

LEGO – The Toy of Smart Investors

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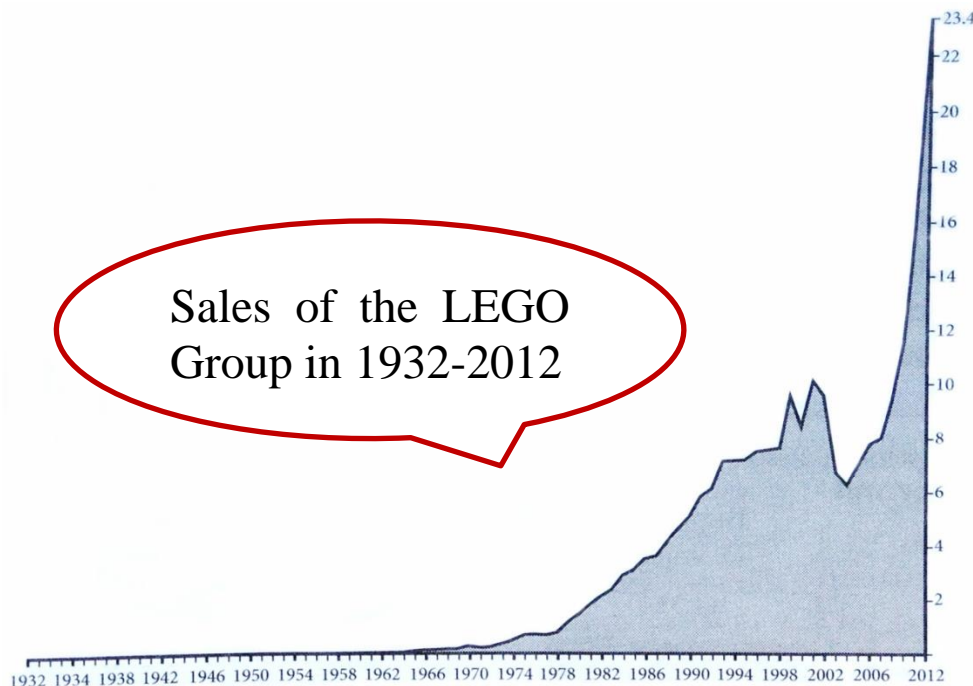
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Why LEGO?

LEGO Group -

- a Danish company established in 1932 as a small wooden toy producer;
- the largest toy producer in the world nowadays.



LEGO – “the toy of the century”
(Fortune, 2000)

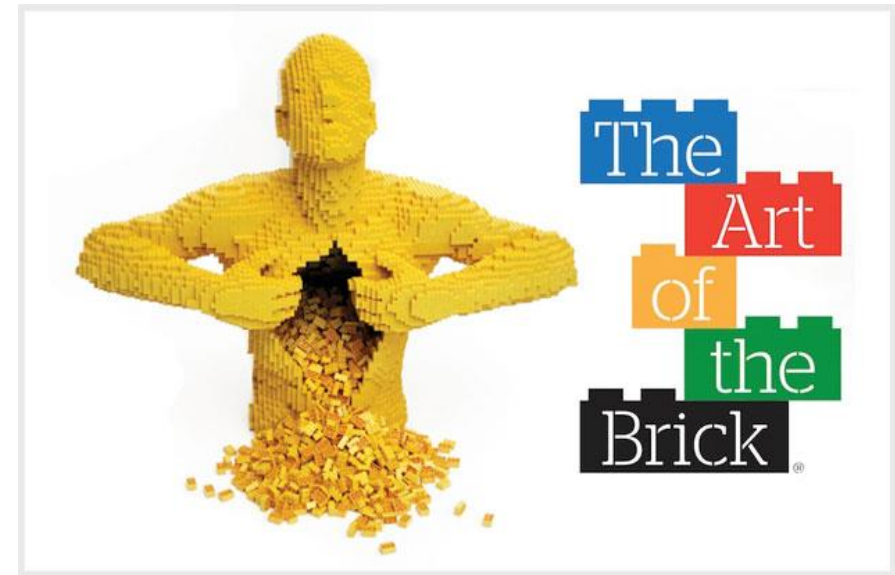
- “the most popular toy of all times”
(Robertson and Breen, 2013)

- 2.2 mln bricks are produced every hour in Billund.

Why LEGO?

LEGO is not only a kids' toy!

- Popular among adult collectors;
- Used by artists (e.g. Nathan Sawaya);
- Used by businessmen (thematic museums, cafes, LEGOLands);
- Serves as an alternative investment:
 - A huge secondary market (e.g. EBay) with tens of thousands of sets traded every day (Maciorovsky, 2015)
 - Average return was 12% pa in 2000-2015 and returns on particular sets reach outrageous numbers (up to 600% pa) (Telegraph, 2015)
 - An asset with diminishing over time supply.



This paper

- We study LEGO as an alternative investment.
- Sample period 1987-2015.
- The average return is 11% (8% in real terms) => LEGO outperforms large stocks, bonds, gold and other ‘hobby investments’.
- The LEGO returns are not exposed to market, value, momentum and volatility risk factors.
- An almost unit exposure to the FF SMB factor.
- A positive alpha of 4-5%, the Sharpe ratio of 0.4, positive skewness.
- Small and huge sets are more profitable than medium-sized sets.
- Seasonal, architectural and movie-based themes deliver higher returns.
- Returns are higher in recent years (deeper secondary market and more LEGO trading platforms).

Alternative investments

- An average HNW individual holds ~10% of wealth in collectible assets (artworks, antiques, jewelry, fine wines, rare automobiles, etc.) to diversify their portfolios (Barclays, 2012).
- Funds which deal with collectible assets improve the accessibility of them to retail investors (e.g. IQ Physical Diamond Trust).
- Types of alternative investments:
 - Art (Baumol, 1986; Goetzmann, 1993; mei and Moses, 2002; Renneboog and Spaenjers, 2013);
 - Precious metals and stones (Renneboog and Spaenjers, 2012, Auer and Schuhmacher, 2013; Low et al., 2016);
 - Collectible automobiles (Martin, 2016);
 - Stamps (Dimson and Spaenjers, 2011, 2014);
 - Violins (Graddy and Margolis, 2011);
 - Fine wines (Dimson et al., 2015);
 - Baedeker guidebooks (Erdos and Ormos, 2012).

Data

- 2,322 LEGO sets in 44 themes released in 1981-2015.
- Primary market prices in the year of release and secondary market (EBay) prices in 2015 in USD.
- Source: “The Ultimate Guide to Collectible LEGO Sets” by Maciorovski and Maciorovski (2015).

Descriptive statistics: returns

	Number of sets	Average return (% pa)
Total	2,322	
Min		-53.61
Average		18.50
Max		613.28
SD		35.09
Skewness		9.10

Descriptive statistics: returns by theme

Theme	Number of sets	Average return (% pa)	Cross-sectional SD (%)	Period
Ideas	8	64.11	83.20	2010-2014
Seasonal	61	58.07	95.00	2006-2014
Super Heroes	46	51.14	78.91	2011-2014
Minecraft	9	45.50	36.19	2013-2014
Friends	82	38.17	65.71	2012-2014
Monster fighters	13	36.01	33.16	2012-2012
Dino	7	34.76	12.38	2012-2012
Hero factory	83	29.76	21.60	2010-2014
Batman	33	27.62	21.92	2006-2014
Legends of Chima	75	24.82	30.59	2013-2014
Miscellaneous	28	24.72	27.71	2010-2014
Pirates of Caribbean	14	20.54	16.83	2011-2011
Indiana Jones	16	19.83	7.18	2008-2009
Creator	123	19.74	27.64	2001-2014
Ninjago	91	19.49	20.20	2011-2014
Disney princess	7	17.99	20.97	2014-2014
Power miners	16	17.84	6.98	2009-2010
Star Wars	341	17.29	46.68	1999-2014
Advanced models	34	16.99	12.71	2000-2014
City	238	16.63	23.95	2005-2014
Harry Potter	52	16.33	8.10	2001-2011

Lone Ranger	8	16.23	27.57	2013-2013
The Lego movie	23	16.08	25.77	2014-2014
Architecture	25	15.89	48.26	2008-2014
Spongebob Squarepants	14	15.43	6.37	2006-2012
Agents	19	15.22	9.93	2008-2014
Cars	22	14.64	12.39	2011-2012
Discovery	6	14.41	6.72	2003-2003
Lord of the Rings	32	12.71	23.08	2012-2014
Technic	124	12.05	11.87	1994-2014
Trains	28	11.67	6.76	2001-2013
Bionicle	243	10.90	6.10	2001-2010
Spider-man	8	10.31	8.65	2003-2004
Castle	189	9.19	8.52	1981-2014
Pirates	62	8.74	4.63	1989-2013
Model team	1	8.51	n/a	1996-1996
Racers	11	8.50	12.87	2002-2010
Toy story	15	6.52	9.90	2010-2010
Atlantis	21	6.08	7.66	2010-2011
Space	62	6.04	11.67	2001-2013
Teenage mutant ninja turtle	18	4.64	17.40	2013-2014
Factory	7	2.69	8.23	2005-2008
Prince of Persia	6	0.90	7.74	2010-2010
The Simpsons	1	-3.52	n/a	2014-2014

Descriptive statistics: returns by size

Group	Average set size (# of pieces)	Range of set sizes	Number of sets	Average return (% pa)	Cross-sectional SD (%)
1 - Big	1,928	1,204-5,922	96	12.07	12.15
2	862	660-1,197	215	6.88	13.26
3	466	340-659	383	10.08	18.66
4 - Small	113	1-339	1628	22.44	39.93

LEGO price indices

- Simple chain index

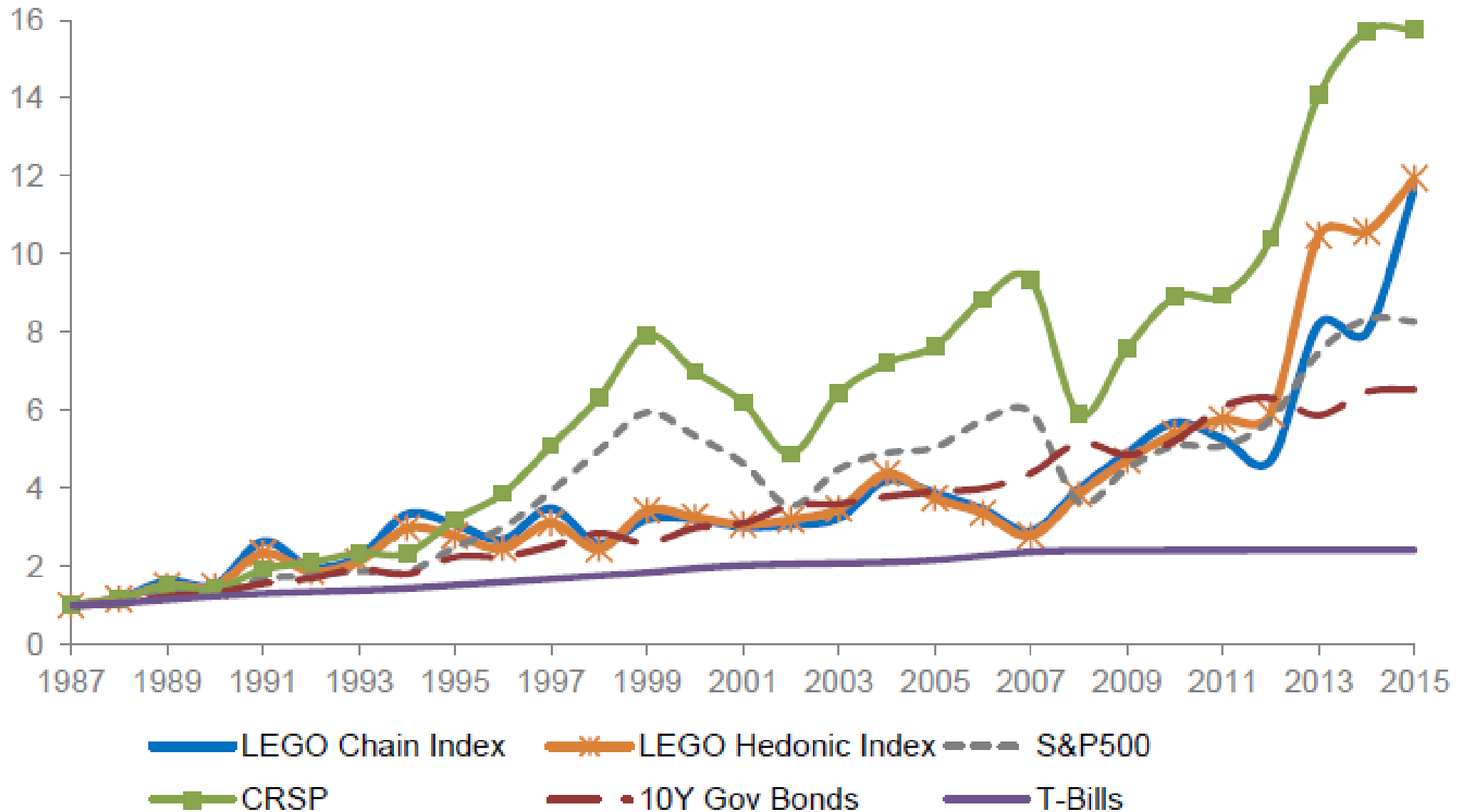
$$(1 + R_t)^{2015-t} = \prod_{i=1}^{2015-t} (1 + r_{t+i}) \quad (1)$$

- Hedonic index

$$\ln \frac{P_{iT} - P_{it}}{P_{it}} = \alpha + \sum_{m=1}^M \beta_m X_{im} + \sum_{t=1}^T \gamma_t \tau_t + \eta_{it} \quad (2)$$

where X_{im} are hedonic characteristics: 43 dummies for themes; 3 dummies for set size (size group 1 – the biggest sets – serves as the benchmark), τ_t are 29 dummies for release years from 1986 to 2014, and η_{it} is an error term.

Dynamics of LEGO price indices



Statistics of LEGO price indices

	Chain index returns	Hedonic index returns	CRSP returns
Average return	0.11	0.10	0.12
Standard deviation	0.28	0.25	0.18
Skewness	0.69	0.75	-0.73
Corr. with S&P500	0.13	0.16	0.99
Corr. with CRSP	0.20	0.24	1.00
Corr. with bonds	-0.13	-0.16	-0.15
Corr. of LEGO indices		0.95	

Hedonic characteristics

	(1)	(2)	(3)	(4)
Size group 2	-0.2438***			
Size group 3	-0.2214***			
Size group 4	0.0536			
Number of pieces		-0.0002***	-0.0005***	-0.0003***
Number of pieces ²			1.33e-07***	9.98e-08***
Number of minifigures				-0.0397***
Advanced models	0.3434***	0.5729***	0.5451***	0.4591***
Agents	-0.0480	-0.1395	-0.0469	0.0163
Architecture	-0.0817	-0.1337	-0.0526	-0.1338
Atlantis	-0.3709***	-0.4067***	-0.3644***	-0.3300**
Batman	0.4484***	0.4101***	0.4741***	0.5098***
Bionicle	-0.0981	-0.1045	-0.0926	-0.0884
Cars	-0.0692	-0.1042	-0.0575	-0.1078
Castle	-0.1130	-0.1385	-0.0972	0.0087
City	0.0090	-0.0386	0.0110	0.0624
Creator	-0.0059	-0.0457	0.0117	-0.0393
Dino	0.4316**	0.3944*	0.4596**	0.4790**
Discovery	0.6124***	0.5117**	0.6241***	0.5718***
Disney princess	-0.0936	-0.1044	-0.0656	-0.0696
Factory	-0.6098***	-0.6234***	-0.4765**	-0.5447***
Friends	0.1585	0.1307	0.1548	0.1585
Harry Potter	0.4008***	0.3783***	0.4366***	0.5439***
Hero factory	0.2018**	0.1996*	0.1982*	0.1749*
Ideas	0.4905***	0.3718*	0.4488**	0.4334**
India Jones	0.3452**	0.2699*	0.3557**	0.4714***
Legends of Chima	0.0210	-0.0162	0.0133	0.0347

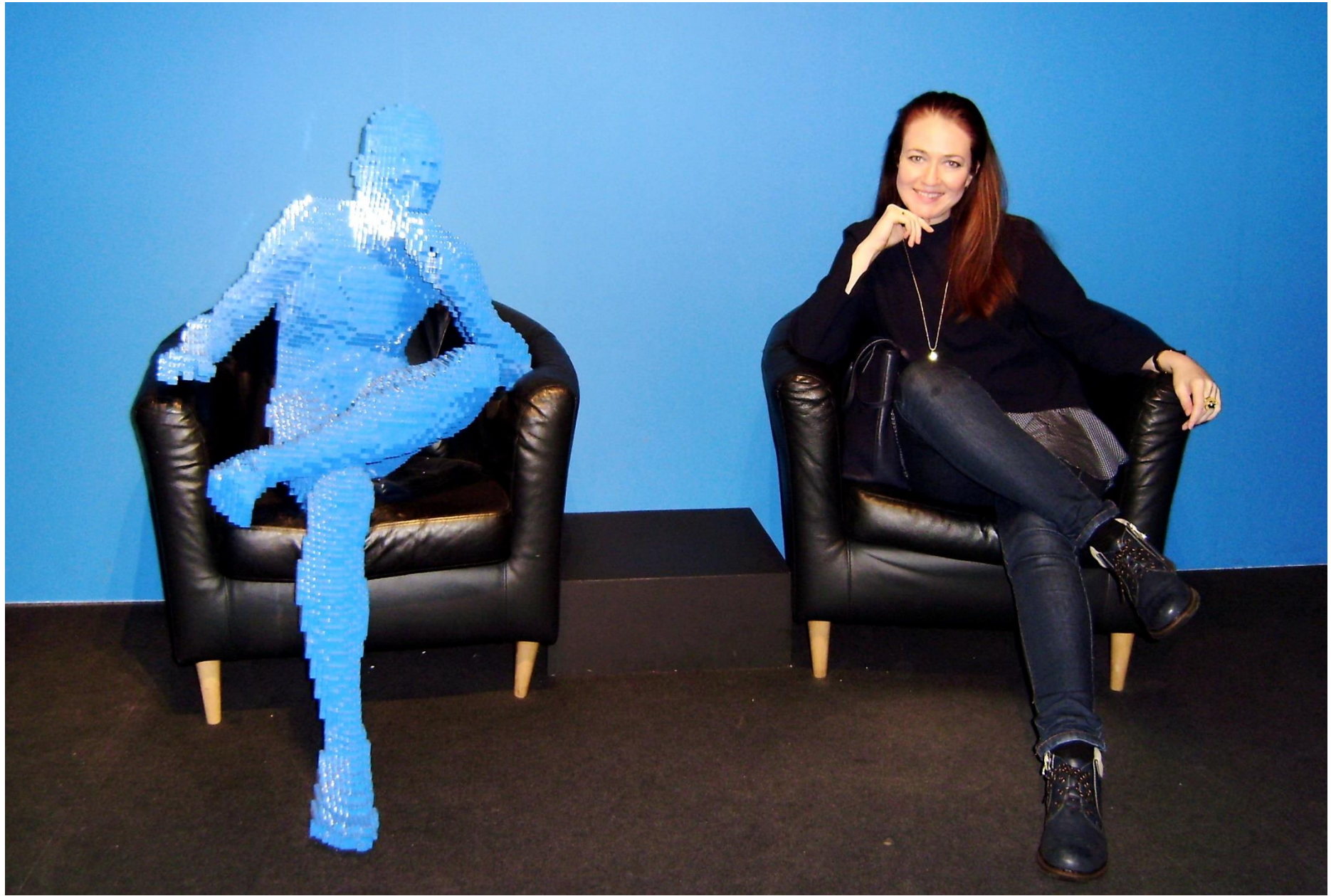
Lone Ranger	0.1025	0.0305	0.0855	0.1754
Lord of the Rings	-0.0746	-0.1219	-0.0533	0.0433
Minecraft	0.3219*	0.1757	0.2730	0.2040
Model team	0.1056	0.3530	0.5332	0.3574
Monster fighters	0.4023**	0.3731**	0.4292***	0.4783***
Ninjago	0.0343	-0.0011	0.0288	0.0692
Pirates	-0.0482	-0.0813	-0.0316	0.0938
Pirates of Caribbean	0.1845	0.1200	0.1727	0.2569*
Power miners	0.1891	0.1645	0.2153	0.2725*
Prince of Persia	-0.6044***	-0.6383***	-0.5821***	-0.4850**
Racers	-0.3956**	-0.3419*	-0.2308	-0.3152*
Seasonal	0.3750***	0.3706***	0.3833***	0.3864***
Space	-0.3169***	-0.3749***	-0.3140***	-0.2575**
Spider-man	0.1293	0.1115	0.1683	0.3179
Spongebob Squarepants	0.0772	0.0334	0.1008	0.1543
Star Wars	0.0454	0.0211	0.0727	0.1289
Super Heroes	0.4408***	0.4034***	0.4252***	0.5052***
Technic	-0.1055	-0.1259	-0.0301	-0.1163
Teenage mutant ninja turtle	-0.0738	-0.1691	-0.1033	-0.0268
The Lego movie	0.0349	-0.0681	0.0072	0.0568
The Simpsons	-0.2677	0.1183	0.0972	0.0830
Toy story	-0.3516**	-0.3887**	-0.3472**	-0.2756*
Trains	0.1911	0.1634	0.2316*	0.2602**
Constant	2.3694***	2.4124***	2.4357***	2.4980***
R-squared	0.4695	0.4472	0.4698	0.4828
Observations	2,303	2,303	2,303	2,302
29 Time dummies	yes	yes	yes	yes

Exposure of LEGO returns to risk factors

	Chain index			Hedonic index		
alpha	0.0424	0.0426	0.0487	0.0358	0.0394	0.0471
	[0.8213]	[0.6879]	[0.7335]	[0.7479]	[0.7330]	[0.8841]
Rm	0.3581	0.2441	0.2149	0.3835	0.2577	0.2212
	[1.0069]	[0.6886]	[0.5234]	[1.0977]	[0.7364]	[0.5723]
SMB		1.1000	1.0749		1.0967	1.0654
		[2.6623]	[2.1889]		[3.2954]	[2.6490]
HML		-0.4667	-0.4859		-0.4894	-0.5133
		[-1.2741]	[-1.2320]		[-2.0049]	[-1.8234]
MOM		0.1934	0.1808		0.1671	0.1513
		[0.9216]	[0.8338]		[1.0401]	[0.9524]
VIX			-0.0321			-0.0400
			[-0.1327]			[-0.1808]
R ²	0.0510	0.2555	0.2560	0.0724	0.3280	0.3289

Conclusion

- A novel analysis of financial returns in the LEGO market.
- LEGO is a reasonable alternative investment with average returns comparable to stock returns, low market and crash risks and a positive alpha.
- Returns on LEGO are higher than returns on most other alternative investments.
- Moreover, discounted purchases of LEGO sets on the primary market make LEGO investments even more profitable.
- Different LEGO sets are not equally attractive (small and very large sets yield higher returns, some themes are more attractive than others).
- However, similarly to other alternative investments, LEGO market is not as liquid as the stock market and requires relatively high transaction and storage costs.



Thank you for the attention!