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The role of dedicated freighter aircraft in the provision of global airfreight services

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ABSTRACT

In 2014, over 51 million tonnes of cargo, valued at over US$6.8 trillion, was flown around the world. Approximately 56% of this total (by global revenue tonne kilometres (RTKs)) was flown on dedicated freighter aircraft which were either manufactured specifically for this purpose or converted from passenger use. The remaining 44% (by total global RTK) travelled as belly-freight in the holds of passenger flights or on combi (combination) or QC (quick change) aircraft that can accommodate both passengers and freight. Although both sources of capacity offer the same basic service – the aerial carriage of time sensitive and/or high value-to-weight goods – they exhibit different cost structures, operating characteristics and spatial patterns of demand and supply. Using empirical data on the contemporary scale and scope of global freighter operations, this paper examines the role of dedicated freighter aircraft in the provision of global airfreight services and identifies a range of exogenous and internal factors which may affect the demand and supply side characteristics of all-cargo air services in the future.

1. Introduction

The provision of safe, efficient and affordable commercial air transport services is a key enabler and driver of international trade and globalisation (Bowen, 2013; Birtchnell et al., 2015). In 2014, over 3 billion passengers and over 51 million tonnes of high value-to-weight and/or perishable goods, including cut flowers, cool chain pharmaceutical products, humanitarian supplies, live animals and consumer electronics (on which see Bowen and Leinbach, 2009), valued at over US$6.8 trillion, were flown around the world (IATA, 2015). Just over half (56%) of the global revenue freight tonne kilometres was flown on dedicated freighter aircraft while the rest was transported in the holds of passenger flights or on combi or QC aircraft operated by passenger-cargo combination carriers (Boeing, 2014). Despite only accounting for 0.5% of total world trade by volume, the particular characteristics of air shipments means air freight accounts for 35% of total world trade by value and air freight underpins the supply chains of many of the world's leading companies (IATA, 2016). Indeed, so reliant has modern society become on networks of aerial just-in-time logistics that any disruption to normal air freight flows, such as that which resulted from the airspace closures which accompanied the eruption of Iceland's Eyjafallajokull volcano in 2010, has widespread social and economic impacts (Budd et al., 2011).

In addition to its socio-economic significance for global society, air freight also represents an important revenue stream for airlines. In 2015, freight generated, on average, 9% of total airline revenues, over twice as much as that derived from first class products (IATA, 2015). For certain carriers, freight's revenue contribution is significantly higher. 25% of Hong-Kong based Cathay Pacific's revenues, for example, come from freight and the airline states that air freight demand enables it to offer both higher frequencies on certain services and serve routes that ordinarily would not be commercially viable based on passenger demand alone (Gangwani, 2015). However, despite its commercial importance to contemporary airline (and, increasingly, airport) operations, air freight was originally considered to be a by-product of passenger services and it was not until the latter half of the twentieth century that dedicated freight-only airlines and specialist airfreight services began to emerge.

Over the last 10 years, regulatory reform combined with weakening global demand, fuel price volatility, increased competition and a growing trend towards on-shoring production have conspired to depress cargo yields and cause commercial airlines to re-evaluate the nature of the freight services they offer. The challenging commercial environment confronting airfreight providers has been further exacerbated by overcapacity in the sector (which has, in part, been caused by the introduction of new passenger

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aircraft that have higher belly hold capacities), modal shift towards cheaper sea shipping, and an increase in international trade protection measures which are restricting cross border trade (IATA, 2016). In response, a number of passenger-cargo combination carriers and specialist airfreight operators have redeployed, reduced or entirely eliminated their freighter aircraft leading some industry commentators to question the long-term viability of maindeck (i.e. dedicated) cargo aircraft (Woods, 2015). However, despite these challenges, dedicated freighters offer both shippers and airlines a number of strategic commercial advantages. According to Airbus (2015), these include: greater control over schedules, volumes and routes; access to airports that are not usually served by passenger flights; and the ability to transport hazardous and outsized loads that cannot be accommodated as belly-freight.

Unlike existing literature which focuses on the airfreight sector as a whole (Morrell, 2011; Kupfer et al., 2011) or the role of belly-freight (Merkert and Ploix, 2014) this paper examines the role of dedicated freighter aircraft in the provision of global airfreight services. As such, the research builds on the work of Kupfer et al. (2016), who studied the factors influencing airport choice for all-cargo aircraft operators in Europe, to examine the role of freight aircraft worldwide. In order to detail the demand for, the contemporary scale and scope of, and the likely future role of freighter role of freighters, the paper is structured into five sections. Following this introduction, section two describes the changing patterns of demand for, and subsequent evolution in the supply of, global airfreight services. Particular attention is afforded to the role of dedicated freighter aircraft and the factors that drive their use. Section three presents empirical data that has been obtained from surveys of global freighter registrations and industry data to detail the contemporary scale and scope of freighter operations worldwide. The fourth section examines the growth potential and challenges facing operators of dedicated freighter aircraft in the period up to 2030 before the conclusions are presented in section five.

2. The development of global airfreight services

The origins of international airfreight date back to the late-1920s when pioneering European airlines began transporting airmail and urgent diplomatic and valuable freight consignments, at marginal cost, between Europe and their respective nations' overseas colonies, dominions and mandates (Budd and Ison, 2015). To protect the interests of cargo consignees and determine air carrier liability in the event of loss or damage, Section III Article 5 of the 1929 Warsaw Convention obliged consignors to complete an 'air consignment note' (later an airway bill) which detailed the date, the origin and destination, personal details of the consignee, and the nature, weight, dimensions and quantity of the goods to be transported (Warsaw Convention, 1929).

After World War Two, in an attempt to protect fledgling air freight operators from destructive competition, the US Civil Aeronautics Board (CAB) prohibited passenger airlines from pricing belly-freight below the cost of carrying it in dedicated freighters (Miller, 1973). This approach was adopted because it was believed that the 'maximum development' of the US air cargo industry required 'the operation of all-cargo aircraft whose costs must be met' (CAB, 1968 p5). This intervention denied US belly-freight its cost advantages and encouraged both the expansion of all-cargo operators and the use of dedicated freighter aircraft by passenger airlines.

From the mid-1960s onwards, dedicated freighter aircraft were principally deployed on the world's major trading routes which linked the manufacturing economies of Asia with growing consumer markets of Europe and North America. These aircraft transported high value-to-weight perishable commodities, including consumer electronics, precision engineered components, fast fashion items, perishable foodstuffs and temperature-sensitive pharmaceutical products, further and faster than could be achieved by road, rail or sea, at higher volumes than that offered by belly-freight and at times and between airports that passenger flights did not routinely serve. As freight consignments were not subordinate to passengers' luggage, the use of freighter aircraft also offered cargo consignors better flown as booked performance, guaranteed capacity, access to a wider range of airports, greater control over routings and timings, and the ability to transport outsized, irregular, hazardous or specialist consignments which could not be transported as belly-freight (Crabtree, 2014). However, the high(er) operating costs of flying freighters as opposed to bellyfreight, which had been recognised by the US CAB in the late 1940s, resulted in airfreight being 4–5 times more expensive than road transport and 12–16 times more expensive than transporting it by sea with airfreight rates typically ranging from $1.50-$4.50 per kilogramme (World Bank, 2016). Nevertheless, the monetary value of airfreight goods combined with the time savings afforded by transporting products by air meant that airfreight came to represent an attractive option for companies who need to transport high value to weight and/or time sensitive commodities over long distances.

A key commercial challenge facing freighter operators was (and remains) not an absence of demand but the uneven spatial nature of it. Unlike demand for passenger services, which is usually bi-directional, the consequence of moving goods from their site of manufacture to their point of consumption almost inevitably means freight flows are unpaired and unbalanced. In order to address this lack of bi-directionality (also known as the 'backhaul problem') and avoid the need to fly empty sectors or sectors with low loads, most freighter aircraft are scheduled to perform triangular or multi-sector (and often intercontinental) routes which incorporate multiple airports in the course of a trip. While this promotes higher loads it also increases trip durations and may not be suitable for conveying certain types of perishable or time critical commodities.

The introduction of wide-bodied jet aircraft in the 1970s presented new opportunities and challenges to airlines. The Boeing 747-100, which entered service in 1970, could transport over 100 tonnes of belly cargo in addition to 300 passengers and their luggage. A freight-only version of the airframe, the B747F, which had a payload of over 120 tonnes and a capacity of almost 25,000 cubic feet, was introduced in 1972 (IAL Cargo, 2015). This was followed by the B747-200F, which was offered with an optional hinged nose door loading system to facilitate faster turnarounds and accommodate outsized loads, and the B747 combi (combination) which held both passengers and cargo on the main deck. The B747 combi was specifically designed to serve long and lean passenger routes that exhibited a higher-than-average demand for freight than passengers (examples of which included KLM's services between Amsterdam and the Caribbean).

The introduction of additional belly-freight capacity that was provided by the growing fleet of wide-bodied passenger jets created a capacity surplus which could be sold at marginal cost (Jansen, 2012). The by-product nature of the space and the increasingly liberalised pricing policies that were introduced after the deregulation of the US airline industry in 1978 meant that belly-hold capacity could be sold more cheaply than the space on dedicated freighters as a large proportion of the flight's direct operating costs could be allocated to passenger services meaning the incremental costs of transporting belly-freight were limited to specialist handling, additional fuel, sales, and administration. As a result, belly-freight can, under certain operating conditions and parameters, charge a lower rate and still generate a profit of 30% or more (Conway, 2013).

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