation and calculating annual yields from it would be too single sided as risks during the value formation have not been taken into account. Therefore, simulation model was enlarged to take into account daily yields (valuation changes of two different strategies). Standard deviation of yields is measure of risk. Of course it is backward looking, but as sample contains such crisis times as 1987 crash, 1997 Asian crisis, 2001 dot.com crisis and 2008–2009 housing crisis, all of the analyzed ten shares have went through some very difficult times, basically at least two or three of them, and USA railway freight companies all four. Even if daily yield is in all cases slightly positive, and variation in general is low (and standard deviation is around 2%), but all of the analyzed shares had very high and extreme changes recorded during the period (±10–20%, these should be nearly impossible if

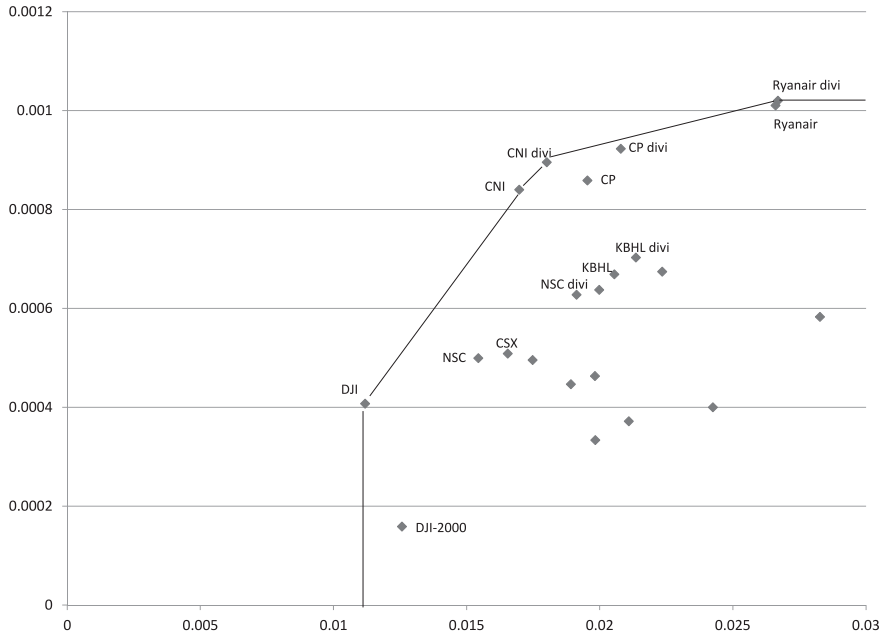

Fig. 5. Analysis of daily yield (*y*-axis) and its standard deviation (*x*-axis) as well as sketching efficiency frontier.

distribution would be normal). This situation was whether dividends were invested back or not. Most robust against changes in our sample were shares of Canadian National Railway and Maersk (so these were having as extreme daily yield changes values near of ±10%). However, extremes exist, like Union Pacific and Copenhagen airports (in both cases min and max daily changes were well above 20% to both directions, in Union Pacific more than 40%).

As factoring in risks and calculating Sharpe ratio (yield divided by standard deviation of yield), we may note that two Canadian railway companies are in the class of their own (see Table 6). Especially Canadian National Railway Company has been low risk and high yield share. These two are followed by Ryanair. After these next group is formed by Copenhagen airports and rest of the North American railway companies.

It is interesting to note that Dow Jones index is rather high in Table 6 as index data series starts from the early 1980. Actually its performance is really close to best performing companies of this research work. However, Dow Jones index does not perform well in shorter time period as data series starts from year 2000. Its Sharpe ratio is actually lowest from all companies analyzed – it means low yield with high risk. Actually after year 2000 analyzed deregulated transportation sector companies have been better investments.

Typically investing back dividends to these analyzed companies does not increase the risk level – this would not be the case always as investing more on same share will increase exposure of future valuation of company. Only Maersk is located somewhat lower in dividend invest back strategy than without it. This finding in general illustrates that railway transports and deregulated transportation sector has been safe investment – all companies have been able to increase their valuations over time.

In Fig. 5 is illustrated graphical efficiency frontier from the data of ten stocks and two different strategies applied to these. As could be noted, top three companies are clearly identifiable in the frontier (Canadian railway companies and Ryanair). Interestingly, Norfolk and CSX are in good position too as their daily yield on the average is low and standard deviation too.

5. Discussion

In overall it could be agreed that railways and some selected transportation sector companies have been in yield sense very good investment targets during previous decades. However, situation is not as flourishing, or one sided, as could be interpreted just by looking end valuation after decades of holding position of one company shares. As risk analysis showed, USA based railway companies are not low risk group of companies and dividend investment back strategy does not provide that significant hedge in here either. Reasons for different shares are always case dependent, but further and deeper analysis could illustrate how much daily yield actually can have variance. More insight is gained, if individual companies are being analyzed in details.

Fig. 6 illustrates the progression of 1000 USD investment in Canadian National Railways (best performing and lowest risk in the previous analysis). Daily yields and dividend invested back strategy overall are presented in Fig. 5. Even if progression in valuation and investment in general has been good and clearly upwards developing, very difficult period could be detected in the crisis time of 2008–2009 (days 2850–3100 in Fig. 6). Daily yields started to heavily fluctuate then, and in valuation sense investment lost roughly 40% within 250 trading days (again triggered by fluctuation in daily yields).

Similar price shock could be detected in the one of the poorest performer of this study, Guangshen Railways. In Fig. 6 is illustrated its daily yields and valuation progression of 1000 USD investment with dividend invested back strategy. In the beginning of the period (1996) Asian economic situation was reasonable, but in 1997 currency crisis hit very hard emerging Asian economies (together with Russia). This could be detected from daily yields as very high fluctuations tend to be present in both directions in Fig. 6 during period 250–500 (day). In the end investment in Guangshen faced very stiff decrease as valuation declined by 60–70% in couple of hundred trading days. Another occasion for sudden price decline could be detected in 2008–2009 crisis time (days 2850–3150 in Fig. 7) – in just 300 trading days investment lost more than 60% out of its value.

We may conclude from these two individual company analyzes that situation changes during the times of economic crisis. In these occasions daily moves can be 10% or more in both directions. This is just good illustration of systemic risk of global markets – in shares of railway or transportation companies we should not have such large-scale moves (how can business prospects change so much overnight?). Of course for individual investor with small stakes in investment could tolerate a bit more of variation, but portfolio managers and alike are really restricted to tolerate this sort of large moves. If valuations drop suddenly funds are forced

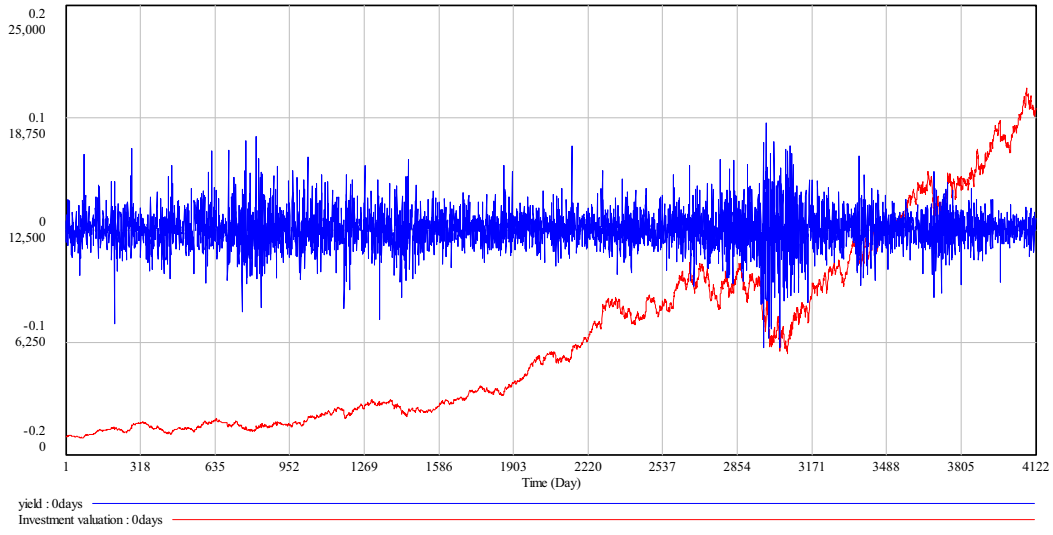

Fig. 6. Daily yields (blue line) and valuation of investment (red line) in Canadian National as dividends are invested back. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.).

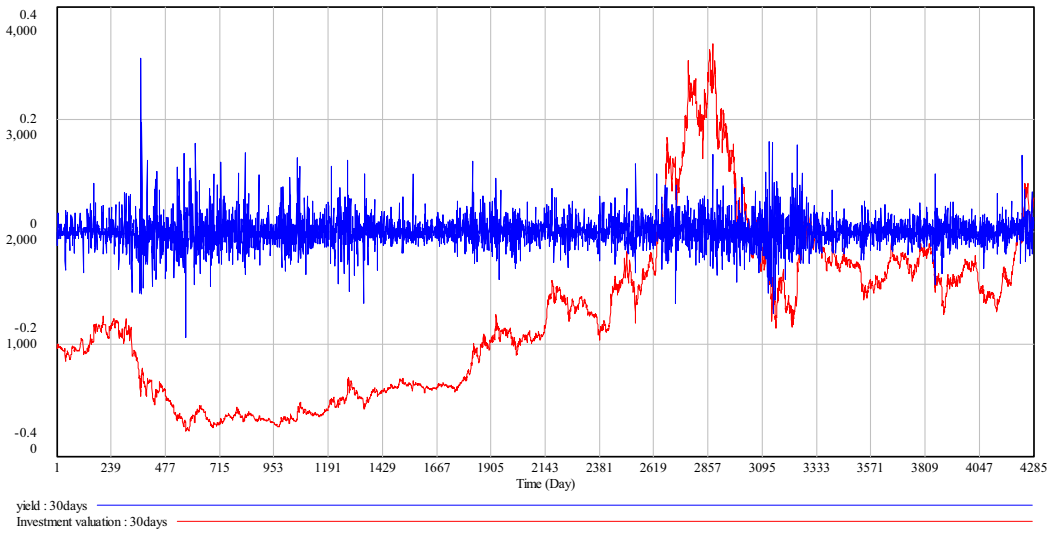

Fig. 7. Daily yields (blue line) and valuation of investment (red line) in Guangshen investment as dividends are invested back. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.).

to start selloffs to protect their asset valuations and equity. This in turn will fuel more change in the market system. Situation in the end is the same: We might have very large-scale moves in the markets, even much larger than standard deviation and Gauss theory of normality could assume in the first place (also discussed in recent financial market research, like Vogel, 2010).

We may also learn from these yield changes and modify our investment approach. It could be so that reinvesting dividends back to shares during the time of crises (basically two major macro-economic/market crises are present in Fig. 6) is not that wise strategy, and holding excessive cash positions would in turn be such. After daily yields start to stabilize, then investment is at safe ground, and also based on our initial analysis of price data, this means very lucrative price opportunity to purchase back (very low valuations). Rules could be practice based even, and such that right after large-scale downside realization (e.g. more than 10%) we ought to wait for 10 trading days to invest more with received dividends. This in order to see, does large-scale change has continuum or not (like in the crisis of 2008–2009: e.g. one analyzed company in this research work, Union Pacific, investment with dividends invested back, lost from its valuation more than 60–65% in just roughly 140 trading days). Other companies in this analysis did repeat similar declines, but in longer time horizons. These include even one of the best performing one, Ryanair, but as well Copenhagen airports. In some companies these hard times are not only one or two times present in yield series – think about three North American and USA based railway companies. These have went through sudden crash of 1987, Asian crisis of 1997, IT bubble burst of 2001–2002 as well as the most recent crisis of real estate during years 2008–2009. In all of these occasions valuations have declined substantial amounts in very short timeframes. For the sake of safety and investment return, it could be wise in long-term to sell entire position away as daily yield fluctuations start to be too high. Long-term return is not having good outsight in this sort of environment – high fluctuation typically leads to declining valuations.

6. Conclusions

Deregulation is typically analyzed and discussed through negative sentiment such as downsizing and layoffs. This has also been the case in railways and airline industry. However, in these research works it is most often forgotten that deregulation has been in numerous cases significant financial success with growing revenues and turning from losses to profits, this especially in North American railway freight companies. In this study we also found some promising counterparts from other parts of the world as Ryanair as well as Copenhagen airports have been such high investment successes too. It could of course be argued that success of these companies is taken from other governmentally owned actors (e.g. in case of Ryanair many European governmentally led airlines have suffered from continuous cost cutting and bankruptcies), but it is typically forgotten that financially successful companies are very important source of tax revenue for the country, where their headquarters are located. Basically annual profits and dividends are always under taxation, but this governmental angle could be enlarged to stock market too. Institutions and individuals registered to the country per se are entitled to pay capital gain taxes (if investments are sold and potential profits realized) – again providing higher governmental revenue to be collected. For example, Boardman et al. (2012) analyzed privatization of Canadian National Railway from this enlarged point of view, and concluded that process has been major success for the government. Similarly, in USA all freight operators in railways were in financial troubles before deregulation (in 1970s), and bankruptcies were common in the sector of heavy regulation and not so much competition (Cramer, 2007; Eakin et al., 2010; Peltzman et al., 1989). Deregulation did not show change for good in short-term, not even in the first decade, but in longer-term situation has changed completely. It is also illustrated in this manuscript with high long-term shareholder yields. One of the most hated sectors became one of the most wanted investment class, and as illustrated in this research work, buy and hold coupled together with dividend investment back has been extremely good strategy over long-term.

As managerial implication for fund managers, but also for individual investors, this research clearly illustrated that deregulated transportation sector provides good long-term alternative for investments and investment portfolios. This especially seems to be the situation with railway sector, and North American freight transports in particular. It is also beneficial for investors to follow dividend development closely and reinvest dividends back to gain more shares (this reinvestment should be made promptly). Based on our research reinvesting dividends back to gain more shares have not increased risk levels of investments, and in retrospective it seems that provided yields are worth of increased standard deviation of yields (risk).

So, what could stop North American railways going strong and hold their favorite position as investment class? Basically in North American case most of the demand is arising or ending to Asia, and currently most solely that of China. Cost advantage is coming from much higher energy efficiency (as compared to road) or short sea shipping. Freight transportation at rails is mixture of raw materials (mostly coal) and intermodal transports (e.g. containers and trucks with trailers). If Asia stops growing as well as has declining export manufacturing performance, and simultaneously oil drops to similar levels, which we have witnessed in 1980s and 1990s, it is possible that railway transports could be hurt and risks could materialize in downside within investments rather suddenly. However, we have no indication that Asian dominance of arising superpower and economic center would not continue. Maybe Chinese led growth is going to be replaced with some other countries of the region, but still Asia is the growth engine in the future. However, we would like to remind that Asia is important for peer group companies of this study too – if Asia experiences problems, they are also going to be experiencing severe decline in valuations.

As an interesting future growth area for railway transports is the booming and growing North American energy industry, and particularly gas. Of course best way to transport gas is through pipelines, but if gas is going to be consumed more in USA and Canada instead of coal and oil, then this will mean lucrative business opportunity for railway freight. Basically substitution will increase price pressure over coal and oil, and it could be assumed that their prices shall remain the same or decrease. For growing economies of Asia (e.g. in raw material starved export industries within growth phase) this means opportunity to import more coal, and possibly also oil from North America. This in turn will mean that railway companies have increasingly more business activity in the region. As raw material manufacturing will in this case boom, then North America will experience improvement over purchasing power, and this will fuel again container transports from Asia. So, positive feedback loops are in place and they are powerful for the next growth leap of railway freight sector.

How peer companies could consistently provide similar high returns in longer-term as what has been case in North American railway freight? This is tricky question to be answered and there does not exist' one remedy or answer. Companies should develop sustaining competitive advantage, what could be identified e.g. in Ryanair (very cheap flights, high volume, high productivity in own operations, and rapid business changes if losses start to appear) and Copenhagen airports (local hub in Northern Europe with good service portfolio and connectivity). In other companies of this study situation is still developing and evolving. For example, sea container transports will most probably have years of low freight rates and high over-capacity – similar to North American railway freight in 1980s. Only way out of this environment is high market share, competitive freight rates and continuous productivity improvement. Similar path could be seen to be appropriate for two remaining companies in peer group (Guangshen Railways and Fraport). However, it should not be forgotten that in North America railway freight companies have not been inactive in mergers and acquisitions. Maybe acquisition wave in North American railways was interesting in a way that it was not that much international, but concerned mostly USA, Canada and only in very small parts Mexico. This could be appropriate route for other deregulated actors in other transportation sectors to follow. This would not change the importance of global positioning of companies, but in daily operations targeting to be superior in some selected geographical area seems to assure sustaining business performance.

Interesting route for further research would be to develop simulation model of this research as more advanced. It seems that stock markets have common norm to create bubbles and bursts, and there exist times, when dividend investment back strategy should be on hold (and wait markets to normalize) or in most radical case, sell entire (or partially) position away (and again wait for normalization, and acquire full position back). This does not mean that activity should be high within a year period, but could mean that investor should complete needed actions once in a decade or so. This seems to provide opportunity for much higher yields over long-term. Within medium-term, and with smaller corrections, it might be wise to hold dividends and make reinvestments in less volatile markets. Also partial sales of held position(s) should be considered as standard deviation of daily yields increase; maybe triggered sales of owned shares should not be complete binary action, but gradual and based on nervousness levels of markets.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.eswa.2014.07.048.

References

Amos, P., & Thompson, L. (2007). Railways in development: Global round-up 1996–2005. World Bank transport note no. TRN-36. Washington, USA.

Andersen, B. (1992). Factors affecting European privatization and deregulation policies in local public transport; the evidence from Scandinavia. *Transportation Research A, 26*(2), 179–191.

Andersson, Å. E., & Strömquist, U. (1998). K-Samhällets Framtid (in Swedish, free translation: The future of the K-society). Prisma: Värnamo, Sweden.

Backman, J. (1981). The problem of regulation. In J. Backman (Ed.), *Regulation and deregulation*. Indianapolis: Bobbs-Merrill.

Baik, Y.-S., Kwak, B., & Lee, J. (2011). Deregulation and earnings management: The case of the U.S. airline industry. *Journal of Accounting and Public Policy, 30*, 589–606.

Banister, D. (1990). Privatization in transport: from the company state to the contract state. In J. Simmie & R. King (Eds.), *The state in action*. London: Pinter.

Bereskin, C. G. (1996). Econometric estimation of the effect of deregulation on railway productivity growth. *Transportation Journal, 35*(4), 34–43.

BH (2008). Buffett makes another bullish bet. Available at URL: <http://finance.yahoo.com/news/Buffett-Makes-Another-Bullish-indie-13843050.html>. Retrieved: Jan. 2009.

Bitzan, J. D., & Keeler, T. E. (2003). Productivity growth and some of its determinants in the deregulated U.S. railroad industry. *Southern Economic Journal, 70*(2), 232–253.

Boardman, A. E., Laurin, C., Moore, M. A., & Vining, A. R. (2012). Efficiency, profitability and welfare gains from the Canadian National Railway privatization. *Research in Transportation Business & Management, 6*, 19–30.

Canadian Pacific (2013). Subsidiaries – Dakota, Minnesota & Eastern Railroad. Available at URL: <http://www.cpr.ca/en/in-your-community/living-near-the-railway/Pages/subsidiaries.aspx>. Retrieved: March 2013.

Cantos, P., Pastor, J. M., & Serrano, L. (1999). Productivity, efficiency and technical change in the European railways: A non-parametric approach. *Transportation, 26*(4), 337–357.

Chapin, A., & Schmidt, S. (1999). Do mergers improve efficiency? *Journal of Transport Economics and Policy, 33*(2), 147–162.

Cowie, J. (1999). The technical efficiency of public and private ownership in the rail industry. *Journal of Transport Economics and Policy, 33*(3), 241–251.

Cramer, B. E. (2007). North American freight rail: Regulatory evolution, strategic rejuvenation, and the revival of an ailing industry. Part of Doctoral dissertation, University of Iowa, US.

Cui, Q., Kuang, H., Wu, C., & Li, Y. (2013). Dynamic formation mechanism of airport competitiveness: The case of China. *Transportation Research Part A, 47*, 10–18.

Deveau, S. (2012). Bill Gates ups CN rail stake to 12%. Financial post, 12. Dec. Available at URL: <http://business.financialpost.com/2012/12/12/bill-gates-ups-cn-rail-stake-to-12/>. Retrieved: Jan. 2014.

De Jorge, J., & Suarez, C. (2003). Has the efficiency of European railway companies been improved? *European Business Review, 15*(4), 213–220.

De Jorge-Moreno, J., & Garcia-Cebrian, L. I. (1999). Measuring of production efficiency in the European railways. *European Business Review, 99*(5), 332–344.

Eakin, B. K., Bozzo, A. T., Meitzen, M. E., & Schoech, P. E. (2010). Railroad performance under the staggers act. *Regulation, 2010–2011*, 32–38. Winter.

ERADIS (2013). European Railway Agency Database of Interoperability and Safety, License Database. Available at <https://pdb.era.europa.eu/safety_docs/licences/default.aspx>. Retrieved: Feb. 2013.

George, S. A., & Rangaraj, N. (2008). A performance benchmarking of Indian Railway zones. *Benchmarking: An International Journal, 15*(5), 599–617.

Goetz, A. R. (2002). Deregulation competition, and antitrust implications in the US airline industry. *Journal of Transport Geography, 10*, 1–19.

Goetz, A. R., & Vowles, T. M. (2009). The good, the bad and the ugly: 30 years of US airline deregulation. *Journal of Transport Geography, 17*, 251–263.

Gomez-Ibanez, J. A. (2004). Railroad reform: An overview of the options. In Conference proceedings of the railway reform. Madrid, Spain.
Gomez-Ibanez, J., & de Rus, G. (2006). *Competition in the railway industry – An international comparative analysis*. UK: Edward Elgar.
Google Finance (2013). Canadian National Railway (USA) historical prices. Available at URL: <http://www.google.com/finance/historical?q=NYSE%3ACNI&ei=d2JQUfCVMumFwAO_Sw#>. Retrieved: Nov. 2013.
Gong, G. (2006). Airfare, competition and spatial structure: New evidence in the U.S. airline deregulation. Doctoral dissertation, Boston University, US.
GSRC (2013). Guangshen railway company – Webpages of "development and history". Available at URL: <http://www.gsrc.com/en/article.php?article_id=102>. Retrieved: Nov. 2013.
Gu, W., & Lafrance, A. (2010). Productivity growth in Canadian and U.S. Regulated industries. *International Productivity Monitor, 19*, 50–65.
Hilmola, O.-P. (2007). European railway freight transportation and adaptation to demand decline – Efficiency and partial productivity analysis from period of 1980–2003. *International Journal of Productivity and Performance Management, 56*(3), 205–225.
Hilmola, O.-P. (2009a). Benchmarking global railway freight transportation efficiency during the period of 1980–2004. *International Journal of Shipping and Transport Logistics, 1*(4), 311–328.
Hilmola, O.-P. (2009b). Global railway passenger transports – Efficiency analysis from period of 1980–2004. *International Journal of Logistics Economics and Globalisation, 2*(1), 23–39.
Hilmola, O.-P., Ujvari, S., & Szekely, B. (2007). Deregulation of railroads and future development scenarios in Europe – Analysis of the privatization process taken place in US, UK and Sweden. *World Review of Intermodal Transportation Research, 1*(2), 146–169.
Holvad, T., & Godward, E. (2012). Technical regulation and its economic implications, European Railway Agency. Valenciennes, France.
Homsombat, W., Zheng, L., & Fu, X. (2014). Competitive effects of the airlines-within-airlines strategy – Pricing and route entry patterns. *Transportation Research Part E, 63*, 1–16.
Huneke, W., Brennan, W. J., Boyles, M. J., & Smith, M. E. (2009). *Study of railroad rates: 1985–2007*. Washington, United States: Surface Transportation Board.
Jahanshahi, M. F. (1998). The US railroad industry and open access. *Transport Policy, 5*, 73–81.
Jansson, E. (2010). Deregulation and the stakeholder model. *Corporate Governance, 10*(2), 129–139.
Jensen, A., & Stelling, P. (2007). Economic impacts of Swedish railway deregulation: A longitudinal study. *Transportation Research Part E, 43*(5), 516–534.
Johnson, J. C., McClure, D. J., Schneider, K. C., & Wood, D. F. (2004). Short-line railroad managers discuss their industry. *Transportation, 31*(1), 97–123.
Joskow, P., & Rose, N. (1989). The effects of economic regulation. In R. Schmalensee & R. D. Willig (Eds.). *Handbook of industrial organization* (Vol. II). Amsterdam: North Holland Publishing.
Jitsuzumi, T., & Nakamura, A. (2010). Causes of inefficiency in Japanese railways: Application of DEA for managers and policymakers. *Socio-Economic Planning Studies, 44*(3), 161–173.
Kay, J., & Vickers, J. (1988). Regulatory reform in Britain. *Economic Policy, 7*, 285–351.
Lahiri, K., & Yao, V. W. (2006). Economic indicators for the US transportation sector. *Transportation Research Part A, 40*(10), 872–887.
Lehn, K. (2002). Corporate governance in the deregulated telecommunications industry: Lessons from the airline industry. *Telecommunications Policy, 26*, 225–242.
Lei, T., & Yuanyuan, D. (2014). Simulation study of coal mine safety investment based on system dynamics. *International Journal of Mining Science and Technology, 24*(2), 201–205.
Mahon, J. F., & Murray, E. A. Jr., (1981). Strategic planning for regulated companies: Summary. *Strategic Management Journal, 2*(3), 251–262.
McIntosh, C. (2013). The fuel use and air emission consequences of shipping great lakes coal through the soo locks. *Transportation Research Part D, 18*(January), 117–121.
Miljkovic, D. (2001). Transporting export-bound grain by rail: rail rates in the post-staggers rail act period. *Transportation, 28*(3), 297–314.
Mu, S., & Dessouky, M. (2011). Scheduling freight trains traveling on complex networks. *Transportation Research Part B, 45*(7), 1103–1123.
Niskanen, W. A. (1989). Economic deregulation in the United States: Lessons for America, lessons for China. *Cato Journal, 8*(3), 657–668.
Oum, T. H., & Yu, C. (1994). Economic efficiency of railways and implications for public policy. *Journal of Transportation Economics and Policy, 28*(2), 121–138.
Patterson, S., & Blackmon, D. A. (2009). Buffett bets big on railroad. *The Wall Street Journal*, 4th Nov. 2009. Available at URL: <http://online.wsj.com/article/SB10001424052748703740004574513191915147218.html>.
Pearce, B. (2012). The state of air transport markets and the airline industry after the great recession. *Journal of Air Transport Management, 21*, 3–9.
Peltzman, S., Levine, M. E., & Noll, R. G. (1989). The economic theory of regulation after a decade of deregulation. *Microeconomics, 1989*, 1–59.
Pettus, M. L. (2009). Growth within the deregulated U.S. Railroad industry. *ACR, 17*(1&2), 8–21.
Pitt, M. (2001). Strategic direction in the airport business: Enabling or disabling? *Facilities, 19*(3–4), 150–156.
PR Newswire (2013). CN completes intra-corporate merger of Elgin, Joliet and Eastern into Wisconsin central subsidiary. Available at URL: <http://finance.yahoo.com/news/cn-completes-intra-corporate-merger-150000306.html>. Retrieved: March 2013.
Quinet, E., & Vickerman, R. W. (2004). *Principles of transportation economics*. London: Edward Elgar Publishing.
Reid, R., & Jennings, A. (2003). *North American freight railroads: Time for the next big move?* MERCER Management Consulting.
Rose, N. L. (1985). The incidence of regulatory rents in the motor carrier industry. *RAND Journal of Economics, 16*(3), 299–318.
Rose, N. L. (1987). Labor rent sharing and regulation: Evidence from the trucking industry. *Journal of Political Economy, 95*(6), 1146–1178.
Shi, F. X., Lim, S. H., & Chi, J. (2011). Railroad productivity analysis: Case of the American class I railroads. *International Journal of Productivity and Performance Management, 60*(4), 372–386.
Siegel, J. (2005). *The Future for Investors: Why the tried and the true triumph over the bold and the new*. USA: Crown Business.
Smith, K. G., & Grimm, C. M. (1987). Environmental variation, strategic change and firm performance. A study of railroad deregulation. *Strategic Management Journal, 8*(4), 363–376.
Spychalski, J. C., & Swan, P. F. (2004). US rail freight performance under downsized regulation. *Utilities Policy, 12*(3), 165–179.
Starkie, D. (2012). European airports and airlines: Evolving relationships and the regulatory implications. *Journal of Air Transport Management, 21*, 40–49.
Thomson One Banker (2013). Investor database service available through Thomson Reuters. Available at URL: <https://www.thomsonone.com/>. Retrieved: March 2013.
United Nations (2012). Review of maritime transport 2012. In United nations conference on trade and development. New York and Geneva.
Viana, J., Brailsford, S. C., Harindra, V., & Harper, P. R. (2014). Combining discrete-event simulation and system dynamics in a healthcare setting: A composite model for Chlamydia infection. *European Journal of Operational Research, 237*(1), 196–206.
Vogel, H. L. (2010). *Financial market bubbles and crashes*. UK: Cambridge University Press.
Vogt, A. (2008). Freight competition generates business in Germany. *International Railway Journal, 48*(12), 40.
Wilson, W. W. (1997). Cost savings and productivity in the railroad industry. *Journal of Regulatory Economics, 11*, 21–40.
Winston, C. (1993). Economic deregulation: Days of reckoning for microeconomists. *Journal of Economic Literature, 31*(3), 1263–1289.
Winston, C. (1998). U.S. industry adjustment to economic deregulation. *Journal of Economic Perspectives, 12*(3), 89–110.
Winston, C., Corsi, T., Grimm, C., & Evans, C. (1990). *The economic effects of surface freight deregulation*. Washington, DC: The Brookings Institution.
Yahoo Finance (2013). *Canadian National Railway, Historical Prices and Dividends*. Available at URL: <http://finance.yahoo.com/q/hp?s=CNI±Historical±Prices>. Retrieved: Nov. 2013.
Ying, J., & Keeler, T. (1991). Pricing in a deregulated environment: The motor carrier experience. *RAND Journal of Economics, 22*(2), 264–273.
Yu, M.-M. (2008). Assessing the technical efficiency, service effectiveness, and technical effectiveness of the world's railways through NDEA analysis. *Transportation Research Part A, 42*(10), 1283–1294.
Yu, M-M., & Lin, E. T. J. (2008). Efficiency and effectiveness in railway performance using a multi-activity network DEA model. *Omega – International Journal of Management Science, 36:6*, 1005–1017.