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A general framework for price regulation of airports

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A B S T R A C T

Price cap regulation (PCR) was first implemented for privatized utilities in the UK in the 1980s. It has since been adopted by numerous countries as a regulatory regime in several sectors. This paper focuses on the development of different forms of price regulation of airports of which PCR is one variant. In countries where airport privatization is still in the early stages, the spectrum of airports and varied nature of regulatory regimes can be confusing and the lack of a general framework can itself become an obstacle to privatization. This paper proposes a general framework comprising decisions to be made for seven variables which is able to accommodate the diversity of airports and varied approaches that may be required as well as transitions between approaches. These approaches include light-handed regulation, price or revenue yield caps, rate of return regulation, earnings sharing, as well as choice of till.

Keywords:
Airport regulatory regimes, Price cap regulation, Earnings sharing, Choice of till

1. Introduction

When the UK began privatization of its state owned utilities in the 1980s, rate of return regulation (RORR) was the form of price regulation most commonly used in the US for the regulation of privately owned utilities. Instead of US style RORR, the UK government introduced price cap regulation (PCR) for industries with no or limited competition. Proponents of PCR argued that RORR did not incentivize cost efficiency and often led to regulatory capture. PCR was held up as a superior form of price regulation where the regulator could delegate pricing decisions to the firm while providing it with the incentive to reap profit increases from cost reductions and productivity improvements.

Other types of incentive regulation include rate case moratoria, profit sharing, revenue sharing, banded RORR and yardstick regulation (Vogelsang, 2002). PCR became widely adopted as it combined simplicity with incentives for cost reductions and flexibility for price rebalancing (Sappington and Weisman, 2010; G_omez, 2013). PCR was subsequently applied to the UK privatized telecoms, electricity, gas, water, airports and railways sectors. PCR was also adopted by many other countries around the world as privatization of utilities and infrastructure gathered momentum from the 1990s.

PCR for airports was introduced for UK privatized airports in 1986. Since then, airports in several other countries have also been privatized and global airport players are increasingly making their presence felt (Graham, 2008a; Gillen, 2011). Different approaches to price regulation of airports have developed of which PCR is one variant. These approaches include light-handed regulation, price or revenue yield caps, rate of return regulation, earnings sharing, as well as choice of till (Forsyth et al., 2004). In countries where airport privatization is still in the early stages, the spectrum of airports and varied nature of regulatory regimes can be confusing and the lack of a general framework can itself become an obstacle to privatization.

This paper proposes a general framework, comprising decisions to be made for seven variables, which is able to accommodate the diversity of airports and varied approaches that may be required, as well as allow for transitions between approaches. We begin with a brief review of price cap regulation in Section 2. Section 3 examines the diversity of regulatory approaches in the airport sector. Section 4 contains a proposal for a general framework that can accommodate the diversity of price regulatory regimes for airports. Section 5 concludes.

2. A brief review of price cap regulation

PCR is typically characterized by the following (Acton and Vogelsang, 1989):

- The regulator chooses initial prices and sets a price ceiling for prices to be charged by the regulated firm;
- In a multiproduct industry, price ceilings are defined for baskets of services offered by the regulated firm which can be expressed as an aggregate price index or weighted average of prices;

- Price ceilings are adjusted periodically by a pre-announced adjustment factor external to the firm;
- The adjustment factor, baskets, and weighting schemes for the baskets are reviewed and changed periodically.

Within the above general framework, PCR has proven to be flexible in accommodating variations in design in response to different goals in different contexts. The main variations in design are briefly described below.

2.1. Pure PCR

In the initial version of PCR, price increases were capped at RPI e X where RPI is the retail price index and the X-factor in the cap is specified by the regulator and typically reviewed at set intervals. Here, the inflation index is the RPI with the X-factor representing the efficiency target. The X-factor represents the positive technical change of the firm's process relative to the economy plus the input cost savings enjoyed by the firm relative to the economy arising from differences in cost weights relative to the average firm in the economy (Wolak, 1998). This pure form of price capping sets the cap independently from the costs of the regulated firm and is also known in the literature as "high-powered" caps. By regulating prices and not earnings, PCR are high-powered in the sense of not continually adjusting prices to reflect costs and thus provide strong incentives for cost reduction.

2.2. Hybrid PCR

Hybrid price caps which take into account the costs of the industry or the regulated asset base in the inflation index do less to decouple prices from costs and are considered to be a less "high-powered" price setting process as compared to pure PCR.

2.3. *Pure revenue cap*

A pure revenue cap regulation (RCR) arrangement caps the total amount of revenue the regulated firm is permitted to earn, with a correction mechanism which adjusts for under or over recovery of revenue (Alexander and Shugart, 1999). Instead of the restriction being on price, the restriction is on revenue or price multiplied by quantity. In order to set the initial price, the regulator will need to have a reasonable forecast of quantity. RCR is appropriate for industries where demand is relatively stable, risk of price volatility is low and where fixed costs are high. High fixed costs industries have costs that do not vary appreciably with units of sale so that the firm has less incentive to adjust forecast output downwards. RCR induces firms to discourage rather than encourage consumption and have been used where demand management is a key objective, such as in water and electricity. However, revenue caps do not cap prices and could result in a situation with price being above and quantity being below the unregulated monopoly level (Crew and Kleindorfer, 1996).

2.4. Hybrid cap

A hybrid cap, comprising both price and revenue components, is designed to make the regulatory regime mimic the mix of fixed and variable costs in a company. The underlying theory is that the fixed variant is regulated through a revenue cap and variable costs are regulated through a price cap (Alexander and Shugart, 1999). Hybrid systems have mostly been used in the electricity sector.

2.5. Revenue yield price cap

A revenue yield price cap (RYPC) sets the maximum weighted average revenue per unit of output for the regulated firm. Total revenue varies directly with an output variable while average revenue is allowed to vary in line with some form of CPIeX formula similar to weighted average PCR. Under PCR, the allowed marginal revenue varies according to the actual price of the additional unit. Under RYPC, the allowed revenue per additional unit is fixed.

2.6. Yardstick competition

In yardstick competition, prices are linked to the costs of a peer group of companies and the regulated firms are not allowed to charge higher prices than the average costs of the peer group. The X-factor could also be based on the average industry productivity improvement.

2.7. Sliding scale regulation

Under a profit or earnings sharing arrangement, the regulated firm may be made to share earnings above a specified level with consumers, thus avoiding excessively high earnings for the regulated firm (Sappington and Weisman, 1996). Under a revenue sharing arrangement, the regulated firm shares with its customers a fraction of the revenues it generates beyond a certain level.

Each of the above regulatory options has its pros and cons (Sappington and Weisman, 2010; Gomez, 2013). These are summarized in Table 1. A hybrid price cap which allows for input costs to be passed through has been

commonly used instead of pure PCR. Hybrid forms of regulation such as combining a price or revenue yield cap with a sliding share profit or revenue regulation have also been devised. The objective of these modifications is to attempt to offset weaknesses of PCR (primarily high degree of risk on the regulated firm from earnings volatility) with the strengths of others. The tradeoff is re-introducing the need for the regulator to track costs and the potential reduction in incentives to maximize efficiency. The design criteria, the kind of mechanism implemented, and parameters chosen depend on a number of factors: efficiency incentives, regulatory risk, political concerns, investment objectives as well as the practicability of information requirements.

Table 1

Comparison of RORR and PCR variants: Summary of pros and cons

Regulatory regime	Regulatory regime	Disadvantages
RORR or cost of service regulation Regulator sets a fair ROR; price increases can only be justified when an increase in cost is incurred. In RORR, normative ROR is linked to a notional weighted average cost of capital (WACC).	• Earnings stability • Low regulatory risk as there can be ongoing corrections to inaccurate initial forecasts	• High regulatory costs • Low incentive to reduce operating cost • Discourage innovation • Over-capitalization (Averch-Johnson effect) • Higher than optimal quality of service • Regulatory capture risk
Pure PCR RPI e X	• Strong incentives for efficiency and cost reductions • Promotes innovation • Easily implemented • Information requirements low, regulator needs only to set X, the differences in productivity gains and cost increases between regulated firm and economy	• Imposes a high degree of risk on the regulated • airport • Higher risk of significant earnings variation raises • cost of capital • Need to monitor no reduction in quality of service • Can result in underinvestment • Serve relatively fewer customers or only classes of customers with highest WTP • Engage in strategic price discrimination to deter competition
Hybrid PCR based on firm or industry costs: • Inflation index - X • Inflation index - X + Z where Z is adjustment factor for exogenous event Pure revenue cap RCR Change in PQ is capped e.g. by RPI - X;	• Allow corrections for unanticipated exogenous shocks • Reduce earnings variations as compared to pure PCR • Strong incentives for efficiency and cost reductions maintained • Profits can be increased by reducing costs as revenues are capped • Profitability more stable than PCR	• More like RORR • Reduced incentive for cost reductions • Higher regulatory costs • Need good forecast of output • Firm has no incentive to increase output • Does not cap prices; • Can lead to monopoly outcome if cap is not binding; • If cap is binding, can lead to price being above and Q being below unregulated monopoly level (Crew Kleindorfer effect)
Hybrid revenue price cap Fixed costs regulated through revenue cap and variable costs regulated through price cap	• Better mimic firm's cost base and can provide better incentive to behave in a way that maximizes welfare • Greater risk sharing compared to PCR or RCR	• Mix of fixed and variable costs always changing • Incentives regarding output and quality less clear
Revenue yield price cap Cap stipulates maximum weighted average revenue per unit of output for the regulated firm; usually includes a sharing arrangement where surplus is returned to customers	• Incentives for cost reduction, investment and productivity improvements • Suited to networks where average costs decreases as output increases • Allow direct means of passing benefits of growth to customers	• Does not provide incentive to set efficient prices • Discourages appropriate demand management • practices • Leads to volatility in profits from changes in demand • Relies on accurate forecasts of demand and a correction mechanism e complex to develop and administer
Yardstick competition	• Strong incentives as profits can be increased by reducing costs in relation to other companies • Lower information requirements • Low threat of gaming or capture • Guards against exceptionally high or low earnings	• Creates incentives for strategic forecasting • Requires a sufficient number of comparative firms whose data can be used to form the yardstick • Risk of collusion to inflate industry costs at time yardstick is set
Sliding scale regulation: Earnings sharing (ESR), Hybrid of PCR and RORR • Establish target ROR • Specifies "no sharing" band of ± a% around target (PCR zone); • When ROR is > or < than band, sharing of gain or • pain b% with consumers (resembles RORR)	• Good efficiency properties e provides intermediate incentives for innovation and cost reduction • Provides greater flexibility to adapt to changing industry conditions • Strong fairness and redistributive properties edelivers portion of high earnings to consumers • Incentives to increase quality relative to revenue sharing • Can generate greater consumer welfare than pure PCR, good when regulator has greater concern for consumer surplus than profits Relative to ESR	• Medium incentives for cost reductions and • innovations • May lead to shifting of costs from unregulated to regulated activities • Requires earnings monitoring, administratively cumbersome • Requires ruling on prudence of investments • Diminishing share of incremental earnings can discourage large cost reductions
Sliding scale regulation: Revenue sharing (RSR) Sharing of revenues above specified level with consumers	• Can ensure more stable earnings without reducing incentive for cost reduction • Limits incentives for cost shifting and wasteful expenditures on prerequisites, price discrimination and lobbying by regulated firm • Limits incentives for expropriation by regulators • Provide greater incentive for information acquisition by the firm about its own costs and increase social welfare	Relative to ESR • Can limit incentives for demand enhancing activities such as quality improvement

Underline represents the types of regulatory regimes.

3. Airport ownership and price regulation

3.1. Airport ownership and privatization

Airport infrastructures are characterized by different levels of private sector participation, degrees of congestion, different price regulation regimes, charge components, charge structure and charge levels. The factors behind this heterogeneity include historical differences, differences in national agendas, degree of market power, hub or destination airport, policy toward airline competition, etc. In the past two decades and following behind the deregulation of the airline industry, the airport sector has evolved rapidly from an industry characterized by public sector ownership and control to one in which the private sector and global players are increasingly making their presence felt (Graham, 2008a; Gillen, 2011). The commercialization of airport activities has been motivated by the well-known arguments for privatization which include greater efficiency, reduced need for public sector investment and improving the organization's ability to diversify and to provide incentives for management and employees to perform well.

However, privatization might also result in a private monopoly which could over-charge, deliver lower standards of service, invest inadequately and/or give insufficient consideration to both positive and negative externalities. Hence, in many instances, there is generally felt to be a need for an appropriate regulatory framework to accompany privatization. However, there is great diversity both in the type of commercialization as well as the type of economic regulation of airports (Forsyth et al., 2004). The main focus of decisions on economic regulation for airports has been on airport charges or tariff control.

In the US, the more than 19,000 airports are publicly owned and operated by the respective state or a local government, or by a combination of the two. Economic regulation on the federal government's part is limited to the Federal Aviation Act which stipulates that airside fees should cover only the costs associated with providing aeronautical services; and the Federal Aviation Administration (FAA) which regulates prices. Aeronautical charges must be cost-related which makes it an essentially cost-plus system loosely overseen by local authorities. Airlines in the US however take an active role in investing in airport terminals and facilities and have considerable influence on how hub airports are developed and managed. The partnership between regional airlines and airports has played a major role in the development of the domestic aviation system (Graham, 2008a, pp. 175e181).

In contrast, in the UK, airports are generally privately owned and operated, with only three London airports out of more than 50 airports subjected to price cap control, viz. Heathrow, Gatwick and Stansted (Gillen and Niemeier, 2008). In Germany, the overwhelming majority of airports are owned and sometimes directly managed by the state or by state agencies. German airports, with the exception of the few public-private partnership airports (Hamburg, Frankfurt, Hannover and Dusseldorf) are annual cost based regulated. Tariffs at Hamburg are revenue yield price cap regulated; Frankfurt and Dusseldorf both have revenue sharing agreements (ICAO, 2008). Australia and New Zealand introduced light-handed regulation in 2002 (Forsyth et al., 2004). This means no explicit regulation of prices, conditional on good performance.

Other public-private partnership arrangements favor a consultative approach or commercial negotiation between the airport and users with regulatory intervention only if an agreement is not reached. In other public-private partnerships, price regulation is embedded within private contractual or framework agreements. The above examples indicate the wide range of regulatory regimes and approaches used.

3.2. Airport price regulation

In the cases where airport facilities and services are price regulated, choice of till is of major concern to airlines (Gillen, 2007: Yang and Zhang, 2011). Three possible approaches have been used, viz., single, dual and hybrid tills. There are arguments both for and against single and dual till regulations, with airports generally favoring dual till and airlines favoring single till.

3.2.1. Single till

The single till was recommended by ICAO in its 1992 guidelines. Under the single till approach, all airport activities are included in the till so that growth in non-aeronautical revenue can be used to offset increases in aeronautical costs and charges. Airlines justify their support for the single till based on the argument that without aeronautical activities, there would be no market for commercial operations. Since non-aeronautical profits are used to cross-subsidize aeronautical charges, single till regulation theoretically results in lower aeronautical charges. However, when airports are capacity constrained and a single till price is in place, such as in London Heathrow, prices end up being lowered when efficiency dictates that they should be raised (Graham, 2008b). Moreover, it has also been argued that using commercial revenues to offset aeronautical fees reduces the airport's incentives to grow commercial profits and develop better commercial facilities, as well as prevents these revenues from being used to help finance capital investment.

3.2.2. Dual till

The dual till approach treats aeronautical and non-aeronautical areas as separate financial entities, and focuses regulation on aeronautical airport charges. As such, only aeronautical activities are regulated where aeronautical price or revenue may be capped. From the mid-1990s (when Australian airports owned by the Federal Airports Corporation were privatized) to 2002 (when all price regulation of airports was removed), the price capped airports in Australia operated with a dual till.[1] Hamburg Airport was the first airport in Europe to utilize a dual till in 2000 (ICAO, 2008; Gillen, 2007). Since aeronautical charges do not receive any subsidy from non-aeronautical profit, dual till regulation results in higher aeronautical charges. However, there is strong incentive for the operator to innovate on its non-aeronautical business because non-aeronautical revenue or productivity gains accrue to the operator. The dual till approach however may result in increased regulatory burden as there is a need for clear separation of aeronautical and non-aeronautical activities, with many fixed and joint costs to be allocated between the two tills.

Yang and Zhang (2011) show that under PCR, when airport congestion is low, single till dominates dual till with respect to social welfare maximization. When airport congestion is significant, dual till regulation performs better than single till. Oum et al. (2004) studied the performance of 60 airports and concluded that dual till regulation is better than single till regulation in terms of economic efficiency, especially for large, busy airports. As a result of the debate, ICAO amended its guidelines in 2001 to state that it may not always be appropriate to use commercial income to offset airport charges (ICAO, 2004). The ICAO 2012 guidelines adopt a neutral position with regard to choice of till (ICAO, 2012).

3.2.3. Hybrid till

Under hybrid till regulation, only aeronautical activities are regulated, with a portion (H%) of projected non-aeronautical economic profits used to subsidize aeronautical expenses. This method is able to manage the trade-off between maintaining competitive aeronautical charges and creating incentives for the operator to innovate. Similar to the dual till regulation, the hybrid till approach requires a clear separation of aeronautical and non-aeronautical activities.

A study of 50 major European airports in 2005 found that 51% used a price cap formula, while 14% used a ROR formula. The single till was the most popular approach (42%), followed by the dual till (29%) and the hybrid till (25%). 59% of airports with a price cap used the tariff basket approach, with the other 41% using the revenue yield method (SH&E, 2006). Table 2 shows the different price regulatory regimes and choice of tills adopted by a sample of airports. In general, where airports are subject to formal price regulation, there have been movements away from RORR to PCR and from single to dual or hybrid till.

Table 2
Airport price regulatory regimes and choice of till.

	Single till	Dual/Hybrid till
Cost-based	• Germany (except Hamburg, Frankfurt and Dusseldorf) • Spain system wide • Portugal system wide	• Netherlands Amsterdam (dual till) • Belgium Brussels (with benchmarking, hybrid till)
Price-cap	• UK London airports • Ireland Dublin	• Australia's main airports (mid-1990s to 2002, price cap dual till) • Malta (price cap dual till) • Hungary Budapest (price cap hybrid till) • Germany Hamburg (revenue yield cap dual till) • France Paris-Orly (price cap hybrid till) • Italy Rome-Fiumicino (price cap dual till) • Singapore (revenue yield cap hybrid till)

Sources: Gillen (2007); Forsyth et al. (2012); Forsyth et al. (eds., 2004).

4. A general framework for price regulation of airports

Multiple airport regulatory regimes may exist within the same country as is the case in Germany. In a country with numerous airports and making the transition toward private sector participation in the airport sector, it is useful to have a general framework within which the heterogeneity of airport types can be accommodated.

In this section, we propose a general framework within which decisions with regard to various options of regulating airport prices can be viewed. The framework is able to accommodate variations in local circumstances and hence policy decisions with regard to choice of regulatory regime, choice between price and revenue yield caps, choice of till, as well as decision on incorporation of sliding scale sharing arrangements. We consider the

[1] From July 2002, the Australian government replaced price regulation of the major airports with price monitoring. For more details of the history of Australia's airport policy, see Forsyth et al. (eds.) (2004), Chapter 1

following decisions within such a general framework and analyze the factors relevant to each decision in the context of airport regulation:

- Choice of regulatory regime: light handed or formal price regulation
- Choice of cap: price or revenue yield
- Choice of till: single, dual or hybrid
- Choice of X and duration of cap
- Choice of earnings sharing parameters

4.1. Choice of regulatory regime

The airport system of a country could comprise airports of varying sizes, location and demand characteristics. The market power of an airport varies and is determined by factors such as inter-modal competition, capacity in relation to demand, inter-airport competition and countervailing power of airlines. A flexible framework that can accommodate different degrees of economic regulatory oversight encompassing the different contexts and operating environments is needed. Economic regulation may not be relevant for all airports; airports with significant market power (usually those serving large cities or regions) require regulation whereas many small airports do not. For example, the UK framework explicitly recognizes that price control regulation may not be relevant for all airports; therefore only airports with significant market power (such as the London airports) are subject to price and service quality regulation. As such the proposed framework needs to be flexible as economic regulation is not "one size fits all".

Airport regulatory regimes can be classified into the following categories: light-handed, medium-handed and heavy-handed (Niemeir, 2010; Forsyth et al., 2012).

- **Light-handed regulation** as practiced in Australia requires airports to prepare Airport Monitoring Reports for public release annually as well as periodic reviews of the sector. There is no formal price regulation.
- **Medium-handed regulation**: A license regime would represent medium-handed regulation and would be appropriate for airports with some degree of market power. This would be a form of regulation via contracts such as is utilized in public-private partnership concessions. PCR could be incorporated within such contracts.
- **Heavy-handed regulation**: Privatized airports which are strategic international air-hubs and which face capacity problems and constraints on expansion have obvious market power and need to be closely regulated not just for charges, but also for airport performance, service quality as well as investment.

4.2. Choice of capping price or revenue yield

Of the various methods to implement incentive regulation, the total revenue cap method is inappropriate in the context of airports given there will be lack of incentive to grow passenger volumes as prices would have to be cut in order to maintain the revenue cap. Both pure price caps (tariff basket) and revenue yield price caps are used in the price regulation of airports. The price cap is simpler and provides strong incentives for the airport to reduce cost and drive demand, but there is less flexibility in revenue management as prices are capped. Revenues and profits are vulnerable to forecast errors or unanticipated shocks and the airport may suffer financial distress or enjoy supra-normal profits.

The revenue yield cap, a ceiling on revenue per unit output $(P_t.Q_t)/Q_t$, also provides similar incentives to reduce cost and drive demand. The firm has greater flexibility to set individual prices, respond to new market developments, manage and rebalance its revenue, and is less vulnerable to errors in forecast. However, this approach requires forecasts of volumes $Q_{t.1}$ with the regulatory burden being higher. Price adjustments could also lead to greater price volatility as compared to a tariff basket.

If the revenue yield cap is expressed as $[(P_{t+1}.Q_{t+1})/ Q_{t+1} - (P_t.Q_t)/Q_t]/[(P_t.Q_t)/Q_t]$. RPI - X, the pure price cap may be considered a special case where $Q_{t.1}$ and Q_t are both set = 1.

4.3. Choice of till

In the area of airport pricing regulation, a great deal of attention has been given to the choice of till. The growth of non-aeronautical revenue is becoming increasingly important as a source for crosssubsidizing aeronautical activities as well as financing the further development of the airport sector. Incentivizing airport development and non-aeronautical revenue growth should be of interest to all airport operators and regulators. A hybrid till arrangement could present the best solution for some airports. A general framework could allow regulators the flexibility to choose the appropriate till depending on the local context. Specifying H . 0% translates to choosing dual-till while choosing H . 100% translates to a single till. If a low H% hybrid till is adopted, the airport operator

would have an incentive to innovate. If a high H% hybrid till is chosen, the airport operator would be able to charge lower aeronautical charges.

4.4. Choice of PCR parameters

If a PCR regime is selected for a particular airport, the X-factor in PCR will necessarily be specific to the airport and dependent on the environment in which it operates. The flexibility of PCR allows the X factor to be varied accordingly as well as inclusion of a Z factor for unanticipated events. The length of time for which a price cap formula is valid before it is reviewed can also be varied.

4.5. Choice of profit sharing arrangement

There are various ways to design profit or earnings sharing arrangements. In the airport regulation context, there are two senses in which the term "sliding scale regulation" has been used. One is the sense used in the US general regulatory literature where profit or revenue sharing arrangements define the level of profit or revenue the regulated firm is allowed to earn. However, the term "sliding scale regulation" has also been used in Europe when the "X" used in a price cap varies according to output such as annual passenger growth. Prior to 2001, Hamburg airport was regulated in this way.[2]

In a basic profit sharing scheme that can be used to complement PCR, an upper bound is specified for profit levels after which the regulator switches to a profit sharing regime. Some schemes with profit sharing intervene when profits are low as well which provides the firm with a form of insurance against market risks relative to pure PCR. One form of profit arrangement would be to specify a target rate of return r%, the band of a% above and below the target rate, and the percentage of profits or losses b% to be shared with consumers when earnings are outside the band.

4.6. A general framework

In a country with a system of many airports of different characteristics, a general framework from which the varied regulatory requirements for different airports could be accommodated would be useful. In this section, we have allowed for different regulatory possibilities to be simplified into policy decisions for seven variables: Q, H, X, T, r, a and b. This allows local governments to choose among different regulation regimes within the same general framework so as to tailor the regulatory mechanism to the specific circumstances of the local airport.

Table 3 provides examples of possible regulatory options for airports within the framework. Where light-handed regulation is appropriate, all seven variables will be set to zero. Under RORR single till regulation, H= 100%, r is the allowed rate of return, and other variables are set to zero. The following are examples of incentive regulation with possible values assigned to the different variables. A pure price cap with a single till will have Q = 1, H=100%, and may have X=1% set for an interval T of 5 years. A revenue yield price cap with a hybrid till may have Q . specified quantities such as number of passengers, H = 60%, X = 2% set for an interval T of 3 years. Where earnings sharing are incorporated into the regulatory regime, r, a and b will take on the appropriate positive values. Such a general framework will also be able to facilitate transitions between different regulatory regimes as circumstances change over time.

Table 3
A general framework for price regulation of airports: Examples of regulatory regimes.

Regulatory regime	Capping price or revenue yield: Choose Q	Till: Choose H%	Choose X (%), duration T (years)	Profit sharing arrangements: Choose r, a, b (%)
Light-handed regulation	Q = 0	H = 0%	X = 0% T = as required	r = 0% a = 0% b = 0%
PCR with single till	Q = 1	H = 100%	X = 1% T = 5 years	r = 0% a = 0% b = 0%
Revenue yield price cap with hybrid till	Q = Q	H = 60%	X = 2% T = 3 years	r = 0% a = 0% b = 0%
PCR with dual till and earnings sharing	Q = 1	H = 0%	X = 1.5% T = 4 years	r = 10% a = 3% b = 50%
RORR single till with no earnings sharing	Q = 0	H = 100%	X = 0% T = as required	r = 10% a = 0% b = 0%

[2] In the Hamburg case, for each percentage of annual passenger growth above 3 percent in a current year, the X component in the CPI e X price cap of the following year had to be increased by an additional 0.5 percentage points. For example, the price cap is CPI - (Z + (g - 3) x 0.5). If Z had been set at 2 percent, passenger growth is 6 percent and CPI is 1 percent, the price cap is 1 - (2 + (6 - 3) x 0.5 .= 2.5%. The sliding scale clause was abandoned immediately after the September 2011 terrorism incident when there was a sudden downturn in demand coupled with the increase in costs from change of security paradigms. See Immelmann (2004) for a discussion of the "emergency exits" that were built into the Hamburg regulatory regime which allowed for deviations during times of unexpected crisis for the aviation industry.

5. Conclusion

Many countries have a system of airports comprising airports of different sizes, airline and passenger characteristics, investment needs and market power. Given the diversity of airports, the regulatory approaches required for each are necessarily different. This paper proposes a general framework comprising decisions to be made for seven variables which is able to accommodate varied approaches. These approaches include light-handed regulation, price or revenue yield caps, rate of return regulation, earnings sharing, as well as choice of till. With privatization and deregulation, the airline and airport sectors have undergone tremendous growth and structural changes in the past few decades. As airline and airport markets evolve rapidly in emerging countries, this will require flexibility in choice of regulatory arrangements. An inappropriate regulatory regime that is not suited to local airport conditions can result in inefficiencies, distortions and present obstacles to investment. The general framework as proposed in this paper can also help facilitate transitions to different regulatory regimes as circumstances change.

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