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REQUEST FOR APPROVAL OF THE PhD THESIS TOPIC

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Name of the study programme	PhD in Economics and business economics
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1. TITLE OF THE PROPOSED TOPIC
1.1. Croatian
Rentijersko društvo: makroekonomski učinci iznajmljivanja privatnog smještaja
1.2. English
A renting society: the macroeconomic impact of private accommodation renting
1.3. Area/field
Economics

2. PROPOSED OR POTENTIAL SUPERVISOR(S)		
2.1. Supervisor(s)		
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<i>Minimal general criteria for supervisor selection:</i>		
<ul style="list-style-type: none"> • has to hold a PhD degree and be awarded a scientific rank, • has to have at least two years of postdoctoral experience, 		

- *has to have a lead (co-lead or partner) position in a national or international project, or in some other way be able to ensure support for scientific research,*
- *has to satisfy the minimal criteria of excellence.*

If the supervisor is not an employee of the University of Rijeka, a co-supervisor from the University's constituent unit implementing the postgraduate study programme is assigned to the PhD candidate.

2.2. Co-supervisor

Title, first and last name	Institution, country	E-mail
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3. TOPIC OUTLINE

3.1. Summary in Croatian

(no more than 4000 characters with spaces)

Ova doktorska disertacija analizira makroekonomske učinke kratkoročnog iznajmljivanja privatnog smještaja te njegove implikacije na tržište rada, s posebnim naglaskom na Hrvatsku kao gospodarstvo ovisno o turizmu. Iako su online platforme za iznajmljivanje značajno povećale mogućnosti ostvarivanja dohotka kućanstava na mikro razini, njihovi agregatni učinci još uvijek nisu dostatno istraženi, ponajprije zbog složenih međusektorskih prelijevanja na tržište rada, tržište nekretnina te općenito na agregatnu ponudu i potražnju.

Hrvatska predstavlja prikladan empirijski kontekst s obzirom na to da udio turizma dostiže petinu bruto domaćeg proizvoda, uz dominantnu ulogu privatnog smještaja u ukupnom broju ostvarenih noćenja. Unatoč značaju ovog segmenta, službeni statistički izvori ne obuhvaćaju adekvatno prihode od iznajmljivanja. Nadalje, hrvatsko gospodarstvo obilježavaju izražene strukturne specifičnosti, uključujući naglašenu sezonalnost većine makroekonomskih pokazatelja, iznimno visoku sezonalnost turističkog prometa, ispodprosječnu stopu participacije na tržištu rada, izražen nedostatak radne snage te snažnu dinamiku tržišta nekretnina u turističkim područjima. Navedene karakteristike upućuju na zaključak da dodatni izvori dohotka, osobito prihodi od iznajmljivanja, mogu imati značajnu ulogu u oblikovanju ishoda na tržištu rada.

Postojeća literatura je fragmentirana te u pravilu ne adresira izravno istraživačka pitanja ove disertacije. Prevladavajući makroekonomski pristupi (poput input–output, CGE i DSGE modela) analiziraju agregatne učinke turizma, ali ne razlikuju privatni smještaj od ostalih oblika turističke ponude. Empirijska istraživanja upućuju na to da kratkoročno iznajmljivanje povećava cijene nekretnina i smanjuje ponudu dugoročnog stanovanja, iako su rezultati heterogeni te ovise o različitim geografskim područjima. Dokazi o učincima na tržište rada ostaju ograničeni i nedovoljno jednoznačni, dok šira literatura ističe i pozitivne učinke (generiranje dohotka,

atraktivnost ulaganja) i negativne posljedice (inflatorni pritisci, distorzije na tržištu rada, rast nejednakosti te potencijalni negativni učinci na ljudski kapital). Istraživanja u području oporezivanja ukazuju na to da porezi u turizmu mogu biti relativno učinkoviti, ali istodobno mogu generirati distorzije, osobito u uvjetima povlaštenog poreznog tretmana prihoda od iznajmljivanja.

Disertacija se usredotočuje na sljedeća ključna istraživačka pitanja: (i) utjecaj privatnog iznajmljivanja na stvaranje radnih mjesta i sudjelovanje na tržištu rada, (ii) odluke kućanstava o alokaciji između rada i dohotka od iznajmljivanja, (iii) učinke na agregatnu potražnju, (iv) udio prihoda od iznajmljivanja u ukupnom raspoloživom dohotku kućanstava te (v) ulogu porezne politike u oblikovanju odluka o sudjelovanju na tržištu rada i investiranju u nekretnine za najam. Pripadajuće hipoteze pretpostavljaju da prihodi od iznajmljivanja mogu djelovati na smanjenje ponude rada i utjecati na sektorsku strukturu zaposlenosti, značajno utjecati na agregatnu potražnju te biti snažno uvjetovani poreznim distorzijama.

Metodološki, istraživanje je strukturirano kroz tri zasebna rada. Prvi rad koristi panel analizu na razini jedinica lokalne samouprave kako bi se procijenio odnos između intenziteta privatnog iznajmljivanja i pokazatelja tržišta rada, uz uvažavanje nelinearnih odnosa i kontrolu ukupne turističke aktivnosti, čime se izolira učinak kratkoročnog najma. Poseban naglasak stavlja se na identifikaciju potencijalnih nelinearnih učinaka povezanih s prekomjernom turističkom specijalizacijom, uključujući efekte takozvane nizozemske bolesti. Drugi rad razvija makroekonometrijski model koji eksplicitno uključuje prihode od iznajmljivanja kao zasebnu komponentu dohotka kućanstava, čime se omogućuje analiza njihovih učinaka na potrošnju, ponudu rada i ukupnu makroekonomsku dinamiku u uvjetima različitih šokova. Treći rad analizira alternativne porezne tretmane prihoda od iznajmljivanja, procjenjujući njihove učinke na društveno blagostanje, javne financije i ekonomske distorzije primjenom simulacijskih metoda i analize ekonomskih politika.

Očekivani znanstveni doprinosi uključuju: (i) prvu empirijsku procjenu učinaka prihoda od iznajmljivanja na ponašanje na tržištu rada, (ii) razvoj novog makromodelskog okvira koji integrira prihode od turističkog iznajmljivanja, (iii) konstrukciju vremenske serije prihoda od najma temeljene na posrednim pokazateljima za Hrvatsku, te (iv) sveobuhvatnu evaluaciju poreznih politika usmjerenih na kratkoročno iznajmljivanje. U konačnici, disertacija ima za cilj ponuditi konzistentan analitički okvir za razumijevanje ukupnih ekonomskih implikacija turističkog iznajmljivanja u gospodarstvima s izraženom ovisnošću o turizmu.

3.2. Summary in English
(no more than 4000 characters with spaces)

This thesis examines broader macroeconomic and labor market effects of short-term private accommodation renting, with a focus on Croatia as a tourism-dependent economy. While peer-to-peer renting platforms have significantly increased household income opportunities, their aggregate economic impact remains insufficiently understood due to complex spillover effects across labor markets, real estate, and more generally aggregate demand and supply.

Croatia represents a suitable case study given tourism's contribution exceeding one fifth of GDP and the dominance of private accommodation in total overnight stays. Despite the sector's scale, official data doesn't capture properly rental income. Moreover, the Croatian economy is characterized with the following distinctive features such as pronounced seasonality in most economic indicators and extremely high seasonality in tourism indicators, below-average labor participation, labor shortages and a dynamic real estate market in tourist areas. These patterns suggest that non-labor income sources, particularly renting, may play an important role in shaping the Croatian labor market.

The related literature is fragmented and in most cases doesn't cover the precise research questions stated in the present thesis. Existing macroeconomic approaches (e.g., input-output, CGE, DSGE) capture aggregate tourism effects but do not distinguish private rentals. Empirical studies show that short-term rentals increase housing prices and reduce long-term supply, though findings vary across regions. Evidence on labor market effects is limited and inconclusive, while broader research highlights both benefits (income generation, investment attractiveness) and costs (price pressures, labor distortions, inequality, and human capital concerns). Papers on taxation indicate that tourism taxes can be efficient but may introduce distortions, particularly when rental income is preferentially treated.

The thesis addresses these key research questions: (i) the impact of private renting on job creation and labor participation, (ii) household labor–rental income trade-offs, (iii) effects of renting on aggregate demand, (iv) the relative share of rental income in total household income, and (v) the role of taxation in shaping investment and labor decisions. Corresponding hypotheses posit that rental income may reduce labor supply and alter sectoral employment, significantly affect aggregate demand, and be strongly influenced by tax policy distortions.

Methodologically, the research is structured into three papers. The first employs panel equations at the municipal level to estimate the relationship between private renting intensity and labor market indicators, accounting for non-linearities and controlling for overall tourism activity thereby isolating the short-term rental impact. Non-linearities are used to assess effects of so-called

overtourism related to a high degree of tourism specialization that can cause so called Dutch disease. The second paper develops a macroeconometric model incorporating rental income as a distinct household income component, enabling analysis of its effects on consumption, labor supply, and economic dynamics under various shocks. The third paper evaluates alternative taxation regimes for rental income, assessing their impacts on welfare, fiscal outcomes, and economic distortions through simulation and policy analysis.

The expected contributions include: (i) this is the first empirical assessment of rental income effects on labor market behavior, (ii) a novel macro-modeling framework integrating tourism-related rental income, (iii) a proxy-based rental income dataset for Croatia will be constructed, (iv) a comprehensive evaluation of taxation policies targeting short-term rentals will be provided. Overall, the thesis aims to provide a unified framework for understanding the economy-wide implications of tourism-related renting in highly tourism-dependent economies.

3.3. Introduction and overview of previous research

(suggested length: 7000 characters with spaces)

Introduction

Short term renting of private homes to tourists can represent an important income source for households in tourist areas around the globe. Demand for and supply of such peer-to-peer renting was additionally boosted over the last decade as online booking platforms emerged. Although this additional income from renting is improving the financial position of a household on the micro level, the macroeconomic and broader social impact is not entirely clear given a large number of spillover effects from tourism activities. Previous research has focused on specific channels to model the relationship between renting income and the rest of the economy, while aggregate effects are, to the best of my knowledge, not analyzed in more detail.

The empirical elements of this thesis will focus on Croatia, a representative tourism-dependent economy. The Croatian economy is characterized by a significant contribution of tourism revenue to total gross value added, with a share of total (indirect and direct effects) typically reaching over 20% according to satellite accounts¹. At the same time, private accommodation represents the single most important category of tourist accommodation in terms of overnight stays. A dynamic real estate market in most coastal areas during the past years shows a great interest in further investments in the mentioned category of accommodation, which is therefore expected to continue playing an important role in the future. However, direct indicators of the importance of private

¹ DZS (2025): Tourism satellite account for the Republic of Croatia, 2022.

accommodation to household income and the entire economy are not available. Nonetheless, based on physical indicators (such as the registered number of overnight stays) we can infer that the mentioned category of accommodation may potentially have far-reaching consequences on the entire economy, including labor market decisions, sectorial job distributions, impact on technological progress, and aggregate demand. Furthermore, observed savings rates based on official disposable income data are relatively low, in particular for non-employed persons which is pointing to potentially missing income categories in official data, out of which renting income might be an important source. Moreover, Croatia has below-EU-average labor participation rates which might also point to significant revenues from non-labor sources such as renting. Some other specificities of the economy also offer possible explanations of the large effect of tourism-related revenues on the entire economy. Examples are relatively low average TFP growth, strong real estate price growth, increasing labor shortages, pronounced seasonality in employment, relatively low tourism sector employment compared to other tourism intensive countries, among others. According to the mentioned arguments, the Croatian economy is an evident choice for empirically estimating the mentioned effects. This topic is, despite the described importance, not yet analyzed, neither at the macro nor at the micro level.

Related literature

This thesis relates to literature on economic effects of tourism, particularly short-term renting. While no existing paper directly addresses this proposal's questions, related work falls into five branches: (1) macroeconomic models including the tourism industry, (2) private accommodation and real estate markets, (3) labor market effects, (4) broader socio-economic impacts, and (5) tourism industry taxation. A separate strand of the literature focuses on Croatian macro models. Except for the second branch, most studies analyze tourism at an aggregate level rather than household renting.

Tourism and macro models

Macroeconomic effects of tourism are typically analyzed using input–output (I–O), computable general equilibrium (CGE), and dynamic stochastic general equilibrium (DSGE) models. Frechtling (2013) reviews I–O and CGE approaches. Zhang and Yang (2019) develop a two-sector DSGE model showing tourism booms can generate Dutch-disease effects, though potentially welfare-enhancing. While these contributions offer insights into the transmission mechanisms of tourism shocks, they model tourism at an aggregate level and do not distinguish between private accommodation and other forms of tourist accommodation.

Private accommodation and real estate market

Zhang and Yang (2021) estimate tourism-related renting effects on real estate using a DSGE model. Empirical studies show short-term rental platforms like Airbnb can increase housing prices by reducing long-term housing supply (Jiang et al., 2022). Cities with high Airbnb presence experience stronger price growth (Thackway and Pettit, 2021), while higher Airbnb activity raises rents (Horn and Merante, 2017). Biagi et al (2015) confirm a positive tourism–price link in Italy, with regional differences. Barron et al (2017) find Airbnb shifts housing from long-term to short-term use.

Škrabić Perić et al (2022) show tourism significantly affects house prices across EU countries, with stronger effects in areas dominated by private accommodation. Similar results are found by Gurran et al (2020). Conversely, Vizek et al (2023) find Croatian areas with more hotels experience faster price growth.

Tourism impact on labor market

Papers analyzing the impact of private accommodation renting on labor market decisions as described in the motivation to this thesis are to the best of my knowledge not available. However, several papers have estimated some more general relationships between tourism and labor market indicators. Zhao et al (2023) find positive employment effects from tourism across emerging economies. Semenovna Morozova et al (2015) show employment gains in Russia, while Telfer and Sharpley (2008) note mixed effects, including possible labor shortages. Walmsley et al (2022) find overtourism may raise output but reduce wages and working conditions. A World Bank report (2018) suggests peer-to-peer renting may reduce full-time hotel jobs and shift income abroad via platform commissions, though evidence is limited.

Tourism – broader impact

Martin-Martin et al (2019) highlight negative effects such as higher prices, reduced housing availability, and infrastructure pressures. Cocola-Gant and Gago (2021) emphasize benefits for investors, including liquidity and returns, but also displacement risks.

Another important study, Kožić (2019) finds that Croatian municipalities with stronger tourism have lower tertiary education attainment, suggesting potential negative effects on human capital.

Taxes on tourism

Research on tourism taxation is limited and does not address short-term renting. Schubert (2010) and Gooroochurn and Sinclair (2005) analyze optimal taxation using macro models, showing tourism taxes can be efficient. Chang et al (2010) demonstrate that tourism taxes do not necessarily

offset Dutch disease behavior in tourist-dependent economies. The World Bank (2018) highlights forgone tax revenues from peer-to-peer renting.

Macro models for Croatia

Croatian macro models include tourism only indirectly, typically via service exports or overnight stays (Nadoveza and Ravnik, 2021; Jooste et al, 2026), while tourism-related renting is not explicitly modeled.

3.4. Research aim and research hypotheses (suggested length: 700 characters with spaces)

The main research hypotheses to be tested within this thesis are:

H1: Private accommodation renting is adversely affecting labor market outcomes in areas in which renting becomes overly dominant through two potential channels: i) reduced households' incentives to actively participate in the labor market (labor supply) and/or ii) weaker job creation in tourist destinations that more heavily rely on renting (sectorial composition impact).

H2: The share of renting income in total household income in Croatia is non-negligible with significant aggregate demand effects, while on the other hand heavy dependence on tourism income increases vulnerability of the country and negatively affects economic activity via substitution and price effects.

H3: Taxation of rental income influences households' investment and labor supply decisions. Specifically, in Croatia, the preferential tax treatment of rental income relative to labor and business income incentivizes investment in rental properties, and, as a result, diminishes incentives to participate in the labor market

3.5. Materials, methodology and research plan (suggested length: 6500 characters with spaces)

This PhD thesis will be structured according to the Scandinavian model with three research papers. The description of data and methodology provided below is thus following this structure and at the same time being aligned with each of the hypotheses listed previously.

Paper 1: Empirically estimating the impact of short-term private accommodation renting on labor market decisions.

This research paper will assess the impact of private accommodation renting on labor market indicators by using disaggregated data for Croatian municipalities. In order to quantitatively examine the relationship described, an econometric assessment based on panel data is suggested. Various specifications of panel regressions will be used for that purpose, including non-linear panel

models. The goal is not to identify a causal effect of private accommodation, but rather to assess whether a stronger relative reliance on private accommodation, conditional on overall tourism intensity and other observable controls, is associated with labor market patterns consistent with excessive tourism specialization and Dutch disease–type mechanisms.

Panel equations that will be estimated in this paper will regress the unemployment rate, total employment and participation rate on tourism-related indicators and control variables. Alternative specifications will include a relative measure of rental versus labor income as the dependent variable, and it will be based on Tax administration office data. The key explanatory variable in these equations is an indicator of intensity of private accommodation renting measured by the relative number of overnight stays in this specific accommodation category. Control variables will include proxies for economic activity measured by municipality development index and total tax revenues in each municipality, and demographic indicators. Importantly, the key control variable is total tourism, measured as the number of overnight stays in a municipality, so that we disentangle overall tourism from private accommodation renting. By doing this, it will be possible to isolate the private accommodation effect over and above the effect of total tourism.

Non-linear specifications will be included in this paper as it is important to distinguish municipalities overly dependent on renting from other less dependent municipalities. The methodology is not imposing an *a priori* form of the non-linear effect. As stated in the first hypothesis, total job creation can become subdued in areas in which renting becomes overly dominant, leading to excess specialization and Dutch disease. On the other hand, the positive income effect might still dominate at lower degrees of private accommodation renting intensity. In order to test such non-linearities, a version of partially nonlinear fixed effects models will be used according to Baltagi and Li (2002).

The data source for tourism overnight stays by accommodation category at municipality level is the Croatia tourist board (HTZ), while labor market variables are published by the Croatian employment service (HZZ) and Geostat and other control variables available from official publicly available statistical sources i.e. Eurostat and Croatian Bureau of Statistics. Data on income from renting and labor is gathered from tax revenue data at municipality level provided by the Tax administration office.

Paper 2: The aggregate impact of tourism related-renting through a macrostructural model: the case of Croatia

A macrostructural model for Croatia with an emphasis on disposable income modeling and labor participation vs. rental decisions will be developed in order to assess the aggregate effects of tourism-related renting. The micro foundation of the model and real estate demand and supply will follow the standard approach developed in Iacoviello (2005), tourism demand will build on Zhang and Yang (2019) while the final model will be extended by additional ad-hoc empirical relationships and estimated and solved in a macroeconometric form by applying Croatian data.

The model will include households which can consume consumption goods and have additional utility from housing and disutility from labor. They can decide to participate in one of the two sectors in the economy: the production or tourism service sector. Disposable income of households will thus be divided into its major categories with income from renting as a novelty in these types of models. A time series representing renting income will be constructed indirectly based on various indicators from a wide range of sources including official data on rental prices for tourist properties, number of tourists, tourist activity surveys, other empirical research and official reports from the relevant ministries. Total household income consists of wage income ($W_t N_t$), other income (e.g. government transfers, remittances and financial income among others) and income from private accommodation renting (Ren):

$$Income_t^{HH} = (W_t N_t(1 - \tau^{Pl}) + oth_t) + (Ren_t - \tau^R)$$

Households will maximize their utility subject to this budget constraint. Therefore, the impact of lifetime income streams from renting on labor market and consumption decisions will be modelled. It is also important to take into account how renting might affect demand for labor, in addition to supply, mainly via second-round effects caused by higher renting income. The model will be estimated on macroeconomic data for Croatia whereby the rest of the model that is not related to tourism will follow Bruns et al (2019). This means that the model will converge into a Cobb-Douglas production function in the long run, while it will have New-Keynesian features in the short- to medium-run including price and wage stickiness, distortionary fiscal policy and exogenous (euro area) monetary policy. The fiscal block includes separate implicit tax rates on income, corporate income, capital, VAT, excises and other taxes. Total exports of goods and services will be broken down such that tourism (part of services exports) is modelled explicitly, which is another non-standard feature of the model.

Results will be analyzed via impulse response functions and scenario analysis for different tourism demand-type shocks. By doing so, the vulnerability of the Croatian economy to tourism demand will be tested which will deepen our understanding of risks related to tourism specialization. Not

only consequences to GDP expenditure categories will be assessed, but also reactions of potential GDP, labor market variables and consumer prices, will be examined in detail. Moreover, the relative importance of tourism income to total income and household consumption will be assessed.

Paper 3: How should tourism-related renting be taxed? A macro-structural perspective

This paper provides an analysis of taxation of short-term renting by using a similar model and data as the one that will be developed in paper 2. The existing lump-sum taxation approach will be compared to other taxation approaches. On one hand, tourism taxes can be welfare enhancing if foreign tourists bear most of the tax burden as described in Gooroochurn, Sinclair (2005). On the other hand, unequal tax treatment of different income tax categories can cause significant distortions and affect households' decisions. Moreover, different rental income taxation strategies will also affect government revenues and more generally the fiscal sector. It is thus important to understand aggregate budgetary and welfare effects of different tax rates and tax treatments of rental income.

Tax rates in the previous equation τ^{PI} and τ^R are labor income taxes and rental income tax. Precisely those tax categories will be the main ones that this paper will work on. In the specification above, the labor income tax is a simplified proportional tax, while the rental tax is a flat tax as it is currently the case in Croatia. Different versions of those flat taxes will be analyzed in this paper. Also, different proportional taxes on rental income will be analyzed. Another specific taxation strategy that will be analyzed is a single proportional income tax that is levied on all income categories without any preferred tax treatments from rental income or any other income category.

This paper will focus on the impact of rental taxation on labor market outcomes (rental vs. labor market participation decision), tourism revenues, residential investment decisions and overall welfare impacts. Fiscal multipliers for various rental taxation types will be compared, and they will also be compared against fiscal multipliers of other tax rates such as VAT, personal or corporate income taxes, or excises within the same model. Also, the reaction of overall fiscal revenues is expected to differ depending on the specific taxation type if the income composition shifts significantly between labor and other incomes. Therefore, not only the impact on the labor market and real economy but also on the fiscal sector will be examined.

The impact of different rental income taxation strategies will be simulated and examined via welfare analysis and impulse response functions as well as fiscal multiplier analysis. By using welfare analysis various taxation types can be ranked relatively depending on their welfare impact. Impulse response functions for specific labor market variables, GDP components, prices and fiscal

indicator and fiscal multipliers will be used to describe the underlying mechanisms and build a narrative around the welfare results.

3.6. Expected scientific contribution of the proposed research
(suggested length: 500 characters with spaces)

This thesis is expected to have the following four contributions to existing literature.

Firstly, this thesis is the **first attempt to empirically estimate the impact of tourism related renting on labor market outcomes**. As defined in the first research hypothesis, the aim is to analyze whether working-aged citizens which have the possibility to rent their properties to tourists, are less motivated to actively participate in the labor market. The analysis further investigates if a high prevalence of private accommodation renting correlates with reduced job availability in those tourist destinations. In other words, highly specialized areas with more renting income might limit overall job availability as the sectorial job distribution can be significantly affected.

Secondly, the thesis will **propose a modelling framework for analyzing aggregate economy-wide effects of renting income** that are not solely applicable to Croatia but can be used for any other tourism-dependent country according to hypothesis H2 listed above. This topic was not yet analyzed by a large macroeconomic model with the necessary transmission channels as the existing literature focuses only on specific channels. On positive effects of renting, one can expect significant aggregate demand effects, which will generate additional jobs. On the other hand, there is a possibility of demotivation for active participation in the labor market due to the income effect, but also adverse effects on purchasing power of residents due to price increases caused by tourism demand. Additional effects on the real estate market are already analyzed in previous studies and this thesis will use insights and modelling approaches from those papers.

Thirdly, this research is expected to **shed some light on the importance of tourism related-renting income relative to total household income in Croatia**, as currently, no official data on income from private accommodation is publicly available. An aggregate renting income series therefore needs to be constructed which will be based on various proxy indicators. Such a data series could find several applications in future research but will also add value to policymakers and the broader public, and it will be used in the present thesis in the modelling chapter (paper 2)

Finally, this thesis will also **contribute to the literature on income taxation and taxation of the tourism sector by comparing economic consequences of various tourism rental tax rates, taxation approaches and policies**. Previous papers have analyzed various tax policies on the

entire tourism industry or directly on foreign tourists while the present thesis will specifically focus on taxes on short-term renting.

3.7. References

(no more than 30 references)

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CONSENT OF THE PROPOSED SUPERVISOR WITH TOPIC APPROVAL REQUEST

I hereby declare that I agree with the proposed PhD thesis topic.

Signature



Ozana Nadoveza
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STATEMENT

I hereby declare that I have not submitted the same PhD thesis topic at any other university.

Signature



Rafael Ravnik
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Rijeka, 15/05/2026