



Rise, Fall, and Implications of the New York City Medallion Market

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Abstract. Capping the number of licenses and granting exclusive right to street hailing passengers, the New York City (NYC) medallion system manipulated the demand and supply of taxicab services and created a medallion market. The lasting system turned the right to operate taxis in NYC into a private property of scarcity and an investment vehicle with disguised risks. Integrating data published by the NYC Taxi and Limousine Commission (TLC), this research identified four phases of the medallion market and argued that (1) the market collapsed because technology and ride-sharing economy have materially weakened the assumptions underlying the market; (2) Yellow Cab is fighting a lost battle against players of ride-sharing economy; and (3) the deregulation of the NYC taxicab industry will adapt and continue despite its adverse impact on the medallion interest groups.

Keywords: App-based · Boro Taxis · For-Hire Vehicle (FHV) · Green Cab · Haas Act · Medallion · New York City (NYC) · Street Hail Livery (SHL) · Ride-sharing · Taxicab · Taxi and Limousine Commission (TLC) · Uber · Yellow Cab

1 Introduction

1.1 NYC Taxicab Market

The NYC taxicab market is one of the largest in the world, with about one million passengers per day and annual revenue of two billion US dollars. By the local government regulations, summarized in Table 1. Classification of NYC Taxicab Services and Providers, the market consists of two sectors of service demand (street hailing and pre-arranged pick-up) and three major classes of service suppliers: Yellow Taxi Cab (Yellow Cab), For-Hire Vehicles (FHV), and Street Hail Livery (SHL).

Street hailing services are provided by taxicabs in response to hails by passengers on the streets. Pre-arranged pick-up services are provided by taxicabs in response to requests made to a taxicab's affiliated service dispatching base.

Identifiable by the color of canary yellow, Yellow Cab taxis are providers of street hailing services. They are permitted to pick up passengers anywhere in all the five NYC boroughs. More, they are granted exclusive right to street hailing in Manhattan, LaGuardia Airport, and John F. Kennedy International Airport [1], where most of the traditional NYC taxi traffic is originated or destined. Customers access this mode of

transportation by standing in the street and hailing with hands. A medallion, the metal plate attached to a car’s hood, is the proof of legal license, i.e., the right for a car to provide street hailing services. There is a cap on the number of available licenses.

Table 1. Classification of NYC taxicab services and providers

	Right to street hailing passengers	Right to pre-arranged pick-ups
Yellow Cab	All NYC	Not permitted
FHVs	Not permitted	All NYC
Green Cab	Northern Manhattan (north of West 110th street and East 96th street) and outer-boroughs (Bronx and Queens excluding the airports)	All NYC

FHVs include Community Cars (aka Liveries), Black Cars, and Luxury Limousines. Those taxicabs can pick up passengers throughout the five NYC boroughs, but only by appointments [2]. Customers access this mode of transportation by submitting a request, via phone, mobile apps, website, or other methods, to a TLC-licensed base or a TLC-licensed dispatch service provider who then direct FHV taxicabs to the customers. Important to note, app-based service providers such as Uber and Lyft are classified as FHVs. They were not permitted to enter the NYC taxicab market until the middle 2011. However, once permitted, they became disruptive against street hailing service providers as smart phones made FHVs as convenient (if not more so) as traditional taxicabs.

SHL, painted apple green and known as “Boro Taxis” or “Green Cabs”, is a hybrid between Yellow Cab taxis and FHVs. They are permitted to accept pre-arranged rides in all the five NYC boroughs, and, beginning in June 2013, are permitted to pick up hailing passengers from the street in northern Manhattan (north of West 110th street and East 96th street) and the outer-boroughs: the Bronx and Queens (excluding the airports), areas historically underserved by Yellow Cab [3].

1.2 Medallion System

Licenses for both drivers and vehicles are required to operate taxicabs in NYC. However, regulations vary on Yellow Cabs, Green Cabs, and FHVs. Yellow Cabs have the strictest licensing. The right to serve street hailers had been exclusively assigned to Yellow Cabs until 2013 – the year Green Cab was created. The number of Yellow Cab Taxis permitted on streets is controlled via medallion licensing, by which the New York state’s legislative body approves additional medallions and the NYC TLC holds auctions to sell them to public.

Introduced in 1937, the medallion system added only limited number of Yellow Cabs with only three legislative approvals in year 1996, 2004, and 2013. Today, only 13,587 Yellow Cab taxis are permitted on the NYC streets, corresponding to the same number of medallions.

2 Evolution of NYC Medallion Market

Based on the data integrated from the TLC websites, annual transfer volumes and average prices for Yellow Cab medallion transactions are graphed in Fig. 1. NYC Yellow Cab Medallion Annual Transfers and Average Sales Prices. According to the price and volume movements, the market can be described in four different phases,

- Born but no value (1937–1946)
- Formed and established (1947–1986)
- Investment tool and booming (1987–2013)
- Collapsed and falling (2014 – Present).

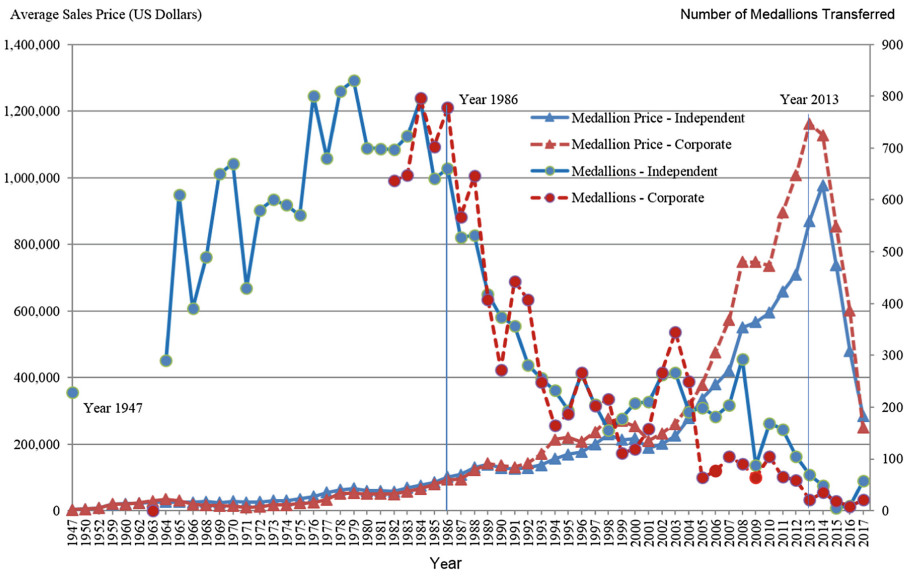


Fig. 1. NYC Yellow Cab medallion annual transfers and average sales prices

Data details are in Table 2. NYC Yellow Cab Medallion Annual Issuance and Sales Transfer.

2.1 Born But No Value (1937–1946)

The first phase of nine years from 1937 through 1946 carried no market values for the medallions. After the great depressions in early 1930s, NYC was flooded with 30,000 drivers. Sometimes there were more taxi cabs than passengers on the streets. Out of concerns about congestion, pollution, and crimes, the Haas Act was legislated in 1937 and official taxis were introduced with medallions attached. The law limited the number of cab licenses to the existing 16,900, but only 13,595 were in active use due to registration lapses [4]. The active licenses dwindled to 11,787 in 1947 due to reduced renewals and stood the same for 50 years until 1996 when 266 more were issued.

Table 2. NYC Yellow Cab medallion annual issuance and sales transfer

Medallion market	Year	Total medallions				Independent medallions		Corporate medallions	
		Approved	Issued	Active	Sales transfer	Average price (\$)	Numbers traded	Average price (\$)	Numbers traded
Phase I	1937–1946	16,900	13,595	13,595	0	0	0	0	
Phase II (1947– 1986)	1947					2,500		2,500	
	1950					5,000		5,000	
	1952					7,500		7,500	
	1959					19,500		20,000	
	1960					20,825		19,450	
	1962					22,000		23,400	
	1963					25,000		28,773	
	1964			11,787	290	26,000	290	34,145	
	1965			11,787	610	26,000	610	30,000	
	1966			11,787	390	25,000	390	19,000	
	1968			11,787	490	27,000	490	16,000	
	1969			11,787	650	24,500	650	15,000	
	1970			11,787	670	28,000	670	14,000	
	1971			11,787	430	25,000	430	10,000	
	1972			11,787	580	26,000	580	12,000	
	1973			11,787	600	30,000	600	17,000	
	1974			11,787	590	30,000	590	17,000	
	1975			11,787	570	35,000	570	22,000	
	1976			11,787	800	42,000	800	24,000	
	1977			11,787	680	55,000	680	33,000	
1978			11,787	810	63,000	810	52,000		
1979			11,787	830	67,000	830	53,000		
1980			11,787	700	60,000	700	50,000		
1981			11,787	699	60,000	699	50,000		
1982			11,787	1,334	57,500	697	49,300	637	
1983			11,787	1,371	68,600	723	57,900	648	
1984			11,787	1,591	75,900	795	66,200	796	
1985			11,787	1,344	84,900	641	79,000	703	
1986			11,787	1,438	101,600	660	92,900	778	
Phase III (1987– 2013)	1987			11,787	1,094	108,700	527	94,600	567
	1988			11,787	1,178	129,700	532	121,500	646
	1989			11,787	826	139,100	418	141,400	408
	1990			11,787	646	128,400	374	135,700	272
	1991			11,787	800	126,067	357	130,360	443
	1992			11,787	688	128,577	281	143,199	407
	1993			11,787	504	137,196	256	170,200	248
	1994			11,787	396	155,633	232	214,221	164
	1995			11,787	381	169,750	194	219,958	187
	1996	400	266	12,053	531	176,333	264	207,292	267
	1997		134	12,187	408	199,875	205	236,500	203
	1998			12,187	370	229,000	155	277,318	215
	1999			12,187	289	212,917	178	269,500	111

(continued)

Table 2. (continued)

Medallion market	Year	Total medallions				Independent medallions		Corporate medallions	
		Approved	Issued	Active	Sales transfer	Average price (\$)	Numbers traded	Average price (\$)	Numbers traded
	2000			12,187	327	217,125	208	253,864	119
	2001			12,187	368	188,958	210	209,458	158
	2002			12,187	529	200,333	262	232,250	267
	2003			12,187	611	224,958	266	260,917	345
	2004	1,050	554	12,741	440	277,583	191	315,636	249
	2005		38	12,779	263	335,583	199	378,556	64
	2006		249	13,028	259	379,000	182	476,000	77
	2007		120	13,148	308	420,964	204	573,489	104
	2008		89	13,237	383	550,000	293	747,000	90
	2009			13,237	150	566,732	87	746,746	63
	2010			13,237	274	595,118	169	736,200	105
	2011			13,237	222	657,665	157	895,462	65
	2012			13,237	164	709,643	105	1,007,203	59
	2013	2,000	200	13,437	90	870,059	69	1,162,381	21
Phase IV (2014-)	2014		150	13,587	84	977,729	49	1,127,371	35
	2015			13,587	24	736,667	6	852,500	18
	2016			13,587	17	479,191	9	600,266	8
	2017			13,587	78	285,168	57	249,891	21

The number-capped medallion system had little impact on the NYC taxi industry during this initial phase. Due to the World War II and lack of demand for taxi services, many medallion owners valued a medallion not worth the annual \$10 renewal fee and chose not to renew. No evidences suggest that, in capping the number of taxis, the law makers of Haas Act intended to turn the right to operate taxicabs on the NYC streets into a property with tradable market value. The establishment of medallion was not much different from other Depression-era legislative efforts: to stabilize and revive the taxicab industry diagnosed suffering from excessive competition [5].

However, the Haas Act did have an ordinance allowing transfer of licenses between owners, conditionally upon the NYC's approval of new owners' qualifications. This transferability was critical to establish medallion values and trade in future when economic conditions improved and demand for taxicabs rose.

2.2 Formed and Established

A medallion market was formed and stabilized during the second phase of almost four decades from 1947 through 1986. Until 1947 had there been no demand adequate to utilize the existing medallions from individuals seeking to drive a taxi. Rationing of fuel and car parts during World War II turned more people to taxis for transportation and the post-World War II prosperity created more business, which led to more drivers than the medallions available [6]. Medallions started to assume value and a medallion market formed in response to the need of medallion trading.

In 1947, the New York Times reported that taxicab owners received bonuses averaging \$1,500 or \$2,500 from selling their medallions with used cabs [7]. In 1950, the “bonus” rose to \$5,000. The “bonus”, on the top of the sales price for a cab, effectively put a price tag on a medallion and indicated the birth of a standalone market. In early 1960s, a medallion was traded around \$25,000.

In 1971, the NYC TLC was created pursuant to Local Law 12 of 1971 to license taxicab vehicles and drivers by establishing and enforcing standards and criteria [8]. The creation and functioning of the TLC brought regulation transparency and consistency, which contributed to the health and stability of the NYC taxicab industry. It also led to legitimization of “gypsy cabs” into what known today as livery cars, community cars, car services or for-hire vehicles [9]. In its annual reports, the TLC stated “taxicab licenses are transferable, and may be pledged as security for loans. . . ., the license has a considerable value” [10]. Explicitly, the TLC pointed to the tradable value of the medallion and existence of a medallion market.

In addition to purchasing that requires a large amount of payment up front, drivers can pay medallion owners for the right of use by operation shift or certain hours, i.e., leasing. The Haas Act mandated that 60% of the medallions go to fleets who hold two or more licenses and can rent them to drivers. In 1979, TLC legalized leasing. Through waves of conversion to lessee-driving from owner-driving - fleet leasing in 1980s and independent owner leasing in 1990s, nearly all fleet drivers and most independent drivers were lessees [11]. Medallion ownerships were effectively separated from their right of use, which made it easy to price and trade medallions. Independent agencies were founded to broker and manage leasing on behalf of medallion owners.

During the second phase, demand for taxicabs rose due to a growing NYC population – residents and tourists, most of whom did not drive, while the number of medallions was capped the same for the whole period. Sales transfer of medallions increased at steadily higher prices. In 1984, the trading volumes went as high as 1,591, or 13.5% of the medallions in circulation. In 1986, 1,438 medallions or 12.2% of existing medallions changed hands. Thereafter both the number of medallions traded and its percentage in the total continued to decrease. As such, year 1986 was deemed the end of this forming phase. In the same year the average sales price for a medallion crossed \$100,000 for the first time, forty times the price at the beginning of this phase (inflation was not adjusted). Without new supply, this phase of the NYC medallion market was characteristic of more transactions, rising prices, and establishment of a regulation agency, the NYC TLC.

2.3 Investment Tool and Booming

During the third phase of 1987 through 2013 (or quarter 2 of 2014 concisely), the medallion price continuously rose, but trading volumes were thin, and thinner. This trend continued despite additional 1,650 or 14% more licenses were issued between 1996 and 2013. Both private sales transfers and official auctions kept recording prices historically high. Medallions were bought and held in anticipation for value appreciation. The license became an investment vehicle, no longer limited to the way gaining the right to drive to make a living in the city. Medallion-owner drivers populously counted on selling their medallions later to make comfortable retirements.

The annually averaged prices peaked at \$1.16 million for a corporate medallion in 2013 and \$0.98 million for an independent one in 2014. Only 90 medallions were transacted in 2013, 21 corporate and 69 independent, less than 0.67% of the total in use. The price was so high that fractions of a medallion were recorded in sales transfer. Except temporary setbacks from the economic recessions in early 1990s and following the terrorist attack on September 11 of 2001, the price trend line was straight up, projecting the medallion as a safe investment risking nothing; the volume trend line was straight down, telling few owners would like to sell. The two lines crossed and formed the shape like a pair of scissors in Fig. 1.

Rising price and known entry control made the NYC medallion a safe bet and gave it many attributes of the bundle of right as a private property [12]. It has been routinely bought and sold, leased, and used as collateral for loans and counted as assets in estate, bankruptcy, divorce, and inheritance settlements. Purchases were financed through credit unions, banks, and other financial institutes. In 1995, Medallion Financial was founded as a firm specialized in originating, acquiring, and servicing loans that finance taxicab medallions and various derivatives. It was listed and actively traded one year later in NASDAQ stock exchange [13]. Taking the Schaller Consulting's estimate that 15% of a medallion's total revenues went to its owners [14], the annual return was computed between 3% and 9% during this period, better than investment in gold and oil in the comparable years. Calculated according to the rate rules in the TLC Promulgation of Rules issued in 2012 [15], a medallion owner can earn \$30,000 to \$80,000 annually by leasing out one medallion. It was commonly believed that buying, holding, and leasing out medallions was a wise business decision. The environment of low interest rate following 2008 financial crisis provided widely accessible, low-cost loans and contributed to the medallion hype as well.

Medallion auctions administrated by the TLC also enforced the perception that investing in the medallion was safe. "Strong medallion sale prices have historically been used to judge the overall health and viability of the industry" [16] was frequently presented in the TLC annual reports. It was no coincidence that TLC auctions always set price records.

2.4 Collapsed and Falling

The good time peaked and started to end in the second half of 2014. Viewed quarterly, the average sales price for a corporate medallion peaked at \$1.26 million in quarter 2 of 2014 and then fell straight to \$208,411 in quarter 4 of 2017, a drop of 83.5%; the average sales price for an independent medallion peaked at \$1.0 million in quarter 3 of 2014 and then fell straight to \$191,749 in Quarter 3 of 2017, a drop of 80.8% (Fig. 2. NYC Yellow Cab Medallion Quarterly Sales Prices). The fall was steep and fast. It took almost twenty years to rise to \$1 million for a medallion in 2013, but less than three years to fall back where it was: around \$200,000. Quarterly data details for individual years are in Table 3. NYC Yellow Cab Medallion Quarterly Sales and Prices.

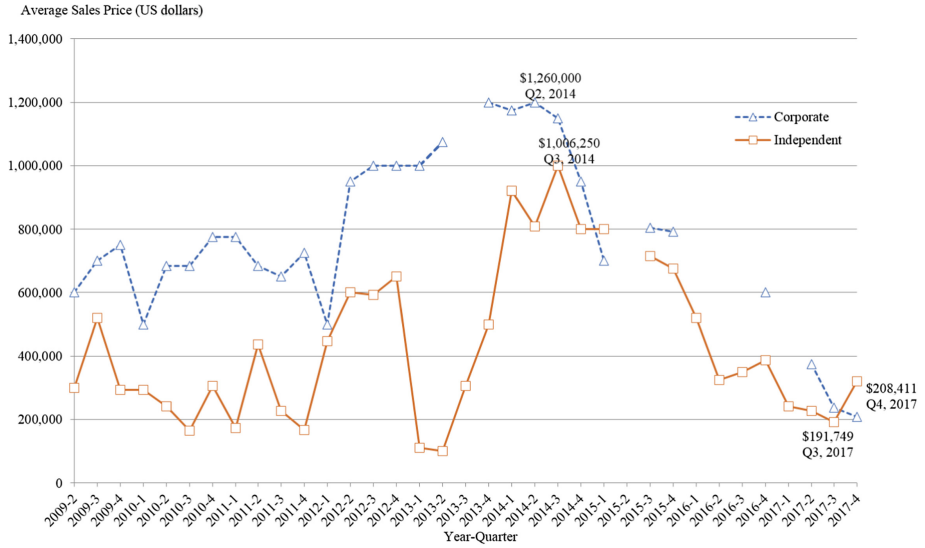


Fig. 2. NYC Yellow Cab medallion quarterly sales prices

Table 3. NYC Yellow Cab medallion quarterly sales and prices

Year	Quarter	Corporate							Independent				
		Transactions	Medallions		Price ('000 US dollars)			Transactions	Medallions		Price ('000 US dollars)		
			Transacted	Transferred	High	Low	Average		Transacted	Transferred	High	Low	Average
2009	2	13	27	27	763	600	735	28	28	27	578	300	561
2009	3	16	32	32	775	700	755	52	52	49	594	520	572
2009	4	2	4	4	775	750	763	11	11	11	600	293	557
2010	1	14	29	29	800	500	721	45	45	39	620	293	577
2010	2	18	36	36	800	685	741	43	43	39	610	242	589
2010	3	13	27	27	825	685	713	51	51	44	615	165	596
2010	4	6	13	13	850	775	807	53	53	48	700	305	614
2011	1	5	10	10	950	775	915	37	37	31	660	173	608
2011	2	9	18	18	975	685	878	74	74	58	695	438	661
2011	3	9	19	19	950	650	862	43	43	35	705	227	675
2011	4	8	18	18	1,000	725	938	37	37	35	710	167	679
2012	1	5	10	10	1,000	500	890	25	25	24	715	447	683
2012	2	6	12	12	1,050	950	996	38	38	35	712	600	703
2012	3	11	22	22	1,125	1,000	1,039	35	35	31	750	592	708
2012	4	7	15	15	1,125	1,000	1,048	16	16	16	850	650	769
2013	1	3	6	6	1,210	1,000	1,103	19	19	16	950	112	822
2013	2	3	6	6	1,320	1,075	1,165	26	26	26	1,100	100	914
2013	3				0	0	0	13	13	13	1,050	305	833
2013	4	4	9	9	1,200	1,200	1,200	14	14	14	1,000	499	878
2014	1	6	12	12	1,254	1,175	1,205	25	25	25	1,050	920	985
2014	2	2	5	5	1,300	1,200	1,260	17	17	15	1,050	808	1,002
2014	3	3	6	6	1,200	1,150	1,183	4	4	4	1,025	1,000	1,006
2014	4	6	12	12	1,000	950	967	5	5	4	866	800	827
2015	1	4	8	8	950	700	863	2	2	2	800	800	800
2015	3	2	4	4	875	805	840	3	3	3	715	715	715
2015	4	3	6	6	875	793	848	1	1	1	675	675	675
2016	1				0	0	0	2	2	2	580	520	550
2016	2				0	0	0	4	4	4	600	325	476
2016	3				0	0	0	2	2	2	570	350	460
2016	4	4	8	8	675	475	600	1	1	1	388	388	388
2017	1				0	0	0	1	1	1	241	241	241
2017	2	1	2	2	375	375	375	8	8	8	300	150	228
2017	3	10	19	19	140	236	236	9	9	9	256	130	192
2017	4	1	1	1	208	208	208	39	39	39	628	150	320

Table 4. NYC Yellow Cab medallion foreclosures

Year	Quarter	Corporate					Independent				
		Foreclosures	Medallions	Recorded unit value ('000 US dollars)			Foreclosures	Medallions	Recorded unit value ('000 US doallars)		
				Foreclosed	Highest	Lowest			Average	Foreclosed	Highest
2011	3						1	1	635	635	635
2014	3						1	1	900	900	900
2014	4	1	1	1,925	1,925	1,925	3	3	905	840	873
2015	1						1	1	800	800	800
2015	2						3	3	777	700	745
2015	3						3	3	725	603	681
2015	4						3	3	725	326	585
2016	1										
2016	2						7	7	615	540	574
2016	3	10	10	1,500	1,250	1,325	5	5	620	550	602
2016	4						3	3	600	550	583
2017	1						1	1	550	550	550
2017	2	1	2	738	738	369	7	9	500	220	348
2017	3	1	2	202	202	202	17	20	581	185	420
2017	4						8	13	450	200	354

Not only were the prices low, but also the transaction volumes were light. Unlike the third phase with few sellers due to appreciation expectations, the fourth phase had fewer sellers because of no buyers when no retainable floor prices were in sight. Corporate and independent medallions combined, only 24 changed hands in 2015 and 17 in 2016, out of the total 13,587. Together, those transactions made a sale of only \$20 million in 2015 and less than \$9 million in 2016. The market, valued over \$14 billion prior to quarter 4 of 2014, collapsed.

Without buyers, many owners were unable to pay back their loans and filed for bankruptcy. Between quarter 3 of 2014 and quarter 4 of 2017, 15 corporate medallions were foreclosed, defaulting loans valued over \$16.3 million, averaged \$1.09 million per piece; 72 independent medallions were foreclosed, defaulting \$35.8 million, averaged about \$0.5 million each. In contrast, there was only one foreclosure recorded (in 2011) prior to quarter 3 of 2014 (Table 4 NYC Yellow Cab Medallion Foreclosures). Not a surprise, impact on independent medallions owned by drivers is far more severe than that on those medallions owned by corporates.

Many medallions are now in possession of credit unions and banks who financed the purchases. In the middle September of 2017, for a total of \$8.56 million, or \$186,000 per medallion, a hedge fund company won the auction sale of 45 medallions foreclosed from an owner who once owned 800 medallions [17]. More foreclosures are likely to follow. Aware of the market distress, the TLC had to hold off auctioning the remaining 1,650 of the 2,000 Yellow Cab medallions authorized in 2013.

3 The Uber Disruption

Blames have been quickly played against Uber for the meltdown of the NYC medallion market – less regulated than Yellow Cab and thus gained an edge in competition.

Table 5. NYC taxicab ridership and market share by provider

Year-quarter	Total market trips (million)	Share of total market trips (%)				
		Yellow Cab	Green Cab	FHV's		
				Uber	Lyft	Other FHV's
2015-1	52.8	73.01	9.10	12.51	0.02	5.37
2015-2	55.1	69.99	9.24	12.69	0.54	7.54
2015-3	55.3	61.39	8.27	18.65	1.75	9.95
2015-4	64.7	54.26	7.38	19.16	2.09	17.11
Year total	227.8	64.14	8.44	15.93	1.15	10.34
2016-1	67.1	50.85	6.68	21.57	2.96	17.94
2016-2	71.2	49.04	6.30	22.23	4.05	18.37
2016-3	67.9	44.71	5.51	26.77	4.55	18.46
2016-4	73.7	42.65	4.92	29.33	4.69	18.41
Year total	279.8	46.74	5.84	25.04	4.08	18.30
2017-1	75.6	38.59	4.30	31.62	6.48	19.01
2017-2	53.5	37.64	4.00	32.94	7.18	18.24
Year to date	129.1	38.19	4.17	32.17	6.77	18.69

Uber and Lyft have been winning both market shares and revenues. Beginning for year 2015, the TLC published trip data for all the providers - Yellow Cab, Green Cab, and FHV's, which made it possible to view individual providers' market shares (Table 5 NYC Taxicab Ridership and Market Share by Provider). By quarter 2 of 2016 Yellow Cab had retreated to take less than 50% of the NYC taxicab service market. While the quarterly market size increased to 75.6 million trips in the first quarter of 2017 with a growth of 43% over the same period two years ago, Yellow Cab's trips dropped to 29.2 million, a loss of 9.4 million or 24%; and its market share dropped to 38.6% from 73%. Not only failed Yellow Cab in grabbing a share from the market growth but also it failed in customer retention – many riders who used to hail a Yellow Cab taxi now turned to Uber, Lyft, or other small FHV's. In the first quarter of 2017, FHV's as one group served 57.1% of the NYC taxicab trips and became NYC riders' first choice. Uber alone captured 31.6%, up from 12.5% two years ago. Figure 3 Market Share of NYC Taxicab Ridership by Provider illustrated the wining stride of Uber and Lyft, in contrast with Yellow Cab's drastic retreat, quarter after quarter.

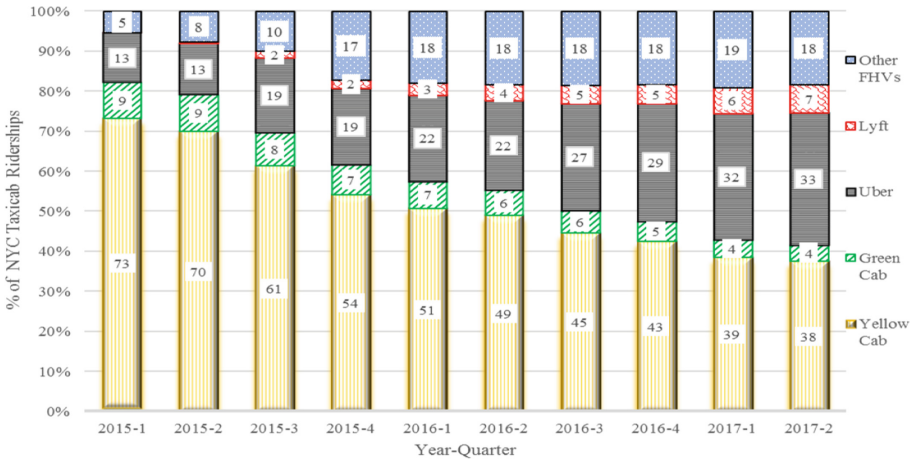


Fig. 3. Market share of NYC taxicab ridership by provider

Table 6. NYC Yellow Cab annual trips and revenues

Year	Medallions	Trips			Revenues		
		Total	Per medallion	Year over year change %	Total (\$)	Per medallion (\$)	Year over year change %
2010	13,237	168,983,489	12,766		1,789,049,841	135,155	
2011	13,237	176,866,900	13,362	4.67	1,992,549,043	150,529	11.37
2012	13,237	177,996,949	13,447	0.64	2,134,910,742	161,284	7.14
2013	13,437	173,136,240	12,885	-4.18	2,322,802,868	172,866	7.18
2014	13,587	165,104,282	12,152	-5.69	2,268,307,017	166,947	-3.42
2015	13,587	146,107,068	10,753	-11.51	2,097,292,315	154,360	-7.54
2016	13,587	130,789,390	9,626	-10.48	1,906,905,626	140,348	-9.08

Trips and revenues per medallion also dropped. Between 2013 and 2016, Yellow Cab’s annual trips per medallion dropped 25%, to less than 10 thousand from around 13 thousand, and annual revenues per medallion dropped 19%, to \$140 thousand from over \$170 thousand (Table 6 NYC Yellow Cab Trips and Revenues). Taking 15% as medallion owner’s share, an average Yellow Cab medallion earned a return of only \$21,000 in 2016, compared to \$25,900 just three years earlier, and \$30,000 to \$80,000 during its booming period.

4 Economic and Regulation Implications

4.1 Breakdown of Market Assumptions

Market functioning and values of the NYC medallions have been relying on one supply policy - restricting issuance of medallions and thus controlling the number of taxicabs on streets and one demand assumption - street hailing and pre-arrangement are two

different demand for taxicab services and can be met with two different service products. Thus, it goes that government can segment the market and designate different service providers accordingly and exclusively. It was further assumed there be growing number of street hailers out of growing economy, visitors, and residents who prefer not to drive or conscious of traffic congestion, air pollution, and inconvenience in driving, which has been mostly true. As such, the supply holds flat while the demand grows, medallion values and driver revenues are assured to rise – law of economics 101.

However, those assumptions, even if used to be true, have been disrupted by emergence and advance in technology-enabled ride-sharing economy. By 2015, 96% of NYC residents had owned mobile phones and 79% of those were smart phones [18]. Almost all taxicab riders can tap mobile apps or dial up from handset devices to pre-arrange a cab, anywhere and anytime, on streets or off streets. The lagging time between hailing and pre-arranging became no longer significant and meaningful. When there are enough taxicabs nearby waiting for the calls, callers can get the benefit of immediacy and convenience, almost no different (if not better off) from that of hailing Yellow Cab taxis. Even more, people would prefer to call their cabs prior to getting off flights, leaving restaurants and coffee shops, and from places of comfort instead of hailing in cold weather or in the rains. App-based on-demand pre-arrangement offers the benefits of instant planning and predictability. The demand for pre-arranged taxicabs has become hardly differentiable from street hailing, or at least the attributes used to enable riders to differentiate the two have diminished or blurred in riders' eyes. The two have become two units of one product that transports people, substitutable to each other, and should be regulated as one product [19]. The primary assumptions, upon which the NYC medallion market and government regulations have been based and functioning, have been fundamentally uprooted.

4.2 Ride-Sharing Economy

When demand for app-based riding rose and the number of Yellow Cab taxis on the NYC streets were restricted, FHV's responded by adding more vehicles and drivers. There were no FHV's legally permitted on NYC streets when the medallion system was born. But the number of FHV's was more than doubled to 80,881 and the FHV drivers increased by 120% to 122,997 between 2011 (the year Uber entered NYC) and 2016. For the same period, only 300 Yellow Cab taxis were added (Table 7 NYC Active Taxicabs and Drivers). More, 19,463 Yellow Cab drivers quit and most of them switched to FHV's. The net result is that FHV's outnumbered Yellow Cab taxis by 6:1; FHV drivers outnumbered Yellow Cab drivers by 4:1; and up to four drivers had to share driving one Yellow Cab vehicle by shift due to the medallion restriction. Uncapped licensing seemingly did give FHV's advantages over Yellow Cabs under the existing regulations.

Successes in business models like Uber's are not uncommon in the era of digital economy – eBay, Amazon, Facebook, Google, etc. Leveraging Internet and smart phones, they built platforms to connect and assemble buyers and sellers directly to create a market ecosystem, economy of scale, and even monopolies via “Size begets size” [20]. Different for Uber, a pioneer in sharing economy, it explores and exploits resources idle prior to the Internet economy – private cars at the times not being driven and personnel at the times outside regular jobs, which makes it theoretically possible

Table 7. NYC active taxicabs and drivers

Year	Drivers		Vehicles		Vehicle driver ratio	
	Yellow Cab divers	FHV drivers	Yellow Cab medallions	FHVs	Yellow Cab	FHVs
1937			13,595	0		
1964			11,787	2,513		
1992			11,787	27,613		
2000	35,160	48,271	12,187	41,813	2.9	1.2
2005	42,512	51,060	12,779	40,449	3.3	1.3
2010	49,129	53,755	13,237	37,782	3.7	1.4
2015	55,390	90,284	13,587	66,604	4.1	1.4
2016	30,488	122,997	13,587	80,881	2.2	1.5

for almost everyone to become an Uber driver and thus provides options and flexibilities in offering, scheduling, and pricing to compete. As it evolves and adapts to market demand and regulations, new features can be expected to address public concerns the medallion system initially intended to address – traffic congestion, air pollution, and safety. For example, dynamic pricing with surcharges can be explored to contain traffic through crowded areas; access to driver and passenger information and their mutual rating can be explored to improve safety. There are advantages over Yellow taxicab drivers who must earn or lease a medallion up front and adhere to stricter licensing criteria and regulated pricing.

Globalization and market size matters too. An estimated online advertising market of \$1 trillion has created the legendary Google and Facebook. The global market for personal mobility is as much as 10 times that [21]. Appealing to investors with the ambition to be another Google or Facebook, Uber has attracted \$18 billion in funding since its setup in 2010 and now carries a valuation closed to \$70 billion, the largest startup in history that raised the most money even before going public. The large capital enabled Uber to extend its platform and business model to more than 450 cities in 78 countries [22] and to build its fleets of autonomous driving for future. In contrast, the medallion system in NYC or the similar ones in other cities confine their taxicab service providers to a geographic locale, potentially blocking their riders from not only the benefits of sharing economy but also the prospects for Uber or any of its existing or potential competitors to replicate those legendary successes in an era of digital age.

4.3 Deregulation Trend

Consumers are standing to benefit from the ride-sharing economy. In the era of mass intelligence and digital economy, the new service mode of ride-sharing has made taxi riding more accessible and affordable, which helps grow the market. In 2016, total NYC taxicab ridership has got bigger, to 280 million, up 23% from one year ago. Meanwhile Uber and Lyft gained not only from the market incremental but also from what Yellow Cab lost: 5.3 million trips and 17.4% market share during the same period. If not lost to Uber, it would have lost to someone else who can materialize the

benefit. Technology is there, demand is there, and consumers are ready to make moves in their riding and opinions on taxicab regulations. Uber and the likes are in right places at right times. But nothing is assured who will be the eventual winner, facing evolving technology, increasing market competition, and regulations that certainly will adapt.

Though the perpetuation of the medallion system was the result of political process subject to more influence from interested supplier groups – owners, drivers, agencies, and creditors than from consumers, political winds seem to shift toward deregulations favoring Uber and the likes who run their business on national and global scale beyond localized monopolies. The advantage of financial power, easily identified common interest, and ease of organizing the medallion interest groups over insufficiency in funding and difficulty in organizing consumers (whose individual interests in taxicab market are scattered and ambiguous), is among the main reasons why the medallion system was perpetuated and lasting [23]. Now Uber, with sufficient funding, concentrated investor interest, and organization power in influencing law makers and public opinion, is up to the task to challenge the traditional order and medallion interest groups. It mobilized public support and launched political campaigns to change regulations. It started “principled confrontation” program in 2015, searching for compromises with local municipalities for entry into their markets. In the summer of 2015, Uber won against NYC and foiled the city’s efforts to cap the number of Uber vehicles on the grounds of traffic congestion [24]; in September of 2015, the New York City won a legal victory against three lawsuits brought by Melrose Credit Union, the largest lender who made almost \$2.5 billion in loans for 5,331 city-issued medallions and claimed it was illegal for Uber and other app companies to operate in New York City [25]; In May of 2016, the New York state senate passed bill to legalize Uber statewide [26]. Similar efforts and successes in other places have produced ordinances favorable to app-based services in more than 23 states in the United States.

The deregulation process of the taxicab industry has started and hardly can that be turned back by any foreseeable political winds. After all, the New York medallion is a “problematic private property” - created in the past, controversial in the present, and potentially burdensome in the future [27]. Instead of patching and reviving the medallion system, local and federal regulations should adapt and, progressively but decisively, catch up with technological innovations and changes in consumer demand. The essence is to let the free market play freely and let the once protected medallion monopoly adapt or die. Instead of holding Uber and the likes back, regulations will foster their growth, monitor their expansions, and intervene timely to prevent them from propelling into monopoly powers like Google, Facebook, and Amazon.

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