Chew Ging Lee

Are we explaining the movement of hotel room rates correctly?

Abstract

Demand function, inverse demand function or market equilibrium condition has been used to estimate the empirical models that explain the movement of hotel room rates. However, hotels generally face excess supply of rooms. This research paper develops a simple theoretical model to link hotel room rates to excess supply of hotel rooms. The annual data of Singapore from 1991 to 2017 is used to test this framework. Due to small sample size, with only 27 observations, the bounds testing approach to cointegration is applied on the annual data of hotel industry in Singapore because the obtained estimators are super-consistent. It is found that average hotel room rate and average hotel occupancy rate are cointegrated to confirm hotel room rates and excess supply of hotel rooms are inversely correlated. In order to avoid model mis-specification, major crises are captured by dummy variables which are treated as fixed regressors in the bounds testing approach to cointegration. The empirical and theoretical frameworks used in this study suggest that when hotel occupancy rate is used as an independent variable in modelling the determination of hotel room rates, a researcher is adopting excess supply framework developed in this paper. Furthermore, this framework teaches students in tourism a simplified way to explain the movement of hotel room rates, while still reminding students about the complexity of hotel industry.

Key words: hotel room rates; disequilibrium; excess supply; crises; cointegration; Singapore

1. Introduction

Tourism industry offers a combination of several services and products that aim to provide a complete travel experience to visitors. Overnight domestic and international tourists require a place to rest when they are in a destination. A star-rated luxurious hotel managed by a large international chain has the capacity to accommodate hundreds of tourists and is equipped with not just a full range of essential and functional services and facilities, but also offers a full set of complementary services and facilities, such as conference facilities, spa, swimming pool and others. The quality and quantity of accommodation services provided by hotel industry affect the image of a destination, since hotel industry, instead of just providing lodging, offers food and beverage services, leisure and entertainment facilities, and business and conference services. Hotels are not just the major consumers of locally supplied goods and services, and imported goods, they also create significant employment opportunities for destinations.

Although hotel occupancies benefit from inbound international tourists, they are also influenced by the growth of domestic tourism. For instance, during school holidays, there will be a surge in the demand for hotel rooms by domestic travellers. The inflow of business travellers is dependent on the number of meetings, incentive travel, conventions and exhibitions (MICE) events hosted by a destination. Destinations are competing to be the hosts of different MICE events. However, the success of a destination to be the host of such events will depend on the availability of reliable supply of hotel rooms which is close to state-of-the-art convention centres, exhibition halls, or meeting venues. Entertainment, food,

Chew Ging Lee, MSocSc, FCMI, FHEA, INTI International University, Persiaran Perdana BBN, Putra Nilai, Nilai, Negeri Sembilan, Malaysia; e-mail: chewging.lee@newinti.edu.my

Original scientific paper
Chew Ging Lee
Vol. 68/ No. 1/ 2020/ 21 - 33
UDC: 338.488.2:640.41(592.3)
https://doi.org/10.37741/t.68.1.2

shopping, and other lifestyle options must also be in close proximity. Some of the major hotels can provide the needed facilities to increase the ability of a destination to attract MICE events under one roof. For instance, Marina Bay Sands is an integrated resort in Singapore which has one of Singapore's largest luxury shopping malls, a museum, a 1-hectare roof terrace, an exhibition and convention centre, a casino, more than 80 restaurants and other facilities (see https://www.marinabaysands.com).

A destination can have a strong and vibrant tourism industry which can improve the economic health of that destination if this industry is supported by a growing hotel industry. Recognising the importance of hotel industry, a number of empirical studies related to tourism focus mainly on identifying the determinants of hotel rooms demanded or hotel room rates. In other words, currently, the demand function and inverse demand function for hotel rooms are estimated to explain the levels and patterns of hotel rooms demanded and hotel room rates, respectively, at a destination to facilitate tourism planning, marketing and destination management. Both inverse demand and demand functions, usually, use the theory of demand to identify a set of variables as the key determinants of each stated function.

Number of hotel rooms sold per period is used as the dependent variable of the model if researchers are estimating the demand function for hotel rooms. Corgel, Lane, and Walls (2013) try to address the extent to which aggregate hotel demand in the US is affected by currency exchange rates while controlling for other key determinants of the demand. Their study shows that currency exchange rates influence the demand for hotels in the US; with disaggregate data, currency exchange rates affect hotel demand among the higher priced and quality hotels in the US, such as hotels in luxury, upper-upscale, and upscale segments.

Others would identify the factors that influence hotel room rates with an inverse demand function. For such studies, hotel room rates are used as the dependent variable. Lee (2011) uses GARCH-M (1, 1) with 3 independent variables: internal economic activities, number of inbound tourists, and terrorist activities happened in the neighbouring countries in ASEAN to estimate the inverse demand for hotel rooms in Singapore. The main finding of this paper is that terrorist attacks in the neighbouring countries of Singapore have negative effects on hotel room rates. Israeli (2002) shows that star rating is the predictor of hotel room rates across different time periods and locations in Israel with regression analysis.

Other studies have examined the inter-relationship between hotel room supply and demand functions with a simultaneous equation framework. Under this framework, equilibrium condition where quantity demanded is equal to quantity supplied is used. Tsai, Kang, Yeh, and Suh (2006), and Qu, Xu, and Tan (2002) use this framework to study the interaction between hotel room supply and demand in Las Vegas and in Hong Kong, respectively. Estimating simultaneous equation framework with the two-stage least squares estimation using annual data from 1980 to 1998, Qu et al. (2002) find that both 1990-91 recession and the 1997-1998 Asian financial crisis have negative effects on the demand for hotel rooms, but the 1997-1998 Asian financial crisis has positive impact on the hotel room rates which is the dependent variable in the supply function of Hong Kong hotel industry. Using the same estimation method as Qu et al. (2002), Tsai et al. (2006) show that current hotel room rates, 12-month lag 3-month Treasury bill rate and 12-month lag gaming revenue per room are affecting the supply function of hotel room, and current consumer price index is affecting the demand function for hotel rooms in Las Vegas, with monthly data from January 1991 to December 1999.

In summary, the mentioned 3 approaches in the existing empirical literature rely on the theory of demand to develop a framework for estimation. All of them focus on the interactions between quantity demanded and price. Also, simultaneous equation framework relies on a further requirement: market equilibrium condition. The demand function or/and market equilibrium are used as the theoretical foundations for such studies because researchers are exposed to these concepts when they pursued their studies. Standard tourism textbooks, such as The Economics of Tourism by Stabler, Papatheodorou, and Sinclair (2010), and Tourism: Principles and Practice by Fletcher, Fyall, Gilbert, and Wanhill (2018), put an emphasis on these concepts when they discuss price determination in tourism industry.

We have to question whether a good knowledge of these 3 approaches will help policy makers in the tourism industry, managers and researchers of hotel industry to understand the movement of hotel room rates in the planning and management of travel and tourism. Hotel room stock of a destination cannot be increased immediately. A hotel related redevelopment/development activity takes years to complete. Only after its completion, the number of hotel rooms can be increased. The supply curve of hotel rooms for hotel industry is perfectly inelastic in the short-run. Even during peak seasons, only a fraction of hotels face overdemand. Sun, Rodriguez, Wu, and Chuang (2013) state that hosting large-scale, high-profile sporting events may not lead to the expected volume of hotel occupancies. Using the 2009 World Games that took place in Kaohsiung, Taiwan, from 16 to 26 July, 2009 as a case study, they find that for the month of July 2009, the occupancy rate of Kaohsiung tourism hotels was 64%, and that of general hotels was 47%, which was only 2% and 4% higher than the national average respectively. Also, Singapore Tourism Board (2016) shows that the annual average occupancy rates of hotels in Singapore did not hit more than 90% for the period 2006-2015. Since the quantity of hotel rooms demanded is generally smaller than the quantity supplied, there is always an excess supply of hotel rooms in this industry.

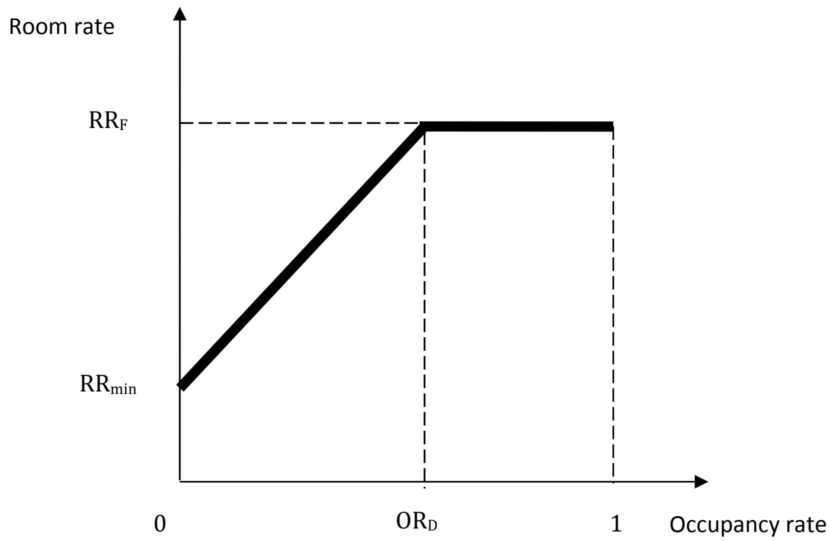
The main focus of this research paper is to challenge the suitability of existing demand theory and market equilibrium condition in explaining the movement of hotel room rates. Since hotel industry generally has an excess supply of rooms, this paper develops a simple theoretical foundation to illustrate how the excess supply in hotel industry can influence hotel room rates. This paper also shows how the proposed excess supply framework can be tested empirically. It proposes the excess supply of hotel rooms can be proxied by hotel occupancy rate. It suggests how the proposed theoretical foundation can be investigated with appropriate empirical research techniques. Therefore, this paper does not just contribute to the theoretical literature in explaining the determination of hotel room rates, it also adds empirical literature in this area.

2. Theoretical foundation

To develop a simple model of the determination of hotel room rates, we assume rooms of a hotel are homogenous. Let Q_S be the number of rooms a hotel has and Q_D be the number of rooms demanded. In a given period, number of occupied rooms of a hotel is equal to Q_D if $Q_D < Q_S$ or Q_S if $Q_D \geq Q_S$. Hence, hotel occupancy rate, OR, can be defined as $\min\{Q_D, Q_S\}/Q_S$. Let RR be the actual hotel room rate. Because of the assumption of homogenous rooms, all rooms will face identical hotel room rate in the same period. The rooms of a hotel may be fully occupied during a peak season. However, a luxury hotel may still have unoccupied rooms during the same period. During the off-peak period, occupancy rate of a hotel is typically low. At the extreme, occupancy rate of some hotels may even be zero.

To avoid the loss of revenue associated with unoccupied room, a hotel will offer sales promotion scheme for group booking, advanced reservation, corporate contract and others. Sales promotion scheme offe-red by a hotel is complex. The levels of discounting vary from period to period and during the same period several sales promotions may be adopted by a hotel not only to retain its regular customers but also to attract tourists who may not choose it for accommodation services at the full rack room rate. Usually, during off-peak period, when occupancy rate is low, a hotel will adopt a more aggressive sales promotion scheme to fill its rooms suggesting that actual room rate and occupancy rate are positively related, $dRR/dOR>0$. But, when occupancy rate is 0, a hotel will not provide "free" rooms and wants to avoid low price because this will create substandard quality signal and that hotel is also unable to cover its variable operating costs. The relationship between room rate and occupancy rate is illustrated in Figure 1. At the occupancy rate of 0, the minimum room rate is RR_{min}. When occupancy rate increases, room rate will increase. However, such positive relationship can be non-linear. When occupancy rate reaches the desirable level, OR_D, or higher, room rate will be at the full rack room rate, RR_F. Such relationship can be generalised to the hotel industry of a destination. In this case, the focus will be on establishing the relationship between average hotel room rate and average occupancy rate.

Figure 1
Graphical presentation of theoretical foundation



Since the occupancy rate of a hotel and the excess supply of its rooms are inversely related, the excess supply of its rooms has a negative impact on its room rates as shown by the equation below:

$$RR=f(Q_S-Q_D , \mathbf{X}) \qquad (1)$$

where **X** is a vector of other variables which can shift the curve in Figure 1. This vector will be discussed further in the next section.

3. Model, data, methodology and results

In this section, Equation (1) is estimated to confirm the presence of negative relationship between hotel room rates and excess supply of hotel rooms, which is the existence of the upward sloping portion of the curve in Figure 1. It also means that the presence of a positive relationship between hotel room rate and occupancy rate is investigated. To avoid misspecification of the model, in terms of omitting important independent variables, additional independent variables, as presented by vector **X**, are added. The estimated model is:

$$RR=f(OR, EP, TA) \qquad (2)$$

where RR is room rate; OR is occupancy rate; EP is economic performance of a destination; and TA is total international tourist arrivals. EP and TA are the variables in vector **X**. Wheaton and Rossoff (1998) state that domestic economic conditions strongly influence the number of rooms occupied. The inbound tourists received by a destination also affect the demand for hotel rooms. To capture the important connections between domestic economy and the demand for hotel rooms, and between inbound tourists and the demand for hotel rooms, which subsequently influence hotel room rates, EP and TA are included in Equation (2) as additional independent variables. Therefore, Equation (2) suggests that RR is influenced by an internal factor and 2 external factors. OR is treated as the only internal factor because it explains the upward sloping portion of the curve in Figure 1. Such relationship between RR and OR refers to "internal" to hotel industry as it is a movement along the curve. Both EP and TA represent external factors because a change in one of these may shift the curve discussed in Figure 1. EP captures the domestic external factor, whereas TA represents the international external factor which can influence the hotel industry.

Annual data from 1991 till 2017 are utilized in this study. This study uses four variables, average room rate (proxy for RR), GDP per capita measured at constant 2010 USD (proxy for EP), average hotel room occupancy rate (proxy for OR), and total international visitor arrivals by country of residence (proxy for TA). RR, OR, and TA are from Singapore Tourism Board. EP is from World Development Indicators. Singapore Tourism Board defines average room rate as total room revenue divided by gross lettings and average occupancy rate as gross lettings in terms of room nights divided by available room nights.

Since time series are used in this study, to avoid spurious regression, pre-testing for unit roots with the augmented Dickey and Fuller (1979, 1981), ADF, test is carried out. Given that the results of the ADF test may be affected by the inclusion of intercept, the inclusion of both intercept and time trend, and the selection of lag length, 1) graphical presentation of each time series is analysed to determine whether a time trend is needed by the ADF test and 2) the lag length is determined by the Schwarz Criterion but with the maximum number of lags fixed at 3 because annual data is used and the sample size is small. To confirm the results of the ADF test, the Ng and Perron (2001), NP, test that yields substantial size and power improvement over the ADF test is also implemented. The lag length of spectral GLS-detrended AR in the NP test is also determined by Schwarz Criterion with the maximum number of lags fixed at 3. Both unit root tests are performed so that the conclusion for the presence of the number of unit roots is robust.

Figure 2 to Figure 5 show the time series plot of the level of each variable. From Figure 2 and Figure 5, it can conclude that both TA and EP exhibit an upward trend. Therefore, an intercept and a time trend are added when the ADF and NP tests are performed on these 2 variables. From Figures 3 and 4, it can be concluded that both RR and OR do not show a trend, except RR has an obvious structural break. Therefore, the ADF and NP tests are performed on these 2 variables with an intercept only. Figure 6 to Figure 9 exhibit time series plot of the first difference of each variable. Generally, each of the first difference of a variable does not exhibit an obvious trend, does not have a mean which is equal to zero and exhibits a structural change. Based on these observations, the ADF and NP tests with an intercept is applied on the first difference of a variable. The results of the ADF test are shown in Table 1. The results suggest that each of these variables is integrated of order 1, except OR is integrated of order 0. The results of the NP test are reported in Table 2. The results of the NP test support the findings of the ADF test. Therefore, none of the variables is integrated of order higher than 1.

Figure 2
Time series plot of total international visitor arrivals

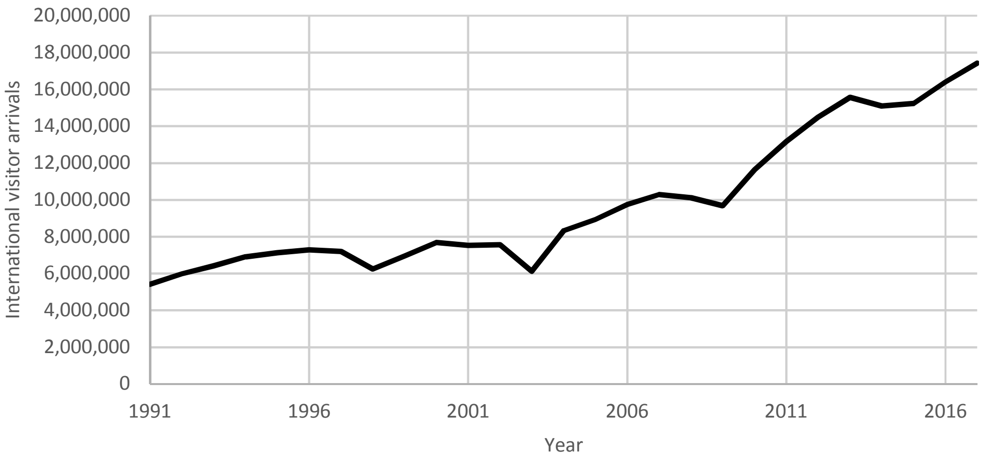


Figure 3
Time series plot of average hotel room occupancy rate

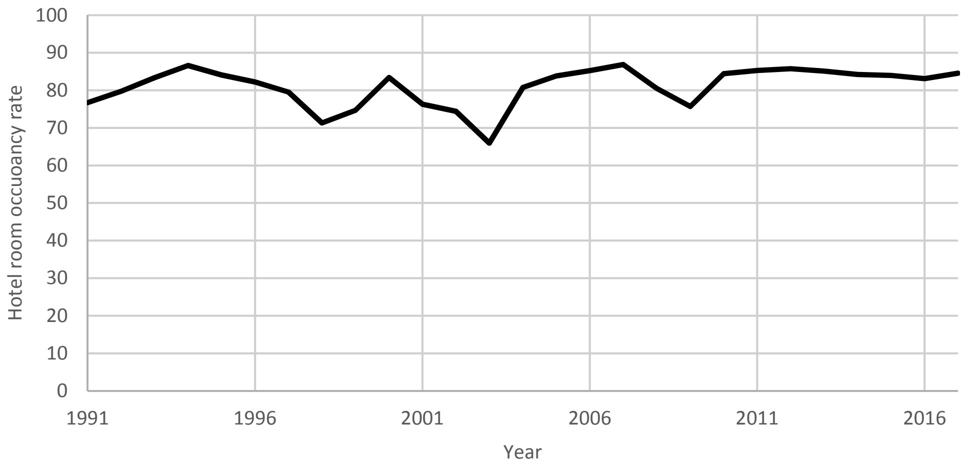


Figure 4
Time series plot of average room rate

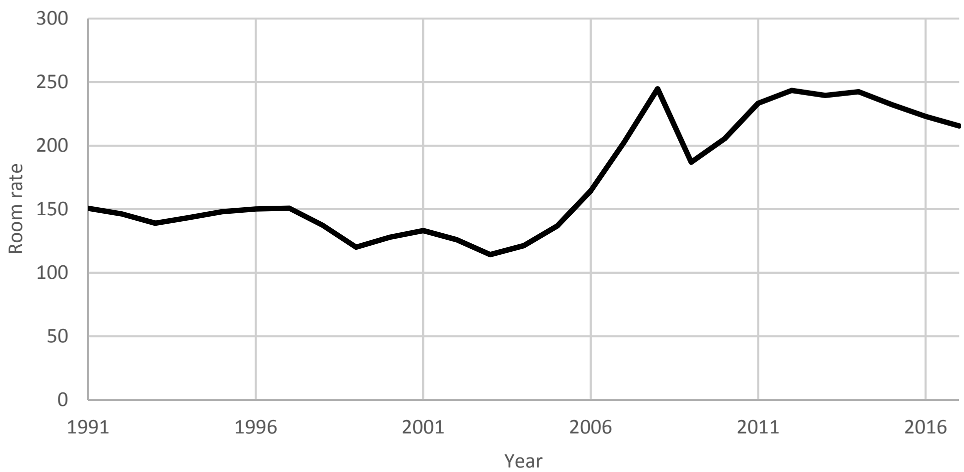


Figure 5
Time series plot of GDP per capita

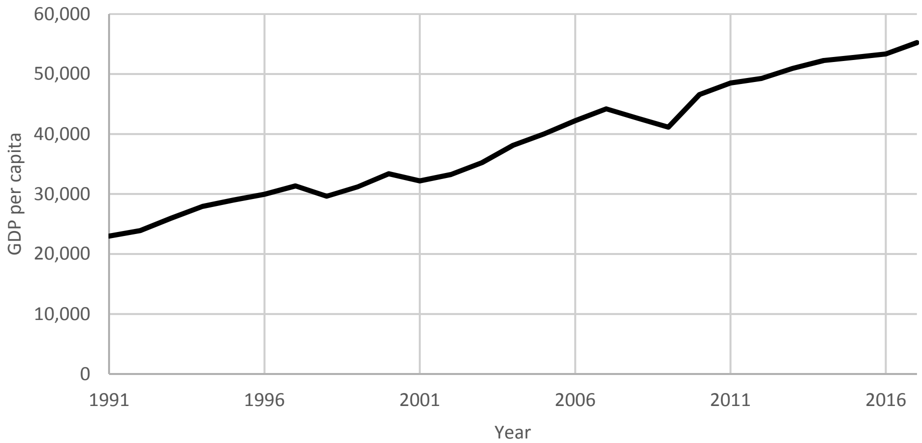


Figure 6
Time series plot of the first difference of total tourist arrivals

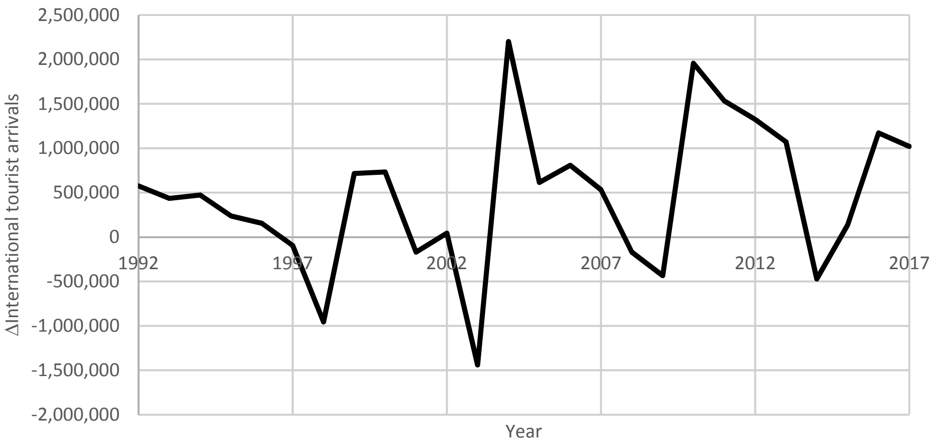


Figure 7
Time series plot of the first difference of hotel room occupancy rate

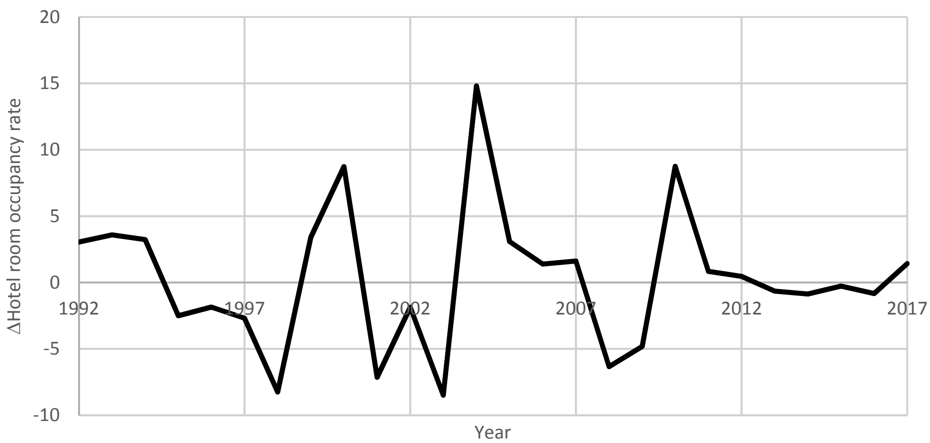


Figure 8
Time series plot of the first difference of average room rate

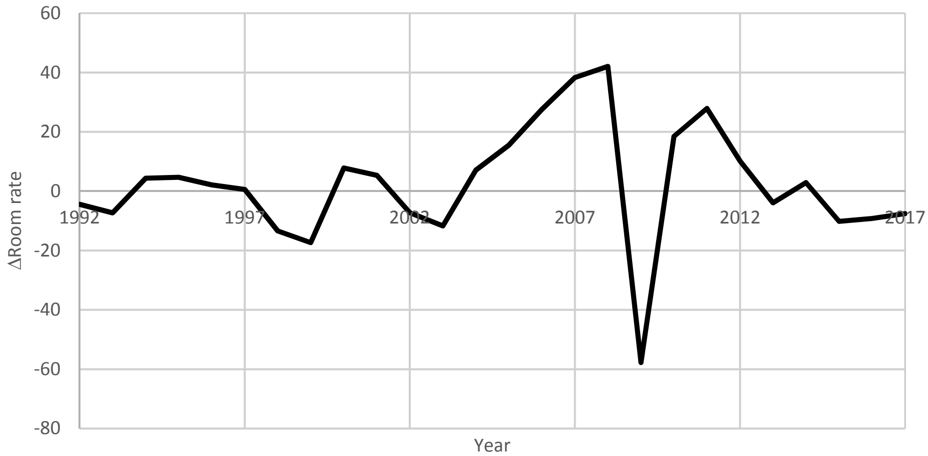


Figure 9
Time series plot of the first difference of GDP per capita

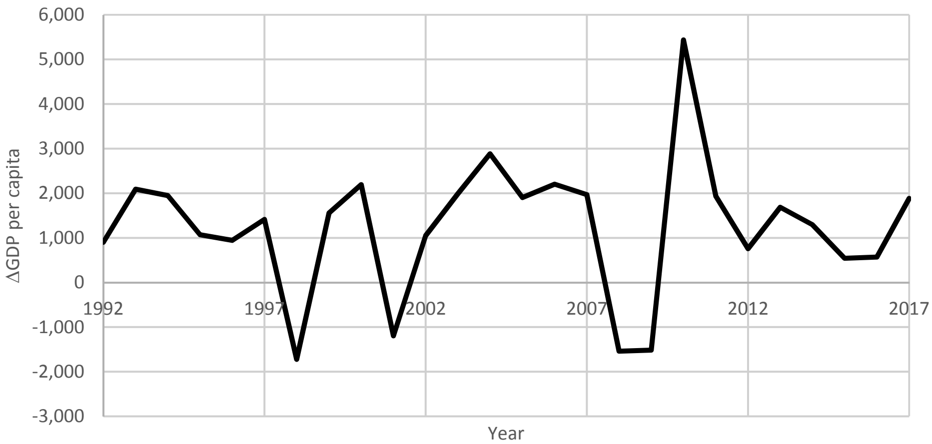


Table 1
Results of augmented Dickey-Fuller test

Variable	Lag	Test statistic
RR	0	-0.9255
ΔRR	0	-4.5362***
OR	0	-2.9323*
ΔOR	0	-5.3589***
EP	0	-2.7120
ΔEP	1	-5.2097***
TA	0	-1.1961
ΔTA	0	-4.5417***

*, **, *** denote statistically significant at the 10%, 5% and 1% levels, respectively.
Critical values are obtained from MacKinnon (1996).

Table 2
Results of Ng and Perron test

Variable	Lag	MZ_a	MZ_t	MSB	MPT
RR	0	-1.8491	-0.8530	0.4613	11.8638
ΔRR	0	-12.4109**	-2.4839**	0.2001**	2.0014**
OR	0	-9.5633**	-2.1460**	0.2244**	2.7161**
ΔOR	0	-12.3594**	-2.4857**	0.2011**	1.9830**
EP	0	-9.5117	-2.1752	0.2287	9.6027
ΔEP	1	-31.6299***	-3.9704***	0.1255***	0.7938***
TA	0	-3.4895	-1.1687	0.3349	23.4755
ΔTA	0	-12.4615**	-2.4790**	0.1989**	2.0314**

*, **, *** denote statistically significant at the 10%, 5% and 1% levels, respectively.

Although graphical presentation, in particular time series plot, has been used to reveal the patterns in each time series, it can only provide preliminary and informal idea of the nature of trend and structural breaks. From time series plot, structural break(s) can be clearly observed in the level/first difference of few variables. Although Perron (1989) shows that the standard unit root tests, such as the ADF test, can have low power when the true data generating process is stationary with a structural break, this study does not perform unit root test with a single structural break, such as Zivot and Andrews (1992) test or unit root test with more than one structural break, such as Lee and Strazicich (2003) test because both ADF and NP tests conclude consistently that the first difference of each variable is stationary. In summary, because the presence of structural break(s) reduces the ability of standard unit root tests to reject a false unit root null hypothesis, and both ADF and NP tests reject the null hypothesis of non-stationary first difference of each variable, unit root tests with structural break(s) are not needed to show each of these variables is integrated of order higher than 1.

Since this study has a mixture of $I(1)$ and $I(0)$ variables, and uses a sample with only 27 observations, to empirically confirm RR is correlated with OR with the presence of other control variables, the model will be estimated by the bounds testing approach to cointegration developed by Pesaran, Shin, and Smith (2001). This approach is utilised because it is applicable when variables are not integrated of order higher than 1 and the estimators of long-run coefficients are super-consistent in small sample size (Pesaran & Shin, 1999). First, an autoregressive distributed lag model as stated by Equation (3) is estimated:

$$RR_t = \beta_0 + \sum_{i=1}^{p} \beta_i RR_{t-i} + \sum_{i=0}^{q} \alpha_i EP_{t-i} + \sum_{i=0}^{r} \gamma_i TA_{t-i} + \sum_{i=0}^{s} \vartheta_i OR_{t-i} + \varepsilon_t \qquad (3)$$

The values of p, q, r and s are selected based on Akaike Information Criterion (AIC) and Schwarz Criterion (SC). Because different values of p, q, r and s may lead to significant change in results, both criteria are used to confirm the consistency of findings. Based on the values of p, q, r and s, Equation (3) will then be reparameterised into the following equation:

$$\Delta RR_t = \beta_0^* + \sum_{i=1}^{p-1} \beta_1^* \Delta RR_{t-i} + \sum_{i=0}^{q-1} \alpha_i^* \Delta EP_{t-i} + \sum_{i=0}^{r-1} \gamma_i^* \Delta TA_{t-i} + \sum_{i=0}^{s-1} \vartheta_i^* \Delta OR_{t-i}$$
$$+\theta_1 RR_{t-1} + \theta_2 EP_{t-1} + \theta_3 TA_{t-1} + \theta_4 OR_{t-1} + \varepsilon_t^* \qquad (4)$$

The null hypothesis is $\theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$ indicating that these 4 variables are not cointegrated. If cointegration is found, cointegrating coefficients are obtained to estimate error correction model (ECM) as below:

$$\Delta RR_t = \sum_{i=1}^{p-1} \beta_1' \Delta RR_{t-i} + \sum_{i=0}^{q-1} \alpha_i' \Delta EP_{t-i} + \sum_{i=0}^{r-1} \gamma_i' \Delta TA_{t-i} + \sum_{i=0}^{s-1} \vartheta_i' \Delta OR_{t-i} + \delta EC_{t-1} + \varepsilon_t' \quad (5)$$

where EC_{t-1} is one lag error correction term. This is the Case II (restricted intercept and no trend) defined in Pesaran et al. (2001).

The lag orders selected by AIC are p=2, q=2, r=3 and s=3, and by SIC are p=1, q=0, r=0 and s=1. Both information criteria select different ARDL models. The F statistics for Equation (4) based on AIC is 6.0832, and based on SC is 6.7403. Although both test statistics are higher than I(1) bound of Narayan (2005) at sample size equal to 30 at the 1% significance level, the obtained results are not reliable because each of them fails at least one of the diagnostic tests. Model selected by AIC fails CUSUM test. Model selected by SC fails CUSUMSQ test and has heteroscedastic disturbance terms.

The results of diagnostic tests suggest that the models may be mis-specified. In order to avoid model mis-specification, two dummy variables, AFC=the dummy variable for Asian Financial Crisis (1 if 1997 or 1998, 0 elsewhere) and GFC=the dummy variable for Global Financial Crisis (1 if 2008 or 2009, 0 elsewhere), are added into Equations (3), (4) and (5) as fixed regressors. With the presence of dummy variables, the lag orders selected by both AIC and SC are p=2, q=2, r=3 and s=3. Both information criteria select the same ARDL model. The F statistics for Equation (4) is 6.4286. The test statistic is higher than I(1) bound of Narayan (2005) at the 1% significance level, suggesting that the null hypothesis is rejected and there is a cointegrated relationship among these 4 variables. Then, the estimated ARDL models are reparameterised to obtain the long-run relationship among these variables as reported in Table 3. Each independent variable is statistically significant at 10% level, except TA. Since the estimated coefficients of EP and OR are positive, EP and OR are positively correlated with RR. Since TA is statistically insignificant, we conclude that TA is not correlated with RR.

Table 3
Results of cointegrating regression

Independent variable	Dependent variable: RR
Intercept	-670.0873** (236.2917)
EP	0.0078* (0.0037)
TA	-1.68×10^{-5} (1.16×10^{-5})
OR	8.4778** (2.6484)

*, **, *** the individual coefficient is statistically significant at the 10%, 5% and 1% levels, respectively.
Standard error of each estimated coefficient is in the parenthesis.

In Equation (5), δ is the speed of adjustment. The estimated value of δ is -0.7221 and has a standard error equals to 0.1040. It is statistically significant even at 1% level with the expected sign and magnitude. The sign, magnitude and statistical significance of the estimated speed of adjustment corroborate the presence of cointegration (Granger, Huang, & Yang, 2000). Since the estimated value of δ is close to -1, the disequilibrium from the previous period's shock will converge back to the long-run equilibrium at high speed. The parameter stability is tested by CUSUM and CUSUMSQ tests. Figures 10 and 11 present CUSUM and CUSUMSQ tests, respectively. Both tests suggest that the obtained equation is stable. Jarque-Bera test statistic is 0.5260 and suggests that normal distribution assumption holds. Breusch-Godfrey chi-square test statistic with degree of freedom equals to 1 for the presence of first order autocorrelation is 2.4254 and Bresuch-Pagan chi-square test statistic with degree of freedom equals to 15 is 19.0981. Both tests indicate that disturbance terms are homoscedastic and are not serially correlated. These diagnostic tests suggest that the model specification is appropriate. Case III (unrestricted intercept and no trend) proposed by Pesaran et al. (2001) also produces similar results, but the results are not reported here. Case IV and Case V are not considered in this study because RR does not exhibit obvious trend.

Figure 10
Result of CUSUM test

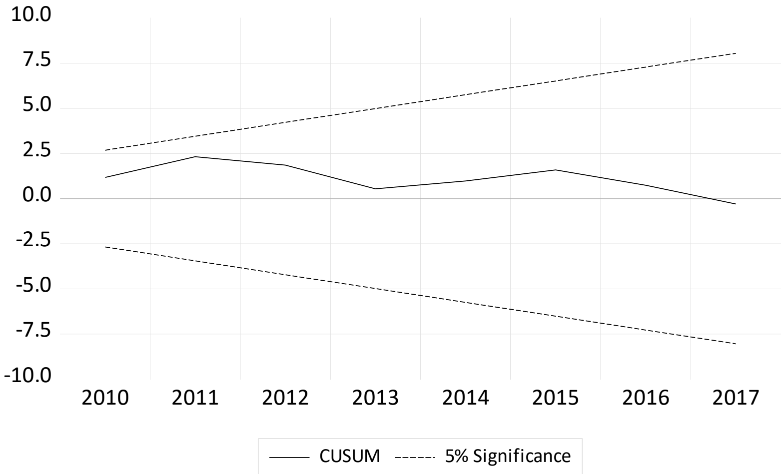
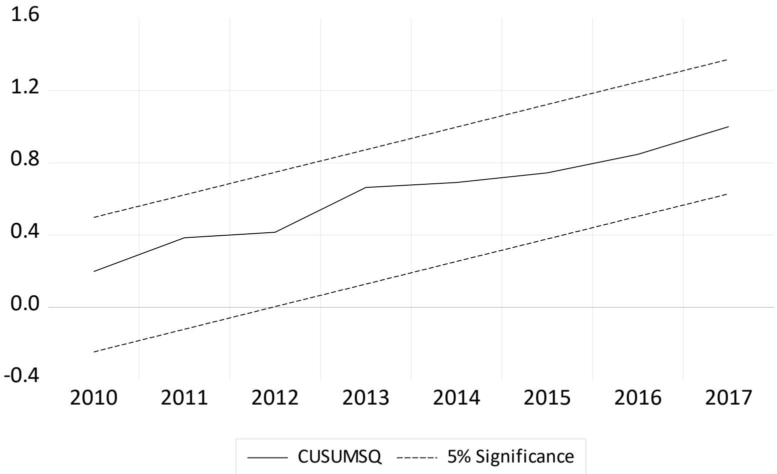


Figure 11
Result of CUSUMSQ test



4. Conclusion

Hotel industry faces excess supply frequently. Therefore, it is imperative for us to challenge the appropriateness of existing empirical literature that explains the determinants of hotel room rates with an inverse demand function or market equilibrium condition. In this study, a simple theoretical framework relying on disequilibrium market condition, the presence of excess supply, is developed to explain the inverse relationship between excess supply of hotel rooms and hotel room rates so that we can gain a better understanding of changing hotel room rates in reality.

To show that this simple theoretical framework is able to explain the reality, cointegration and error correction model are estimated with appropriate control variables to avoid misspecification of the model. It is found that economic performance of Singapore has a positive effect on hotel room rates and excess supply of rooms has a negative impact on hotel room rates. However, the number of inbound international tourists has no effect on hotel room rates. The findings confirm that economic performance is a variable in vector **X** of Equation (1) which shifts the curve in Figure 1 upward, and the number of inbound international tourists should be excluded from vector **X**. This suggests that with a given excess supply (occupancy rate), when an economy is growing, a higher hotel room rate is needed to cover the rising labour costs and material costs caused by inflation. To avoid model misspecification, occurrences of major events, such as crises, must be captured as exogenous regressors in the estimated model. Lastly, when hotel occupancy rate is used as an independent variable of the determination of hotel room rate (see Lei & Lam, 2015), such empirical study accepts the presence of excess supply in a hotel or a hotel industry.

In summary, this study makes several contributions to the literature. It explains why basic economic theory for price determination fails to explain the movement of room rates in hotel industry. It develops a simple excess supply framework to explain the changes in room rates while still takes into account of the complexity of hotel industry. Furthermore, this framework can be understood easily by the students in the field of tourism with abstraction from the reality but still reminding them about the complexity of hotel industry. It ends with a data analysis to validate the proposed framework. This paper also suggests that occupancy rates and room rates, together with relevant control variables can be used to create a revenue management framework for practitioners. However, there are several limitations to this study. Current study only looks at the aggregate data of Singapore with time series econometric techniques. Future research may focus on firm level data of different hotels with cross-sectional econometric techniques. In addition, theoretical foundation must be strengthened to explain why different control variables are included in this framework.

References

Corgel, J., Lane, J., & Walls, A. (2013). How currency exchange rates affect the demand for U.S. hotel rooms. *International Journal of Hospitality Management*, *35*, 78-88.

Dickey, D. A., & Fuller, W. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, *74*, 427–431.

Dickey, D. A., & Fuller, W. (1981). Likelihoods ratio statistics for autoregressive time series with a unit root. *Econometrica*, *49*, 1057–1072.

Fletcher, J., Fyall, A., Gilbert, D., & Wanhill, S. (2018). *Tourism: Principles and practice* (6th ed.). Harlow: Pearson.

Granger, C. W. J., Huang, B., & Yang, C. (2000). A bivariate causality between stock prices and exchange rates: Evidence from recent Asian flu. *The Quarterly Review of Economics and Finance*, *40*, 337–354.

Israeli, A. A. (2002). Star rating and corporate affiliation: Their influence on room price and performance of hotels in Israel. *International Journal of Hospitality Management*, *21*, 405–424.

Lee, C. G. (2011). The determinants of hotel room rates: Another visit with Singapore's data. *International Journal of Hospitality Management*, *30*, 756-758.

Lee, J., & Strazicich, M. C. (2003). Minimum Lagrange multiplier unit root test with two structural breaks. *The Review of Economics and Statistics*, *85(4)*, 1082–1089.

Lei, W. S., & Lam, C. C. (2015). Determinants of hotel occupancy rate in a Chinese gaming destination. *Journal of Hospitality and Tourism Management*, *22*, 1-9.

MacKinnon, J. G. (1996). Numerical distribution functions for unit root and cointegration tests. *Journal of Applied Econometrics*, *11*, 601-618.

Narayan, P. K. (2005). The saving and investment nexus for China: Evidence from cointegration tests. *Applied Economics*, *37*(17), 1979-1990.

Ng, S., & Perron, P. (2001). Lag length selection and the construction of unit root tests with good size and power. *Econometrica*, *69*, 1519-1554.

Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica*, *57(6)*, 1361–1401.

Pesaran, H., & Shin, Y. (1999). An autoregressive distributed lag modeling approach to cointegration analysis. In S. Strom (Ed.), *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*. Cambridge: Cambridge University Press.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*, 289-326.

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*, 335–346

Qu, H., Xu, P., & Tan, A. (2002). A simultaneous equations model of the hotel room supply and demand in Hong Kong. *International Journal of Hospitality Management*, *21*, 455-462.

Singapore Tourism Board (2016). *Annual Report on Tourism Statistics 2015*. Singapore: Singapore Tourism Board.

Stabler, M. J., Papatheodorou, A., & Sinclair, M. T. (2010). *The Economics of Tourism* (2nd ed.) London: Routledge.

Sun, Y., Rodriguez, A., Wu, J., & Chuang, S. (2013). Why hotel rooms were not full during a hallmark sporting event: The 2009 World Games experience. *Tourism Management*, *36*, 469-479.

Tsai, H., Kang, B., Yeh, R. J., & Suh, E. (2006). Examining the hotel room supply and demand in Las Vegas: A simultaneous equations model. *International Journal of Hospitality Management*, *25*, 517-524.

Wheaton, W., & Rossoff, L. (1998). The cyclic behaviour of the U.S. lodging industry. *Real Estate Economics*, *26*, 67–82.

Zivot, E., & Andrews, D. (1992). Further evidence of the great crash, the oil-price shock and the unit-root hypothesis. *Journal of Business and Economic Statistics*, *10*(3), 251–270.

Received: 01/04/2019
Accepted: 16/01/2020