Kuehn & Lampe (2023): replication summary

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1 What we do

We seek to replicate the main results of the paper as well as some of the counterfactuals. We also propose two additional counterfactuals (one of which turned out successful, the other not), and a robustness check concerning the size of the relevant market in the third stage.

2 Replication summary

Our replication of third stage parameters (Table 1), determinants of expected quality (Table 2), fixed costs (Table 3), counterfactuals (Table 4), and welfare analysis (Table 5) was successful. We also replicated the summary statistics but they are not very interesting (and it would be very surprising and worrying if they did not replicate) so they are omitted from this summary.

Variable	Original	Replication	Robustness
σ	0.5296	0.5296	0.5512
λ_1	-0.1953	-0.1953	-0.1866
λ_2	-0.0104	-0.0104	-0.0094
Netflix subscribers	-0.0167	-0.0167	-0.0490

Table 1: Nested logit demand model results in the original paper, in our replication, and in our robustness check where the relevant market is 9 times smaller.

Estimating the release timing equilibrium turned out to be computationally very cumbersome. Due to this computational burden and not having access to clusters/supercomputers on such short notice, we had to tune down the complexity of the model by decreasing the number of simulated shocks from the 30 used by the authors. Even after this change, simulating the counterfactuals took several days. We relied on a low-performance laptop and a high-end gaming PC for the counterfactual simulations. Aside from the computational limitations vis-a-vis the computer used by Kuehn and Lampe (2023), using personal computers involved logistic issues.

3 Challenges and problems

The authors' code does not work as such. After some detective work, it turned out that a vector needed transposing; while not a major flaw, this raises some questions on whether the codes have actually been tested during the peer review process. Another issue was that some simulation code used the function dropmovie_quick instead of the function dropmovie. The problem is that unlike dropmovie, dropmovie_quick is not defined anywhere in the replication package, and has different outputs than dropmovie. After locating and correcting these issues, the code works. However, small issues like these add up in terms of time, aside from being quite annoying.

In addition, there were computational challenges. Apparently, a laptop with 4GB of RAM is not the optimal tool for running such heavy algorithms that are needed in simulating the counterfactuals. We were able to replicate the composition-and-timing equilibrium and simulate our added counterfactual that splits a studio (which took about a week using the more powerful computer available to us), but our second additional counterfactual of increasing Netflix subscribers was not successful (it was run with the low-performance laptop). It first ran for 6 days straight without managing to pass even the first year (out of ten), and after terminating was tried again with a smaller number of demand shocks but that also did not pass even the first iteration of years. We reckon that the code itself is fine (as it was a minor change to the existing code) and would have finished had we had a few more months of time, but

that the computational burden of this counterfactual exercise was just too large considering the resources at hand. It is not impossible that the authors also ignored this counterfactual for the same reason, even though it feels like a quite obvious counterfactual considering the current media environment (instead, they did *two* different counterfactuals of decreasing Netflix subscribers which seems a little one-sided).

4 Modifications

4.1 Additional counterfactuals

We propose two kinds of modifications. First, we add two counterfactuals. The authors simulate two different counterfactuals involving the competitive pressure from Netflix exerted through the outside option; one holding Netflix subscribers constant at their 2011 level, and another setting them to zero for all years. But what if Netflix had been bigger instead? What would happen to theatricals if the competition from video-on-demand (VOD) services was larger? This may be actually be a more relevant counterfactual than decreasing the outside competition, considering the current high market penetration of VOD services, and the possible implications that may have for the film industry in the future. However, as described above, estimating this counterfactual was not successful due to the lack of computational capacity.

The second counterfactual that we add involves splitting Warner Brothers (the studio with the largest amount of movies) into two studios, which both get approximately half of the movies produced by Warner Brothers in every budget category. Both new studios get Warner Brothers' quality fixed effect. The replication package includes the authors' code for this counterfactual, but for some reason it is neither reported nor mentioned in the final paper. This counterfactual simulation took about a week to run with a high-performance personal computer.

Admittedly, this counterfactual is conceptually rather similar to counterfactual 3 presented and discussed in the paper (new studio entry), but there are some differences in details. In counterfactual 3, Kuehn & Lampe clone the smallest studio (Paramount), and in our counterfactual, the split studio is the

largest one (Warner Bros). However, both studios have similar quality fixed effects (0.4375 for Paramount and 0.4234 for Warner Brothers, which was about average). The crucial difference is that in counterfactual 3, the "baseline" number of movies is increased (the new studio starts with the same number of movies as Paramount), and studios adjust the number of movies released from there. In our counterfactual scenario, the "baseline" number of movies does not change. Both scenarios do involve an increase in competition.

In both scenarios, other studios react to the new studio by increasing the number of low-budget and high-budget movies and decreasing the number of medium-budget movies. However, the change in the number of movies released is positive in counterfactual 3, but negative in our counterfactual. The result that increased competition decreases the number of medium-budget movies released is line with other results and simulations of the paper. It seems that the effect of this split is quite muted in other budget tiers. The decrease in high-budget movies released by the two parts of the split studio might be because producing even one high-budget movie per year might require too much resources for the new studios individually (looking at figure 3, high-budget films become unprofitable very quickly).

Counterfactual 4 (merger between Disney and Fox) shows that assumptions about quality fixed effects are crucial for the results of counterfactual simulations. In these simulations, other studios responded to the merger by dropping more medium-budget films if Fox movies got the Disney quality fixed effect, but this effect was not pronounced in other budget categories. It is reasonable to suspect the quality fixed effect of the split studio in our counterfactual has a major effect on how other studios respond to this split. Counterfactuals cannot be run on all studios, however, and splitting the largest studio with an "average" quality FE is likely informative.

Finally, it seems reasonable to suggest that splitting a major studio is a more realistic scenario of a new entry into the movie industry than an outright new studio. Entering as a major film studio likely requires a large amount of initial investment, and given the increased competition from streaming platforms for views, there might not be enough incentives for potential entrants. This is why splitting a major studio seems like a more salient scenario of a new major studio. In practice, such a split might for example correspond to a spin-off of existing

IP, such as Marvel, from a major studio.

4.2 Replication results and an additional robustness check for the demand model

In addition, we present a small modification to the discrete choice model of the third stage. The market shares constructed by the authors are calculated by assuming that the relevant market is the entire U.S. population each week, but this seems like a rather strong assumption, when the statistics reveal that people in the U.S. go to the movies on average 5.8 times a year (in 2018; Forum-Theatre 2022), which would imply that the relevant market is almost 9 times (52/5.8) smaller. Therefore, we re-estimate the model with this change and compare the results to those yielded by the authors' original model.

As we see from Tables 1 and 2, the effects of this robustness change on the parameter estimates are minor. However, η, the parameter for the effect of Netflix subscribers on the outside utility, is almost trebled as we see from Table 1.

4.3 Replicated tables and figures

	Original	Replication	Robustness
log_budget	0.3636628	0.3636628	0.3503302
distributor2	0.5592161	0.5592161	0.5338648
distributor3	0.3550339	0.3550339	0.3896356
distributor4	0.4376533	0.4376533	0.4083835
distributor5	0.2646038	0.2646038	0.253352
distributor6	0.4233722	0.4233722	0.3933038
distributor7	0.4120885	0.4120885	0.3798953
highbudget	0.1870654	0.1870654	0.178188
medbudget	0.0797995	0.0797995	0.0753444
_cons	-7.099106	-7.099106	-7.881286
Y10	-0.1678791	-0.1678791	0.0489188
Y11	-0.0680184	-0.0680184	0.1427981
Y12	0.2120841	0.2120841	0.6228204
Y13	0.3829796	0.3829796	1.19719
Y14	0.5686274	0.5686274	1.435195
Y15	0.7884627	0.7884627	2.157578
Y16	1.049214	1.049214	3.167453
Y17	1.281325	1.281325	3.848684
Y18	1.894757	1.894757	5.173646

Table 2: Original, replicated, and robustness (relevant market 9 times smaller) results for estimating the expected quality of movies ("theta regressions"). The replication results in exactly the same estimates, and the robustness check does not radically change the results (although it clearly changes the year fixed effects).

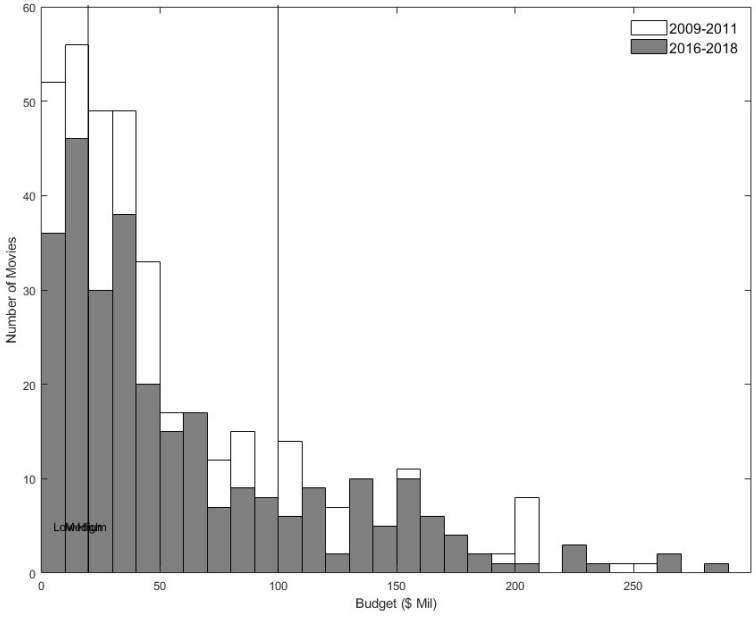

Figure 1: Replication of Figure 2.

	Disney						Fox					
	Low Budget		Medium Budget		High Budget		Low Budget		Medium Budget		High Budget	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
2009	8.6954	0	19.5618	22.3974	45.1248	76.9269	1.7885	2.8375	9.9252	10.2018	24.1562	43.0198
2010	6.9346	11.4361	15.2995	19.666	38.5601	67.6844	2.1996	3.0682	7.9665	7.8477	16.9294	23.7358
2011	4.5749	6.7909	14.6017	17.0333	32.8047	56.663	0.1872	0.3202	7.4365	8.2148	18.9156	26.5609
2012	9.0262	13.1719	19.7109	22.6409	51.7713	101.9874	0.2144	0.3561	10.1757	11.3523	26.3222	41.3264
2013	9.3086	0	20.1427	23.2222	46.4885	82.641	2.3569	3.5426	9.9032	12.3518	26.4726	40.7644
2014	8.9579	0	18.4577	21.5661	37.5414	82.8267	0.7546	1.3231	10.1521	11.077	28.0333	39.8028
2015	9.3951	14.3502	23.0081	32.7086	54.1805	77.921	2.9552	4.4157	10.9526	12.1267	26.7835	44.3267
2016	7.8212	12.3489	21.8563	31.357	50.07	65.2019	2.3785	3.3257	9.6273	10.5142	23.9529	34.6404
2017	10.3211	0	28.902	0	58.0684	89.5008	0.6679	1.2223	9.7959	10.3944	27.4942	41.1599
2018	12.1171	0	35.4573	48.8588	66.453	99.2434	4.344	6.2471	12.9201	13.8438	21.3098	0

	Paramount						Sony					
	Low Budget		Medium Budget		High Budget		Low Budget		Medium Budget		High Budget	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
2009	0.053	0.0926	13.8564	16.5508	32.1194	61.9842	1.6826	2.5428	7.6314	8.0255	21.6641	27.7288
2010	1.6847	2.7553	10.4051	13.3344	25.9008	44.137	0.748	1.1896	5.9528	5.4679	15.591	20.8588
2011	2.4204	3.6804	10.037	11.4662	26.2297	40.0235	0.4472	0.733	6.3385	6.6304	15.8406	20.7066
2012	1.0415	1.6667	11.2225	14.2962	4.3742	0	0.616	1.0004	8.6395	9.1509	24.6037	36.5405
2013	5.6723	7.6769	14.6129	16.8578	36.908	63.04	0.8562	1.4229	8.9252	10.3688	22.9157	31.8835
2014	3.177	5.0467	14.0694	16.5376	36.8407	55.6323	0.9587	1.632	8.9358	10.7005	22.0983	29.051
2015	1.6786	2.6181	13.2616	15.8274	27.0964	51.2081	0.459	0.7742	8.2483	8.8595	16.7828	21.5396
2016	2.7579	4.0066	11.6089	13.6136	29.2823	46.8446	1.4784	2.1638	7.9896	8.6732	21.4599	29.3888
2017	0.9652	1.5965	13.1256	15.4327	35.4069	54.3661	3.6544	4.8205	9.0654	8.2698	19.0618	29.1107
2018	5.4963	8.5194	16.7487	20.4436	32.1923	63.641	1.0658	1.6988	10.5877	13.2429	15.3813	0

	Universal						Warner Brothers					
	Low Budget		Medium Budget		High Budget		Low Budget		Medium Budget		High Budget	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
2009	3.4939	5.1916	11.4115	13.8127	27.9979	43.0243	5.0672	7.7628	11.2327	12.105	32.048	47.0654
2010	2.0007	2.8009	9.2949	11.1273	22.3852	36.4335	3.6229	4.9924	8.7102	9.8272	20.9733	35.817
2011	1.6979	2.4972	8.5334	9.2567	20.2953	34.2054	3.8908	6.6014	9.5278	10.7183	22.7323	32.8835
2012	0.9278	1.458	12.5109	14.0041	25.4752	47.0261	1.0898	1.6909	14.5993	16.8627	43.0989	62.8924
2013	2.1203	3.2735	12.0923	15.0971	26.8019	35.9796	6.1243	8.5087	12.5829	15.4942	38.797	52.0373
2014	2.342	3.4121	10.2036	11.3936	6.0997	0	3.265	4.6991	14.2318	17.0904	33.9687	50.2915
2015	0.9348	1.4974	11.531	12.8486	23.7699	47.3031	0.1677	0.3001	11.0545	12.4817	28.006	41.3853
2016	2.2991	3.7599	10.433	11.5485	25.0367	37.4392	2.5645	3.7916	12.9141	15.3942	31.8667	49.3858
2017	2.3919	3.5971	11.7649	14.3173	23.9581	39.2438	4.3457	6.0703	11.4405	12.3329	31.4877	46.0563
2018	2.5846	3.9178	13.8646	16.0244	34.9668	51.8528	4.9412	7.393	14.3178	15.8125	33.6384	58.7313

Table 3: Our version of Table 6. Fixed cost parameters are calculated via simulation, so the results differ slightly from Kuehn & Lampe, but the differences are not large.

Counterfactual: studio split			
	All studios	Split studio	Other studios
Movies observed	1510	199	1311
Movies CF	1499	214	1285
Total Change	-11	15	-26
LB observed	591	33	558
LB CF	622	47	575
LB Change	31	14	17
MB observed	700	124	576
MB CF	656	128	528
MB Change	-44	4	-48
HB observed	219	42	177
HB CF	221	39	182
HB Change	2	-3	5

Table 4: Our version of Table 7. Results from our counterfactual simulation, where Warner Brothers splits. The increased competition from the split results in the rest of the studios releasing less medium-budget films, which is in line with the general results of the paper. As it pertains to the results of the counterfactual simulation, "Split studio" refers to both parts of post-split Warner Brothers.

Low Budget										
	Drop				Add				Fixed Cost	
Disney	Own	Other Own	Other Studio	Total	Own	Other Own	Other Studio	Total	LB	HB
Fox	-24.0398	12.575	6.9142	-4.5506	12.5105	-13.0778	-0.5356	-1.1029	8.7152	12.7844
Paramount	-5.8289	3.1682	1.3297	-1.331	3.0634	-2.9747	-0.0871	0.0016	1.7847	2.6658
Sony	-7.5021	3.7168	2.0373	-1.748	4.0019	-3.7514	-0.2394	0.0111	2.4947	3.7659
Universal	-4.0947	2.23	0.9948	-0.8699	2.213	-2.1178	-0.1059	-0.0107	1.1967	1.7978
Warner Bros	-6.2956	3.1846	1.6289	-1.4821	3.299	-3.0229	-0.212	0.0641	2.0793	3.1405
	-12.8252	7.605	2.861	-2.3592	6.1044	-7.3915	0.4406	-0.8465	3.5079	5.181

Medium Budget										
	Drop				Add				Fixed Cost	
	Own	Other Own	Other Studio		Own	Other Own	Other Studio		LB	HB
Disney	-61.6554	33.7696	16.2166	-11.6692	29.0844	-34.0916	0.19	-4.8172	21.6998	27.4058
Fox	-28.6383	17.5945	6.1307	-4.9131	15.0147	-17.2573	0.9738	-1.2688	9.8855	10.7924
Paramount	-37.5537	21.8708	8.8408	-6.8421	19.3161	-22.7836	1.4567	-2.0108	12.8948	15.436
Sony	-25.8915	16.1279	5.1022	-4.6614	13.5556	-16.047	1.1152	-1.3762	8.2314	8.939
Universal	-33.8152	20.6755	7.1536	-5.9861	17.6309	-20.6016	1.257	-1.7137	11.164	12.943
Warner Bros	-35.3872	20.6531	7.9582	-6.7759	17.4638	-20.7974	1.3378	-1.9958	12.0612	13.8119

High Budget										
	Drop				Add				Fixed Cost	
	Own	Other Own	Other Studio		Own	Other Own	Other Studio		LB	HB
Disney	-209.7862	121.3086	53.1684	-35.3092	86.2016	-127.3683	16.0297	-25.137	48.1063	80.0597
Fox	-125.1718	85.9107	21.8023	-17.4588	58.9663	-89.3744	15.9787	-14.4294	24.037	36.9567
Paramount	-157.0746	103.1359	31.1637	-22.775	70.6573	-113.5441	22.1457	-20.7411	28.6351	50.7351
Sony	-116.6337	87.9834	16.6235	-12.0268	56.4983	-90.2403	18.3375	-15.4045	19.5399	26.9611
Universal	-145.1467	98.4142	26.0341	-20.6984	65.1309	-102.0849	19.0154	-17.9386	23.6787	39.4365
Warner Bros	-144.5114	96.2251	27.1246	-21.1617	64.294	-99.4679	16.9922	-18.1817	31.6617	47.6546

Table 5: Replication of Table 8. Welfare is calculated via simulation, so the results differ slightly from Kuehn & Lampe.

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