

Forecasting the Effect on Transport Demand of a Market “Shock”: Case Studies of the Fiji and Tonga Air Travel Markets

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Abstract: Market “shocks” are especially problematic for demand forecasting. Conventional approaches assume that the future will be like the past and that the market will continue to develop and evolve in a smooth and continuous way. But this approach breaks down if the market is hit by an external “shock”. This paper explores the process of forecasting the short and longer term impact of a negative market shock on demand for travel. The suggested method is a bottom-up approach based on market segmentation and a simple response-recovery model that represents the profile of the response over time using a small number of parameters, each with a clear practical interpretation. The paper uses the Fiji and Tonga air travel markets as case studies, but the approach is transferable and could equally be applied to a range of other markets, transport modes and types of market shocks.

Key Words: Demand Forecasting, Market Shock, Air Transport

1. INTRODUCTION

Forecasting demand for travel generally proceeds from a basis of established trends and relationships in the marketplace. It involves analysis of past behavior as an indicator of likely future trends, and assumes that the future will be like the past and that the market will continue to develop and evolve in a smooth and continuous way. But this approach breaks down if the market is hit by an external “shock”. A market “shock” is a sudden and unexpected event that has a major impact on the market. It may be a natural event (such as an earthquake or volcanic eruption), or a quantum shift in a market input (such as a sudden jump in the world oil price or sudden crash in the world financial system), or a political event (such as civil unrest or terrorism). In many cases, these market shocks are unprecedented, which means that local “history” no longer provides a basis for predictions about how the market and travel demand is likely to respond.

This paper explores the process of forecasting the short and longer term impact on demand for travel of a negative market shock that has just happened, or happened so recently that its full impact is not yet apparent. The paper develops and applies a simple response-recovery model and a structured forecasting methodology with the potential for wider application in demand forecasting. The paper examines two case studies. The first is an analysis of the observed impact of recent market shocks on the Fiji air travel market. The second describes the practical experience of applying the response-recovery model to predict the likely impact on short and longer term trends in the Tonga international and domestic air travel market of a political “shock” that occurred in 2006. Interest in this issue was stimulated by the author’s involvement in business planning and financial modeling for corporatisation of the Tonga airports sector, and the need to gauge the likely impact of the political shock on airport sector activity and profitability.

2. THE IMPACT OF MARKET SHOCKS ON THE FIJI AIR TRAVEL MARKET

Fiji has had several recent political “shocks” that have had a significant and well-documented impact on the air travel market. In 1987 and 2000, the Fiji government was deposed by coups d'état which in the case of the May 2000 coup was accompanied by looting and burning of the downtown area, a prolonged siege of the Parliament Building, and extensive international media coverage. There was a further coup in December 2006 in which the military seized control of Government. The observed impact of these market shocks on the Fiji air travel market, and especially the May 2000 coup, provides a case study for examining the profile and structure of response to a market shock.

Data relating to the Fiji air travel market is available from various Fiji Islands Bureau of Statistics publications and from the Quarterly Bulletins of the Reserve Bank of Fiji. For further analysis of trends in the Fiji visitor market, see Narayan (2002) and Katafono and Gounder (2004).

2.1 Impact of the 2000 coup on the Fiji International Air Travel Market

Figure 1 shows visitor arrivals by air on a yearly basis since 1985 and the best-fit exponential trend line for the period from 1985 up to the end of 1999. It shows that the effect of the political “shocks” has been an immediate and in some cases prolonged drop in visitor arrivals (visitors are non-resident travelers arriving in Fiji for leisure, business or other purposes). In particular, the initial effect of the 2000 coup was a drop by around 25-30% in arrivals compared to the year before the coup, and it took up to another three-to-four years for arrivals to recover to the pre-coup trend line. Similar behavior is evident for the 1987 coup and there is some indication of similar behavior for the 2006 coup. In addition, as indicated by the arrows, there is also some evidence of a short-lived 5-10% rebound effect following the recovery.

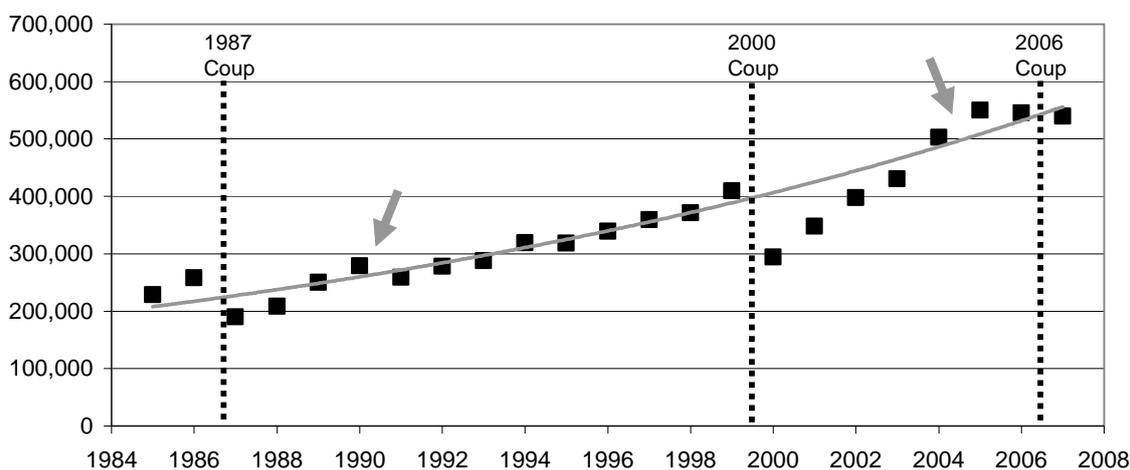


Figure 1 Trend in visitor arrivals in Fiji

Timeseries data is also available from the Fiji Islands Bureau of Statistics for arrivals by traveler type (resident or visitor) and trip purpose. This enabled a more detailed analysis of whether or not the impact was uniform across the international travel market. The charts in Figure 2 look more closely at the impact of the 2000 coup in terms of its effect on major market segments relative to the pre-shock trend line. The segments comprise Residents

(international travel by residents of Fiji) and five categories of visitor to Fiji corresponding to different trip purposes: Business, Holiday, Visiting Friends & Relatives (VFR), Conference and Education. Note that visitors comprise almost 85% of all international arrivals in Fiji; with about 80% of visitors arriving in Fiji on holiday.

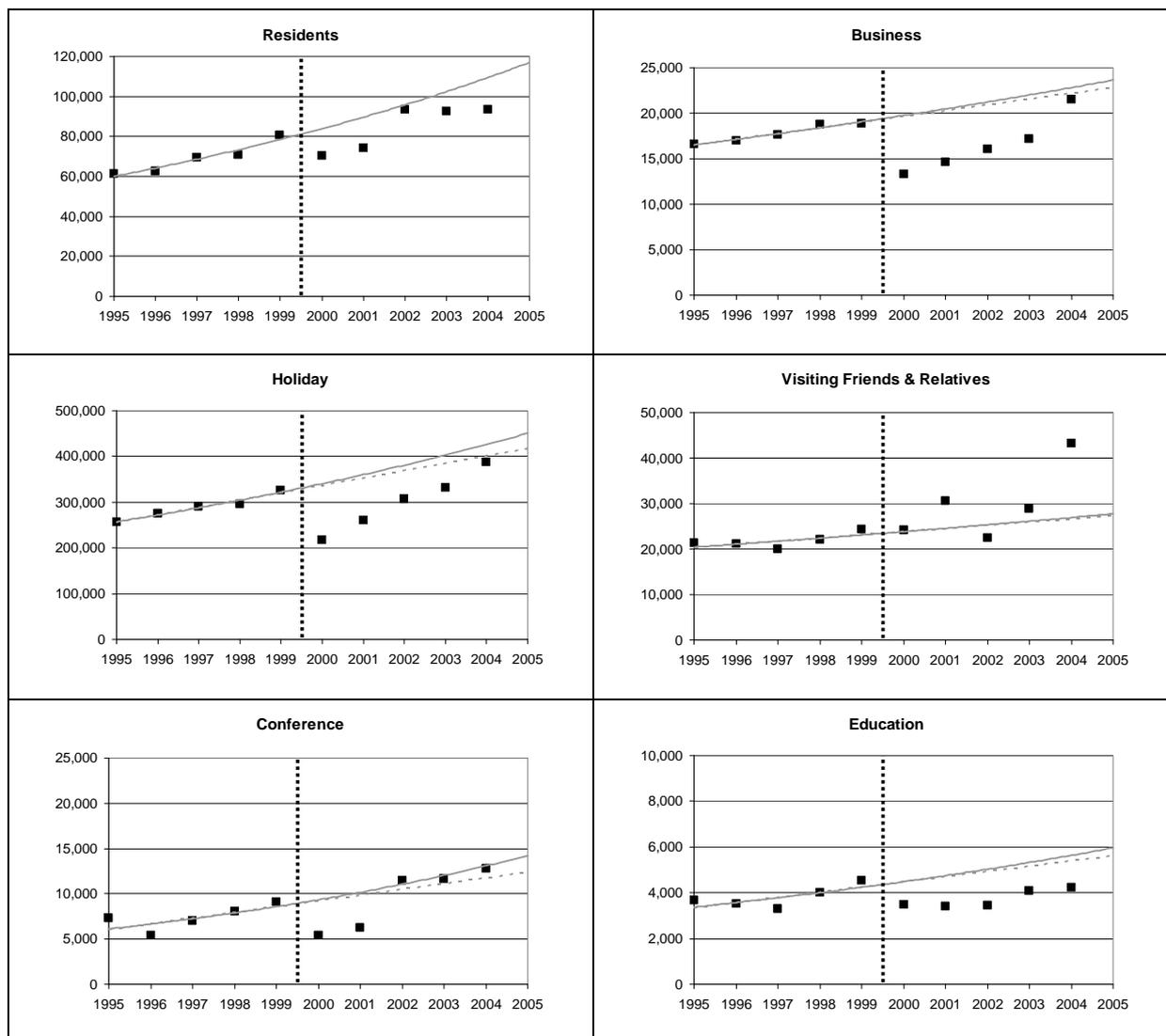


Figure 2 Trends in international travel to Fiji by market segment

From Figure 2, it is clear that the effect of the market shock was not uniform; instead showing significant variation between market segments in terms of initial impact and recovery period, in particular:

- the impact on VFR travel was minimal; the initial drop was very small (only around 2%) and recovery was almost immediate. Indeed, VFR travel increased soon after the political “shock”, perhaps as an indication of strong family and community links between expatriate and resident populations;
- the impact on travel by Fiji residents was relatively small (less than 15% drop) and short-lived. The volume of travel by Fiji residents recovered to the pre-shock trend line in around two years but has been flat since the recovery;

- the conference market was hard-hit but recovered quite quickly. The initial response was a 40% drop in the market but recovered in around two years as a result of restoration of political stability and rebuilding of confidence;
- the education market was also hit hard. The initial drop was lower at around 25% but the effect appears to be prolonged. This market segment had not recovered to pre-coup levels by 2004 and is well below the longer-term trend line. Other factors such as regional political and economic issues, and competition from educational institutions in other countries may have also contributed to the slow recovery of the education market segment; and
- the effect on the holiday and business markets was similar. The initial impact was large (around 30-35% drop in arrivals) and recovery was slow (around 4 years). Because holiday travel dominates the overall visitor market in Fiji (75-80% of arrivals), the trend in total visitor arrivals is closely aligned with the trend in holiday travel.

The initial impact and recovery period for each of these market segments and for total visitor arrivals are summarized in Figure 3. These parameters were estimated by comparing the observed “post-shock” demand against the extrapolated “pre-shock” trend line. The spread of impacts shown in Figure 3 highlights the critical importance of market segmentation when analyzing response-recovery behavior to identify consistent and transferable behavior. It also highlights the difference between the impact on resident and expatriate travel (small, short-lived impact) versus travel by foreigners (larger and more long-lived impact). This reinforces the conclusion that the structure of the travel market and the relative size of these segments will have a large effect on the length and depth of the market impact.

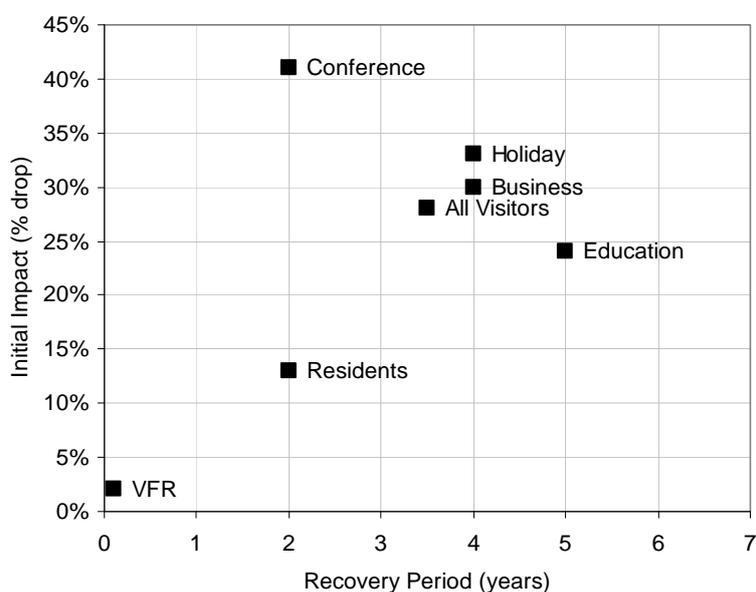


Figure 3 Size and duration of Fiji 2000 “shock” by market segment

2.2 Impact on the Fiji Domestic Air Travel Market

The impact of the market shocks has also been felt strongly in the Fiji domestic air travel market, principally as a consequence of the resulting downturn in the local economy and loss of business confidence, plus the flow-on effect of the impact on international travel. In Fiji, the domestic air travel market is smaller than and strongly linked to the international air travel market. This is not uncommon amongst many developing countries.

Detailed segmented travel data was not available for the domestic market, but based on available airport activity data, it is evident that:

- the initial impact of the 2000 market shock was greatest on domestic routes serving tourist areas and other routes with a high proportion of international connections (business and holiday);
- there was also a large and prolonged impact on trunk routes for local business travel; and
- the impact was relatively small on routes to outer islands. These routes have a strong social connection function and less emphasis on business or tourism travel.

Overall, the effect of the market shock on the Fiji domestic air travel market was similar to (possibly larger than) its effect on the international market in terms of initial impact, and similar in recovery profile. In terms of transferable behavior, the main findings are the strength of the flow-on effects and linkages between the Fiji domestic and international air travel markets, and their similarity in terms of initial impact and recovery period.

3. A SIMPLE MODEL OF A MARKET SHOCK

3.1 Response-Recovery Model

The Fiji case study confirms practical judgment that the typical effect of a negative market shock is an immediate drop in demand for travel followed by an extended recovery period. This pattern reflects impacts on individual perceptions and travel choice behavior as a result of the shock, which may involve delaying the trip until conditions settle down; changing to a different destination; or cancelling the trip altogether.

The structure of this response-recovery behavior can be represented by a simple model with three components are illustrated in Figure 4:

- *trend line* – this is the trend that demand was tracking prior to the market shock.
- *initial impact* – this is the initial drop (percentage) in demand immediately after the market shock.
- *recovery period* – this is the length of the period (months, years) until demand recovers back to the pre-shock trend line. It is similar to the ramp-up period that occurs when a travel market adjusts to the introduction of a new or changed transport option.

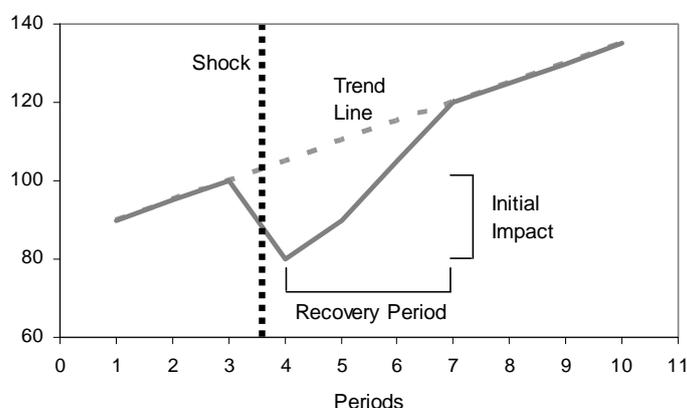


Figure 4 Simple model of a market “shock”

Note that this model assumes that the effect of the shock will eventually wear off, for instance, as infrastructure and/or business/consumer confidence is rebuilt. The model does not cater for cases where the impact of the shock is large and prolonged enough to cause the market to realign into a new mode of operation.

The response-recovery model provides a simple generic framework for forecasting the impact of a market shock, but the real challenge is to estimate the three components. The *trend line* can be estimated from demand statistics available for periods before the market shock using standard econometric techniques. For the *initial impact* and *recovery period*, there is no theoretical model available for directly predicting the depth and duration of a market shock. A practical alternative is to estimate these parameters by analogy, that is, to find a similar event in a comparable market (or an earlier event in the same market) that best matches the characteristics of the “shock”. The following case study of the impact of a market shock on the Tonga air travel market illustrates the use of the model and the process of estimating each of the model components.

3.2 Extended Response-Recovery Model

Closer examination of the Fiji case study and several other examples of “real life” response-recovery processes indicates that in some instances the recovery process has an additional phase. Following the recovery period, there can be a short period during which demand overshoots the trend line before settling back down to the long term trend. In effect, some of the latent demand is released as an over-correction or *rebound* effect, probably caused by some travelers delaying their trip and re-entering the market after the effect of the shock has worn off. This adds two more components to the structure of the response-recovery model:

- *rebound* – this is the size of the rebound (percentage) in demand immediately after the recovery period.
- *rebound period* – this is the length of the period (months, years) when demand exceeds the long-term trend line.

The components of the extended model are illustrated in Figure 5.

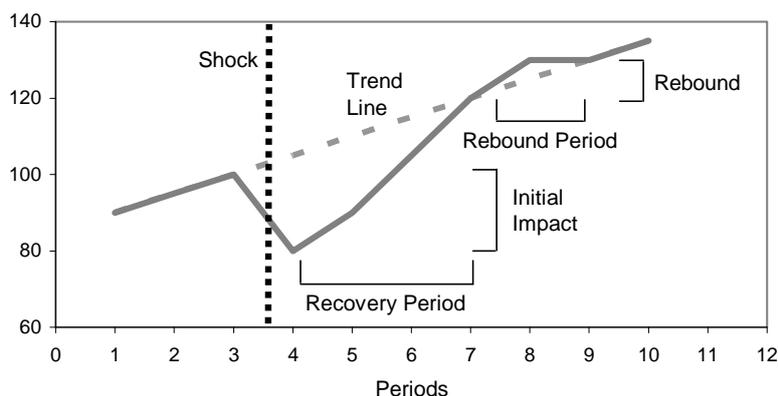


Figure 5 Extended model of a market “shock”

4. FORECASTING THE RESPONSE OF THE TONGA AIR TRAVEL MARKET TO A MARKET SHOCK

On 16 November 2006, political rioting broke out in the Tongan capital of Nuku'alofa. Although the unrest was short-lived, damage from looting and burning was extensive, with some reports estimating that 60 to 80% of the central business district was destroyed. The events and aftermath were widely reported in the international media. These events caused a market shock with profound impacts for the Tonga economy and travel market. In addition to the direct and immediate impact on infrastructure and the local economy and fiscal situation, there are expected to be longer term impacts on business confidence and the image of Tonga as a safe and secure destination for tourism and investment. In turn, this is expected to translate into short and longer term effects on the market for international and domestic air travel in Tonga.

3.1 Forecasting the Effect of the Market Shock in Tonga

The events of November 2006 provided an opportunity to test the validity and forecasting ability of the response-recovery model. In early 2007, using data available at the time, the response-recovery model was used as a basis for forecasting the likely length and depth of the impact of the market shock in terms of its effect on the number of passenger traveling on international flights to Tonga and on domestic flights within Tonga.

Historical data about longer term trends and the structure of the Tonga air travel market was available from several sources including the Tonga Ministry of Civil Aviation, Central Reserve Bank and Visitors Bureau. This provided information to estimate the pre-shock *trend line*, but the market shock of November 2006 was unprecedented in Tonga. With no local "history" on which to base a conventional forecast, an alternative approach was required to estimate the *initial impact* and *recovery period*. To estimate these parameters, an analogy was drawn with the observed impact of recent market shocks on the Fiji travel market. Although the Fiji air travel market is somewhat larger than the Tonga market and more heavily dependent on tourism, there are strong parallels in terms of the type of shock, international perceptions, location relative to other markets, and geography.

One of the key observations from the Fiji case study was the extent to which the initial impact and recovery period varies between residents and visitors, and between visitor market segments. The Fiji experience suggests that holiday travel is strongly affected by a market shock, while there is a much smaller impact on travel by residents and on VFR travel. Therefore the first step in preparing a forecast of the impact of the 2006 shock on the Tonga international air travel market was to estimate a market segmentation based on traveler type and trip purpose. Some official figures from arrival documentation was available as a starting point for market segmentation, but adjustments were required to align the data with the Fiji categories, and because many of the visitors that self-classify themselves into the "holiday" category are expatriate Tongans (rather than foreign tourists) who have travel behavior that is more closely aligned with VFR travelers. The resulting segmentation is shown in Figure 6.

The calculation of the estimated length and depth of the response of the Tonga international air travel market after the 2006 shock is shown in Table 1. Response-recovery parameters (initial impact and recovery period) from the 2000 market shock in Fiji (see Figure 3) were adopted for each market segment; and then weighted by the Tonga segmentation (see Figure 6) to derive an aggregate estimate of the response. The equivalent calculation for the Fiji market 2000 shock is also shown for comparison. The impact on particular periods during the recovery can then be estimated by interpolation and overlaid on the trend line.

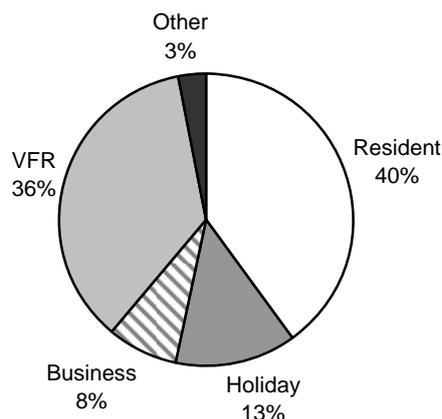


Figure 6 Market segmentation – Tonga international air travel market

Table 1 Estimation of impact of market shock on the international air travel market

	Tonga			Fiji		
	Market Shares	Initial Impact (% drop)	Recovery Period (years)	Market Shares	Initial Impact (% drop)	Recovery Period (years)
	(a)	(b)	(c)			
Residents	40%	15%	2	16%	15%	2
Visitors						
Holiday	13%	33%	4	66%	33%	4
Business	8%	30%	4	4%	30%	4
VFR	36%	0%	1	6%	0%	1
Conference	-	40%	2	2%	40%	2
Education	-	25%	5	1%	25%	5
Other	5%	0%	1	6%	0%	1
		$\Sigma (a) \times (b)$	$\Sigma (a) \times (c)$			
Aggregate Response		13%	2.0		26%	3.3

The predicted impact of the Tonga market shock is an initial reduction in total international travel to Tonga by around 13%, with recovery back to the pre-shock trend line taking around 2 years. This is a much smaller impact and quicker recovery than the predicted and observed impact for Fiji. The origin of this difference lies in the relative importance of the various market segments. The Fiji international air travel market is heavily reliant on visitors and especially on tourism. As shown in Table 1, holiday-makers typically comprise around two-thirds of all international arrivals in Fiji. Analysis of the response to the 2000 Fiji market shock (see Figure 3), shows that this segment is one of the most sensitive to market shocks. An estimated 80% of the initial drop in international arrivals in Fiji following 2000 market shock is attributable to the holiday segment. Conversely, Tonga is much less reliant on foreign tourism (estimated around 10-15% of arrivals) and has a much greater proportion of resident and expatriate VFR travel (estimated at around 75% of arrivals). These segments have a high proportion of family, social and community-related travel and the Fiji experience indicates that they are much less affected by political market shocks.

For the Tonga domestic air travel market, previous analysis had already established that like Fiji, trends in the market are highly correlated with trends in the international air travel market. This suggests that there would be significant flow-on effects to the domestic market from the impact on the international air travel market, and based on the Fiji experience, that the overall impacts on Tongan international and domestic markets would likely be similar in size and duration.

In summary, based on the Fiji experience and Tonga market segmentation, the predicted impact of the civil unrest and associated market shock experienced by Tonga in November 2006 was an initial drop in the international and domestic air travel by around 13%, with recovery to the pre-shock trend line taking around 2 years. About half of the drop in international arrivals was estimated to result from a reduction in tourist travel. Note that if the aggregate market response figures had simply been transferred from Fiji, then this would have over-estimated the severity of the shock by a factor of two and the recovery period by more than one year (see Table 1). This emphasizes the critical importance of market segmentation.

3.2 Validating the Response-Recovery Model

Sufficient time has now passed to enable the actual impact of the 2006 Tonga market shock to be tested against the predicted impact shown in Table 1. This provides a validation check for the response-recovery model and forecasting procedure. Figure 7 charts the seasonally adjusted quarterly trend in visitor arrivals in Tonga over the last 5 years along with the pre-shock long-term trend line. It shows that the profile of 2006 political shock agrees well with the response-recovery model, and also shows signs of a rebound effect as indicated by the arrow.

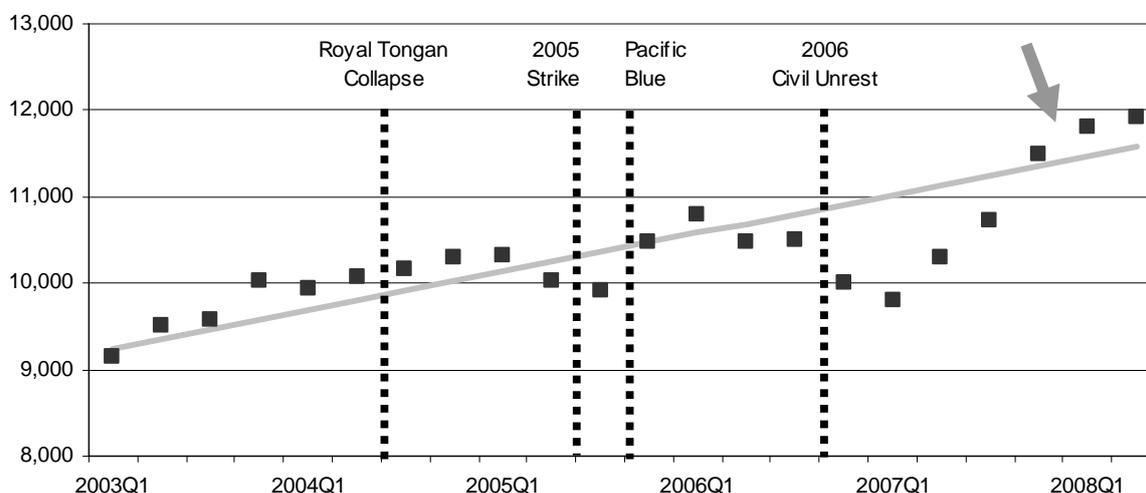


Figure 7 Trend in visitor arrivals in Tonga (seasonally adjusted)

The shock occurred mid-way through the fourth quarter of 2006 and its effects were not fully felt until the first quarter of 2007. Arrivals for the year to March 2007 were down 12% compared to the long term trend. This agrees well with the forecast response of a 13% drop in arrivals. However the recovery period was much shorter than predicted, being around one year compared to the forecast 2 year recovery period. A possible explanation is that in Tonga

the civil unrest was resolved very quickly and political stability returned much more quickly than was the case with the Fiji coup.

Figure 7 also highlights three other events over this period which had potential to generate a market shock. The first was the collapse of Royal Tongan Airlines in May 2004. This appears to have had little impact on the international air travel market since Royal Tongan was a small player in the market and the loss of seat capacity was quickly absorbed by other airlines. Secondly, a six-week strike by civil servants in July-August 2005 created an economic shock and downturn in international arrivals, but its impact appears to have been quickly overtaken by the market entry of the low-cost carrier Pacific Blue in October 2005 which generated a countervailing positive market shock. These events created ripples in the long term trend but had a much smaller impact than the 2006 political shock.

4. CONCLUSIONS

Forecasting the impact of a market shock on demand for travel, especially an unprecedented political “shock”, is somewhat of an exercise in predicting the unpredictable. This paper has described a systematic and practical approach to this task. It uses the Fiji and Tonga air travel markets as case studies, but the general approach is transferable and could equally be applied to a range of other markets, transport modes and types of market shocks.

The suggested approach is based on a simple response-recovery model that represents the profile of the response behavior over time using a small number of parameters, each with a clear practical interpretation. These parameters are the *trend line* that demand was tracking prior to the market shock; the *initial impact* in terms percentage drop in demand immediately after the market shock; and the *recovery period* until demand recovers back to the pre-shock trend line. The trend line can be estimated from demand statistics available for periods before the market shock using standard econometric techniques, but there is no theoretical model available for directly predicting the depth and duration of a market shock.

The suggested approach is to identify an analogous shock in the same or a comparable market and use the observed impact as the basis for estimating the response-recovery parameters. It is strongly recommended that the market should be segmented on the basis of trip purpose (or other key behavioral determinant) to as fine a detail as allowed by available data. This is important because the behavioral response of individuals in a particular market segment is much more likely to be consistent and transferable across markets; than is the response of the market as a whole. This is critical, for example when the analogy market has a significantly different mix of trip purposes than the forecast market, and different segments respond in different ways, as observed in the Fiji case study.

Adopting a systematic “bottom-up” approach builds a forecast that reflects best available information about the known structure of the local market and its long term trends, and about the likely response to the shock of each particular market segment. This avoids likely errors from simply transferring an aggregate observed response from another market, and also helps to mitigate the effects of “optimism bias”. The analysis also suggests that a rebound effect may occur after the effect of the shock has worn off as suppressed demand is released before the market settles back down to its long term trend. It is important to recognize that this rebound effect may occur and that it may be short-lived. Otherwise there can be a tendency to over-estimate the strength of the recovery.

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