

Chapter Five

Fishery Assessment of Proposed Options for the Gulf of Mexico and South Atlantic

5.1 Shrimp Fisheries as Open Access Resources

Based on the simulation analysis for the Gulf of Mexico and the South Atlantic shrimp fisheries, it is clear that some type of effort reduction is needed to restore these fisheries to sustainable profitability. The average real price of shrimp has been trending downward since the early 1980s. As a result, these shrimp fisheries cannot support as many vessels as they once did.

The essence of the problem is demonstrated in Graphs 5.1 and 5.2. In Graph 5.1, the vertical axis measures revenue from and cost of shrimp fishing and the horizontal axis measures total fishing effort in terms of the number of vessels in the shrimp fishery. As the number of vessels increases, revenues increase, but at a decreasing rate. Total costs, which include both accounting costs and normal operating costs, are assumed to increase at a constant rate as the number of vessels in the fleet increases.

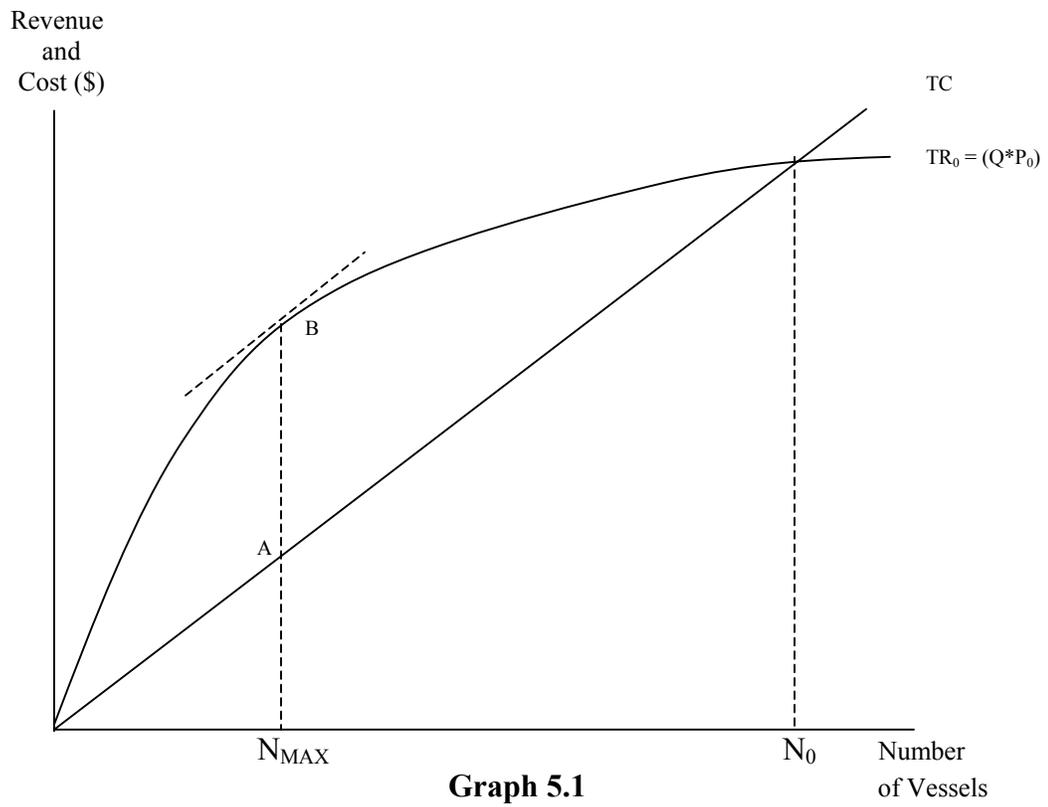
If the price of shrimp is P_0 , as in Graph 5.1, then when there are N_0 vessels, total revenue equals total cost and the fishery, while making “normal accounting” profits, is making zero “economic” profit.¹ This point is called the open-access equilibrium because vessels have no incentive to either exit or enter the fishery. Now if the fishery could be managed under sole ownership² to maximize economic profits, then only N_{MAX} vessels would be used, and the economic profit for the fleet of vessels would be the distance from A to B (economic profit = $TR - TC$ at N_{MAX}). Economic profit is also referred to as rent, or pure profit.

In Graph 5.2, we suppose the price of shrimp declines to P_1 (i.e., $P_1 < P_0$). This would rotate the TR curve downward to the bold line as shown in Graph 5.2. The new open access equilibrium would be where N_1 vessels are in the fishery. With the fall in the price from P_0 to P_1 , the number of vessels must be reduced from N_0 to N_1 ; otherwise, total cost will exceed total revenue and vessels will be operating at a loss from their fishing activities.

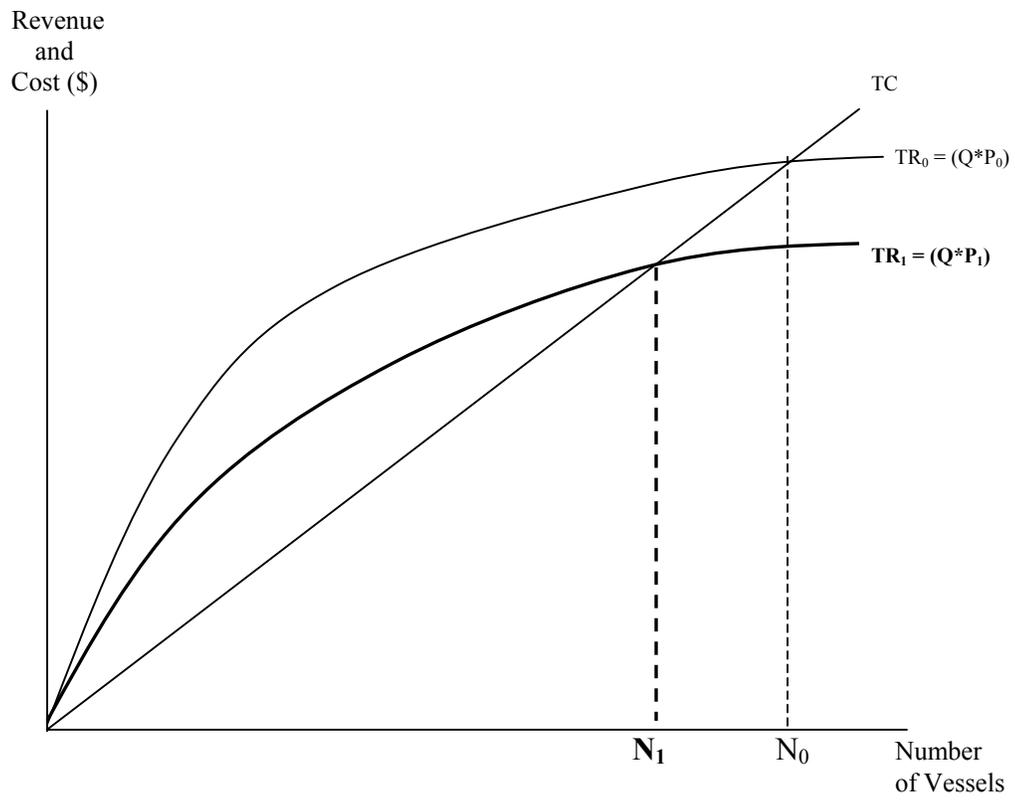
Basically, this is a simplified representation of what is occurring in the shrimp fisheries in 2003. For the most part, biologically speaking, the shrimp resource is just as productive as ever.

¹ Economic profit is profit made in excess of normal profits. Total costs include normal profits, i.e., the opportunity costs of labor and capital of the vessels owner.

² Sole ownership management allows many small operators to own a portion of the living marine resource. It is analogous to the small family owned farm in agriculture. Also, individual transferable quotas are a form of sole ownership in fisheries.



Graph 5.1



Graph 5.2

Economically, however, shrimp fisheries cannot support as many vessels as they once did because the real price of shrimp has been declining. In reality, reductions in the fleet are slower than might be predicted because vessel operators can for a time ignore maintenance and depreciation costs. In this situation normal profit is essentially zero. Simulation analysis demonstrates that to make long-term improvements in the financial condition of the shrimp fishery and develop an economically sustainable fishery, the number of vessels in the fishery must be reduced and barriers to entry must be established.

5.2 Options Analyzed

Seven options were identified through the Shrimp Summit that could be analyzed by the General Bioeconomic Fisheries Simulation Model (GBFSM). They are:

1. Permit/License Moratorium;
2. Government Buyback Program;
3. Price Support Program;
4. Increase Price through Marketing Paid for by Tax on Per Pound of Shrimp Landed;
5. Cooperatives for Maximum Profit (Collective Group Action);
6. Fractional License; and
7. Operating Loan with Payback.

5.2.1 Description of Options

Permit/License Moratorium: A moratorium on permits/licenses could be placed on vessels and compared to a fishery with open access. GBFSM has the option to place the moratorium on large (>60 ft) and small (<60 ft) vessels, and it will have the option to place the moratorium only on vessels >60 ft (those with permits in the EEZ).

Government Buyback Program: With this buyback option, the government would purchase the permit/license and vessel at a price equal to one year of revenue per vessel (for an average vessel). The model is set up with small vessels fishing inshore/near-shore, and therefore fishing mostly in state controlled waters. These vessels will do very little fishing in the EEZ. Large vessels fish in near-shore/offshore waters and must have a permit to fish in the EEZ. The buyback program has the option to buy back both large and small vessels, and it will have the option to only buy back large vessels. The buyback program will be analyzed with both open access and a permit/license moratorium. Funding options for the government buyback program will be analyzed from two sources, which include a government grant and a loan to the shrimp fishery to be paid back with a tax on per dollar of shrimp landed over a five-year period at a 5% interest rate.

Price Support Program: The price support government program would set a target price by size class of shrimp. If the average price by size class falls below the target price, the government would pay shrimpers the difference between the target price by size class and the average price by size class.

Increase Price Through Marketing Paid for by Tax on Per Pound of Shrimp Landed: A marketing program to increase the price of shrimp could be paid for by a self-

imposed tax of \$0.01 on each pound of shrimp landed. Since the real effect of this marketing program is unknown, sensitivity analysis will be conducted by increasing the price by 0%, 5%, 10%, 15%, and 20% to deter the impact to shrimpers.

Cooperatives for Maximum Profit: This program assumes a cooperative would be formed and that members of the cooperative would manage their cooperative like a monopolist and use only enough vessels and effort to maximize profits to the cooperative. It will be assumed in each state there will be one cooperative for large vessels and one cooperative for small vessels. In this analysis, we vary effort from 0% to 100% in 5% increments to determine where approximate maximum profits will occur.

Fractional License Program: A fractional license (FL) is a program that permanently reduces effort in the fishery by eliminating a portion of the licenses. This could be accomplished by granting each vessel a tradable FL right – for example, a right to a portion of a full license – yet establishing that a vessel can operate only if it obtains a full license. Fractional rights are traded among fishermen, so that a fraction of the total number of licenses is removed from the fishery.

A FL program is included in the “Option Paper For Amendment 14 To The Shrimp FMP,” Alternative 3.C (8/1/03). In the current FL program in GBFSM the models calculate the potential profits of individual vessels. These potential profits determine the vessels’ willingness to pay (WTP) to complete their license and the willingness to accept (WTA) to sell their license. It is assumed that trading leads to a permanent transfer of the right from one vessel to another. Each vessel’s WTP to complete its license is equal to the present value (PV) of future annual economic profits.

In the reported results, we assume that vessels purchasing rights obtain government-backed long-term loans. It is assumed that shrimpers will make a single, equal payment per year until the loan is paid off.

Operating Loan w/ Payback: After careful consideration, it was determined the operating loan would not be analyzed in GBFSM for two reasons. First, such loans cannot be included in GBFSM without major revisions to the model, which is far beyond the cost of this project. Second, operating loans are designed to be paid back within a year. If shrimp prices stay at the 2002 level for more than a year, the following table projects profit per vessel, given an open access fishery with no government assistance. Under these conditions and assuming that the operating loan must be paid back within a year, it would be of little use. A suggestion was made to use the capital construction fund for the operating loans. However, only a small number of vessel owners receive this source of funds, so such action would not have much fishery impact. Also, it would take legislative action to make these funds available. For all these reasons, operating loans will not be included in this analysis.

Estimated average economic profit per vessel*		
Year	Length < 60ft	Length > 60ft
2002	-2,972	-28,577
2003	-2,689	-25,446
2004	-2,338	-20,813
2005	-2,008	-16,028
2006	-1,711	-11,461

*Average economic profit goes up over time due to vessels exiting the shrimp fishery.

5.2.2 Specific Options Analyzed in the Simulation

1. Permit/License Moratorium:
 - a. Open access (no permit/license moratorium³)
 - b. On large vessels
 - c. On large and small vessels
2. Government Buyback Program (with open access and permit/license moratorium; funded with a grant and with a tax on per dollar shrimp landed):
 - a. Buy 0%, (open access)
 - b. Buy 10%, one market for large vessels
 - c. Buy 30%, one market for large vessels
 - d. Buy 50%, one market for large vessels
 - e. Buy 10%, five markets for small vessels and one market for large vessels
 - f. Buy 30%, five markets for small vessels and one market for large vessels
 - g. Buy 50%, five markets for small vessels and one market for large vessels
3. Price Support Program:
 - a. Target price 0% above average price (open access)
 - b. Target price 10% above average price
 - c. Target price 20% above average price
 - d. Target price 30% above average price
4. Increase Price through Marketing Paid for by Tax on Per Dollar of Shrimp Landed:
 - a. No tax and 0% increase in price (open access)
 - b. \$0.01 tax on pound and 0% increase in price
 - c. \$0.01 tax on pound and 5% increase in price
 - d. \$0.01 tax on pound and 10% increase in price
 - e. \$0.01 tax on pound and 15% increase in price
 - e. \$0.01 tax on pound and 20% increase in price
5. Cooperatives for Maximum Profit:
 - a. Base – no cooperative (open access)
 - b. For large and small vessels

³ Texas small vessels have been under a buyback program of bay and bait licenses that has been in effect since 1995. Therefore, all simulations are run with Texas small vessels under a limited entry program.

6. Fractional License Program:
 - a. Buy 0% vessels (open access)
 - b. Buy 10%, one market for large vessels
 - c. Buy 30%, one market for large vessels
 - d. Buy 50%, one market for large vessels
 - e. Buy 10%, five markets for small vessels and one market for large vessels
 - f. Buy 30%, five markets for small vessels and one market for large vessels
 - g. Buy 50%, five markets for small vessels and one market for large vessels

5.3 Simulation Analysis

The analysis will be a 20-year simulation from 2002 to 2021. Different simulations for each of the options are given below. Each set of simulations will be made for both the Gulf of Mexico shrimp fishery and the South Atlantic shrimp fishery. Each set of simulations will be analyzed at 2000 and 2002 shrimp prices as shown in Figure 5-1. For the low price level, we assume that the 2002 price level will remain through 2021. For the high price level, we assume that prices in 2004 will return to the 2001 price level, and in 2005, we assume that prices will return to the 2000 price level and remain there through 2021. In the year 2000, the average shrimp vessel was making some profit. In the year 2002, all shrimp harvesters were incurring a significant loss.

In the simulation analysis, options are implemented at the end of 2004 so that the first year the options takes effect is 2005. The year 2005 was chosen since it is doubtful that any of these options could be implemented before the end of 2004. It is assumed that if economic profits are positive and there is a permit/license in effect, no capital stuffing or effort creep will occur. It is also assumed that the shrimp fishery would be an open access fishery (except for Texas small boats) during the period 2002 to 2004. It should be remembered that many of the options would take beyond 2004 to be implemented.

Since the options are implemented in the simulation at the end 2004, PV of economic profit is discounted for the period 2005-2021. Therefore, the PV of economic profit does not include the first three years of the simulation.

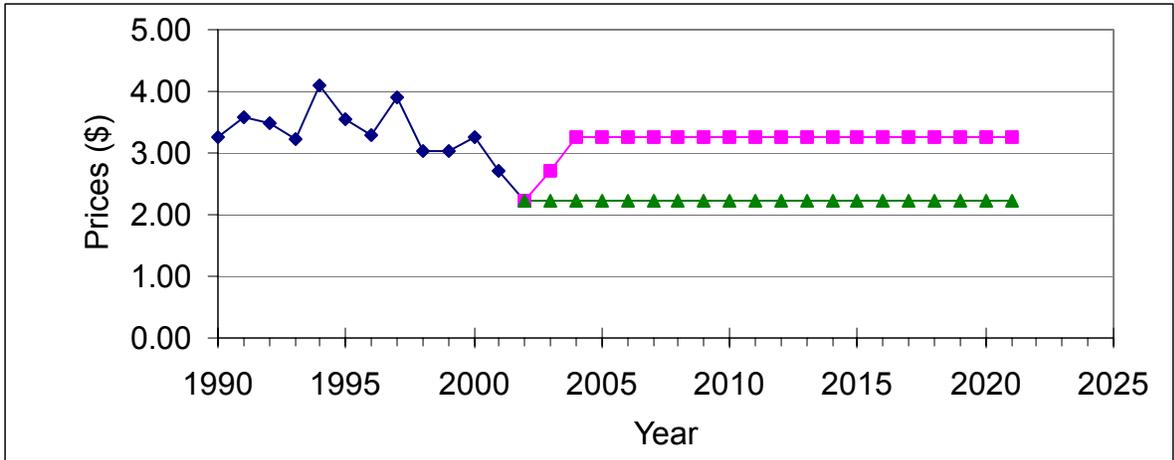


Figure 5.1. Average real ex-price of shrimp in the Gulf of Mexico, 1990 to 2002, and price used in the simulation from 2002 to 2021

Two differences between the Gulf and South Atlantic should be elaborated upon before evaluating results of the simulation. Basically, the Gulf of Mexico has six size classes of shrimp and five depths at which to fish (one inshore and four offshore), whereas the South Atlantic has only two size classes of shrimp and two depths at which to fish (inshore and offshore). The greater dimensions in the Gulf of Mexico will allow a better separation of impacts than will occur in the South Atlantic. For example, we know the small vessels fish inshore and offshore in both the Gulf of Mexico and the South Atlantic. In the Gulf, however, small vessels fishing offshore do so in near-shore waters and do not fish within the far offshore waters. This gives large vessels access to larger shrimp in the far offshore areas that small vessels do not have access to. This allows a better measure of the individual impacts of both the small and large vessels from the various options analyzed. In the South Atlantic, there is only an offshore area and, therefore, it must be assumed that small vessels are able to fish at all depths and for all size classes of fish in the offshore.

The dimensions of the General Bioeconomic Fisheries Simulation Model (GBFSM) for this study are as follows:

Species of fish:	Gulf of Mexico	South Atlantic
	Brown shrimp (<i>Penaeus aztecus</i>)	One species (all combined)
	Pink shrimp (<i>P. duorarum</i>)	
	White shrimp (<i>P. setiferus</i>)	

Sizes of shrimp	Gulf of Mexico	South Atlantic
Tail count/pound:		
1	>20	<50
2	21-30	51>
3	31-50	
4	51-67	
5	68-116	
6	> 117	

Regions landings occur:	Gulf of Mexico	South Atlantic
Region 1	West Florida	North Carolina
Region 2	Alabama	South Carolina
Region 3	Mississippi	Georgia
Region 4	Louisiana	East Florida
Region 5	Texas	

Areas fished:	Gulf of Mexico	South Atlantic
Area 1	Lower FL (Stat. grids 1-3)	North Carolina
Area 2	Upper FL (Stat. grids 4-9)	South Carolina
Area 3	AL, MS, E. LA (Stat. grids 10-12)	Georgia
Area 4	W. LA (Stat. grids 13-17)	East Florida
Area 5	Upper TX (Stat. grids 18-19)	
Area 6	Lower TX (Stat. grids 20-21)	

Shrimp vessel length:	Gulf of Mexico	South Atlantic
Vessel class 1	< 60 ft (small vessels)	< 60 ft (small vessels)
Vessel class 2	≥ 60 ft (large vessels)	≥ 60 ft (large vessels)

Depths fished:	Gulf of Mexico	South Atlantic
Depth 1	Inshore/bay	Inshore/bay
Depth 2	1-5 fathoms	Offshore
Depth 3	6-10 fathoms	
Depth 4	11-20 fathoms	
Depth 5	> 20 fathoms	

5.4 Results of Simulation Analysis

The objective of this paper is to evaluate a series of options that the shrimp harvesting industry can pursue to reduce the presently existing financial pressure on its operation that will, at the same time, result in both a long-term improvement to its financial condition and an economically sustainable fishery. This objective is especially important when shrimp prices are low. Therefore, the results presented here in the text are for low prices (year 2002 shrimp prices).⁴ That is, how can financial stability be achieved when shrimp prices are low and when they are expected to remain low over a long period of time?

Before discussing the various options, we will briefly examine the shrimp fisheries in the Gulf of Mexico and South Atlantic under open access for the 20-year simulation at the two price levels. In this analysis, economic profit (referred to as rent or pure profit in Appendix A) is zero when the average vessel is making normal profit.⁵ If economic profit is greater than zero, the average vessel is making above normal profits and, given the open access nature of the fishery, additional vessels will enter the shrimp fishery. If economic profit is less than zero, the average vessel is making below normal profit and vessels will leave the shrimp fishery.

Gulf of Mexico: Open access simulation results are presented in Figures 5.2 for the Gulf of Mexico shrimp fishery. When prices remain low (at the 2002 price level), small FTEV⁶ are making negative economic profits in 2002 (Figure 5.2d); therefore, some small FTEV will leave the fishery (Figure 5.2e). If shrimp prices remain low, the number of small FTEV is expected to decline through the simulation period. With the decline in small vessels, CPUE will increase over time (Figure 5.2f), reaching by the year 2021 nearly 440 pounds per day fished (Table 5.1). In the simulation run with high shrimp prices, small FTEV increase because they are making positive economic profit. This increase in small vessels over the simulation period will cause CPUE to decline over the time period to approximately 330 pounds per day fished.

Large vessels are affected by what small vessels do in shore and near shore. With low prices, negative economic profits (Figure 5.2a) are incurred and large FTEV will begin to exit the shrimp fishery. As large vessels leave the shrimp fishery, their CPUE will increase (Figure 6.2c). Since small vessels are also exiting the shrimp fishery, this will allow more shrimp to escape to the near-shore and offshore depths where large vessels fish. Thus, large vessels' CPUE increase at a greater rate than do small vessels, and will increase over time to just over 600 pounds per day fished.

When the price of shrimp increases to the higher price level by 2005, the number of large FTEV increases through about year 2011 (Figure 5.2b); however, an increase in the number of

⁴ Results with high and low shrimp prices are presented in Appendix A.

⁵ Normal profits include the opportunity costs of capital and labor.

⁶ FTEV is full-time equivalent vessels and represents the number of vessels it would take to harvest the current amount of landings in the month with the greatest amount of landings if all vessels were working full time; i.e., no part-time vessels. Vessels used in the text refer to FTEV.

small FTEV causes slight negative economic profit (Figure 5.2a) and the number of large vessels decline slightly through 2021. Because the number of large and small FTEV increased, the CPUE declines for both vessel sizes. The permit/license moratorium was implemented in the simulation at the beginning of 2005; therefore, annual economic profit is discounted at the beginning of 2005 (Figure 6.2c). The PV of economic profit for large FTEV is -\$21.7M with low shrimp prices and \$141.5M with high shrimp prices. The PV of economic profit for small FTEV is -\$36.3M with low shrimp prices and \$98.2M with high shrimp prices.

South Atlantic: Open access simulation results are presented in Figure 5.3. As with the Gulf of Mexico, vessels exit the fishery when prices are low and enter the fishery when prices are high. The direction of change is basically the same as in the Gulf. The exception is for large FTEV under high prices. There is a more marked decrease in large FTEV for high prices beginning about year 2011 than occurred in the Gulf of Mexico. The reason they decrease is that small vessels increase 47% over the simulation period, leaving less shrimp for the large vessels. It should be remembered that with the South Atlantic simulation, there is only a single depth offshore and this probably biases the results in favor of small vessels. The PV of economic profit for large FTEV is -\$27.2M with low shrimp prices and \$2.7M with high shrimp prices. The PV of economic profit for small FTEV is -\$7.4M with low shrimp prices and \$42.6M with high shrimp prices.

Summary: In the open access fishery over the long run, assuming all other things that affect the vessels' economic profit remain unchanged, vessels will enter the fishery when economic profits are positive and exit the fishery when economic profits are negative. Under open access, the fishery will come to equilibrium when all economic profits are zero. Therefore, any option that produces economic profits when implemented will be short-lived because of vessels entering the shrimp fishery. Therefore, consider that any option that will cause positive economic profit will be short-lived without an associated permit/license moratorium.⁷

5.4.1 Permit/License Moratorium

A moratorium would restrict the issuance of new licenses to fish for shrimp. In this section we examine the permit/license moratorium without any other option associated with it under low shrimp prices when shrimp vessels are making negative economic profits.⁸

Gulf of Mexico: Moratoriums keep vessels from entering the fleet when economic profits are positive. At low prices, however, when economic profits are negative the moratoriums have little effect, since there is no incentive for vessels to enter the fishery. Notice in Figure 5.4 there is little difference in the number of large and small FTEV leaving the fishery under permit/license moratorium and open access (N). With or without the permit/license moratorium, sufficient vessels leave the fishery for economic profit to approach zero over the

⁷ Options without a permit/license moratorium are presented in Appendix A.

⁸ Simulation results for the permit/license moratorium with high shrimp prices are presented in Appendix A. It shows that when the price increases and a permit/license moratorium is in place, positive economic profit can be maintained provided capital stuffing and effort creep can be controlled.

simulation period. In year 2021, the number of small FTEV remaining in the fishery under a permit/license moratorium is 4,681, and with open access it is 4,537 (Table 5.1). The number of large FTEV remaining in the fishery under a permit/license moratorium is 1,254, and with open access it is 1,357 (Table 5.2).

When a permit/license moratorium on both small and large vessels was in place, the PV of economic profit for large vessels was -\$22M and -\$2.4M with a permit/license moratorium. For small vessels, the PV of economic profit was -\$36M and -\$29M with a permit/license moratorium. Apparently there is slightly more benefit to larger vessels under a permit/license moratorium.

South Atlantic: Results for the South Atlantic are basically the same as for the Gulf of Mexico. Figure 5.5 actually shows no difference in the curves for FTEV and economic profit for the entire simulation period. Under open access, the small vessels' PV of economic profit is -\$11.0M, and it is -\$7.4M with a permit/license moratorium. Large vessels' PV of economic profit is -\$30.0M for open access and -\$27.2M with a permit/license moratorium.

Summary: The objective of financial stability during low shrimp prices is not achieved when the only option used is a permit/license moratorium. When prices of shrimp are expected to remain low over the long run, in the absence of some other option in place which will cause vessels to have positive economic profit, a permit/license moratorium is unnecessary.

5.4.2 Government Buyback Program

With this buyback option, the government will purchase the permit/license and vessel at a price equal to one year of revenue/vessel (for an average vessel). Funding for the government buyback program is analyzed from two sources, which include a government grant and a loan from the government to the shrimp fishery where repayment of the loan is made at the end of each year over a ten-year period at 5% interest. The percent of permits/licenses bought back and compared in the simulation analysis is 0, 10, 30, and 50.

5.4.2.1 Buyback with a Grant

Gulf of Mexico:

Buy back only large vessels: Results of a large vessel buyback program are given in Figure 5.6, when only large vessels participate in a license buyback program and a permit/license moratorium. The simulation analysis found that with low shrimp prices, economic profits are negative and the government would need to purchase more than 30% of the large vessel permits/licenses at the end of 2004 to yield them positive economic profits in 2005. Purchasing 30% of the permits/licenses is predicted to cost the government \$55.5M, with a price per vessel purchased of \$100,127 (Table 5.5). Purchasing 30% of the permits/licenses would cause the large vessels to have a PV of economic profit of \$63.9M, a change of \$85.6M from open access that more than offsets the cost to the government (Table 5.2). A buyback of 50% of the large vessels would produce PV of economic profit of \$186.2M (Table 5.2).

When large vessels are bought back, it reduces fishing pressure in the near-shore waters of the Gulf of Mexico; this slightly improves the economic profit of small vessels, though it still remains negative (Figure 5.6e). Small vessels will continue to leave the shrimp fishery but at a slightly slower rate. For small vessels, a government buyback of 30% of the large vessels at the end of year 2004 would give them a PV of economic profit of -\$25.1M, compared to -\$36.3M when large vessels operated under open access (Table 5.1).

Buy back large and small vessels: Figure 5.7 shows the results when both large and small shrimp vessels participate in a buyback program and in a permit/license moratorium. The most important thing to notice in Figure 5.7 is the amount of FTEV that are removed from the fishery when permits/licenses are purchased. Purchasing the permit/license is effective in removing large FTEV but is ineffective in removing small FTEV. In the small vessel fishery, the number of licenses exceeds the number of FTEV by a large amount, whereas this is not the case in the large vessel fishery. Table 5.5 shows that if the government were to buy 30% of the small vessel licenses (which would be 3,656 licenses), it would only remove 433 FTEV. Buying back 30% of the large vessels' permits/licenses would reduce the licenses by 554 and the FTEV by 507.

Removing 30% of the permits/licenses of both large and small vessels, versus removing only 30% of the large vessels' permits/licenses, improves only slightly the PV of economic profit for small vessels (-\$25.1M to -\$22.5M; Table 5.1) or large vessels (\$63.9M to \$69.6; Table 5.2). Removing 30% of the permits/licenses of both large and small vessels would cost the government \$79M. If the government would buy 50% of the permits/licenses, small vessels would experience a positive PV of economic profit of \$6.9M, and large vessels would reap \$227.7M in PV of economic profit at a total cost to the government of \$131.1M. It should be noted that the cost to remove the small vessel license exceeded the benefits to the small vessels. The permit/license approach would cost about \$6,300 for small vessels and \$100,000 for large vessels, regardless of the percent of vessels purchased (Table 5.5).

South Atlantic: For this analysis, we did not have license data; thus, the number of permits/licenses is equal to the number of FTEV.

Buy back only large vessels: Results of a large vessel buyback program are given in Figure 5.8, when only large vessels participate in a license buyback program and a permit/license moratorium. The simulation analysis found that with low shrimp prices economic profits are negative, and buying 50% of the large vessels' permits/licenses at the end of 2004 would not yield large vessels a positive economic profit in 2005. Buying 50% of the large vessels permits/licenses would improve their PV of economic profit from -\$30.0M to only -\$7.1M (Table 5.4). Even after this buyout, large vessels would continue to leave the fishery.

There is only a single offshore depth in this South Atlantic analysis where both small and large vessels fish; therefore, removal of large vessels from the shrimp fishery has greater effect on the small vessels' economic profit (rent) than the same situation would incur in the Gulf of Mexico. In the South Atlantic, large and small vessels fish together in the inshore and offshore areas, whereas in the Gulf of Mexico, four depths are fished offshore and large vessels fish in deeper depths where small vessels do not go. If 50% of the large permits/licenses were removed, the small vessels' PV of economic profit would be \$2.4M (Table 5.3).

Buy back large and small vessels: Figure 5.9 shows the results when both large and small shrimp vessels participate in a buyback program and in a permit/license moratorium. Since purchasing one permit/license is equivalent to removing one FTEV, buying 50% of both small and large vessels' permits/licenses will produce almost zero economic profits for large vessels and positive economic profits for small vessels in year 2005.

Buying 30% of both large and small vessels permits/licenses will yield a positive PV of economic profit for small vessels of \$4.9M (Table 5.3, and it will reduce the large vessels' negative PV of economic profit to -\$8.7M (Table 5.4) at a cost to the government of \$14.6M (Table 5.5). Thus, the benefit to South Atlantic shrimpers would be less than the cost to the government. Buying 50% of both will yield PV of economic profit for small and large vessels of \$13.6M and \$4.2M at a cost to the government of \$24.3M. Again, it would cost the government more than it would benefit the shrimpers. The cost of licenses is higher in the South Atlantic for small vessels than in the Gulf of Mexico, whereas the reverse is true for large vessels.

Summary: In the Gulf of Mexico, a buyback program for only large vessels is effective in producing long-term financial sustainability for large vessels, provided something greater than 10% of the large vessels permits/licenses are removed and there is an effective permit/license moratorium in place. For the same program in the South Atlantic, removing up to half of the permits/licenses would not produce long-term financial sustainability for large vessels. This difference is probably due to a lack of data for analysis in the South Atlantic.

In the Gulf of Mexico, a buyback program for large and small vessels is effective in producing long-term financial sustainability for small vessels only when 50% of the licenses are removed from the fishery. The reason for this is that the number of licenses far exceeds the number of FTEV in the small vessel fishery. This same program in the South Atlantic is more effective for small vessels than it is for large vessels; however, this may be due to a lack of data.

Finally, only in the buyback program for large vessels in the Gulf of Mexico did the benefits to the shrimpers exceed the cost to the government, provided something greater than 10% of the permits/licenses were purchased.

5.4.2.2 Buyback with a Loan to Fishermen

This buyback program is the same as the previous one cited, except that fishermen remaining in the fishery will pay for the buyback. In this case, the government will provide a loan to the shrimp industry that is paid back over a 10-year period at 5% interest.

Gulf of Mexico:

Buy back only large vessels: Results of a large vessel buyback program are given in Figure 5.10, when only large vessels participate in a license buyback program and a permit/license moratorium. Comparing Figure 5.10 with Figure 5.6, we see the economic profit (rent) curve is shifted down by the amount of the loan payment for years 2005 through 2014. A 30% buyback reduces the PV of economic profit to large vessels from \$63.9M to \$43.7M. The

annual payment per licensed large vessel would be \$5,564, and the total annual payment by all large vessels in the Gulf of Mexico would be \$7.2M (Table 5.7). The rent per vessel increases about \$20,000 in year 2005, including the loan payment.

Buy back large and small vessels: Figure 5.11 shows the results when both large and small shrimp vessels participate in a buyback program and in a permit/license moratorium. Comparing Figure 5.11 with Figure 5.7, we see the economic profit (rent) curve is shifted down by the amount of the loan payment for years 2005 through 2014. A 30% buyback reduces the PV of economic profit to large vessels from \$69.6M to \$58.8M. The annual payment per licensed large vessel would be \$5,564, and the total annual payment by all large vessels in the Gulf of Mexico would be \$7.2M (Table 5.7). The rent per large vessel increases about \$20,000 in year 2005, including the loan payment.

Up to a 50% buyback for both small and large vessels does not yield a positive PV of economic profit for small vessels. It should be noted, however, that for a 50% buyback the economic profit (rent) becomes positive in year 2015 when the loan is paid off for small vessels. The annual payment per licensed small vessel would be \$819, and the total annual payment by all small vessels in the Gulf of Mexico would be \$5M (Table 5.7). The rent per small vessel increases about \$5,000 in year 2005, including the loan payment. However, the rent would still be negative.

South Atlantic:

Buy back only large vessels: Results of a large vessel buyback program are given in Figure 5.12, when only large vessels participate in a license buyback program and a permit/license moratorium. Comparing Figure 5.8 with Figure 5.6, we see the economic profit (rent) curve is shifted down by the amount of the loan payment for years 2005 through 2014. The PV of economic profit is negative to the large vessel for all percent levels evaluated. The annual payment per licensed large vessel would be \$5,386, and the total annual payment by all large vessels in the Gulf of Mexico would be \$1.7M (Table 5.7). The rent per vessel would increase less than the annual loan payment; for example, revenue would increase less than the loan payment.

Buy back large and small vessels: Figure 5.12 shows the results when both large and small shrimp vessels participate in a buyback program and in a permit/license moratorium. Comparing Figure 5.13 with Figure 5.9, we see the economic profit (rent) curve is shifted down by the amount of the loan payment for years 2005 through 2014. For a 30% buyback of both large and small vessels, small vessels will have a positive PV of economic profit (Table 5.3). However, large vessels will not experience a positive PV of economic profit even at a 50% buyback. The annual loan payment per small vessel would be \$788 for a 30% buyback.

Summary: Large vessels in the Gulf of Mexico would achieve long-term financial stability if the government were to loan them money to buy back something greater than 10% of the vessels and then let shrimpers pay off the loan over the ensuing 10 years. The large vessels would benefit even if the small vessel fishery in the Gulf of Mexico remained an open access fishery. The small vessel fishery in the Gulf of Mexico would not achieve long-term financial

stability if the government were to loan it money to buy back at any buyback percent level evaluated.

Large vessels in the South Atlantic could not achieve long-term financial stability with this buyback program, whereas the small vessel could.

5.4.3 Government Price Supports

The price support government program sets a target price by size class of shrimp. If the price by size class falls below the target price, the government will pay shrimpers the difference between the target price by size class and the average price received by size class. In this simulation, the target price is set at 0%, 10%, 20%, and 30% above the average price received by size of shrimp. Price support options are assumed to apply to both large and small vessels. It should be noted that the government price support was assumed to go into effect in 2004; therefore, we discounted the PV of economic profit for the period 2005-2021 so that it could be compared to other options with respect to PV of economic profit.

Gulf of Mexico: The results given in Figure 5.14 show that an increase in the average price received for shrimp by size class would have to be 30% for small and large vessels to achieve a positive economic profit (rent) in year 2005. The average price received for shrimp by size class would have to be 50% for small and large vessels to achieve a positive economic profit (rent) in year 2005. The PV of economic profit is positive at 10% for large vessels and at 30% for small vessels. The annual cost to the government per year for a 10% increase in shrimp price would be \$13.1M, and the PV of government costs for the period 2005-2021 is \$129.6M. The annual cost to the government per year for a 50% increase in price would be \$61.9M, and the PV of government costs for the period 2005-2021 is \$604.4M.

South Atlantic: The results given in Figure 5.15 show that large vessels could not achieve a positive economic profit (rent) in year 2005, even with a 50% target price above average price. The average price of shrimp by size class would have to be 30% for small and large vessels to achieve a positive economic profit (rent) in year 2005. The PV of economic profit is never positive for large vessels and 10% for small vessels. The annual cost to the government per year for a 10% increase in price would be \$6.6M, and the discounted government costs for the period 2005-2021 are \$64.2M. The annual cost to the government per year for a 50% increase in price would be \$14.5M, and the discounted government costs for the period 2005-2021 are \$142.3M.

Summary: Target prices are an expensive proposition for the government. To increase the average price by 10% to shrimpers, the discounted costs to government for the period 2005-2021 for the Gulf of Mexico and South Atlantic would be \$193.8M. It would cost \$426.6M for a 20% increase in average price and \$746.7M for a 30% increase.

5.4.4 Marketing Program to Increase Shrimp Prices

A marketing program to increase the price of shrimp could be paid for by a self-imposed tax of \$0.01 on each pound of shrimp landed. Since the real effect of this marketing program is

unknown, sensitivity analysis is conducted by increasing the price by 0, 5, 10, 15 and 20 percent to deter the impact to shrimpers. It should be noted that the marketing program was assumed to go into effect in 2004; therefore, we discounted the PV of economic profit for the period 2005-2021 so that it could be compared to other options with respect to PV of economic profit.

Gulf of Mexico: Figure 5.16 shows results for the Gulf of Mexico marketing program. For positive economic profits (rents) to occur in 2005 for both large and small vessels, it would take a marketing program that would raise the price of shrimp by at least 20%. A marketing program that would raise the price of shrimp 15% would achieve near zero positive economic profit (rent) by 2007. The more successful the marketing program, the fewer number of vessels will leave the fishery. Each 5% increase in the average price of shrimp due to the marketing program will allow an additional 5% of both large and small vessels to remain in the shrimp fishery. The marketing program would cost approximately \$1.5M per year.

South Atlantic: Figure 5.17 shows the results for the Gulf of Mexico marketing program. For large vessels, a 20% increase in price will not achieve positive economic profit (rent) by 2021, whereas small vessels will achieve a positive economic profit (rent) by 2005. Large vessels continue to leave the fishery for the entire simulation period. At lower percent increases in shrimp price, small vessels will continue to leave the fishery. Table 5.4 shows that large vessels never have a positive PV of economic profit from the marketing program. Small vessels do achieve a positive PV of economic profit, provided the marketing program is successful, at a minimum, in increasing price by 10%. The cost of the marketing program in the South Atlantic is about \$150,000, based on \$0.01/ pound of shrimp harvested.

Summary: The marketing program is uncertain in terms of outcome. It takes a 5% increase in price for large vessels in the Gulf of Mexico and for small vessels in the South Atlantic to achieve a positive PV of economic profit. A marketing program would have to achieve a 15% increase in price of shrimp to cause positive PV of economic profit to small vessels in the Gulf of Mexico. Large vessels in the South Atlantic never achieve a PV of economic profit.

5.4.5 Cooperatives for Maximum Profit (Collective Group Action)

This program assumes that a cooperative will be formed by 2005 and the members of the cooperative will manage their cooperative like a monopolist and use only enough vessels to maximize profits to the cooperative. In this analysis, we first vary effort from 0 to 100 percent in 5 percent increments to determine the approximate number of FTEV that will maximize profits for both large and small vessels. We then combine an open access simulation for the period 2002-2004, with the derived maximum economic profit for the period 2005-2021. Thus, from 2002 to 2004 the fisheries will operate under open access and in 2005 they are assumed to have formed cooperatives and will operate their cooperative from 2005 to 2021 with just enough FTEV to maximize profit. Shrimp prices are assumed not to change because of collective action.

Gulf of Mexico: Figure 5.18 shows the result of forming a cooperative and operating it for maximum profit. Large FTEV are reduced by 70% beginning in 2005, as compared to the end of 2004. Economic profit jumps to just under \$50M per year, and the PV of economic profit for

the period 2005-2021 is \$489.4M. Small FTEV are reduced by 65% beginning in 2005, as compared to the end of 2004. Economic profit jumps to \$10M per year, and the PV of economic profit for the period 2005-2021 is \$102.3M. Large vessels' CPUE increased from 515 pounds in 2004 to 1,087 pounds in 2005—an increase of 110%. Small vessels' CPUE increased from 373 pounds in 2004 to 584 pounds in 2005—an increase of 57%.

South Atlantic: Figure 5.19 shows the result of forming a cooperative and operating it for maximum profit. Large FTEV are reduced by 77% beginning in 2005 as compared to the end of 2004. Economic profit jumps to \$2M per year, and the PV of economic profit for the period 2005-2021 is \$18.4M. Small FTEV are reduced by 73% beginning in 2005, as compared to the end of 2004. Economic profit jumps to \$2M per year, and the PV of economic profit for the period 2005-2021 is \$19.5M. Large vessels' CPUE increased from 310 pounds in 2004 to 1,307 pounds in 2005—an increase of 320%. Small vessels' CPUE increased from 310 pounds in 2004 to 522 pounds in 2005—an increase of 68%.

Summary: It is unrealistic to believe that all shrimpers will work for a single cooperative in the Gulf of Mexico and South Atlantic. But these results illustrate that the shrimp fisheries in the Gulf of Mexico and South Atlantic are overcapitalized. It is possible, however, that small cooperatives could be formed and a certain amount of catch could be assigned to the cooperative. Then the cooperative could manage its vessels so that economic profit could be maximized.

5.4.6 Fractional License Program

A fractional license (FL) is a program that permanently reduces effort in the fishery by eliminating a portion of the licenses. This is accomplished by granting each vessel a tradable FL right; for example, a right to a portion of a full license. A vessel can operate only if it obtains a full license. Fractional rights are traded among fishermen, so that a fraction of the total number of licenses is removed from the fishery.

In the current FL program in GBFSM, the model calculates the potential profits of the individual vessels. These potential profits will determine the vessels' willingness to pay (WTP) to complete their license and the willingness to accept (WTA) to sell their license. It is assumed that trading leads to a permanent transfer of the right from one vessel to another. Each vessel's WTP to complete its license is equal to the PV of future annual economic profits.

In the following results, we assume that vessels purchasing rights obtain government-backed long-term loans. It is assumed that shrimpers make a single, equal payment per year until the loan is paid off. The loan is for 10 years at a 5% interest rate.

Buy back only large vessels: Results are given in Figure 5.20 when only large vessels participate in a FL program and a permit/license moratorium. The simulation analysis found that with low shrimp prices, economic profits are negative, and there would need to be a reduction in permits/licenses of 30% of the large vessels at the end of 2004 to yield them positive economic profits in 2005. This would give a PV of economic profit of \$103.4M (Table 5.2).

A 30% reduction in permits/licenses means that every vessel would be issued 70% of a license. Any vessel wanting to stay in the shrimp fishery would need to buy an additional 30% of a permit/license to complete its license from those who are willing to sell their permits/licenses. Table 5.9 shows that the additional 30% of a license could be obtained for an average price of \$200. This means that for those selling their 70% of a permit/license, they would receive an average price of \$467. This seems like an extremely low amount; however, it must be remembered that by the end of 2004 there had been three years with large negative rents (Figure 5.20). Many marginal vessels would be leaving the fishery with or without selling their part of a permit/license. Notice that when the FL is 10%, the average price to complete a permit/license is zero; yet there is a reduction in permits/licenses of 223. If there is a 50% FL, the average price to complete a permit/license is \$28,607.

It is interesting to compare the FL prices when shrimp prices are low (Table 5.9) to FL prices when shrimp prices are high (Table 5.10). Here we see that for high shrimp prices (which means economic profits are positive), the average price to complete a permit/license is \$13,695 for a 10% FL, \$60,371 for a 30% FL, and \$130,762 for a 50% FL. With large vessels, it is possible that fleet owners may retire a part of their fleet and combine the license for the remainder.

Even though small vessels are not participating in the FL program, they do benefit from it (Figure 5.20). This is because both small and large vessels fish in the near shore. A 50% FL will cause small vessels to have near zero economic profit in year 2005.

Buy back large and small vessels: Results of a large vessel buyback program are given in Figure 5.21, when both large and small vessels participate in a FL program and a permit/license moratorium. There is little difference in Figures 5.20 and 5.21, except that small vessels' economic profit is positive for a 50% FL program. The reason there is little difference between the two analyses is that there are considerably more licenses than FTEV for small vessels (Figure 5.21). Therefore, removing 50% of small vessel licenses removes very few small FTEV.

Summary: A fractional license (FL) program⁹ reduces the number of licenses held in the fleet by requiring a fixed percentage of the permits/licenses. Under low prices and negative economic profits, large vessel economic profits become positive as long as 30% or more of the licenses are retired. The loans per remaining large vessels are predicted to be negligible for a 10% program, about \$200 for a 30% program, and up to \$31,000 for a 50% program. For small vessels, positive economic profits can be achieved only for the 50% FL scenario. At lower reductions, the vessels continue to lose money and exit the fishery voluntarily.

⁹ The FL program was only considered for the Gulf of Mexico, since data were not available to analyze this program for the South Atlantic.

Table 5.1. Simulation results in 2021 and the PV of economic profit for the period 2004-2021 for *small* vessels in the Gulf of Mexico with low shrimp prices (i.e., 2002 shrimp prices)

Option Description			Results in Year 2021					
Percent License Bought	Percent Increase in Price	Vessels w/License Moratorium	FTEV	Days Fished (1000)	Landings (mil. lbs)	CPUE	RPUE	PV of Economic Profit (mil. \$)
-----Open Access-----								
		Year=2004	5,993	120.0	46.8	373	607	
			4,537	91.5	40.1	438	741	(36.3)
-----Permit/License Moratorium-----								
		L	4,705	95.0	42.2	444	761	(29.5)
		SL	4,681	94.3	42.0	445	764	(28.9)
-----Government Buyback with a Grant-----								
10		L	4,673	94.5	41.7	441	758	(30.7)
30		L	4,816	97.8	43.0	439	759	(25.1)
50		L	5,177	105.8	46.3	437	767	(12.0)
10		SL	4,659	94.1	41.6	442	760	(30.2)
30		SL	4,787	96.8	42.7	441	762	(22.5)
50		SL	4,620	92.6	42.6	460	801	6.9
-----Government Buyback with a Loan to Shrimp Fishery-----								
10		L	4,703	95.2	42.0	441	759	(29.6)
30		L	4,881	99.3	43.6	439	760	(22.9)
50		L	5,205	106.4	46.6	437	769	(9.9)
10		SL	4,612	93.1	41.4	444	766	(31.9)
30		SL	4,591	92.8	41.7	450	780	(28.5)
50		SL	4,399	88.4	41.5	469	823	(10.0)
-----Government Price Support-----								
	10	SL	5,322	107.0	45.4	424	767	(16.1)
	20	SL	5,790	115.9	47.1	407	780	5.6
	30	SL	5,952	119.2	47.3	397	826	53.2
-----Marketing Program Funded with \$0.01/ pound-----								
	5	SL	5,063	101.9	43.9	431	769	(18.5)
	10	SL	5,437	109.3	45.7	418	775	(7.8)
	15	SL	5,717	114.9	46.8	407	784	7.9
	20	SL	5,908	118.4	47.4	400	798	25.9
-----Cooperatives Managed for Maximum Profit-----								
		SL	2,076	41.6	24.3	584	1,072	102.3
-----Fractional License-----								
10		L	4,669	94.4	41.6	441	757	(30.7)
30		L	4,933	100.3	43.9	438	759	(23.9)
50		L	5,324	109.2	47.8	438	776	(0.5)
10		SL	4,669	94.4	41.6	441	757	(30.7)
30		SL	4,858	98.4	43.4	441	764	(19.4)
50		SL	4,537	90.6	42.6	470	823	23.9

* L is large vessels only, and SL is small and large vessels.

** Present value of economic profit is discounted to 2004 when the option was implemented.

*** This result is for year 2004, the year prior to the option being implemented.

Table 5.2. Simulation results in 2021 and the PV of economic profit for the period 2004-2021 for *large* vessels in the Gulf of Mexico with low shrimp prices (i.e., 2002 shrimp prices)

Option Description			Results in Year 2021					PV of Economic Profit (mil. \$)
Percent License Bought	Percent Increase in Price	Vessels w/License Moratorium	FTEV	Days Fished (1000)	Landings (mil. lbs)	CPUE	RPUE	
-----Open Access-----								
		Year=2004	1,796	133.3	69.0	517	1,390	
			1,357	118.5	114.7	614	1,704	(21.7)
-----Permit/License Moratorium-----								
		L	1,253	95.9	92.9	653	1,846	(2.7)
		SL	1,254	95.9	92.9	654	1,848	(2.4)
-----Government Buyback with a Grant-----								
10		L	1,326	99.3	96.2	647	1,815	(17.2)
30		L	1,212	90.1	87.3	668	1,894	63.9
50		L	901	67.1	65.0	737	2,148	186.2
10		SL	1,326	99.3	96.2	647	1,816	(17.0)
30		SL	1,213	90.2	87.4	670	1,899	69.6
50		SL	915	68.3	66.2	764	2,229	227.7
-----Government Buyback with a Loan to Shrimp Fishery-----								
10		L	1,292	96.7	93.7	653	1,838	(19.4)
30		L	1,147	85.7	83.1	680	1,937	43.7
50		L	867	64.6	62.6	747	2,183	122.5
10		SL	1,295	97.0	94.0	655	1,844	(15.6)
30		SL	1,162	86.5	83.8	690	1,965	58.8
50		SL	874	65.1	63.1	785	2,304	175.2
-----Government Price Support-----								
	10	SL	1,295	99.0	96.0	623	1,823	0.2
	20	SL	1,432	108.8	105.4	584	1,813	24.7
	30	SL	1,615	121.2	117.4	549	1,845	75.4
-----Marketing Program Funded with \$0.01/ pound-----								
	5	SL	1,325	100.8	97.7	625	1,842	12.8
	10	SL	1,394	105.6	102.3	600	1,839	27.9
	15	SL	1,474	111.2	107.7	577	1,837	45.9
	20	SL	1,559	117.2	113.6	558	1,841	65.0
-----Cooperatives Managed for Maximum Profit-----								
		SL	536	39.67	38.42	1,087	3,381	489.4
-----Fractional License-----								
10		L	1,326	100.2	97.0	644	1,806	(12.8)
30		L	1,117	84.3	81.6	683	1,948	103.4
50		L	733	55.6	53.9	782	2,316	232.5
10		SL	1,326	100.2	97.0	644	1,806	(13)
30		SL	1,120	84.5	81.8	688	1,961	115
50		SL	733	55.6	53.9	830	2,471	289.6

* L is large vessels only, and SL is small and large vessels.

** Present value of economic profit is discounted to 2004 when the option was implemented.

*** This result is for year 2004, the year prior to the option being implemented.

Table 5.3. Simulation results in 2021 and the PV of economic profit for the period 2004-2021 for *small* vessels in the South Atlantic with low shrimp prices (i.e., 2002 shrimp prices)

Option Description			Results in Year 2021					PV of Economic Profit (mil. \$)
Percent License Bought	Percent Increase in Price	Vessels w/License Moratorium	FTEV	Days Fished (1000)	Landings (mil. lbs)	CPUE	RPUE	
-----Open Access-----								
		Year=2004	1,521	23.2	7.2	310	928	
			1,274	18.8	7.1	375	1,135	(11.0)
-----Permit/License Moratorium-----								
		L	1,274	18.8	7.1	375	1,135	(7.4)
		SL	1,246	18.3	6.9	377	1,138	(7.4)
-----Government Buyback with a Grant-----								
10		L	1,297	19.0	7.2	379	1,150	(6.3)
30		L	1,395	20.3	7.7	379	1,154	(2.1)
50		L	1,516	21.8	8.3	380	1,159	2.4
10		SL	1,193	17.5	6.7	383	1,159	(4.5)
30		SL	1,022	15.4	6.1	397	1,198	4.9
50		SL	756	11.5	5.0	433	1,303	13.6
-----Government Buyback with a Loan to Shrimp Fishery-----								
10		L	1,305	19.1	7.2	379	1,151	(6.1)
30		L	1,435	20.8	7.9	382	1,163	(1.1)
50		L	1,586	22.9	8.8	384	1,174	4.9
10		SL	1,174	17.2	6.6	386	1,167	(5.1)
30		SL	978	14.5	5.9	407	1,233	3.1
50		SL	720	10.8	4.9	451	1,366	9.3
-----Government Price Support-----								
	10	SL	1,453	22.0	7.6	347	1,206	8.6
	20	SL	1,484	22.6	7.6	336	1,246	18.0
	30	SL	1,511	23.1	7.5	324	1,288	28.2
-----Marketing Program Funded with \$0.01/ pound-----								
	5	SL	1,330	19.7	7.2	364	1,154	(2.9)
	10	SL	1,398	20.9	7.4	353	1,171	1.6
	15	SL	1,456	22.0	7.6	343	1,186	6.1
	20	SL	1,492	22.7	7.6	334	1,203	10.3
-----Cooperatives Managed for Maximum Profit-----								
		SL	407	6.3	3.3	522	1,570	19.5

* L is large vessels only, and SL is small and large vessels.

** Present value of economic profit is discounted to 2004 when the option was implemented.

*** This result is for year 2004, the year prior to the option being implemented.

Table 5.4. Simulation results in 2021 and the PV of economic profit for the period 2004-2021 for *large* vessels in the South Atlantic with low shrimp prices (i.e., 2002 shrimp prices)

Option Description			Results in Year 2021					PV of Economic Profit (mil. \$)
Percent License Bought	Percent Increase in Price	Vessels w/License Moratorium	FTEV	Days Fished (1000)	Landings (mil. lbs)	CPUE	RPUE	
-----Open Access-----								
		Year=2004	650	12.1	8.7	310	928	
			308	6.3	5.6	889	2,777	(30.0)
-----Permit/License Moratorium-----								
		L	308	6.3	6.3	889	2,777	(27.2)
		SL	309	6.3	6.3	897	2,802	(26.9)
-----Government Buyback with a Grant-----								
10		L	294	6.0	6.0	915	2,841	(25.0)
30		L	253	5.2	5.2	922	2,860	(15.1)
50		L	203	4.3	4.3	929	2,885	(7.1)
10		SL	308	6.2	6.2	931	2,891	(23.3)
30		SL	307	6.3	6.3	960	2,983	(8.7)
50		SL	310	5.8	5.8	1,033	3,214	4.2
-----Government Buyback with a Loan to Shrimp Fishery-----								
10		L	287	5.9	5.9	918	2,849	(26.4)
30		L	226	4.7	4.7	931	2,890	(19.8)
50		L	151	3.3	3.3	946	2,936	(15.4)
10		SL	303	6.1	6.1	937	2,909	(24.4)
30		SL	291	5.8	5.8	988	3,070	(12.2)
50		SL	227	4.6	4.6	1,090	3,394	(1.6)
-----Government Price Support-----								
	10	SL	394	8.0	8.0	831	2,894	(16.5)
	20	SL	454	9.1	9.1	802	2,963	(10.1)
	30	SL	530	10.4	10.4	761	3,018	(1.7)
-----Marketing Program Funded with \$0.01/ pound-----								
	5	SL	340	6.9	6.9	866	2,840	(22.6)
	10	SL	371	7.5	7.5	837	2,871	(18.3)
	15	SL	409	8.2	8.2	809	2,896	(14.3)
	20	SL	456	9.1	9.1	783	2,923	(10.1)
-----Cooperatives Managed for Maximum Profit-----								
		SL	150	2.8	2.8	1,307	4,072	18.4

* L is large vessels only, and SL is small and large vessels.

** Present value of economic profit is discounted to 2004 when the option was implemented.

*** This result is for year 2004, the year prior to the option being implemented.

Table 5.5. Simulation results of the government buyback program with a grant for the period 2004 - 2021 with shrimp prices at the 2002 level

Percent Vessels Bought	Vessels Affected w/License and Moratorium	Number Purchased				Buyback Price		Cost to Gov't (mil. \$)	
		Small Vessel License	Large Vessel License	Small FTEV	Large FTEV	Small Vessels	Large Vessels	Small Vessels	Large Vessels
-----Gulf of Mexico-----									
10	L	-	185	-	142	-	99,946	-	18.5
30	L	-	554	-	507	-	100,127	-	55.5
50	L	-	924	-	875	-	100,054	-	92.5
10	SL	1,218	185	348	142	6,330	99,946	7.7	18.5
30	SL	3,656	554	433	507	6,327	100,127	23.1	55.5
50	SL	6,096	924	849	875	6,324	100,054	38.6	92.5
-----South Atlantic-----									
10	L	-	65	-	65	-	41,461	-	2.7
30	L	-	195	-	195	-	41,461	-	8.1
50	L	-	326	-	326	-	41,333	-	13.5
10	SL	152	65	152	65	14,183	41,461	2.2	2.7
30	SL	457	195	457	195	14,152	41,461	6.5	8.1
50	SL	762	326	762	326	14,146	41,333	10.8	13.5

* L is large vessels only, and SL is small and large vessels.

Table 5.6. Simulation results of the government buyback program with a loan to shrimp fishermen for the period 2004 - 2021 with shrimp prices at the 2002 level

Percent Vessels Bought	Vessels Affected w/License and Moratorium	Number Purchased				Buyback Price		Total Gov't Loans (mil. \$)	
		Small Vessel License	Large Vessel License	Small FTEV	Large FTEV	Small Vessels	Large Vessels	Small Vessels	Large Vessels
-----Gulf of Mexico-----									
10	L	-	185	-	142	-	99,946	-	18.5
30	L	-	554	-	507	-	100,127	-	55.5
50	L	-	924	-	875	-	100,054	-	92.5
10	SL	1,218	185	348	142	6,330	99,946	7.7	18.5
30	SL	3,656	554	433	507	6,327	100,127	23.1	55.5
50	SL	6,096	924	849	875	6,324	100,054	38.6	92.5
-----South Atlantic-----									
10	L	-	65	-	69	-	41,461	-	2.7
30	L	-	195	-	199	-	41,461	-	8.1
50	L	-	326	-	328	-	41,333	-	13.5
10	SL	152	65	155	69	14,183	41,461	2.2	2.7
30	SL	457	195	458	199	14,152	41,461	6.5	8.1
50	SL	762	326	762	328	14,146	41,333	10.8	13.5

* L is large vessels only, and SL is small and large vessels.

Table 5.7. Simulation results of the government buyback program with a loan to shrimp fishermen for the period 2004 - 2021 with shrimp prices at the 2002 level

Percent Vessels Bought	Vessels Affected w/License and Moratorium	Number Remaining				Total Annual Payment (mil. \$)		Annual Payment Per Licensed Vessel (\$)	
		Small Vessel License	Large Vessel License	Small FTEV	Large FTEV	Small Vessels	Large Vessels	Small Vessels	Large Vessels
-----Gulf of Mexico-----									
10	L	-	1,661	-	1,653	-	2.4		1,442
30	L	-	1,291	-	1,288	-	7.2		5,564
50	L	-	923	-	920	-	12.0		12,972
10	SL	10,967	1,661	5,645	1,653	1.0	2.4	91	1,442
30	SL	8,529	1,291	5,560	1,288	3.0	7.2	351	5,564
50	SL	6,093	923	5,144	920	5.0	12.0	819	12,972
-----South Atlantic-----									
10	L	-	584	-	582	-	0.3		598
30	L	-	454	-	452	-	1.0		2,306
50	L	-	324	-	323	-	1.7		5,386
10	SL	1,366	584	1,366	582	0.3	0.3	204	598
30	SL	1,063	454	1,063	452	0.8	1.0	788	2,306
50	SL	759	324	759	323	1.4	1.7	1,839	5,386

* L is large vessels only, and SL is small and large vessels.

Table 5.8. Results of simulation for the average price per pound, target price per pound, annual cost to government and total discounted cost to government for a target price program beginning in 2004 in the Gulf of Mexico shrimp fishery

Percent Increase in Average Price	Vessels w/License Moratorium	Average Price Per Pound	Target Price Per Pound	Target Less Average Price Per Pound	Approximate Annual Cost to Government (mil. \$)	Discounted Cost to Government (mil. \$)**
-----Gulf of Mexico-----						
10	SL	2.33	2.45	0.12	13.1	129.6
20	SL	2.33	2.60	0.30	33.5	327.4
30	SL	2.33	2.83	0.54	61.9	604.4
-----South Atlantic-----						
10	SL	3.04	3.48	0.44	6.6	64.2
20	SL	3.04	3.70	0.66	10.0	99.2
30	SL	3.04	3.98	0.94	14.5	142.3

* L is large vessels only, and SL is small and large vessels.

** Present value of economic profit is discounted to 2004 when the option was implemented.

Table 5.9. Results of simulation for the for a fractional license program beginning in 2005 in the Gulf of Mexico shrimp fishery for low shrimp prices

Option Description			Total Government Loans (\$1000)	Price to Complete License and Loan per Vessel (\$)	Annual Payment By Vessel	License Reduction	FTEV Reduction
Percent License Bought	Vessels w/License Moratorium	Shrimp Prices Received					
-----Results for small vessels-----							
10	L	Low	-	-	-	-	-
30	L	Low	-	-	-	-	-
50	L	Low	-	-	-	-	-
10	SL	Low	221,821	157	20	1,411	348
30	SL	Low	744,008	176	23	4,229	503
50	SL	Low	1,244,386	177	23	7,045	1,023
-----Results for large vessels-----							
10	L	Low	-	-	-	223	618
30	L	Low	133,579	200	26	669	618
50	L	Low	31,867,908	28,607	3,705	1,114	618
10	SL	Low	-	-	-	223	175
30	SL	Low	133,927	200	26	669	618
50	SL	Low	34,724,561	31,171	4,037	1,114	1,063

* L is large vessels only, and SL is small and large vessels.

Table 5.10. Results of simulation for the for a fractional license program beginning in 2005 in the Gulf of Mexico shrimp fishery for high shrimp prices

Option Description			Total Government Loans (\$1000)	Price to Complete License and Loan per Vessel (\$)	Annual Payment By Vessel	License Reduction	FTEV Reduction
Percent License Bought	Vessels w/License Moratorium	Shrimp Prices Received					
-----Results for small vessels-----							
10	L	High	-	-	-	-	-
30	L	High	-	-	-	-	-
50	L	High	-	-	-	-	-
10	SL	High	241,976	171	22	1,411	43
30	SL	High	1,019,646	241	31	4,229	269
50	SL	High	11,511,610	1,634	212	7,045	849
-----Results for large vessels-----							
10	L	High	3,114,246	13,965	1,809	223	618
30	L	High	40,388,259	60,371	7,818	669	618
50	L	High	145,668,356	130,762	16,934	1,114	618
10	SL	High	3,138,964	14,076	1,823	223	172
30	SL	High	40,846,297	61,056	7,907	669	618
50	SL	High	148,524,997	133,326	17,266	1,114	1,063

* L is large vessels only, and SL is small and large vessels.

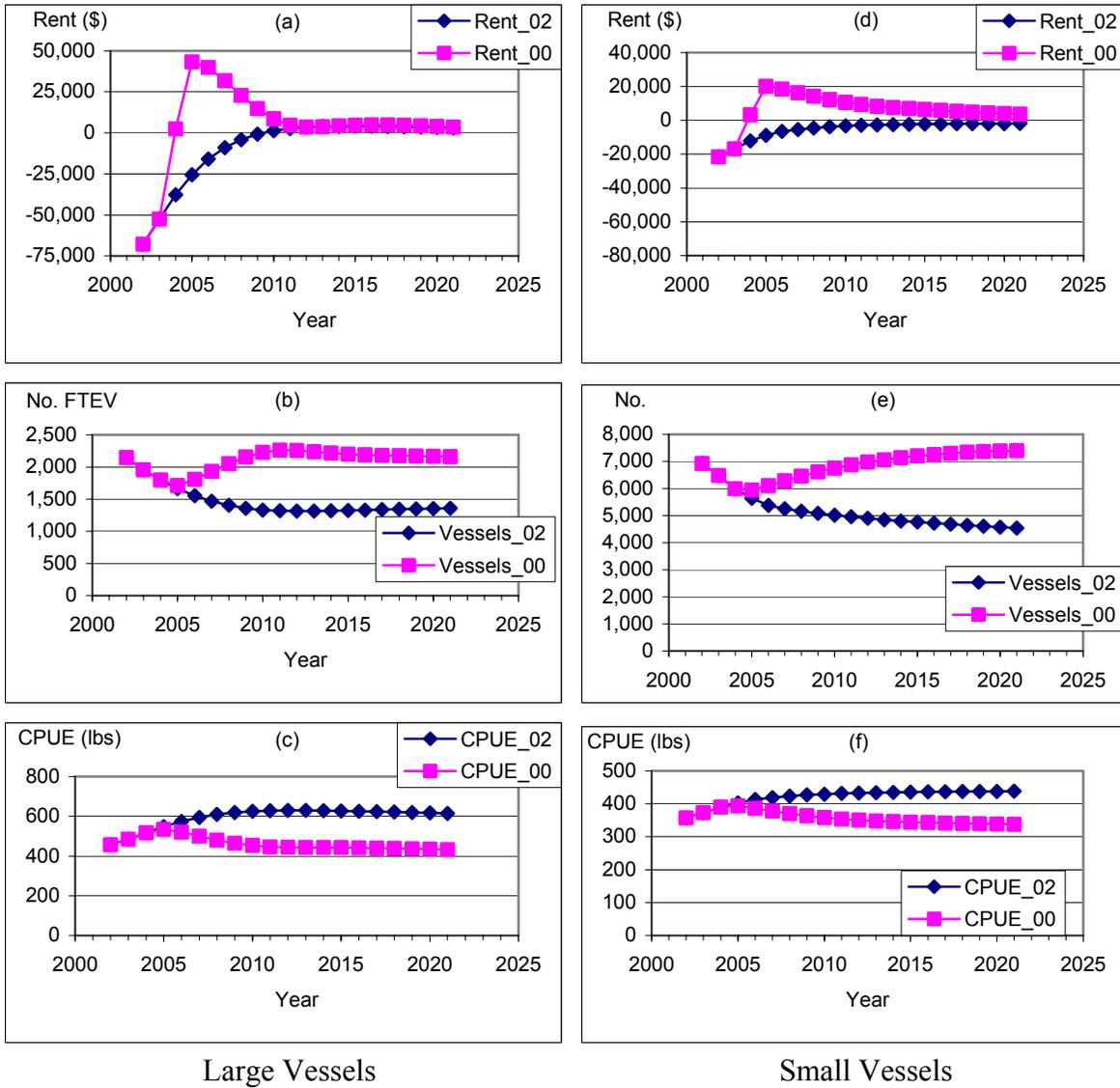


Figure 5.2. Open access in the Gulf of Mexico shrimp fishery: Simulated rent, number of FTEV, and CPUE for large and small vessels, 2002-2021; (Rent = economic profit = pure profit)

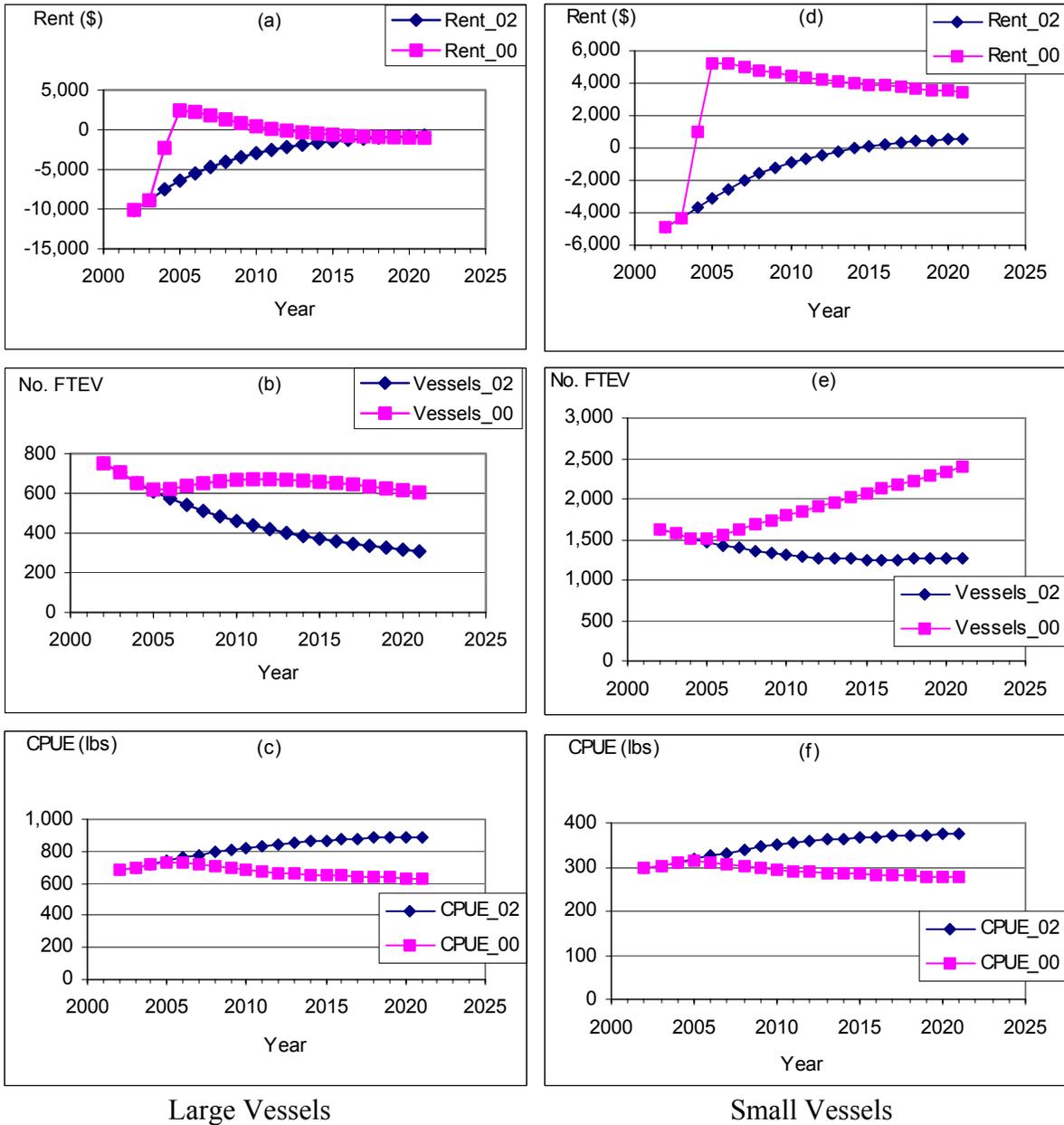


Figure 5.3. Open access in the South Atlantic shrimp fishery: Simulated rent, number of FTEV, and CPUE for large and small vessels in the South Atlantic, 2002-2021; (Rent = economic profit = pure profit)

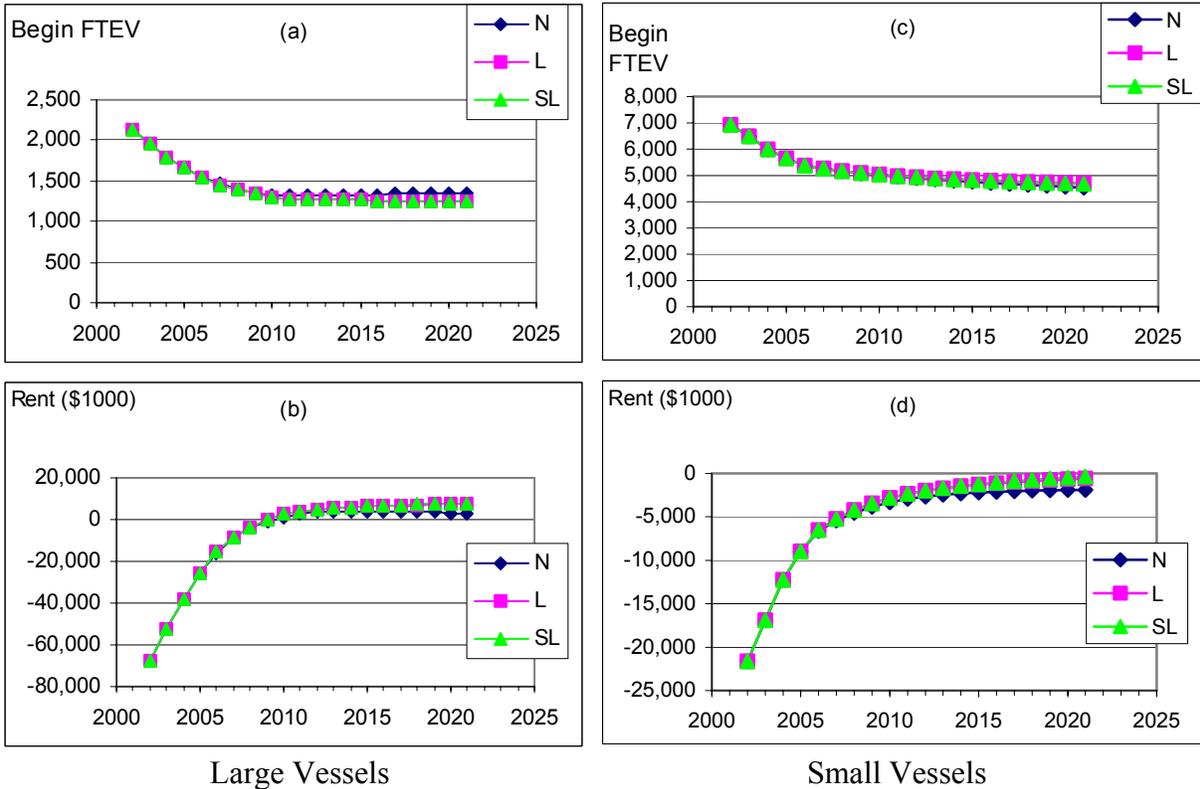


Figure 5.4. Permit/license moratorium for the Gulf of Mexico shrimp fishery: Simulation over the period 2002-2021 with low shrimp prices (year 2002 shrimp prices) where N is no permit/license moratorium (except Texas small vessels), L is a permit/license moratorium on large vessels (>60ft) beginning in 2004, and SL is a permit/license moratorium on small (<60ft) and large vessels (>60ft) beginning in 2004; (Rent = economic profit = pure profit)

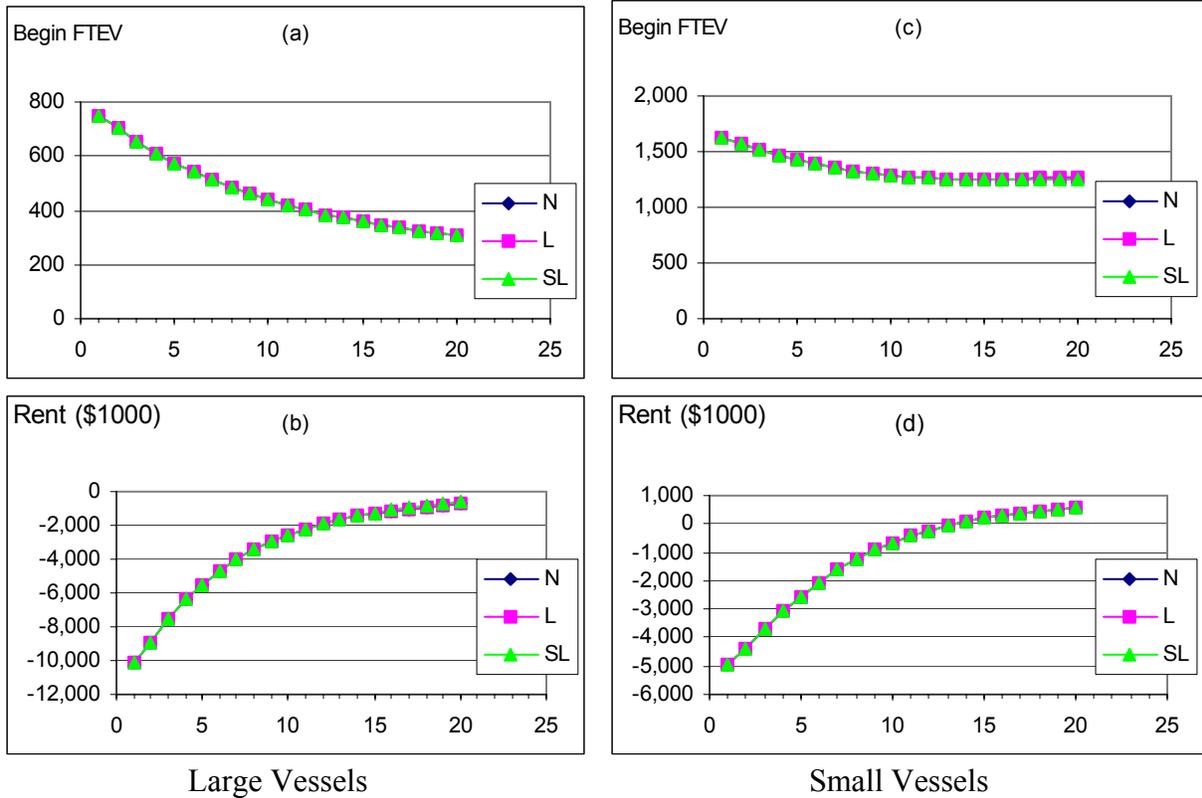


Figure 5.5. Permit/license moratorium for the South Atlantic shrimp fishery: Simulation over the period 2002-2021 with low shrimp prices (year 2002 shrimp prices) where N is no permit/license moratorium, L is a permit/license moratorium on large vessels (>60ft) beginning in 2004, and SL is a permit/license moratorium on small (<60ft) and large vessels (>60ft) beginning in 2004; (Rent = economic profit = pure profit)

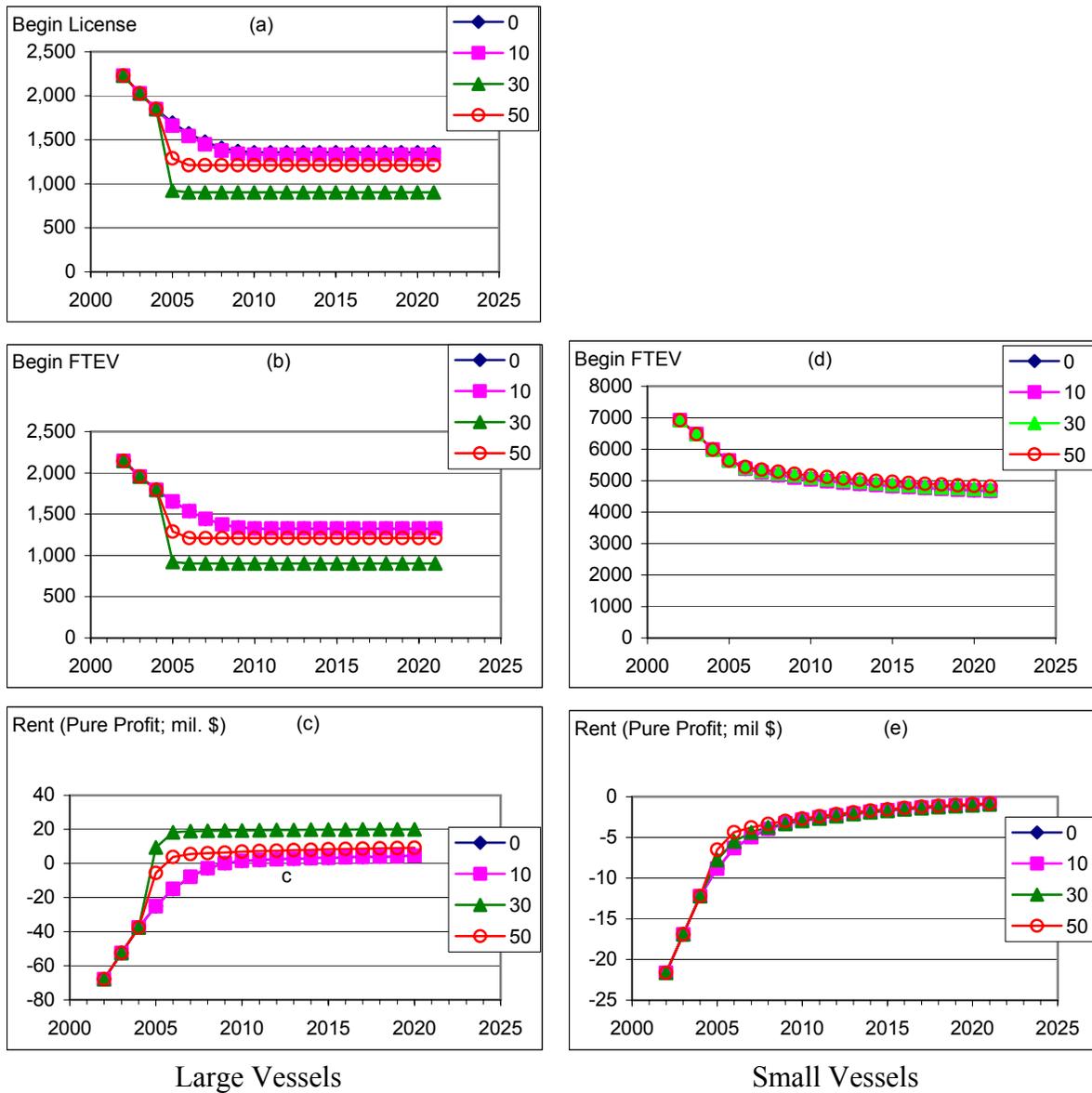


Figure 5.6. Government buyback with grant only for large vessel in the Gulf of Mexico: Simulation over the period 2002-2021 with a large vessel buyback at 0%, 10%, 30%, and 50% of the fleet in year 2004 in the Gulf of Mexico with low shrimp prices (year 2002 shrimp prices), and with a permit/license moratorium on large vessels. Small vessels in open access (except Texas); (Rent = economic profit = pure profit)

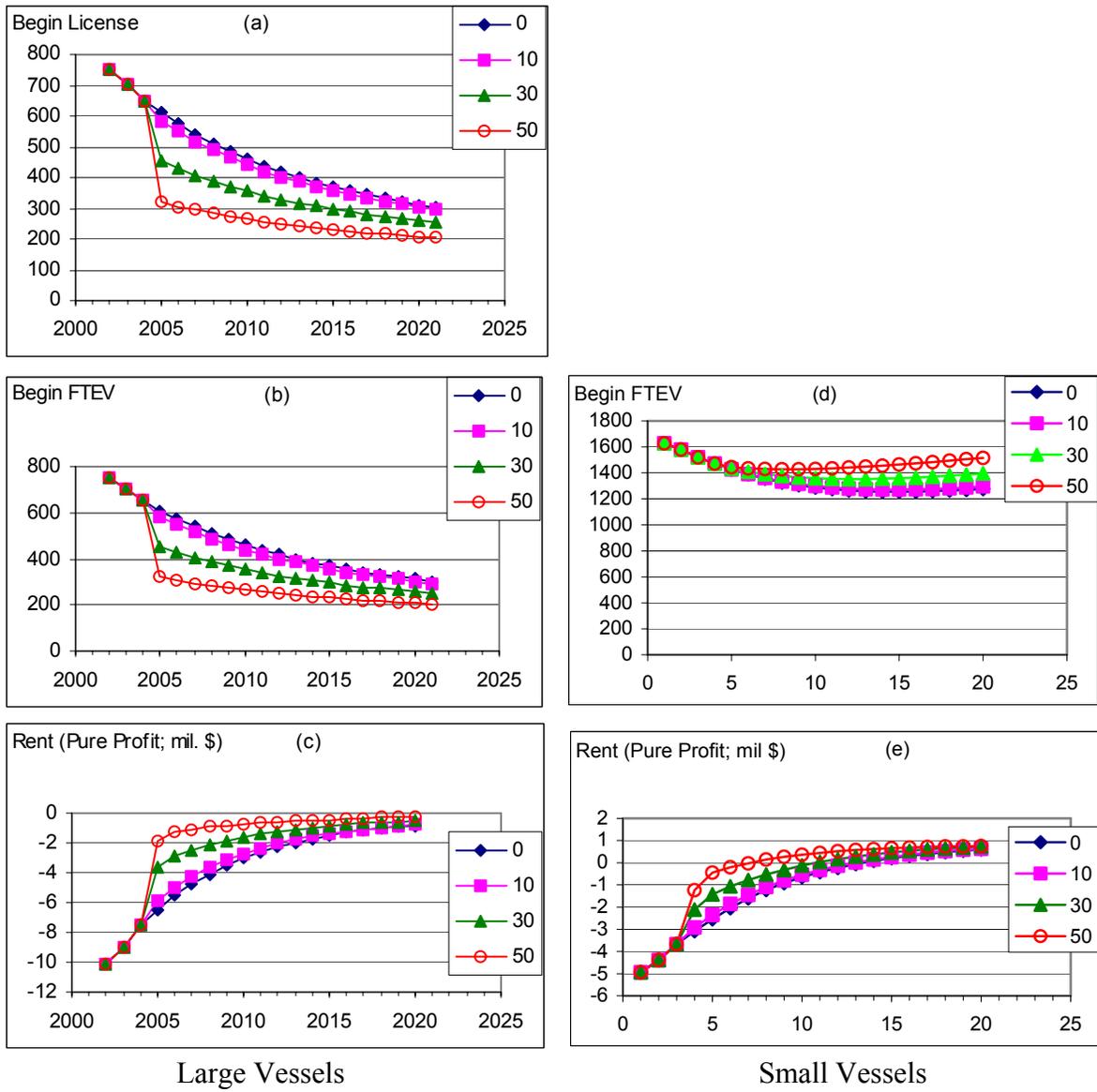


Figure 5.7. Government buyback with grant only for large vessel in the South Atlantic: Simulation over the period 2002-2021 with a large vessel buyback at 0%, 10%, 30%, and 50% of the fleet in year 2004 in the Gulf of Mexico with low shrimp prices (year 2002 shrimp prices), and with a permit/license moratorium on large vessels. Small vessels in open access (except Texas); (Rent = economic profit = pure profit)

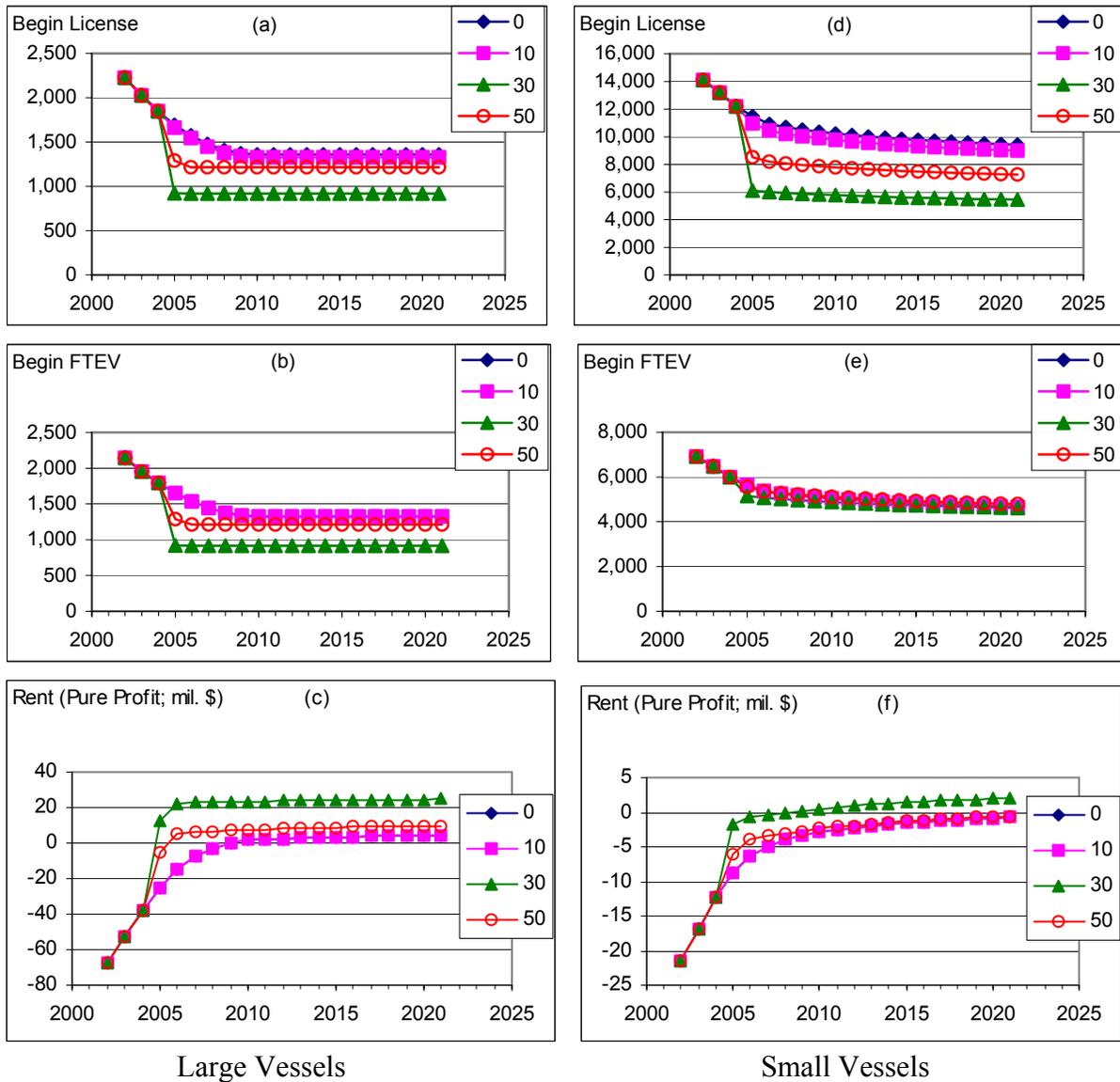


Figure 5.8. Government buyback with grant for large and small vessel in the Gulf of Mexico: Simulation over the period 2002-2021 with a buyback at 0%, 10%, 30%, and 50% of the fleet in year 2004 with low shrimp prices (year 2002 shrimp prices), and with a permit/license moratorium on large and small vessels; (Rent = economic profit = pure profit)

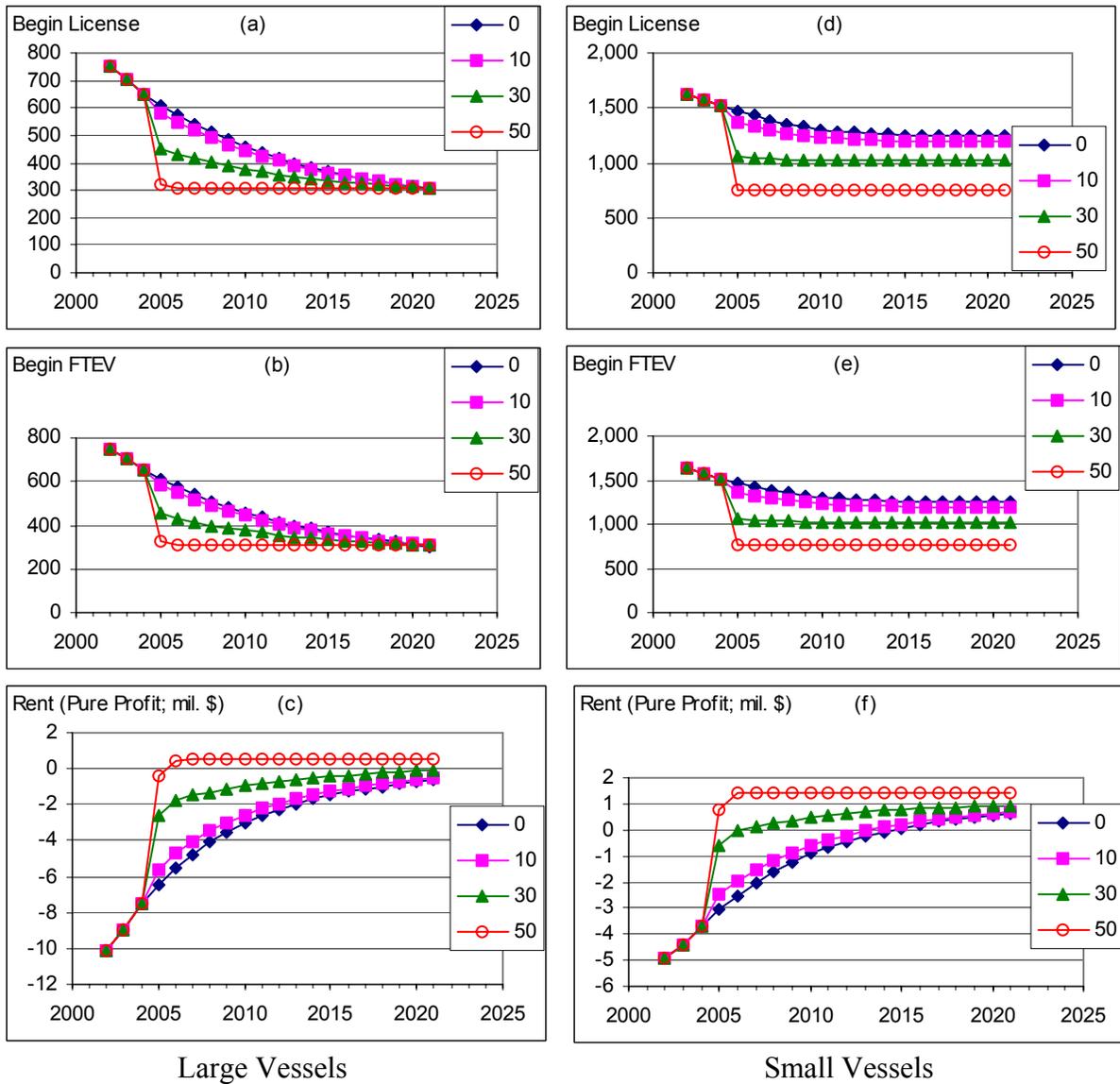


Figure 5.9. Government buyback with grant for large and small vessel in the south Atlantic: Simulation over the period 2002-2021 with a buyback at 0%, 10%, 30%, and 50% of the fleet in year 2004 with low shrimp prices (year 2002 shrimp prices), and with a permit/license moratorium on large and small vessels; (Rent = economic profit = pure profit)

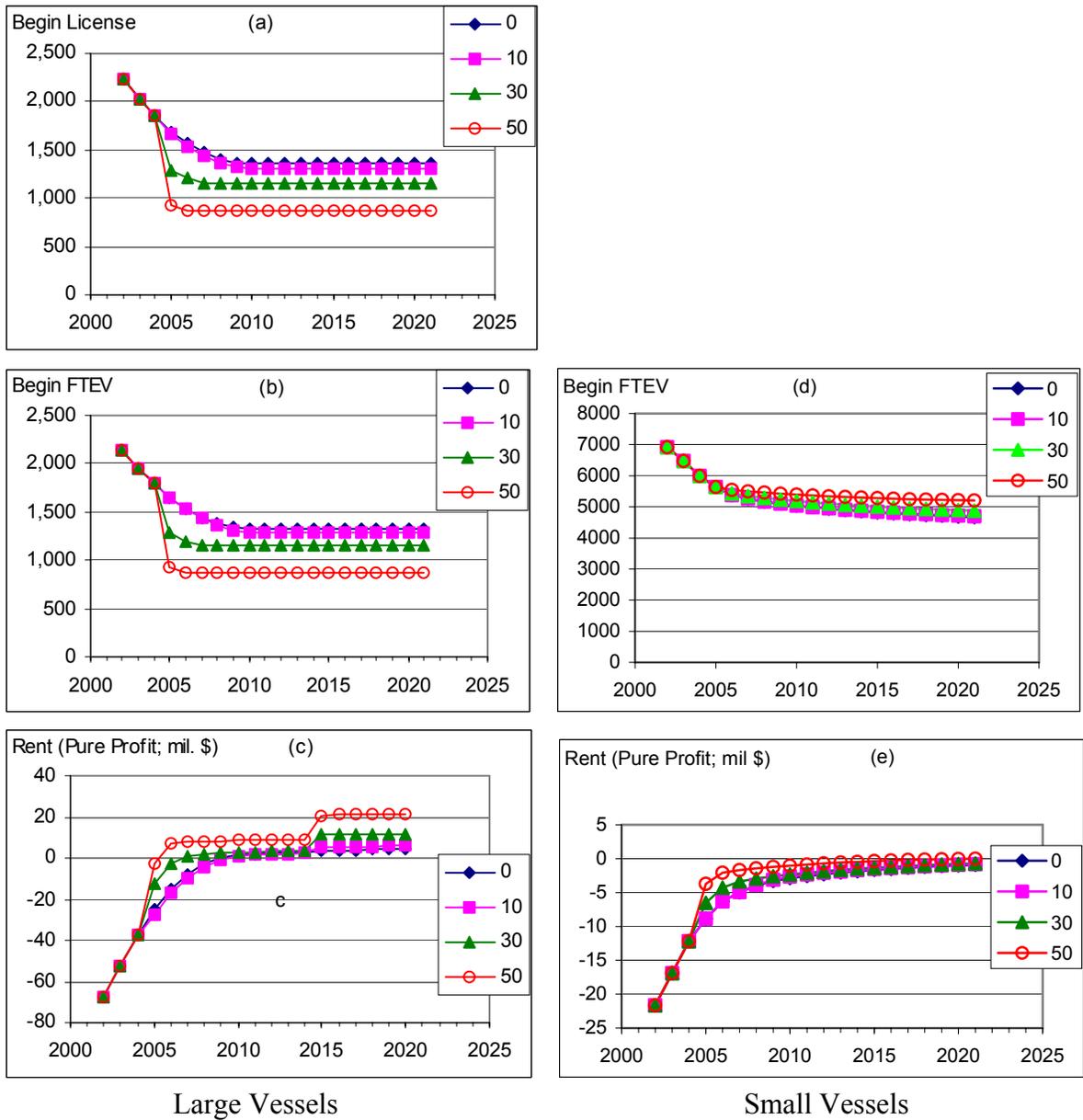


Figure 5.10. Government buyback with a loan only for large vessel in the Gulf of Mexico: Simulation over the period 2002-2021 with a large vessel buyback at 0%, 10%, 30%, and 50% of the fleet in year 2004 with low shrimp prices (year 2002 shrimp prices), and with a permit/license moratorium on large vessels. Small vessels in open access (except Texas); (Rent = economic profit = pure profit)

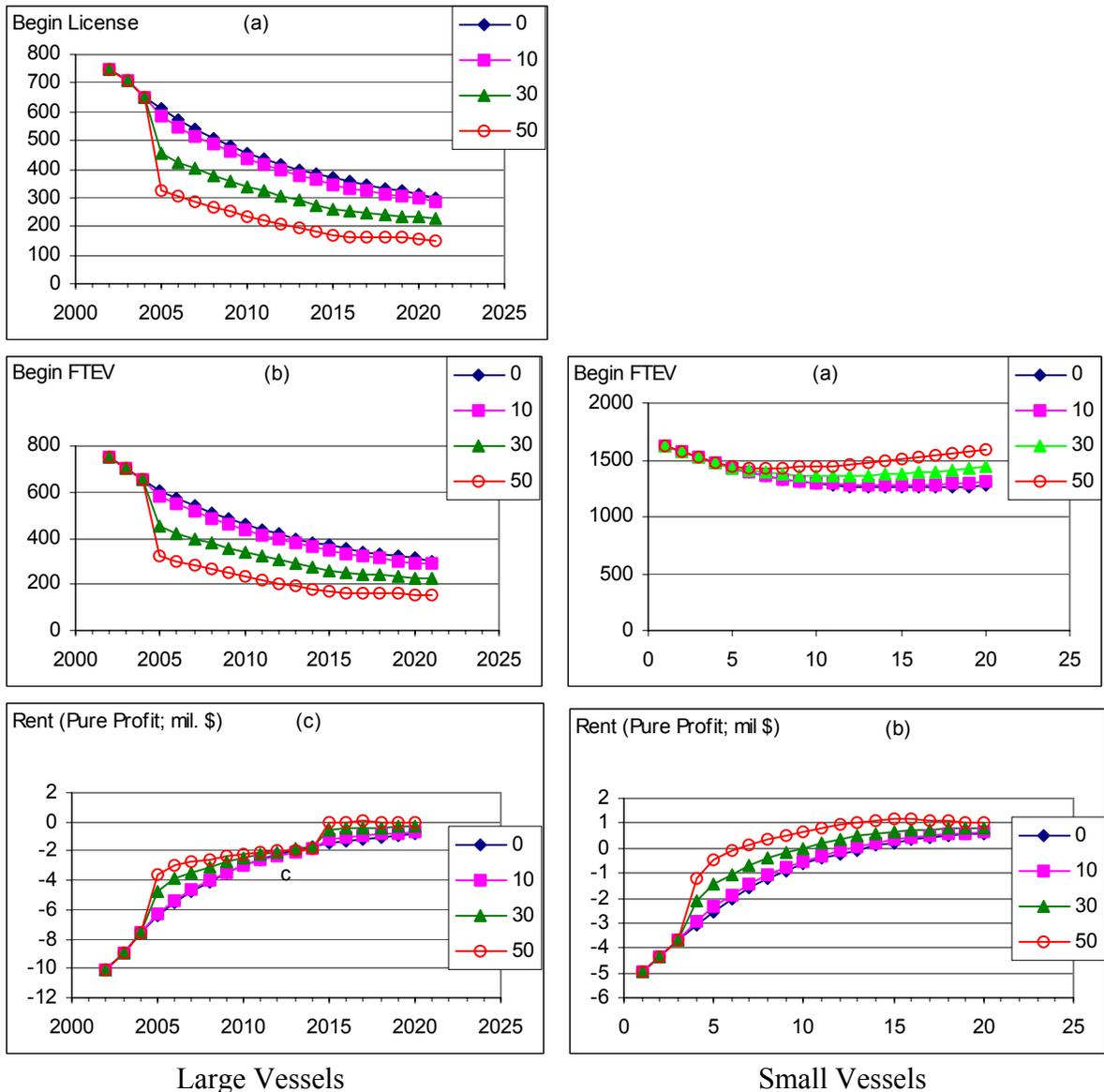


Figure 5.11. Government buyback with a loan only for large vessel in the south Atlantic: Simulation over the period 2002-2021 with a large vessel buyback at 0%, 10%, 30%, and 50% of the fleet in year 2004 with low shrimp prices (year 2002 shrimp prices), and with a permit/license moratorium on large vessels. Small vessels in open access; (Rent = economic profit = pure profit)

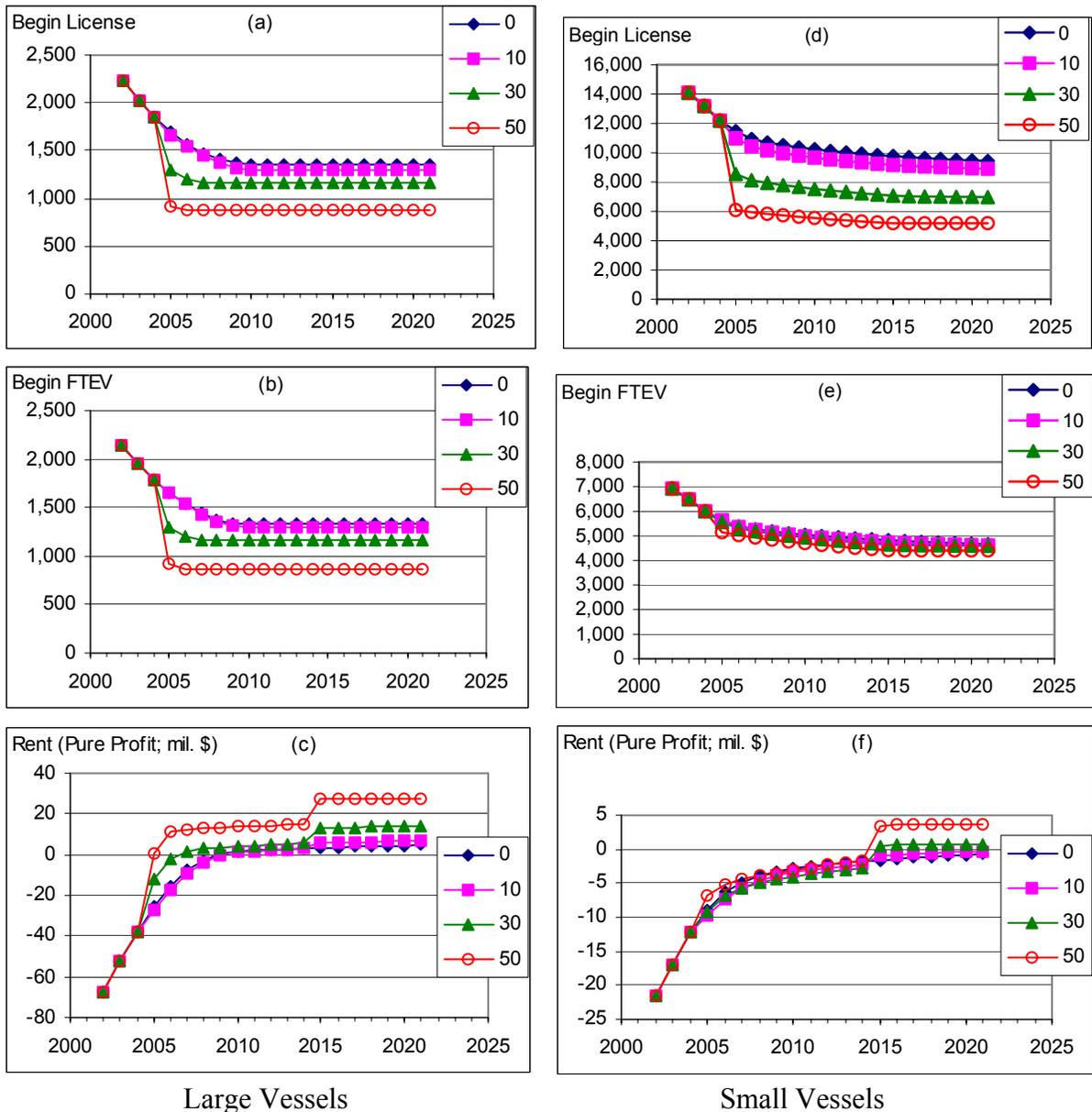


Figure 5.12. Government buyback with a loan for large and small vessel in the Gulf of Mexico: Simulation over the period 2002-2021 with a buyback at 0%, 10%, 30%, and 50% of the fleet in year 2004 with low shrimp prices (year 2002 shrimp prices), and with a permit/license moratorium on large and small vessels; (Rent = economic profit = pure profit)

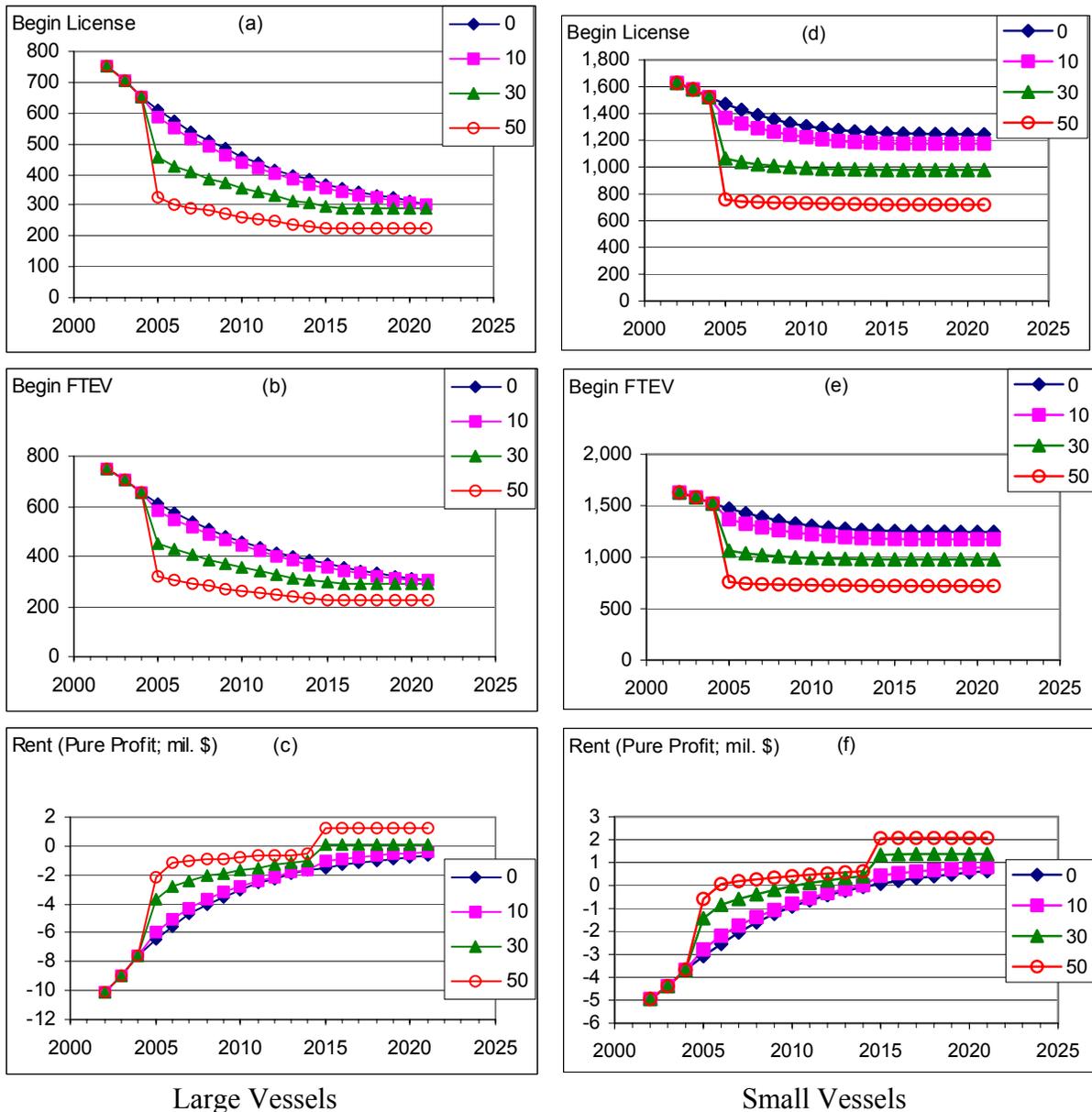


Figure 5.13. Government buyback with a loan for large and small vessel in the south Atlantic: Simulation over the period 2002-2021 with a buyback at 0%, 10%, 30%, and 50% of the fleet in year 2004 with low shrimp prices (year 2002 shrimp prices), and with a permit/license moratorium on large and small vessels; (Rent = economic profit = pure profit)

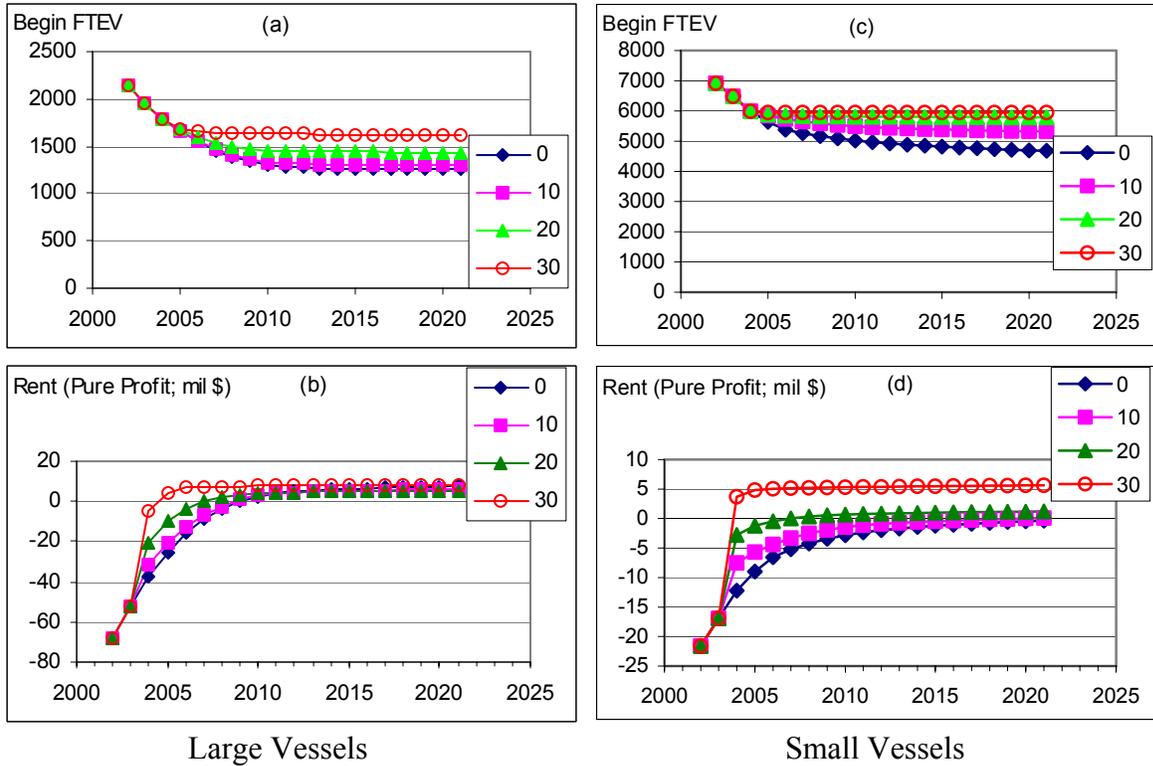


Figure 5. 14. Government price support for large and small vessels in the Gulf of Mexico: Simulation over the period 2002-2021 with a target price at 0%, 5%, 10%, 15%, and 20% above the average beginning year 2004 with low shrimp prices (year 2002 shrimp prices), and with a permit/license moratorium; (Rent = economic profit = pure profit)

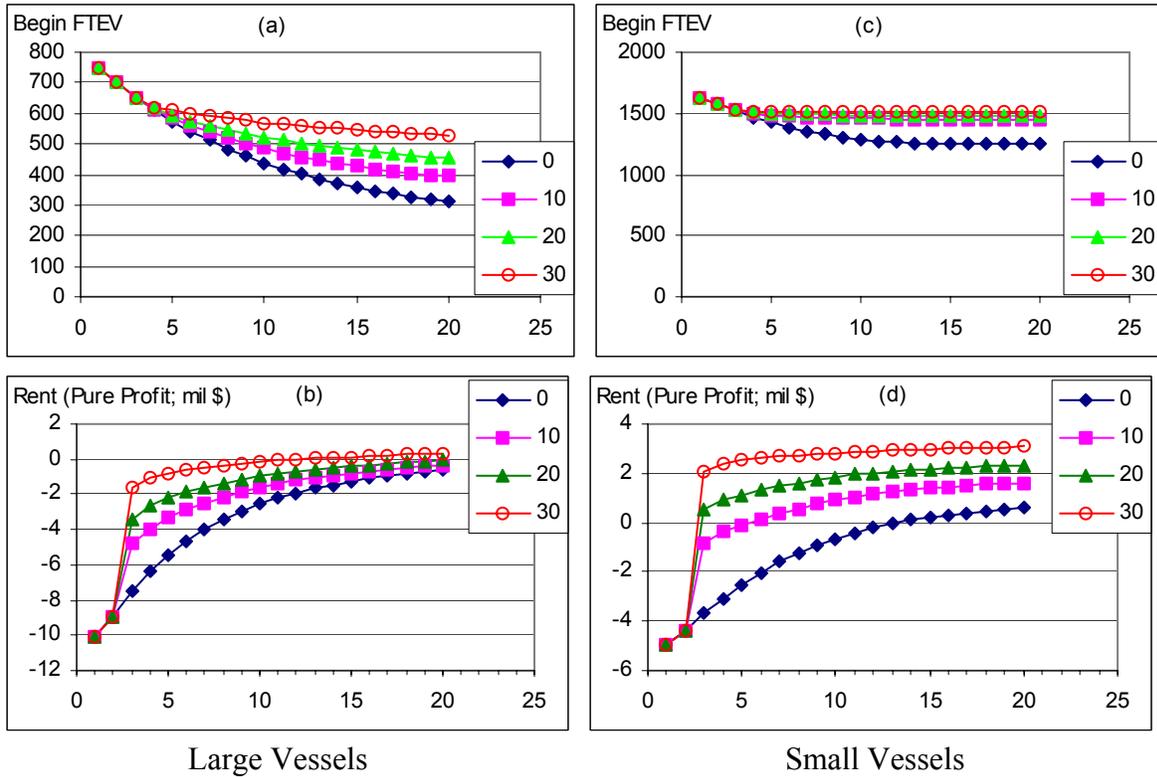


Figure 5.15. Government price support for large and small vessels in the South Atlantic: Simulation over the period 2002-2021 with a target price at 0%, 5%, 10%, 15%, and 20% above the average beginning year 2004 with low shrimp prices (year 2002 shrimp prices), and with a permit/license moratorium; (Rent = economic profit = pure profit)

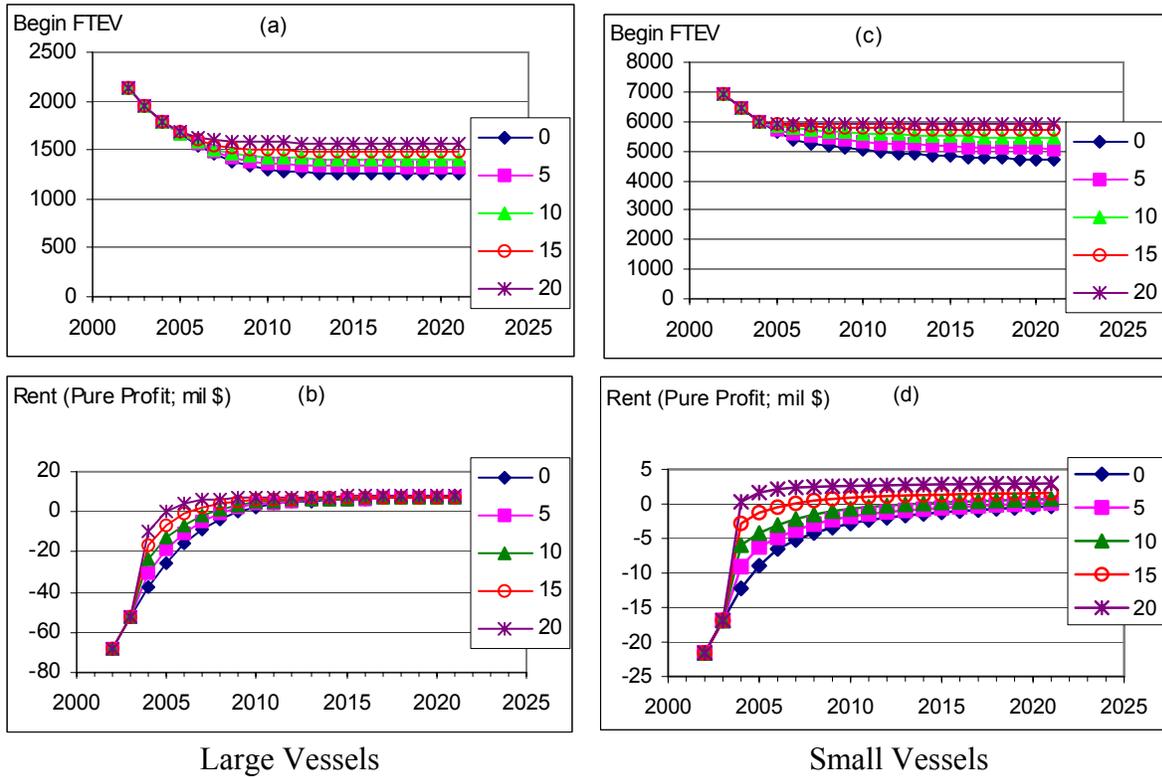


Figure 5.16. Marketing shrimp for large and small vessels in the Gulf of Mexico: Simulation over the period 2002-2021 with marketing increasing prices 0%, 5%, 10%, 15%, and 20% above the average beginning year 2004 with low shrimp prices (year 2002 shrimp prices), and with a permit/license moratorium; (Rent = economic profit = pure profit)

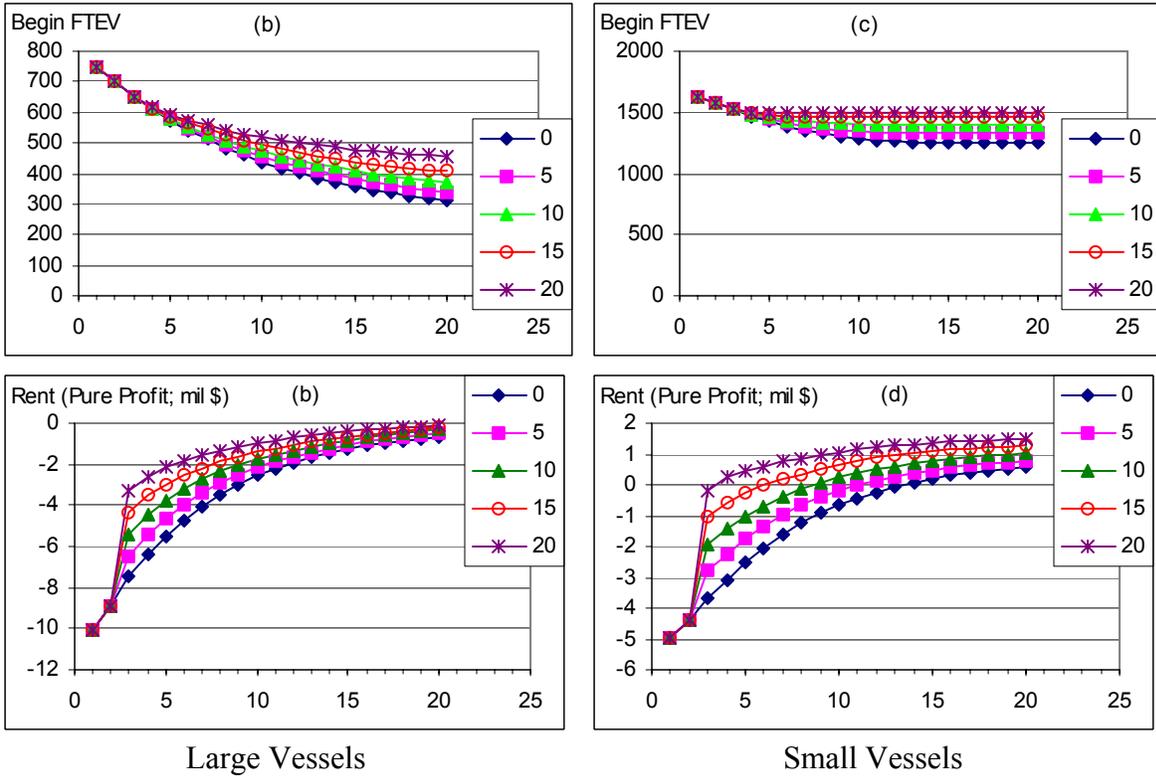


Figure 5.17. Marketing shrimp for large and small vessels in the South Atlantic: Simulation over the period 2002-2021 with marketing increasing prices 0%, 5%, 10%, 15%, and 20% above the average beginning year 2004 with low shrimp prices (year 2002 shrimp prices), and with a permit/license moratorium; (Rent = economic profit = pure profit)

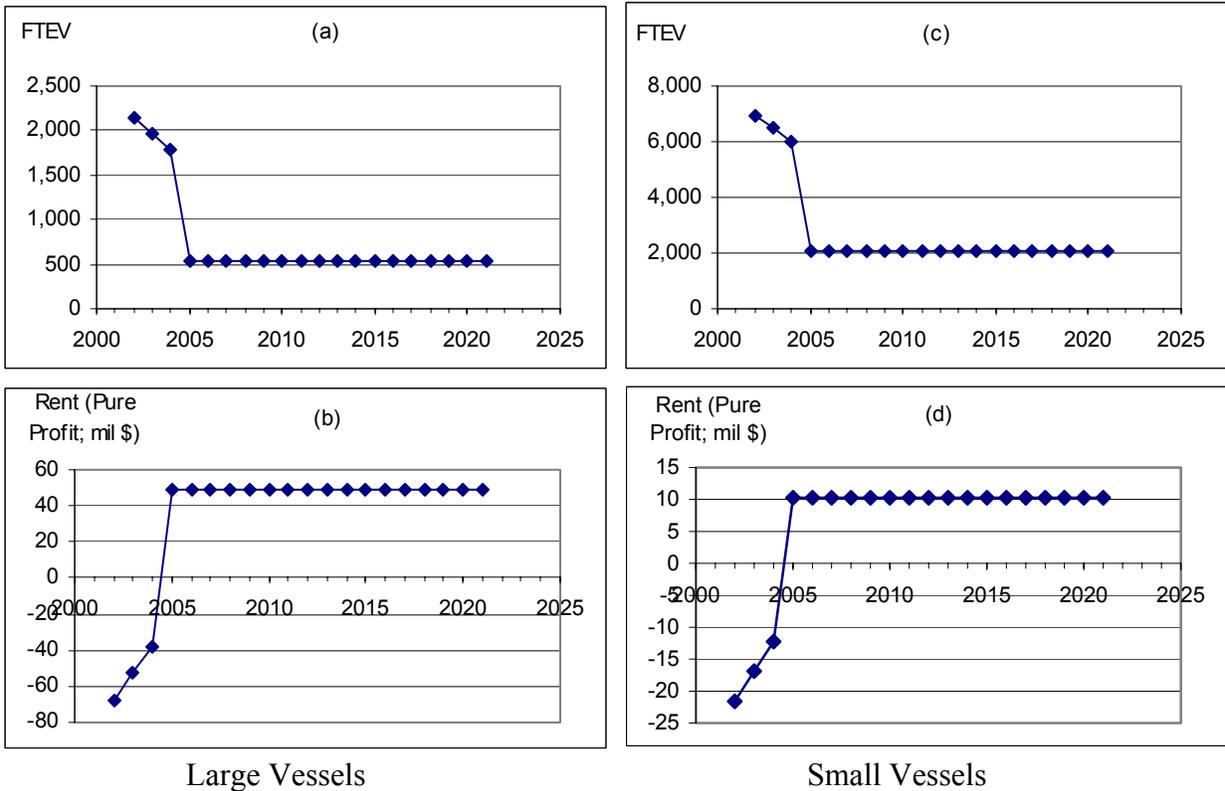


Figure 5.18. Cooperatives operating for maximum profit for large and small vessels in the Gulf of Mexico: Simulation is open access for 2002-2004 and then operate as a cooperative that uses only FTEV to maximize economic profit; low shrimp prices (year 2002 shrimp prices); (Rent = economic profit = pure profit)

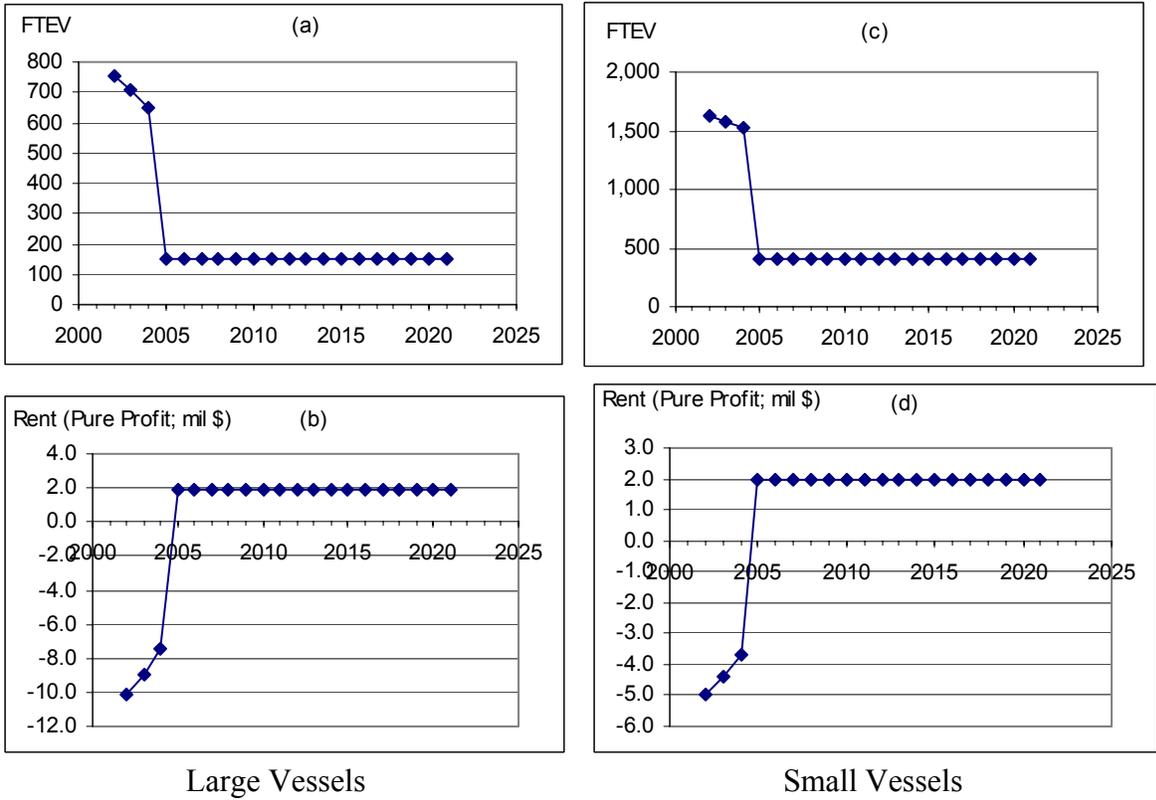


Figure 5.19. Cooperatives operating for maximum profit for large and small vessels in the South Atlantic: Simulation is open access for 2002-2004 and then operate as a cooperative that uses only FTEV to maximize economic profit; low shrimp prices (year 2002 shrimp prices); (Rent = economic profit = pure profit)

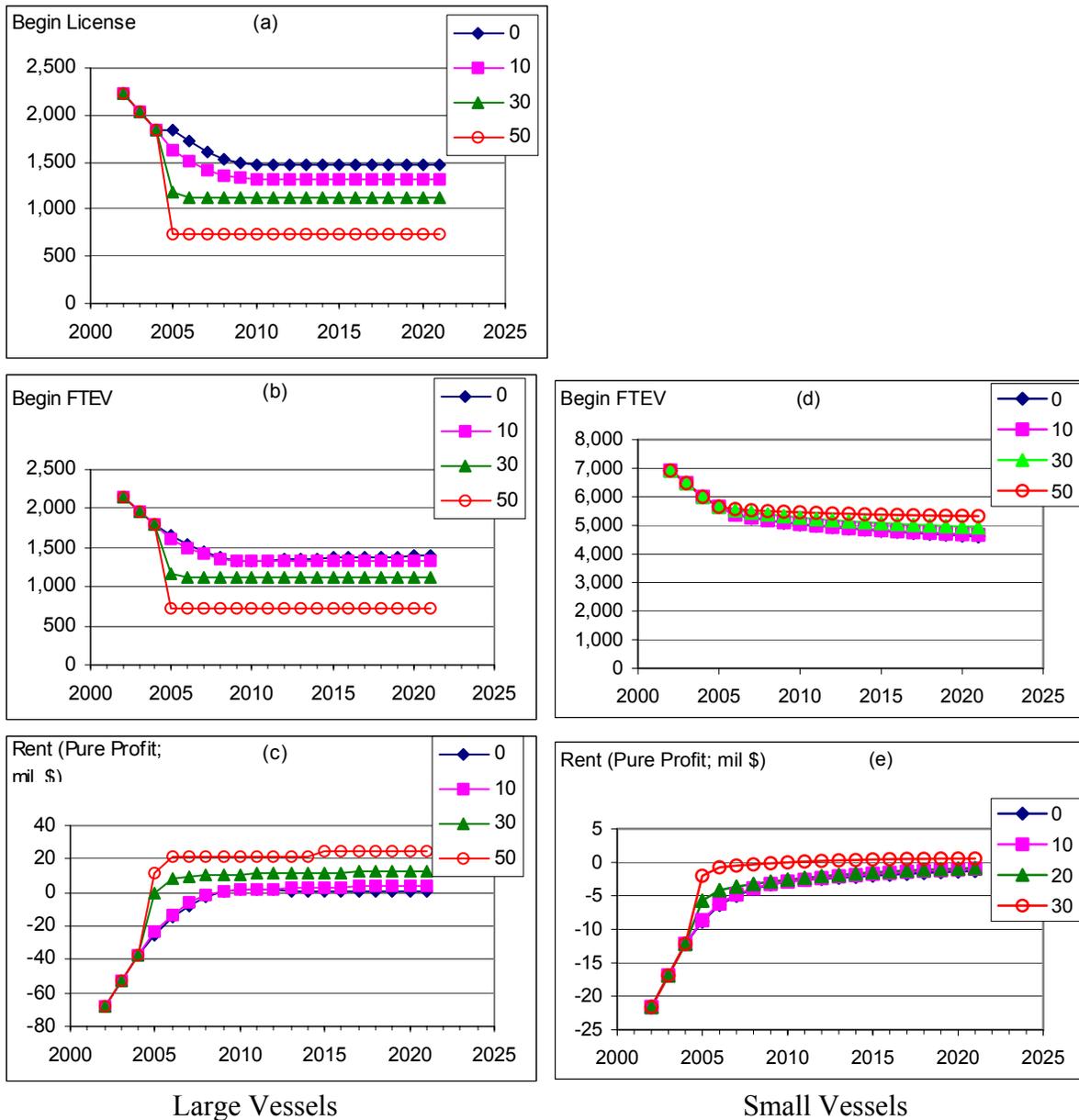


Figure 5.20. Fractional license program for large vessels in the Gulf of Mexico: Simulation over the period 2002-2021 with 0%, 10%, 30%, and 50% reductions in the number of licenses in 2004 with low shrimp prices (year 2002 shrimp prices). Small vessels are in open access (except Texas); (Rent = economic profit = pure profit)

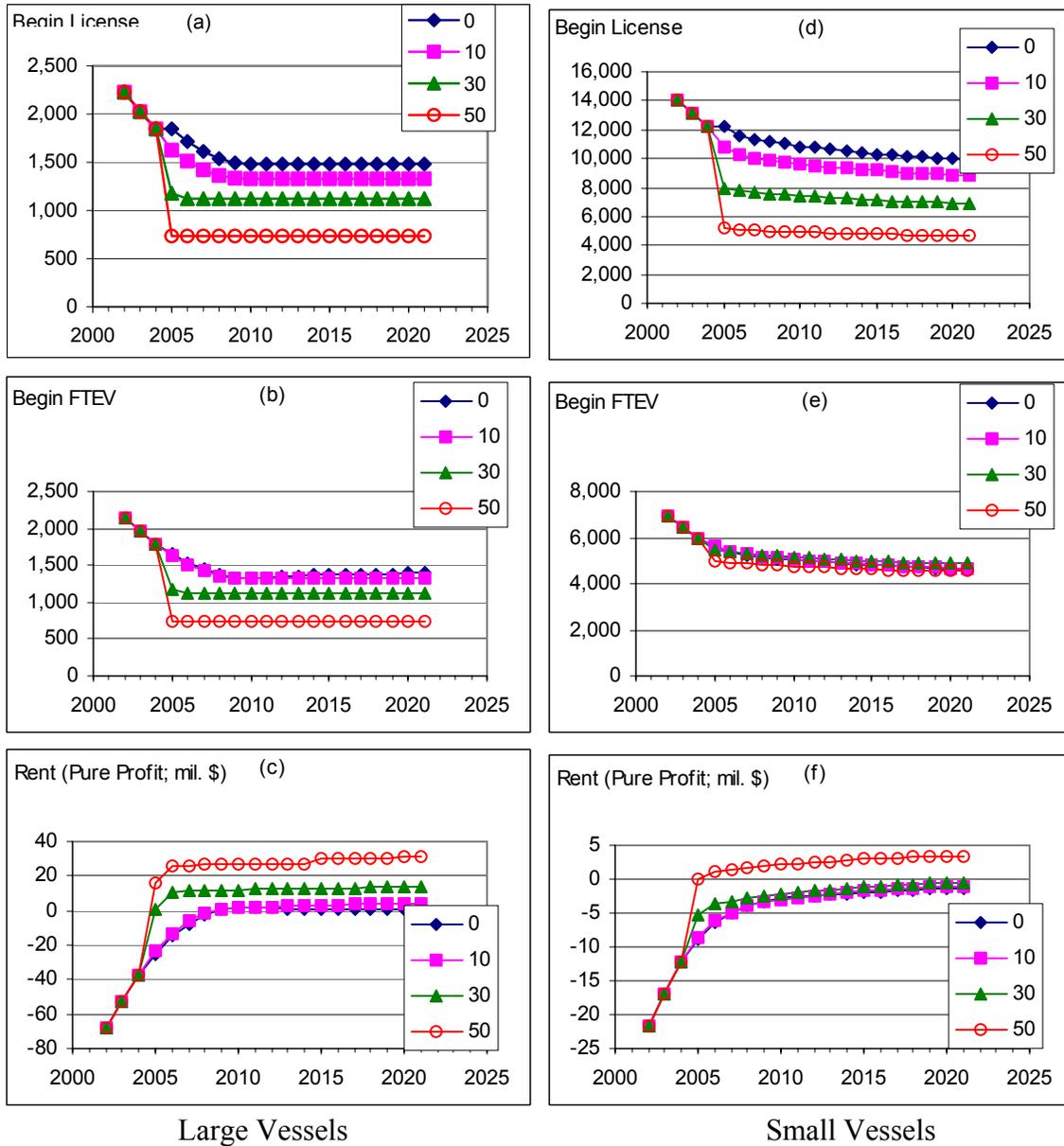


Figure 5.21. Fractional license program for large and small vessels in the Gulf of Mexico: Simulation over the period 2002-2021 with 0%, 10%, 30%, and 50% reductions in the number of licenses in 2004 with low shrimp prices (year 2002 shrimp prices); (Rent = economic profit = pure profit)

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