Introduction to the *Handbook on Transport Pricing and Financing*

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I.1 TRANSPORT PRICING AND FINANCING IN THE FACE OF MAJOR CONTEMPORARY SOCIETAL CHALLENGES

Pricing and financing constitutes one of the main battlefields in the design and implementation of transport policy, and represents what many may associate with transport economics. Indeed, the price of a transport service is the most evident cost when moving around in geographical space, and funding and financing decisions are necessary for achieving the stable operation of both physical infrastructure and the various organised services provided on it. From this point of view, it may seem like pricing and financing are just unavoidable bitter pills to swallow for users as well as decision makers, where only in a fairy tale world, mobility could be ensured without painful monetary payments by any of the parties involved. To refute this perception, our *Handbook* summarises decades of research on the usefulness of carefully crafted transport pricing and financing schemes in the pursuit of societal objectives.

The 24 chapters to follow reflect that pricing is probably the most sophisticated tool of transport service management, potentially ensuring that social and environmental resources are utilised according to the value they truly represent. With careful oversight, pricing policy becomes the key instrument in the control centre of the transport system, from which the volume of interactions within the spatial economy and the (re)distribution of resources among members of society can be fine-tuned in line with higher-level policy objectives. From the viewpoint of funding and financing, the *Handbook* delivers theoretical foundations and practical lessons on the wider toolbox that complements pricing in achieving financial stability and sustainability for transport projects and services. We believe the *Handbook* is timely, as transport pricing and financing policies will have an important role to play in the strategies needed to address some of the main contemporary societal challenges.

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I.2 CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT

Pricing will play a leading orchestrating role in the battle of humanity against what many of us foresee as the single biggest societal challenge of the century to come: climate change. The substantial share of the transport sector in global energy consumption, pollution, and greenhouse gas emissions is undeniable. Also, there is little doubt about the need for change in habits and everyday human behaviour, notably also in transport, to keep our energy reliance under control. However, there is no sign of agreement on the exact magnitude of the behavioural adjustment needed, and on what share in the global effort should be acceptable, to ensure the sustainability of our future development. Pricing should be one of the key elements in the debate on transport demand management, and a naïve belief in a technological fix will
most likely not resolve the existential challenge the planet and its inhabitants face today. We postulate that the implementation of a universal and global system of incentives through transport pricing is a necessary step to take to make every single household realise and understand the level of contribution needed for stabilising energy use in an efficient way.

Besides this relatively new challenge that may not have seemed as obvious to so many a few decades ago as it appears to be today, the more classic policy challenges of accessibility and traffic externalities, such as congestion and accidents, will also remain with us. Economic science recognises, and we intend to disseminate this throughout this book, that road congestion and equivalent phenomena in other modes cannot be fully neutralised as we often imagine: congestion is the inevitable consequence of the spatial and temporal concentration of human interactions. The existence of congestion is therefore pretty inevitable, but its magnitude can be controlled with appropriate tools – notably including pricing. We learn from spatial economics that congestion management is to an important extent an art of balancing the benefits and costs of spatiotemporal concentration. This is a particularly tricky endeavour when many benefits and costs are external to the traveller herself; research on agglomeration economies (external benefits) and congestion and crowding burdens (external costs) go hand-in-hand with the aim of identifying the travel volume that we can consider the optimal balance between offsetting these forces. Technological development and new channels of human interaction may shift this optimum one way or another, but the intellectual challenge of travel demand regulation remains a cornerstone of policymaking, and thus also of this Handbook.

I.3 BALANCING NEGATIVE AND POSITIVE EXTERNALITIES OF SPATIAL DENSITY

In the early days of the COVID-19 pandemic, billions of urban residents temporarily witnessed a congestion-free state. The pandemic has also shown that disruption in face-to-face human interactions comes at a huge cost in terms of substantial economic downturn, collapsing supply chains, inflation, rising inequality, and tensions within and between societies. Recent data suggests that, as ever since the early days of human history, cities survive, and accordingly also congestion is now gradually rebuilding in metropolitan areas. But this costly natural experiment demonstrated that the adverse effects of transport are better not neutralised simply by completely eliminating motorised transport flows; accessibility is an undeniable ingredient of modern life, and our tools better be more sophisticated when it comes to regulation in mobility.

This Handbook documents the most recent findings in the literature of transport pricing and financing, but the underlying theoretical foundations already have decades of history – in fact, as Roger Vickerman highlights in Chapter 1 of this Handbook, more than a century has passed since Pigou’s seminal writings on traffic congestion. Transport economists often feel that their policy recommendations are not fully understood and acknowledged in the political arena or among the wider public. Urban road congestion pricing is a leading example, but pricing and funding in public transport is also heavily debated, and not always in ways that do full justice to fundamental economic insights on these matters. Two hypotheses could explain this observation. First, researchers may need to pay more attention to the (joint) dissemination of research findings, and explain the intuition behind them more clearly. Second, it is very well possible that the research community overlooks or underrates some of the unwanted
I.4 EQUITY AND DISTRIBUTIONAL TENSIONS IN TRANSPORT POLICY

There is a genuine desire in modern societies, in both developed and especially developing countries, to make public interventions contribute to a more equitable outcome – whichever definition one may use to operationalise this. The underlying motivation is clear and hardly questionable: the unequal distribution of wealth, information, access to amenities, and influence in decision-making is considered morally intolerable by many, causing tensions within society. On top of that, if transport policies are to be developed via democratic institutions, a strongly unequal distribution of perceived benefits is more likely to prevent the implementation of pricing reforms through majority voting, even if they deliver a net increase in aggregate welfare. Researchers react to these societal challenges by looking more closely at the distributional impact of new policies, identifying winners and losers in the population affected, and predicting the conditions of political acceptance under the surrounding institutional setting, such as elections or referenda.

Distributional analyses are sometimes hampered by the lack of a clear understanding of what quantitative measures are better aligned with the perceptions and preferences of individual users and voters. Even if the traditional utilitarian measures of individual welfare were in line with these perceptions, the way in which utility functions are established in a quantitative model might have profound implications for projected distributional outcomes. For example, low accessibility in locations where low-income households live is often perceived as unfair, suggesting that reducing the price of transport service provision or improving transport infrastructure might be a progressive policy in such areas. However, when one translates this setup into a general equilibrium model in which transport and housing costs are interlinked, the improvement in accessibility can easily make the local area more attractive for richer households as well, thus leading to rising housing costs and reducing the intended distributional effects of this intervention. Spatial heterogeneity in access to mobility is often just a consequence instead of the cause of inequality. Therefore, naive equity-oriented transport policies may not be as effective as direct redistributional interventions targeting the original cause of income inequality, including differentiated income taxes.

The aggregation of individuals or households into income segments, as is usually done in distributional analyses of transport policy, can also be problematic, as shown in Chapter 6. When segmenting into income quintiles, within each quintile there are households who are affected positively and negatively by a pricing policy, as the intensity of car use may vary substantially between households with similar incomes. Therefore, aggregating over income to analyse the average impact per income quintile hides these divergent effects.

Demand management through pricing incentives is often perceived as an unfair practice simply due to the higher marginal utility of income and the higher price elasticity of

consequences of the proposed policies, which makes them appear unattractive at least for a fraction of end users, whose political influence is substantial. Both conjectures have been recognised by researchers. This Handbook as a dissemination tool represents a major effort of almost 50 authors from around the world with the aim of making academic outputs more accessible for students, practitioners, and early-career researchers. To address the second concern, there is a clearly visible shift in the recent literature to extend traditional normative analyses towards positive investigations of social acceptance and redistributional consequences.
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low-income households, both triggered by the tighter budget constraints they face. More generally, monetary payments seem to be more salient from an equity perspective than other sources of travel inconvenience, such as time loss, schedule delay and crowding. To the extent that people’s perception is biased in this sense, education and dissemination might be an effective way to inform the wider public about the non-pecuniary benefits of pricing, and on the benefits that may arise from the use of revenues. These are key issues for the acceptability of almost any transport pricing reform, because it is often neglected that a pricing policy does not end at the moment when the tolls or fares are paid by the user; recycling revenues from transport pricing enables the implementation of almost any redistributio
ditional pattern as part of a wider policy package combined with tax cuts for low-income households, as well as targeted transfers and subsidies. Finally, with the rapid spread of advanced technological solutions for pricing in every mode of transport, price discrimination based on equity considerations is an available but mostly unlocked possibility in practice. This Handbook is meant to showcase that pricing is too effective as an incentive-based regulatory tool to be sacrificed in response to platitudinuous claims about its fairness in general.

I.5 THE RISE OF THE SHARING ECONOMY AND NOVEL PRICE-SETTING MECHANISMS

The past decade has brought about substantial technological innovations in (usually) deregulated transport markets, such as ride-hailing (also called ride-sourcing in the academic literature) and car sharing. Pricing is an important component in the wider trend frequently described as the sharing economy. A noticeable demonstration of the power of time-varied pricing and online matching could be observed in the ride-hailing industry, where new entrants became dominant over traditional taxi service providers. The price of hailing a car using smartphone applications reflects the instantaneous cost of operating the service and the occupancy rate of available vehicles, with the application of so-called ‘surge pricing’ when there is a temporary mismatch between demand and availability of drivers. It is very likely that vehicle sharing will become even more popular in the future, especially if automated private cars overcome the barriers that currently impede their proliferation. Understanding competition in this emerging sharing economy market generates new challenges from the regulatory point of view, given that (i) tight competition could make price-setting mechanisms extremely volatile on the one hand, whilst (ii) identifying market power and optimising market power are complex tasks in the presence of economies of network size and fluctuating prices.

Interestingly, despite the high efficiency and general popularity of ride-hailing companies (Transportation Network Companies in the United States), simplicity in pricing is still a frequently voiced expectation in the case of publicly provided transport services, including road tolling and fare setting in public transport. Public opinion rarely distinguishes revenue-generating motivations from the aim of efficiency enhancement behind time-varying pricing strategies. The Handbook explains that price differentiation between peak and off-peak periods or network segments of different demand intensities can be more important than identifying the ideal average toll or fare level. In other words, tariff structures are at least as important as tariff levels, and a departure from pre-existing flat (undifferentiated) or subscription-based pricing traditions can be more impactful than a marginal adjustment in the cost recovery ratio of
transport services. Contactless payment methods and other emerging technological solutions are paving the way for a wide range of feasible ticketing solutions – it is up to the transport economist to make the necessary contributions to the development of new algorithms for fair and efficient resource allocation.

I.6 THE FORESEEN UPTAKE OF AUTOMATION, ELECTRIFICATION, AND SHIFTING MODAL PRIORITIES

The electrification and automation of road vehicles will not change the fact that pricing is among the most pressing issues in transport policy, with important questions already emerging for the near future. Traditional fuel duties and vehicle excise duties together constitute a substantial source of tax revenue for local and national governments. The transition to a ‘net zero’ transport sector will create an imminent funding gap in many countries, heavily affecting the financial sustainability of infrastructure development and maintenance, and social programmes outside the transport sector. At the same time, fuel duties are among the most efficient environmental taxes, given their proportionality with the amount of fuel consumed.

Due to the financial pressure, it is becoming more likely that novel (electronic) road pricing instruments will replace fuel duties, thus ensuring that electric vehicle owners also pay their fair share of infrastructure provision and other uses that governments have for the current fuel tax revenues. The early signs of such developments are already visible in several European countries with a growing penetration rate of private electric vehicles, including the United Kingdom, Norway, Denmark, and the Netherlands, and proposals for a per-km tax on electric cars in countries such as Australia (Chapter 24). Electronic road pricing had been promoted by transport economists since the infancy of the discipline, and it now seems it may be an external financial pressure that will finally turn this policy proposal into reality. Nevertheless, it is perhaps too early to declare as certain the adoption of road pricing, if only because a poorly designed road pricing mechanism could cause more harm than good compared to a simple tax linked to fuel or electricity consumption. Amid intensifying debates on the ideal electronic road pricing scheme, we have encountered fierce proponents of flat road tolls, which would enable even less differentiation in the price of road use than what fuel duties achieved so far through their proportionality with CO₂ emissions. In such debates, a proper understanding of the principles of road externality pricing is more important than ever. We trust the readers of this Handbook will find munition on the forthcoming pages to enter this dialogue with sufficient knowledge on what an efficient road pricing system would look like, and what could make it acceptable for the majority of society as well.

Whilst transitional changes are eagerly anticipated in private car use, enthusiasm around public transport remains far less pronounced. This is partly due to the aftermath of the COVID-19 pandemic, which had a huge impact on the public image of public transport. We are much less pessimistic about the future of bus and rail-based modes. First, electrification in bus transport is already a reality and in the situations that allow for automated driverless bus operation, recent findings suggest that automated bus networks should be denser, more frequent, and less reliant on public subsidies than how human-driven buses operate today (see Chapter 13 in the Handbook). Second, in the age of mounting energy prices and geopolitical tensions in the global energy sector, it is no longer just the environmental emission that
matters in transport, but also the absolute level of energy consumption, no matter how our vehicles are propelled. Railways and other forms of mass public transport feature unparalleled energy efficiency within and between dense urban areas. It is unlikely that technological innovation will ever neutralise scale economies in the capacity of vehicle operations.

I.7 THE HANDBOOK’S OBJECTIVES

This Handbook’s primary objective is to explain the economic theory of pricing, including the most recent contributions in the field, and to transform research findings into relevant policy recommendations. Although the scope we cover in 24 chapters is narrower than in some of the well-known more general handbooks of our field (e.g. A Handbook of Transport Economics by de Palma, Lindsey, Quinet, and Vickerman), we provide a wide range of detail and analysis of pricing theory and financing that has not been covered in earlier transport economics handbooks.

Most of the forthcoming chapters follow a welfare economic approach to transport pricing. That is, our initial standpoint is that the price of a transport service is a key decision variable in the process of policy optimisation, where a public decision-maker’s objective is to do well according to some predefined social welfare function – and in theory would aim to optimise it. Naturally, this exercise becomes more complicated in a liberalised transport market where the regulator has no direct control over prices set by profit-oriented companies. Also, we do recognise that welfare economics is not a consensual toolbox for policy optimisation in the transport sector. There might be many other driving forces behind pricing-related policies, e.g. strictly political, equity-oriented, or ecological ones. Several clearly expressed and theoretically underpinned policy recommendations of the transport economics community have remained neglected in the policy arena. Therefore, the book presents a critical assessment of the practical applicability and social/political acceptance of the outcomes of theoretical analyses.

Due to the narrowly defined welfare economic focus of several pricing studies in the past, the financial aspects of transport pricing have received less attention in the literature on transport economics. This is in contrast to industrial practice, where pricing is often understood as a tool for ensuring financing stability, neglecting its impact on transport demand and resource allocation. The Handbook recognises that pricing and funding/financing are closely related and intertwined subjects in transport policy, where the role of pricing goes way beyond fulfilling the financial requirements of project implementation and service provision. In doing so, the book addresses a critical disharmony in the transport sector between the economic and financial definitions of pricing.

The book devotes ample attention to new technologies, thus providing another important contribution in comparison with earlier publications. First, new developments will be discussed in relation to digital payment technologies, information provision, and the pricing techniques they now allow for (e.g. price differentiation and dynamic pricing). Second, we address the challenges and opportunities caused by the appearance of new transport technologies (i.e. new modes), such as ride-hailing and automated vehicles. This way the handbook reflects on the quickly evolving landscape of the urban transport scene and becomes an up-to-date source of information on hot topics in the policy arena.
I.8 BOOK STRUCTURE

The Handbook’s 24 chapters are structured into four parts. Part I provides comprehensive coverage of the theoretical foundations of transport pricing. The journey begins in Chapter 1 with a unique overview of the history of thought behind the discipline. The microeconomic principles of transport pricing are then introduced in two chapters, focusing first on what we call ‘first-best’ in welfare economics and then extending this scope to alternative policy objectives and various constraints on welfare maximisation. In the rest of Part I, we cover cross-cutting aspects of transport pricing that remain applicable across various modes of transport and geographical areas: these include climate change (Chapter 4), general equilibrium implications and urban form (Chapter 5), equity and distributional issues (Chapter 6), and the political economy of transport pricing and investment in Chapter 7.

After the general theoretical discussions, we guide the reader’s attention to mode-specific models of transport pricing in Part II of the book. Our aim here is to highlight the unique features of traditional and new transport technologies and the most relevant implications in terms of policy interventions. For example, Chapter 8 covers a very broad literature on road congestion pricing, Chapter 9 highlights the economic rationale behind subsidies in public transport. This part pays special attention to emerging technologies in the transport sector, such as ride-hailing (covered in Chapter 10) and connected and automated vehicles (Chapter 13). We believe that these subjects will draw considerable attention among Handbook readers in the upcoming years.

The book covers transport financing in the five dedicated chapters of Part III. The methodological backbone of the related chapters is public and corporate finance. In other words, this part differs from earlier chapters in the sense that economic efficiency and welfare economics in general do not play a leading role here. The foundational concepts of transport financing, including the distinction between funding and narrowly defined financing, are introduced in a unique contribution in Chapter 14. Chapter 15 focuses on investment appraisal, where the authors identify a crucial connection between transport pricing and project financing. Chapter 16 is devoted to public–private partnerships in the context of infrastructure development, whilst Chapters 17 and 18 present global and local approaches to transport financing, respectively.

Finally, the six condensed chapters in Part IV of the Handbook review and discuss a variety of regional specificities of Africa, Asia, Europe, Latin America, North America, and Oceania. The role of the regional overview is again to take the theoretical insights of transport pricing and financing closer to practical applications by focusing on local achievements and challenges of the future.

We believe that the Handbook is valuable for a wide range of readers, including undergraduate and postgraduate students, early-career researchers, senior researchers, practitioners, and anyone with an interest in transport pricing, financing and policy. We hope you enjoy reading it.

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