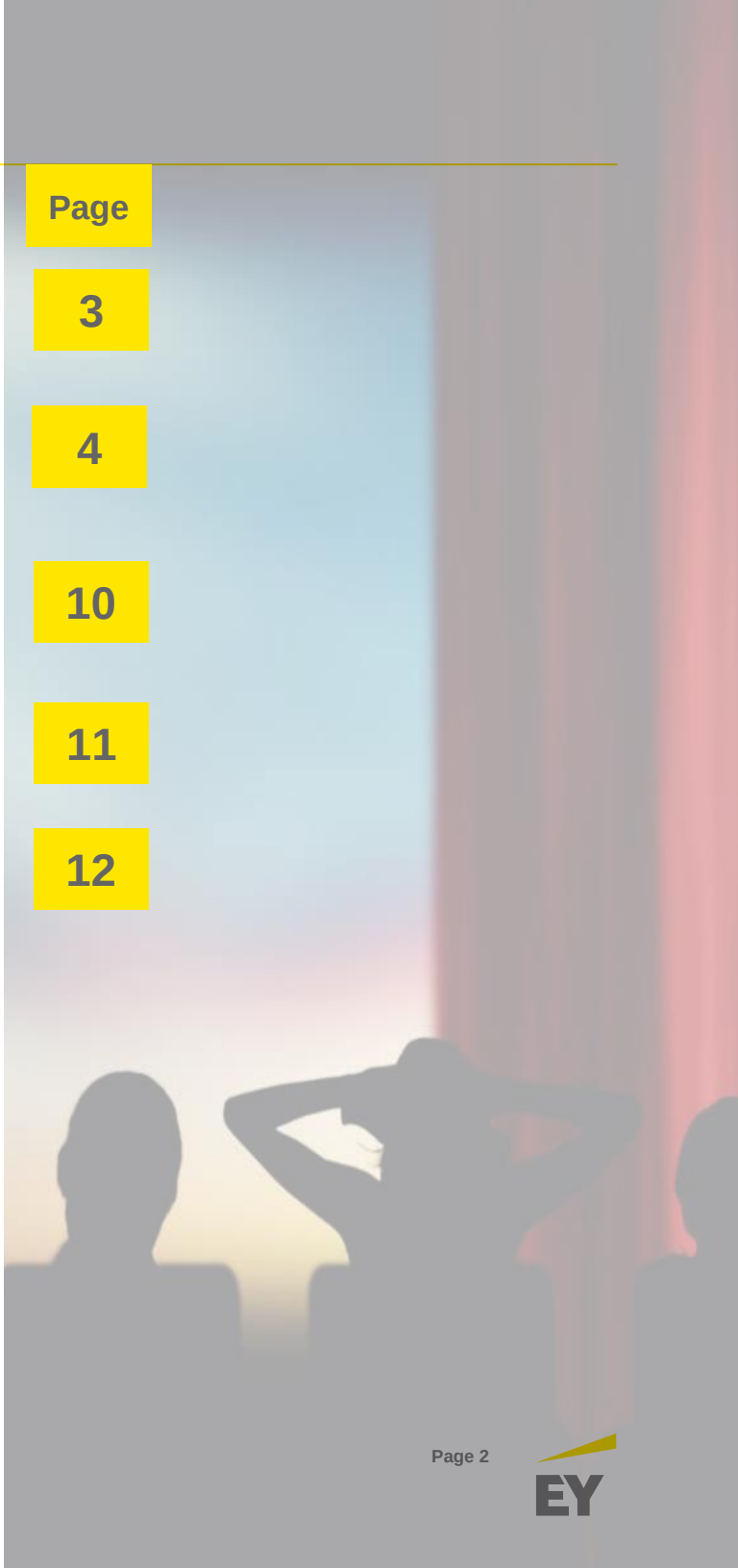
The statistical relationship between home release window length and movie sales

April 2020

Building a better working world

Table of Contents



Executive summary

EY was engaged by NATO (National Association of Theatre Owners) to perform a statistical analysis of the relationship between the length of the home release window and home sales, box office sales, and total sales. The home release window is defined as the total number of days between the theatrical release date and the home release date.

The statistical analysis incorporates data from publicly available sources including Box Office Mojo (domestic box office weekly sales) and Rotten Tomatoes (audience score) in addition to data provided by The Numbers (total home sales) and data on film characteristics (e.g. theatrical release date, home release date, and total box office sales) provided by NATO for the period between 2012 and 2017.

As the purpose of this analysis was to determine if a shortened theatrical release window has an any association with home, theatrical, and overall revenue, it proposes no hypothesis as to why there is one.

Key findings of the study are provided below:

- After accounting for other variables (box office sales, length of theatrical run, audience ratings, time of year, etc.), the statistical model shows that a longer home release window relative to the length of the theatrical run is positively correlated with total film sales, total box office sales, and total home sales
- Without controlling for the influence of any other variables, the length of theatrical run is more highly correlated to home sales than to box office sales
- On average, movies have decreasing release window lengths and home sales between 2012 and 2017

A longer home release window relative to theatrical run is correlated with higher home sales

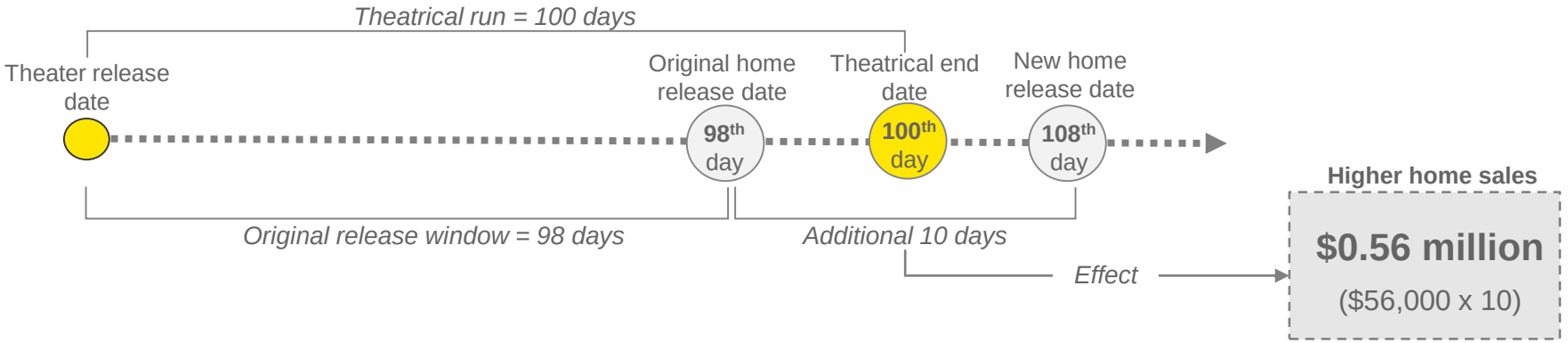
- A one percentage point higher ratio of the lengths of the home release window to the theatrical run is associated with $56,000 higher home sales.

Ratio of release window to theatrical run

Total home sales

- Considering an average movie earns about $54 million from home sales, $56,000 represents 0.10% higher total home sales.

- **Example:** Consider a movie which has a theatrical run of 100 days and is released on DVD/digital after 98 days. An identical film with a theatrical run of 100 days but a home release window of 108 days (instead of 98) would be expected to have $0.56 million (= $56,000 x 10) higher home sales.



Note: This result is statistically significant at 90% confidence level.

A longer home release window relative to theatrical run is correlated with higher box office sales

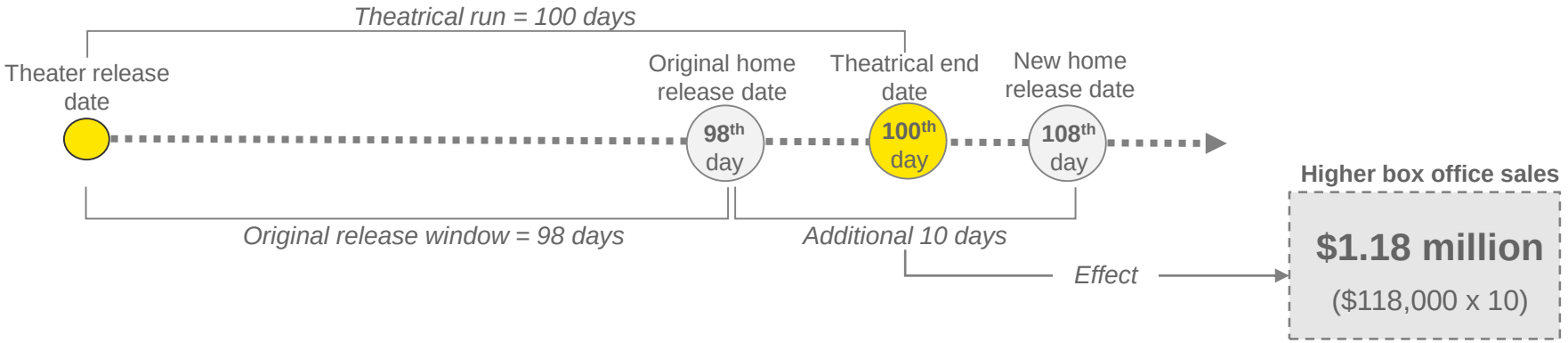
- A one percentage point higher ratio of the lengths of the home release window to the theatrical run is associated with $118,000 higher box office sales.

Ratio of release window to theatrical run

Total box office sales

- Considering an average movie earns about $103 million from box office sales, $118,000 represents 0.11% higher total box office sales.

- **Example:** Consider a movie which has a theatrical run of 100 days and is released on DVD/digital after 98 days. An identical film with a theatrical run of 100 days but a home release window of 108 days (instead of 98) would be expected to have $1.18 million (= $118,000 x 10) higher box office sales.



Note: This result is statistically significant at 99% confidence level.

A longer home release window relative to theatrical run is correlated with higher total sales

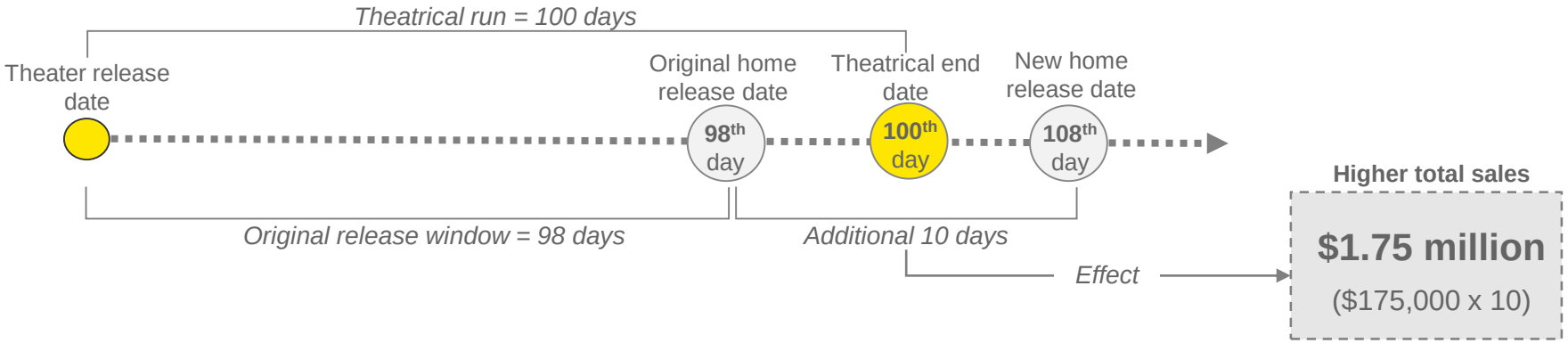
- A one percentage point higher ratio of the lengths of the home release window to theatrical run is associated with $175,000 higher total sales.

Ratio of release window to theatrical run

Total sales (Home sales + box office sales)

- Considering an average movie earns about $157 million in total sales, $175,000 represents 0.11% higher total sales.

- **Example:** Consider a movie which has a theatrical run of 100 days and is released on DVD/digital after 98 days. An identical film with a theatrical run of 100 days but a home release window of 108 days (instead of 98) would be expected to have $1.75 million (= $175,000 x 10) higher total sales.



Note: This result is statistically significant at 99% confidence level.

A longer home release window relative to theatrical run is correlated with a higher positive difference in box office sales than home sales

- A one percentage point higher ratio of the lengths of the home release window to the theatrical run is associated with $175,000 higher total sales. 67% of the total effect ($118,000) comes from box office sales, and the remaining comes from home sales.

Note: The home sales result is statistically significant at 90% confidence level. The box office sales and total sales results are statistically significant at 99% confidence level.

While both box office sales and home sales are highly correlated with theatrical run, the correlation coefficient is higher for home sales

- EY also conducted a correlation analysis to test the direction of the relationship between total sales (home sales and box office sales) and the theatrical run and home release window length. The correlation coefficients show whether the two variables of interest in the dataset increase or decrease together or opposite from one another. These results are reflective of correlation, but not causation, meaning that this analysis does not test if the change in one variable is the cause of the change in another variable.
  - Total sales, box office sales, and home sales are all highly correlated with the length of theatrical run. Considering a scenario where two films are identical in all ways other than the length of the theatrical run, the film with the longer theatrical run would be expected to have higher total sales, box office sales and total home sales as compared with the film with the shorter theatrical run.
  - The correlation coefficient between home sales and length of theatrical run is higher than the coefficient between box office sales and length of theatrical run. Considering a scenario where two films are identical in all ways other than the length of theatrical run, the film with the longer theatrical run would be expected to have higher total sales, box office sales and total home sales than the film with the shorter theatrical run.

Table showing correlation coefficients

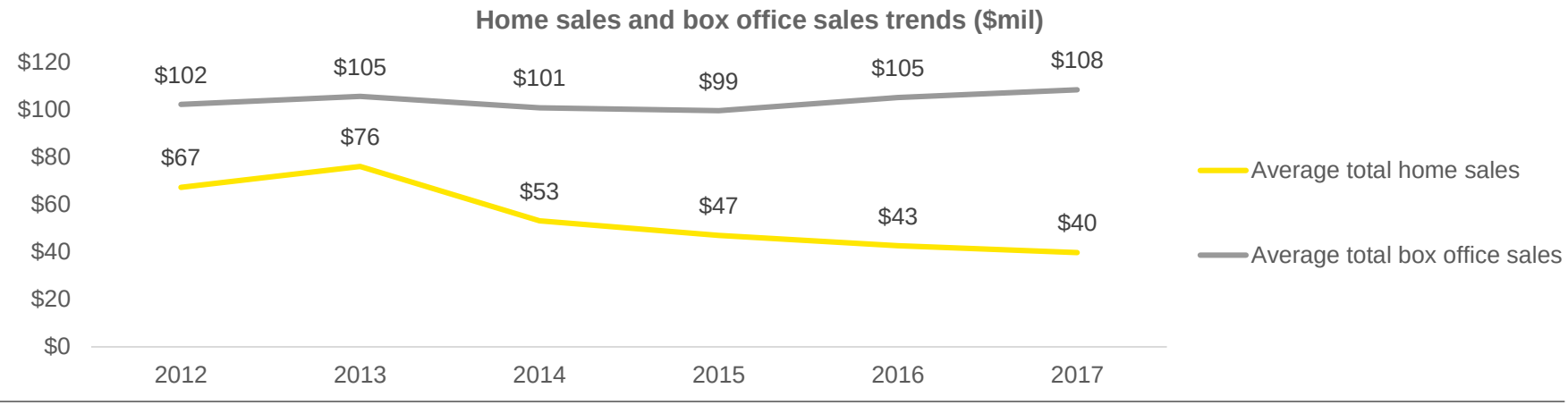
	Total sales	Total box office sales	Total home sales	Length of theatrical run	Release window
Total sales	1.00				
Total box office sales	0.98	1.00			
Total home sales	0.89	0.77	1.00		
Length of theatrical run	0.63	0.59	0.62	1.00	
Home release window	0.21	0.20	0.21	0.18	1.00

On average, movies have decreasing home release window lengths and decreasing home sales between 2012 and 2017

- On average, movies tend to be released to the home around the same time that they leave the theaters (2012-2017). However, if we look at the year-over-year trend, movies are, on average, released to home and removed from theaters more quickly. In 2012, the average theatrical run was 102 days and the home release window was 112 days. In 2017, the average theatrical run was 94 days and the home release window was 85 days.
- During this period, box office sales remained relatively static, but home sales rapidly declined. Home sales represent transactional home sales which includes home sales and rentals in any form, including video on demand sales, DVD sales, Blu-Ray sales and physical disc rentals. It does not include any sales related to streaming services or related sales. While video on demand has been increasing during this time, DVD spending, Blu-Ray, and physical disc rental have rapidly declined.

Release window, total sales, home sales, and box office sales trends from 2012- 2017

Year	Average Theatrical Run	Average Release Window	Average Total Sales	Average Home Sales	Home-Total Ratio	Average Box Office Sales	Average Box-Total Ratio
2012	102	112	169,000,000	67,143,989	40%	102,100,000	60%
2013	103	109	181,000,000	75,954,732	42%	105,400,000	58%
2014	101	99	154,000,000	53,037,809	34%	100,600,000	65%
2015	94	95	146,000,000	46,943,041	32%	99,392,037	68%
2016	94	90	146,000,000	42,563,798	29%	105,000,000	72%
2017	94	85	148,000,000	39,636,126	27%	108,200,000	73%
			$944,000,000	**$325,279,495**	-	**$620,692,037**	-



Methodology

- EY constructed an econometric model to predict total sales, home sales, and box office sales for each movie based on the independent variables shown below.
- While the home release window (in days) is the primary variable of interest, the variable is modified to "home release window as a share of theatrical run" to address a possible two-way causality issue between the home release variable and movie sales (i.e. endogeneity bias, see slide 11).
- The "home release window as a share of theatrical run" variable helps account for how quickly the movie is released to home relative to the length of time in theaters. If this variable is a statistically significant predictor of movie sales in the model, the release window is found to be associated with sales.

Independent variables

Film exhibition characteristics

- Home release window as a share of theatrical run
- Theatrical run
- Rotten Tomatoes audience score
- Whether the film is a sequel
- Special theatrical release
- Total box office sales in peak week of theatrical run
- # of theaters playing movie in peak week of theatrical run
- 4th week box office sales as a share of 1st week
- Month of the year

Effect?

Dependent variable

Sales ($)

Option I: Home sales

Option II: Box office sales

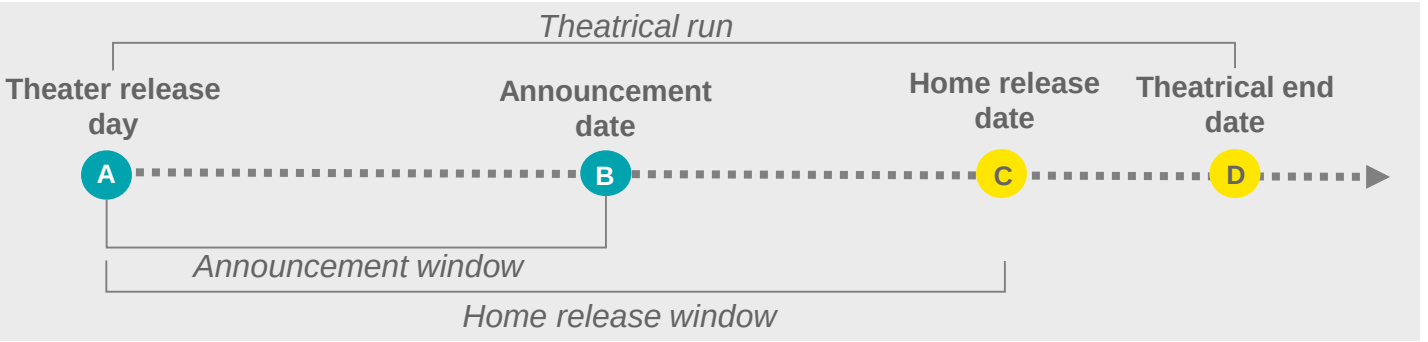
Option III: Total sales (box office + home sales)

Key variable of interest

Home release window as a share of theatrical run

=

Home release window / Theatrical run



Model description and limitations

Model description:

- A simple regression model with the home release window (in days) as a primary variable of interest finds that there is no significant relationship between the home release window and movie sales. **However, the analysis finds that this simple model suffers from a two-way causality issue (endogeneity bias), leading this result to be biased.** As we are trying to test whether there is there is a relationship between the home release window and sales, it is also possible that the timing of the home release date is motivated by the quality of the movie and the performance in terms of the box office sales. In other words, when movies perform poorly in the box office, the home release window may be shortened. (The results presented as "Model I" on pages 12, 13, and 14 use this approach.)

- The length of the theatrical run and the home release window are both determined by the quality and sales generating potential of a film. I.e., one typically assumes high quality films with market appeal tend to stay in theaters longer and are released to the home later. Therefore, examining the length of the home release window in isolation would erroneously attribute higher sales to the longer window which may in fact be a result of a higher quality film simply because higher quality films tend to have both longer theatrical runs and longer home release windows.

- To avoid this endogeneity issue, the home release window is analyzed in terms of its relative length to the theatrical run (i.e., the ratio of days of home release window length to theatrical run). This allows the length of both the theatrical run and home release window to move together related to the quality of a film, but helps to isolate the effect of just the home release window. (The results presented as "Model II" on pages 12, 13, and 14 use this approach.)

Limitations:

- As the purpose of this analysis was to determine if a shortened theatrical release window has any association with home, theatrical, and overall revenue, the analysis does not propose any hypothesis as to why there is one.

- Although the analysis attempted to fix the two-way causality issue (endogeneity issue) by transforming the home release window to the relative length of the theatrical run, it is difficult to determine if the issue is fully eliminated. The two-stage least squares model is considered to be an appropriate methodology to address endogeneity issues; however, there was no easily identifiable instrumental variable to implement this method.

- Ideally while conducting an econometric analysis, consistency of results (pertaining to statistical significance and magnitudes) across different model specifications implies more statistically valid findings. Unfortunately, during the EY analysis, the statistical significance and magnitudes of the effect of the home release window coefficient would change across different model specifications. The instability suggests the model could be suffering from omitted variable bias, meaning the release window variable may have been inadvertently picking up some of the effects of a variable not specified in our model.

- The data was available to EY only for the period between 2012 to 2017. As a result, changes that may have occurred in the movie industry since 2017 are not captured in the analysis.

Appendix I: Total sales econometric model results

Effect of home release window on total sales (home sales + box office sales)

Independent variables	Model I: Using home release window	Model II: Using ratio of home release window to theatrical run (x 100)
Ratio of home release window to theatrical run (x 100)	NA	174,608.71***
Days between theatrical release and home release	93,671.12	NA
Theatrical run (in days)	913,064.01***	1,111,849.09***
Rotten tomatoes audience score	912,744.24***	937,846.75***
Sequel	561,964.31	572,603.69
Special theatrical release (1 = special release, 0 = regular release)	-5,407,477.46	-4,770,275.78
Total box office sales in peak week of theatrical run	1.84***	1.81***
Number of theaters showing movie in peak week of theatrical run	40,398.19***	43,294.54***
4th week box office sales as a share of 1st week	-90,693.56	-102,612.38

Notes:

1. **** p<0.01 (significant at 99% confidence level) ** p<0.05 (significant at 95% confidence level), * p<0.1 (significant at 90% confidence level)*
2. *While the descriptive analysis presented in this report are in nominal dollars, the data used for the econometric analysis were adjusted for inflation and expressed in real dollars.*

Appendix II: Home sales econometric model results

Effect of home release window on home sales

Independent variables	Model I: Using home release window	Model II: Using ratio of home release window to theatrical run (x 100)
Ratio of home release window to theatrical run (x 100)	NA	56,172.98*
Days between theatrical release and home release	-28,665.71	NA
Theatrical run (in days)	395,820.26***	457,565.15***
Rotten tomatoes audience score	225,841.61***	226,725.20***
Sequel	-3,727,093.88	-3,798,569.28
Special theatrical release (1 = special release, 0 = regular release)	-14,341,869.00*	-14,075,047.23*
Total box office sales in peak week of theatrical run	0.35***	0.33***
Number of theaters showing movie in peak week of theatrical run	15,196.67***	16,426.59***
4th week box office sales as a share of 1st week	-25,559.37	-38,721.30

Notes:

1. **** p<0.01 (significant at 99% confidence level) ** p<0.05 (significant at 95% confidence level), * p<0.1 (significant at 90% confidence level)*
2. *While the descriptive analysis presented in this report are in nominal dollars, the data used for the econometric analysis were adjusted for inflation and expressed in real dollars.*

Appendix III: Box office sales econometric model results

Effect of home release window on box office sales

Independent variables	Model I: Using home release window	Model II: Using ratio of home release window to theatrical run (x 100)
Ratio of home release window to theatrical run (x 100)	NA	118,435.73***
Days between theatrical release and home release	122,336.83	NA
Theatrical run (in days)	517,243.76***	654,283.95***
Rotten tomatoes audience score	686,902.60***	711,121.53***
Sequel	4,289,057.37	4,371,172.14
Special theatrical release (1 = special release, 0 = regular release)	8,934,392.35	9,304,772.27
Total box office sales in peak week of theatrical run	1.50***	1.48***
Number of theaters showing movie in peak week of theatrical run	25,201.52***	26,867.95***
4th week box office sales as a share of 1st week	-65,134.20	-63,891.09

Notes:

1. **** p<0.01 (significant at 99% confidence level) ** p<0.05 (significant at 95% confidence level), * p<0.1 (significant at 90% confidence level)*
2. *While the descriptive analysis presented in this report are in nominal dollars, the data used for the econometric analysis were adjusted for inflation and expressed in real dollars.*

Appendix IV: Theatrical run and home release window in the current data

- On average, about 50% of movies tend to be released at home before leaving theaters. This share has been trending upward over the past few years (2012-2017).

Total number of movies with home release before and after end of theatrical run

Level	2012	2013	2014	2015	2016	2017	Total
Home release before end of theatrical run	37	40	48	43	37	48	253
Home release after end of theatrical run	50	45	37	43	41	38	254
Total	**87**	**85**	**85**	**86**	**78**	**86**	**507**

Share of movies with home release before and after end of theatrical run by year

Level	2012	2013	2014	2015	2016	2017	Total
Home release before end of theatrical run	43%	47%	56%	50%	47%	56%	50%
Home release after end of theatrical run	57%	53%	44%	50%	53%	44%	50%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Appendix V: Relationship of movie sales to home release window

Table showing relationship of movie sales to home release window

In millions of US dollars

	0-34	35-39	40-44	45-49	50-54	55-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100-104	105-109	110-114	115-119	120-129	130-134	135-349
Avg. home sales ($)	-	8.6	-	15.6	9.0	-	21.9	36.7	48.5	44.0	59.2	79.5	57.5	53.0	57.4	61.6	57.9	53.3	58.5	87.5
Avg, box office sales ($)	-	3.7	-	12.3	18.3	-	56.2	73.7	109.9	79.1	126.4	111.7	97.7	89.0	116.9	121.4	104.3	105.2	141.0	171.8
Avg. total sales ($)	-	12.3	-	27.9	27.3	-	78.1	110.4	158.4	123.1	185.6	191.2	155.3	141.9	174.3	183.2	162.1	158.5	199.5	259.2
Home sales over total sales	**-**	**70%**	**-**	**56%**	**33%**	**-**	**30%**	**35%**	**31%**	**36%**	**32%**	**42%**	**37%**	**37%**	**33%**	**34%**	**36%**	**34%**	**29%**	**34%**
Number of movies	0	1	0	1	1	0	5	74	18	84	45	17	57	47	36	11	31	19	17	44

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