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Overwhelming a Digital Carrying Capacity: The Case of Oxford Health Plans*

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Since the early 1980s, one of the major forces driving the dynamics of managed care in the health care industry has been the need to obtain a high volume of patients to ensure financial success. In some cases, the growth of patient membership due to aggressive marketing has outrun either the development of provider networks, the infrastructure needed to support patient volume, or both.

One example of an HMO exceeding its infrastructure carrying capacity is Oxford Health Plans of Connecticut. During the late 1990s, the growth of Oxford's membership base, along with its concomitant growth in patient treatments, began to strain its management information system causing many reimbursements to member physicians to be lost and/or delayed. This generated significant dissatisfaction among Oxford physicians and eventually led many of them to separate from the plan. In response to the defection of Oxford physicians, Oxford members became concerned that their ability to obtain quality care would be affected and they thus began pursuing alternative health care options. In addition, the falling member and physician populations created concerns about Oxford's long-term viability among its stockholders which, in turn, led to a fall in its share price. Finally, Oxford's troubles with its current and former physicians intensified when the doctors filed a multimillion dollar lawsuit alleging that the HMO owes them millions of dollars in reimbursements.

This paper presents a system dynamics model of the Oxford Health Plans case. In addition to capturing the dynamics of Oxford's problems managing its growth during the 1990s, the model reveals insights into what Oxford managers could have done to prevent or limit the damage caused by the demands on its digital carrying capacity. The paper concludes with some generic insights into the dynamics associated with digital carrying capacities in organizations and some suggestions for future research.

The Case of Oxford Health Plans

Oxford Health Plans was started in 1984 by Steven F. Wiggins, a forty-one year old Harvard Business School graduate. The strategy behind its development was for the delivery of high quality health care, with a market niche appealing to white collar employees (Fintz, 1999).

Oxford's first license was issued in New Jersey in 1985. It initially had a small membership base, with its first client being Morgan Stanley. In June 1986, Oxford became licensed in New York and a year later it signed Columbia University with 6000 enrollees. This gave Oxford credibility and allowed it to expand its marketing efforts. In April 1992, Oxford went public at approximately $15 per share. In 1993, Oxford became licensed in Connecticut. By June 30, 1993, the company's enrollment had jumped 85%, with a total enrollment of 168,040 (Wall Street Journal, 1998b). By the end of June 1995, Oxford's enrollment totaled 765,200 members, more than double the enrollment of a year earlier (Pulliam, 1994).

Place Figure 1 About Here

Throughout the period 1995 to 1998, Oxford kept signing up members at a torrid pace, about 100,000 per quarter. The soaring membership (see Figure 1) boosted revenues, which rose like clockwork (see Figure 2). Oxford appeared to be growing in size by fifty percent each year (Winslow and Paltrow, 1998).

Place Figure 2 About Here

Concerns

By 1994 concerns about Oxford's rapidly growing membership base began to surface. Several analysts worried that Oxford could become a victim of its own success and began to question whether Oxford's financial controls were able to handle the load, especially when it came to keeping track of enrollments and estimating the cost of future claims. "At this level of growth, it becomes harder and harder to come up with good estimates of claims," said Kim Purvis, an analyst at Donaldson, Lufkin & Jenrette (Pulliam, 1994). Other analysts raised different concerns. Anne Anderson of Atlantis Research, said she spent months trying to make heads or tails out of Oxford's insurance filings and was troubled by the frequent restatements of enrollment (Pulliam, 1994).

Oxford's membership base, along with its growth in treatments, began to strain its management information system. Computer systems at health care providers face heavy demands as they track patient files and hospital and physician bills, while simultaneously evaluating information needed for estimations of future costs, so that premiums can be set accordingly. The problem that many rapidly growing health care companies face is a lack of infrastructure needed to keep up with the pace of rapid growth. They grow to a certain point and then their infrastructures break down.

Computer Capacity

By 1992, Oxford had started assessing its computer needs and realized that its original "Pick Systems" could not keep up with its growth. As a result, Oxford's managers decided to develop a new management information system that was powerful enough to handle its 50% annual growth rate, and increasing complexity they were beginning to see (Fintz, 1999). According to reports (see Winslow and Paltrow, 1998), a new management information system was started in 1993 and put on-line in 1996. By this time, Oxford's membership had grown sevenfold. Shortly thereafter, Oxford made the decision to convert account information on 1.9 million members simultaneously.

The MIS conversion project was enormous. Software developers had to mesh billing codes for hundreds of diagnoses and treatments, accounts for thousands of doctors and employers, and personal data for approximately two million members. But the new system, known within Oxford as "Pulse," took far longer to build than anyone had anticipated. When Oxford flipped the switch in September 1996, converting nearly everything to the new system in one fell swoop, all hell broke loose (Winslow and Paltrow, 1998). Billing went awry and links between member lists and claims-processing broke down. To link the new system to its predecessor, Oxford programmers had created their own "backbridge" software to reach in and retrieve data from the old network. But the backbridge code hadn't been thoroughly tested, and it ended up corrupting data from both systems (Winslow and Paltrow, 1998).

According to CEO Steve Wiggins, the biggest problem facing Oxford during the mid-1990s was its database management tools which, he claimed, "needed more computing resources and created more bottlenecks than anyone understood at the time" (Hammonds and Jackson, 1997). Oxford's own developers and contractors also made errors. The logjam was compounded, former insiders say, because Oxford hadn't kept the old billing system running as it brought up the replacement system (Hammonds and Jackson, 1997).

The problems that were created by the lack of computer capacity, and the unreliability of Oxford's management information system, had a cascade effect. Both the HMO's collections and its payments fell behind schedule. This generated significant dissatisfaction among Oxford physicians and eventually led many of them to separate from the plan.

After Oxford's story began to appear in the press, New York State Attorney General Dennis Vacco started investigating the HMO. To reassure the market, Oxford released a statement saying that it had cash reserves of $1 billion and could thus pay off all its bills and still have $500 million left in reserve. (New York Times, 1997).

By October 1997, health care regulators had come to the conclusion that Oxford had no reliable handle on its claims backlog, unable even to say how many claims were 30, 60 or 90 days old. To them, this meant that Oxford had little idea of its liability for unbilled medical costs (Winslow, and Paltrow, 1998).

Provider, Patient and Quality Effects

In response to the defection of Oxford physicians, Oxford members became concerned that their ability to receive continuity of care would be affected, and they thus began pursuing other care plans. In 1998, this prompted Oxford to report that: "…the Company expects that revenue growth will be adversely affected by customers' concern regarding recently publicized operating losses and provider dissatisfaction with timeliness of claims payment" (SEC 10K 3/24/98, p. 23).

In 1998, the National Committee for Quality Assurance, a Washington-based organization that evaluates health care plans on their ability to deliver high-quality care to their members, downgraded Oxford two notches, to "provisional" from "full" accreditation, citing its financial and data-management problems (Winslow, 1998).

System Problem

The evidence seems to indicate that Oxford was its own worst enemy. Nevertheless, some have argued that unreliable computer technology somehow thwarted the company's wonderful planning (Way, 1998).

Building a service business requires infrastructure investment before growth. In reality, however, service businesses often follow a catch-up strategy. Since no inventory is available to act as a buffer for control and for managing growth, capacity for the management of the service is often added only when customer needs demand it. In the case of information management, the customer is internal and often internal demands are not met as rapidly as those from the external environment. In the case of managed care, the external environment required growth for survival, taking attention away from other demands. Health care companies need to understand that they have many functions (e.g., financial management, information systems management, stakeholder relations, etc.), not just the provision of health care.

Epilogue

With Oxford's computer systems in disarray, and its medical costs still up in the air, the company has accumulated hundreds of millions of dollars in losses and has alienated many of its doctors and customers (Abelson, 1998). In fact, Oxford admits that turnaround times for claims, and the accuracy of its accounts, are still not up to acceptable levels (Medical Economics, 1999, p. 11). As of December 23, 1999, Oxford's share price had fallen to $11.50 from a high of $96.94 on March 25, 1995. Texas Pacific, a group of investors who put

$350 million into Oxford in 1998 (Holson, 1998), has indicated that it would like to sell the company but probably will not until it can exercise its warrants to acquire 22.5 million shares at $17.75 per share (Levick, 1999).

The Oxford Model

In an effort to provide a rigorous explanation for the problems Oxford experienced during the mid-to-late 1990s, and to offer Oxford managers a laboratory for experimentation with proposed policy changes, a system dynamics model of Oxford Health Plans was created. Figure 3 provides an overview of the this model.

Place Figure 3 About Here

Inspection of Figure 3 reveals that the Oxford model consists of two main sections – a physician or "Providers" section and an HMO or "Oxford" section. The providers section is itself divided into a "Physicians Sector" and a "Physicians' Accounting Sector," while the Oxford section is divided into five sectors including: "Complaint Management," "Membership," "Human Resources," "Computer Conversions," and "Accounting."

Figure 3 also outlines some of the major "between-section" and "within-section" causal relationships present in the Oxford model. An overview of these relationships is as follows.

Major Causal Relationships Present *within* the Providers Section

Within the Providers section of the Oxford model, the Physicians Sector works to balance the supply of, and the demand for, doctors. It also keeps track of physician satisfaction, which is influenced by the rate at which the doctors collect their accounts receivable from Oxford's Accounting Sector. In the model, a fall in on-time collections by the doctors results in a drop in physician satisfaction which, in turn, causes the rate at which doctors leave Oxford to rise and the HMO's reputation among physicians to drop. A fall in Oxford's reputation makes it more difficult to get new physicians to join the HMO. The Physicians' Accounting Sector monitors the physicians' accounts receivable, both due and past due, and passes this information to the Physician Sector.

Major Causal Relationships Present *between* the Providers and Oxford Sections

The Providers section is linked to the Oxford section via several causal linkages. The Physicians Sector of the Providers section provides care to the sick members of the Membership Sector who have been approved for treatment, and information on the fraction of physicians who are leaving the HMO to the population of the Membership Sector. The Physicians' Accounting Sector of the Providers section sends invoices to the Accounting Sector of the Oxford Section for treatments rendered, and sends complaints to the Complaint

Management Sector when the doctors' accounts receivable from the HMO become overdue. Going the other way, the Accounting Sector of the Oxford Section sends payments to the Physicians' Accounting Sector for treatments provided to Oxford members, while the Membership Sector helps the Physician Sector of the Providers section calculate the doctor-patient ratio which influences the physician recruiting rate.

Major Causal Relationships Present *within* the Oxford Section

Within the Oxford section of the model, the Complaint Management Sector sends out requests for labor to the Human Resources Sector, information about to when to start rework to the MIS Conversion Sector, and information about overdue accounts payable that have been identified and corrected to the Accounting Sector.

The Membership Sector sends out information to the Human Resources Sector that leads to more HMO staff being hired, premium payments to the Accounting Sector, and information about when to begin converting the Oxford MIS into a system with a larger capacity.

The MIS Conversion Sector sends out requests for labor to the Human Resources Sector and influences the ability of the complaint management staff to correct overdue physician accounts payable, while the Accounting Sector sends out requests for new accounting staff and wage payments to the Human Resources Sector. Finally, the Human Resources Sector supplies labor to the Accounting, MIS Conversion, and Complaint Management Sectors.

Base Run

Two base runs for the Oxford model have been identified. The first is a global equilibrium run which can be used for structural testing of the model. The second is a run that mimics the behavior of Oxford Health Plans during the 1990s and provides some evidence that the model is able to provide a formal explanation for the problems being experienced by the HMO[1]. It is against this latter run that policy changes will be evaluated.

Place Figure 4 About Here

Figure 4 consists of eight time series plots from the base run of the Oxford model. Together these plots tell the story of Oxford during the 1990s.

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[1] Compare Figures 1 and 2 with the membership and premium revenues plots presented in Figure 4. Note that the plots in Figure 4 are in months while the plots in Figures 1 and 2 are in quarters.

Inspection of Figure 4 reveals that for the first four years (forty-eight months) of the base run, Oxford's membership grows steadily and aggressively. Around month forty, however, Oxford's membership begins to approach the capacity of its management information system. As a result, the willingness of Oxford's management to modernize its management information system reaches its threshold value of one.

Once Oxford's managers decide to modernize its management information system, a conversion staff is hired and conversion tasks begin to be completed. Unfortunately, as in virtually any software project, some conversion tasks are not completed correctly and rework is generated. The problem (again, as in virtually any software project), is that Oxford's mangers do not discover the necessary rework before launching the converted management information system (note the difference between the apparent fraction of the project completed and the actual fraction completed in Figure 4).

Once the new, error-filled, management information system is launched (approximately month fifty) Oxford's ability to pay its physicians on time degrades, and the past due accounts receivable of the Physicians' Accounting Sector begins to rise (Figure 4). This causes a dramatic fall in physician satisfaction and, after a lag, a dramatic fall in Oxford's reputation among physicians in general. The drops in both satisfaction and reputation cause an increase in the number of physicians who leave Oxford and problems for Oxford in recruiting new physicians to replace them. As a result, the total number of physicians associated with the Oxford begins to fall (Figure 4). Finally, the high rate of physicians leaving Oxford causes a dramatic drop in patient satisfaction and thus in HMO membership and premium revenue.

Policy Analysis

One of the strengths of a simulation model is that it enables its users to run "what-if" experiments in a computerized laboratory setting. In such a setting, the results of changing one thing in the model can be evaluated *ceteris paribus* -- i.e., while keeping everything else the same. Simulation experiments typically evaluate what would have happened in the past if different policies had been implemented or what may happen in the future if different policies are implemented. In this paper, the results of experiments of the former kind will be presented.

Place Figure 5 About Here

Simulation Experiment 1: Do Nothing

The first simulation experiment examines what would have happened if Oxford's managers had chosen to do nothing about the increasing demands on their original "Pick Systems" management information system. As can be seen in Figure 5, in this run the past due accounts receivable by the doctors is triple the amount generated in the base run and consequently both doctor and patient satisfaction fall further. The number of doctors associated with the HMO also drops below the final level shown in the base run. An interesting result in this run, however, is that Oxford's membership ends up being slightly higher than in the base run due to the compensating effects of a greater marketing effort generated by the model in response to a membership base that falls earlier and peaks sooner (relative to management's targets) than in the base run.

Simulation Experiment 2: Reduced Rework in the MIS Conversion Process

In the actual case history of Oxford, CEO Steven Wiggins admitted that he should have hired more "seasoned managers for information systems" (Winslow and Anders, 1997) to supervise the MIS conversion process so that the amount of necessary rework would not have been so dramatic. Figure 6 shows the results of testing this policy.

Place Figure 6 About Here

Inspection of Figure 6 reveals that Steven Wiggins was entirely correct. If more experienced MIS are hired to do the conversion (and thus the fraction of conversion tasks done incorrectly is reduced), all aspects of Oxford's economic health are improved vis-à-vis the base run. Membership, doctors, member satisfaction, and doctor satisfaction and reputation are all higher, while past due accounts receivable by the doctors are dramatically lower.

Simulation Experiment 3: Delayed Start-Up of the New MIS with Later Willingness to Convert

In the actual case history of Oxford, CEO Steven Wiggins also acknowledged that "a more incremental conversion would have been preferable" (Winslow and Anders, 1997). In other words, Wiggins felt that a preferable approach would have been to bring the new MIS on line gradually, instead of all at once when it was "apparently" ready to go. Figure 7 shows one possible result of testing this policy.

Place Figure 7 About Here

Inspection of Figure 7 shows that, at least in some instances, Steven Wiggins will not be correct. If Oxford's new MIS is brought on-line only after its bugs have been uncovered and it has been thoroughly tested, the burden of processing Oxford's accounts payable to the doctors must be undertaken during the conversion process by its old MIS. If Oxford's growth is robust enough to swamp the capacity of the old management information system prior to the new system coming on-line, enough errors can be generated so that the outcome is not marginally better than the base run.

Simulation Experiment 4: Delayed Start-Up of the New MIS with Earlier Willingness to Convert

To avoid the problem of the last simulation experiment, the model was changed to reflect a willingness of Oxford's managers to begin the MIS conversion process in the earlier stages of the firm's growth. Inspection of Figure 8 reveals that a delayed start-up of the new MIS is now a good policy, as the new system is up and running correctly, prior to the capacity of the old system being reached.

Place Figure 8 About Here

Conclusions

The rise and fall of Oxford Health Plans is one instance of a classic case in the field of system dynamics -- i.e., the problems associated with rapid growth in a service oriented firm. Such firms have the tendency to outrun their carrying capacities and hence to sow the seeds of their own demise. The trick for managers in such situations is to manage both the growth process, and the acquisition of service capacity, so that an overshoot and collapse situation can always be avoided.

In Oxford's case and, for that matter, the case of any firm that relies heavily on its management information system to handle a large load of vital day-to-day data, the key is to start the process of acquiring digital capacity far enough in advance so that the new system is up and running correctly prior to the old system being swamped. This may mean beginning the process far before common sense and management intuition suggests that it must occur.

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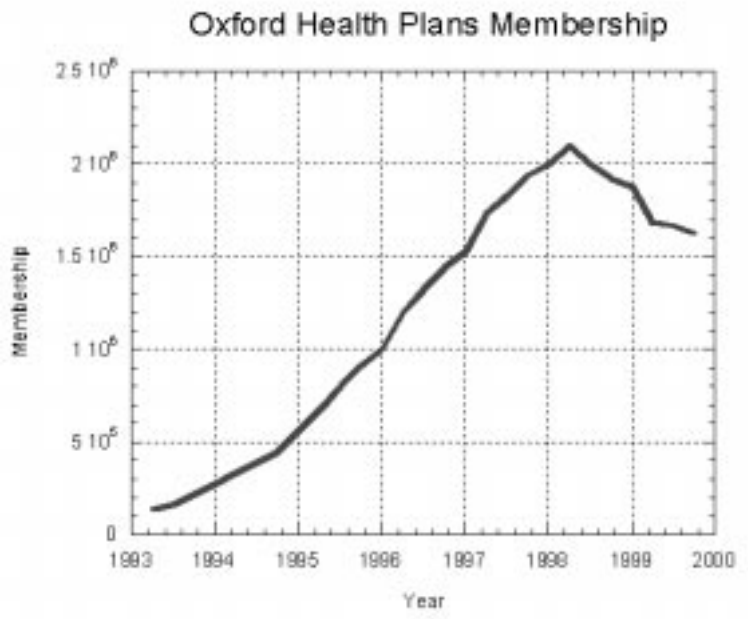

Figure 1: Oxford Health Plans Membership 1993 - 2000 (Source: Oxford Health Plans SEC 10K)

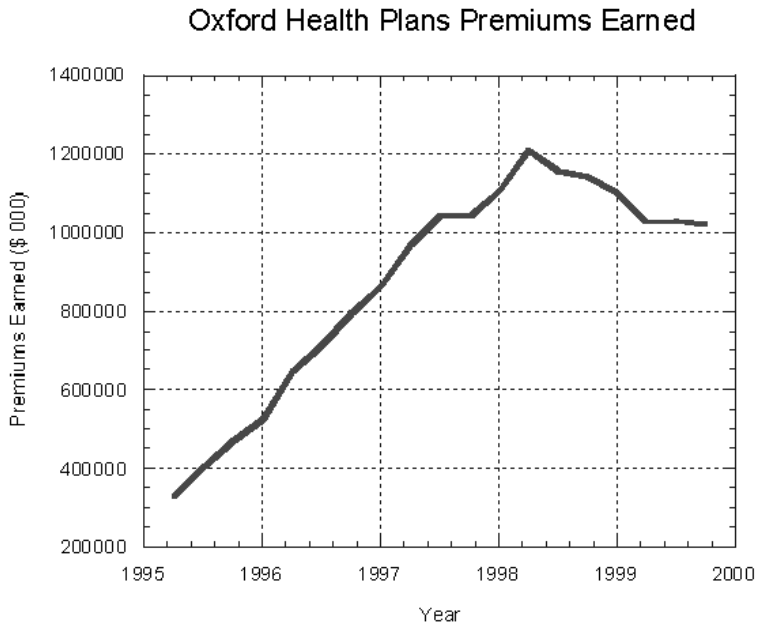

Figure 2: Oxford Health Plans Premiums Earned 1995 - 1999 (Source: Oxford Health Plans SEC 10K)

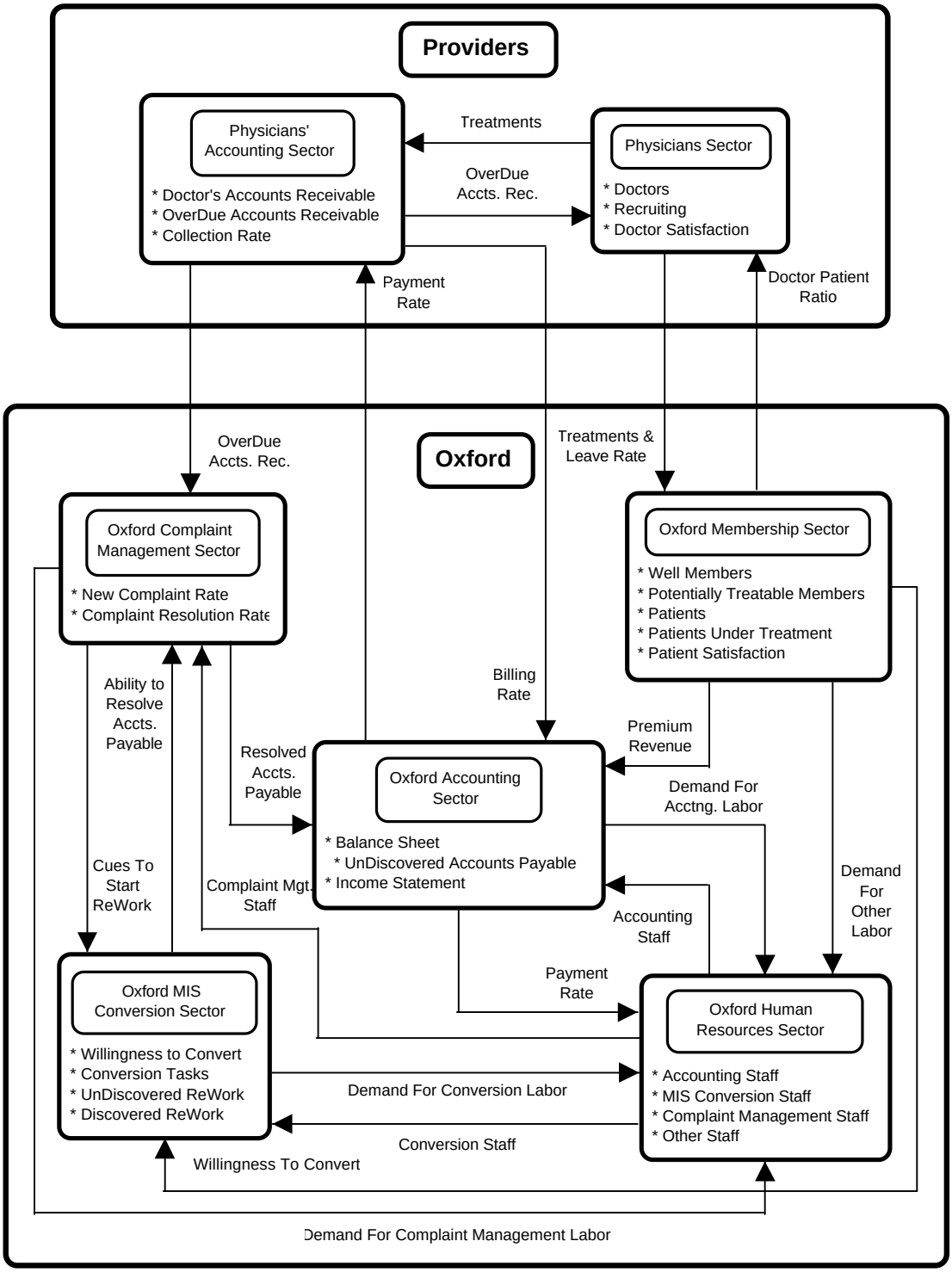

Figure 3: Sector Overview of the Oxford Health Plans Model

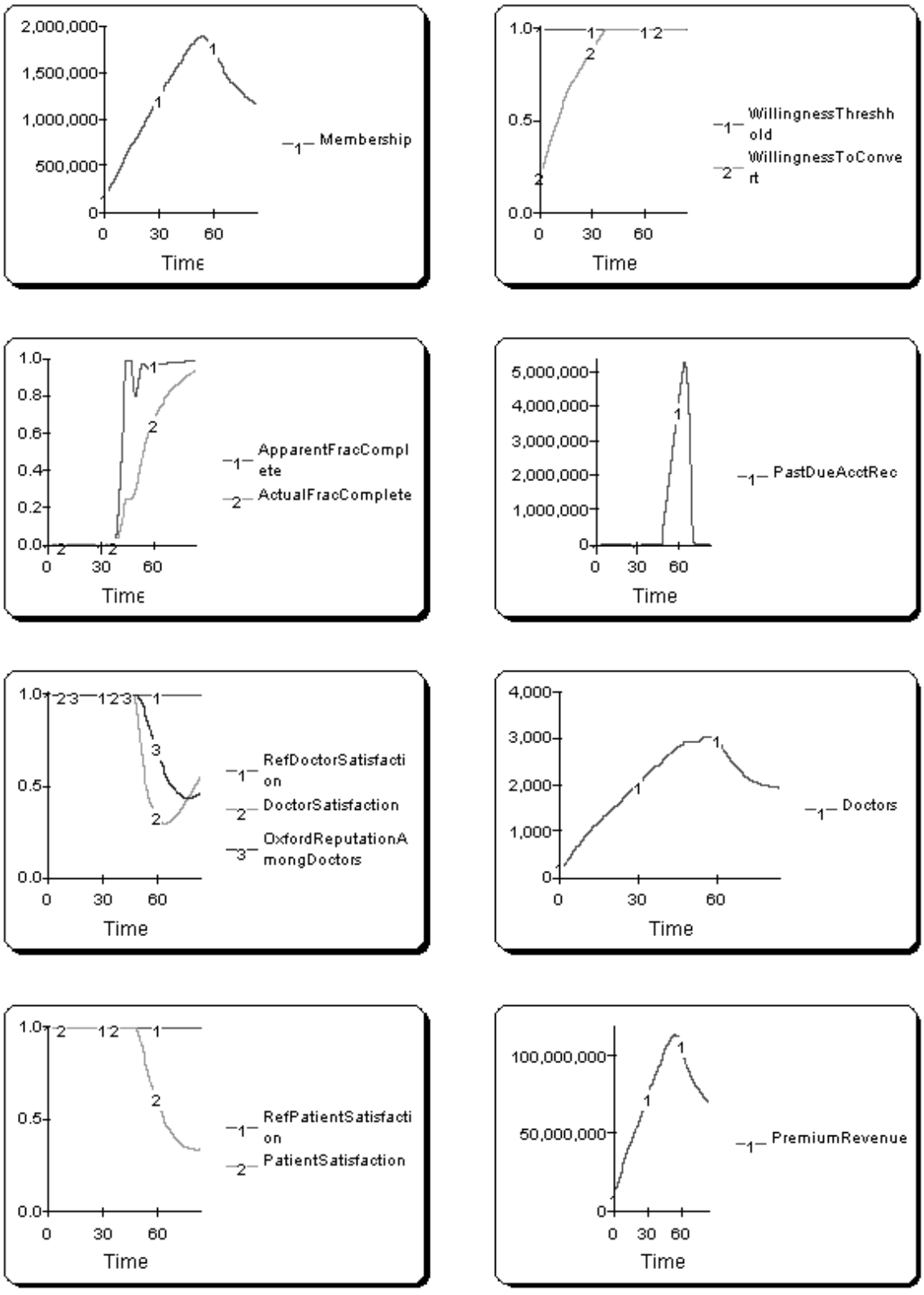

Figure 4: Base Run of the Oxford Health Plans Model

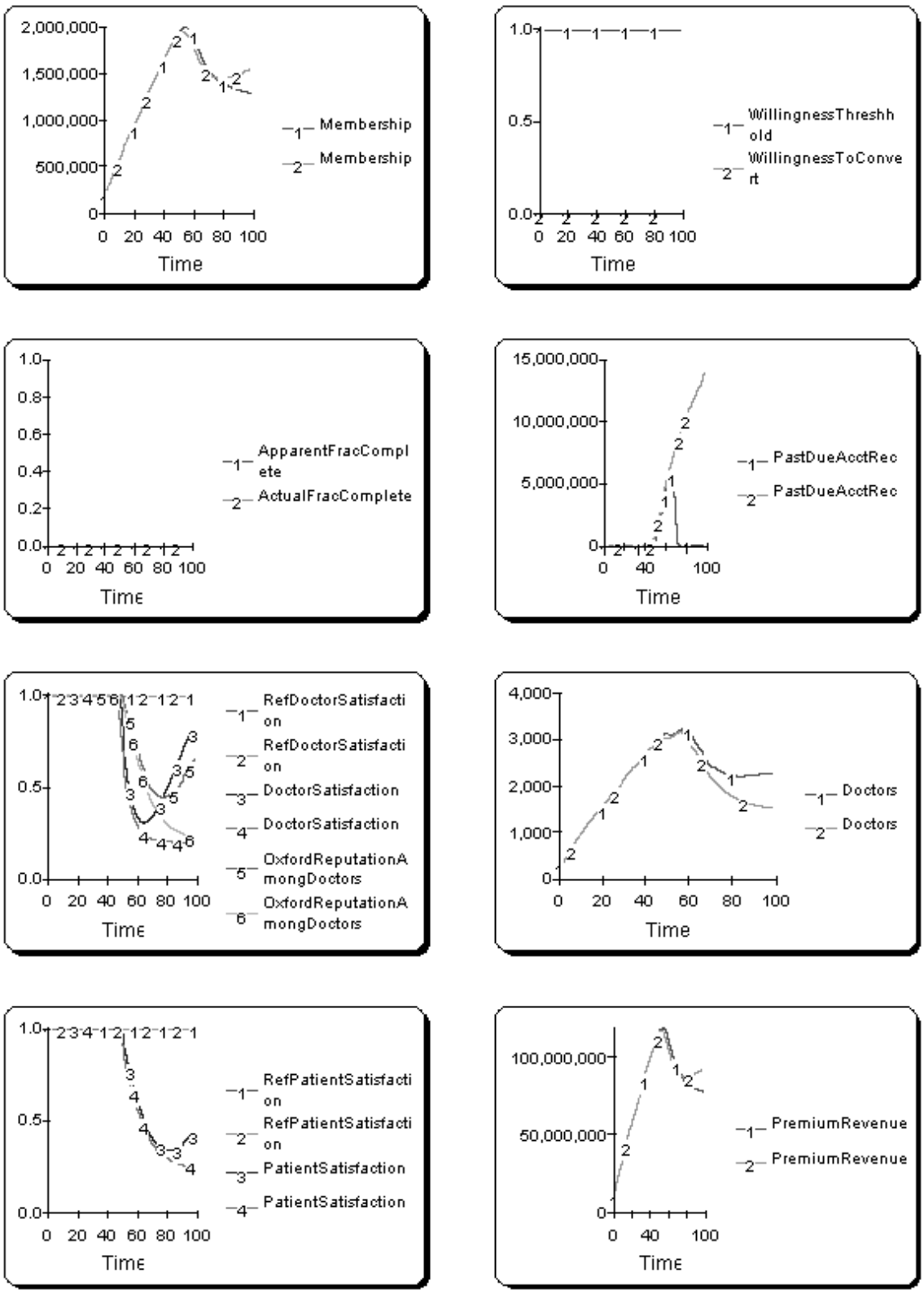

Figure 5: Do Nothing Run Against Base Run of the Oxford Health Plans Model

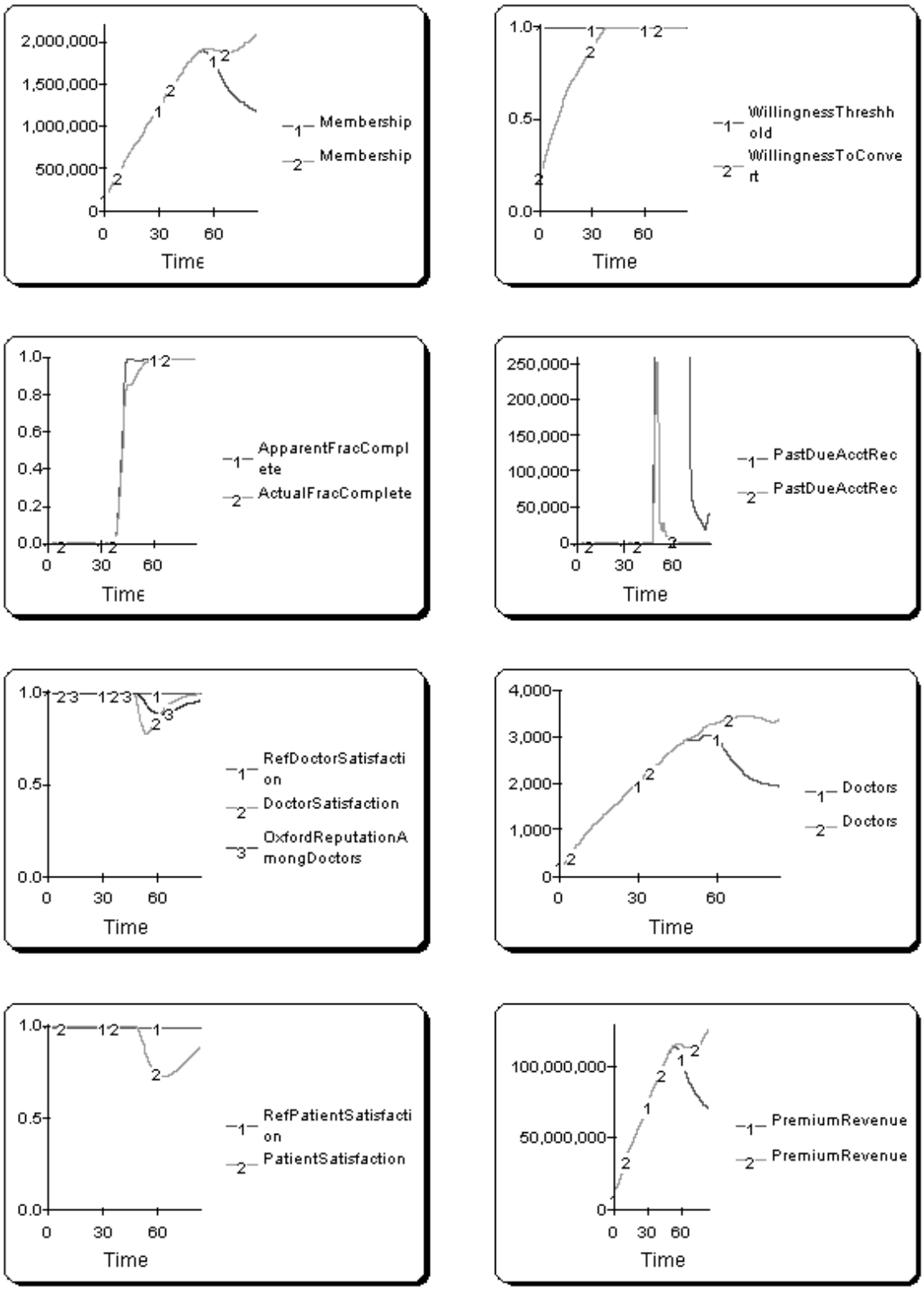

Figure 6: More Seasoned Managers Run Against Base Run of the Oxford Health Plans Model

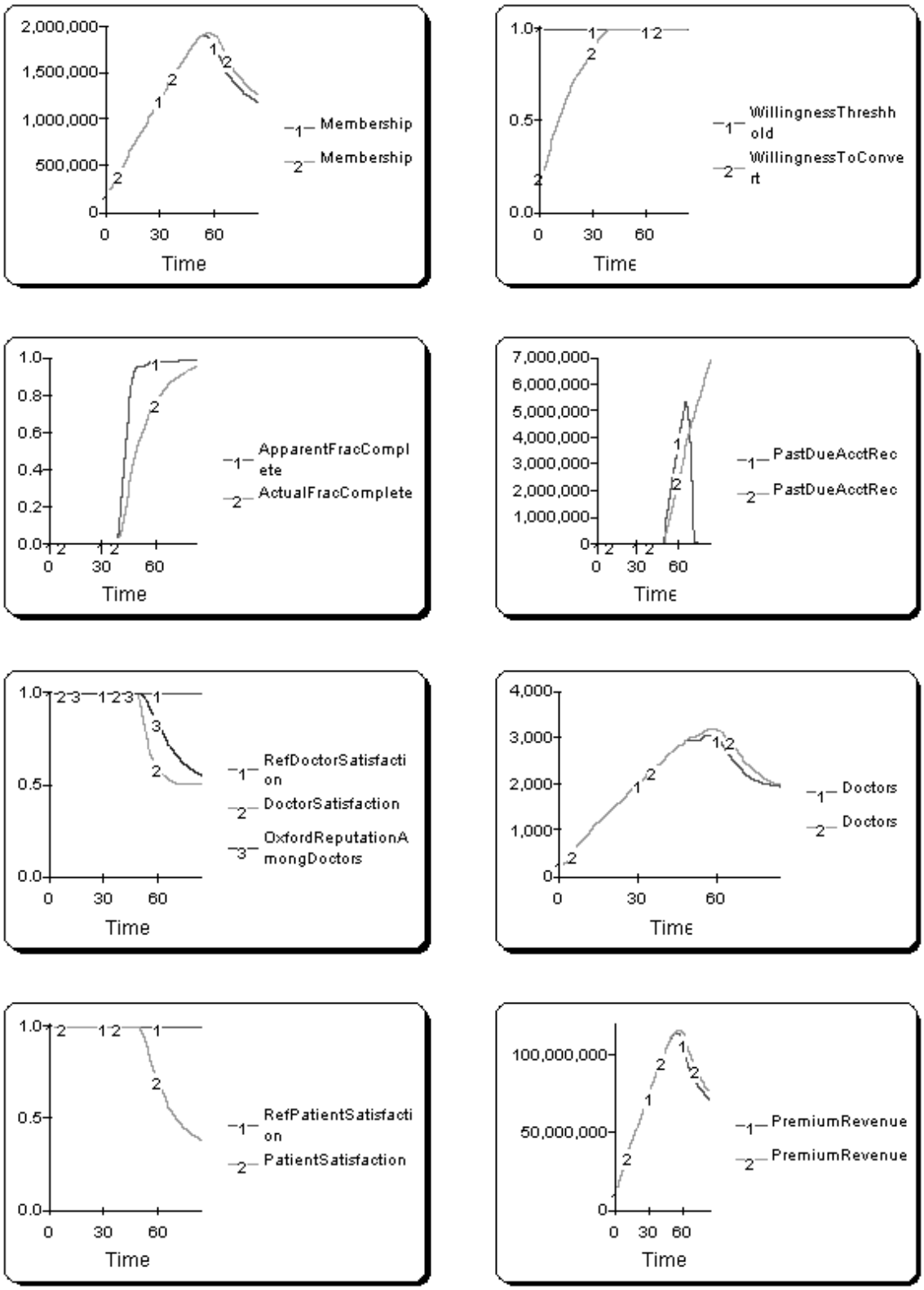

Figure 7: Delayed Start-Up of New MIS with Later Willingness to Convert Against Base Run of the Oxford Health Plans Model

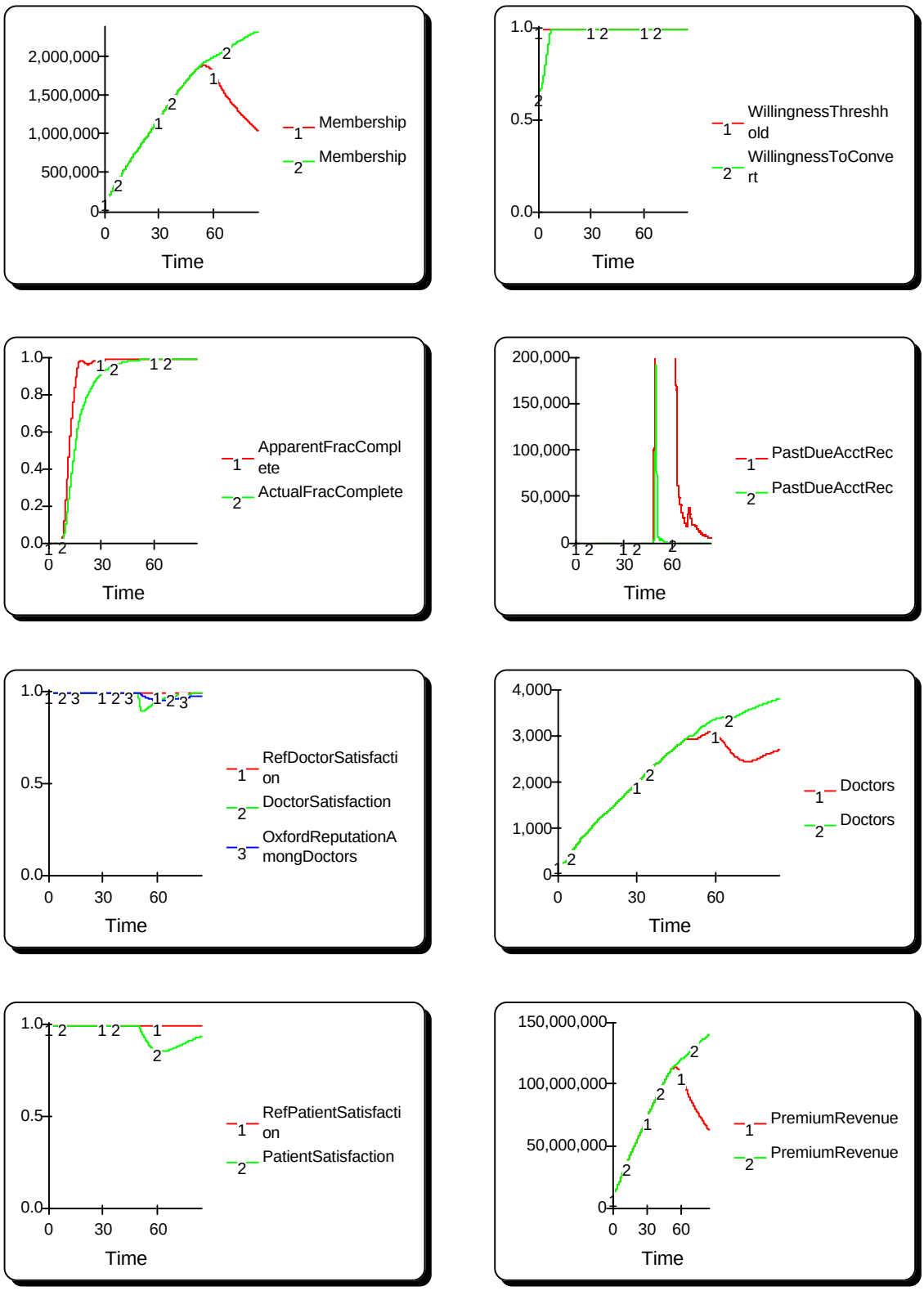

Figure 8: Delayed Start-Up of New MIS with Earlier Willingness to Convert Against Base Run of the Oxford Health Plans Model