

Using the Structural Time Series Model to Analyze the Nexus Tourism and Foreign Real Estate Investment

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**Abstract**

Tourism and foreign real estate investment (FREI), both represent important sources of foreign income for some emerging nations. Mauritius, a small island economy depends largely upon tourism and it has been promoting FREI over the past two decades to promote its economic growth. Under such a context, it would be interesting to study the relationship that could exist between tourism and FREI. For the research, yearly data spanning from 2000 to 2021 has been used. To depict the relationship between the two variables, a structural time series model was used. It was found that the trend (level), cycles, and tourism significantly and positively affected FREI. Using a similar approach, it was established that the trend (level and slope) and FREI were positive and significant determinants of tourism. To further delve into the relationship between the two variables, a bidirectional causal analysis was undertaken. From the dynamic analysis, it was found that in the long term the two variables had a bidirectional causal relationship. Further, a pairwise Granger causality test also indicated that a short-term causal link existed between the two variables.

**1. Introduction**

Tourism represents one of the main economic activities for some small island developing states (SIDS) (WTO, 2015). A SIDS relying quite heavily on the tourism sector is the island of Mauritius. On average between 2005 to 2019, the contribution of tourism to GDP has been around 20% (Statistics Mauritius). A large percentage of Mauritians are employed in the tourism sector and over the past years, the average level of employment in the sector stood at around 20% (Statista, 2022). Globalization has been promoting the mobility of individuals, with more individuals traveling for business purposes or holidays or some retired individuals acquiring a secondary home in foreign locations. The aforementioned tourists can be classified into three main categories, namely, business tourism, residential tourism, and tourists traveling mainly for holiday purposes.

Over the past decades, emerging markets have been encouraging more foreign investments to promote development. Some SIDS, including Mauritius, has been promoting foreign real estate investments (FREI). Since the year 2002, the Mauritian government has opened its real estate market to foreign investors, with the set up of residential foreign investment schemes such as the Integrated Resort Schemes (IRS). Over the past decades, several other real estate schemes, mainly residential investments have been set up along the coastal regions of Mauritius (for example in 2002 FREI was at MUR100 million, in 2010 at MUR3422 million, in 2015 at MUR8120 million, and in 2019 at MUR16148 million). Mauritius is considered a tourist destination, with many foreigners regularly visiting and appreciating the island, which might have led the foreigners to undertake FREI. The infrastructures set up under the FREI schemes might also be inducing more foreigners to visit the island.

Given the importance of both tourism and FREI in Mauritius, it represents an interesting context to establish the relationship between these two distinct sectors. The aim is to establish if tourism has been encouraging FREI in Mauritius. Some researchers have depicted that as the level of tourism increased it led to more FREI (for example, Rodriguez and Bustillo, 2010). To gain a more thorough knowledge of the link between the two variables, some studies used granger causality tests. Whilst at the same time trying to depict if the link could also be from FREI to tourism.

Most of the studies on the link between FREI and tourism have assessed how tourism affected FREI. These studies have been conducted in contexts where FREI and/ or tourism have been prominent. Among the pioneering studies was that of Rodriguez and Bustillo (2010) conducted in Spain, where the authors found that tourism had a positive significant influence on FREI. Using a sample of 19 OECD countries, Fereidouni and Masron (2011) found that tourism agglomerations positively affected FREI. Another study was undertaken by Fereidouni (2013), consisting of 14 Malaysian states, where the positive link between tourism and FreI was validated. In Australia, Wong et al., (2017a) established that tourism affected FREI in both the short and long term. Subsequently, through a survey, Wong et al., (2017b) found that it was mainly residential tourism that was having a positive influence on FREI. He and Zhu (2010), used a sample of 35 major cities in China and found tourism having a positive significant influence on FREI. In another study, using data from 30 provinces over the period 2005 to 2010, Hui et al., (2014) found that tourism was insignificant in explaining FREI. Similarly, Poon (2017), using data from the UK real estate market also concluded that tourism did not influence FREI.

Whilst the studies that have empirically verified if FREI could affect tourism have been scantier. A few studies have analyzed the bidirectional causal link between the two variables. For instance, Fereidouni et al., (2010) found that in the long run, tourism growth positively affected FREI in Dubai. In the same study, the existence of a bidirectional causal relationship between FREI and tourism in the short run, was also validated. Fereidouni and Al-mulali (2014), using a sample of 24 OECD countries over the period 1995 to 2009 in a panel co-integration framework, depicted a long-run positive relationship between FREI and tourism arrival while also

confirming a bidirectional causal relationship. More recently, Gopy-Ramdhany et al., (2021) empirically verified FREI as having a positive significant influence on tourism in the long-term, by using a sample of 33 countries, including both developed and developing countries. In the same study, it was further highlighted that the influence of FREI on tourism was more pronounced in developing countries as compared to developed countries.

To find if tourism has been leading to more FREI in the Mauritian context or whether FREI has been leading to tourism, the unobserved components model (UCM) will be used. Through such an approach, it is possible to establish whether unobserved components/ latent variables or explanatory variables are explaining the dependent variable. One advantage behind such an approach is that it allows the estimations to be done with a relatively small number of observations. A specificity of this approach is the use of time-varying parameters, through which the evolution of the link FREI and tourism can be assessed. To further delve into the relationship between FREI and tourism, a dynamic estimation technique, namely the vector error correction model (VECM) was used. The purpose of using this approach is mainly to assess if the bidirectional causal relationship between FREI and tourism could be a short-term one and whether it can subsist in the longer term.

The originality of this study remains in terms of the methodology used, given that no previous study on this topic used a structural time series model. Such a methodology allows the inclusion of latent variables, a category of variables not included in past studies establishing the determinants of FREI. Further, it analyses the relationship between FREI and tourism, from both perspectives by assessing if tourism affects FREI, as well as whether FREI affects tourism level. The link from FREI to tourism has been scantily studied in past research and this remains one of the main contributions of this study. Both the long and short-term causal relationships between the two variables would be analyzed.

The rest of the paper is organised as follows: section 2 details the methodology employed, section 3 discussed the results while section 4 concludes

## **2. Methodology**

### *Unobserved Components Model (UCM)*

The UCM decomposes the distribution of a particular variable in terms of particular components; namely a trend (level/ slope), cycle/s, seasonal and irregular (error).

From Harvey (1989), the simplest form of a structural time series model, also known as a local linear trend model is specified as follows for a particular variable. Where the particular variable ( $Y_t$ ) could be replaced by tourism or FREI.

$$Y_t = \mu_t + \varepsilon_t \quad [1]$$

In equation 1,  $\mu_t$  represents the trend component and  $\varepsilon_t$  is the random component, with  $\varepsilon_t \sim NID(0, \sigma_\varepsilon^2)$ . The trend component measures the long-term fluctuations in the variable and it can be broken down into two components namely a level and slope.

The local linear trend model can be extended and other unobserved components, namely cycles and seasonal components could be included in the model. From Harvey and Shephard (1993), apart from the unobserved components included in the model, it can also integrate explanatory variables.

The following models would be used to ascertain if tourism has a significant influence on FREI or if other unobserved variables are contributing to fluctuations in the level of FREI. Similarly, it will be verified if FREI can influence the tourism level or other unobserved (latent) variables are significant in explaining tourism.

$$FREI_t = \mu_t + \phi_t + \varphi_t T_t + \varepsilon_t \quad [2]$$

$$T_t = \mu_t + \phi_t + \beta_t FREI_t + \varepsilon_t \quad [3]$$

FREI<sub>t</sub> is used for foreign real estate investment; T<sub>t</sub> is used for tourism;  $\phi_t$  represents the cycle component. The coefficient  $\varphi_t$  measures the influence of tourism on FREI, whilst  $\beta_t$  measures the influence of FREI on tourism.

Equations 2 and 3 are estimated by using the maximum likelihood estimation technique and the Kalman filtering for updating the state vector. The regression type chosen allows the estimation of both fixed and random regression coefficients. When the time-varying parameter framework is applied, the coefficients are allowed to vary over time and the evolution of the relationship between the two variables is assessed.

To complement the results obtained through the UCM, a dynamic regression approach will be used. Before choosing the regression technique, unit root and cointegration tests are undertaken.

#### *Unit Root Tests and Cointegration*

To verify the stationarity of the variables under study, the Augmented Dickey-Fuller (ADF) and Philips Perron (PP) unit root tests for time series data were used. Further, the Johansen cointegration test was undertaken to ascertain if the variables had a long-term convergent relationship.

#### *Vector Error Correction Model (VECM)*

The unit root test results (ADF and PP) indicated that both tourism and FREI are nonstationary at the level and are stationary at first difference. Subsequently, the Johansen cointegration test led to the conclusion that the two variables converge in the long term. Under such conditions, an appropriate regression estimation technique is the VECM. Through this dynamic approach, both the long and short-term relationships between the variables would be estimated.

## Data

In the Mauritian context, data on foreign real estate investments is available from the year 2000. Annual data on FREI has been collected from the year 2000 to 2021 from the website of the Bank of Mauritius. The annual tourism figures have been obtained from the World Bank website.

## 3. Results & Analysis

### *Descriptive Statistics*

Table I contains information on the distribution of data for the variables FREI and tourism. Both variables are almost normally distributed. With FREI having a higher dispersion in terms of the distribution of the data.

*Table I. Descriptive Statistics for Tourism and Frei*

	Tourism	Foreign Real Estate Investment
Mean	1181014	5186772727
Median	1201829.5	4880500000
Maximum	1874768	16148000000
Minimum	246260	4000000
Std. Dev.	418258	4240295979
Skewness	-0.206	0.569
Kurtosis	2.86	3.02
Jarque-Bera	0.17	1.19
Probability	0.92	0.55
Sum	25982309	114109000000
Sum Sq. Dev.	367373385	3.78
Observations	22	22

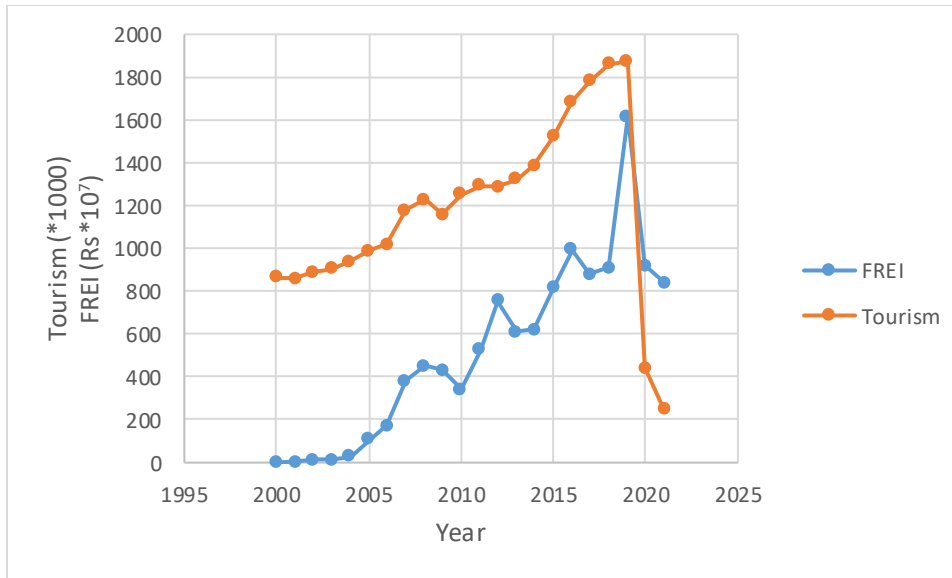


Figure 1. Evolution of Tourism and FREI over the past decades

From figure 1, it is observed that tourism and FREI have had an increasing trend over the past decades. With tourism undergoing a gradual constant increase and FREI containing both an increasing trend, as well as some cycles. FREI has been promoted by the Mauritian government over the past decades and new schemes have been set up to further encourage foreigners to invest both in the residential real estate sector and the hotel sector. A sharp decrease was observed in both FREI and tourism for the years 2020 and 2021, which could be explained mainly as a consequence of the Covid-19 pandemic. Although the decrease in tourism was more significant than that of FREI, mainly due to the travel restrictions imposed by the pandemic. From the graphical representation, given that FREI and tourism follow a relatively similar trend, in the following sections a more in-depth analysis of the link between tourism and FREI is undertaken.

### *Determinants of FREI*

Using UCM, it is assumed that FREI is explained by tourism (explanatory variable) or other underlying factors (measured by the unobserved components). The other underlying factors would mainly consist of latent variables. The potential latent variables could be, for example, the procedures and ease with which foreign property can be acquired in a particular country. Some foreigners could be influenced by their compatriots when purchasing real estate in a foreign country, for example in Mauritius over the years many South Africans have bought FREI.

The increasing trend observed in tourism and FREI justifies the use of the UCM. The non-stationarity of the data at the level, as verified by the ADF and PP tests also makes the use of the UCM<sup>1</sup> appropriate.

The pre-component analysis of the UCM shows that two components are significant in explaining FREI and these are the level and cycle. The slope component in the trend is found to be insignificant and it is the local level term that is most significant in explaining FREI in the long term. The trend level measuring the intercept illustrates that over the study period there are no fluctuations in the FREI fixed at 13.928 (Rs1.12 million)<sup>2</sup>. The other component significant in explaining the fluctuations in FREI is the medium-term cycles. The significance of these components illustrates that latent variables are important in explaining FREI. Suggesting that factors such as regulations promoting FREI or marketing campaigns or herding behaviors have been affecting FREI in a positive and significant way.

*Table II. Results UCM with FREI as Dependent Variable*

	<b>Coefficient</b>	<b>T-stat</b>
<b><i>Unobserved Components</i></b>		
Trend/ Level	13.928***	2.59
Trend/ Slope	0.483	0.55
Cycle 2 (comp.#1)	-0.150	-0.29
Cycle 2 (comp.#2)	1.111**	2.16
<b><i>Explanatory Variable</i></b>		
LNTourism	0.731*	1.72
R <sup>2</sup> = 0.93		

\* significant at 10%, \*\* significant at 5%, and \*\*\* significant at 1%

The graphics illustrate the breakdown of FREI in terms of the significant components and tourism. From the first quadrant, FREI is largely explained in terms of the level and the explanatory variable tourism. In the second quadrant, the evolution of FREI is explained in terms of the components. A comparison of quadrants 1 and 2 shows that the higher FREI curve is mainly explained by tourism. From the results, an increase of 1% in tourism would lead to an increase of 0.73% in the FREI level. Similarly, Rodrigues and Bustillo (2010) also found that tourism had a significant positive influence on FREI. Whilst the components explain the general evolution of FREI. The components can be justified by latent factors such as regulations encouraging foreign investments or the herd behavior of foreign real estate investors.

<sup>1</sup> When using the UCM the stationarity of the variables is not a requirement.

<sup>2</sup> For the estimations, the figures for FREI and tourism are in their logarithm form. For the interpretation of the results these are converted to their actual values.

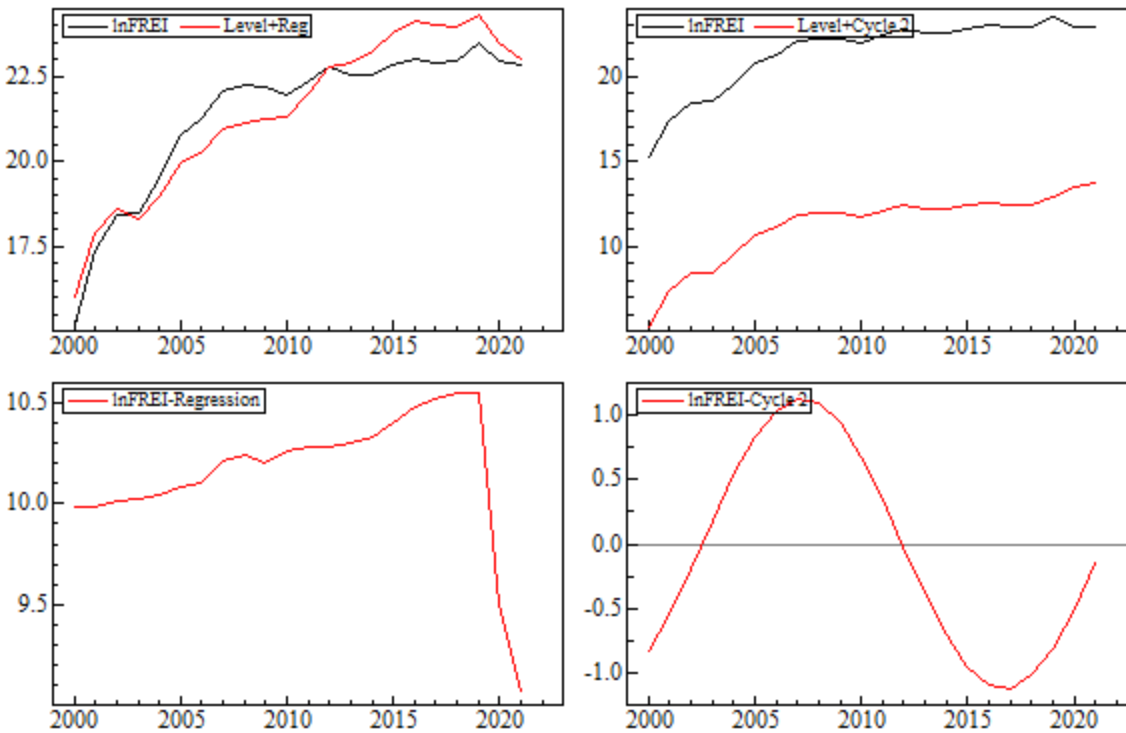


Figure 2. Graphical breakdown of FREI in terms of components and explanatory variable

A thorough analysis of the link between tourism and FREI over the years was possible by using the time-varying parameter estimates. From figure 3, it is depicted that tourism started positively influencing FREI in the year 2001 and the positive link continued to increase quite significantly till around the year 2007. Subsequently, the relationship between the two variables has continued to increase more gradually. It is noted that even over the Covid-19 pandemic period (years 2020 and 2021), although lower levels of tourism and FREI were observed, the link between the two variables still remained positive and approached a value of 0.5.

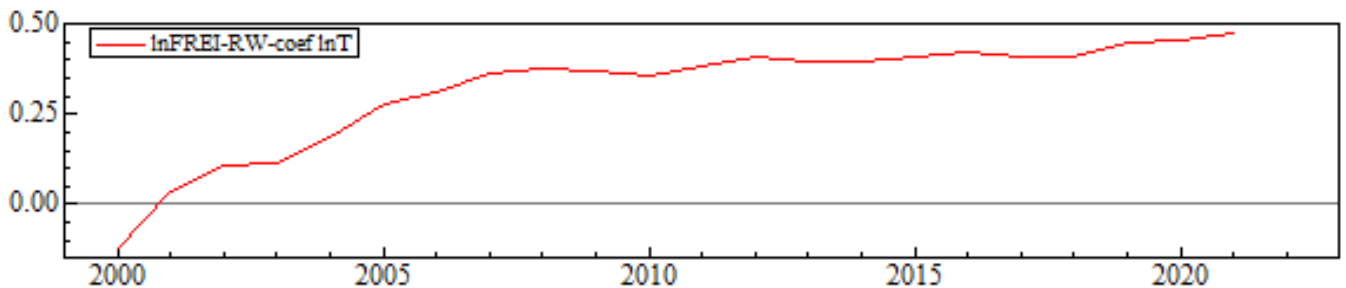


Figure 3. The time-varying coefficient measuring the influence of Tourism on FREI



### Determinants of Tourism

Using the UCM, it is assumed that tourism can be explained through latent variables and the explanatory variable FREI.

Table III. Results UCM with Tourism as Dependent Variable

	Coefficient	T-stat
<b>Unobserved Components</b>		
Trend/ Level	7.333**	2.48
Slope	-0.647***	-2.71
Cycle 2 (comp.#1)		
Cycle 2 (comp.#2)		
<b>Explanatory Variable</b>		
LNFREI	0.222*	1.72
R <sup>2</sup>	0.63	

\*\*\* represents significance at 1%, \*\* represents significance at 5%, \* Represents significance at 10%

The component found significant in explaining tourism is the trend (both the level and slope), whilst the other components are insignificant. The trend level measuring the long-term movements is the most significant in explaining tourism. The unobserved components depict a positive link with tourism containing a small negative slope, which might be explained as a consequence of the drastic decrease in tourism levels following the Covid-19 pandemic. The results suggest that there are some latent variables significantly explaining tourism demand, for example, destination image, and customer satisfaction, among others.

FREI is found to have a significant and positive influence on tourism in Mauritius. An increase of 1% in FREI led to an increase of 0.22% in tourism. Although most studies considered tourism as an explanatory variable for FREI (Rodriguez and Bustillo, 2010; Fereidouni and Masron, 2011; Wong et al., 2017), the result obtained in the present study corroborates with that obtained by Gopy-Ramdhany et al., (2021), who also found that FREI affected tourism demand from a sample of 33 countries.

The R<sup>2</sup> (0.63) when studying the determinants of tourism is lower as compared to the R<sup>2</sup> (0.93) when studying the determinants of FREI. This illustrates that other explanatory variables apart from FREI should be justifying the changes in the tourism level. Whereas for FREI most of the fluctuations are explained in terms of the trend, cycle components, and tourism arrival.

A further analysis, of the time-varying link between FREI and tourism, illustrates that the influence of FREI has been gradually increasing since the year 2001. A consequential increase in the influence of FREI on tourism from the year 2012 until the year 2019 has been observed. Then the subsequent years a lower link was observed between the two variables, this can mainly be justified as a consequence of the Covid-19 pandemic. As tourism has drastically decreased from 1.87 million in year 2019 to around 440000 in 2020 and 246000 in 2021.

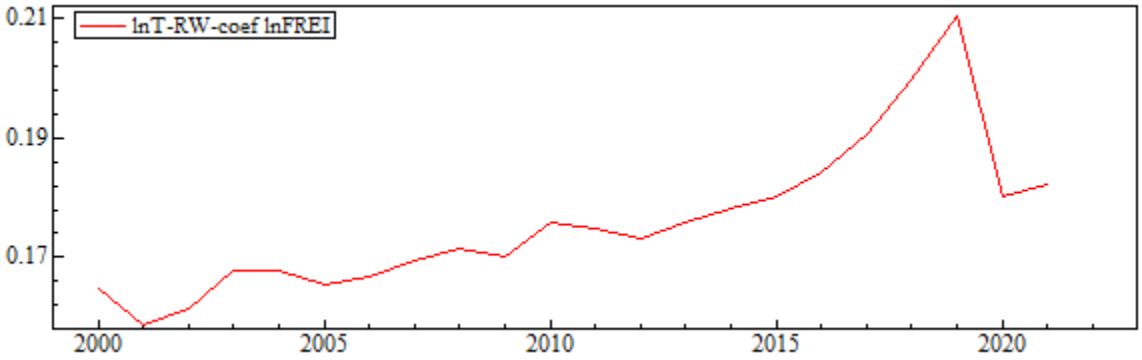


Figure 4. The time-varying coefficient measuring the influence of FREI on Tourism

*Bidirectional Causal Link Between FREI and Tourism*

The unit root test results showed that both variables are stationary at first difference. The dynamic vector error correction model (VECM) is subsequently applied to ascertain if there are long and/ or short-term causal links between the two variables.

Table IV. Long Term and Short Term Causal Relationship Between FREI and Tourism

Granger Causality based on VECM estimation				
Dependent Variable	Short Run Granger Causality		Long Run Granger Causality	
	Explanatory Variables		Dependent Variable	ECT
	D(LNT)	D(LNFREI)		
D(LNT(-1))	0.40* (1.71)	-0.15 (-0.57)	LNT (-1)	0.61*** (-53.56)
D(LNFREI(-1))	-0.22 (-1.25)	-0.08 (-0.40)	LNFREI (-1)	1.64*** (-55.03)

*t-values are given in (); \* denotes 10% level of significance and \*\*\* denotes 1% level of significance*

It is found that in the long term, the one-year lagged value of FREI has a positive significant influence on tourism. Likewise, the lagged value of tourism is also having a positive and significant influence on FREI. A long-term bidirectional causal link is confirmed between the two variables. Normally when a country is benefiting from FREI, it would induce the set up of infrastructures that in the longer term would be promoting tourism. Likewise, tourists might visit a country to introspect the real estate market and subsequently undertake FREI.

The VECM short-run Granger Causality results indicate that there is no bidirectional causal link between the two variables. Only tourism arrival in the previous periods is still influencing actual tourism levels. When applying the pairwise Granger Causality test, it was concluded that there is a bidirectional causal link between the two variables in the short term. With lagged values of tourism affecting FREI and also lagged values of FREI affecting tourism.

Table V: Pairwise Granger Causality

Null Hypothesis	F-Stat	Prob
Tourism does not Granger Cause FREI	2.84*	0.10
FREI does not Granger Cause Tourism	8.33***	0.01

\* denotes significance at 10% and \*\*\* significance at 1%

#### 4. Conclusion

This study consisted in finding if a link was present between FREI and tourism. Over the study period and in the Mauritian context it was found that tourism positively and significantly influenced FREI. Using a UCM it was depicted that the trend level explained a significant part of the FREI variation. This allowed us to conclude that latent variables significantly affect the FREI level. When considering tourism as a dependent variable, from the UCM it was found that the trend had a significant influence on the variable. This specification also allowed us to conclude that FREI had a positive and significant influence on tourism.

To further probe the link between FREI and tourism, the long-term and short-term bidirectional causal relationships between the variables were studied. It was found that they had a long-term bidirectional causal, with both FREI and tourism positively influencing each other. The pairwise Granger causality test using one lag also found that FREI affected tourism and likewise tourism influenced FREI.

Normally a consequence of the increase of FREI in SIDS would be an increase in the tourism level. These countries should be setting up the appropriate policies to monitor both aspects. Whilst in economic terms they would be benefiting from the increase in both FREI and tourism.

An important result obtained is the positive significant influence of FREI on tourism. This can be justified by the fact that FREI allowed the set up of infrastructures (for example villas and hotels) and this promoted tourism. FREI encourages foreigners to settle in Mauritius and generates residential tourism. This further encourages friends and relatives to visit those who have settled in Mauritius, thus enhancing tourism arrival. Such a result indicates that the set up of appropriate infrastructures would be enhancing tourism and countries that want to further develop their tourism industry could encourage FREI.

The bidirectional causal links between FREI and tourism, illustrate that the two factors reinforce each other. With past FREI allowing actual tourism to increase. Simultaneously after having visited the destination country, a foreigner might be interested to undertake FREI in that country, that is tourism leads to FREI. The above results indicate that if a country is considered a tourist destination and it decides to open its real estate market to foreigners, then it should be benefiting from relatively significant levels of FREI and this would further promote the tourism industry in the country.

The main limitation of the current research is in terms of the number of observations used. Nonetheless, the period of study should start from the year 2000 as before that the FREI level

was almost zero, and most of the FREI is part of the real estate schemes set up from the year 2002.

## 5. Referencing

Fereidouni H. G, Masron T.A., Malekmohammadi A., and Ooi A.Y. (2010). ‘The Interaction Between Foreign Real Estate Investment and Tourism: The Iranian Case in Dubai’, *World Applied Sciences Journal* 10 (Special Issue of Tourism & Hospitality): 40-44.

Fereidouni, H.G, and Masron, T.A. (2011), ‘The Effect of Tourism Agglomeration on Foreign Real Estate Investment: Evidence from Selected OECD Countries’, *International Journal of Strategic Property Management*, 15(3), 222-230.

Fereidouni, H.G., (2013). ‘Determinants of foreign investments in residential properties: evidence from Malaysian states’, *International Journal of Strategic Property Management*, 17(3), 317–332.

Fereidouni, H.G, and Al-mulali, U. (2014). ‘The interaction between tourism and FDI in real estate in OECD countries.’ *Current Issues in Tourism*, 17:2, 105-113.

Gopy-Ramdhany, N., Seetanah, B. and Bhattu-Babajee, R., (2021). Analysing the relationship between foreign real estate investment and tourism development. *Journal of Policy Research in Tourism, Leisure and Events*, pp.1-17.

Harvey, A.C., 1989. Forecasting, Structural Time Series and the Kalman Filter. *Cambridge University Press*.

Harvey, A.C. and Shephard, N., 1993. Structural time series models. *Handbook of Statistics*, Volume 11, 261-302.

He, C. and Zhu, Y. (2010). ‘Real Estate FDI in Chinese Cities: Local Market Conditions and Regional Institutions’. *Eurasian Geography and Economics*, 51, 3, 360–384.

Hui, E.C.M., and Chan, K.K.K. (2014). ‘Foreign direct investment in China's real estate market’. *Habitat International*, 43:231–239.

Poon, J. (2017). ‘Foreign direct investment in the UK real estate market’, *Pacific Rim Property Research Journal*, 23, 3.

Rodríguez, C., and Bustillo, R. (2010). ‘Modelling Foreign Real Estate Investment: The Spanish Case’. *The Journal of Real Estate Finance and Economics*, 41(3): 354-367.

Statista (2022). Travel, Tourism & Hospitality. Employment in travel and tourism as a share of total employment in Mauritius from 2019 to 2021. <https://www.statista.com/statistics/1262276/share-of-employment-in-travel-and-tourism-in-mauritius/#:~:text=Employment%20in%20travel%20and%20tourism%20in%20Mauritius%20re-presented%20a%20share,declined%20by%20around%2031%20percent>.

Wong, P.Y., Higgins D., and Wakefield, R. (2017a). 'Foreign real estate investment, residential tourism and the Australian residential property market'. *International Journal of Housing Markets and Analysis*, 10, 5: 586-606.

Wong, P.Y., Higgins, D., and Wakefield, R. (2017b). 'Chinese investors investment strategies in the Australian residential property market'. *Pacific Rim Property Research Journal*, 23 (3), 227-247.

World Tourism Organization (UNWTO), (2014). 'Tourism in Small Island Developing States (SIDS)'