Financial Services Dynamics in Florida

Third Quarter 2022

The Florida Department of Financial Services

August 8th, 2022

Summary:

This brief is made pursuant to section 20.121(6), Florida Statutes. This brief examines an abstracted reality in game theory format between government and insurance companies, with different strategies yielding different rewards. The example shows that there are limits to cost increases, and, more importantly, if both parties intend to raise revenue, only a marginal fraction may materialize. On recessions, the National Bureau of Economic Research (NBER) defines the start and end dates of U.S. recessions using national data. Although a recession may be driven by broader economic developments, its cause is in individual decisions and thus local in nature.

Game Theory: Millage versus Property Insurance Premiums

For this exercise, assume the two parties are the government and property insurers, with both real-estate tax/millage and insurance premiums and respective revenues; and assume the same economic model as presented in the "Financial Services Dynamics in Florida" brief (dated July 1st, 2022),[1] with both millage and insurance premiums to have a negative impact on home values. In lieu, consider a non-cooperative, two-party game with a finite number of strategies,[2] which enables presentation of the game in a payoff matrix. Both negative impact effects are constraints on home purchasing budgets, which depend on earning capacity. Each recurrent or structural cost will lower free home buying capacity, and thus on home values clearing the market (lower home prices, which in turn will impact assessments etc.). In short, with costs rising, budget and substitution effects will impact the real-estate market. In addition, assume each party has one millage-rate/insurance premium strategy, *i.e.,* to leave millage/premium unchanged or raise it by one percent. For each possible outcome there is a corresponding payoff for each party (note: payoff based on the strategies chosen by all/both players). First, there is a prime mover premium of +1 percent. In addition, payoff rests on the adverse effect on house values as noted. Table 1 shows the games setting, whereas Table 2 provides the pay-off or possible outcomes of the game (including the prime mover premium).

Table 1. The Conditions or Setting of the Game

Strategies		Insurance	
		0%	+1%
Millage	0%	$329,433	$328,126
	+1%	$327,646	$326,339
	0%	-	$(1,307)
	+1%	$(1,787)	$(3,094)
	0%	0.00%	-0.40%
	+1%	-0.54%	-0.94%

The estimated average home value, according to the used model, is $329,433 (January 2022). Since the model may be used under a Ceteris Paribus assumption (applying a small change on one variable while other variables are kept equal or unchanged), small deviations in home values may be calculated as a result of a one percent increase in millage/insurance-premiums. A one percent increase in millage rate sets the average home at $327,646. Likewise, a one percent increase in insurance premiums sets estimated home values at $328,126. An increase in both results in an estimated average home value of $326,339 (see top part of Table 1). The middle section of Table 1 shows the absolute differences with respect to the initial value of $329,433,

[1] Florida Department of Financial Services (DFS), Financial Services Dynamics in Florida, Second Quarter 2022 (dated July 1st, 2022). See: https://www.myfloridacfo.com/docs-sf/cfos-executive-offices-libraries/cos-documents/strategic-markets-report-q2-2022.pdf?sfvrsn=6673f7b5_0

[2] See e.g., J. von Neumann and O. Morgenstern, *The Theory of Games and Economic Behavior*, Princeton University Press, Princeton, N.J. 1953, 3rd ed.

whereas the bottom section of the table depicts the same changes as shown in relative terms. In Table 2 the "prime mover premium" of +1 percent is added, resulting in the pay-off matrix.

Table 2. The Payoff Matrix of the Game

Strategies		Insurance	
		0%	+1%
Millage	0%	(0.00%, 0.00%)	(-0.40%, 0.60%)
	+1%	(0.46%, -0.54%)	(0.06%, 0.06%)

The first combined entry (0.00%, 0.00%) in Table 2 represents the payoff to the government first and the insurance companies second. For example, if both players adopt their respective first strategies, *i.e.,* not changing millage-rate/insurance premiums, the payoff will be zero (0.00%, 0.00%). However, if the government chooses to leave millage the same, while insurance companies opt to increase premiums (+1%), the government will face a real-estate tax revenue setback of minus 0.40 percent (due to the same millage against marginal lower home price values across the board, whereas the insurers will see a marginal revenue gain of 0.60 percent (≈ +1% – 0.4%)). Likewise, if millage is raised by one percent, and insurers opt to leave their premiums, the government home property tax revenue increases by approximately 0.46 percent (≈ +1% - 0.54%). In the fourth quadrant, both parties raise millage-rate/premium by one percent with both gaining the strategy premium of one percent, but also facing a marginal lower base in home values of 0.94 percent, resulting in overall marginal revenue gains of approximately 0.06 percent.

The dominant strategy, or solution to this game, is that both parties will raise millage-rate/insurance premiums. Regardless of whatever the insurance companies do, the government is better off choosing to raise millage; likewise whatever the government does, insurance companies are better off raising insurance premiums. Put differently, if insurers opt to raise premiums, the government would be better off choosing to increase their millage rates as well, and vice versa. The final reward for both parties/players, however, is a meager 0.06 percent instead of a loss of 0.54 and 0.40 percent, respectively.

In stretching the argument a bit, while still assuming all other things are equal, even under raising millage-rate/insurance-premiums in eight one-percent increments, the payoff matrix appears as shown in Table 3. Note that the fourth quadrant turns negative for both parties. If either party expects the game results to be as depicted, neither will move to change. If information assumed is not transparent, neither will be tempted to move with negative results. Hence, non-cooperation will fail either party.

Table 3. The Payoff Matrix of the Game

Strategies		Insurance	
		0%	+1%
Millage	0%	(0.00%, 0.00%)	(-0.42%, 0.58%)
	+1%	(0.42%, -0.58%)	(-0.01%, -0.01%)

Static analyses does not always reflect reality, as a multitude of other factors drive home values. The real estate market in Florida has been active, with both increasing real estate tax revenues (via higher property appraisals even without changing millage rates) and rising insurance revenues (such as assessments and rising construction costs). The solution may be government not moving (as it knows revenues will increase), leaving room for insurance companies to take their chances and raise premiums. Whatever the case, game theory shows that there are different strategies for different stakeholders yielding different rewards. The example also shows that there are limits to cost increases, and more importantly, if both parties intend to raise revenue, only a marginal fraction may materialize (0.06% according to Table 2, or in slightly different conditions even -0.01 as per Table 3). In both cases, the lion's share of intended revenue increases is lost in marginally lower home values.

Is Florida in a recession?

What is a recession, and when does the U.S. economy officially fall into a recession? In principle, a recession is a natural part of a business cycle especially when an economy contracts. The National Bureau of Economic Research (NBER) provides the following definition of a recession, "a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales."[3] Provided

[3] See: https://www.nber.org/business-cycle-dating-procedure-frequently-asked-questions

a handful of criteria/variables, the NBER defines the start and end dates of U.S. recessions. That said, no formal formula is used where the research method is an expert panel (to exchange perceptions and form consensus).

Absent a formal relation, here, an attempt to capture or mimic a NBER recession decision-making, by quantifying and dating a U.S. recession. Once developed, the question is: can the same be used to determine a recession for Florida? Given that no formal calculus or decision-making model is known, the approach will be all variables mentioned for both the U.S. and Florida. No attempt is made to hypothesize variable relations, selection of more relevant variables based on t-Stat and P-values, and no time lags are analyzed in order to remain fully comparative and inclusive comparing results between the U.S. and Florida. The following multi-variate formula is used:[4]

$$R_i = \alpha_i + \beta_i * \dot{RPI}_i + \delta_i * \dot{NFPR}_i + \eta_i * \dot{CON}_i + \lambda_i * \dot{MANF}_i + \mu_i * \dot{HHE}_i + \rho_i * \dot{INDP}_i + \zeta_i * \dot{GDP}_i + \varepsilon_i$$

Input data are Q-to-Q relative changes ($=x_t/x_{t-1}$). Applied, this formula yielded the following results for the U.S. as depicted in Figure 2.[5] Gray highlighted periods are NBER proclaimed recessions (<0 recessions, >0 growth).

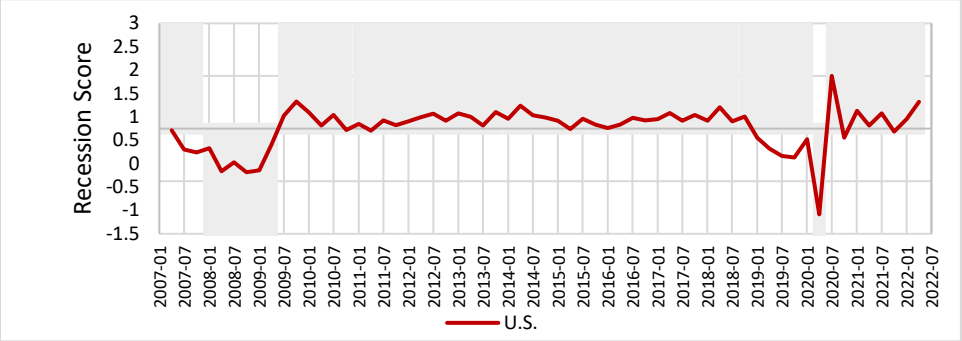
As may be taken from Figure 1, the multivariate analysis (mv-analyses) aligns with the dates obtained by the NBER on the past two recessions. With focus on present scores, it doesn't look like the NBER will declare a U.S. recession for now.

[4] Note: the formula used is intentionally a "nonsense" multi-variate analysis.
Data from Q1:2007 through Q2:2022 as available, resulting in only two recessions to match. Some limitations were encountered for matching U.S. versus Florida data. Inter-extrapolations where necessary were done using Bessel Spline.
In which: **R** = 1 for periods of growth and -1 for periods of recession, dates according to NBER. See: https://www.nber.org/research/data/us-business-cycle-expansions-and-contractions.
RPI is real personal income less transfers. Used: U.S. Bureau of Economic Analysis, Real Personal Income [RPI], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/RPI, and U.S. Bureau of Economic Analysis, Real Personal Income for Florida [FLRPI], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/FLRPI, (Note, no data was found on excluding current transfer receipts, this especially for Florida. Hence both were used as is).
NFPR is nonfarm payrolls. Used: Automatic Data Processing, Inc., Total Nonfarm Private Payroll Employment [NPPTTL], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/NPPTTL, and U.S. Bureau of Labor Statistics, All Employees: Total Nonfarm in Florida [FLNA], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/FLNA.
CON is real personal consumption expenditures. Used:
Bureau of Economic Analysis, Total personal consumption expenditures, SAPCE1 Personal consumption expenditures (PCE) by major type of product 1/ Retrieved from: https://apps.bea.gov/itable/iTable.cfm?ReqID=70&step=1
MANF is real manufacturing and trade sales. Used: U.S. Bureau of Economic Analysis, Real Gross Domestic Product: Retail Trade (NAICS 44-45) in the United States [USRETAILRQGSP], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/USRETAILRQGSP, and Federal Reserve Bank of St. Louis, Real Gross Domestic Product: Retail Trade (NAICS 44-45) in Florida, Millions of Chained 2012 Dollars, Annual, Not Seasonally Adjusted. Retrieved from: https://fred.stlouisfed.org/series/FLRETAILNQGSP.
HHE is household employment. Used: U.S. Bureau of Labor Statistics, Employment Level [CE16OV], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/CE16OV, and U.S. Bureau of Labor Statistics, Employed Persons in Florida [LASST120000000000005], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/LASST120000000000005.
INDP is index of industrial production. Used: Board of Governors of the Federal Reserve System (US), Industrial Production: Total Index [INDPRO], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/INDPRO, and U.S. Bureau of Economic Analysis, Chain-Type Quantity Index for Real GDP: All Industry Total in Florida [FLQQGSP], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/FLQQGSP.
GDP is Gross Domestic Product. Used: U.S. Bureau of Economic Analysis, Real Gross Domestic Product [GDPC1], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/GDPC1, and U.S. Bureau of Economic Analysis, Real Gross Domestic Product: All Industry Total in Florida [FLRQGSP], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/FLRQGSP.
Suffix *i* pertaining to the U.S., and *j* for Florida. For one of the comparisons the *i* and *j* suffixes are combined, e.g. in $R_j = \alpha_i * \dot{RPI}_j + \cdots etc.$
Where necessary, data is converted to 2012 dollars to abstain from inflation issues, using Sahr, R.C., Consumer Price Index (CPI) Conversion Factors for Dollars of 1774 to 2028, Oregon State University. Data retrieved from: http://liberalarts.oregonstate.edu/spp/polisci/research/inflation-conversion-factors.
Note: no attempt is made to hypothesize on relation or causality on selected and/or relevant variables based on t-Stat and P-values, nor on potential lags, this for comparative and inclusive purposes. (Hence, the formula represents a "nonsense" multi-regression).

[5] Multi-variate analysis results for U.S. based on NBER recession pivot dates:

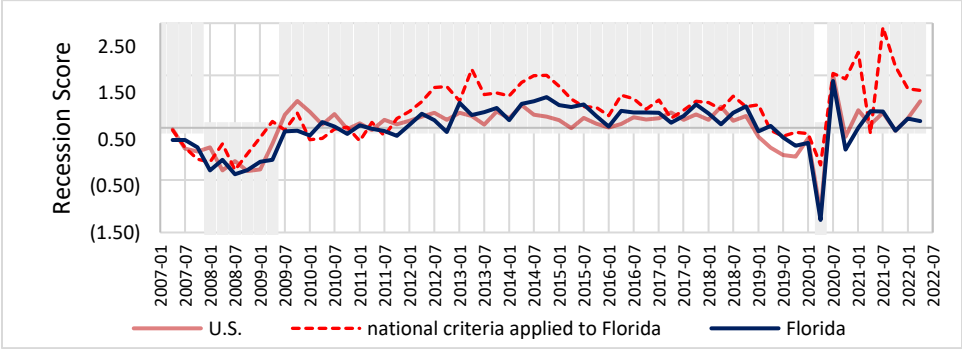
Variable	*Intercept*	*RPI*	*NFPR*	*CON*	*MANF*	*HHE*	*INDP*	*GDP*	*Multiple R^2*
Coefficient	-40.0116	0.9734	15.4064	7.7021	26.7855	-12.6262	15.7754	-13.1561	0.7073
t Stat	-3.9291	0.2867	0.9334	1.1309	3.1804	-0.9546	2.9090	-1.1093	***Adj. R^2***
P-value	0.00025	0.7755	0.3549	0.2632	0.0025	0.3441	0.0053	0.2723	0.4343

Figure 1. Recession Scores on the U.S. Q1:2007 through Q2:2022



Since no Florida recession determination approach or procedure exists, two exercises are conducted. First, the same U.S. or national coefficients are used on Florida data, based on the present practice of the NBER putting a stigma of recession on each and every state based on their national perspective. This approach results in recession scores as illustrated by the red dashed line in Figure 2. It may be taken that individual states may experience a different reality as major parts of the red dashed line scores are well above the U.S. scores (see faded brown U.S. line from Figure 2, this for reference purposes). (Note: the correlation coefficient between the U.S. and the red dashed line is 0.643). In addition, the periodicity or recession pivot points are slightly off. Secondly, the same multivariate analysis was applied, but now using Florida data.[6] This approach results in the blue line in Figure 2.

Figure 2. Recession scores on Florida State Q1:2007 through Q2:2022



Using this metric poses a much better fit with the recession scores on the U.S. (correlation coefficient between the two is 0.854). Although the overall pattern is similar, 62 percent of Florida's scores are greater than the same U.S. scores. Given the analysis, Florida is not in a recession yet. It is important to note, that the results shown are based on data with different mv-coefficients. Point in case, a recession may be driven by broader economic developments; its cause is in individual decisions and thus local in nature. Use of national determinations may even pose a self-fulfilling prophecy, hampering local and state economic activity.

Key Takeaways:

- Using a game theory model provides insights to stakeholders' strategies and payoffs. With raising millage and/or insurance premiums, most value is lost in lower home values.
- A recession may be evaluated nationally, based on broad economic developments, its origin is in individual decisions, hence local in nature.

6 Multi-variate analysis results for Florida State based on NBER recession pivot dates:

Variable	*Intercept*	*RPI*	*NFPR*	*CON*	*MANF*	*HHE*	*INDP*	*GDP*	*Multiple R^2*
Coefficient	-48.6838	-32,136.0	43.3578	17.3535	3.9980	-25.7099	32,143.8	2.4598	0.7542
t Stat	-6.3879	-1.9408	2.3844	2.6039	0.9376	-2.0266	1.9410	0.8574	***Adj. R^2***
P-value	4.35E-08	0.0576	0.0207	0.0119	0.3527	0.0478	0.0576	0.3951	0.5119