Research note

What caused the rise of Airbnb? An examination of key macroeconomic factors

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ARTICLE INFO

ABSTRACT

The social and economic implications of the Airbnb phenomenon have been the subject of much research. Yet, the academic literature on Airbnb is nascent. Specifically, the issue of whether major macroeconomic conditions affect the supply of Airbnb has not been investigated. To address this gap, we propose a conceptual model that explains the determinants of Airbnb supply and examine the extent to which major macroeconomic factors affect the supply of Airbnb. Specifically, we analyze the effects of hotel room rates (ADR), hotel demand, tourism demand, house prices, gross domestic product (GDP), wages and unemployment on the supply of Airbnb in 50 U. S. states. Results show that increases in hotel ADR, house prices, and GDP have contributed to an increase in the supply of Airbnb, whereas increases in unemployment rates and wages have adverse effects on Airbnb supply. Theoretical and policy implications are discussed within realms of macroeconomic theory.

1. Introduction

Airbnb has been at the center of discussion among scholars and practitioners in recent years due to its exponential growth (Dogru, Mody, & Suess, 2019; Sigala, 2017; Zervas, Proserpio, & Byers, 2017). It has become the largest alternative lodging accommodation company with more than six million listings, including entire homes, shared rooms, and private rooms, which is more than the world's largest three hotel chains combined (Dogru et al., 2019). A wide range of research themes has emerged to understand the Airbnb phenomenon; Airbnb consumers' experiential behavior vs. hotels (e.g., Mody, Suess, & Lehto, 2017), why people, whether it be consumer or supplier, participate in Airbnb (e.g., Kim, Yoon, & Zo, 2015; Lampinen & Cheshire, 2016; Möhlmann, 2015), the effects of Airbnb on the hotel industry (e.g., Choi, Jung, Ryu, Do Kim, & Yoon, 2015; Dogru, Mody, & Suess, 2017; Zervas et al., 2017), economic impacts of Airbnb (e.g., Levendis & Dicle, 2016), price determinants of Airbnb properties (e.g., Dogru & Pekin, 2017; Wang & Nicolau, 2017), supply and demand dynamics of the sharing economy (e.g., Dogru et al., 2017; Gunter & Önder, 2018; Haywood, Mayock, Freitag, Owoo, & Fiorilla, 2017; Heo & Blengini, 2019; Yang & Mao, 2018), and the regulation of and legislation pertaining to Airbnb and other short-term rental providers (e.g., Kaplan & Nadler, 2015; Miller, 2014; Yang & Mao, 2018).

Furthermore, the economic implications of Airbnb have been subject to much debate in academic research. On one hand, proponents of Airbnb argue that Airbnb has positive economic impacts on hospitality and tourism institutions, such as restaurants, bars, and other area attractions, through increases in income and employment. For example, studies of Dogru, Hanks, Mody, Suess, and Sirakaya-Turk (2020) and Fang, Ye, and Law (2016) reported that Airbnb benefits the tourism industry by generating new jobs and sources of income. In another study, Airbnb is found to have positive economic impacts in New Orleans, with a total increase of $134 million in income and 4480 additional jobs created in the city (Levendis & Dicle, 2016).

On the other hand, critics of Airbnb suggest that the potential adverse economic impacts of Airbnb cannot be overlooked: Airbnb

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might negatively affect the hotel industry, if visitors were to shift their demand from hotels to Airbnb accommodations. Zervas et al. (2017) showed that a 1% increase in Airbnb listings decreases hotel revenue by 0.04% in Texas. In a recent study, Dogru et al. (2019) found that a 1% increase in Airbnb listings decreases hotel room revenues by 0.03% in top ten US cities. More strikingly, these authors showed that Airbnb supply has been increasing more than 100% year-over-year since its inception in 2008, resulting in an average 3% loss in RevPAR for hotels in the ten U.S. cities they examined.

While such research on the social and economic implications of Airbnb has proliferated in recent years, academic literature on the subject is still nascent. Several important questions pertaining to the rise and consequences of Airbnb remain unexplored. In particular, the role of macroeconomic factors on the rise of Airbnb has not been widely investigated. To fill this gap in the extant literature, the purpose of the present study is to propose a conceptual model that explains the rise of Airbnb supply and examine the extent to which major macroeconomic factors are associated with the supply of Airbnb properties. Specifically, we analyze the relationships of hotel average daily rate (ADR), hotel room sold (i.e., hotel demand), airport passenger arrivals, house prices, gross domestic product (GDP), wages and unemployment with the supply of Airbnb in 50 states in the U.S. for the period between 2010 and 2017. The general macroeconomic theory along with the extant literature on sharing economy suggests that these macroeconomic factors might have a relationship on the rise of Airbnb supply (see Dogru et al., 2019; Gunter & Önder, 2018; Kim et al., 2015; Lampinen & Cheshire, 2016; Möhlmann, 2015; Yang & Mao, 2018; Zervas et al., 2017). In addition to Airbnb listings, we further examine the relationships between these macroeconomic factors and the different types of Airbnb supply—entire homes, private rooms, and shared rooms—to provide robust estimates and to identify whether these macroeconomic dynamics differ in their relationships with Airbnb supply. Analyzing the relationships of macroeconomic factors with Airbnb supply of entire homes and private and shared rooms listings is also essential to account for the different types of Airbnb supply because the determinants of entire home Airbnb listings might be different than that of private and share rooms (Dogru et al., 2019; Fang et al., 2016; Zervas et al., 2017). Examining these relationships can provide an explanation for why Airbnb has so quickly emerged as such an important accommodation firm. Also, given that we examine potential relationships between hotel market dynamics and Airbnb supply, our results provide guidance to hoteliers in developing strategies to adapt to changing consumer preferences.

2. Literature review

In the tourism and hospitality literature, a number of studies have investigated the implications of Airbnb for the industry's various stakeholders. One of the main questions that scholars have sought to answer is "why do people participate in Airbnb?". Participants of Airbnb (both guests and hosts) indicate that Airbnb provides cost savings to travelers, while allowing hosts to generate extra income (Möhlmann, 2015). For example, Ikkala and Lampinen (2015) showed that beyond the income earned from Airbnb, hosts engaged with the sharing economy to enhance their social activities through interactions with guests. For guests, both social and economic factors, such as experiencing a sense of localness, obtaining insider tips, seeking authenticity, and receiving a quality stay at a lower cost drive their participation in the sharing economy (Ikkala & Lampinen, 2015; Mody, Suess, & Lehto, 2017; Sigala, 2017; Tussyadiah & Pesonen, 2016a; Tussyadiah & Pesonen, 2016b). That is, the mutually benefiting characteristics of Airbnb is considered one of the main reasons behind its significant adoption i.e. the potential economic, social, and cultural benefits that Airbnb offers both guests and hosts attracts them to the platform.

Furthermore, although researchers have suggested that important macroeconomic factors—such as increases in hotel room prices, house

prices, tourism demand, wages, income, and decrease in unemployment rate—may have contributed to Airbnb's remarkable growth (Dogru et al., 2019; Fang et al., 2016; Guttentag, 2015; Zervas et al., 2017), there is no empirical research to date that tests this proposition. To understand the macroeconomic factors influencing property owners' decision to enter the Airbnb market, this study proposes a conceptual model to explain the mechanisms that cause the growth in Airbnb supply.

2.1. Theoretical model

The conceptual model proposed in this study is called Airbnb Supply Model (see Fig. 1). It is mainly based on Fogg Behavior Model, which states that human behavior is the product of three factors: motivation, ability, and triggers (Fogg, 2009). In the context of Airbnb supply, it is reasonable to believe that an Airbnb host's behavior to rent a property on Airbnb is determined by the *motivation* to rent their properties to earn extra money, backed by the *ability* afforded by owning a house that can be rented, and *triggered* by the demand for Airbnb. Therefore, the demand for Airbnb, hosts' motivation to rent their properties to earn extra money, and hosts' financial ability to have a spare house or room are three direct factors of the supply of Airbnb.

The demand of Airbnb can be affected by major macroeconomic factors, such as hotel industry dynamics, tourism demand dynamics and overall economic conditions. Although positioned as a sharing economy platform, Airbnb essentially provides alternative lodging accommodations to travelers. While it is not clear whether Airbnb should be considered a direct competitor to traditional hotels, there is evidence to suggest that hotel industry dynamics may have contributed to the rise of Airbnb supply (Dogru et al., 2019; Yang & Mao, 2018; Zervas et al., 2017). Due to a certain level of competition between hotels and Airbnb properties, when the overall demand for commercial accommodation is constant, the increase of hotel prices may make customers look for less expensive accommodations, such as Airbnb properties, and more customers choosing hotels may lead to the lower sales in Airbnb. Accordingly, we expect an increase in hotel ADR is associated with an increase in Airbnb supply. Moreover, while an increase in hotel demand might be associated with an increase in Airbnb supply due to an increased number of travelers visiting a destination, a growth in hotel demand may, in turn, lead to a decrease in Airbnb supply if Airbnb guests opt to stay at traditional hotels instead. Airbnb hosts may also choose to delist their properties from Airbnb if there is insufficient demand, which suggests an inverse relationship between Airbnb supply and hotel demand. Also, tourism demand is another important determinant of hospitality business performance (Gunter & Önder, 2018; Yang & Mao, 2018). An increase in overall tourism demand is expected to increase demand for lodging at a destination. Thus, considering Airbnb a key lodging provider, we expect an increase in tourism demand—as measured by airport passenger arrivals—is correlated with an increase in Airbnb supply. Accordingly, we propose the following hypotheses.

H1. Ceteris paribus, there is a positive relationship between hotel ADR and the supply of Airbnb (in terms of all Airbnb listings, entire homes, private rooms, and shared rooms).

H2. Ceteris paribus, there is a negative relationship between hotel room sold and the supply of Airbnb (in terms of all Airbnb listings, entire homes, private rooms, and shared rooms).

H3. Ceteris paribus, there is a positive relationship between airport passenger arrivals and the supply of Airbnb (in terms of all Airbnb listings, entire homes, private rooms, and shared rooms).

Hosts' motivation to rent their properties on Airbnb to generate additional income can be influenced by wages, house prices, and GDP. Airbnb units consist of residential properties, where the host might rent out the entire home, a private room, or a shared room. While Airbnb hosts may have varied motivations to rent out their properties, such as
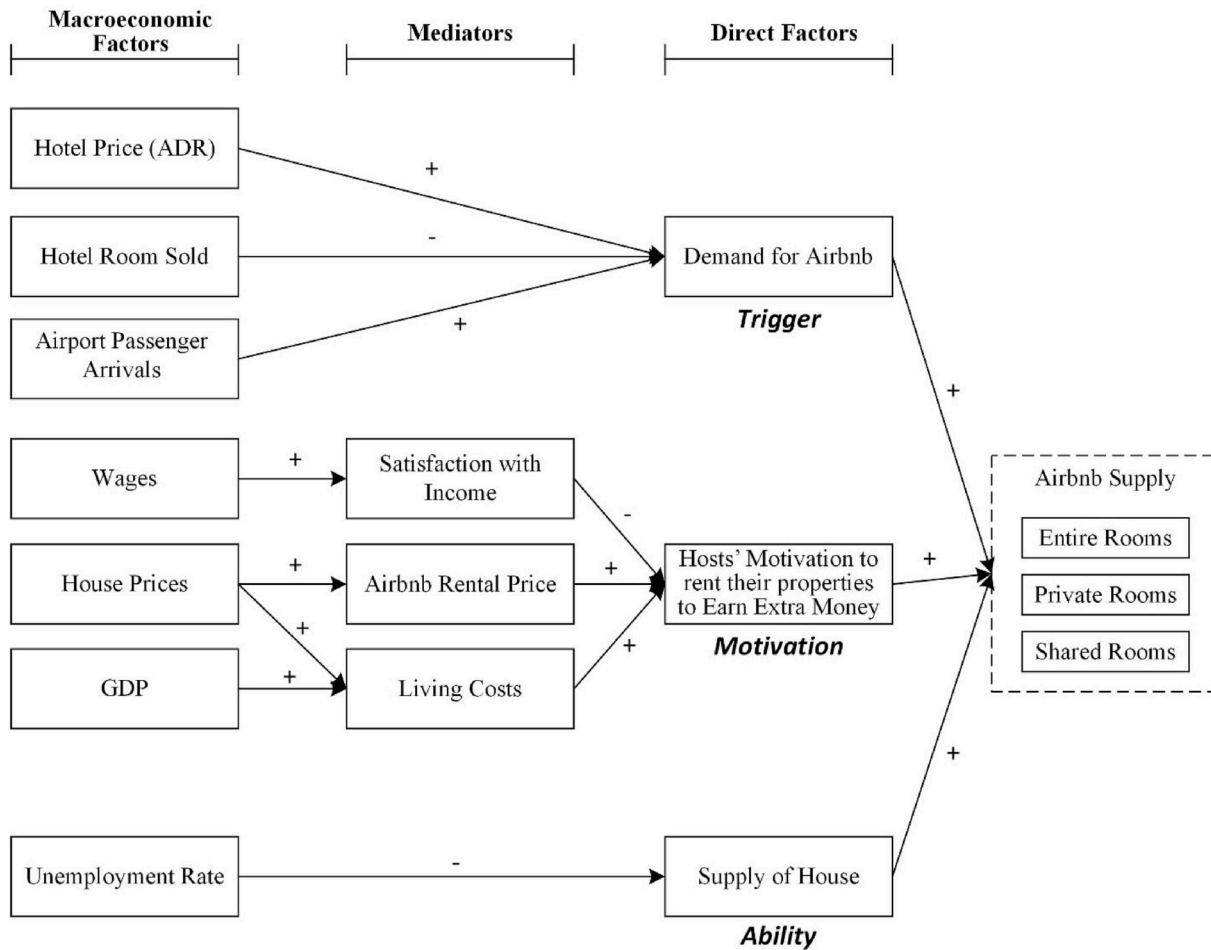
Fig. 1. Airbnb supply model.

social interactions with guests, generating an additional source of income arguably is the primary motivation (Möhlmann, 2015). Homeowners may be particularly motivated to become Airbnb hosts to effectively utilize their properties and compensate for increasing house expenses (Kim et al., 2015; Lampinen & Cheshire, 2016; Möhlmann, 2015). When house prices increase, individuals' living costs and Airbnb rental prices may increase too. To cover the increased living costs, their motivation to rent their properties on Airbnb may increase, especially with the temptation of increased Airbnb rental income. People travel more when the economy is expanding; when businesses thrive and employee wages and salaries increase, we observe a decrease in unemployment and an increase in income during periods of economic expansion. When wages increase, people tend to be more satisfied with their incomes and hence have less motivation to rent their properties on Airbnb to earn extra money. When an area's GDP increase, the living costs tend to increase too, and consequently, their motivation to rent Airbnb properties increases. Hosts' financial ability to have a spare house or room for rent may be affected by unemployment rate. When unemployment rate decrease, more people have jobs. Consequently, more people have financial ability to afford to buy a house or a larger house. Thus, more people are likely to have a spare house or room. Having a spare house or room is important for being an Airbnb host. Therefore, the following hypotheses were proposed.

H4. Ceteris paribus, there is a negative relationship between wages and the supply of Airbnb (in terms of all Airbnb listings, entire homes, private rooms, and shared rooms).

H5. Ceteris paribus, there is a positive relationship between house

prices and the supply of Airbnb (in terms of all Airbnb listings, entire homes, private rooms, and shared rooms).

H6. Ceteris paribus, there is a positive relationship between GDP and the supply of Airbnb (in terms of all Airbnb listings, entire homes, private rooms, and shared rooms).

H7. Ceteris paribus, there is a negative relationship between unemployment rate and the supply of Airbnb (in terms of all Airbnb listings, entire homes, private rooms, and shared rooms).

Fig. 2 depicts the proposed relationships as postulated in the proposed hypotheses.

We must note that the impact of the general macroeconomic variables on Airbnb supply can be expected to be positive or negative. On one hand, it is reasonable to postulate an increase in Airbnb supply with a decrease in unemployment and increases in GDP and wages. These expectations are consistent with people's tendency to travel more when the economy thrives, leading to higher demand for lodging accommodations including Airbnb. However, it is possible that actual and potential Airbnb hosts also benefit from a stronger economy and thus do not need to generate additional income through Airbnb i.e. with increased income levels, Airbnb hosts may not be willing to list their properties on Airbnb since they do not need an extra source of income. Thus, it is possible to observe an inverse relationship between general economic conditions and the rise of Airbnb. Overall, our propositions pertaining to how these macroeconomic factors are associated with Airbnb supply are based on the principles of macroeconomic theory.
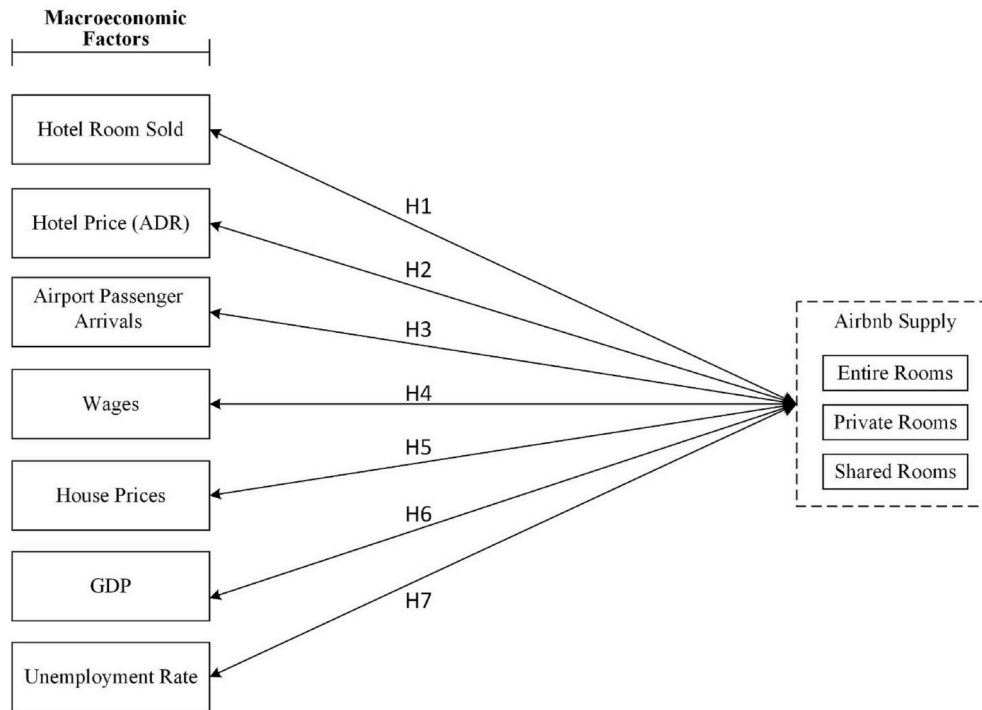
Fig. 2. Hypotheses.

3. Methodology

3.1. Data collection

The sample for this study consists of 50 U.S. states with available data for the period between 2010 and 2017, including Washington D.C. The State of Delaware was not included in the sample due to unavailability of data. Consequently, the sample consists of 400 state-year observations. The study period is limited to the years with collectively available data for study's dependent and independent variables. That is, the number of observations is limited to 400 state-year observations because data for study's dependent and independent variables were collectively available for the 2010–2017 time period in 50 U.S. states (excluding the state of Delaware).

Based on previous studies that examine Airbnb's economic impact (e. g., Dogru et al., 2019; Zervas et al., 2017), we utilized four Airbnb supply measures as the study's dependent variables. The study's main dependent variable is total Airbnb supply, which consists of the total number of Airbnb units created and listed on Airbnb's website, including entire homes, private rooms, and shared rooms. Each of these three types of Airbnb listings—entire homes, private rooms, and shared rooms—also serve as separate dependent variables. In addition, we used an alternative set of Airbnb supply measures to provide reliable and robust estimates from our model; this alternative set of Airbnb supply variables only included units that had been booked at least once within a given year. These were considered measures of "active" Airbnb supply, and included the four variables of total active Airbnb supply, and the active supply of entire homes, private rooms, and shared rooms separately. We obtained the Airbnb data from AirDNA, a company that offers short-term rental data and analytics to academic researchers and investors. Table 1 presents the Airbnb supply data in detail.

Following extant literature, we examine the role that major macroeconomic factors may have played in the rise of Airbnb supply (Dogru et al., 2019; Gunter & Önder, 2018; Kim et al., 2015; Lampinen & Cheshire, 2016; Möhlmann, 2015; Yang & Mao, 2018; Zervas et al., 2017). Specifically, we included two key hotel industry-specific macroeconomic variables in our empirical model: the annual hotel average daily rate (i.e., ADR), and annual room sold (the total number of hotel rooms sold in a year in the 50 U.S. states). Smith Travel Research (STR) provided the hotel ADR and room sold data. We also included the airport passenger arrivals variable to examine the effect of tourism demand on the supply of Airbnb. We obtained airport passenger arrivals data from the Bureau of Transportation Statistics. To analyze the extent to which the rise of Airbnb can be attributed to hosts' motivations for additional income, we investigate the effect of house prices on Airbnb supply. We obtained state-level house prices from Zillow, which provides the most

Table 1
Airbnb supply.

Year	All Airbnb Supply				"Active" Airbnb Supply*			
	All Listings	Entire Home	Private Room	Shared Room	All Listings	Entire Home	Private Room	Shared Room
2010	2619	1635	963	21	2213	1402	799	12
2011	8355	5331	2940	84	7017	4545	2409	63
2012	21,612	14,000	7390	222	17,857	11,727	5978	152
2013	46,094	30,587	15,011	496	38,415	25,894	12,147	374
2014	99,345	66,779	31,424	1142	80,151	54,795	24,558	798
2015	222,372	150,705	68,735	2932	169,246	117,062	50,309	1875
2016	433,972	297,774	129,859	6339	339,853	239,561	96,125	4167
2017	862,980	594,654	253,507	14,761	706,016	500,133	195,633	10,219
*Airbnb listings with at least one booking in a given year.								

comprehensive real estate dataset. General macroeconomic conditions may also contribute to the rise of Airbnb (Yang & Mao, 2018; Zervas et al., 2017). Thus, we further examine the effects of gross domestic product (GDP), employee wages and unemployment rates on Airbnb supply. We obtained GDP data from the Bureau of Economic Analysis, and employee wage and unemployment data from the Bureau of Labor Statistics.

We use the following empirical model to predict Airbnb supply with hotel ADR, hotel room sold, airport passenger arrivals, house prices, GDP, wages and unemployment rate as predictors.

$$lnAirbnb_{it} = \beta_{0i} + \beta_{1i}lnHotelADR_{it} + \beta_{2i}lnHoteldemand_{it} + \beta_{3i}lnArrivals_{it}$$
$$+ \beta_{4i}lnHouseprice_{it} + \beta_{5i}lnGDP_{it} + +\beta_{6i}lnWages_{it} + \beta_{7i}lnUnemployment_{it}$$
$$+ \varepsilon_{it} \tag{1}$$

The dependent variable takes the forms of total Airbnb listings, entire homes, private rooms, shared rooms, total active Airbnb listings, active entire homes, active private rooms, and active shared rooms in state i at time t. The independent variables are hotel ADR, hotel demand, number of passenger arrivals, house prices, GDP, wages and unemployment rates in state i at time t. β_{0i}—β_{7i} are the model parameters, and ε is the error term. All variables were transformed to natural logarithmic forms to account for skewness. The double logarithmic empirical specification also allows for the interpretation of the coefficients as elasticities.

3.2. Empirical approach

We employ the panel generalized method of moments (GMM), which is a dynamic panel data model, to examine the extent to which major macroeconomic factors affect the supply of Airbnb. A dynamic panel data model can be described as follows (Baltagi, 2008):

$$y_{it} = \delta y_{i,t-1} + x_{it}\beta + u_{it} \tag{2}$$

where i = 1, 2, …N; t = 1, 2, …T, δ is a scalar, x_{it} is 1xK, β is Kx1, and $u_{it} = \mu_i + \nu_{it}$. For such a dynamic panel data model, y_{it} is a function of μ_i, and $y_{i,t-1}$ is also a function of μ_i. Hence, $y_{i,t-1}$ is correlated with the error term, implying the strict exogeneity assumption is violated. Therefore, the pooled ordinary least squares (OLS) estimator, the fixed effects model, and the random effects model would produce biased and inconsistent findings for equation (2) even if there exists no serial correlation (see Greene, 2003 and Baltagi, 2008 for details). However, the panel GMM estimator is capable of providing unbiased and consistent findings for dynamic panel data models, and is thus commonly performed in empirical studies with such models. The panel GMM estimator can be performed by researchers for the cases with (i) small time-series dimensions and large cross-section dimensions, (ii) a linear relationship, (iii) a dependent variable that depends on its past values, and (iv) serial correlation and heteroskedasticity within individuals but not across them (Roodman, 2009). Besides, a great advantage of the panel GMM estimator is that it can be employed without examining panel time series

properties of the variables, such as unit root and cointegration.

In the econometrics literature, researchers have developed two types of panel GMM estimators: the difference GMM method and the system GMM method. While the difference GMM method uses the first difference transformation, the system GMM method uses the forward orthogonal deviations transformation. The first difference transformation is based on subtracting the previous value from the current value, while the forward orthogonal deviations transformation is based on subtracting the average of all available future observations from the current value.

Simulation studies by Alonso-Borrego and Arellano (1999) and Blundell and Bond (1998) reveal that the system GMM approach developed by Arellano and Bover (1995) produces more efficient output in dynamic panel data models with large autoregressive parameters and low time series observations than the difference GMM method suggested by Arellano and Bond (1991). Thus, in the present study, we employ the system GMM method to analyze the proposed relationships in our theoretical model.

4. Empirical results

We utilized the system GMM approach to investigate the relationship between the supply of Airbnb and hotel ADR, hotel demand, tourism demand, house prices, GDP, wages and unemployment rate. Table 2 presents these findings for the first set of dependent variables comprising total Airbnb listings, and entire homes, private rooms and shared rooms separately. Results show that H1 (hotel ADR as a predictor) and H5 (house price as a predictor) are completely supported, and H2, H3, H4, H6, and H7 (hotel room sold, airport passenger arrivals, wages, GDP, and unemployment rate as predictors, respectively) are partly supported.

The results show that hotel ADR (β: 1.011, p < 0.05), house prices (β: 0.965, p < 0.01) and GDP (β: 2.736, p < 0.01) are found to have a positive relationship with total Airbnb supply. While tourism demand i. e. airport passenger arrivals also has a positive relationship with total Airbnb supply, this relationship is statistically insignificant at conventional significance levels. Wages (β: −5.053, p < 0.01) and unemployment rate (β: −0.581, p < 0.01) have negative relationships with total Airbnb supply. Although hotel demand has a negative relationship with total Airbnb supply, this relationship is statistically insignificant.

While this overall examination explains the relationships between major macroeconomic factors and the supply of Airbnb, these factors may have varying relationships with the different types of Airbnb properties. Thus, we further analyzed the relationships between hotel ADR, hotel demand, tourism demand, house prices, GDP, wages and unemployment rate and separate measures of entire homes, private rooms and shared rooms. As evident in Table 2, the relationship between hotel ADR and Airbnb supply is positive and significant across all three types of Airbnb properties. However, this relationship is largest in magnitude on the supply of shared rooms. While hotel demand is not significantly correlated with shared room supply, significant negative

Table 2
Panel system GMM results: All Airbnb Listings.

	Ln Total Airbnb	Ln Entire Homes	Ln Private Rooms	Ln Shared Rooms
Ln Hotel Room Sold	−0.024 (−0.054)	−1.081[b] (−1.978)	−1.215[c] (−1.798)	0.177 (0.080)
Ln Hotel Price (ADR)	1.011[b] (2.299)	2.306[a] (4.320)	2.214[a] (4.048)	5.813[a] (5.080)
Ln Airport Passenger Arrivals	0.208 (1.125)	−0.159 (−0.896)	0.469[c] (1.751)	0.258 (0.515)
Ln Wages	−5.053[a] (−4.768)	−3.658[a] (−3.726)	−5.903[a] (−5.631)	−1.716 (−0.470)
Ln House Price	0.965[a] (5.413)	0.694[a] (2.953)	1.145[a] (5.980)	2.537[a] (3.501)
Ln GDP	2.736[a] (4.081)	4.415[a] (4.488)	3.724[a] (4.861)	−2.381 (−1.210)
Ln Unemployment Rate	−0.581[a] (−4.555)	−0.101 (−0.595)	−0.889[a] (−6.241)	−1.995[a] (−6.335)
J-statistic	37.459	37.489	31.076	19.982

Notes: a, b, and c indicate 1%, 5%, and 10% statistical significance levels, respectively. J-statistic is produced by Hansen (1982) to test the joint validity of instrumental variables. The null hypothesis of the test indicates that instrumental variables are properly chosen.

relationships are found on the supply of entire homes and private rooms. Tourism demand i.e. airport passenger arrivals has a positive and statistically significant relationship with the supply of private rooms. The relationships between house prices and the supply of all types of Airbnb properties are all positive; however, the magnitude is larger for the supply of private rooms and shared rooms. The relationships between GDP and entire home and private room supply are positive and statistically significant, but the relationship between GDP and shared room supply is statistically insignificant. While both wages and unemployment rate have negative relationships with the supply of entire homes, private rooms and shared rooms, the relationship between wages and shared room supply and the that between unemployment rate and entire home supply are statistically insignificant.

Although our analyses provide substantive evidence of the relationships between major macroeconomic factors and the supply of Airbnb, we recognize that some Airbnb listings may never have been booked in the preceding twelve months. Thus, we also examined the relationships between these macroeconomic factors and the active supply of the same four Airbnb supply measures i.e. total active Airbnb supply and separate measures of active entire homes, private rooms and shared rooms. Table 3 presents these results for this second set of dependent variables.

This additional analysis provides outcomes similar to those of our initial analysis, with minor differences. Hotel ADR has a positive but statistically insignificant relationship with total active Airbnb supply. However, its relationship is statistically significant with the three different types of active Airbnb supply, and has the largest magnitude with shared room supply. Hotel demand is found to only have a negative relationship with active entire homes. Similar to our initial findings, GDP has positive and statistically significant relationships with total active Airbnb supply, entire homes and private rooms. Furthermore, wages and unemployment rate have negative relationships with all four active supply measures. These findings collectively suggest that our results are robust to alternative specifications of Airbnb supply measures.

5. Discussion

The positive relationships between hotel ADR and total Airbnb, entire homes, private rooms, and shared rooms supply may imply that when hotel prices increase, customers seek out less expensive accommodations, and Airbnb supply increases to fill this gap. Consequently, the supply of Airbnb rises. For customers, Airbnb thus becomes a viable substitute for hotels when hotel prices increase. If hotel prices decrease, less people would be likely to seek out Airbnb accommodations and instead would prefer to stay in hotels. Our findings confirm the positive impact of hotel price (hotel average list price) on the supply of Airbnb in Yang & Mao, 2018's study.

The significant and negative relationship between hotel room sold and entire homes only reveals that the market for hotel rooms has more of an overlap with that of entire home listings on Airbnb than with that of private or shared rooms. Entire homes are most directly comparable

to hotel rooms in terms of the level of privacy they afford, as opposed to private and shared rooms where guests have to share the unit with others. Thus, as demand for hotel rooms increases and more customers choose hotels over Airbnb, the supply of this category of Airbnb accommodation is most likely to be reduced.

A decrease in wages is associated with the increase of the supply of Airbnb in terms of entire home and private rooms, but not shared rooms. This may imply that there exists a significant number of people who would like to rent out their units and rooms when wage levels are not satisfactory. For these people, renting spare entire homes or private rooms are more acceptable than renting shared rooms Also, sharing a room with others requires larger sacrifice in the comfort of living and hence it may be less appealing to potential Airbnb hosts.

The large positive relationships between house prices and all types of Airbnb properties reveal that people's key motivations for renting rooms on Airbnb may include reducing the financial burden caused by these high house prices, especially for renting private or shared rooms. For renting entire homes when house prices keep increasing, purchasing and renting an entire home can be considered as a type of investment. These hosts are attracted by the increased value of the property and higher rental income associated with higher house prices, given that these units may be situated in better locations and/or offer better amenities and thus command a premium in the Airbnb marketplace.

GDP growth tends to increase prices for many products and services, including Airbnb. These increased Airbnb prices may further motivate more people to rent their properties on Airbnb. Another explanation may be that because living costs increase with GDP growth, people would like to have extra income to cover these growing costs and thus look to rent out spare capacity on Airbnb. However, GDP does not have a significant relationship with the supply of shared rooms. It is likely that the lower economic benefit/rent obtained from shared rooms is not attractive enough to make people willing to tolerate the inconvenience caused by renting these rooms. Our findings pertaining to the positive relationships between GDP and the supply of entire homes and private rooms are different from those found in Heo and Blengini's (2019) study, in which these relationships were insignificant. These differences may be due to the fact that Heo and Blengini (2019) applied multiple linear regression, while the current study employed the more robust panel GMM for the analysis, which is more efficient and capable of providing unbiased and consistent findings for dynamic panel data models.

Relatedly, a decrease in unemployment rate is associated with an increase in the supply of Airbnb in terms of private rooms and shared rooms. More people having jobs indicates a strong economy, which makes it affordable for more people to buy a house. Owning a house gives individuals the possibility to do business on Airbnb as hosts, especially renting out private rooms or shared rooms. However, unemployment rate is not significantly correlated with the supply of entire homes. This may be due to the fact that unemployment conditions mainly affect low income individuals who rarely have more than one house to allow them to rent an entire house on Airbnb.

Table 3
Panel system GMM results: Active Airbnb Listings.

	Ln Total Active Airbnb	Ln Active Entire Homes	Ln Active Private Rooms	Ln Active Shared Rooms
Ln Hotel Room Sold	−0.219 (−0.515)	−1.831[b] (−2.231)	−1.032 (−1.611)	−2.316 (−0.857)
Ln Hotel Price (ADR)	0.628 (1.497)	2.670[a] (5.618)	1.568[a] (3.188)	3.904[a] (2.710)
Ln Airport Passenger Arrivals	0.159 (1.104)	−0.152 (−0.910)	0.564[c] (1.939)	2.122[a] (3.020)
Ln Wages	−4.435[a] (−4.888)	−3.588[a] (−3.638)	−5.126[a] (−4.982)	−1.536 (−0.305)
Ln House Price	1.055[a] (6.351)	0.839[a] (3.468)	1.294[a] (6.937)	3.631[a] (4.836)
Ln GDP	2.973[a] (4.555)	4.591[a] (5.028)	3.615[a] (4.648)	−1.257 (−0.667)
Ln Unemployment Rate	−0.473[a] (−3.088)	−0.219 (−1.314)	−0.745[a] (−4.395)	−2.516[a] (−4.691)
J-statistic	36.458	35.531	25.034	16.586

Notes: a, b, and c indicate 1%, 5%, and 10% statistical significance levels, respectively. J-statistic is produced by Hansen (1982) to test the joint validity of instrumental variables. The null hypothesis of the test indicates that instrumental variables are properly chosen.

While the results for other macroeconomic factors were consistent for active Airbnb supply, in this context, we also found that an increase in airport passenger arrivals stimulates the supply of Airbnb, mainly for shared rooms, less so for private rooms, and not for entire homes. Airport passengers who need commercial accommodation can be broadly classified into two groups: 1) hotel/entire home customers who have higher spending power and value privacy more highly; and 2) private/shared room customers who have lower spending power and value privacy less. For the first group of customers, hotels tend to be their first choice. These customers choose entire homes on Airbnb because hotels cannot meet specific needs, such as the need for space as a family or the need for a local culture experience. Thus, increased airport passenger arrivals i.e. higher tourism demand does not necessarily enhance the demand for and supply of entire homes. For the second group of customers, shared rooms on Airbnb have a significant price advantage over hotels, and, in the absence of strong privacy requirements, are highly preferred. These relationships between airport passenger arrivals and the supply of entire homes, private rooms, and shared rooms on Airbnb are similar to the those found in Heo and Blengini's (2019) study.

6. Conclusion

This study investigated the relationships between major macroeconomic factors—hotel ADR, hotel demand, tourism demand, house prices, GDP, wages and unemployment rate—and the supply of Airbnb in terms of total supply, entire homes, private rooms and shared rooms. Although using macroeconomic data, it attempted to understand a micro research question—what affected Airbnb hosts' decision making—based on Fogg Behavior Model (Fogg, 2009). We postulated an Airbnb host's behavior to rent a property on Airbnb is determined by the *motivation* to rent their properties to earn extra money, which is triggered by the demand for Airbnb (Dogru et al., 2019; Gunter & Önder, 2018). Accordingly, we proposed that tourism demand and hotel prices will have an impact on Airbnb supply (Yang & Mao, 2018). In addition to lodging market dynamics, overall economic environment might contribute to the explanation of determinants of Airbnb supply. That is, Airbnb supply might be affected by wages, house prices, and GDP. For example, hosts can generate additional income through Airbnb with the intention to cover some of their mortgage or rent payments.

Overall, the results show that (1) when hotel prices are considered high, customers would like to choose Airbnb private rooms or shared rooms as alternative accommodation, but not Airbnb entire homes (Gunter & Önder, 2018; Yang & Mao, 2018); (2) the competition from Airbnb for traditional hotels is mainly from Airbnb's entire homes, less from Airbnb private rooms and shared rooms (Dogru et al., 2020); (3) travelers with high spending power and a privacy focus may choose hotels and treat Airbnb entire homes as second choices, whereas travelers with low spending power may choose Airbnb private rooms or shared rooms with the cost of lacking some privacy (Lampinen & Cheshire, 2016; Möhlmann, 2015); (4) when wages decrease, more people would like to rent their entire homes or private rooms, but this impact on shared rooms is not significant; (5) when house prices are high, more owners would choose to rent their properties on Airbnb, no matter for entire homes, private rooms, or shared rooms (Kim et al., 2015; Lampinen & Cheshire, 2016); (6) more people would like to rent entire homes or private rooms to cover the increased living costs caused by the rise of GDP (Yang & Mao, 2018; Zervas et al., 2017); (7) when more people have jobs, more people can afford to buy larger houses which may give them spare space (private rooms or shared rooms) for rent on Airbnb (Dogru et al., 2019; Möhlmann, 2015). These findings provide support for the postulations that was offered in previous studies (see e.g., Dogru et al., 2019; Gunter & Önder, 2018; Kim et al., 2015; Lampinen & Cheshire, 2016; Möhlmann, 2015; Yang & Mao, 2018; Zervas et al., 2017) that the macroeconomic factors affect property owners' decision to enter the Airbnb market.

6.1. Theoretical and practical implications

Theoretically, the present study enriches our understanding of the rise of Airbnb from the perspective of macroeconomic factors with a longitudinal approach. In particular, this study examined the relationships between these various macroeconomic factors and the supply of three types of accommodations on Airbnb. Analyzing the relationships of macroeconomic factors with Airbnb supply, the findings of this study provide an explanation for why Airbnb has so quickly emerged as such an important accommodation firm in the lodging landscape. The proposed Airbnb Supply Model based on Fogg Behavior Model does not only provide a theoretical explanation of the relationships between many macroeconomic factors and the supply of Airbnb, but also helps understand Airbnb hosts' decision making (Fogg, 2009). Moreover, the proposed Airbnb Supply Mode provides a framework for future empirical inquiry on this topic. This model identifies three direct factors and three mediators that help explain the relationships between macroeconomic factors and the supply of Airbnb. Although the roles of the direct factors and mediators require empirical testing, the conceptual model, informed by the findings of the present study, provides a framework for guiding future research on the predictors of Airbnb supply.

The results of this study also have several practical implications. First, for hotels, the main challenge from Airbnb is the competition from entire homes because of the similarities between their target customers, i.e. individuals who have relatively higher spending power and place great emphasis on privacy. For these customers, hotels should target solo travelers and travelers with one or two travel partners. Compared to an entire Airbnb home, one hotel room can offer more standard service and cost less for a travel party with no more than three visitors. Hotels should also target group customers because hotels typically have many rooms which allow to accommodate the visitors in the group, while an Airbnb entire home does not have this advantage. Airbnb entire homes should target families and other travelers with a size of 4–6 visitors since one entire home is more convenient (allowing them to stay in the same unit) and economic for them than multiple hotel rooms. Second, Airbnb has significant advantages in the case of shared/private rooms for customers who have lower spending power and care less about privacy. In this regard, Airbnb's shared/private rooms are direct competitors to hostels and low-end hotels, both of which may need to reduce their prices when facing fierce competition from Airbnb. Third, renting properties on Airbnb may be an approach employed by the public to reduce the financial burden caused by purchasing homes, low wages, or increased living costs. Governments can encourage people that face such a confluence of factors to consider using Airbnb to alleviate such financial challenges. Fourth, having high wages and being unemployed prevent individuals from becoming Airbnb hosts. Those who are employed with median wages have a higher probability to become Airbnb hosts since they are more likely to both own a house (ability) and be motivated to earn extra money through the platform. Airbnb can make a greater outreach to such individuals in order to expand its supply.

6.2. Limitations and recommendations for future research

Despite its contribution, this study has limitations. This study does not include all macroeconomic factors, such as exchange rate, tourist arrivals, inflation rate and so on because including too many related macroeconomic factors could lead to multicollinearity issue. Also, some of the related macroeconomic factors data were not available at the monthly frequency. Another limitation is that some potential mediators were not considered in this study. These include neighborhood safety (Suess, Woosnam, & Erul, 2020), previous experience as an Airbnb guest (Juric, Lindenmeier, & Arnold, 2020), the relationship between residents and tourists (Juric et al., 2020), and residents' perceived impacts of Airbnb in their neighborhoods (Yeager, Boley, Woosnam, & Green, 2019). We encourage future researchers to examine the relationships between the supply of Airbnb and other relevant macroeconomic factors

or potential mediators to enrich the proposed Airbnb supply model. Additionally, this study did not empirically test the influences of the suggested direct factors and mediators on the supply of Airbnb (see Fig. 1). Future research can empirically examine these effects in order to operationalize the proposed supply model.

Impact statement

The economic implications of the Airbnb phenomenon have been the subject of much research in the context of tourism and hospitality literature and beyond. However, the extent to which major macroeconomic conditions affect the supply of Airbnb has not been investigated. We propose a conceptual model that explains the relationships between major macroeconomic factors and Airbnb supply. We examine the extent to which major macroeconomic factors are associated with the supply of Airbnb properties. Hotel ADR, house prices, and GDP are positively associated with the supply of Airbnb. Unemployment rates and wages have negative relationships with Airbnb supply. The findings offer explanations for why Airbnb has so quickly emerged as such an important accommodation firm Also, the results provide guidance to hoteliers in developing strategies to adapt to changing consumer preferences, and to local authorities in addressing some issues associated with sharing economy and Airbnb.

Declaration of competing interest

None.

CRediT authorship contribution statement

Tarik Dogru: Conceptualization, Data curation, Project administration, Writing - original draft. **Yingsha Zhang:** Conceptualization, Writing - original draft. **Courtney Suess:** Formal analysis, Methodology, Writing - original draft. **Makarand Mody:** Writing - original draft. **Umit Bulut:** Writing - original draft. **Ercan Sirakaya-Turk:** Writing - original draft.

Acknowledgements

None.

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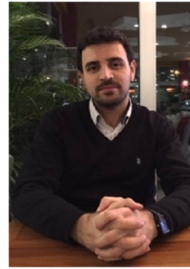
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