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AN ANALYSIS OF LONG-RUN TRENDS for TOLL-FREE NUMBERS in USE

Prepared for SMS/800, Inc.

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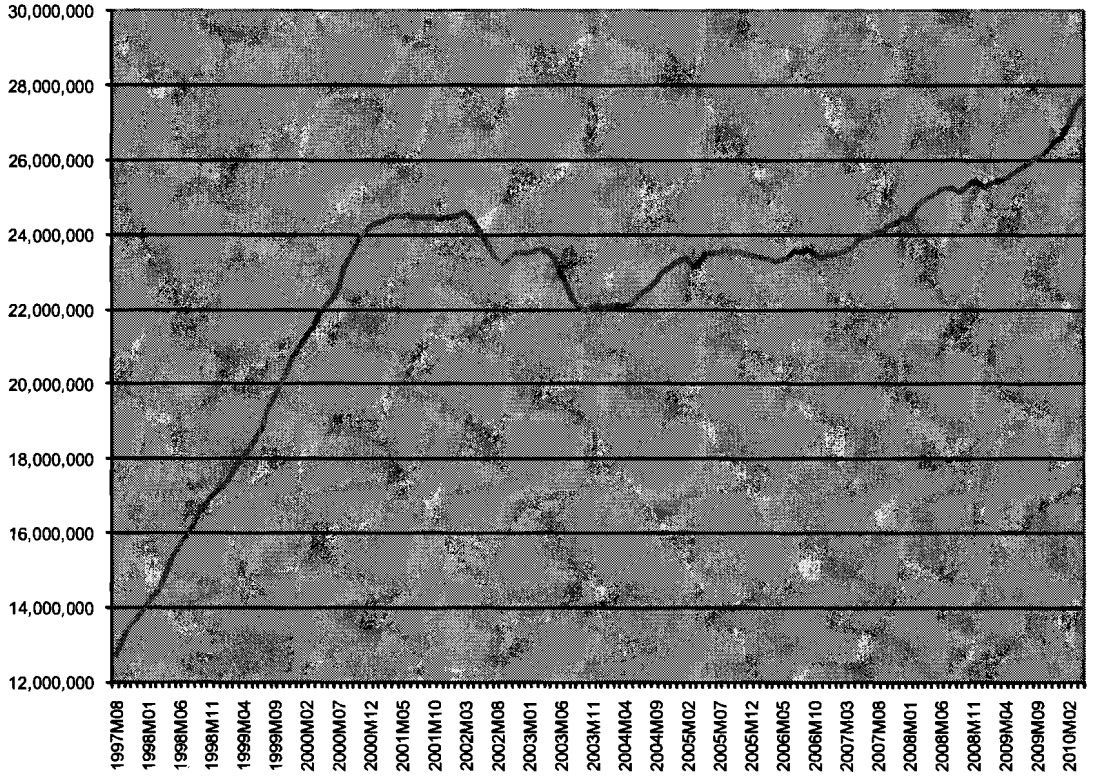
PURPOSE

At the request of SMS/800, OffHook Consulting has examined several long-run trends for toll-free numbers in use (TFN). With the opening of a new Service Access Code (SAC), i.e., 855, expected in the near future, this exercise is not focused on the short term exhaust of the current pool of TFNs but on the long term growth of TFNs. This analysis is different from previous analyses which have been focused on forecasting exhaustion of an existing pool of TFNs using a rigorous forecasting methodology. In contrast, this effort is a simple and expedited examination of possible trends for TFNs in use based on the historical data available.

HISTORICAL TFN ENVIRONMENT

TFNs have increased over time, though not at a constant rate as seen in figure 1 below. TFNs increased rapidly in the latter half of the 1990s, during which two SACs were introduced. TFNs peaked in early 2002 after a fourth SAC was introduced in July 2000. TFNs in use declined from early 2002 to October, 2003, but have experienced general growth since then. Growth has accelerated dramatically in early 2010.

Figure 1: TFNs in Use 1997 - 2010



Changes in TFNs over time may be attributable to many factors. Among these are the economic climate, administrative events (such as the opening of new toll-free SACs), changes in technology and the cost of substitutes, and the introduction of new business applications that rely on toll-free services.

Administrative events, such as the depletion of existing toll-free service area codes (SACs) or the opening of new toll-free SACs, may cause short-term surges in TFN usage. As the pool of existing TFNs nears depletion, demand for TFNs may accelerate. Then, after a new toll-free SAC opens, TFN reservations may surge temporarily as clients rush to reserve preferred numbers in the new code. Such temporary surges in TFN usage associated with depletion or opening of toll-free SACs may cause short-term accelerations in TFN activity but are unlikely to influence long-term rates of growth of TFNs.

Changes in technology and in the costs of substitute long-distance services may reduce the rate of growth in TFN usage. The spread of Internet Protocol (IP) telecommunication services and the use of mobile telephone services with "free" long-distance can reduce businesses' perception of the value of providing toll-free access for subscribers. Similarly, reductions in prices of long-distance land-line minutes and/or growth in bundles of unlimited local and long distance land-line service, may reduce businesses' perception of the value of providing toll-free access.

Fluctuations in these factors certainly may influence the rate of growth in TFNs. However, past research into the relationship between TFNs and these possible causal factors has not established reliable relationships that were helpful for producing long-term forecasts.

New uses for toll-free numbers can increase businesses' demand for toll-free numbers. For example, use of toll-free numbers can help businesses to assess the effectiveness of alternative media and advertising campaigns. The adoption and spread of such "ad-tracking" as a marketing research tool can boost the demand for TFNs.

In light of the recent run-up in TFNs and the imminent opening of a new code, OffHook has been requested to provide guidance on possible TFN trends. This effort is not considered a formal forecast of TFNs. Rather this effort is a simple extension of historical trends, to illustrate some possible future growth paths. In fact, because of the recent surge in TFN usage (approximately six times the longer term growth rate), this is a particularly difficult time to forecast long-term TFN growth. If future client behaviors of TFN usage differ from historical behaviors due to the influence of factors like those discussed in this section, future TFN usage may differ from the illustrated trend extrapolations.

METHODOLOGY

This analysis uses statistical time series techniques with historical TFN data from August 1997 through April, 2010, to extend historical trends into the future. Models were prepared to capture the effects of all the data available as well as subsets of the historical data in order to accentuate or discount different

growth rates throughout the history of TFN usage. Even without statistical methods, one could guess that the choice of the time period of data (given the drastically different rates of growth of TFNs over time) employed will influence the historical trend that is extrapolated into the future.

This methodology is critically dependent on the underlying structure of the past changes in TFNs. Indeed, any technique that relies upon the past values of a time series alone is intrinsically tied to the trends embodied in that data series. If the Resp Org and industry behavior underpinning past patterns of TFN usage should change, then future TFN growth will differ from the extrapolations. As discussed below, this aspect of the methodology is especially important in examining the implications of the recent acceleration of TFN usage thus far in 2010.

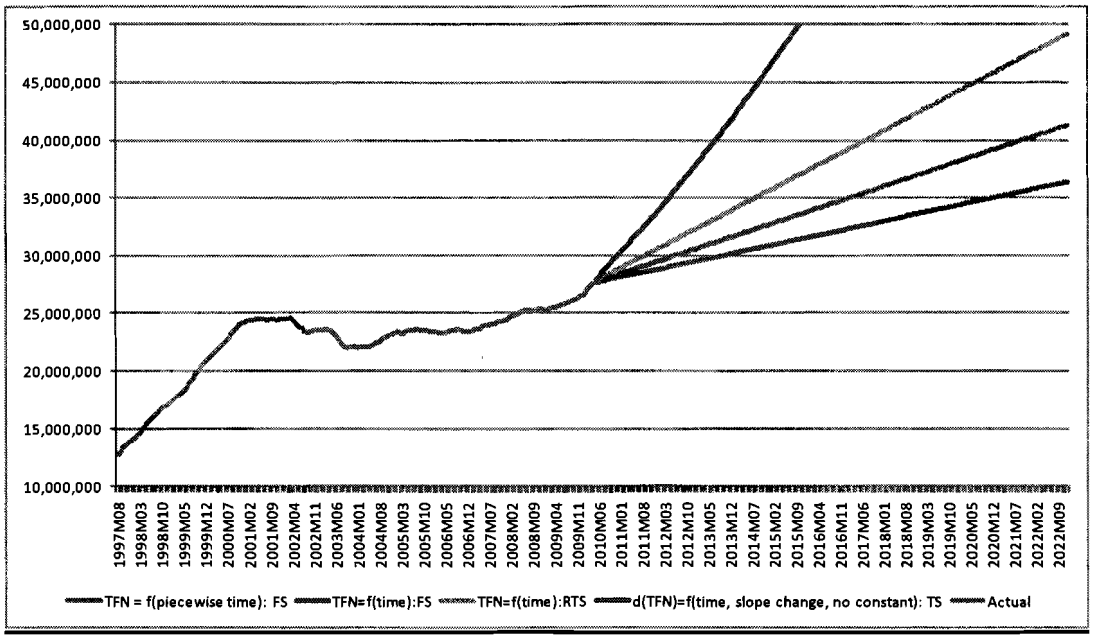
As the request was for OffHook to prepare this analysis quickly, it is limited in scope and depth. Unlike prior TFN usage analyses prepared by OffHook, this analysis relies heavily on linear and non-linear time trends. Also, whereas past analyses have followed a strict testing procedure using hold-out samples to evaluate alternative models' out-of-sample prediction accuracy, the time available for analysis preparation (as well as the rapid growth in TFNs in recent months) precluded the systematic use of such procedures in this effort.

RESULTS

Using the full historical sample of TFN data from 1997 through April 2010 in a linear trend regression model (see Appendix 1, Model 1), the monthly rate of increase in TFNs in use has been about 58,000 per month. This model is represented by the red line in Figure 2 below. Figure 2 also shows:

- actual TFNs in use data from August 1997 through April 2010 (light blue line);
- a piecewise linear regression of the full sample (blue line) resulting in a monthly growth rate of approximately 90,000;
- a linear trend regression using a truncated sample from January 2009 through April 2010 (green line) resulting in a monthly growth rate of more than 141,000; and,
- a non-linear trend model using a truncated sample from October 2003 through April 2010 (purple line) which results in an accelerated monthly growth rate starting at approximately 280,000 and increasing to more than 550,000.

Figure 2: TFN Trend Models



Another way to consider the results is to examine future points in time and the TFNs in use for each of the models. Figure 3 examines the results five and ten years from the date of this report.

Figure 3: TFNs in Use (millions) 5 and 10 Years in the Future

Model	May 2015	May 2020
Linear piecewise regression on full sample (blue line)	33.11	38.51
Linear regression on full sample (red line)	31.13	34.59
Linear regression on truncated sample (green line)	36.27	44.78
Non-linear model on truncated sample (purple line)	47.97	74.57

Figures 2 and 3 demonstrate the wide diversity of results produced by what appear to be reasonable long run trend analyses. The models used to create the extrapolations in Figure 2 are presented in Appendix 1. Additional more complex models are presented in Appendix 2. These models use cubic trends, lagged TFN, and Box-Jenkins ARIMA techniques to extrapolate past patterns in TFN usage. As noted in Appendix 2, these models produce a range of results similar to those presented in Figure 2 and Appendix 1. Hold-out tests were run on some of these models to see if the additional complexity

improved reliability in out-of-sample extrapolations. It is not clear that the additional complexity of such models insures greater reliability.

Very recently monthly rates of increase in total TFNs have accelerated dramatically from historical trends. According to SMS/800's Number Administration Reports the TFNs in use grew by 1,108,937 from January 30, 2010 to May 1, 2010, or an average monthly increase of nearly 370,000 - over six times the historical monthly rate of increase.

The 855 SAC opening will add approximately 8 million numbers, raising the pool to about 40 million TFNs. Within the first quarter that SAC 855 is open, historical experience from the 866 and 877 openings suggests that SMS/800 customers will reserve approximately 1,000,000 of the numbers in the new SAC, leaving about 7,000,000 numbers available. Figure 4 below estimates when TFNs in use will rise to 40 million based on alternative assumptions regarding the typical rate of growth.

Figure 4: How Long to Reach 40 Million TFNs

	Monthly rate of increase	Projected months to reach 40,000,000 TFNs	Year
Historical growth rate	58,000	126	2021
Average rate for Feb 2010-Apr 2010	370,000	21	2012

The table illustrates the importance of gaining a better understanding of the underlying cause(s) of the recent acceleration in TFN growth. If the causes of the recent acceleration in growth are temporary, then eventually growth should revert to historical norms and the augmentation of the TFN pool by code 855 may last about 10 years. If the causes of the recent acceleration in growth are permanent or may diffuse to other clients (i.e., corresponding to an adoption curve of a new technological application) and accelerate growth even faster, then the augmentation of the TFN pool by code 855 may last only a few years.

Some explanations for the recent acceleration are consistent with a one-time temporary surge followed by reversion to the historical norm. If the recent acceleration is due to SMS/800 Resp Org behaviors associated by depletion of the current TFN pool, then growth should revert to the historical norm sometime in 2011 or perhaps 2012, and the augmentation of the TFN pool by code 855 will last as much as 10 years. Similarly, if the acceleration is associated with the economic recovery that began in 2009, then TFN growth should slow as the recovery ages and the economy returns to its long-term growth path.

Based on inquiries (regarding these possible causal factors) to the few Resp Orgs whose TFN usage has increased dramatically recently, the acceleration in growth may be due to the acquisition of new contracts with new business subscribers and/or the adoption of ad tracking using TFNs as a marketing

research tool. If these are one-time events, TFNs will surge but later revert to historical growth patterns. Alternatively, if these events are harbingers of new Resp Org behaviors that may diffuse to other Resp Orgs, then growth will remain high and perhaps even accelerate further, despite the introduction of code 855. In this case the augmentation of the TFN pool by code 855 may last only a few years. The length and slope of such an increase in TFN usage would depend on the nature of the adoption curve of this technology/application.

Waiting a year or more to see which pattern prevails is not a viable strategy. Depletion of the current pool followed by the opening of code 855 will disrupt TFN data. It is unlikely that the TFN data reported during the next year will reliably reveal which long-term growth pattern will prevail.

For this reason, statistical models based solely on historical data will not be able to provide the necessary insight into the causes of the recent acceleration in TFN growth. Such insight can come only from research focused on SMS/800's customers and a review of the state of marketing research applications such as ad tracking. Such research would take months, not days, and require careful design of customer interviews to insure useful responses and protection of customer confidentiality. OffHook is prepared to assist with such research if SMS/800 should choose to proceed.

CONCLUSIONS

SMS/800, at the request of the FCC, asked OffHook to provide an analysis of long-term trends in TFN usage and the timing of the need for additional codes to augment the pool of available numbers.

The trend models examined for this effort produce a wide diversity of results with monthly growth rates ranging from approximately 58,000 to over 550,000 in the later stages of the non-linear modeling of a truncated sample. At the historical pace of 58,000, the available TFN pool augmented by code 855 could last ten years. However, with recent increases in early 2010 having exceeded 300,000 TFNs per month, if this pace were to continue or accelerate, the available pool augmented by code 855 may last only three years.

More definitive prediction requires research into the reasons for the recent acceleration of TFN growth. Such research should attempt to ascertain if the underlying causes are temporary or permanent. Interviewing selected SMS/800 customers and reviewing current trends in the application of TFNs in the practice of marketing research are possible steps in this research endeavor.

APPENDIX 1 - ILLUSTRATIVE TIME SERIES MODELS

Model 1: Long-run linear time trend using monthly sample from August 1997 through April 2010 (red line in graph below)

Dependent Variable: TFN_MONTH
Method: Least Squares
Date: 05/07/10 Time: 17:59
Sample: 1997M08 2010M04
Included observations: 153

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18076157	328396.9	55.04363	0
TIME	57629.49	3699.518	15.57757	0

R-squared	0.616421	Mean dependent var	22513628
Adjusted R-squared	0.613881	S.D. dependent var	3252532
S.E. of regression	2021075	Akaike info criterion	31.88914
Sum squared resid	6.17E+14	Schwarz criterion	31.92876
Log likelihood	-2437.519	Hannan-Quinn criterion	31.90523
F-statistic	242.6606	Durbin-Watson stat	0.007422
Prob(F-statistic)	0		

Note: monthly growth rate is 57,629 TFNs per month; TFNs would reach 40 million in 2021.

Model 2: non-linear trend model with error correction (purple line in graph below)

Dependent Variable: D(TFN_MONTH)
Method: Least Squares
Date: 05/10/10 Time: 12:04
Sample: 2003M10 2010M04
Included observations: 79

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TIME	540.0273	99.04525	5.452329	0
AD_D_TIME	1273.15	337.7667	3.769316	0.0003

R-squared	0.20968	Mean dependent var	70340.78
Adjusted R-squared	0.199416	S.D. dependent var	109356.3
S.E. of regression	97846.98	Akaike info criterion	25.84519
Sum squared resid	7.37E+11	Schwarz criterion	25.90517
Log likelihood	-1018.885	Hannan-Quinn criterion	25.86922
Durbin-Watson stat	1.71112		

Note: this model uses the rate of increase of TFNs per month as the dependent variable. It is essentially a quadratic trend model with a flexible slope. TFNs would exceed 40,000,000 as early as late summer 2013, which is in line with the most recent 2010 monthly data.

Model 3: Piecewise linear trend regression using full sample (dark blue line in graph below)

Dependent Variable: TFN_MONTH
Method: Least Squares
Date: 05/07/10 Time: 18:01
Sample: 1997M08 2010M04
Included observations: 153

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13700875	225976.3	60.62971	0
TD1_TIME	237942.2	8469.256	28.09482	0
TD2_TIME	-31070.72	7688.429	-4.041231	0.0001
TD3_TIME	-60508.1	6391.103	-9.467552	0
TD4_TIME	-56359.65	3546.423	-15.89197	0

R-squared	0.931602	Mean dependent var	22513628
Adjusted R-squared	0.929753	S.D. dependent var	3252532
S.E. of regression	862053.4	Akaike info criterion	30.20416
Sum squared resid	1.10E+14	Schwarz criterion	30.30319
Log likelihood	-2305.618	Hannan-Quinn criterion.	30.24439
F-statistic	503.9516	Durbin-Watson stat	0.280226
Prob(F-statistic)	0		

Monthly rate of growth
in 2010: 90003.73

Note: this model allows the trendline to flex with observed extrema and inflection points. TFNs would exceed 40,000,000 by late 2021.

Model 4: linear trend using data from 2009 and 2010 only (green line on graph below)

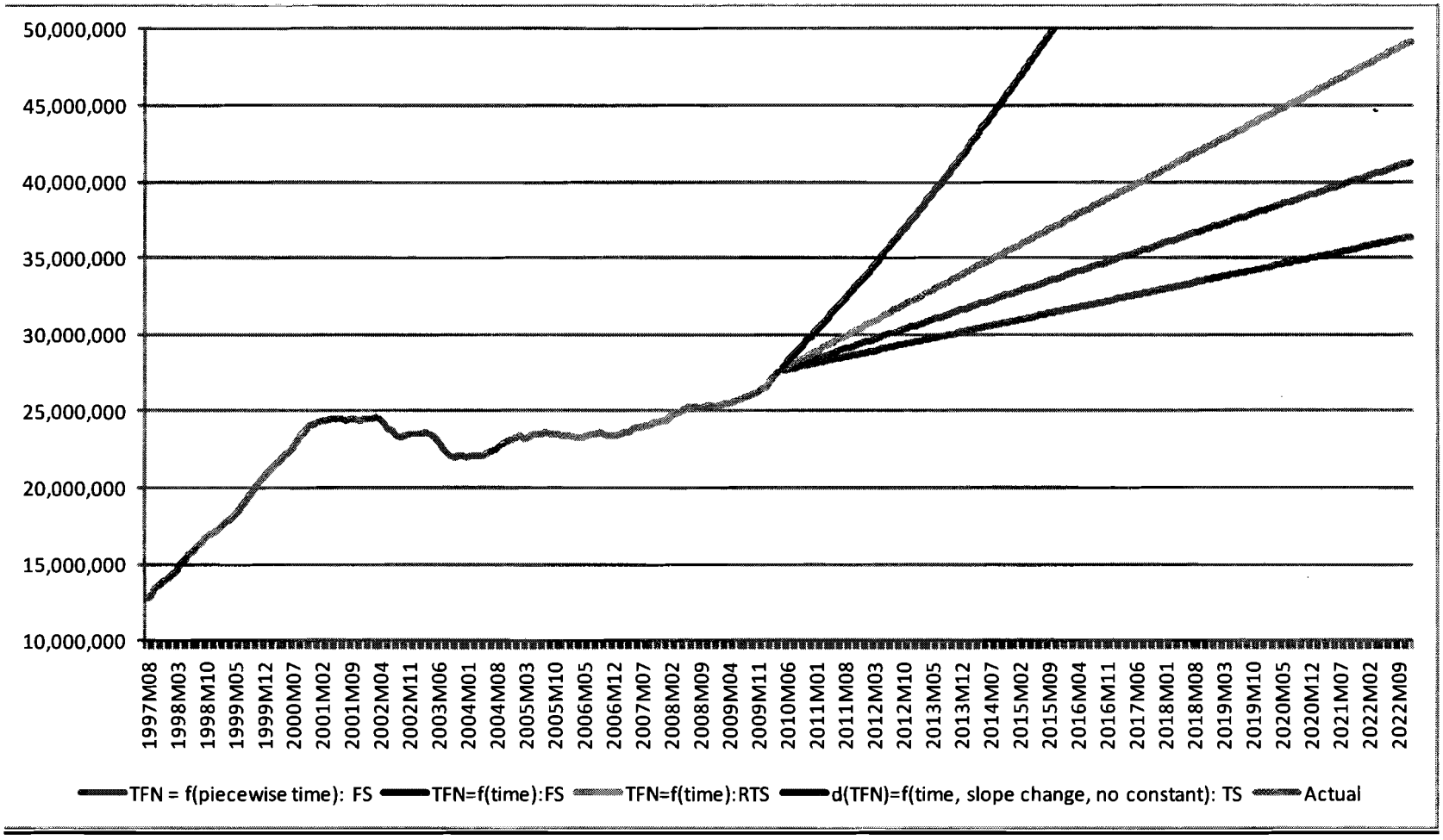
Dependent Variable: TFN_MONTH
Method: Least Squares
Date: 05/07/10 Time: 17:38
Sample: 2009M01 2010M04
Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5504240	1497233	3.676276	0.0025
TIME	141820.5	10285.1	13.78893	0

R-squared	0.931418	Mean dependent var	26139124
Adjusted R-squared	0.926519	S.D. dependent var	699617.4
S.E. of regression	189647.8	Akaike info criterion	27.26019
Sum squared resid	5.04E+11	Schwarz criterion	27.35677
Log likelihood	-216.0816	Hannan-Quinn criterion	27.26514
F-statistic	190.1346	Durbin-Watson stat	0.332921
Prob(F-statistic)	0		

Note: Monthly rate of growth: 141,820; TFNs would exceed 40,000,000 by late summer 2017.

Graphical overview of long-term forecasts provided by the four models above:



APPENDIX 2 - ADDITIONAL MODELS

Model 5: Cubic time trend using short sample and error corrections

Dependent Variable: TFN
Method: Least Squares
Date: 05/09/10 Time: 10:32
Sample (adjusted): 2003M10 2010M04
Included observations: 79 after adjustments
Convergence achieved after 18 iterations
MA Backcast: 2003M09

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-36022364	31051123	-1.160099	0.2498
TIME	1524177	756102.8	2.015833	0.0475
TIME^2	-13188.14	6096.146	-2.163356	0.0338
TIME^3	38.84416	16.25261	2.390026	0.0194
AR(1)	0.886154	0.060104	14.74356	0
MA(1)	0.245131	0.12197	2.009768	0.0482

R-squared	0.995371	Mean dependent var	24111720
Adjusted R-squared	0.995054	S.D. dependent var	1363700
S.E. of regression	95906.69	Akaike info criterion	25.85305
Sum squared resid	6.71E+11	Schwarz criterion	26.03301
Log likelihood	-1015.195	Hannan-Quinn criter.	25.92515
F-statistic	3139.42	Durbin-Watson stat	1.956503
Prob(F-statistic)	0		

Inverted AR Roots	0.89
Inverted MA Roots	-0.25

NOTE: Like Model 2, this model allows for accelerating growth. TFNs would exceed 40 million in late 2012. In hold-out tests using data from May 2007 to April 2010, however, the model shows a clear tendency to overpredict TFNs.

Model 6: cubic time trend with full sample and lagged TFN

Dependent Variable: TFN
Method: Least Squares
Date: 05/10/10 Time: 11:16
Sample (adjusted): 1997M10 2010M04
Included observations: 151 after adjustments
Convergence achieved after 16 iterations
MA Backcast: 1997M09

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	292928.2	89681.55	3.266315	0.0014
TFN(-1)	1.796833	0.071803	25.02458	0
TFN(-2)	-0.817331	0.070962	-11.51782	0
TIME	8345.738	3835.139	2.176124	0.0312
TIME^2	-112.5289	47.44083	-2.371984	0.019
TIME^3	0.472398	0.184836	2.555766	0.0116
MA(1)	-0.322111	0.117511	-2.741111	0.0069

R-squared	0.998959	Mean dependent var	22641007
Adjusted R-squared	0.998915	S.D. dependent var	3077367
S.E. of regression	101357.6	Akaike info criterion	25.93595
Sum squared resid	1.48E+12	Schwarz criterion	26.07582
Log likelihood	-1951.164	Hannan-Quinn criterion	25.99277
F-statistic	23021.49	Durbin-Watson stat	1.961624
Prob(F-statistic)	0		

Inverted MA Roots	0.32

NOTE: Like Model 2, this model allows for accelerating growth. TFNs would exceed 40 million in fall, 2012. In hold-out tests using data from May 2007 to April 2010, however, the model shows a clear tendency to overpredict TFNs.

Model 7: ARIMA 115 with full sample

Dependent Variable: D(TFN)
Method: Least Squares
Date: 05/09/10 Time: 09:44
Sample (adjusted): 1997M10 2010M04
Included observations: 151 after adjustments
Convergence achieved after 13 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	72148.35	63404.32	1.137909	0.257
AR(1)	0.953805	0.030082	31.70662	0
MA(5)	-0.282934	0.081048	-3.490964	0.0006
MA(1)	-0.390105	0.085174	-4.580103	0

R-squared	0.637138	Mean dependent var	96446.26
Adjusted R-squared	0.629732	S.D. dependent var	169054
S.E. of regression	102868.7	Akaike info criterion	25.94643
Sum squared resid	1.56E+12	Schwarz criterion	26.02636
Log likelihood	-1954.955	Hannan-Quinn criter.	25.9789
F-statistic	86.03746	Durbin-Watson stat	1.947596
Prob(F-statistic)	0		

Inverted AR Roots	0.95				
Inverted MA Roots	0.87	.32+.72i	.32-.72i	-.56+.45i	-.56-.45i

NOTE: This model was used in past TFN forecast reports. Like Model 1 it suggests that the next code might last over 10 years. TFNs would exceed 40,000,000 in 2022.