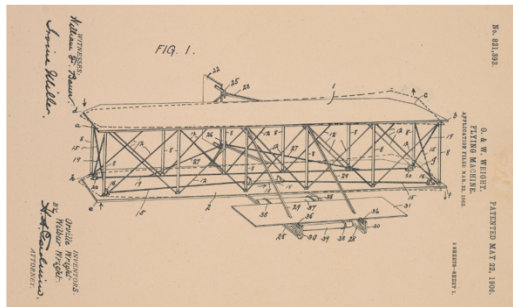


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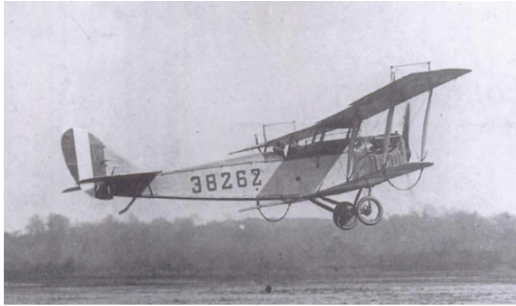
The important thing for government is not to do things which individuals are doing already, and to do them a little better or a little worse; but to do those things which at present are not done at all.

John Maynard Keynes, The End of Laissez-Faire, 1926

Man's relationship with the heavens found its inflection point in 1903 when a jerry-rigged plane defied gravity for a modest twelve seconds above the sandy dunes of North Carolina. Icarus' dream became a thing in the realm of possibility rather than mere fiction. Despite the brevity powered flight would no longer be circumscribed to literature but rather nursed into an industry by caretakers with ambition. The last frontier of the skies would be quickly colonized with the advent of mechanized aviation thanks to the Wright brothers who were the progenitors of this paradigm shift. A leap for mankind even greater than that of railroads and roadways came to underscore the metaphysical that perhaps civilization's destiny lay beyond the stars. The watershed thus had a practical as much as a cosmological significance for a people who began to look askance at whether they were meant to be earthbound. Airborne aspirations like these precipitated the momentum that saw humanity extemporizing flight to collecting lunar soil amidst Apollo's moonshot. From this cradle of aviation did a series of one-upmanship set about the creation of an industry that profoundly reshaped transportation. As technology matured flagship routes like New York to Paris that once took a fortnight by ship now required a few hours. Great change was afoot.



Original Wright Brothers Patent, 1906.

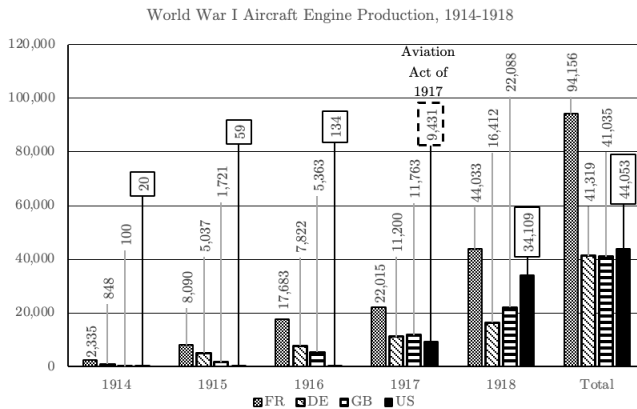
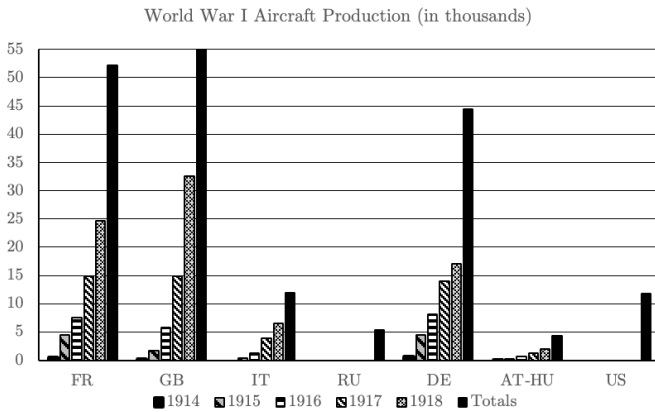


America's maiden flight of its air mail service, 1918.

Man's dominion over the sky was in the main an inheritance from industrial policies that later conduced to the novelty's commercialization. Indeed government procurement was the primary if not only impetus to the industry's growth in its experimental years. Widespread application was not a foregone conclusion as operations of manufacturers were scattershot with a handful of handicraft shops patronized by even fewer enthusiasts. Bereft of this monopsony the technology in its infancy would have withered on the vine were it not for the countenance by government contracts. Amongst the first acquisitions would be the Wright Military Flyer in a competition that enumerated a litany of desiderata for endurance and speed that the prototype abided by. The Army Signal Corps' \$1m selection in 1909 meant the aircraft was ipso facto the foremost machine to be the reconnaissance asset that stipulations alluded to. Likened to most major discoveries whether it was unlocking the latent power of the atom or the silent guardian of modern radar in the Battle of Britain it would be no different for the provenance of airplanes. Conflict invariably midwifes innovation. The Great War would thereby incubate the science of flight a few short years after the Army's initial foray into adopting the technology (Anderson 1976).

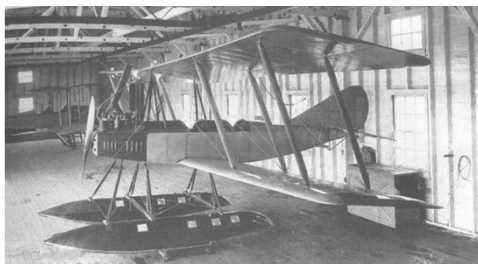
America's aviation industry first found its *raison-d'être* in the arms race of Europe's trenches across a spectrum of artillery spotting, dogfighting, and tactical bombing. Prior to hostilities planes were marginalized as little more than a sporting curiosity for civilian use but the furnace of combat compelled the Beltway to bootstrap the industry's growth in little time. In short order President Woodrow Wilson elected himself to be the patriarch for the National Advisory Committee on Aeronautics (NACA was the predecessor of NASA) in an attempt to restore parity with Europe's scientific breakthroughs. No longer a silent investor the government's new bureaucracy in

1915 vested with a budget of \$150k in today's currency sought to be the industry's skunkworks. A trove of technical reports on R&D between aerodynamics and applied aviation were generated by this intellectual nerve centre whose findings were imparted to a consortia of stakeholders. Once America shunned neutrality in 1917 upon the German Empire's provocations of unrestricted submarine warfare and its overtures of alliance with Mexico in the Zimmerman Telegram did Congress exploit the purse. A detached spectator no more another fiscal investment of \$640m by the government catapulted the industry from a backbencher into a vanguard as production ratcheted up for a high benchmark of orders.

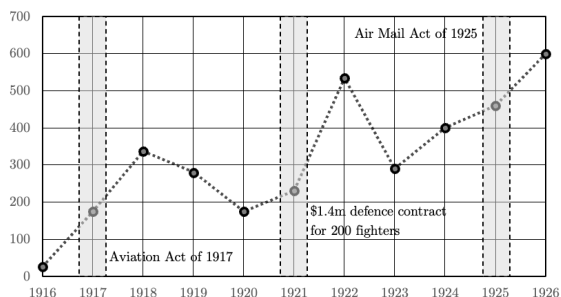


It was determined that the mobilization of manufacturers could remedy the asymmetry of capacity compared to Europe which had thrown down the gauntlet for air supremacy. Immortalizing the

fledgeling industry was then the endgame anticipated by the Aviation Act that promised production of 22,000 aircraft and 44,000 engines over an eighteen-month period (Hunt 2010; Murphy 2005). The Armistice only a year later pared down output to 11,754 aircrafts from the cessation of hostilities when military contracts petered out. But immortalize it did as neophyte manufacturers like the storied Boeing would partake in the downstream effects of President's Wilson's industrial policies. The direct stimulus from the government's war chest was de facto seed capital for the nascent company since the Navy procured its flagship product of fifty Model-C seaplanes in 1917 (Petrescu et al. 2017). Boeing girded itself for wartime production as a defence contractor even though it belied its size at the time. The company nevertheless scaled production from 23 employees to 337 at the war's peak to bridge the hardware deficits of America's fleet (Myers 2007). Despite the industry's existential crisis when the guns fell silent these procurement programs were a saving grace for Boeing's solvency with an injection of \$1.4m in 1921.



Boeing Employee Headcount, 1916-1926



Source: Stear 1997.

The contest of machines in the skies over Europe was where the emergence of America's aviation industry really began. Companies that were otherwise saplings hinged on state patronage in virtue of how markets were either amorphous or nonexistent. The Army Signal Corps' possession of two hundred aircraft and the Navy faring no better with fifty-four bore testimony to the stagnation of an

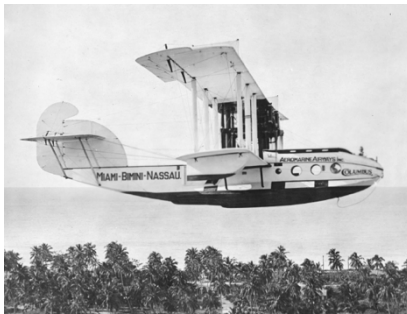
industry that had yet to embrace the future unlike Europe. As it was raring for accolades of leadership in production after inaugurating the age of flight on its own soil America would leverage policy to upset the status quo. The exigencies of war delivered the industrial muscle for scale and growth that manufacturers had been wanting. Redolent of a Keynesian stimulus the Aviation Act meted out contracts to artificially create a market around which companies rallied to industrialize and thus scale operations for profitability. Such rapid buildup erased the strategic vulnerability of underdevelopment and the ignominy of being an idle observer at the outset of the Great War. The \$640m of appropriations in nominal value or the equivalent of \$19b when adjusted for inflation really did come to epitomize the cardinal pivot for the industry after it originally languished as a laggard. The riveting transformation would presage greater exploits.

WINGED CHARIOTS OF MAIL

Industrial policy poured resources into aircraft production to address how woefully unprepared America was for the dawn of aerial warfare. But know-how was not what necessarily harried the industry. The core deficit and the thing most conspicuously missing was capacity and the scale economies therefrom. America was caught flatfooted since the Atlantic and Pacific oceans were moats that obviated any need for militarization unlike Europe's Old World revanchism. A species of military-industrial complex had long been an antagonist to peace on that continent because of imperial hubris. So America's isolationism throttled the industry until the law of supply and demand roundly reversed this lethargy to the point where even Ford motors was retrofitted and retooled for production. War created the market. A second bane to aircraft adoption was the paradox of how despite being an object of fascination the technology proved unviable other than monetizing the visceral thrill of flight for a niche market. The barnstorming of aerial acrobatics entertained the masses but a consumer market remained terra incognita. Widespread adoption of the motorcar was a function of practicality which had a natural ally in the omnipresence of roads whereas planes were scarce and airfields scarcer still. Seawater conversely was abundant.

In the wake of WWI when assembly lines once teemed with aircraft these selfsame bastions of production became subdued as America found itself awash with a surplus of inventory. The sunk costs of

mothballing this technology would have squandered an opportunity until the Aeromarine company and others of its ilk commercialized sea routes in 1920. A fire-sale of these warbirds with a markdown of 90 percent denied the fatalism that awaited them with the maritime frontier now repurposing their fuselage (Leary 1979). This rebirth from a hunter of submarines to a mail-passenger carrier allowed aircraft to remain useful after the spectre of war had gone. It was pure alchemy. The detritus destined for scrapyards avoided liquidation and was turned into gold. Aeromarine's business strategy would then be to convert the Navy's Curtiss F-5L seaplanes for two international routes between Florida, Cuba and the Bahamas. A ferry crossing which might have taken half a day was promptly truncated down to one hour. These planes that would have otherwise rusted into obsolescence commoditized transit into carrying upwards of thirty thousand travellers in four years (Davies 1987). Offloading stockpiles for such application also redounded to public-private partnerships in the guise of postal contracts for Aeromarine.



Aeromarine's F-5L mail and passenger service, 1920.

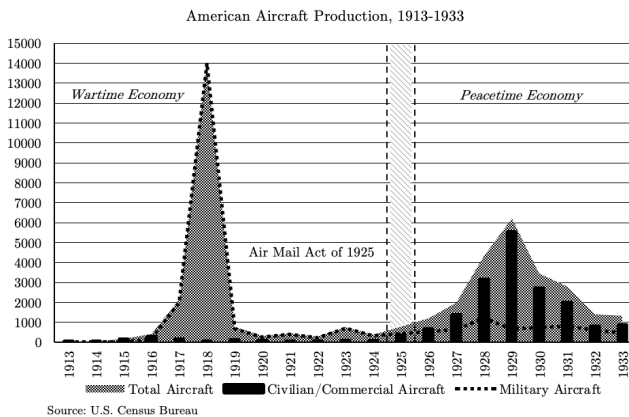


Aeromarine's sea routes, 1920-1923.

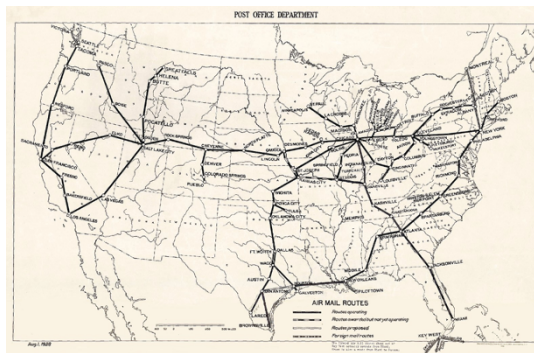
The first marriage of state and commercial interests for flying letters to their destination would underwrite the industry's buildout in 1920. Aeromarine's blueprint was emulated at scale five years later with the passage of the Air Mail Act after the learning-by-doing stage had ended. This prototypical initiative was not almsgiving but rather a full-throated vote of confidence for the future of aviation. Aeromarine's archive of operations was to be a proof-of-concept that dispelled the skeptics who looked upon the industry's profitability as suspect. Not only was the geometry of communication upended but the glut of aircraft found a second life in a peacetime economy. The airmail sector signalled to policymakers once and for all that planes were not playthings for dilettantes nor were they a crackpot idea but rather a legitimate business. The Postmaster gave a ringing endorsement for Aeromarine's viability by paying \$20k in its first

year to fly 500 pounds of mail each day and a \$1.68 bonus per pound of special postage (Leary 1979: 185). The company also padded profits by bootlegging throughout Prohibition with the import of Cuban spirits or flying passengers to places of hedonism like Havana where they could tipple (Bilstein 1993: 276). Rather than a footnote in history Aeromarine fructified the industry in a prologue to so much more.

With the efficacy of this pilot program assured after some stocktaking the Air Mail Act of 1925 wed the public good of postal service to aviation (Bilstein 1996). Where the government had created a market sourced in war eight years earlier now a peacetime economy would plumb the commercial virtues of these flying contraptions. By parceling off parts of its monopoly over mail the government opened the floodgates for private enterprise to fill this void as a fillip to the industry. Quasi-privatization laid the foundations for the future of manufacturers and airlines. It stands to reason that the architects of this legislation were well acquainted with mail routes doubling for human transit as they did under Aeromarine's contract term. Such maximization of payloads from cargo and passengers alike to eke out value from all angles of operation was in itself an impetus to aircraft design in material science. Weight economies and streamlined shapes drove profit and so aluminum was embraced as the darling of the aviation industry due to its tensile strength-to-weight ratio. By letting capitalism loose upon the transport of letters the Air Mail Act incentivized innovation alongside the influx of private capital where little might have existed before. The power of competition thereby heralded the commercial use of aircraft.



The industrial policy was dead set on the promotion of manufacturers at home as it was laced with protectionism to prohibit the use of foreign aircraft. A stable revenue of 80 percent from the sale of airmail stamps for each route could be had under the caveats that only domestic planes be flown and three-fourths of carrier ownership be American (Van der Linden 2002). Lesser contracts on feeder routes were first doled out to separate the wheat from the chaff until the proficiency of companies merited more lucrative corridors like New York to San Francisco. Out of the woodwork came many suitors like Ford's aviation division or Boeing which vied for a share in this lattice of skyward highways. Rather than speculative Ford's \$2m investment in aircraft lent credence to the industry as it spotted market trends towards air travel en masse. The company put its faith in this diversification not as a hedging strategy but for the reason that its automobile disruption could be extrapolated onto an enterprise where much pent-up demand abounded. A second reason alluded to cost leadership by exerting greater control over production. A quick pipeline supplying car parts between factories in Detroit and Chicago inspired the consolidation of planes into the anatomy of supply chains by way of vertical integration.



U.S. Post Office Air Mail Routes, 1928.

Lo and behold Ford would become such a doyen of this route between both metropolises that the Postmaster General conferred to it the first airmail contract in 1925. Thereon the company plied its 2-AT model whose designs informed the debut of the 4-AT Trimotor variant that later took to the skies in symbolizing a new benchmark. This powerful plane mainstreamed the commercial aspect of aviation in the public's consciousness. Heightened capacity would democratize air travel as it dovetailed to the plane's safety profile whereby the redundancy of three power plants attenuated the vertigo amongst the more discerning flyer. Longer range, fuel

economies and less downtime ascribed to the unimpeachable airframe composed of corrugated aluminium further enshrined the design as one to imitate. Innovations of this sort were precisely what the industrial policy of the Air Mail Act envisaged. Ford would capitalize on the emerging market and flew 4,115 trips for the Post Office boasting a 94 percent completion rate with weather cancellations being rare (O'Callaghan 2000). But this heyday was ephemeral when the Great Depression soon impinged on operations. Headwinds from retrenchment meant the capital-intensive venture could not be kept aloft so it shuttered to instead privilege the company's core competency of automobiles.



Ford's 2AT Model Aircraft, 1925.

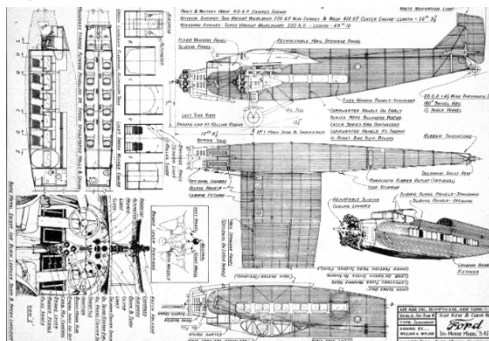


Ford's 4AT Model Aircraft, 1927.

Ford Aircraft Production by Year and Model, 1925-1933

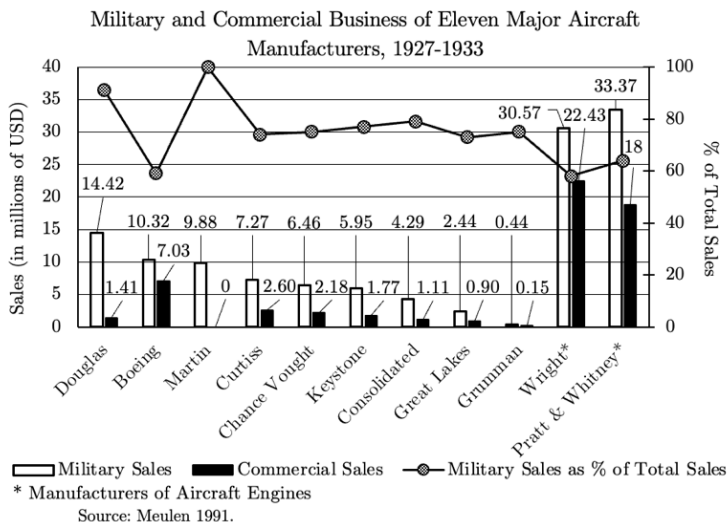
	2AT	3AT	4AT	5AT	8AT	14AT	X (Experimental)	Total
1925	6	1						7
1926			2				1	3
1927			12				3	15
1928			38	17				55
1929			25	68	1			94
1930				10				10
1931			1	19	1			20
1932				3		1		4
1933				2				2

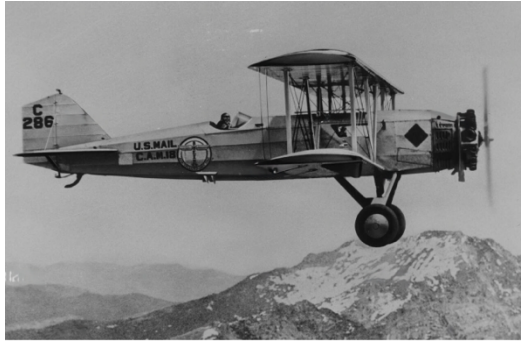
Source: O'Callaghan 2000.



Ford's 4AT Model Aircraft Schematics, 1926.

Boeing on the other hand was not overextended like the automaker nor was it estranged from this proverbial watering hole left by the Air Mail Act where companies drew sizeable income. The company's sights however were much loftier in its bid to secure the coveted Chicago-San Francisco route which might as well have been analogous to the riches of the Silk Road. This contract was to Boeing what the discovery of the New World was to the British Empire. The Model 40 stood head and shoulders above competitors and was uniquely suited to be the workhorse for this twenty-six hour long haul. A payload in excess of twelve hundred pounds and the throttle to match from a 420-horsepower engine under the artistry of Pratt & Whitney enabled a speed of 128mph and a range of 650 miles (Dow and Daub 2007). Post-acquisition Boeing would carry 837,211 pounds of letters and 149,068 pounds of express packages in its first year on twenty-four of these magnificent specimens of a machine (Stear 1997). By the end of the 1920s one-third of America's air mail was monopolized by this aircraft. The Post Office's golden ticket came to make an empire out of Boeing's market position. In the company's precocity it pivoted very early away from military production at odds with industry peers and in so doing captured commercial aviation.

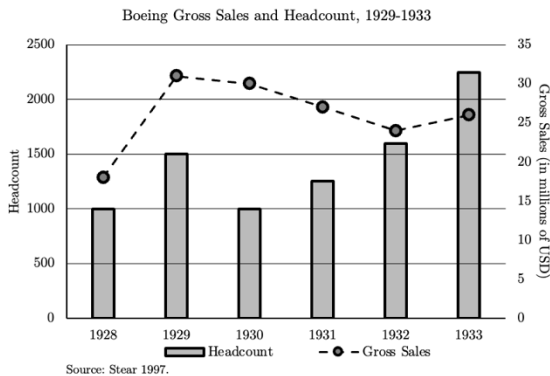




Boeing's Model 40-A Inaugural Flight between Chicago and San Francisco, 1927.

THE BIG FOUR

The industrial policy of the skyway contracts stoked the development of companies which had hitherto been operating in hardship on shoestring budgets to remain solvent. This incentive structure was the scaffolding that braced aviation which had initially been deprived of a commercial identity with the legacy of WWI's military procurement still looming large over production. All of a sudden a Cambrian explosion in business came to manifest in the aftermath of the Air Mail Act. A number of these small outfits would grow into the legacy leviathans we know today that dominated for the better part of the 20th century. In Boeing's case its headcount increased fivefold from 313 to 1500 personnel within a decade because of the stimuli from airmail routes. Hence the quintessential market force that is competition set off a spree of innovation to capture marketshare in a growing industry that did not exist a few years earlier. Government proffered a springboard and bullish industrialists pounced. Some of the most iconic marques in the pantheon of aviation including Trans World Airlines (TWA), Pan American Airways (Pan Am), American Airlines and United Airlines each found their origins not inside boardrooms but from the fount of this industrial policy. What was once a hobbyist venture mutated into a technostucture with expanding fleets.



The structured subsidies inherent in the airmail contracts financed the TWA's predecessors prior to the spate of oligopolies from mergers which the late 1920s bookended. Western Air Express was the first carrier that preceded the esteemed airline and was a beneficiary of government largesse. The company serviced the Commercial Air Mail route between Kansas, Los Angeles and Salt Lake City or otherwise denominated as CAM-4 in 1926. For the fiscal year of 1929 two Douglas M-2s flew this dense skyway to the profit of \$870k in nominal value or \$15m in real value when adjusted for inflation (Jones 2003; Van der Linden 2002: 108). This artery of communication was so prodigious in pecuniary promise for Western that its margins enabled it to dedicate a separate passenger line along the same route. No longer having to hooverize space between cargo and clients this peculiarity differentiated the company from competitors which did not have the luxury of segregating operations. To curate customer experience Western acquired a more commodious aircraft that could seat twelve passengers as in the Fokker-10 whose manufacturer was governed by the controlling interest of the carrier itself (Van der Linden 2002: 38). Four years on from its maiden flight on CAM-4 did the giant find common cause with another.

The second piece of the jigsaw puzzle that became TWA was Transcontinental Air Transport (TAT) founded in 1928. This airline's business model was a departure from its contemporaries in that it uniquely catered to passengers. Although omitted from the roster of airmail routes the company's technocrats were steeped themselves in the workings of such traffic. The mastermind behind TAT's transcontinental route was none other than Charles Lindbergh who had intimate knowledge of aircraft that he imbibed from piloting CAM-2 between Chicago and St. Louis (Duffy 2010). Lindbergh's

recruitment to helm the technical aspects of TAT buoyed its brand appeal since he rose to prominence with the first transatlantic flight between New York and Paris upon the Spirit of St. Louis plane. The lone aviator who was learned in optimizing routes between airfields and refuelling stops became highly sought after as his daring feat beguiled the public into relinquishing their skepticism over flight. The constellation of mail routes Lindbergh once plotted would obliquely inform TAT's hybrid service that ferried passengers from New York to Los Angeles in under forty-eight hours. Daytime legs were flown by plane that were interrupted by nocturnal transit via trains on a nonstop itinerary. This seamless coordination later coloured the future of TWA.

It was Black Tuesday in 1929 that wiped out billions in market valuation which was the primer for the wave of mergers in the aviation industry. The economic contraction from the credit crunch lost \$746k on TAT's balance sheet in retained earnings thereby making the safe refuge of a merger more hospitable (Van der Linden 2002). The union between Western Air and TAT to form the TWA manifested into an antidote against the Darwinism of the Great Depression. Fortunately for the two airlines their struggle for profitability was staved off by the partnership which became greater than the sum of its parts as history would adjudicate. In 1930 the industry welcomed TWA into its bosom that later became the stuff of aviation lore pitting the company against Pan Am both of which jockeyed for exclusive rights over international routes. In the preface to this saga the TWA secured the Post Office's longest route dubbed CAM-34 between New York and Los Angeles. The mastery of this transcontinental skyway sowed the beginnings of TWA's airborne empire. Lessons from this learning curve were to be imported for inroads into European and Asian markets. CAM-34 proved to be less a route and more of a dress rehearsal towards exotic destinations. The wellspring for this triumph again was no other than the Air Mail Act.



Yet a public outcry would emerge where allegations of cronyism scandalized the industry as the Postmaster General was believed to be partial to larger airlines with mail routes akin to the quid pro quo of an old boys club. The controversy prompted President Franklin Roosevelt to abrogate all contracts and reverse this cartelization by turning back the clock to when the onus of service rested on the Army Air Corps. Had Roosevelt read the tea leaves he would have surmised how the Army lacked the know-how for the rigours of air mail. This folly led to the deaths of twelve airmen in two months. Night-flying and blind-flying were skillsets mastered in the main by commercial pilots who relied on avionics to navigate fogs and storms lest they be disoriented. Out of the contingent of 250 pilots deployed for this stopgap a mere 31 of them had more than fifty hours of nighttime experience in an ethical blunder architected by Roosevelt. Army pilots might have had the bravado and bravura for combat but civilian airmail was beholden to an entirely different schedule. Routes were largely flown at night in inclement weather and snaked around terrain with elevations jutting out haphazardly (Correll 2008). Nature's fury beset airmen most acutely as they discharged their task in the thick of winter. The Air Mail Fiasco got much worse from there.

There was the medley of military aircraft enlisted for operations which were inapt for the vocation of cross-country sorties that exacerbated the task of airmail. Some of these spartan machines were even devoid of lights inside the cockpit which spoke to the Army's philosophy of placing function over form. This misapplication of military assets was prone to accidents where internal cavities laden with mail bags might suddenly see their centre of gravity shift due to mid-flight turbulence. Control inputs to mitigate the pitch or roll were alien to pilots unversed in the science of flying such cargo. Boeing P-12 Fighters were then jettisoned after the first week in favour of the Douglas O-38 reconnaissance aircraft although the latter was not ideal either with a payload limited to 160 pounds. The skies quickly turned into a charnel-house within a fortnight as ten airmen perished. Roosevelt's caprice to shoehorn military hardware into the civilian logistics of airmail aroused the public's wrath that would browbeat him into a tactical retreat from his errant policy. The imbroglia really did become a third rail for the Oval Office after its ad hoc policy charged the Army with a task for which it was illiterate and that ran afoul of its mission. The Army's very brief tenure as a courier saw 66 crashes at a time when expertise was forsaken for expediency (Correll 2008).

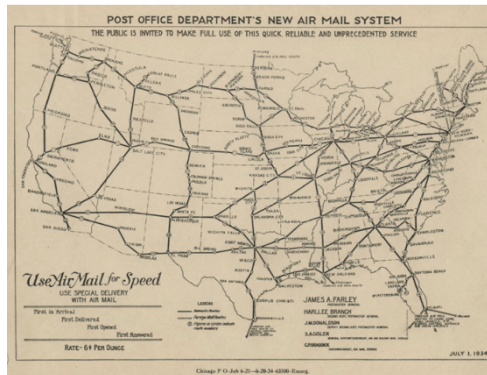


Boeing P-12 Fighter for the Army Air Corps, 1934.



Douglas O-38 Reconnaissance Aircraft for the Army Air Corps, 1934.

Three months after operations had debuted the new Air Mail Act of 1934 restored commercial service with two major provisos: (1) vertical and horizontal integration between airlines or their affiliated manufacturers would be disaggregated to diversify markets; and (2) all past contracts were annulled and reopened to blind bidding for the sake of a meritocracy within the industry. The first provision that severed the umbilical cord between the subsidiaries of conglomerates galvanized a rush of innovation when airlines were no longer captives of their parent manufacturing divisions. The breakup of vertical monopolies meant airlines with their new autonomy could now sample and source the offerings of other makers. The United Aircraft and Transport Corporation was therefore sundered by the industrial policy into United Aircraft, Boeing and United Airlines. The horizontal monopolies of airline holdings did not escape the antitrust law either. The Aviation Corporations' clutch of subsidiaries were also cleaved into American Airlines and other fledgling carriers. So the reform courtesy of the Air Mail Act of 1934 reinserted market competition into an industry whereby companies vied for marketshare not through backroom chicanery but through efficacy and innovation. The skies were no more the playground of monopolies.

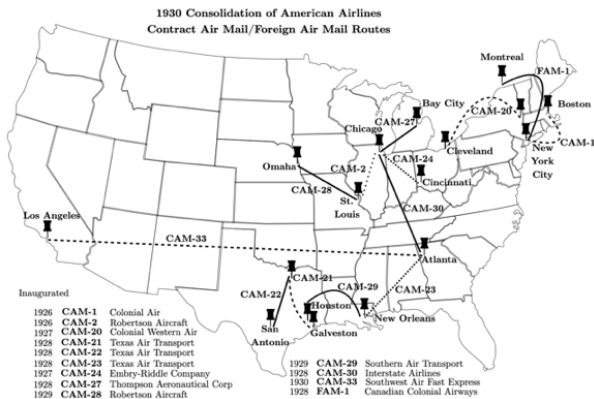


Post Office Air Mail Routes, 1934.

American Airlines was rebranded as such from American Airways during this restructuring. The name went beyond semantics or a cosmetic change. For many companies espousing a new nomenclature it signalled to the public that the contours of their business model would adhere to the sudden rise in passenger traffic. What better way to articulate this strategy than to import the lexicon of ocean 'liners' which ferried people to their destinations as did 'airlines'. The parallelism seamlessly put customers at ease whose experience would be crafted to emulate the sea-borne comfort they had long been accustomed to. The industry transposed a whole glossary like First, Second and Steerage versus First, Business and Economy or rhetoric like 'galley', 'cabin' and 'deck'. A linguistic tenor shared with the industry's competitors of floating palaces ensured that the perception of new flyers would still be moored to the romance and traditions of the oceans below. Airlines then adopted a new identity so they may distance themselves from being the workhorse of airmail towards capturing the marketshare of a new demographic as lower prices democratized travel piecemeal. American Airlines was amongst those which elected to rebrand so it may garner the positive market reception for its push and its longevity vouches for the success.

Much of the reason for the airline's immunity against time lives in its genesis. Every single incumbent today flew many if not the most salient CAM routes which were incubators for passenger aviation. Industrial policy of the Airmail Act by and large financed the future of this development. The revenue for these fledgling enterprises predominantly derived from government and this cash-cow boasting a steady stream of income was what companies availed themselves of for growth. The revenue was ploughed back into R&D whether for

aerodynamics or fuel economies with the aim of downmarket stretching whereby ticket prices could be lowered to increase sale volumes. Stretching the offerings of travel to a lower market segment would yield higher profit margins as airlines courted the middle-class. The industry thus converted a luxury into a norm since the handsome premiums from a niche market populated by the elite were unsustainable in the long run. Here lies the two disparate vantage points in the saga of the Air Mail Act. For companies the legislation epitomized a cushion of capital infusion for the sake of bolstering their balance sheets with little risk. For government the legislation was a totem for a loftier ambition of democratizing the skies. American Airlines would be an instrument of this altruism.

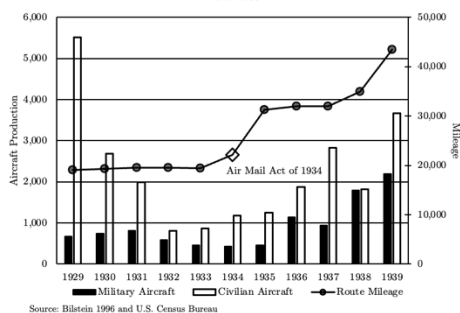


THE WATERSHED FROM MAIL TO PASSENGER REVENUE

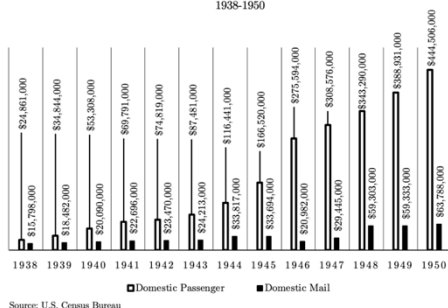
Ledger books compelled American Airlines to diversify its business model and set greater store in passengers with the advent of the Air Mail Act of 1934. The pivot was an existential one since this market of travellers was no longer peripheral and the fiscal sustenance of airmail grew modest by comparison. Whereas in 1931 roughly 85 percent of revenue was under the auspices of CAM routes and 15 percent from passengers by 1935 a near parity of earnings prompted a transition towards society's itinerants (Airports Council 2019). Three years later the operating revenue from passengers exceeded airmail by 45 percent. Airline route mileage manifestly rose then following this artifact of legislation. The red-letter reason behind why the industry came to be turbocharged gives vent to the incentive

structure previously fostered under the Air Mail Act of 1930. In the most laconic of descriptions the former policy rewarded size. The larger the plane the better. Heretofore the remuneration of airmail hinged on weight but now it was instead premised on payload dimensions. To exploit this new parameter it was incumbent on airlines to maximize their cubic footage if weight was to be given short shrift. Space was the new currency and airlines began to adopt larger aircraft for the dual revenue stream of mail and passengers.

American Aircraft Production and Route Mileage of Airlines, 1929-1939



Operating Revenues of Airlines between Domestic Passenger and Mail Service, 1938-1950



At the outset American Airlines might have been a mail carrier with a few seats to spare but the incentivization of space heralded a Eureka moment turning the company into a bona fide gateway to the skies for passengers. The Air Mail Act of 1930 re-engineered the DNA of aviation overnight with the implicit premium on these patrons. This renaissance changed the optics of air travel from pragmatism to comfort akin to the experience atop the deck of an ocean liner. The industry no longer saw itself tethered to the transport sector as it began to interface with hospitality and tourism. Later in the postlapsarian world where an unholy alliance of business and government culminated in the Air Mail Act of 1934 American Airlines would liaise with the Douglas Aircraft Company to offset the

new cutbacks. The airline harboured a desire to begin an overnight service for transcontinental flights upon an aircraft that was fast and spacious. Douglas was cowed into producing such a machine bejewelled with a dormitory for onboard passengers to sleep since the commission came from its largest buyer (Leary 1992). The DC-3 seating 21 to 32 souls would be based on its DC-2 sibling. Endowed with a cruising speed of 180mph the plane generated enough income bereft of any airmail revenue which itself began to free fall.

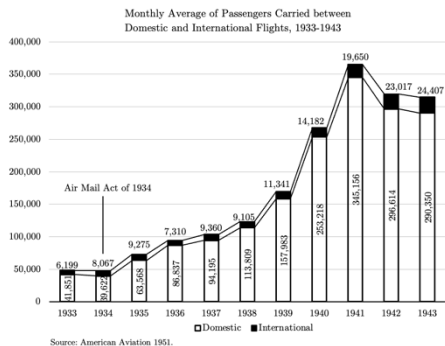
The newer industrial policy proved to be a clarion call for such innovation with the impulse to maximize earnings from passengers. From the ateliers of Douglas emerged a frontier technology so profound it redefined flight from a luxury into a utility. The socioeconomics was indelibly a function of the plane's engineering. A range of 1,500 miles coupled with a lower cost per mile calculus and punctuated by larger capacity would in concert laud the aircraft as a runaway success. These metrics eclipsed the nearest competitor of Boeing's 247 which could scarcely travel 750 miles. Douglas' flying salon was leagues apart from other designs so that by 1939 over 90 percent of the world's airline traffic boarded this skyward locomotive (Smithsonian Institution 2020). This prodigious figure and the DC-3 itself were the poster child of the Air Mail Acts. Claustrophobia may have once been the *bête noire* of air travel but it became an anachronism in this new age of aviation with the DC-3 as its protagonist. American Airlines capitalized on this aircraft's magic within the brief interstice between the new Air Mail Act and 1938 when passenger miles rose 150 percent (Leary 1992: 39). From the company's inception it had lamented a burn rate of \$758k per annum until this first positive cash flow upon flying the DC-3 for just a short two years.



Douglas DC-3, 1935.

The wisdom of remunerating capacity over weight was the original muse for the take-off of airlines and aircraft. Once the impetus of

payload factored into the equation and airmail revenue subsequently dried up a race for innovation saw Douglas' form factor adopted by the firmament of aviation. Passenger service would come to epitomize the Cinderella of airlines as it was no longer subordinated to airmail. The scale economies wrought by the Douglas DC-3 engendered this epiphenomenon as the greater number of passengers minimized operating costs. In pithier language it meant more people and cargo could be flown for less money at 27 cents per ton-mile (Isard 1945). Dramatic reductions in expenses were leaps and bounds ahead of rivals which went on to vouchsafe the latitude for curbing airfare. If the Air Mail Act of 1934 sought to democratize the skies then the DC-3 prosecuted the mission. Even the aircraft's rationalization of fuel and range saw fewer landing fees and less layovers that reduced overhead by circumventing ground crews and their wages. The fiscal advantages of counting this plane amongst a fleet spoke to why it conquered the skies in short order. American Airlines' own alacrity of procurement in droves would be what fortified its competitive advantage over marketshare.



Costs of Air Transport			
Aircraft	Payload lbs.	Total Cost (direct and indirect) in Cents, Capacity Payload	
		Per Mile	Per Ton-Mile
DH (1920)	600	48.3	161.0
Ford (1925)	3,200	69.3	43.3
Boeing 40 (1927)	1,200	43.6	72.7
Lockheed Vega (1929)	1,350	38.1	56.5
Boeing 247 (1933)	2,800	51.9	37.2
Douglas DC-3 (1936)	5,000	68.6	27.4

Source: Isard 1945.

Aircraft Utilization of Domestic Airlines

Aircraft	No. of Engines	1940	1945	1948	1949	1950
Beechcraft	2	....	1	6	....	....
Boeing 247-D	2	35	....	1	....	....
Boeing SA-307B	4	3	4	5	5	5
Boeing 377	4	....	....	....	10	10
Consolidated	2	....	....	16	93	103
Convair						
Douglas DC-2	2	42	....	....	....	....
Douglas DC-3	2	145	314	442	398	388
Douglas DST	2	39	....	....	....	....
DC-4	4	....	....	151	160	150
DC-6	4	....	....	54	104	111
Lockheed Electra	2	34	1	4	....	....
Lockheed Lodestar	2	4.4	18	12	11	11
Lockheed	4	....	....	32	55	83
Constellation						
Sikorsky	2	6	2	....	....	....
Stinson Motor	1	....	11	7	....	....
Stinson Tri-Motor	3	2	4	....	....	....
Martin 202	2	2	4	....	....	....
Curtis 46	2	....	....	....	2	....

Source: American Aviation 1951.

So the seesaw of industrial policy nourished commercial aviation by the paternalism of government until airlines and manufacturers had matured enough to optimize their revenue streams. By the time the proverbial noose of the Great Depression tightened around airmail contracts companies had already outgrown their dependency. Leaner earnings decoupled the industry from government as the former embraced passenger service to fill the void. In 1934 airlines flew a meagre 475k passengers but by 1940 this number soared over 146 percent. The economic imperatives of the contraction in the business cycle abreast of the sunk costs in payload-friendly aircraft found opportunity in whisking the middle class away to faraway destinations. The fanfare around airmail had begun to give way from its heyday as its viability waned which the Air Mail Act of 1934 symbolized. The spirit to defy gravity from commoners would instead be where airlines and manufacturers rediscovered their identity. Fleet expansions together with the proliferation of routes were obvious harbingers of this renewed focus on arousing the wanderlust of consumers. The planes themselves lent credence to this divergence bespoke by their plush interiors, berths and in-flight dining. The gimmicks knew no bounds in seducing passengers.

AIR MAIL ACTS EXPLAINED

The manifold of amendments between the Air Mail Act of 1925 and 1934 fertilized the growth of the aviation industry. It was government munificence that provided a linchpin of capital for operations as it hedged against risk for companies to expand through adventurism. Rather than some throwaway aberration such subsidies have long been a leitmotif in the development of commerce. From the Phoenicians whose rulers bolstered their merchant fleets or their outposts like Carthage with bullion to Britain's dominion of the seas the use of subsidies has been the sine quo non in scaling business. The rough-and-tumble world of markets beseeches governments to isolate industries until they are more resilient in the prelude to them being stand-alone incumbents. United Airlines similarly evolved from its ragtag roots into a legacy company under the aegis of industrial policy as a way to overcome economic inertia. Market purists in their Manichean worldview malign this use of public funds but America became a world industry benchmark as a result of them. It only took a decade from the enactment of the Air Mail Act of 1925 before passenger revenue exceeded airmail subsidies. The *deus ex machina* of this industrial policy unilaterally created the aviation industry by its influx of capital.

United Airlines came to be uniquely positioned as a prime mover of world aviation but it was only so under duress. The Air Mail Act of 1925 winnowed out the couriers which could not withstand the entry barriers to its new market. Spoils were reserved for the most resourceful companies hewing to performance metrics prescribed by the government. These stragglers would soon be offered an exit strategy via buyouts from competitors so as to acquire additional routes, fleets and clients in a show of corporate cannibalism that saw a bevy of consolidations. A paucity of wherewithal and know-how was invariably the death-knell for most. Survivors that were triumphant were those which could see beyond the next fiscal quarter and it was the seizure of profitable routes that guaranteed such longevity. After this attrition by 1930 the skyline of American aviation was carved up amongst an oligopoly christened the Big Four. From the Hobbesian war of the market between its barrages of operational costs and fierce bidding did there emerge American Airlines, United Airlines, Eastern Airlines and TWA. Once the dust settled the Air Mail Act of 1930 was more of a coronation than a moment of stocktaking when routes were reappraised with perquisites. The dominant market position of these four would later become the stuff of legends.

Despite allegations to the contrary the oligopoly in the aviation industry was the product of natural selection. The ‘Spoils Conference’ of 1930 where the lion’s share of routes were doled out in backrooms to major conglomerates was a crescendo of the breakneck competition that preceded it. In reality the invite-only conference should be adjudicated through a prism of ambivalence. Whispers of favouritism did inform the parley but these stakeholders had proven their merit for the reshuffling of coast-to-coast and feeder routes whilst also retaining exclusive rights to them (Wolfram 2004). Deference to these industry leaders in the guise of such a conference was a *de jure* assent to a *de facto* reality that from a pool of 45 prospects only 4 champions emerged in the survival of the fittest. The cutthroat parameters of the market were themselves the catalysts for the oligopolistic structure that was left standing in the epilogue of the competition. President Roosevelt’s caprice when he later legislated reforms to atomize contracts was blinkered to how these monopolies were the offspring of what was already a meritocracy. The economies of scale achieved by the Big Four with their resort to mergers when the industry was analogous to the Wild West issued from shrewd business alone hence the reason for their immortality now.

As the government spun off its airmail routes in 1925 United Airlines’ precursor and later subsidiary Boeing became the spearhead of the holding company that would follow. The airplane manufacturer and its arm of transport service were the tentpole of what later evolved into a veritable institution in American aviation. The synergy of these two companies in their vertical integration might be analogized to owning a goldmine and its mint. A direct pipeline between the two meant state-of-the-art technology could be seamlessly transitioned from the drawing board to the skies as another addition to the fleet. This just-in-time application and real-time data therefrom telescoped the production cycle by orders of magnitude enabling Boeing to swiftly pivot into the second generation of its Model 40. The Model 80 graced the azures after a quick three-year span from the original platform manufactured in 1925. For a subject that is never broached it is interesting to see how the business models of Ford and Boeing shared a predilection for the vertical integration of value chains. Both companies were manufacturers and each held eponymous airlines as the two were suppliers and customers of their own products. Lateral thinking of this sort was a desiderata for the competition that coloured the early years of aviation.

Although Ford would later abort its foray into the industry Boeing continued with airplanes and their rapid induction into service in the years preceding the company's strategic merger. United Airlines then inherited the legacy route of CAM-18 for its operational grid and the in-house prerogative of priority access for the first airplanes off Boeing's production lines. This privilege was what pushed United to the front of the queue in standardizing its fleet with the Boeing 247 upon its introduction in 1932 as 59 units were ordered (Johnson 1974). Although the technology was relegated to a position of lesser prominence since the Douglas DC-3 upstaged it two years later the aircraft did attract passengers into United's fold as long as it lasted. The standout feature of this aerial locomotive was its power plant of Pratt & Whitney Wasp engines which supplied it with an ample amount of throttle for a cruising speed of 180mph. Another audacity of design was the novel aerodynamics from a retractable landing gear which streamlined the profile to reduce drag. United Airlines would end up investing \$4m into the acquisition of these capital assets. A third inheritance for United was Boeing's value-added service of differentiating itself within markets by having stewardesses aboard flights to humanize the experience which was the first (Johnson 1974).

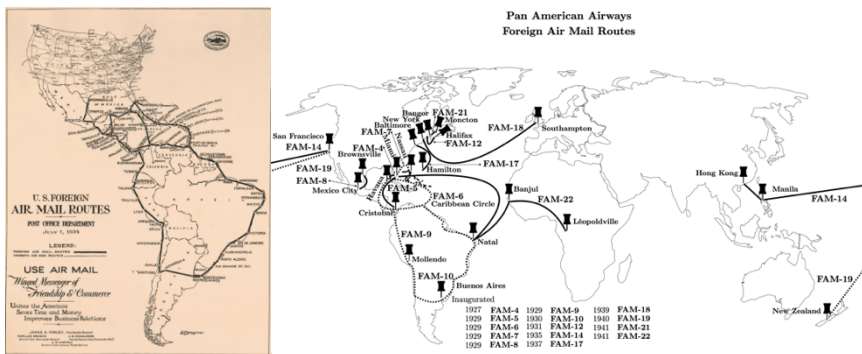


United Airlines' Boeing 247, 1933



PAN AMERICAN'S CAMELOT IN THE CLOUDS

As the Big Four cemented their hegemony over the domestic market an iconoclast busied itself on a more cosmopolitan business model faraway from America's shoreline. Pan American Airways did espouse the same core strategies of expansion as the airline quartet but it also set its gaze further afield whose mimicry was writ large by comparison. Whilst the consortium embroiled itself in a wrangle over CAM routes the contrarian cornered Foreign Air Mail (FAM). The virgin skies of international routes contrasted with the hive of saturated markets and fratricide between the initial 45 competitors vying for domestic contracts from the Air Mail Act of 1925. The economics of a turf war fraught with overcrowded airspaces was incentive enough for Pan Am to market itself as a passport to the world by setting a premium on foreign flights. In the parlance of industrial economics Pan Am's ownership of these skies begot a first-mover advantage as it was the first entrant in the market (Lieberman and Montgomery 1988). Rather than be mired in the parochial scuffle between carriers in their backyards the airline would exploit the asymmetry of its prime position. A monopoly over Latin America, the Caribbean, Asia and Europe generated so much scale economies and brand reputation that these ostracized competitors in the future.

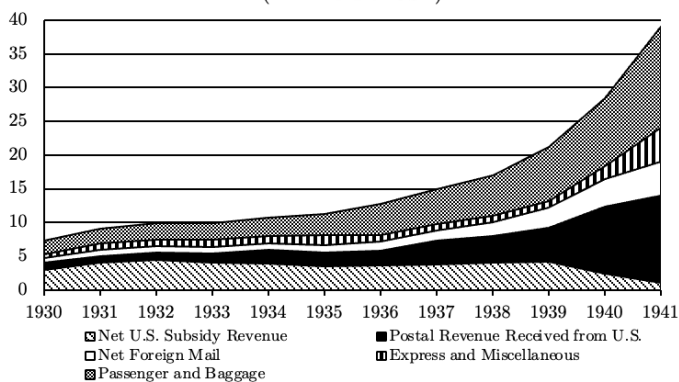


Foreign Air Mail Routes, 1934.

Pan Am did not shore up its primacy in an economic vacuum but instead via industrial policy. Geopolitics was inextricably linked to FAM routes such that the airline personified Washington's wings as a handmaiden to the State Department with certain preferential treatment (Benson 2004). Pan Am's monopoly therefore became a function of statecraft to Americanize Latin America and serve as an avatar for the 1823 Monroe Doctrine by establishing a protectorate

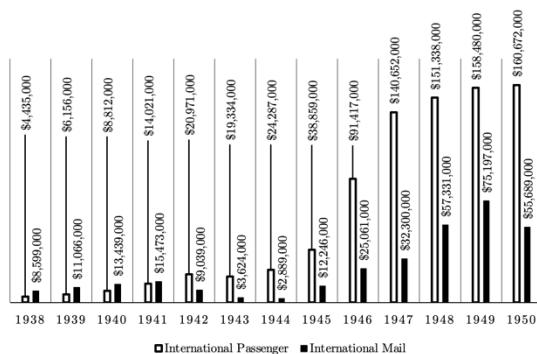
over the region. The Foreign Air Mail Act of 1928 would articulate the degree to which the government invested in the airline's marketshare to fend off the vestiges of colonialism from Europe which flew airmail in the Americas. Industrial policy saw in Pan Am an emissary to champion interests abroad hence the conferral of FAM-5 between Miami and Panama that paid a lucrative \$2 per mile for the 4,000-mile trip (Homan and Reilly 2000). Lawmakers surreptitiously made sure the airline could run roughshod over any competitor despite the transparency in the bidding wars for contracts. How these machinations materialized was through the legalese that left it up to the Postmaster's discretion to cull the 'responsible' bidder in determining their eligibility (Smith 1991). This carte blanche empowered Pan Am to muscle out competitors and usurp operations akin to the Big Four's biography.

Consolidated Revenues of Pan American Airways, 1930-1941
(in millions of USD)



Source: Annual Reports of Pan American Airways

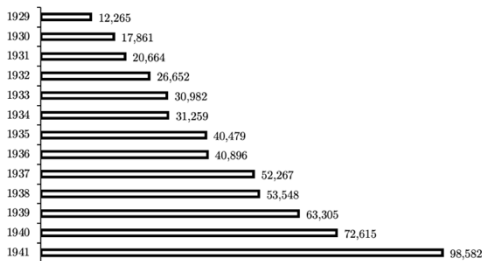
Operating Revenues of Airlines between
International Passenger and Mail Service,
1938-1950



Source: U.S. Census Bureau

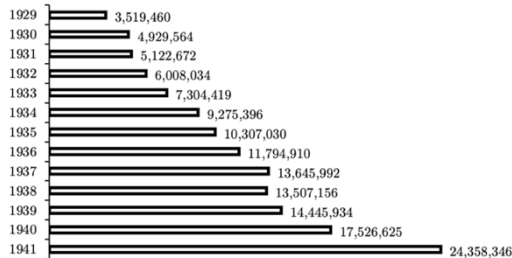
As the government outsourced mail delivery the airline's stature as the physical manifestation of America's exceptionalism bore the trappings of invincibility. In three years between 1927 and 1929 Pan Am was conferred six airmail routes spanning a total of 12,265 miles and 23 countries across the Caribbean and Latin America (Hawes 1943). Not only did this purchase on contracts monopolize markets but the handsome subsidies groomed the airline for its transoceanic empire as it ploughed this capital into strategic acquisitions and joint ventures. The incentive structure remunerated Pan Am with the maximum rate of \$2 per mile in juxtaposition with the average 54 cents a mile for domestic carriers (Ladd 1991). Another vignette of government picking its champion was how the Foreign Air Mail Act of 1928 appropriated \$1.75m or \$31.2m in real value which mostly replenished the airline's war chest. A year later FAM-5 and 6 were vouchsafed to Pan Am with \$2.5m per annum or \$44.6m in constant dollars (Bender 1982). The company flying the blue globe livery in its inexorable expansion would soon become a torchbearer of the Good Neighbour Policy that bound Latin American satellites to America. The more Pan Am befriended the Beltway the more its development grew in lockstep with Washington's diplomacy.

Pan American Airways System Route Miles, 1929-1941



Source: Annual Reports of Pan American Airways

Pan American Airways System Flight Miles, 1929-1941



Source: Annual Reports of Pan American Airways

Through the artifice of industrial policy the airline took a leaf from the playbook espoused by the Big Four in domestic markets whose buyouts informed their proper empire-building. In 1928 the partiality shown towards Pan Am had competitors already crying foul when the prejudice against this lot left them exposed to bankruptcy. This fate befell the West Indian Aerial Express as its routes scattered across an archipelago of islands from Cuba to Puerto Rico were acquired by the juggernaut. In 1929 Pan Am's acquisitions would resume in earnest with the assimilation of *Compania Mexicana's* route between Brownsville in Texas and Mexico City for \$150k (Bender 1982: 112). This foothold founded the company's beachhead into penetrating the continent more deeply as additional feeder routes were linked to form the spine of operations. The merger veritably staked Pan Am's claim over the Western hemisphere like an atavism of the region's subjugation by the Conquistadors on horseback. That year a joint venture with the Grace Corporation would see further inroads by tracing a route from Panama into Uruguay with a stopover in the pearl of South America that was Buenos Aires. Later in 1930 two of the most paramount coups would transcend the practice of an asset grab and forge Pan Am's legacy for years to come.

The company assumed the mantle of a *de facto* air bridge between the Americas upon these acquisitions. The expediency of the mergers relates to how the government was loath to having airmail flown by a company other than Pan Am. Washington in its intransigence thereby stonewalled *Sociedad Colombo-Alemana de Transportes Aéreos (SCADTA)* headquartered in Columbia as well as the New York, Rio and Buenos Aires Line (NYRBA) on contracts into American airspace. This industrial policy of protectionism abreast of subsidies hobbled competition with the sole intent of propping up Pan Am. The officialdom equally forbid SCADTA from venturing anywhere North beyond the Panama Canal Zone which resided under its sovereignty. This second far more invasive restriction corralled the company that was fathomed to be under the spell of Berlin as a Trojan horse outside of its parent country. In little time the bogeyman was neutralized by way of a takeover as the latter jettisoned 84 percent of its stock for \$1.14m (Bender 1982: 145). Virtual ownership of SCADTA intimated that Pan Am would inherit access to Columbian air traffic which was a chokehold for any aggrandizement into South America. To Washington's content the region became sanitized of German influence that appeared sympathetic to Nazism.

The next conquest after this investment spotlighted the extent to which Pan Am was privy to preferential treatment by the government. The subsequent annexation of NYRBA's marketshare quashed the existential threat this rival once posed. For Washington the opportunity cost of inaction was too prohibitive since the said competitor was in league with the French government to secure landing rights across colonies emblazoned with the fleur-de-lys (Bender 1982). It was made abundantly clear that the outright rejection of airmail contracts to NYRBA was an essential use of industrial policy to safeguard Pan Am's monopoly amidst the Great Depression. Bargain rates below market standards for South American airmail fell woefully short relative to the dollars Pan Am found itself awash with from its benefactor. Upon the stock market's collapse the economic contraction squeezed out NYRBA's investors whose fatigue grew from the apartheid that left operations to wither outside of American airspace. Despite a patchwork of contracts between Argentina, Uruguay and Brazil the business could not labour under razor-thin margins imposed by the deprivation of market access. Near the end of 1930 Pan Am purchased the flagging airline for \$2m and arrogated to itself 32 aircraft. The very next day the giant was awarded FAM-10 to Brazil.

The duality of the Goliath that was Pan Am spurred its growth between proxying Washington's goodwill towards Latin America and capturing a monopoly. The use of gunboat diplomacy was scuttled in favour of this benign business that saw it become the single largest recipient of airmail contracts. This sentinel for the Monroe Doctrine and America's sovereignty over the Panama Canal colonized the region in virtue of how it was neither challenged in the air nor on the ground. No penetration of the railroad industry existed in the wilds of inhospitable rainforests that left a fecund market for Pan Am's dominance over an otherwise logistical nightmare. The anatomy of the airline's growth would later be tantamount to the same strategy that actuated TWA, American Airlines, United Airlines and Eastern Airlines in the homeland. Takeovers and mergers together with the rising sophistication of fleets future-proofed the business models of these companies as they partook in their aggressive expansion. One such symmetry alluded to the curation of aircraft as it related to the Big Four's penchant for the Douglas' DC-3 and Pan Am's Martin M-130 or Boeing 314. The pivot towards these larger aircraft hewed to the market trend of greater passenger service. Flying boats in turn became indelible hallmarks of Pan Am.

These fabled seaplanes affectionately called 'Clippers' like ships of

old were ocean liners with wings that circumvented any scarcity of airstrips that foiled operations. The wisdom of Archimedes' Principle might be the Rosetta Stone here in understanding how these machines bequeathed Pan Am its competitive advantage in the 1930s. The ancient science remarks how buoyancy is a function of the water displaced by the weight of a submerged body. Hence the larger the hull of a Pan Am Clipper the greater was the upward force buoying this seaworthy aircraft upon its touchdowns and takeoffs. The vast internal volume therefore boasted more capacity for passengers, dining salons, lounges and sleeping berths for those keen on siestas. This epiphany from antiquity on the mechanics of fluids motivated Pan Am to standardize the Clipper amongst its fleet to great effect. Bragging rights were reserved for the payload and endurance of Boeing's 314 which seated 77 per sortie and flew 4,700 miles versus Douglas' DC-3's passenger manifest of 32 and 1,500 miles. Pan Am's Clippers made feasible the route from San Francisco to Manila in the Philippines and later Hong Kong. The symbiosis between the airline and government would see the Navy build waypoints on Midway, Wake, Guam and Hawaii's Pearl Harbour for this itinerary (Van Vleck 2013: 97).



Martin M-130 Departing San Francisco for Manila, 1935.



Pan American's Boeing 314, 1938.

PAN AMERICAN AIRWAYS ENTERS WWII

Of all the routes proffered to Pan Am the island-hopping of FAM-14 destined for Manila and Hong Kong entailed the most lavish sums of public funds. The steep rates that cascaded into these segments bridging San Francisco to Manila were adjusted from \$2 per mile to \$3.35 and \$7.12 between the latter and Hong Kong (Van Vleck 2013). Such magnanimity belied a simple business transaction and lent credence to how Pan Am epitomized an insurance policy to check Japan's imperialism whose war drums portended conflict in the Pacific. This route masquerading as a token of expansion was instead a furtive way to build Navy installations from Hawaii to Midway in the contingency of war. Tokyo had already telegraphed its militarism by the annexation of Manchuria in 1931. As the region evolved into a powder-keg the tit-for-tat riposte by Washington recruited the airline to be a silent patrol against the aggression of bullets and battleships in those waters. The premium rates on these tranches of flight transcended the calculus of distance versus dollars and paid for the projection of power in the prelude to war. Pan Am's Clippers signalled to Japan that America could bring vast resources to bear right onto its very doorstep should the proverbial Rubicon be crossed. The air bridge therefore spoke to a brinkmanship in deterrence and diplomacy.

Airmail subsidies thus defended America's westernmost colony of the Philippines when the Tydings-McDuffie Act forced a drawdown of troops in the archipelago only a year prior. Under the smoke screen of commercial adventurism to appear less provocative and not to arouse suspicion Pan Am allied itself to the Navy as its surrogate to monitor radio traffic in the area's ether. At the outset of hostilities the airline proved instrumental in wartime mobilization when Washington militarized the omnipresence of its infrastructure. Pan Am's empire at that juncture encompassed 88,478 route miles eclipsing the combined total of the top ten domestic airlines by a staggering factor of two. A fleet of 162 aircraft, the real estate of 300 airports and the omniscience from 192 meteorological outposts with its parity in code-breaking between weather and eavesdropping were prodigious (Van Vleck 2013: 100). Pan Am would double for supply drops and espionage whilst immune to the U-boat menace lurking in the seas below whose lethality for mariners was in itself an invisible blockade. When it first requisitioned Pan Am's know-how American airpower was in dire straits and laden with deficits on the eve of

Pearl Harbour. The Navy and Air Corps' blind spots would find solace in the airborne Maginot Line architected by the company.

Isolationism had been a long-standing policy and the Air Corps' manpower of 26,000 personnel was acutely outnumbered by the Luftwaffe's 500,000 on the warfront (Van Vleck 2013). Only 1,600 planes could be fielded amidst this austerity which were generations behind the Third Reich's modern fleet of 3,750 units that breached the Treaty of Versailles. Germany's doctrine of Blitzkrieg in the guise of the Messerschmitt versus America's mainstay of the Curtiss P-36 Hawk was the difference between predator and prey. The gulf in technology upon years of budget constraints ascribed to the Great Depression distilled how America was outgunned by every metric. Unfortunately the buffer purveyed by the Atlantic and Pacific oceans lulled military planners into complacency. It was only until the advent of the P-51 Mustang when the Air Corps upset the status quo by reversing its sombre status as an underdog. Pan Am's strategic depth in the interim with its involvement in the Air Transport Command (ATC) connected the frontlines with materiel and warfighters from the European theatre to the jungles of Burma. Back-end logistics of this scale thwarted the Axis powers when supply chains circumvented the seas where convoys were left beleaguered by submarine infested waters. Airlifts were often the source of bridgeheads in all this carnage.

Aerial operations like the Cannonball Express shuttled supplies to the Allied war machine against the onslaught of General Erwin Rommel's Afrika Korps in Libya and Egypt. Seven flights departed Miami daily diverting materiel from vulnerable sea lanes into war efforts during Germany's terror (McCarthy 2003). Pan Am touched four continents flying the 11,500-mile route in under four days with a relay of five crews to captain C-54 cargo planes along a manifold of waypoints (Bender 1982: 364). Essential munitions and machinery bypassed the maritime chokeholds that jeopardized supply thereby ensuring their delivery when punctuality determined life or death. Entire campaigns hinged on the influx of provisions ferried upon this umbilical cord. Whether it was intel for agents in Casablanca or Sherman tank paraphernalia for a mechanic in Cairo this conveyor whisked essentials to their destinations with gusto. In another arcane factoid that is little known Pan Am even transported uranium from the Belgian Congo and loaded it onto its China Clippers in Léopoldville for America's string of atomic bombs. In the art of subterfuge all of the Manhattan Project's stock that hastened the war's end in the nuclear age flew aboard Pan Am to sidestep the

vagaries of the sea. The maze of flights begot the perfect shroud of secrecy (Beth 2008).



Out of Pan Am's stables did the Cannonball Express function as a critical pipeline over the Hump of the Eastern Himalayas to shore up efforts against Japan. The transport of aircraft inventory countenanced the exploits of the Flying Tigers whose seasoned aviators were the sole vanguard against strafing fighters that donned the Rising Sun insignia. Bereft of this clockwork in sustenance the fleet of P-40s that was kept aloft on a shoestring would have been grounded allowing for Japan to wreak havoc with impunity. In the first two years of the war the Empire had vaporized 95 percent of China's industries. Pan Am then bequeathed upon the feted squadron scores of tires, batteries, propellers, solenoids, oxygen bottles, high-octane gasoline and tracer ammunition to stave off bombers from exacting a terrible toll on locals. One such supply mission over the Himalayas that even modern airlines do not brave in virtue of its altitude and microclimates directly abetted the downing of twenty-six Japanese fighters and bombers on Christmas Day in 1941 (Vaz 2019: 231). Pan Am saw the events as *schadenfreude* for the attack at Pearl Harbour and Wake Island where nine personnel perished as collateral damage just a week prior (Brady 2012). Boeing 314 Clippers therefore had an outsized role lest the Chinese front be abandoned.

The extraction plan for the parties in the Doolittle Raid that firebombed Tokyo as a way to debunk the myth of its invincibility in retaliation to Pearl Harbour was also undersigned by Pan Am (Vaz 2019: 264). Bombers that had never flown from an abbreviated runway off a carrier defied physics to rain ordinances over Tokyo but

the sheer distance with little fuel impinged on crews to bail out over friendly territory once the deed was done. A premature take-off to avoid detection flirted too much with range that left the sanctuary of airfields beyond reach whereby Pan Am's Cannonball Express would exfiltrate the stranded. What this route showcased was just one of many ways the pragmatism of the War Department privatized certain tasks that befitted the niche expertise of the airline. Between 1941 and 1943 Pan Am racked up over 2m miles over resupply missions for Washington. Eastbound shuttles hauled materiel as the inbound trips repatriated personnel and thousands of tons of rubber for retreading. The airline would equally place its training facilities at the disposal of the Air Corps for its brand of pedagogy for novices on navigation, meteorology and radio communication (Vaz 2019). Cadets learned to decipher the cryptic reports from weather patterns to foreclose any chances of lost aircraft or cargo. Pan Am was manifestly ambidextrous.

Across a gamut of know-how and hardware the symbiosis between Pan Am and the government determined the war's outcome. Were it not for the leviathan's cosmopolitan footprint a capitulation would not have been inconceivable. As the war's protagonist its feats over the Himalayas of moving supplies at speed recalling Hannibal's proper passage over the Alps was what enabled momentum on a sundry of fronts. Although less glamorous in the absence of the paeans to heroism all wars since time immemorial have remained subservient to logisticians. Shortcomings in supply chains have presaged the demise of a great many war marshals akin to Napoleon's own ignominy in Russia between inflows and his army's rate of attrition. In the case of Pan Am it epitomized a godsend to America's war efforts. At first the country's isolationism exacerbated by the gauntlet of U-boats interdicting merchant ships antagonized the transition to a wartime footing. Neutrality had abjectly neutered Washington and the scourge of submarines throttled the Lend-Lease Act's provisions of everything from bullets to bread for Britain's survival. Indeed 14.5m gross tons of Allied goods were sunk by these wolves of the sea (Cheng 2021). Pan Am's infrastructure would conversely compress the mobilization curve.

This was done by truncating the lead time required to enter into the breach against German tyranny. So despite its atrophy America did not begin from a blank slate since its industrial policy for overseas airmail saw a network of aerodromes, fuel depots, radio towers and meteorological stations. Unbeknownst to Washington an *ex ante* launchpad had been constructed for such a contingency in far-flung

places like Africa and Asia. Ready-made infrastructure would expedite operational readiness and this verity was what emphatically arrested the annexation of a continent by totalitarianism. Remember that Europe had been swallowed whole by the Wehrmacht and Operation Barbarossa in transgression of the Molotov-Ribbentrop Pact had sought to do the same in Russia. The Blitzkrieg doctrine hitherto rendered France prostrate in a mere six weeks as the puppet state of the Vichy regime oversaw the spoils. A monopoly of force over the Mediterranean had already been established. London's proper pyrrhic victory in the Battle of Britain had come at great expense with its spent airforce hemorrhaging machines and men. In 112 days the Royal Air Force (RAF) incurred the loss of 1,023 aircraft and 544 airmen (Sarkar 2020). Absent of air supremacy any invasion was stillborn but the rest of Europe did not fare as well.

For all intents and purposes defeatism had overrun the West. The cadence of the belligerence was too onerous once mechanized infantry poured through the Ardennes. But where Pan Am might have been a cipher at first blush this misnomer was a falsehood when it served as a fillip to America's shakeout. The utility of the Clippers cannot be overstated. These locomotives zipped across the Atlantic in a day with a modicum of the risk posed to merchant ships which meandered for a week. Simultaneously as Continental Europe fell under the jackboot of fascism Pan Am's radio station in Lisbon was the last stenographer of intelligence still under Allied control that peered into the plans of rogue spymasters. This node of espionage intercepted many missives at the behest of the War Department. Further south the disruption to supply anesthetized Britain's expulsion of Axis forces which eventuated in fifty-two stopovers across South America and Africa being built to ferry materiel (Bender 1982: 333). Since the heuristic knowledge of raising infrastructure in primitive hellscapes like jungles was unique to Pan Am it authored the building spree across the Sahara. Although vested with great burdens the dividends were quite opulent. Industrial policy financed the projects whilst Pan Am retained exclusive rights to their use.

Pan Am's leg of the Cannonball Express over Africa resupplied the desert troops but the eleventh hour mission also compounded a sense of anti-colonialism in a quiet putsch against Pax Britannica. Supply drops would be what saved the Suez Canal from ruin when the vice of Nazi control was poised to seize the strategic asset and oilfields therewith. As traditional routes for reinforcement in the

Mediterranean were close to obsolete since they often became impassable the only recourse were airlifts. On its maiden flight the airline crated bombers to be plied by the RAF in its buildup of armament for an offensive against the Panzer divisions in the vicinity. Pan Am was in the thick of war where on one occasion with little notice it was summoned to carry anti-tank fuses between Lagos in Nigeria and Cairo posthaste to repel frontline attacks (Vaz 2019). Fifteen tons of this critical device were readied in thirty-three hours with little time to spare for the Battle of El Alamein at the gates of Cairo (Brady 2012). The brevity of shipping to alleviate shortages prevented the British Eighth Army in its direst hours from being routed out of North Africa. Pan Am's salvation from the skies in this embattled region would also save Whitehall from cannibalizing resources earmarked for the broader strategy of Operation Overlord at home.

The Cannonball Express between Miami and the wartime capital of China's Chungking borne out of the airline's bravura was of greater import than the Red Ball Express for truck convoys in Europe. To wit Pan Am serviced three warfronts on this single route in the midst of the multi-pronged offensive. Bereft of resupplies into Cairo the Axis forces would have captured the Suez Canal as a trophy in paralyzing the British war machine without its oil (Caviggia 1990). Bereft of the Lend-Lease stock for the Red Army at the rendezvous in Tehran the gymnastics of the Eastern front would have failed to divert the Führer's attention long enough for Britain to regroup. Bereft of the 650,000 tons of materiel over the Himalayan Hump the Chinese would have resigned themselves to Japan's nefarious designs (Scott et al. 2000). Three discrete battles were waged on this one route under the custody of Pan Am. The airline furnished the grist for the resistance until such a point when the Allied forces could muster a decisive coup once they were adequately provisioned. The airborne empire of the private sector that was the progeny of industrial policy had an ecumenical role in the war. Pan Am was even the first to fly a sitting president overseas aboard the Dixie Clipper when Roosevelt had a tête-à-tête with Churchill at the Casablanca Conference.

A HISTORY OF THE AVIATION INDUSTRY

Perhaps it is an inconvenient truth for apologists of free markets to heed but history vindicates how government directives and aviation have perennially been close bedfellows. The industry did not manifest ex nihilo but rather under paternalism across a spectrum

of procurement, subsidies and protectionism to make imports anathema. It was in 1914 when Archduke Ferdinand's assassination in Sarajevo precipitated the charnel-house of trenches and bayonets that would seed the quantitative leap in aircraft production. Amidst the nursery of WWI America's industry developed these novelties into necessities to break the stalemate at a time when ground incursions became an exercise in futility. These machines evolved into the cavalry of the sky that saw America scale its output commensurately with the wartime imperative of mass production. Herein lies the industry's genesis. With the advent of a *modus vivendi* in 1918 the glut of aircraft found a second life for commercial use. Markdowns of up to 185 percent from \$5,000 to \$200 per plane offloaded the idle fleet onto a civilian market raring to exploit its utility for barnstorming and cargo (Darling 2015). Analogous to Say's Law of Markets supply induced its own demand in a peace dividend from the Great War as a boon to the industry.

Introspecting further back in this chapter what unfolded thereafter was the Air Mail Act of 1925. This seminal piece of legislation was to aviation what *The Wealth of Nations* by Adam Smith was to economics. Industrial policy at this inflection point auctioned a public service to the private sector moving the onus of mail delivery onto businesses (Glines 1990). The endgame in this stimulus bill was to incubate the aviation industry by authorizing the privatization of an old-world institution courtesy of public dollars. A more viable springboard as mail is nowhere to be found. The primal need of communication would be serviced all the while the fiscal credibility of steady revenue became a market signal for investors who warmed to less exposure in this new industry. A trifecta of stakeholders was summarily rewarded in a positive-sum game. Government balanced its budget by skirting the pitfalls of a profligate bureaucracy that had once monopolized mail logistics. Airlines and manufacturers fledged into giants with greater fleets and routes. Wall Street did not gamble so much as it was guaranteed significant upside without the risk. Private interests alone could not shoulder such a venture wherefore industrial policy transcended the monotony of administration to become the patron saint of this budding sector.

Amongst the forty-five companies which jockeyed for contracts the Darwinism of performance thresholds conduced to a small oligopolistic market. A meritocracy came to spur a frenzy of mergers as a scattered constellation of competitors were whittled down to four major airlines. High barriers to entry in this capital-intensive industry between the costs of fixed assets like runways and aircraft

intimated that the wild frontier of aviation would slowly gravitate towards these few carriers. Only incumbents like TWA, United Airlines, American Airlines and Eastern Airlines for example had the wherewithal to acquire a \$55k Ford Tri-Motor plane in nominal value or \$1m when adjusted for inflation. With reliable income sourced from the public purse the said Big Four ploughed their profits into capital accumulation whose silhouette can still be gleaned in an industry that is hailed a century later. The buying spree meant these czars of the skies who weathered the shakeout established the future of an industry. By delegating airmail under stringent standards the attrition from adaptation or death left little option but to espouse vertical and horizontal integration. Hence the pedigree of legacy companies like Boeing, Pratt and Whitney and the Big Four can all be traced back to a time when mergers were in vogue.

Phase one of the industrial policy sought to decentralize airmail as a vector of growth wherein an oligopoly was organically fostered as a function of economic pressures. Apex predators emerged in this habitat. Economist Joseph Schumpeter would chime in that perfect competition is short-lived anyhow in a paradox where monopolies and oligopolies are natural outgrowths of capitalism. Seldom is it that the process of 'creative destruction' does not consolidate fragmented markets. The incentive to minimize the time under the existential threat of losing marketshare and roundly defeat rivals is quite pressing. In spite of how conventional wisdom couches monopolies as a bane to markets this belief betrays a certain level of ignorance much like President Roosevelt's own in his trust-busting of the industry in 1934. The parochialism omits the market's past. This static exegesis fails to recognize how scale economies are staples of growth. It is ironically the same logic why governments discriminate against imports to protect infant industries that would otherwise fall victim to foreign raiders. Aggressive expansion staves off the asset-stripping by vulture capitalists. Eat or be eaten. Antitrust remedies should be reserved for when a critical mass of a bloated monopoly causes inimical distortions in markets likened to a prophylactic purging damaged cells.

Predatory pricing or the suppression of innovation bespeak the moments when it behooves the state to intervene once a company turns into a tyrant. A cycle between perfect and imperfect competition should thus inform the proper workings of an economy. Firms in the first market may be efficient but only earn enough to stay in business. Firms in the second market plough their princely

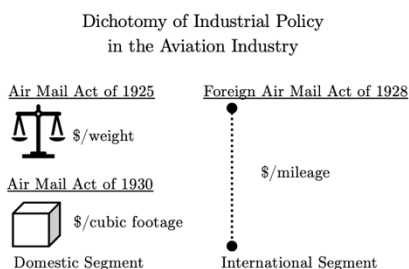
profits into R&D to differentiate their offerings at competitive prices for consumers. Industrial policy as a result tamed the Wild West into an oligopoly that would be poised to capitalize on the subsequent phase of diversifying commercial aviation into passenger service. By 1930 the second iteration of the Air Mail Act boasted the loftier ambition of turbocharging an industry it had just created. A pivot in pecuniary incentives henceforth privileged the usable space aboard aircraft rather than cargo weight to invite a paradigm shift favouring mail and travellers alike. Every cubic foot in effect courted more subsidies and flyers thereby setting greater store in seats over postal bags. The economies of scale from these larger planes insinuated that operating costs could be defrayed over a larger number of patrons whose ticket prices also declined *pro tanto*. This Act of 1930 became the penultimate stage prior to the industry's take-off.

The final Air Mail Act of 1934 would be a verdict on how domestic firms had sufficiently matured to be rid of the scaffolding initially propping them up. The industry could be weaned off subsidies as it achieved the escape velocity needed to decouple from its dependency on succour. Washington's divestment then coincided with the climacteric when passenger exceeded mail revenue which had long been the mission towards the financial autonomy of airlines and manufacturers. This coming of age signalled that a withdrawal in public funds was consonant with the winds of the market in the preamble to its take-off lest parasitism frustrate further development. It was time for consumer demand to steer the industry rather than risk stifling innovation via subsidies. This same disincentive to innovate beset General Motors and its ilk decades later when protectionism had shielded them from imports of Toyotas and Volkswagens with better fuel economies that exacerbated the 1973 Oil Crisis. Inertia in the engine design of thirsty V8s left Detroit's automakers blindsided to OPEC and foreign competitors as the myopia of tariff walls hobbled technology. In 1975 Japanese cars boasted an average of 32 miles per gallon versus the 13 miles by American counterparts (Brown 1984). The 1934 Air Mail Act stopped short of such a debacle.

Capital infusions did not orphan the industry's international operations either. The acute difference however is that the Foreign Air Mail Act of 1928 bore a distinct diplomatic personality whose mission was to recruit an envoy for the State Department. Notice the singularity here in which a monopoly was sought to project the soft power of Pax Americana beginning in Central and South America. Washington brandished this sceptre of flying embassies to reconcile

its extraterritorial sovereignty with the geopolitics of other countries. The veracity of such a priority over the unidimensional one of basic growth in the domestic industry can be plumbed in two metrics. The first adverts to passenger revenue for the sake of profitability since airlines at home were exhorted to reach autarky by 1932 whereas Pan Am took a decade longer. The second recalls the denial of contracts to any carrier other than the imperial-blue liveried leviathan that possessed exclusive rights to inbound and outbound routes. Commercial success in this calculus was relegated to a secondary concern despite the first-mover advantage and prodigious contracts being consigned to the airline by government. Instead Pan Am's foothold in markets abroad was usurped to proxy America's footprint so it may double for a bulwark against European influence.

Privatizing the foreign policy apparatus by dint of subsidies redounded to the penetration of markets so they may warm to Washington. This 'bloodless invasion' in a less caustic form of coercion just as economist Albert Hirschman (1945) would term did in effect substitute for gunboat diplomacy. Pan Am whilst donning this role of a civilizing agent was therefore acquitted of the vicissitudes in markets by one very specific method. Whereas mail subsidies for domestic carriers hinged upon weight or later volume Pan Am's fortunes was hitched to the number of miles flown. The foregoing incentive structure is the sine quo non of how industrial policy was plied to grow two discrete segments of the aviation industry. Growth of the Big Four cartel that included TWA, United Airlines, American Airlines and Eastern Airlines was limited by aircraft technology vis-à-vis payload. Indeed Boeing, Pratt and Whitney, and United acted in unison for this very reason prior to Roosevelt atomizing their vertical integration. This same caveat furthermore became the impetus for adopting passenger revenue to complement the parsimony of airmail contracts. In laconic terms cargo was king. On the other hand Pan Am's business model maximized revenue based on distance as industrial policy conscripted it into the role of a bona fide ambassador.



Expansion in faraway places at a brisk clip would shower the firm with an orgy of helicopter money from the government's purse to stimulate commercial ties with protectorates. In the brief space of a decade Pan Am's route mileage jumped by orders of magnitude from 12,265 to 63,305 or 135 percent. This distance-based framework furnished a carte blanche for the company's buildout spanning across a manifold of continents. From picayune beginnings did the august airline burgeon into America's sole carrier for flights overseas in just three years between 1927 and 1930. By the twilight of the Roaring Twenties the outfit was lauded to have the most extensive cartography of routes than any other airline in the world. The perquisites of such a feat rewarded managers with an income of \$4m each by tying compensation to their adventurism (Solberg 1979). At no time did subsidies account for less than half of the airline's earnings amidst its heyday in the 1930s. Not only did Pan Am evade being pigeonholed in the same revenue model where its domestic counterparts languished but government patronage equally underwrote its monopoly. Operations would not be fraught with even a whiff of competition which NYRBA's hostile takeover exhibited when Pan Am acquired the rival for pennies on the dollar in 1930.

The return on investment from this industrial policy would be most apparent in the buildup to WWII. The equivalent of Roman roads that were once the envy of the world was replicated across a string of barren atolls in the Pacific to be metamorphosed into bustling staging grounds for the war. In the spring of 1935 with the spectre of conflict at large a route between San Francisco and the Orient was inaugurated to nourish operations. The archipelagos of Midway and Wake were colonized as sheltered lagoons to nestle seaplanes and amenities that were later pressed into service by the Navy for its counteroffensive on Japan. Unbeknownst to most laypeople the lynchpin of Wake Island in the military's island-hopping strategy owes its discovery to Pan Am's mastermind Juan Tripp. The founder combed through ship logs in New York City Library's archives until stumbling upon this sandspit bereft of which his plans would have petered-out. A 1,300-mile gap or the size wider than continental America between Midway and Guam arrested any chance of a transoceanic flight longer than a day. Undeterred by such a damper Tripp scrutinized hydrographic charts to confirm this solitary speck of land (Daley 1980). The Pacific Ocean could be crossed via Wake and its infrastructure later harboured troops as a sanctuary for military planners.

Pan Am transplanted the know-how inculcated by this route between Hawaii, Midway, Wake and Guam onto its Cannonball Express to shore up logistics of Allied forces. In 1942 alone the storied outfit ferried more than 542 bombers and transports through Africa upon this route (Daley 1980). Seldom brought to the fore is how in the recesses of the conflict the uranium ore for America's atomic bombs was equally imported atop this venerable line from the bowels of the Belgian Congo. Onto the furthestmost Eastern fringe of Pan Am's cartography its planes crossed the Himalayas every eighty seconds to airlift materiel over the Cannonball's Hump into Burma and China (Hope 1995). The firm's library of experience financed by Washington's industrial policy became a centrifugal force pushing supply chains past their breaking point so America could decisively win the war. Upon the end of hostilities a seamless conduit of convoys to repatriate servicemen fell under the preserve of Pan Am's fleet in Operation Magic Carpet. Three years later as the Iron Curtain drew across Europe the Berlin Airlift would see the airline invoked anew in humanitarian efforts to stem the tide of Soviet expansion amidst the Cold War. In the end corporate and government interests converged through the nexus of industrial policy to create an empire.